Ecologically Sustainable Design (ESD SEARs) Report

47-97 Marlborough St, Surry Hills NSW

7 April 2026

192-200 Euston Rd,
Alexandria NSW 2015
Phone: +61 2 8488 4600
Fax: +61 2 9475 4588
Email: admin@igs.com.au
Web: www.igs.com.au
linkedin.com/company/3213174
ABN: 68 163 019 029

Document Control

Revision	Date	Author
1.0	2 April 2026	B. Shojaei
2.0	7 April 2026	B. Shojaei

CONTENTS

1. Executive Summary

This report has been prepared to support a State Significant Development Application (SSDA) SSD-78545225 for the site at 47–97 Marlborough Street, Surry Hills.

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, Housing and Infrastructure (DPHI) for assessment.

The principles of ecologically sustainable design will be an integral consideration throughout this development. This report summarises the ESD provisions for the development which demonstrate commitment to environmental sustainability.

The sustainability targets for the development will be achieved in an integrated and staged approach through minimising the need for energy consumption (via passive measures) and then consumption optimisation (energy efficiency) and use of renewable resources where required.

The initiatives presented in this report demonstrate a wide range of measures which will result in high levels of environmental performance and also improvement of occupants' health, productivity, comfort, and satisfaction.

Aiming at leading practice in energy and environmental targets, the project architect and building services design team will maximise energy efficiency in an integrated and staged approach as described in Table 1 below.

Table 1. Sustainability Approach.

Load Reduction (Minimising the need for resource consumption e.g., energy, water, and material)	Passive Design
	Building fabric improvements
	Maximise use of natural lighting
	Maximise use of Natural ventilation
	Maximise use of native plants and species
Optimising resources consumption (energy, water & materials)	High efficiency Heating, Ventilation and Air Conditioning
	High efficiency lighting
	High efficiency hot water systems
	High efficiency appliances
	Commissioning and tuning of building services post completion
	High efficiency building control, automation and BMS
Indoor Environmental Quality	Thermal Comfort
	Acoustic comfort
	Effective Daylighting / Natural Lighting
	Natural Ventilation g
	Volatile Organic Compounds (VOC) & Formaldehyde Minimisation
Material	Maximise separation and recycling of demolition and construction materials.
	Minimise use of Ozone Depleting materials
	Avoid specifying materials with environmentally sensitive content
	Participation in waste minimisation training for contractors and sub-contractors.

	Waste minimisation plan to reduce site waste to landfill.
Transport Efficiency	Sustainable transport measures & bicycle racks
Use of renewable resources (renewable energy and rainwater harvesting)	Application of Solar Energy & Heat Pump technology
	Rainwater harvesting
Land use and Ecology	Maintaining and improving the ecological value of the land
Emissions	Insulation products with low Ozone Depletion Potential
	Refrigerants with Ozone Depletion Potential of zero
	Stormwater Management
	Light Pollution: Minimise light beams directed upwards or outside the buildings.

Benchmarking and compliance requirements:

The development will meet and outperform the following regulatory sustainability requirements:

- Standard Secretary's Environmental Assessment Requirements (SEARs) – ESD requirements.
- NCC Section J – Energy Efficiency
- BASIX – Energy, Water and Thermal Comfort.

1.1 Response to SEARs

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 19 December 2024 (SSD-78545225). Specifically, this report has been prepared to respond to the following SEARs Table 2.

Table 2. SEARs Relevant References.

SEARs Items	Project Response
Identify how ESD principles (as defined in section 193 of the EP&A Regulation) are incorporated in the design and ongoing operation of the development.	The sustainability targets for the development will be achieved in an integrated and staged approach through first minimising the need for energy consumption (via passive measures) and then consumption optimisation (energy efficiency) and use of renewable resources where required. The outcome of this staged approach is to ensure the development aligns with the ecological sustainable development principles of Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. Refer to section 8 for the proposed ESD initiatives.
Where relevant, provide an assessment of the development against the standards for non-residential development set out in Chapter 3 of State Environmental Planning Policy (Sustainable Buildings) 2022.	The development will be designed to comply with the provisions outlined in Chapter 3.2(1) of SEPP (Sustainable Buildings) 2022.
Demonstrate how the concept development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.	The proposed development will outperform the minimum regulatory requirements of NCC Section J. While a formal Green Star certification is not being pursued, the design team will incorporate sustainable design principles where feasible, guided by established sustainability frameworks. Refer to Section 8 for the targeted sustainability measures, including strategies for energy and water conservation.

Demonstrate how the concept development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.	Mitigation of the operational GHG emissions of the development has been considered in the design. Section 8 provide building performance measures considered to reduce resource consumption and carbon emissions.

2. Project Description

The application seeks development consent for the redevelopment of the site for an in-fill affordable housing residential development comprising 172 market and affordable housing dwellings. The works will involve the adaptive reuse of the heritage listed warehouse building known as the 'Former David Jones Factory'.

Specifically, this application seeks approval for the following:

- Demolition of the existing car park on the northern portion of the site.
- Site preparation works including:
  - Tree removal.
  - Excavation on the northern portion of the site.
- Alterations and additions to the existing warehouse building for the purposes of a residential flat building comprising:
  - Heritage conservation works to the warehouse building and alterations to the warehouse roof profile on level 8.
  - Four level addition to the warehouse building on the central portion of the site.
  - 134 residential apartments across 9 levels.
  - Indoor communal resident amenity and rooftop communal open space.
  - Service vehicle access from Goodlet Street to an at-grade loading dock.
  - Lower ground storage, plant and services area.
- Construction of a new residential flat building on the northern portion of the site comprising:
  - Basement car stacker and vehicular access from Landsdowne Street.
  - Retail tenancy on ground level on the corner of Marlborough Street and Landsdowne Street.
  - 38 residential apartments across 9 levels.
- Landscaping and associated public domain works including a private pedestrian link along the western site boundary.
- Provision of 15% affordable housing to be managed by a community housing provider for a period of 15 years from date of the Occupation Certificate.
- Extension and augmentation of physical infrastructure and utilities as required.

Refer to Architectural Plans prepared by Wardle appended to the Environmental Impact Statement.

2.1 The Site

The site is located at 47-97 Marlborough Street, Surry Hills and is legally described as Lot 1 in DP225393 and Lot 1 in DP251056. It is regular in shape and has an area of approximately 3,408 sqm.

The site is located in the City of Sydney local government area (LGA) in Surry Hills, which is well-serviced by public amenities such as a supermarket, cafes, destination retail shops and a library. Community facilities such as swimming pools, tennis courts, and active open space are easily accessible. The southern portion of the site comprises a locally listed heritage item (the former David Jones Warehouse building) and the northern portion of the site accommodates a car park. The area to the east and south of the site is a Heritage Conservation Area.

The site is in a highly accessible area with the nearest Light Rail Station (Surry Hills) 200m to the north of the site. The site is also close to regular bus services in the immediate vicinity.

The existing building is built to the site boundaries. There are existing street trees along Marlborough Street, as well as some planter boxes containing vegetation on the site's north-eastern frontage to Marlborough Street. The location of the site is illustrated in Figure 1.

Figure 1. Site Location.

3. Overview

The design team recognise the importance of sustainable developments in terms of environmental preservation, occupants' health, safety, and wellbeing, as well as in terms of greenhouse gases emissions reduction.

The project architect, consultants and contractors will strive to design and construct the building based on the Environmentally Sustainable Design (ESD) principles which exceed the minimum regulatory NCC Section J requirements.

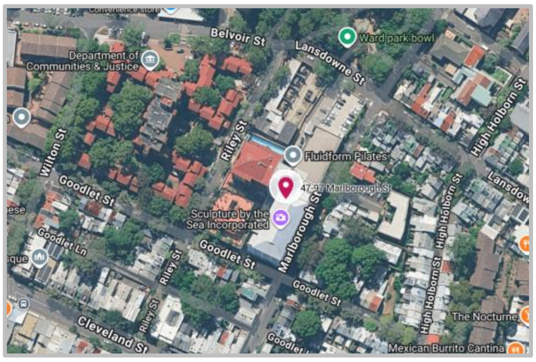


Figure 2. Location – 47-97 Marlborough St, Surry Hills NSW

The facade and floor plans are designed with the vision to give occupants the very best in terms of passive heating and passive cooling. This, when combined with other energy efficiency strategies (listed later in the report) will lead to low energy demands for the tenancies and base building and therefore lower greenhouse gas emissions during the life of this development.

This report has been prepared to support a State Significant Development Application (SSDA) SSD-78545225 for the site at 47–97 Marlborough Street, Surry Hills.

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, Housing and Infrastructure (DPHI) for assessment.

Natural lighting and natural ventilation will be utilised very effectively throughout the development. In addition to thermal comfort, energy and water efficiency, the proposed building design will provide sustainable and efficient operation to the occupants.

The proposed sustainable design initiatives will not only improve the building services life but are low-cost, low maintenance and reliable, especially when compared to often prohibitively complex and expensive retrofits. Furthermore, the passive design principles will facilitate a low-energy and cost-effective operation for the occupants.

The following are some of the design initiatives which will improve the environmental performance of the development and deliver long term energy efficiency during the life of the building.

- Optimising the size of the mechanical plant to ensure the plant is working at its peak efficiency and minimise the capital cost of the plant.
- Having high efficiency lighting and air conditioning equipment will reduce the energy consumption of the buildings.
- Variable Speed Drives (VSD) controls the speed of pumps, fans, and other mechanical plant to ensure that they are only using as much power as it is needed.
- Commissioning of all services equipment to ensure their correct operation.
- A high-performance façade will limit the heat entering the buildings, reducing air conditioning system sizes and the energy use over the year.
- A mixed mode approach allowing the buildings to be naturally ventilated when outdoor conditions are suitable allowing significant energy reduction by not requiring the air conditioning system to operate at all times.
- Emission reductions and material optimisation.
- Maximise use of non-toxic building materials.
- Maximise use of materials that are recyclable.
- Minimise Waste in Construction.
- Minimise Waste in Operation.
- Renewable Energy generation – Solar PV & Heat Pump technology.

4. Benchmarking

Benchmarking and compliance requirements:

The development will meet and outperform the following regulatory sustainability requirements:

- Standard Secretary's Environmental Assessment Requirements (SEARs) – ESD requirements
- NCC Section J – Energy Efficiency
- BASIX – Energy, Water and Thermal Comfort.

4.1 National Construction Code (NCC) Section J

Section J of the NCC sets regulations for energy efficiencies for all types of buildings with respect to the building's construction, design, and activity.

The objective of the NCC Section J is to reduce the greenhouse gas emissions. Section J requires that a building, including its services, must have features to the degree necessary that facilitate the efficient use of energy.

The NCC offers two compliance methods that differ in complexity and flexibility. The two compliance methods are:

- Deemed-to-Satisfy (DTS) Compliance.
- J1V3 – Verification using a referenced building.

The Deemed-to-Satisfy Provisions in Section J of the NCC 2022 Amendment 2 include the following 8 components.

- Part J1 - Energy efficiency performance requirements.
- Part J2 - Energy efficiency.
- Part J3 - Elemental provisions for a sole-occupancy unit of a Class 2 building or a Class 4 part of a building.
- Part J4 - Building Fabric relates to the building fabric and minimum thermal performance for constructions according to climate zone for roofs, ceilings, roof lights, walls, glazing and floors.
- Part J5 – Building Sealing – Provisions to reduce the loss of conditioned air and restrict unwanted infiltration to a building.
- Part J6 - Air-Conditioning and Ventilation – Requirements to ensure these services are used and use energy in an efficient manner.
- Part J7 - Artificial Lighting and Power – Requirements for lighting and power to ensure energy is used efficiently within a building.
- Part J8 - Heated water supply and swimming pool and spa pool plant – Restrictions for hot water supply design except for solar systems within climate zones 1, 2 and 3.
- Part J9 - Energy monitoring and on-site distributed energy resources.

The development will meet and outperform the NCC energy efficiency requirements of Part J4 report will be prepared once the design is further progressed.

4.2 Building and Sustainability Index (BASIX)

The National Construction Code (NCC) Section J deems those developments with a building class of 1 or 2 in NSW should be assessed against the BASIX rating scheme. The BASIX rating scheme investigates the thermal comfort of the building, energy consumption and water consumption.

There are three input sections: Energy, Thermal Comfort, and Water. Each of these three categories is integrated and often influences each other.

New residential developments in NSW must reduce their energy and water use, according to BASIX requirements developed by the Department of Planning, the objectives of the BASIX scheme are relative to an average development in NSW.

- 40% reduction in water consumption,
- 60% reduction in greenhouse gas emissions, depending on building height,
- Minimum thermal performance requirements for heating and cooling loads.

The maximum allowable heating and cooling loads for each apartment are dependent on the glazing and floor area.

Achievement of the specified targets is demonstrated through use of a web-based prediction tool. This tool requires input of several aspects of the dwelling's design and produces a BASIX certificate and report listing all of the environmental initiatives proposed and required to achieve the mandatory performance.

A BASIX Certificate is a DA requirement and demonstrates compliance with the NSW Government’s sustainability targets. The development will meet and exceed the minimum requirements for all following areas.

- Water Efficiency: 41% reduction (minimum requirements under BASIX: 40%)
- Energy Efficiency: 60% reduction (minimum requirements under BASIX: 60%)
- Thermal Comfort: Will pass the thermal performance requirements under BASIX.

5. Development Location

The development will be located in Surry Hills NSW which is within the NCC climate zone 5 (Warm temperate). The climate zone map of the development is depicted in Figure 3.

