TAFE NSW Construction Centre of Excellence

2-44 O'Connell Street, Kingswood NSW 2747

ESD SSDA DESIGN REPORT

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ESD concept Report

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Table of Contents

1. Introduction

Northrop Consulting Engineers have been engaged to provide Ecologically Sustainable Design (ESD) consultancy and services for the design of the new Construction Centre of Excellence for TAFE NSW. This report outlines how the proposed development meets the Secretary's Environmental Assessment Requirements (SEARs) and summarizes ESD initiatives.

This report has been prepared to accompany a detailed State Significant Development Application (**SSDA**) SSD_8571481 for the development of an educational facility at the TAFE Nepean Kingswood Campus, located at 2-44 O'Connell Street Kingswood (**the site**). The legal description of the site is Lot 1 in DP 866081. The site comprises a rectangular lot with an area of approximately 23 hectares.

Specifically, the SSDA seeks development consent for the construction and operation of the TAFE NSW Construction Centre of Excellence (**TAFE CCoE**) a multi-level, integrated educational facility designed to accommodate specialized training and education for the construction-related TAFE NSW courses (**the project**). The TAFE CCoE will be a new learning environment with an emphasis on flexibility and adaptability, to encourage cross-disciplinary collaboration, industry engagement, and educational excellence. On 27 February 2019, the NSW Government announced the delivery and associated funding of the CCoE.

The proposed development is classified as a State Signification Development (**SSD**) on the basis that it falls within the requirements of Clause 4, Schedule 19 of the *State Environmental Planning Policy (State and Regional Development) 2011* (**SRD SEPP**), being 'development for a tertiary institution… that has a capital investment value of more than $30 million'.

The Minister for Planning, or their delegate, is the consent authority for the SSDA and this application is lodged with the NSW Department of Planning, Industry, and Environment (**NSW DPIE**) for assessment.

1.1 Objectives

The project is targeting the following sustainability objectives.

- Incorporating principles of Ecologically Sustainable Development
- Demonstrate 'Design Excellence' by integrating sustainability principles of Green star and demonstrating project intent to achieve a 5 Star Green Star Design & As Built v1.3
- Minimum code compliance – BCA Section J energy efficiency provisions; and
- Consideration of the CSIRO's climate projections for the site location and design measures to create adaptable spaces and inclusion of climate change adaption and mitigation measures within the building design.

1.2 Response to Secretaries Environmental Assessment Requirements (SEARs

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) issued for the project. Specifically, this report has been prepared to respond to the following SEARs

Table 1 - Response to SEAR Requirements

Item	Action to Address the Requirement	Report Location
Detail how ESD principals (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation will be incorporated in the design and ongoing operation phases of the project.	This ESD report details how the project aims to address the Sustainability Principles by targeting 5 Star Green Star Design & As Built v1.3 rating and through design considering by incorporating strategies for resource efficiency	Section 2 and 3
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 waste reduction design measures, future-proofing, use of sustainable and low-carbon materials, energy and water-efficient design (including water sensitive urban design), and technology and use of renewable energy;	The framework for sustainable development used for the project is Green Star V1.3. The project includes significant energy and water efficiency by providing efficient building systems, and onsite energy generation, and inclusion of rainwater reuse and greywater recycling to reduce potable water consumption	Section 2 and 3
Include preliminary consideration of building performance and mitigation of climate change, including consideration of Green Star Performance	By targeting the Adaptation and Resilience initiatives the project commits to addressing all high and extreme risks posed to the project by Climate Change over the forecast building lifetime.	Section 5
Provide a statement regarding how the design of future development is responsive to the CSIRO projected impacts of climate change, specifically: o hotter days and more frequent heatwave events o extended drought periods o more extreme rainfall events o gustier wind conditions o how these will inform landscape design, material selection, and social equity aspects (respite/shelter areas).	The project design includes consideration of future climate alterations into its design as detailed in Section 6. The assessment covers both primary and secondary risks posed to the site.	Section 5
Detail any sustainability initiatives that will minimize/reduce the demand for drinking water, including any alternative water supply	The civil and landscape design has included an Integrated Water Management Plan element of which is included within this	Section 2

and end uses of drinking and non-drinking water that may be proposed, and demonstrate water sensitive urban design (principles are used), and any water conservation measures that are likely to be proposed.	report including the proposed alternative water supplies, their proposed end uses, and landscaping design for Water Sensitive Urban Design. A stormwater control tank (OSD) and rainwater storage (RWT) has been provided to assist in managing water flows onsite. Additional permeable landscaping has been provided in the play areas to manage this consideration.	

1.3 Site Description

The proposed site is highlighted in blue in the next image;

Figure 1 - Overall site plan showing proposed building towards the Eastern edge of the site

1.3.1 Resources

- Planning Secretary's Environmental Assessment Requirements
- Building code of Australia 2019
- Climate Change in Australia; https://www.climatechangeinaustralia.gov.au/en/
- NSW Government, Environment and Heritage, Adapt NSW; http://climatechange.environment.nsw.gov.au/

1.3.2 Limitation

Due care and skill have been exercised in the preparation of this report.

No responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact Northrop for detailed advice, which will take into account that party's particular requirements.

2. Principles of Ecologically Sustainable Development

The principles of Ecologically Sustainable Development as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 have been incorporated into the design and on-going operation phases of the development as follow.

- **Inclusion of the precautionary principle** – through the implementation of environmental management and building maintainability, the project attempts to incorporate adaptability and resilience into the project design. The concept behind the precautionary principle is to create spaces that can both; accommodate for changes, which may eventuate in the future, and avoid the risk of serious or irreversible damage to the environment.
- **Inter-generational equity** to ensure that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations – through the inclusion of, best practice PVC and low impact paints, sealants, and adhesives, alongside a focus on providing greater vegetation and support for the building's connection with nature, the project demonstrates a strong commitment to the preservation of environmental health, diversity, and productivity of the local area.
- **Conservation of biological diversity and ecological integrity** – through the planting of native vegetation, improvement of stormwater runoff from the site, and use of integrated landscaping, the project will act to improve, conserve and support the local biological diversity and integrity. Improving water balance for the building to manage water and wastewater more efficiently. Integrating rainwater harvesting for toilet flushing and Irrigation and greywater recycling for toilet flushing and garden irrigation
- **Improved valuation, pricing, and incentive mechanisms** - the project has involved significant input from the Quantity Surveyor who will be involved throughout the entire design process to ensuring that the project both remains on budget and effectively considers environmental factors in the valuation of assets and services. Furthermore, the project has looked more broadly and considered the economic cost benefits that will stem from the project both short and long term, these are included within the economic analysis provided as part of the project submission.
- **Trajectory to reduce the carbon emission** of the proposed building by proposing active and passive design strategies, building service innovation, efficient building systems, and onsite energy generation. Building service innovation includes strategies for reducing the carbon footprint of the Heating, ventilation, and air conditioning systems, efficient lighting, and providing controls around these systems.
- **Providing learning and an engaging environment** by providing features like exposed services, building automation, operational waste reduction measures, etc. and providing measures to incorporate whole-building environmental comfort which includes acoustic, visual, and thermal comfort, and enhancing the students' collaboration by providing engaging enclosed and open spaces and amenities.

2.1 Resources efficiency

Procuring a low carbon material and offering resources efficiencies by incorporating passive design strategies, efficient building services systems, onsite energy generation, and measures to monitor and minimize the consumption of energy and resources like water (including water sensitive urban design)

2.1.1 Energy Efficiency

Energy efficiency has been considered throughout the project schematic design and will continue to heavily influence the design development process with the following improvements already considered as part of the design process.

2.1.1.1 Passive Design Measures

A focus has been placed on good passive design within the building and shading systems for the project. Examples of this include the following;

- Incorporation of shading on the north, east, and west facades of the buildings.
- Use of well-designed slit windows towards west and use of shading canopy for large full height windows.
- high use of thermal mass to regulate temperatures. This is achieved through the selection of concrete for structural elements and floor.
- Natural Ventilation in Circulation Spaces. The central core atrium will be able to operate as a naturally ventilated space exploiting the building's design to promote natural airflow.
- The central stair will naturally support cross-ventilation by removing the hot air from the roof level and creating a negative space for the outdoor air to fill in.
- Integration of landscaping into the building designs to minimize heat islanding and promote passive cooling through transpiration.

2.1.1.2 Improved building fabric and glazing performance

The building will comply with the Building Code of Australia 2019 (BCA) with Section J Energy Efficiency, J1 (Building Fabric), and J2 (Glazing).

The proposed envelope comprises of high thermal mass material that can absorb and store heat. The proposed scheme uses a combination of high-performance glazing to lower heat gains throughout summer while maintaining good views and daylighting throughout the building. The operable windows and doors on the façade also contribute strongly to the natural ventilation strategy allowing for minimal use of space conditioning across the year.

The use of high-performance glazing and building materials will assist the project's targets for energy efficiency, acoustic separation, and thermal comfort. Additionally, the selection of light roofing colors and façade elements will help to limit heat gain throughout the building operational periods falling within summer.

2.1.1.3 Hybrid HVAC system

The mechanical systems proposed in the workshops are to be mixed mode to account for opportunities to use the operable windows, cross-ventilation, and adaptive thermal comfort approach to the site. Radiant floor heating will still be provided to accommodate heating and, a combined cooling strategy of spill air from adjacent conditioned spaces, smoke exhaust, and possibly operable louvers, evaporative coolers/mechanical ventilation will ensure the edge is taken off of the hot day and to cater to peak periods across the year. This system's design will be to minimize its use when external conditions can meet the occupant's comfort needs.

2.1.1.4 Water-cooled VRF/VRV

Other spaces include office, learning classrooms, learning lounge, meeting room and comms room will be air-conditioned via water-cooled VRV/VRF (variable refrigerant volume/flow) Heat Recovery System due to the high COP, can provide simultaneous operation of cooling and heating to each space. The control of the air conditioning system shall be designed to minimize energy consumption.

2.1.1.5 HVAC System Control

The proposed HVAC system will incorporate individual room control for thermal comfort conditions allowing building occupants to maintain comfort conditions suitable to the use and occupancy of spaces. This system assists in optimizing the site's energy efficiency while maintaining comfortable conditions within the conditioned areas and ensures that vacant spaces are not conditioned.