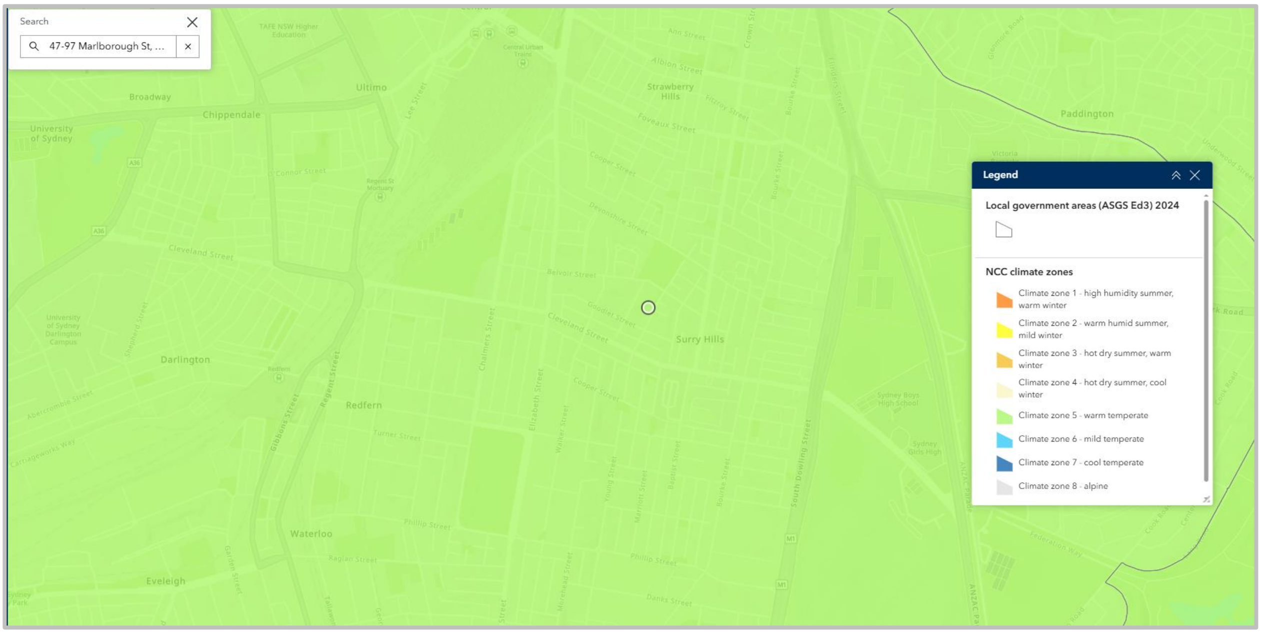


Figure 3. Climate zone map.

5.1 Information Used in Review

Our review is based on the following preliminary architectural drawings by Wardle Architects in March 2026 (Table 3).

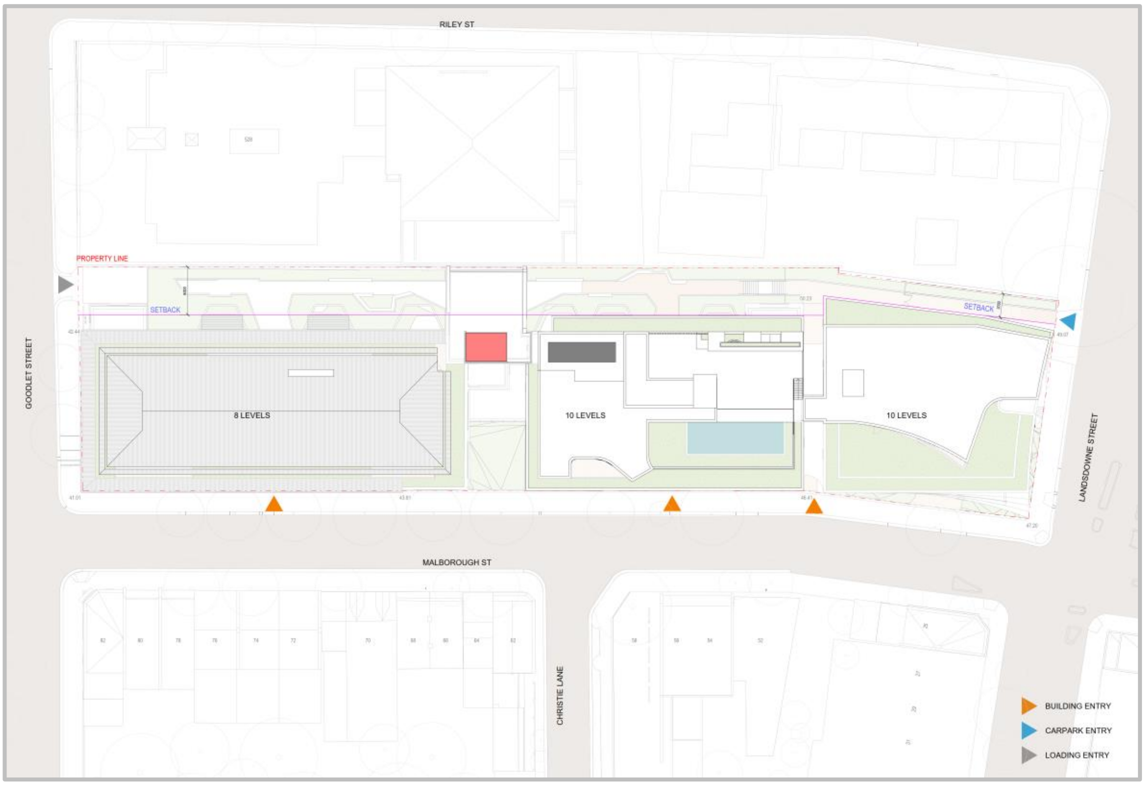
Table 3. Architectural drawing list.

Drawing title	Drawing number	Revision
Drawing List	AR 001	3
Context Plan	AR 010	2
Existing Site plan	AR 011	2
Proposed Site plan	AR 013	3
GA Plan - Level B06	AR 100	4
GA Plan - Level B01, B02, B03, B04, B05	AR 101	6
GA Plan - Ground Floor (G-G-B)	AR 102	11
GA Plan - Level 01 (01-01-01)	AR 103	15
GA Plan - Level 02 (02-02-02)	AR 104	9
GA Plan - Level 03 (03-03-03)	AR 105	10
GA Plan - Level 04 (04-04-04)	AR 106	9
GA Plan - Level 05 (05-05-05)	AR 107	9
GA Plan - Level 06 (_-06-06)	AR 108	10
GA Plan - Level 07 (06-07-07)	AR 109	10
GA Plan - Level 08 (_-08-08)	AR 110	10
GA Plan - Level 09 (07-09-09P)	AR 111	9
GA Plan - Level 10 (08P-10P-10P)	AR 112	13
GA Plan - Roof Plan	AR 113	8
Elevation - North and South	AR 300	6
Elevation - East	AR 301	6
Elevation - West	AR 302	6
Building Section AA - North-South Long Section	AR 400	7
Building Section BB and CC – Southern and Central Building Cross Section	AR 401	7
Building Section DD - Northern Building Cross Section	AR 402	7

5.2 Architectural Drawings

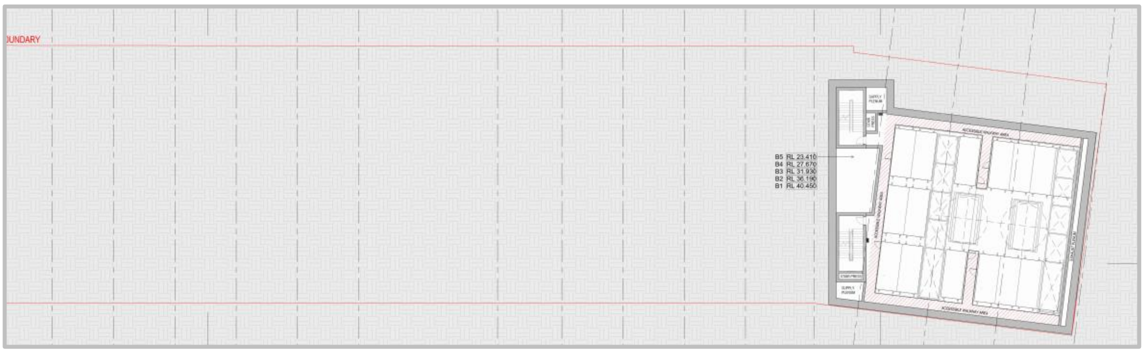
Selected architectural plans and elevations for the proposed development are provided below.