2.1.1.6 Adaptive Thermal Comfort Control

Through consideration of space uses and expected clothing use when HVAC systems are active, they will be set to drift within a larger than a standard dead band to reduce overcooling and heating of spaces. These setpoints will be determined for each space through consideration of the expected comfort bands across the year, considering things such as external temperatures, activity, clothing values, and room layouts.

2.1.1.7 Energy Metering and Monitoring

An energy metering and monitoring strategy will be considered to effectively monitor the main energy use within the project, alongside the lighting and small power use. This aims to provide fault detection and monitoring of the different areas of the project. This system will also look to provide an educational tool and assist in creating behavioural change for **TAFE CCoE** students and staff.

2.1.1.8 Improved outdoor air provision.

The project will aim to improve the outdoor air provided to regularly occupied spaces and the workshop areas. This will minimize CO2 build up and improve cognition for the building occupants. Mechanical ventilation via natural ventilated make up air is proposed for the workshop areas.

2.1.1.9 A highly efficient lighting system

The installation of LED lighting throughout all areas of the building will assist in the minimization of lighting energy use. Improved lighting energy also reduces the heat loads within the spaces and therefore lowers the energy used to condition the building.

2.1.1.10 Onsite Renewable Energy

The project has been designed to include a rooftop solar array providing energy production onsite to both reduce energy costs and provide educational outcomes for TAFE students.

2.1.2 Water Efficiency

A strong focus has been put on the effective management of water and design for water balance to reduce potable water use.

Water-efficient fixtures and fittings

Water Efficient fixtures and fitting will reduce the water consumption of the site. As an indication, the following is being targeted:

- Wash hand basin taps 6-star WELS
- General taps 6-star WELS
- Toilets dual flush 5-star WELS
- Urinals 0.8 L per flush 6-star WELS
- Showerheads 4.5-6 L per minutes 3WELS

Figure 2 - WELLS Label

2.1.2.1 Use of low maintenance landscaping

The site's landscaping will incorporate native and low maintenance vegetation where possible which will significantly reduce the potable water consumption of the site. This use of native vegetation will also help support local flora and fauna, create a strong connection to space, and incorporate learning opportunities for the students.

2.1.2.2 Water Sensitive Urban Design

In line with the aim of the SEARs, the project is incorporating a strong focus on water sensitive urban design with the external landscape design assisting to minimize water use for irrigation. The inclusion of vegetation within the building and the surrounding site assists in the reduction of site stormwater discharge and the management of the project's broader impact on urban stormwater flows.

There is a possibility that the basin may be utilized for On-site Stormwater Detention of flows generated from the TAFE CCoE, however, for the SSDA an onsite detention tank will be considered. Additional permeable landscaping has been provided in the play areas to manage this consideration.

2.1.2.3 Rainwater reuse

Rainwater collected will be reused for irrigation, hardstand washdown, and toilet flushing. Rainwater will be collected from the roof and stored in rainwater tanks either above or below ground with the above-ground been the more cost-effective option. From the rainwater tanks, the water will then be pressurized and filtered on its route to the water using a fixture.

2.1.2.4 Greywater reuse

Greywater from hand basins and showers will be collected for re-use. The greywater will reticulate to the greywater treatment plant where it will be filtered, and chemical dosed for use on irrigation and WC flushing.

2.1.3 Low carbon material use

An early-stage material assessment: to determine the embodied carbon of each material and determine possible reduction. The local supply chain for construction materials will be explored. The project will select low Impact materials for the building which are Reused Products or has Recycled Content Products; can provide Environmental Product Declarations (EPD) or has Stewardship Programs.

Materials selection for the project aims to improve the internal environment of the site with materials with a low volatile organic compound and formaldehyde content preferred to help minimize respiratory issues for building occupants. Additionally, the use of natural materials such as stone, timber, rubber floors will be prioritized during the detailed design, these materials help to facilitate a biophilic response in occupants and have been shown to improve educational outcomes.

Maximum TVOC limits for paints, adhesives, and sealants are detailed in the table below:

Table 2 Maximum TVOC Limits for Paints, Adhesives, and Sealants

Product Category	Max TVOC content in grams per liter (g/L) of ready to use product
General-purpose adhesives and sealants	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes, and wood stains	75
Primers, sealers, and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants, and adhesives	250
Structural glazing adhesive, wood flooring, and laminate adhesives and sealants	100

2.2 Environmental comfort

incorporating biophilia for acoustic, visual, and thermal comfort, providing engaging enclosed and open spaces and amenities, and optimizing air conditioning systems to increase the provision of outside air while maintaining thermal comfort in the workshop and office areas.

2.2.1 Visual Comfort

In educational environments research indicates that maximum access to natural light helps to be more productive and also provides better health outcomes. Hence a well-lit internal space and visually striking external views to create user experiences and engagement.

2.2.2 Daylight Access

The design of the building addition aims to allow daylight penetration into both internal and external spaces. This will minimize energy used for lighting and will improve occupant connection to their external environment.

2.2.2.1 Daylight

Where feasible the project will look to also provide window coverings, which can be used to block out unwanted summer sun (east-facing windows in the morning, and west-facing windows in the afternoon). In winter, these can also be closed window coverings at the end of the day to help rooms stay warmer overnight. Central core atrium entry and skylights glazing has also been provided to promote ambient daylight access to the double-height and triple-height workshop areas.

2.2.2.2 *Access to Views*

Access to external views allows the switch between short and long focal lengths reducing eye strain for office staff and students. There is significant evidence to support that eyestrain and related health problems can be significantly reduced in situations where the eyes can be refocussed periodically on a distant object. This is easier to achieve where there is a nearby window or through open workshop areas or outdoor amenities areas.

2.2.3 Acoustics Comfort

Internal noise levels will be actively considered with the building layout and systems design considering how noise will reverberate through the building. The use of acoustic insulation and sound isolation will ensure that interior noise levels to be maintained below acceptable limits. Tertiary spaces or transition spaces are planned between the workshop and office spaces to reduce reverberation and noise transfer.

2.2.3.1 Interior noise level control (sound masking + treatment) -

Acoustic considerations have been included in the design of the building layout and systems design with interior noise levels to be maintained below the acceptable limit of 45dB (this is in line with industry-accepted practice).

2.2.3.2 *Reverberation through the building*

The reverberation of noise throughout the building will be considered throughout the detailed design phases of the project with isolation measures to prevent the transition of noise through the building structure.

2.2.3.3 *Acoustic separation*

Acoustically sensitive spaces such as meeting rooms, or quiet spaces will incorporate measures to separate these areas from noise transmission, by incorporating soft furnishings, carpets, sealing, and acoustic panels.

2.2.4 Thermal Comfort

Good learning spaces need to be comfortable across the year for staff, students, and visitors. To ensure that the proposed buildings achieve this the project a mixed-mode design and VRV system are designed to achieve this.

2.2.4.1 Passive Solar Design & External Shading

Focus on the use of optimized glazing and window shading to allow solar heat gains through winter while blocking the majority of heat from entering the building throughout the summer period. The proposed indoor-outdoor spaces within the overhanging roof provide shaded external spaces.

2.2.4.2 Thermal Mass

The project has included the use of a concrete structure to capture energy throughout the day and release this at night minimizing the internal temperature variation across the day.

2.2.4.3 Glazing Selection

The project is aiming to use double glazing throughout with a Low-E spectrally selective coating to help to maximize daylight penetration into the spaces while effectively managing heat gains and losses across the year. To add to this passive control of heat entry, blinds will also be provided to external windows.

2.2.4.4 Incorporation of Fans

Where possible the project will consider the use of fans to help control the room comfort conditions by moving air around. In summer, with the windows open, ceiling fans can help to push hot air outside.

2.2.5 Lighting Comfort

2.2.5.1 A highly efficient lighting system

The installation of LED lighting throughout the facility will assist in the minimization of lighting energy use with a target of a lighting power density of less than 4.5W/m2. Improved lighting energy also reduces the heat loads within the spaces and therefore lowers the energy used in the conditioned areas.

2.2.5.2 Motion, photoelectric (PE), and timer controls for circulation space lighting

The project will install motion and PE controls on lighting throughout the circulation and recreation spaces. This will ensure that lighting is not used when spaces are unoccupied. Lighting systems will also be linked to the after-hours timers to ensure that lighting does not remain on after hours and is active when students are entering circulation spaces.

2.3 Learning and engaging environment

Exposed building services, building automation, operational waste reduction measures, etc. Integration of educational signage, wayfinding, and monitoring systems across the site.

2.3.1 Active learning environment

To promote an active learning environment for the students, a strip back approach with exposed services will be explored in the students learning and transitional areas. Integrated services, design, and installation with color-coding of different services can become an education feature of the proposed building. Exposed services will not only reduce the embodied cost of the material to cover the services but will also act as an exposed thermal mass for space. Repair and maintenance work for services can be easy in these areas.

2.3.2 High-quality amenities

High-quality amenity spaces are to promote collaborative studies which also act as a collection between indoor and outdoor spaces. The project intends to have effective amenities spaces like breakout spaces, informal meeting spaces, Café, and outdoor collaboration space. The amenity is intended for use by staff and students.

2.3.3 Integrating the latest technology

A micro GPS downloaded on the student's smartphones can be used to communicate the students about the building and information about the current ventilation strategies, energy use, new amenities, etc. This technology can be used as a way-finder for new students and for the students who keep returning.

2.3.4 Waste Management

The provision of separated waste and recycling streams allows for more effective recycling of the project's operation waste. Providing separate bins for cardboard/paper waste, glass, food wastes, commingled recycling, and general waste will improve the building's operational efficiency and result in significant environmental benefits.

Figure 3 Waste bin colors

3. Green Building Council of Australia Framework

3.1 Overview

The Green Building Council of Australia provides an internationally recognized system to assess sustainable outcomes throughout the life cycle of the built environment. It was developed by the Australian Building Industry through the Green Building Council of Australia (GBCA), which is now the nation's leading authority on sustainable buildings and communities. If assessed against Green Star, the project with the initiatives outlined in the preceding sections, the project will achieve a rating of 5 Stars or Australian excellence.