Site Plan

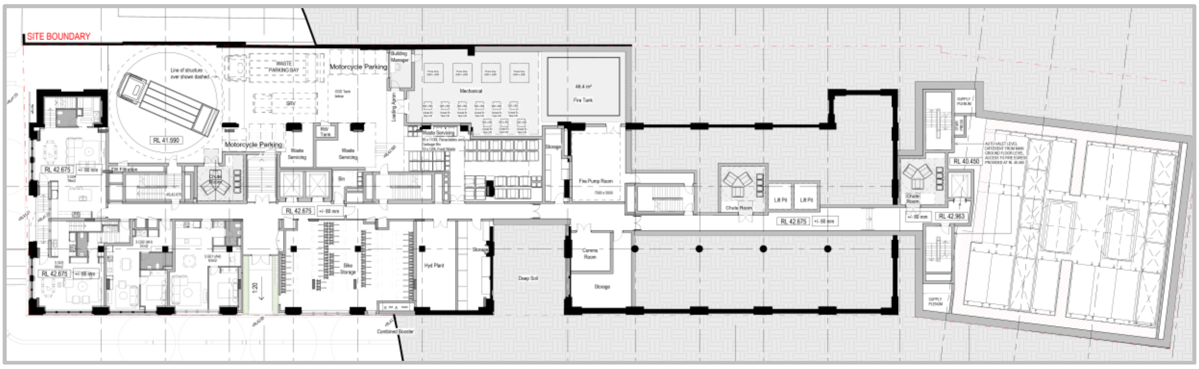


Level B06 Floor Plan

Typical Basement Floor Plan



Ground Floor Plan



Level 1 Floor Plan

Level 2 Floor Plan

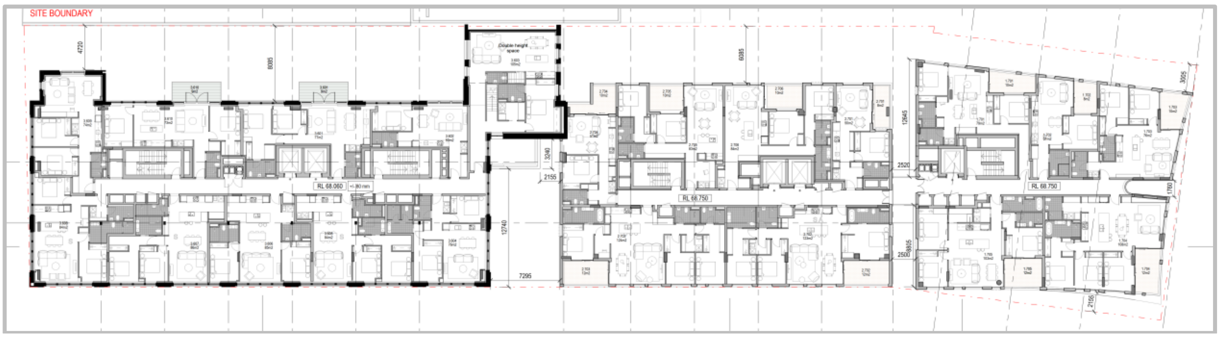
Level 3 Floor Plan

Level 4 Floor Plan

Level 5 Floor Plan

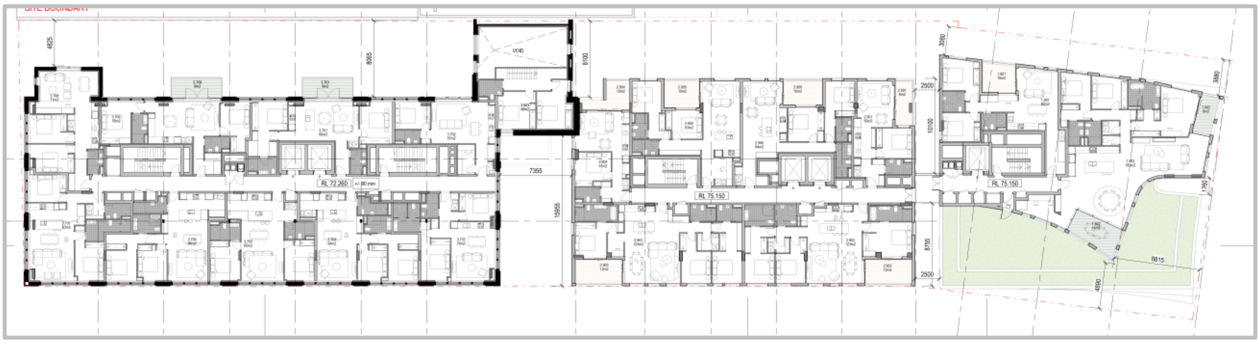
Level 6 Floor Plan

Level 7 Floor Plan

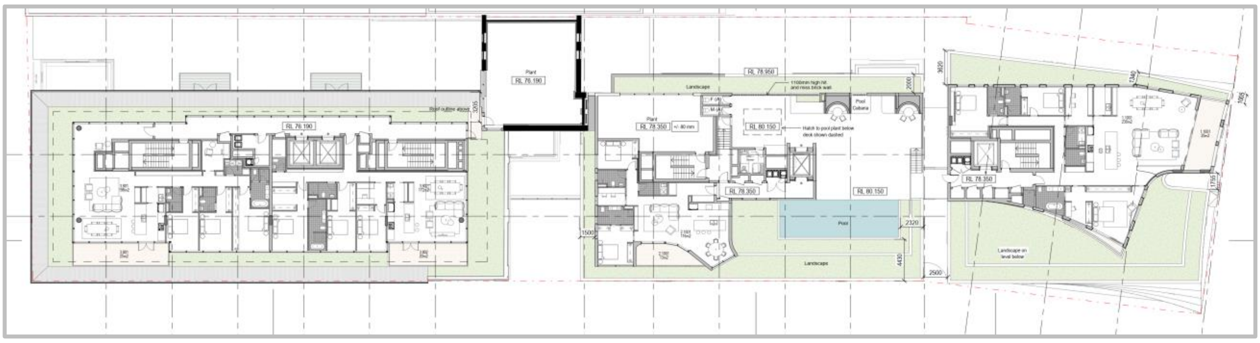


Level 8 Floor Plan

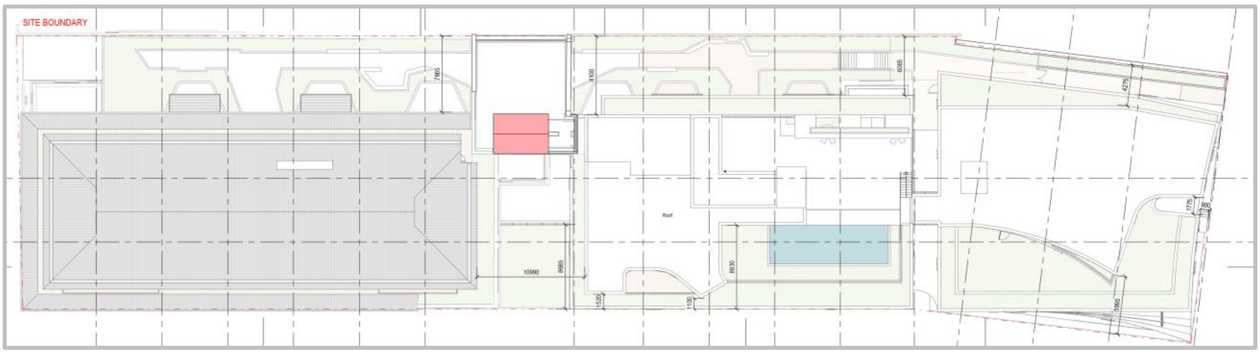
Level 9 Floor Plan



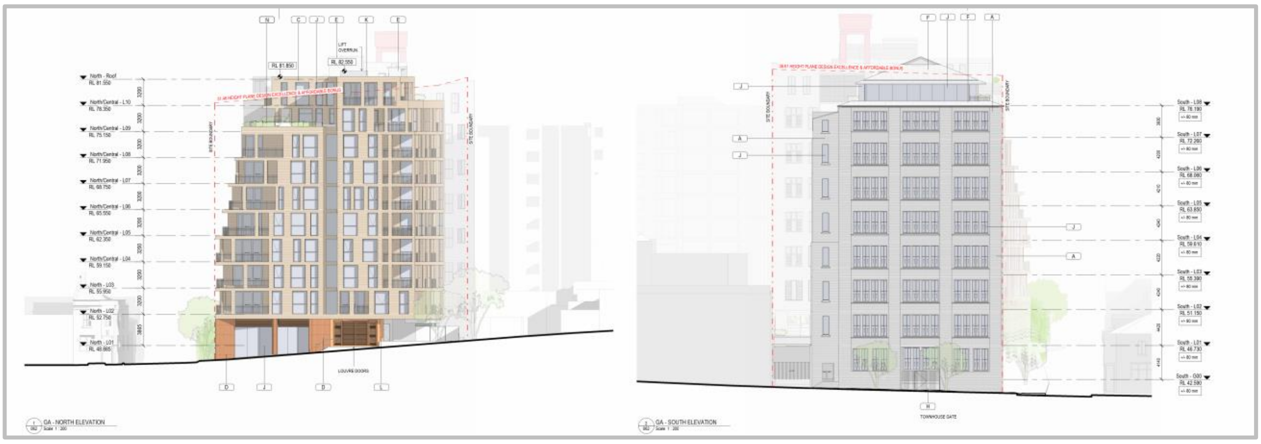
Level 10 Floor Plan



Roof Plan



North & South Elevation

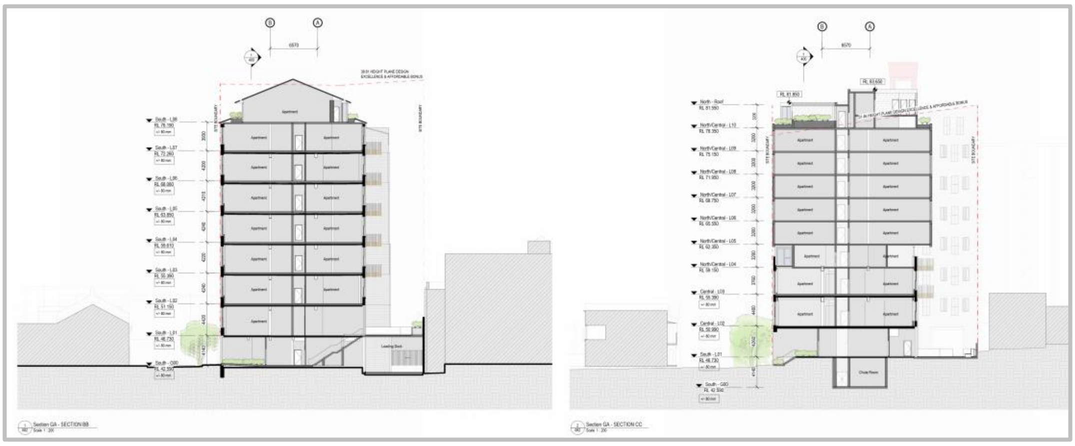


East Elevation

West Elevation

Building Section AA - North-South Long Section

Building Section BB and CC - Southern and Central Building Cross Section



Building Section DD - Northern Building Cross Section

6. Stakeholder Engagement

Stakeholder engagement is to be undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and any supporting comments issued by Council and relevant NSW Government agencies. This process is intended to confirm key sustainability considerations, identify any agency-specific expectations, and ensure that matters raised are appropriately addressed within the proposal and supporting documentation.

At the time of issuing this report, no Council or NSW Government agency referral responses (or supporting comments) have been provided to the ESD consultant for review. Accordingly, this report does not confirm closure of agency matters. Where referral responses are received, they will be reviewed in detail and all relevant issues will be addressed and/or justified within the updated assessment report, with clear cross-references to the relevant sections, drawings and specifications.

Once stakeholder correspondence and/or agency comments are received and provided to the project team, this section will be updated to document:

- The relevant authorities/agencies consulted and key contact(s);
- The date and method of engagement (meeting/telephone/email);
- The key issues raised; and
- How those matters have been addressed within the proposal, including any resulting changes to the final plans and/or report findings.

This report has been prepared having regard to the issued SEARs. Where Council or Government Agency comments are received, responses will be incorporated into the proposal documentation and cross-referenced in the relevant sections of the updated report.

7. Assessment and Mitigation of Impacts

Where relevant, the proposal is assessed through specialist technical inputs having regard to: (i) the existing environment and relevant catchments, (ii) applicable statutory requirements, (iii) the scale and nature of impacts (including cumulative impacts), and (iv) mitigation measures.

Existing environment: Each assessment describes the locality and the impact catchment (e.g. noise, air, traffic), including surrounding land ownership/land uses, key natural and built features (buildings, open space, infrastructure), and relevant risks/hazards (as applicable) such as topography, flooding/overland flow, contaminated land and climate change considerations.

Statutory requirements: Relevant legislation, plans, policies and guidelines are identified with clause/section references where appropriate. Statutory text is not reproduced; requirements are addressed through the assessment outcomes and proposed controls.

Scale and nature of impacts (including cumulative impacts): Impacts are considered in the context of the existing environment and statutory requirements, including interactions with (a) existing development/uses, (b) approved development/uses, and (c) likely future development/uses where relevant. Where applicable, surrounding DAs/approvals may be considered based on the relevant catchment.

Mitigation measures: Measures to avoid, minimise and/or manage impacts are identified through design responses and, where relevant, operational and construction-phase controls. Mitigation actions are documented in the relevant report sections and supporting plans/specifications.

8. Ecologically Sustainable Design (ESD) Initiatives

The principles of ecologically sustainable development are an integral consideration in design and construction of proposed development and also in assessing its benefits and impacts.
The design team will focus on a wide range of ESD strategies which will result in high levels of environmental performance and an increment on occupant's health, productivity, comfort and satisfaction.

8.1 Integrated Design Approach

The integrated design process is a process by which all of the design variables that affect one another are considered together and resolved in an optimal fashion. Often referred to as holistic design, this approach considers the development as a whole with the emphasis on integrating the different aspects of building's design.

8.2 Greenhouse gas emission reduction

Greenhouse gas emission reduction is achieved in a staged approach:

- First, reduction in overall energy consumption through demand reduction, passive design and energy efficiency, then;
- Reduction in electricity and gas utility consumption by utilising waste products, rainwater harvesting and renewable energy technologies (where feasible).

The integrated response to energy proposed for this project is summarised below:

1. Load Reduction and Passive Design.
2. System Efficiency.
3. Capture Waste.
4. Renewable Energy (where feasible).

Energy consumption will be reduced through the efficient design of lighting, air-conditioning and ventilation systems, as well as energy efficient water heating and renewable energy technologies (where feasible). The development will consider Greenhouse gas emission reduction in design and operation through utilising energy conservation measures suitable for the development.

The following sections of the report outline the sustainability initiatives that will be considered and further developed by the design team during the detailed design stages.

8.3 Management

The initiatives under the management category promote the adoption of environmental principles from project inception, design, and construction phases to the operation of the building and its systems.

This category aims to highlight the importance of a holistic and integrated approach to constructing a building with good environmental performance. The following measures are some of the initiatives targeted within the management category and are subject to further design development. These initiatives aim to reduce environmental impacts at construction and operational stages as well as to maximise building performance at commissioning.

8.3.1 Commissioning Clauses

Commissioning of building systems to a high standard, with independent oversight, will ensure that a quality process is followed and provide an outside review of the practicalities of the design. An extended building tuning period should be undertaken following defects liability period to ensure that systems are performing as intended, taking into account different seasonal variables, and that any need for recommissioning is identified and carried out.

To adopt commissioning and handover initiatives that ensure that all building services can operate to optimal design potential, such as:

- Where possible, comprehensive pre-commissioning, commissioning, and quality monitoring to be contractually required to be performed for all building services (BMS, mechanical, electrical and hydraulic).

8.3.2 Building Tuning

After handover, the building owner is expected to implement tuning of all building systems and undertake full re-commissioning 12 months after practical completion.

8.3.3 Building User's Guide

To produce a Building User's / Occupant's Guide, information management that enables building users / occupants to optimise the building's environmental performance during its operation.

8.3.4 Environmental Management Plan

The contractor is expected to adhere to a comprehensive Environmental Management Plan (EMP) for the works. Contractors are recommended to be ISO 14001:2004 certified. Environmental management plans and systems should be implemented to ensure that demolition and construction activities appropriately manage and mitigate environmental impacts.

8.3.5 Waste Management System

To encourage and facilitate effective waste management once the development is in operation, sufficient spatial provision will be made to allow for the effective separation of waste from recycling. Dedicated waste recycling room allow space for the storage of general, recyclable, and food waste.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse, and composting are examples of waste management options.

8.3.6 Environmental Management and Maintenance

Effective environmental and waste management will be implemented throughout the demolition, construction, and operational stages of this development.

The EMP shall include a Waste Management Plan, specifying recycling targets for demolition and construction waste. It is recommended that construction and demolition contracts stipulate a minimum 90% target for diversion of waste from landfill. This may be achieved through recycling or reuse.

- Identification of appropriate waste sub-contractors for recycling, costs of collection and timing of collection service.
- Participation in waste minimisation training for contractors and sub-contractors.
- Published waste minimisation plan to reduce site waste to landfill.

Provision of separate waste skips for cardboard, timber, metal, soft plastic, polystyrene, insulation, concrete, glass, and bricks.

8.4 Indoor Environmental Quality (IEQ) Initiatives

Indoor Environmental Quality initiatives consider the wellbeing of occupants, addressing factors such as heating, ventilating and air conditioning (HVAC), lighting, indoor air quality and building attributes, all of which contribute to good indoor environmental quality.

The following measures are some of the initiatives targeted within the IEQ category for further consideration and development during detailed design.

- Improvement of outside air rate by providing at a rate greater than AS1668.2 requirements. Air-conditioning system will be installed with carbon dioxide monitoring and control to ensure sufficient outside is delivered to occupants.
- Optimisation of the air quality by improving air change effectiveness

- Maximisation of natural lighting level to the building occupants
- Minimisation of the contribution and levels of Volatile Organic Compounds (VOCs) via the use of low VOC paints, adhesives and sealants, carpets, and flooring.
- All engineered wood products to be used in the development will have low formaldehyde emission.
- High efficiency lighting system with suitable luminance levels to avoid causing discomfort and strain for the occupants. All fluorescent luminaries are to be installed with high frequency ballasts to avoid discomfort caused by low frequency flicker.
- External Views: The design allows unobstructed external views for the majority of occupied spaces.
- Internal noise level at an appropriate level to ensure the occupants' satisfaction and wellbeing.

8.4.1 Thermal Comfort

Thermal comfort can be provided by passive and mechanical means. Passive design initiatives will be considered before the design of the mechanical systems to reduce operational energy costs, with potential reductions in the air conditioning size and ongoing maintenance.

Thermal comfort is a function of the following factors:

- Radiant temperature (45% of net comfort effect).
- Air temperature and humidity (35% of net comfort effect).
- Air movement, clothing, and activity (20% of net comfort effect).

Passive heating and cooling design strategies which will improve occupant thermal comfort include:

- Roof insulation not only reduces heat gain and loss, but will also moderate radiant temperatures from the walls, floor, and ceiling.
- Building facades with high performance glazing and window frames will have a combination of external shading and high-performance glass to reduce heat transfer and radiant temperatures in proximity to the windows.

Indoor areas will be designed to be protected from excessive summer solar radiation, reducing radiant heat loads on the space, but still providing enough daylight during appropriate times of the year to improve comfort levels.