This section provides a summary of the additional elements drawn from the Green Star tool that will be investigated for the TAFE CCoE

Figure 4 - Green Star Design & As-Built Categories

Few categories which are not mentioned above are detailed below.

3.2 Management

The Management category promotes the adoption of environmental principles from project inception, design, and construction phase, to commissioning, tuning, and operation of the building and its systems. The following credits are currently being considered for incorporation;

3.2.1 Commissioning and tuning

3.2.1.1 Services and Maintainability Review

- The project team will perform a comprehensive service and maintainability review led by the head contractor or the owner's representative during the design stage and before construction.

- The services and maintainability review is to facilitate input from the design team, the facilities manager and operations staff, and any relevant suppliers and subcontractors. The review looks to address Commission ability, Controllability, Maintainability, Operability, including 'Fitness for Purpose'; and Safety of the project:

3.2.1.2 Building commissioning and Building system tuning

- Contractual documentation indicating responsibilities, pre-commissioning procedures, commissioning requirements, witnessing requirements, phased completion requirements (if needed), post-occupancy checks, and any training requirements for operator
- At a minimum, the commitment must include quarterly adjustments and measurements for the first 12 months after occupation and a review of building system manufacturer warranties.

3.2.2 Climate Adaption Plan

The project will consider the impacts of climate change through identifying and addressing all high and extreme risks posed over the expected lifecycle of the TAFE CCoE. This will be done through the creation of a climate adaption plan.

The Climate Adaption Plan will contain as a minimum the following information:

- Summary of project's characteristics (size, location, climatic characteristics);
- Assessment of climate change scenarios and impacts on the project using at least two-time scales, relevant to the project's anticipated lifespan. This must include a summary of potential direct and indirect (environmental, social, and economic) climate change impacts on the project;
- Identification of the potential risks (likelihood and consequence) for the project and the potential risks to people. This risk assessment is to be based on a recognized standard;
- A list of actions and responsibilities for all high and extreme risks identified; and
- Stakeholder consultation was undertaken during plan preparation and how these issues have been.

3.2.3 Metering and monitoring

Metering shall be provided to allow for monitoring of the relevant areas or functions of the project. The monitoring strategy needs to be developed following a recognized standard, such as CIBSE TM39 Building Energy Metering. The same principles described in the standard will be used for developing water metering and monitoring strategies.

3.3 Materials

The materials category aims to reward projects that include building materials that are responsibly sourced or have a sustainable supply chain. The following credits are currently being considered for incorporation;

3.3.1 Permanent Formwork, Pipes, Flooring, Blinds, and Cables

90% (by cost) of all cables, pipes, flooring, and blinds in the project will either:

- Do not contain PVC and have an Environmental Product Declaration (EPD);
  or
- Meet Best Practice Guidelines for PVC.

3.3.2 Construction and Demolition Waste – Percentage Benchmark

Effective waste management throughout demolition, construction, and operation of the site will help to promote resource efficiency and minimize the adverse environmental impacts of the project. The following are being considered as part of the design process:

The project will also look to limit the amount of construction and demolition waste sent to landfill with the aim of at least 90% of all waste produced by the project to be sent to recycling facilities or reused on-site Construction and Demolition Waste Minimisation.

3.4 Sustainable transport

The green star transport category aims to reduce the carbon emissions arising from occupant travel to and from the project when compared to a reference building. Refer to Traffix Consultant SEAR report for a detailed consultation on sustainable transport.

3.5 Land Use and Ecology

Through planting native vegetation and promoting improved interaction with the natural environment, the project will look to improve the site's ecology and minimize the ongoing environmental impact of the project. The 'Land Use & Ecology' category aims to reduce the negative impacts on sites' ecological value as a result of urban development and reward projects that minimize harm and enhance the quality of local ecology.

3.5.1 Endangered, Threatened, or Vulnerable Species

At the date of site purchase or date of the option contract, the project site did not include old-growth forest or wetland of 'High National Importance' or did not impact on 'Matters of National Significance'.

3.5.2 Heat Island Effect Reduction

At least 75% of the whole site area (when assessed in plan view) comprises of one or a combination of the following:

- Vegetation;
- Green roofs;
- Roofing materials, including shading structures, having the following:
- For roof pitched <15°– a three-year SRI >64; or For roof pitched >15°– a three-year SRI >34.
- Only where the three years Solar Reflectance Index (SRI) for products is not available, use the following:
- For roof pitched <15° – an initial SRI > 82; or For roof pitched >15° – an initial SRI > 39.
- Unshaded hard-scaping elements with a three-year SRI > 34 or an initial SRI > 39;
- Hard-scaping elements shaded by overhanging vegetation or roof structures, including solar hot water panels and photovoltaic panels;
- Areas directly to the south of vertical building elements, including green walls and areas shaded by these elements at the summer solstice.

3.6 Emissions

The 'Emissions' category aims to assess the environmental impacts of 'point source' pollution generated by projects. Negative impacts commonly associated with buildings include damage to the environment through refrigerant leaks or disturbances to native animals and their migratory patterns as a result of light pollution. The following credits are currently being considered for incorporation;

3.6.1 Reduced Peak Discharge

The project is aiming to achieve a post-development peak event discharge from the site which does not exceed the pre-development peak event discharge using the design Average Recurrence Interval (ARI) that corresponds to the associated flooding risk identified in the Climate Change and Adaption Assessment undertaken as part of the Adaption and Resilience credit.

3.6.2 Reduced Pollution Targets

Additionally, the project aims to demonstrate that all stormwater discharged from the site meets the pollution reduction targets in Table 3 below.

Table 3 Minimum Pollution Reduction Targets

Pollutant	Reduction Target (% of the typical urban annual load)		
	A	B	B
Total Suspended Solids (TSS)	80%	80%	90%
Gross Pollutants (GP)	85%	90%	95%
Total Nitrogen (TN)	30%	60%	75%
Total Phosphorus (TP)	30%	60%	70%
Total Petroleum Hydrocarbon	60%	90%	90%
Free Oils	90%	90%	98%

3.6.3 Light Pollution to Neighbouring Bodies and Light Pollution to Night Sky

The project design ensures that all outdoor lighting on the project complies with AS 4282:1997 at all inhabited boundaries, apart from boundaries with roads.Outdoor lighting has been designed to achieve the following;

- Control of upward light output ratio (ULOR) by demonstrating that no external luminaire on the project has a ULOR that exceeds 5%, relative to its actual mounted orientation.

3.7 Innovation

The 'Innovation' category aims to recognize the implementation of innovative practices, processes, and strategies that promote sustainability in the built environment.

Market Transformation

The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or the world. Through the targeting of world-leading sustainability principles at the project is contributing to a broader market transformation that repositions student health and well-being as a key indicator of sustainability.

Innovation Challenge – Occupant Engagement

Occupant Satisfaction Surveys can be used to evaluate occupant's comfort and its relation to thermal comfort, acoustics, indoor air quality, lighting comfort to which buildings enable users to fulfill their intended goals.

Innovation Challenge – Reconciliation Action Plan

An endorsed reconciliation action plan must be prepared by the organization where the registered Green Star project must demonstrate a relationship to, and a role in delivering, the action items within the organizational RAP

Global Sustainability - Green Cleaning Policy

Under Global Sustainability credit, 30 E - Global Sustainability, 1 point can be claimed in Green Star - Design & As Built v1.3 by meeting all compliance requirements under 6.1 Green Cleaning from the Green Star - Performance v1.2 submission guidelines. A conditional requirement is to implement this policy for a minimum of 10 years.

Global Sustainability - Qualities of Amenities

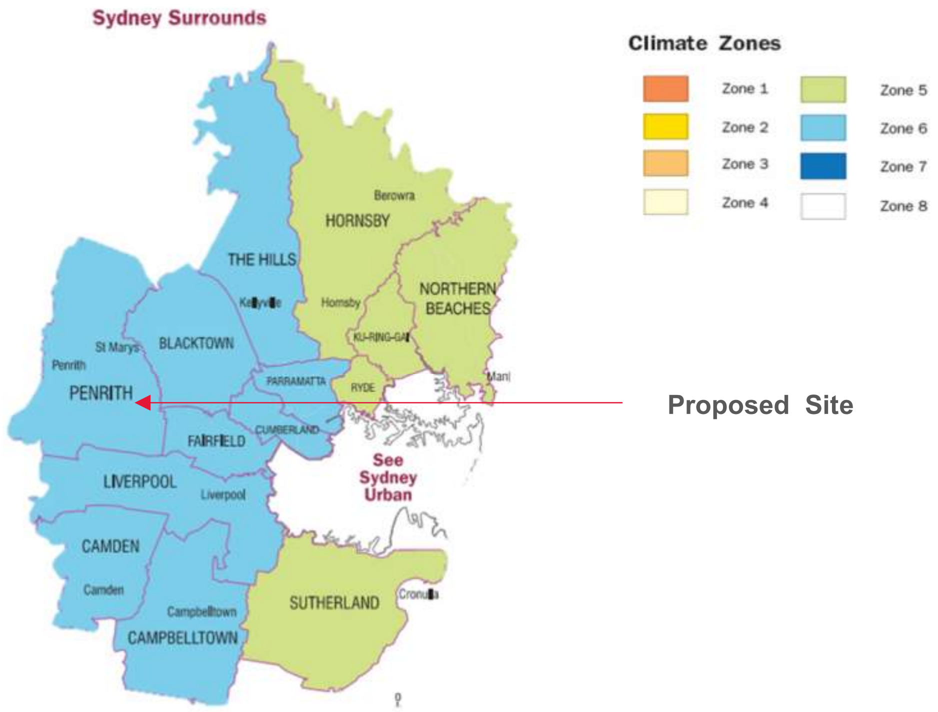
where at least 5% of the primary and secondary nominated area comprises high-quality amenity spaces. Amenity spaces are to promote the engagement between occupants and active living, such as a lunch area, breakout space, or informal meeting space. The amenity is intended for use by staff or regular occupants and meet at least three of the specified criteria of interaction, ventilation, daylight, views, landscaping, and noise.