The approximate annual Dry-bulb temperature and comfort range for the site is shown in Figure 4:

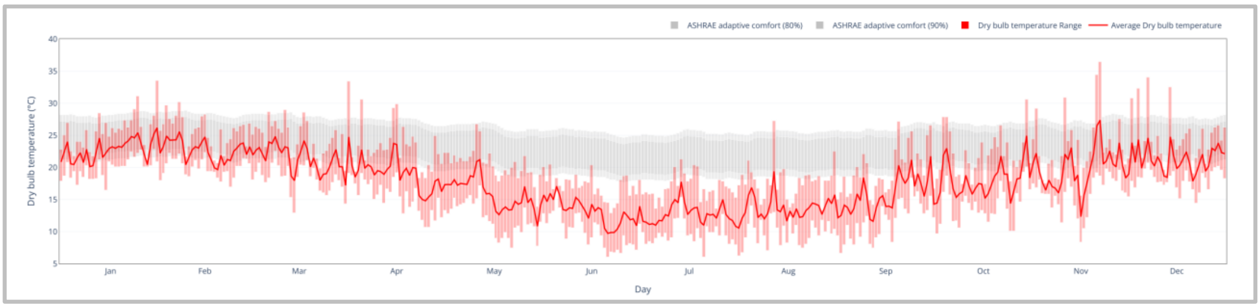


Figure 4. Annual Dry-bulb temperature and comfort range

8.4.2 Effective Daylighting / Natural Lighting

Daylighting is the architectural and services design to allow maximum daylight penetration into a building whilst minimizing heat gain and thereby reducing indoor lighting loads.

The level of natural light in the building is primarily determined by the extent and type of glazing, and the depth of the building floor plate. Extent of glazing must be optimised to allow maximum daylight, views, and winter sun, while minimising uncomfortable glare and excessive solar heat gains in summer. Glazing should be selected with a high Visual Light Transmission to maximise daylight penetration.

Daylighting strategies will be considered to allow effective control of indoor lighting levels whilst minimising power consumption for the building. High level of architectural input regarding design, orientation and external shading will be considered to effectively maximise natural lighting for the building.

Daylighting strategies combined with dimmable lighting systems will allow high control of indoor lighting levels whilst minimising power consumption for the building.

8.4.3 Volatile Organic Compounds (VOC) & Formaldehyde Minimisation

To ensure long term comfort of occupants, all due care will be taken to minimise VOC and formaldehydes used within the building. Maintaining VOC limits below the recommended levels will assist in reducing any potential detrimental impacts on occupant health arising from products which may emit volatile pollutants.

VOCs are commonly found in carpets, paints, adhesives, and sealants uses in construction and extensive exposure to VOC's can cause Sick Building Syndrome effects (eye, nose and skin irritation, headaches lethargy etc.).

Formaldehydes are found within composite wood products and extensive exposure can cause irritation to eyes, nose, and throat, lead to skin ailments and respiratory system ailments such as asthma.

Where possible, contamination of indoor air by common indoor pollutants will be minimised in this development by careful material selection, including:

- Use of low-VOC and water-based paints rather than oil-based paints, stains, or sealants, reducing indoor air contamination and consequent side-effects including sick-building syndrome and respiratory problems.
- Selection of low-VOC carpets and adhesives.
- Selection of low formaldehyde composite wood products, avoiding the carcinogenic effects of formaldehyde off-gassing.

8.5 Energy Conservation Initiatives

It is essential to ensure the building is designed and built to minimise energy consumption and reduce or eliminate greenhouse gas emission to the atmosphere. Energy performance is considered by the design team as a crucial issue.

The energy conservation initiatives aim to reduce the overall energy consumption for the project directly contributing to greenhouse gas emissions and energy production capacity.

Greenhouse reductions are achieved in a staged approach:

- Reduction in overall energy consumption through demand reduction and energy efficiency.
- Reduction in electricity and gas utility consumption by utilising waste products and renewable energy technologies.

Several strategies will be assessed and put in place to minimise energy consumption.

The integrated energy strategies being considered for the development include items which are listed in Table 4 below:

Table 4. The integrated energy strategies.

Load Reduction (Minimising the need for energy consumption)	Passive Design
	Building fabric improvements
	Maximise use of natural lighting
	Maximise use of natural ventilation
Optimising energy	High efficiency Heating, Ventilation and Air Conditioning

consumption	High efficiency LED lighting with occupancy controls
	High efficiency hot water systems
	High efficiency appliances
	Commissioning and tuning of building services post completion
	High efficiency building control, automation and BMS
Use of renewable resources (renewable energy and rainwater harvesting)	Application of Solar Energy & Heat Pump technology

8.5.1 Passive Design

The development will utilise passive design to minimise the amount of air-conditioning required and therefore significantly reduce the building's energy consumption and greenhouse performance. A building's form, fabric and orientation will have the biggest influence on its thermal comfort and environmental performance. The following factors will be considered in the detailed stages of the design:

- Orientation.
- Shading.
- Structure.
- Insulation.
- Glazing.

Climate data for the site

The following indicative site information data can be used to inform the design team (Figure 5).

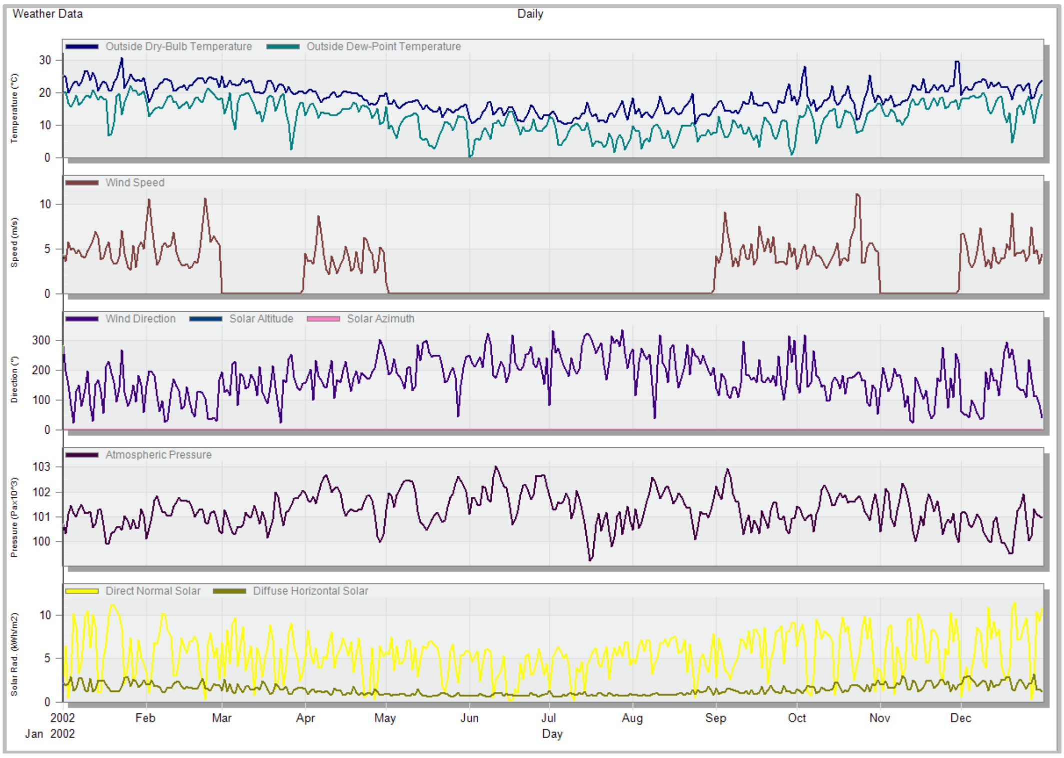


Figure 5. Climate data for the site.

Wind data based on the nearest weather station

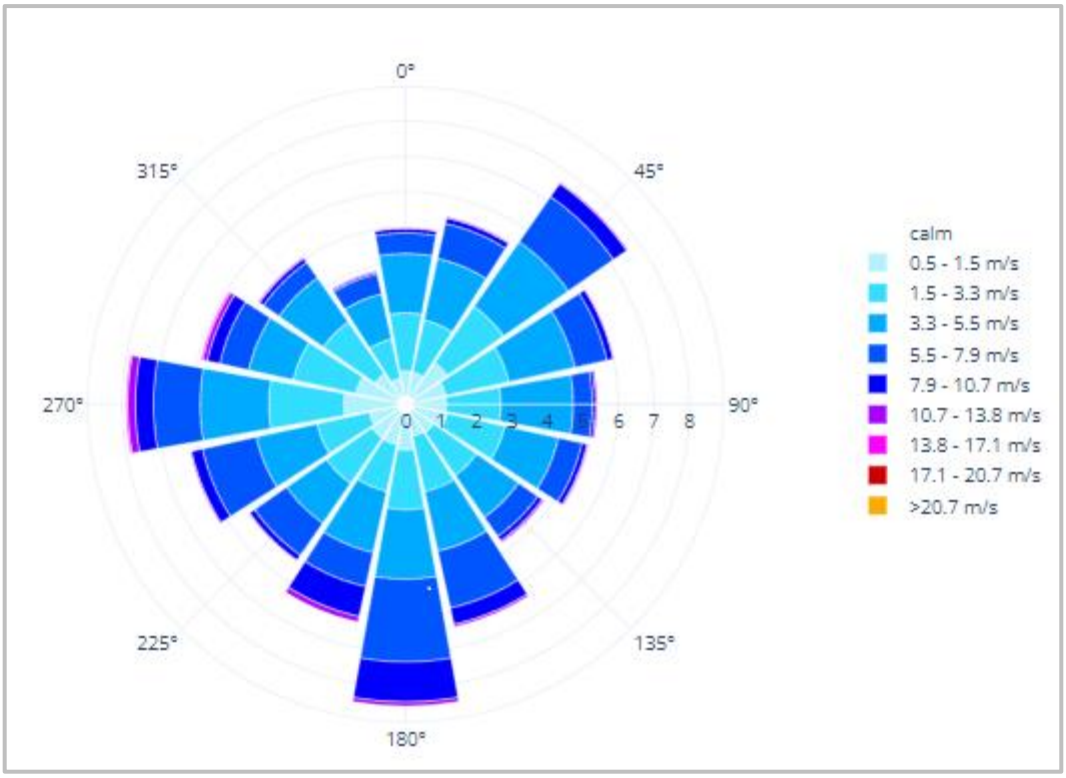


Figure 6. Wind data based on the nearest weather station

Sun path and temperature chart for the site

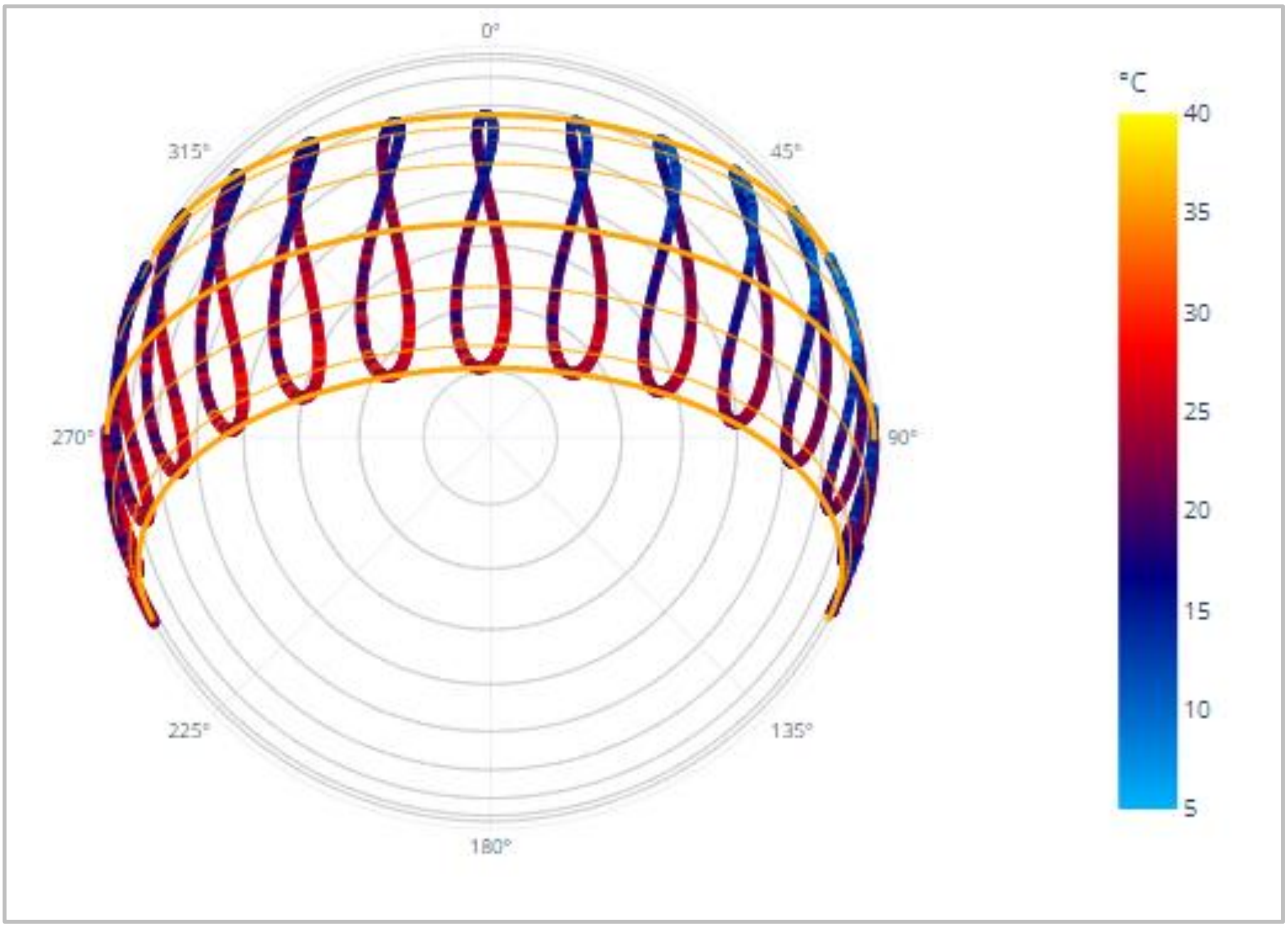


Figure 7. Sun path and temperature chart for the site.