4. National Construction Code (NCC) SECTION J

4.1 Overview

TAFE CCoE classified as Class 9b and is in Climate Zone 6.

Figure 6: Map of the BCA Climate Zones for Sydney Urban



There are two methods of achieving Section J compliance. The building can be assessed against the Deemed-to-Satisfy (DTS) provisions of the code, or JV3 performance-based solution.

It is envisioned that the proposed wall to window ratio will not be limited to 20% of the building fabric, hence the project will eventually be assessed under the JV3-Performance pathway. However, these advice notes are only providing preliminary fabric R-value requirements for the schematic design stage as if the building is assessed under Deemed to satisfy pathway (DTS) This memorandum is intended as a guide to illustrate the potential NCC section J compliance fabric to be considered in the development. It should be read in conjunction with the other schematic documentation Specific applications may vary during the development of the project.

Table 1: Insulation System requirements for the main building elements

Building Fabrics	Estimated total R-value Requirement
Roof and Ceiling	3.2 (SHGC 0.45)
External Walls	1.6*
Insulated Partition Walls	1.2*
Suspended Floors	2.0
Floors and Ceilings to non-conditioned space e.g. workshop	2.0
Glazing System	Generally recommended thermally broken High-performance double-glazed window with total system (Frame + glass) U values of between 2.8-3.0 W/m2K and SHGC between 0.3- 0.4 The accurate information will be provided when the glazing calculations are complete.

Note: The total system R-Value of the external walls must reflect thermal performances inclusive of the thermal bridging effect caused by building support structures. As such the build-up must achieve the stipulated R-Values with the effects of thermal bridging is considered.
Should the requirements listed above be deemed unfeasible, it is recommended that the project team should proceed with a JV3 performance-based solution. This approach is more flexible as it offers a holistic assessment of the building performance, rather than individual components.

5. Climate Adaption

As identified in the previous section the design team will go through a climate adaption planning process which will look at longer-term risks and adaption opportunities repeatedly over the building lifetime. This assessment of the site's initial design has included a risk assessment and the following provides an overview of how the design of the development is responsive to the CSIRO projected impacts of climate change.

5.1 Climate Region

The project is in BCA climate zone 6 (inland) which is characterized by mild temperate and diurnal temperature range throughout the year. This climate zone is characterized by 4 distinct seasons:

- Summer and winter - summer and winter temperatures can exceed the human comfort range. The primary source of HVAC will be required to maintain the indoor comfort levels
- Spring and autumn –These seasons are ideal for human comfort, mild to cool winters with low humidity, hot to very hot summers, moderate humidity. This will provide the opportunity to utilize passive strategies like natural ventilation by windows opening to regulate ventilation and remove any unwanted heat gains as detained in the report.

5.1.1 Local Climate

- Summer Maximum (Extreme): 48.9 °C on Jan 2020
- Summer Average Maximum Temperature: 31 °C
- Winter Minimum Extreme: -1.8 °C in July 2018
- Winter Average Minimum Temperature: 5 °C

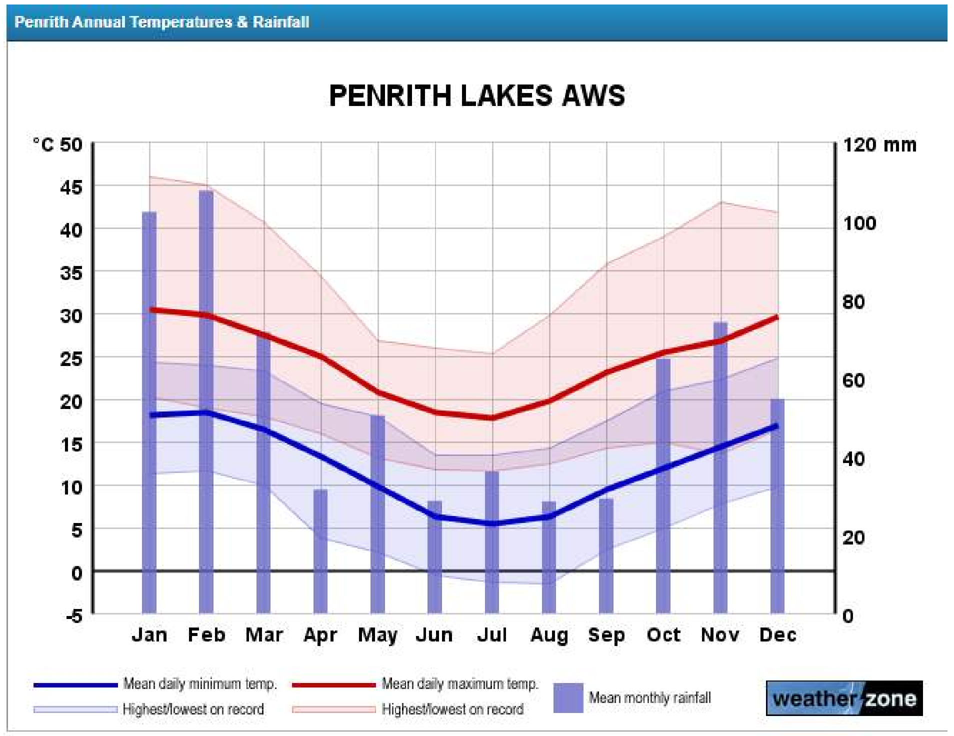


Figure 5– Penrith annual temperature and rainfall

Table 3 Identified Climate Hazards

Climate Hazards	Exposure	Vulnerability Risk	Comments for 2030 time period
Extreme Heat	Medium to high	Medium	Hot days Increases are dominated in northwest regions (Penrith area) in summer and spring.
Floods	Low	Low	the site is flood-affected to the north towards the existing pond because of the Werrington Creeks Catchment. However, the mean rainfall change is -12.5 to 2.5%, which is low.
Bushfire	Low	Low	The site is not located on bush fire prone land as identified by the NSW Rural Fire Service (RFS). The forest fire danger index (FFDI) is 0.5-1% which is low summers (Climate Change in Australia CMIP5, RCP4.5 climate modelling).
Severe Thunderstorms/ Hail	Medium-high	Medium	More than 20 storms occur here annually, with a 5% probability. During the 100yr storm event, over 200 mm of rainfall is predicted to fall in 24hrs.
Extreme Winds	Medium	Medium	The site is located on 23 hectares open campus. The Summer wind is predominately from the South and Southwest and Winter winds are predominately from the North, west, and South. Increase of 3m/s of wind speed by 2030. (Climate Change in Australia CMIP5, RCP4.5 climate modelling).
Cyclones	Low	Low	The site is not located in a cyclone-prone region.

5.2 Climate Change Effects

The following list provides a summary of the primary climate effects and the risks associated due to secondary climate effects applicable to the development. The climate change projection data relevant to the climate and site conditions of the project identified within the CSIRO projected impacts of climate change were utilized to establish the below scenarios for the development and how they have been addressed within the design of the project.

5.2.1 Changing Surface Temperature

- An increase in the average surface temperature could lead to reduced thermal comfort for the building occupants over time – reflective and vegetated surfaces have been included throughout the site to minimize urban heat island effects; the building has been designed to capture multidirectional breezes and promote movement of air across the site; mixed-mode ventilation and conditioning strategy allows the building to ramp up space
- An increase in extreme heat could lead to an increase in energy and water demand and associated utility and maintenance costs – the incorporation of native low water use vegetation and not water-based heat rejection

systems will minimize water demand for key systems; the use of a flexible mixed-mode system supported by onsite solar power generation will work to balance increased energy costs for space conditioning.

- An increase in extreme heat could place additional stress on building services including air conditioning equipment – an increased average outside design temperature will be used to size the air conditioning systems to ensure that they are sufficiently sized for the potential temperature increases; adaptability of these systems will also be considered with the potential to add additional cooling capacity if required in the future.

5.2.2 Changing Precipitation

- An increase in rainfall intensity could increase local flood events limiting access to the building for vehicles, building occupants, and pedestrians – the onsite stormwater management systems will be designed for the forecast increases in rainfall intensity; the landscape design incorporates significant vegetation to assist in the management of stormwater runoff and the project will improve the permeability of the site.
- Increased severe thunderstorms and intensity could result in blockages in roof drainage systems from the build-up of hail and debris, causing stormwater to overflow and damage the building asset, goods, and equipment owned by the TAFE – the projects hydraulic design will consider this risk and increase the capacity of roof drainage to accommodate.
- Power outages during major storm events could lead to a potential disturbance to building systems including security, lighting, etc, posing a safety issue to occupants on-site – the flexible mixed-mode ventilation systems and project focus on good daylight penetration will enable the building to continue operating across most of the year in the occasion of power outages; emergency lighting and safety systems will have redundancy to minimize safety risks posed to building occupants.

5.2.3 Changing Wind Speed

- An increase in wind speed intensity could lead to damaged building assets including windows and roof elements – this is considered within the structural and landscaping design of the site.
- Increased wind speed intensity could result in damaged vegetation, creating a disturbance to the local ecosystems and increased maintenance costs for the property – this risk is considered within the landscaping design with the use of endemic native species well suited to the site, and these future risks.
- An increase in wind speed intensity could potentially damage power lines, resulting in a power outage for the building - the flexible mixed-mode ventilation systems and project focus on good daylight penetration will enable the building to continue operating across most of the year in the occasion of power outages.

5.2.4 Changing Humidity

- A decrease in humidity could relate to higher risks of fires – the inclusion of rainwater supplied a drip irrigation system for landscaping and the general location of the site should minimize this risk.
- A decrease in humidity could lead to changes in the micro-climate, impacting the local ecology (flora and fauna) of the site – the use of endemic native vegetation will act as a buffer to this impact as will the provision of the rainwater supplied irrigation systems.

5.3 Statement on Design

The project design has included specific measures detailed within sections 2-6 of this report to respond to the CSIRO and projected impacts of climate change. These measures include simple alterations such as building orientation and site layout to promote airflow through the building and site, color selection and the use of vegetation, through to more complex solution such as the proposed HVAC controls and mixed mode ventilation strategy. Overall, these measures alongside the adaptability of the building and its systems shows a strong consideration within the design of potential future climate change adaptation needs.