8.5.2 Building Envelope

The building envelope will be designed to reduce heating and cooling requirements through passive design principles. The role of the building envelope is to block solar gains from penetrating the building fabric in summer while optimising daylight and minimising glare. The glazing performance and shading configuration for each orientation will be optimised to ensure that thermal comfort is achieved, and solar gains are adequate for the efficient operation of the mechanical system.

8.5.2.1 Insulation

The building envelope will be treated with the required levels of thermal insulation to reduce heat gains in hot days and to minimise heat losses in cold days through conduction. This will have significant impact on reducing energy consumption.

Insulation reduces the heat transfer between the internal and external conditions. Adequate insulation will be allowed for the ceilings, floors, and walls to reduce the heating and cooling load of the building and to reduce the ongoing operational costs. This has a twofold saving through a smaller mechanical system capacity along with operating energy consumption reduction.

All insulations installed are required to meet NCC and AS/NZ 4859.1 and the builder is required to ensure compliance, during construction.

8.5.2.2 Glazing and Window Framing

Adequate performance glass will be provided to reduce excessive heat gains in hot conditions, reducing the frequency of air conditioning use.

The following glazing parameters will be considered:

- U-Value: a measure of how much heat is passed through the glass.
- Solar Heat Gain Coefficient (SHGC)
- Visible Light Transmission (VLT): the percentage of visible light transmitted by the glass.

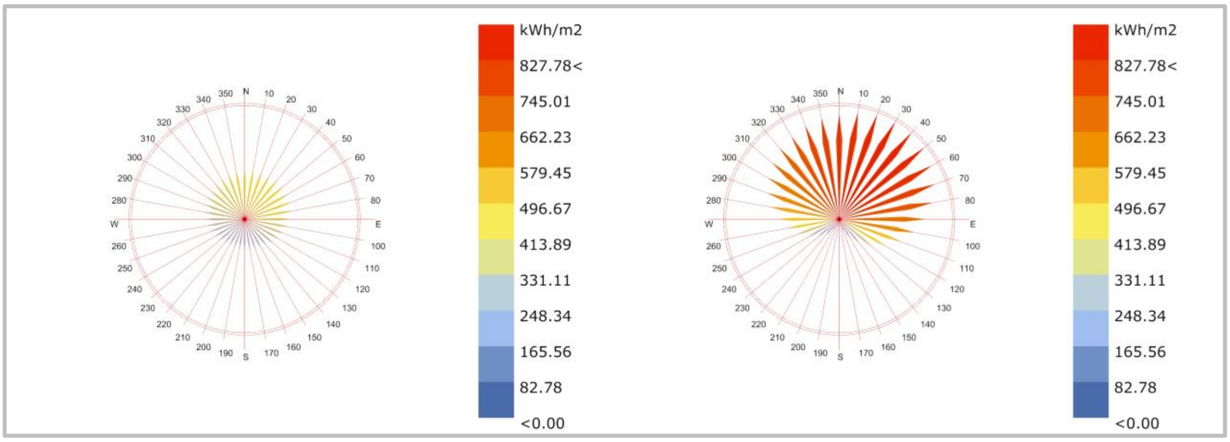
Where possible, the glazing will have a low SHGC to avoid heat gains in the summer, and a low U-value to reduce losses in the winter through the glass. The performance of the proposed glazing systems (glass and frame) is required to comply with NFRC100-2001 conditions and using the tested AFRC values.

Consideration will be given to incorporating effective shading features into the design to avoid the necessity for low shading coefficients in the glass, which usually also decrease the visible light transmission (VLT) of the glass. To maximise the natural daylight within the building, VLT should be as high as possible.

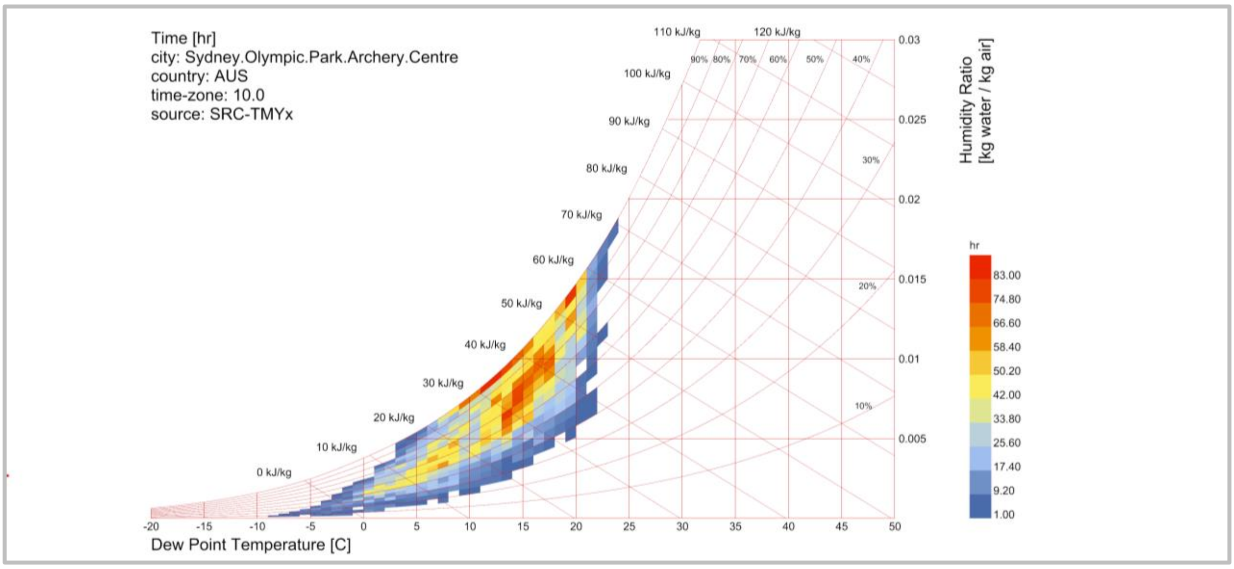
Glazing properties will be specified in conjunction with the shading arrangement on each orientation to control solar loads imposed on the mechanical systems, ensuring thermal comfort, optimising daylight penetration, and preventing glare. This strategy will effectively minimise direct solar loads whilst maximising daylight penetration and access to views.

To reduce heat losses in cold days, especially at night, the use of blinds will limit the contact between the internal air and the glass, therefore reducing heat losses by conduction.

Solar Radiation Rose



Psychrometric Chart



8.5.3 Energy Efficient Systems and Services

The mechanical and electrical design for the buildings will be developed to minimise the need for plant equipment and will be designed to be responsive to the immediate climatic conditions. Energy consumption will be reduced through the efficient design of lighting, air-conditioning, hot water, and ventilation systems. The following energy efficiency initiatives will be further investigated and where feasible incorporated in the building services design.

8.5.3.1. Efficient Artificial Lighting

Lighting efficiency is important in maintaining low energy consumption for reuse projects. Lighting consumption for a facility such as this could account between 15-25% of the estimated energy use of the facility.

High efficiency lighting and effective control initiatives such as daylight and movement sensors will be considered to reduce artificial lighting energy consumption and allow maximum advantage to be taken of natural lighting.

Lighting power density is required to meet AS1680 and NCC requirements. Energy efficiency for the internal lighting throughout the building is required to be in accordance with NCC energy efficiency requirements and the following.

- High quality LED lighting.
- Lighting control system based on smart zoning, occupancy profiles and operational hours, dimming controls and timers.

Photoelectric (PE) / Photodiode sensors or similar controls to detect when external lighting should switch on and off to reduce the energy consumption associated with external lighting where possible.

No external lighting is to be installed such that any direct light beam results into the night sky either generated from within the site. The path of any direct light's angle of incidence that is directed to the sky must be obstructed by a non-transparent surface and the lighting design and is to comply with AS4282 'Control of the Obtrusive Effects of Outdoor Lighting.

8.5.3.2. Efficient Heating, Ventilation & Air-Conditioning (HVAC)

Heating and cooling of the building accounts for a large portion of the building's energy use throughout the year. Selection of highly efficient HVAC equipment with high performance levels not only minimises energy consumption, but also reduces operational energy costs.

The design of the mechanical services will be to industry Best Practise Standards. An emphasis will be placed on providing low energy Heating Ventilation Air Conditioning (HVAC) systems and strategies. To ensure the energy efficient performance of HVAC systems specified and installed mechanical plant will be of high quality and supplied by leading industry manufacturers.

The energy efficiency of HVAC system is required to meet the minimum requirements of the National Construction Code (NCC), Green Star provisions where feasible and relevant Australian Standards including but not limited to AS1668.1, AS1668.2, AS 1682 and AS3666.

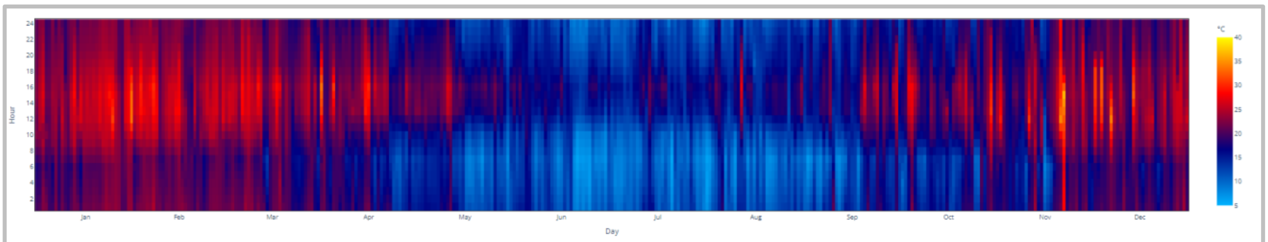
The following energy initiatives will be further considered in the detailed design phase:

- The air conditioning strategy is optimized to reduce energy consumption and maximize efficiency. For example, by moderating the amount of fresh air relative to the number of people in the space, through the use of CO2 detectors. The system will be zoned to increase the flexibility in the use of different spaces and reduce overall consumption.
- Variable speed drives will be provided to fans and pumps where feasible.
- Full outside air cycle will be provided to all air handling systems.
- Building commissioning and building tuning to be undertaken to ensure that the building systems function as required to achieve energy efficiency design targets.
- All refrigerant plant will be specified such that the refrigerant type has Zero Ozone Depletion Potential (ODP).

Common area ventilation systems are to include variable speed modes where appropriate and are to be linked to light switches where feasible to limit the extent of operation and improve energy efficiency of these areas.

The Mechanical services will be designed to satisfy the minimum NABERS requirements.

Heatmap Chart based on the data from the nearest weather station is depicted in Figure 8 below:

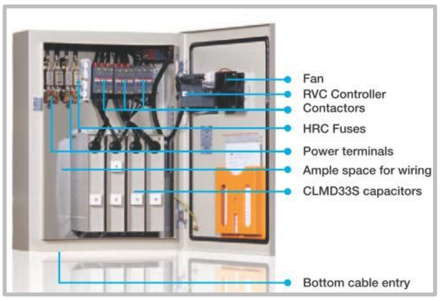


Descriptive statistics

month	mean (°C)	std (°C)	min (°C)	1% (°C)	25% (°C)	50% (°C)	75% (°C)	99% (°C)	max (°C)
Jan	22.78	2.55	16.4	18.03	21	22.6	24.4	30.16	33.5
Feb	22.67	2.48	16.9	18.04	20.78	22.4	24.32	29	30.2
Mar	21.45	2.86	12.9	15.2	19.6	21.2	23.3	28.11	29
Apr	19.16	3.66	10.7	11.7	16.8	19.3	21.2	29.7	33.4
May	15.86	3.64	7.4	8.4	13.2	15.6	18.6	24.51	26.7
Jun	13.14	3.07	6	6.72	11	13.3	15.6	19.38	20.5
Jul	12.8	2.82	6	7.67	10.5	12.5	14.9	20.06	21.3
Aug	13.71	3.28	6.2	6.9	11.7	13.4	15.9	22.67	27.3
Sep	15.83	3.84	6.6	8	13.4	15.4	18.3	25.68	27.2
Oct	17.9	3.69	9.7	10.6	15.3	17.55	20.2	27.76	30.6
Nov	19.8	4.06	8.3	10.58	17.4	19.6	22	31.48	36.5
Dec	21.26	3.04	14.4	15.6	19.1	20.8	22.8	31.66	34
Year	18	4.83	6	7.9	14.3	18.3	21.5	28.64	36.5

Figure 8. Heatmap Chart.

8.5.3.3. Power Factor Correction



To reduce maximum kVA demand on the electricity grid and lower the demand charges, power factor correction units will be provided at the main switch board(s) in accordance with the NSW Installation and Service Rules.

The power factor correction units proposed will improve the power to a factor of 0.98 or higher.

8.5.3.4. Monitoring & reporting

To enable effective monitoring and tracking of energy and water consumption, sub-metering will be considered for systems with major energy use, to help identify areas of inefficiency with potential for improvement.

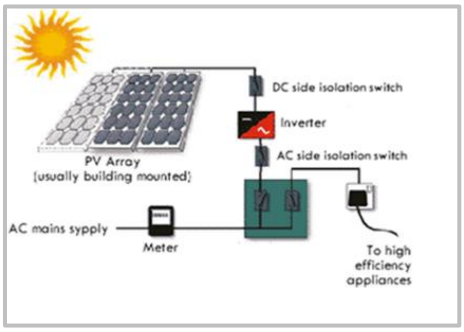
Metering is to be provided throughout the building and central services for all major building plant and equipment. An effective monitoring system is to be provided to monitor energy and water consumption throughout the building as required.

Ongoing reporting may allow the manager of the facility to set goals for energy consumption reductions and attributed energy costs to particular uses. By monitoring energy, losses and wastage can be identified, therefore improving the overall performance of the building in operation. This initiative is subject to further design development and review.

8.5.3.5. Hot Water Systems

High efficiency heat pump hot water systems will be used to provide the Hot Water demands for the buildings.

8.5.4 Renewable Energy – Solar Photovoltaic (PV) System



Photovoltaic (solar PV) is a common and widely accepted technology to generate electricity onsite. The generated electricity can be harnessed and used to power any number of devices. It is proposed that the PV panels are mounted on the roof where they will be out of sight and produce the optimum energy output.

PV modules have a very long lifetime with many manufacturers guaranteeing an output of at least 80% of manufactured capacity for 20 years. Another benefit of PV is that it can be installed in various system sizes and the modular design of the systems allows retrofitting of additional panels if required in the future.

There are generally three types of solar panels available: mono-crystalline (proposed for this development), poly-crystalline and amorphous. Each of these have their advantages and disadvantages and efficiencies range from 8% for amorphous to 22% for mono-crystalline

A 20 kW Solar PV system has been nominated for the development. The expected renewable energy generation by the overall 20 kW system is approx. 22.1 MWh per annum.

8.5.4.1 Solar PV - System Components

The Photovoltaic (PV) system may consist of the following main components or of equal capacity (Table 5).

Total nominal power: **20 kW**

Approx. roof space requirements: **125 m^2**

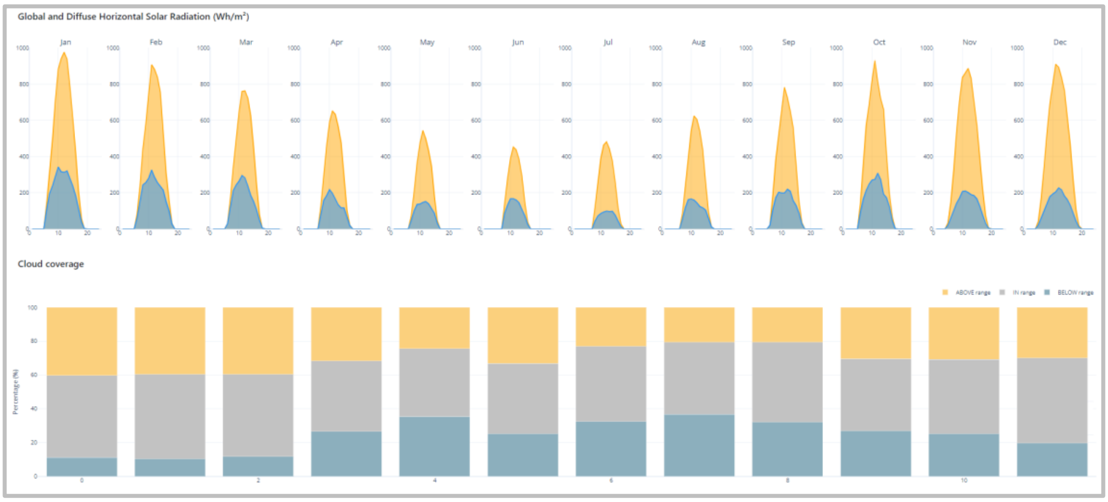
Table 5. Solar PV components information.

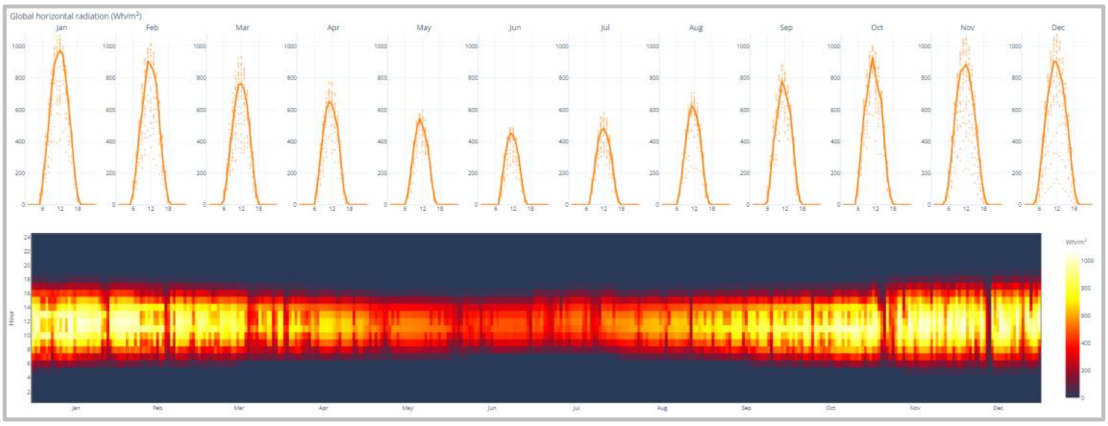
Components	Sample Brand, Model & Quantity
Sample PV Inverter	Sungrow 17kW – SG17RT – Quantity: 1
Sample PV Panels	Trina Vertex 600 W - TSM-DEG20C.20 Quantity: 34 approx.
PV mounting frame and system balance	Quantity: depending on the requirements and final design

Table below summarises the estimated annual Renewable Energy generation for the proposed Solar PV (20 kW).

The exact sizing, configuration and final design will be completed during the design stage. Please refer to Appendices A & B for technical data sheets of the proposed PV panels (Trina) and grid-connected inverter (Sungrow).

8.5.4.2 Solar Ration and Cloud Coverage for the site



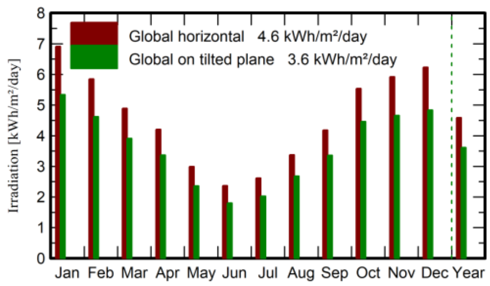


8.5.4.3 Solar PV - Projected energy generation based on 20 kW system

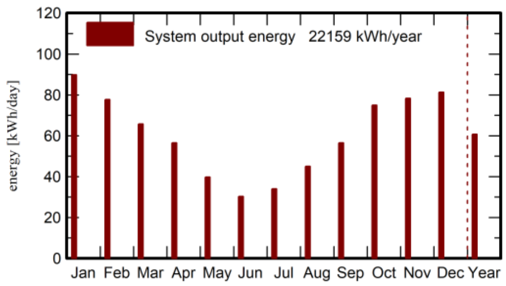
System summary

Nominal power	20.0 kWp	Total area	125 m²
Module type	Standard	Supports for modules	Flat roof
Technology	Monocrystalline cells	Ventilation property	Free air circulation
Annual yield	22.2 MWh		
Specific prod.	1108 kWh/kWp		

Weather data and incident energy



System output



	Horizontal global kWh/m²/day	Coll. plane kWh/m²/day	System output kWh/day	System output kWh
Jan.	6.91	5.34	89.76	2783
Feb.	5.85	4.62	77.64	2174
Mar.	4.89	3.91	65.64	2035
Apr.	4.21	3.36	56.52	1695
May	2.99	2.36	39.73	1231
June	2.37	1.80	30.21	906
July	2.61	2.02	34.02	1055
Aug.	3.37	2.68	45.03	1396
Sep.	4.18	3.36	56.45	1694
Oct.	5.54	4.46	74.93	2323
Nov.	5.92	4.66	78.29	2349
Dec.	6.24	4.83	81.22	2518
Year	4.58	3.61	60.71	22159

8.6 Net Zero Statement

Achieving Net Zero emissions is critical to meeting the NSW government's ambitious targets of reducing greenhouse gas emissions by 70% by 2035 and achieving net zero by 2050. According to the Sustainable Buildings SEPP (SB SEPP) and Section 35C of the Environmental Planning and Assessment Act Regulation, large developments must submit a Net Zero Statement demonstrating how the building will either be fossil fuel-free upon occupation or transition to fossil fuel-free operation by 1 January 2035.

8.6.1 Limitations Due to Current Project Stage

At this early stage of the project, a full detailed energy assessment is not feasible. A comprehensive energy assessment requires detailed information on mechanical design, equipment specifications, building systems, and operational schedules. Without these critical data points, any full simulation or precise estimation would be premature and potentially misleading.

Therefore, this report presents a preliminary Net Zero pre-assessment based on typical energy consumption profiles, informed by industry benchmarks and best practice assumptions.

8.6.2 Net Zero Approach

Net Zero initiatives adopted for this development aim to minimise operational energy emissions through the elimination of fossil fuel use, enhancement of energy efficiency, and integration of renewable energy generation and storage systems. The key design strategies proposed for this development include:

- High-performance building envelope with enhanced insulation, shading, airtightness, and glazing.
- Electrification of heating, cooling, and hot water systems, prioritising heat pumps and electric technologies.
- Optimised HVAC and lighting systems with smart controls and sensors.
- Integration of onsite renewable energy generation such as rooftop photovoltaics (PV).
- Provision for future transition infrastructure to enable fossil fuel systems to be fully replaced by electric alternatives by 2035.

8.6.3 Emission Considerations and Compliance

While precise emissions estimates require detailed energy modelling, this preliminary assessment confirms that the project will be designed to meet the fossil fuel-free or transition requirements mandated by NSW regulations. Infrastructure and space allowances for electrification will be integrated into the design to ensure compliance with the Net Zero Statement requirements.

8.7 NABERS Embodied Emissions

Embodied emissions refer to the greenhouse gas emissions generated throughout the lifecycle of building materials—from extraction, manufacturing, transportation, construction, through to end-of-life disposal. These emissions represent a significant portion of a building's total environmental impact and must be addressed alongside operational emissions to achieve true sustainability.

In compliance with Section 35BA of the Environmental Planning and Assessment Act Regulation, a NABERS Embodied Emissions Materials Form might be required.

This form discloses the number of embodied emissions attributable to the development and supports transparency and accountability in reducing the building's carbon footprint.

8.7.1 Methodology and Data

The embodied emissions assessment is based on detailed quantification of materials used across the building's structure, envelope, internal walls, services, and external works. Quantities are reported primarily in metric units (such as cubic metres, kilograms, and square metres), supported by cost data where applicable, and exclude labour and equipment.

Due to the early project stage, some quantities have been estimated based on previous projects and best available data. The form captures at least 80% of the total material costs for the main contractor scope, consistent with NSW Government guidelines.

8.7.2 Integration with Project Sustainability

This embodied emissions disclosure complements the operational Net Zero commitments of the project by addressing the lifecycle emissions associated with building materials. The project team is committed to reducing embodied carbon through material selection, use of recycled content, and exploring low-carbon alternatives wherever feasible.

8.8 Transport sustainability measures

The use of transport (both private and commercial) is a major contributor to environmental pollution and the excessive consumption of natural resources. The following sustainable transport principles are recommended.

- Improve amenity for active transport users (pedestrians and cyclists), with attention paid to the needs of specific user groups likely to have a greater reliance on active transport.
- Promote nearby cyclist facilities to enhance the uptake of cyclists to the site.
- Integrate transport initiatives into community engagement and communication strategies.

Given the site location of the development, the occupants will be able to take advantage of local public transport networks and available facilities around the site such as retail shops.
The following measures are some of the initiatives recommended to reduce dependence on motorised vehicles, encouraging walking, cycling and the use of mass public transport.

- **Cyclist facilities:** provide secure bicycle parking/storage for residents and bicycle racks for visitors (where applicable).
- **Public Transport:** The building is close to public transport with a number of bus routes served; building occupants are encouraged to use mass transport to travel to work.
- **Trip Reduction:** The development is located adjacent to several local amenities, reducing the need for trips.
- **Fuel efficient vehicles:** encouraging the use of more fuel-efficient vehicles by providing adequate parking spaces at prime parking spot solely dedicated for use by small cars, car-pool participants or other alternative fuel vehicles and EV charging points.

8.9 Water Conservation and Management Initiatives

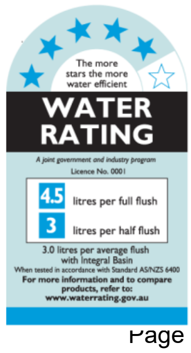
The water conservation category aims to reduce the overall water potable consumption and provide effective mechanisms for recycling of water uses on site.

The approach to water efficiency for the development will focus on reducing water demand through conservation measures and water reuse systems. Water conservation strategies proposed for this project include:

- Reducing the potable water consumed within the development through demand management.
- Substituting mains water required to meet this demand by utilising alternative sources such as rainwater.

8.9.1 Demand Management

Strategies to minimise consumption include water-efficient fittings and fixtures, water-efficient appliances and low-water use air-conditioning and irrigation systems. In order to reduce the overall water consumption for this development, the following initiatives will be considered.



All water fixtures to be installed to the building are to be water efficient and where possible outperform the minimum requirements. The following criteria are provided as a guide and subject to further design development (Table 6).

Table 6. Surplus design criteria.

Water Fixtures	Hand wash basins – 5 Star WELS;
	Kitchen taps (where provided) – 5 Star WELS
	Showerheads (where provided) – 4 Star WELS or higher
	Toilets – 4 Star WELS or higher
Appliances	Dishwashers (where provided) – 4 Star WELS or higher
Air Conditioning	Minimise use of water-cooled systems
Landscape Irrigation (where applicable)	Native and water efficient species
	Sub-surface irrigation
	Rainwater usage for landscape

8.9.2 Landscape Selection

The use of native, drought-resistant planting will be considered to reduce water consumption used in irrigation. Sub-soil irrigation systems should be considered where non-native species are selected.

The landscape design shall enhance Biodiversity in terms of Landscape Area and Diversity of Species

8.9.3 Rainwater collection and recycling

In order to reduce the impacts of stormwater runoff from the site, the following stormwater management strategies will be considered:

- Rainwater captures from rooftops for reuse in building reducing stormwater runoff as well as mains potable water use.
- The use of permeable surfaces to be considered where suitable, allowing stormwater to seep directly into the earth and reducing stormwater flows off-site.

Collecting rainwater from roof runoff is a common way to recycle water. In addition to saving potable water, it allows preparation for times of low rainfall, so landscapes will be maintained throughout the year. It also reduces loads on storm water systems because roof runoff is not flushed into the drains. Rainwater will be collected from roof runoff and piped to storage tanks and will be used on site.

Ultra-violet (UV) treatment is the disinfection process of passing water by a special light source. Immersed in the water in a protective transparent sleeve, the special light source emits UV waves that can inactivate harmful microorganisms. This method of treatment is growing in popularity because it does not require the addition of chemicals.
Harvested water will be considered to supplement non-potable water uses such as common area landscape irrigation.

This strategy will assist to significantly reduce the potable water consumption for the facility.

8.9.4 Water consumption monitoring and reporting

Where practical, it is recommended that all major water uses within the building to be provided with water meters. This includes central services, rainwater tanks, irrigation systems, potable water, non-potable water sources.

Water monitoring will assist to identify abnormal usage patterns usually associated with leaks, helping to reduce the considerable water lost in this way. In addition, it would also allow to measure and verify the impact of any water efficiency measures implemented in the facilities.

8.10 Materials

This category aims to reduce the consumption of natural resources and encourage the reuse of materials. The various environmental and human health impacts arising from building materials are reduced when special attention is given to the selection of ecologically preferable materials.
To minimise the environmental impact of the development, preference will be given to environmentally responsible materials during the selection process, according to the following principles:

- Avoidance of ecologically sensitive products (such as scarce minerals and old-growth forest).
- Selection of materials with a low embodied energy and high recycled content.
- Low toxicity material selection.
- Low impact on the indoor environment.
- Durability, flexibility, and recyclability.
- Emissions in manufacture and composition, including greenhouse gases and ozone depleting substances.
- Waste reduction.
- Provisions for appropriate recycling storage space that facilitates recycling.

The targeted initiatives will reduce embodied energy and environmental impacts caused by the whole life cycle of building materials.

8.10.1 Reuse and Conservation of materials

Where possible reuse the building material to conserve embodied energy and water. By conserving the building fabric or structure the waste volumes are significantly reduced for the development.

8.10.2 New Materials

Material specifications for the project will consider elements of sustainability that relate to the following factors of durability, embodied energies, renewable sources content, ease of manufacturing, ability to be recycled / reused / reconditioned, maintenance, local availability, VOC content, emission production, affordability, and toxicity.
Where feasible the materials specified for this project are to consider the above environmental measures through a comparison between different product types and manufacturers where possible. The design team is to adopt this approach in assessing suppliers and products for the development.

Interiors finishes will consider the concentration of Volatile Organic Compounds with products for adhesives, paints, carpets, and floor sealants. The design team will work with suppliers and contractors to identify opportunities to reduce the level of VOC’s within products and finishes.

8.10.3 Materials with Ozone Depletion Potential

Selection of insulation will be targeted to minimise Ozone Depletion Potential (ODP).

8.10.4 Operational Waste Minimisation

To encourage and facilitate effective waste management once the facility is in operation, sufficient spatial provision will be made to allow for the effective separation of waste from recycling. Dedicated waste recycling rooms allow space for the separation and storage of recyclable waste during the building’s operation, allowing for the following waste streams to be separated:

- Glass.
- Cardboard.
- Paper.
- Organics.
- Plastics.

- Metals.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse, and composting are examples of waste management options.
The following waste streams have currently been identified:

- Paper and cardboard.
- Plastics.
- PET bottles and containers, cans, and glass.
- Compostable material.
- Grease and fats.
- Cigarette butts.
- Light tubes.
- Toxic or hazardous materials.
- Foam.
- Cleaning products and other substances going down drains.
- Composting of organic waste from the restaurant, for re-use within the Greenhouse.

8.10.5 Timber

Where possible, timber will be supplied from sustainable sources including Forestry Stewardship Council (FCS) certified plantation timbers and recycled products. No timber (either solid or veneer form) will be sourced from rainforests or old-growth forests.

8.10.6 PVC Minimisation

PVC is being phased out in the European Union, as there is widespread evidence to its harmful environmental impact, particularly during disposal or fire. PVC is used in almost all electrical and data cabling and for drainage pipework. Alternatives to PVC products will be used where feasible:

- HDPE and polypropylene pipe work instead of PVC pipe for water supply and drainage systems.
- Linoleum and other natural products instead of vinyl floor coverings.
- Composite materials for electrical cabling.

8.11 Land Use and Ecology

This initiative refers to improvements through Reuse of Land or Change of Ecological Value. The site has been previously built on, and is not a Greenfield. The new development will aim to enhance permeable area and vegetation improving the ecological value of the site.

8.12 Emissions

In addition to the reduction in greenhouse emissions as a result of lower on-site energy usage, emissions to land, air and water will be minimised. The following measures are some of the initiatives targeted within the emissions category:

- Where available, thermal insulation products should be selected which have a low Ozone Depletion Potential in their manufacture and composition, reducing the impacts of insulation on the atmosphere.
- Where feasible, refrigerants will have an Ozone Depletion Potential of zero; and integrated refrigerant leak detection will ensure early identification of leaks.
- Estimated wastewater discharge to sewer will be significantly reduced relative to a standard building through the implementation of water efficiency measures.
- Watercourse Pollution: Design that minimises stormwater run-off to and the pollution of the natural watercourses.
- Light Pollution: No light beam will be directed upwards or outside the building. External lighting will be in accordance with AS 4282-1997. This will assist to minimise interference and disturbance to neighbouring properties and wildlife.

9. Climate Change Adaptation

9.1 NARCliM Climate Change Projections

The information provided in this section of the report follows the climate change projections based on the NSW and ACT Regional Climate Modelling (NARCliM) project. NARCliM is a multi-agency research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. NSW Government funding comes from the Office of Environment and Heritage (OEH), Sydney Catchment Authority, Sydney Water, Hunter Water, NSW Office of Water, Transport for NSW, and the Department of Primary Industries.

Climate change projections are presented for the near future (2030) and far future (2070), compared to the baseline climate (1990–2009). The projections are based on simulations from a suite of twelve climate models run to provide detailed future climate information for NSW and the ACT.

The climate change projections are made for the following 5 parameters:

1. Temperature extremes.
2. Hot days.
3. Cold nights.
4. Rainfall.
5. Fire weather.

Reference: https://climatechange.environment.nsw.gov.au/
NSW Office of Environment and Heritage (OEH)

9.1.1 Temperature

Surry Hills NSW is expected to experience an increase in all temperature variables (average, maximum and minimum) for the near future and the far future

- Maximum temperatures are projected to increase by 0.7°C in the near future and up to 1.9°C in the far future. Spring will experience the greatest change in maximum temperatures, increasing by up to 2.2°C in the far future. Increased maximum temperatures are known to impact human health through heat stress and increasing the number of heatwave events.
- Minimum temperatures are projected to increase by 0.6°C in the near future up to 2°C in the far future. Increased overnight temperatures (minimum temperatures) can have a considerable effect on human health.

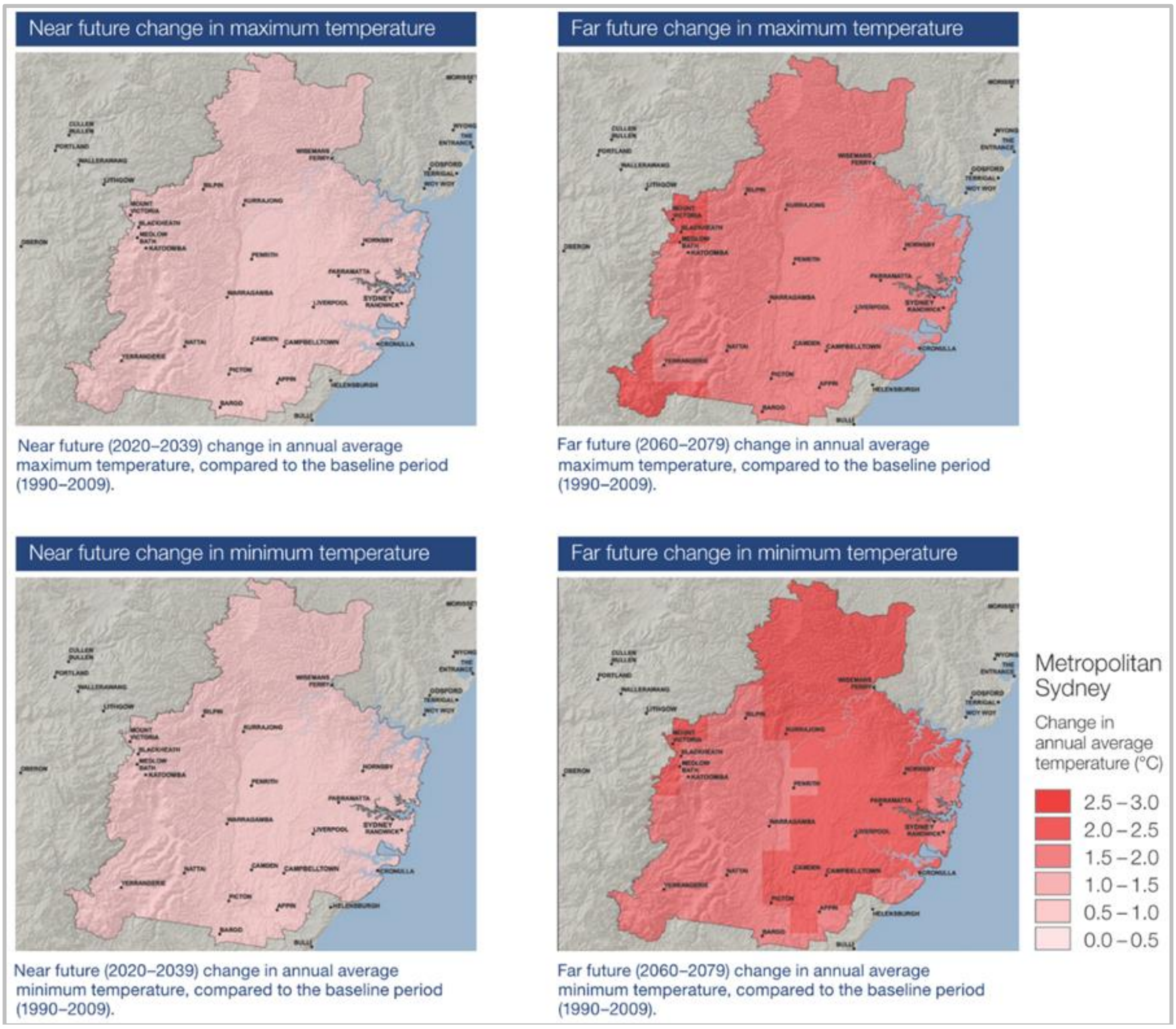


Figure 9. Annual average temperature – Sydney variation map.

9.1.2 Hot days (days per year above 35°C)

Currently Surry Hills NSW experiences fewer than 10 days above 35°C each year due to its proximity to the coast. Seasonal changes are likely to have considerable impacts on bushfire danger, infrastructure development and native species diversity.

- The facility is expected to experience more hot days in the near future and in the far future.
- These increases in hot days are projected to occur mainly in spring and summer although in the far future hot days are also extending into autumn.

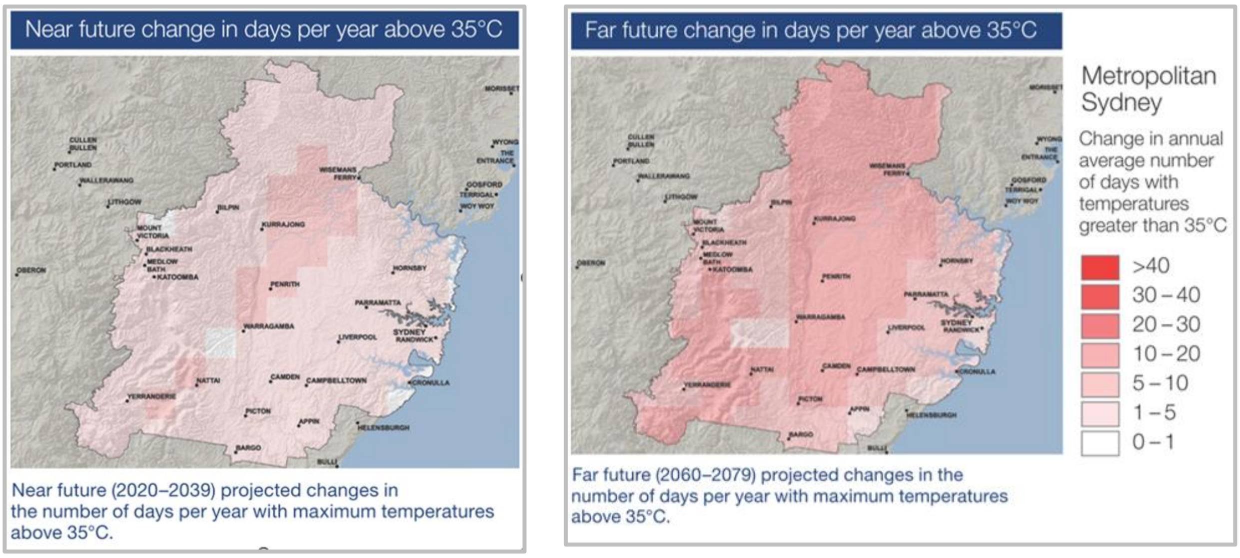


Figure 10. Change in annual average number of days with temperatures greater than 35°C – Sydney variation map.

9.1.3 Cold nights (days per year below 2°C)

Most of the emphasis on changes in temperatures from climate change has been on hot days and maximum temperatures, but changes in cold nights are equally important in the maintenance of our natural ecosystems and agricultural/horticultural industries. For example, some common temperate fruit species require sufficiently cold winters to produce flower buds.

- The greatest decreases are projected to occur in the south-west and in the Blue Mountains, with decreases of up to 20 nights by 2030 and more than 40 fewer cold nights by 2070.
- NARCliM projections suggest that Surry Hills NSW will not see a considerable decrease in cold nights (see the white areas in the map).

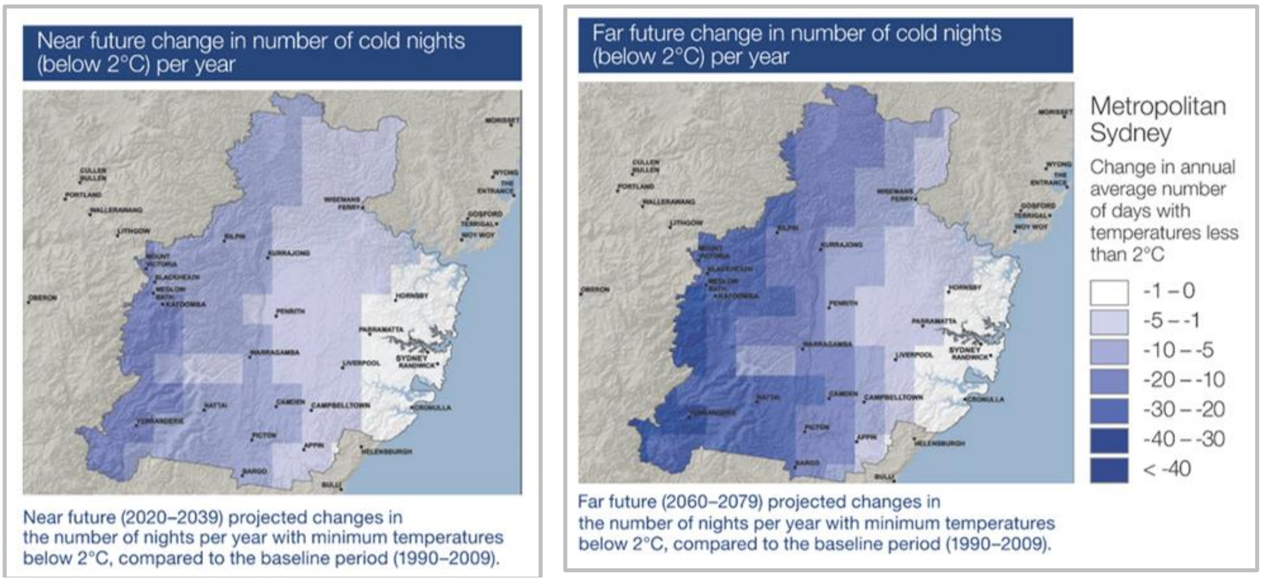


Figure 11. Change in annual average number of days with temperature less than 2°C – Sydney variation map.

9.1.4 Rainfall

Changes in rainfall patterns have the potential for widespread impacts. Seasonal shifts can often impact native species' reproductive cycles as well as impacting agricultural productivity, for example crops that are reliant on winter rains for peak growth. The majority of models (8 out of 12) agree that autumn rainfall will increase in the near future and the far future (7 out of 12). Rainfall is projected to increase in autumn.

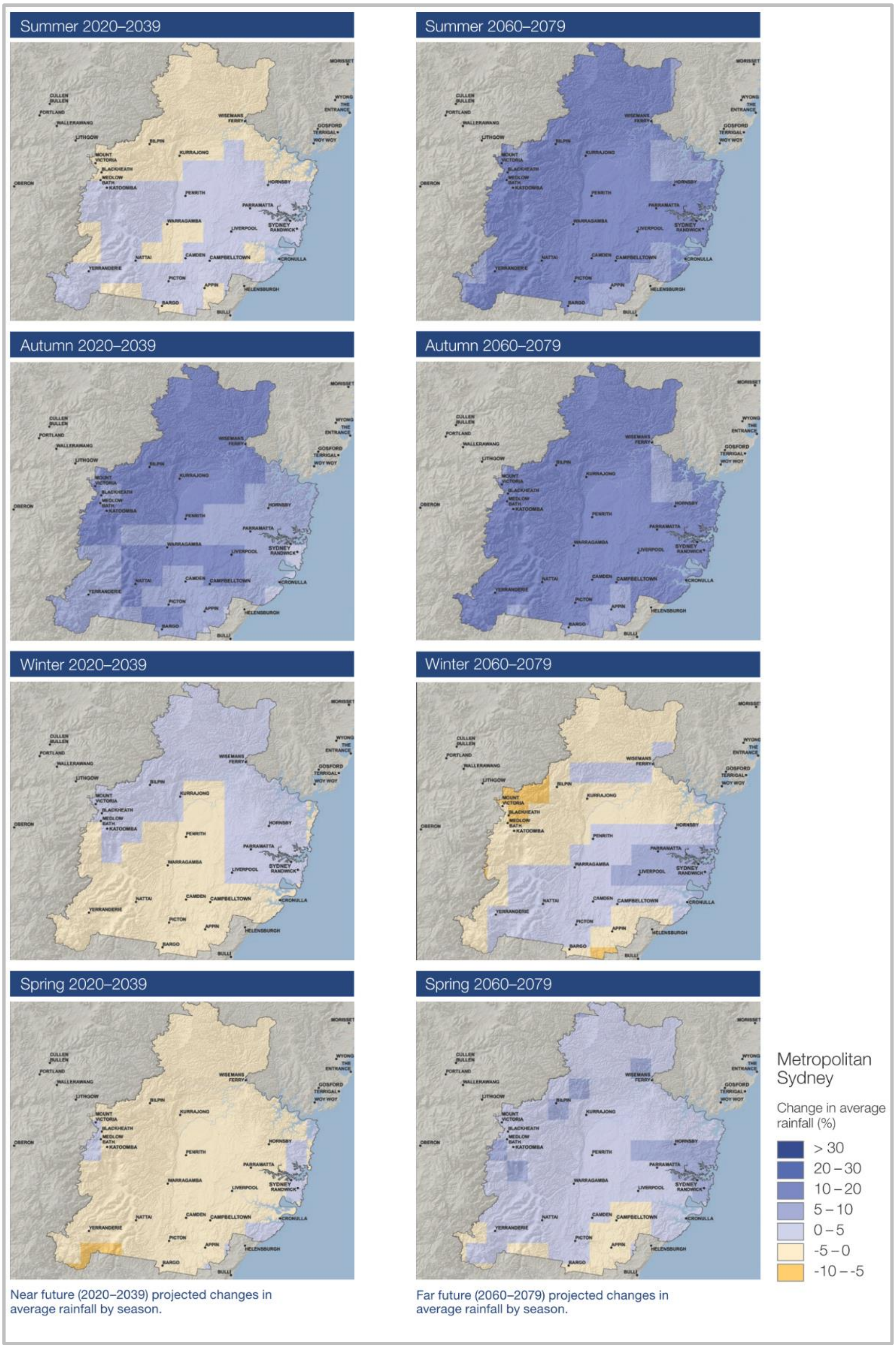


Figure 12. Change in average rainfall (%) – Sydney variation map.

9.1.5 Fire weather

The Bureau of Meteorology issues Fire Weather Warnings when the FFDI (Forest Fire Danger Index) is forecast to be over 50. High FFDI values are also considered by the Rural Fire Service when declaring a Total Fire Ban.

Projected regional climate changes

- Metropolitan Sydney is expected to experience an increase in average and severe fire weather in the near future and the far future.
- The increases are projected mainly in summer and spring in the far future. These changes are projected in prescribed burning periods (spring) and the peak fire risk season (summer).
- The majority of models (7 out of 12) project an increase of severe fire weather in spring in the near future, with a greater confidence in the increase in the far future.

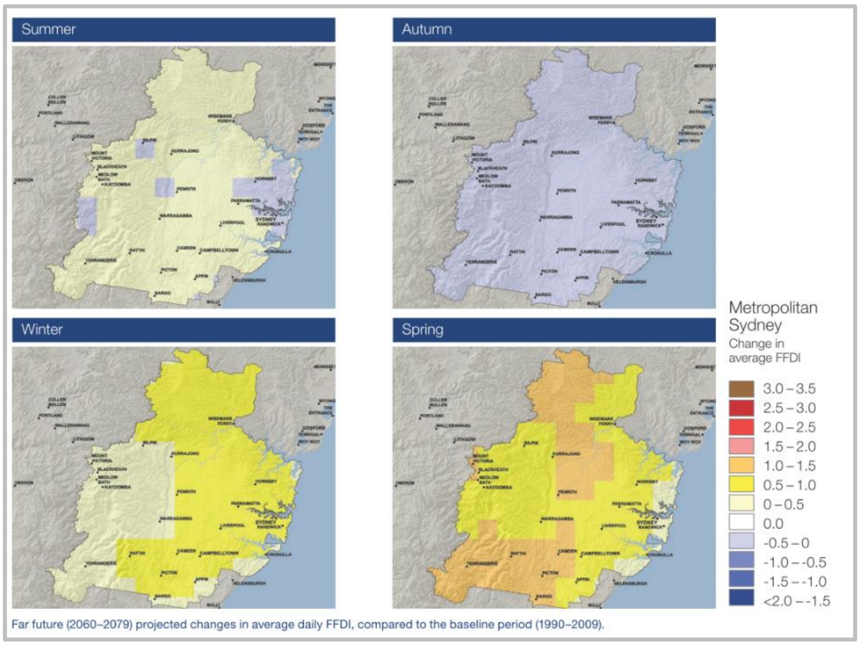


Figure 13. Change in average FFDI – Sydney variation map.

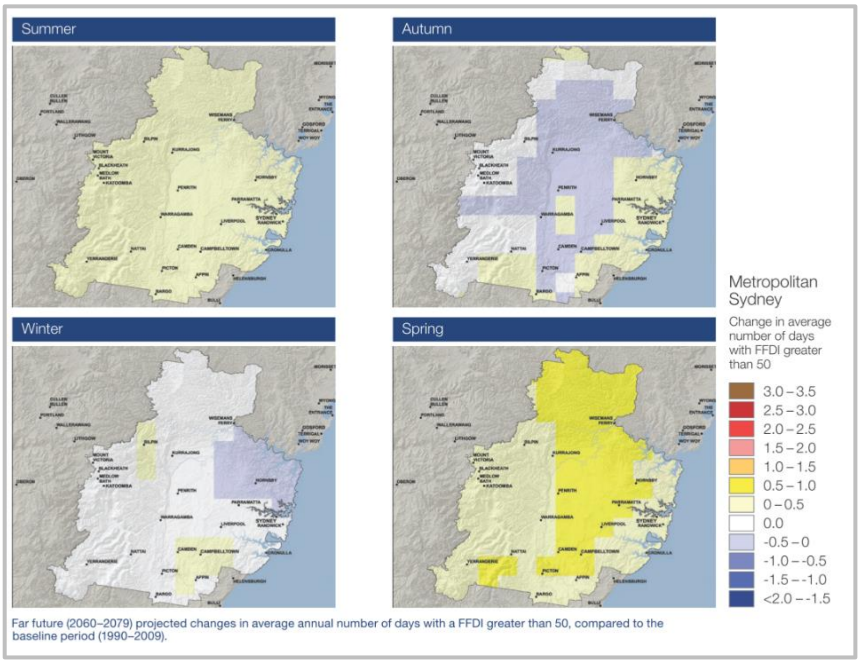


Figure 14. Change in average number of days with FFDI greater than 50 – Sydney variation map.

9.2 Climate Change Adaptation Plan

The climate change adaptation plan (CCAP) follows the ISO31000 Risk Management Process.

The plan involves three key steps to develop risks and mitigation strategies collaboratively with key project stakeholders.

1. Review of the development and context.

2. Risk analysis.
3. Mitigation Strategies.

9.2.1 Risk Assessment Framework

To assess risks systematically, a likelihood scale was used to determine how likely a risk was to occur, followed by consequence assessment. The first stage of the assessment is to define the likelihood of a given risk. The likelihood level can be described as the frequency or probability for a risk to occur.

Table 7. Risk likelihood matrix.

Likelihood	**Almost Certain** expected in most circumstances.
	Likely will probably occur in most circumstances.
	Possible might occur at some time.
	Unlikely could occur at some time.
	Rare may occur, only in exceptional circumstances.

Table 8. Example Consequence Scale and Success Criteria (AGO 2007).

	Public Safety	**Local Economy and Growth**	**Community and Lifestyle**	**Environment and Sustainability**	**Financial /Time Program/Budgets**
Catastrophic	Large numbers of serious injuries or loss of life	Precinct decline leading to widespread business failure	The area is considered very unattractive, moribund, and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Loss or increased cost of 50% or greater of annual budget.
Major	Isolated instances of serious injuries or loss of lives	Precinct stagnation such that businesses are unable to thrive	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Loss or increased cost of 25%-50% of annual budget.
Moderate	Small numbers of injuries	Significant general reduction in precinct economic performanc e	General applicable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Loss or increased cost of 10%-25% of annual budget
Minor	Serious near misses or minor injuries	Isolated areas in precinct decline	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Loss or increased cost of 5% to 10% of annual budget
Insignificant	Appearanc e of a threat but no actual harm	Minor shortfall to forecast growth	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	Loss or increased cost of less than 5% of annual budget

Risk likelihood and consequence were then combined using the risk assessment matrix in Table below, leading to the systematic development of a risk rating used to prioritise risk management strategies.

Table 9. Example Risk matrix:

Show	**Matrix Score**				
Risk Rating Number + Name	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Critical	Critical
Likely	Medium	Medium	High	Critical	Critical
Possible	Low	Medium	Medium	High	Critical
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	High

Risk management strategies listed in Table 10 aim to reduce risk levels by reducing either likelihood or consequence of the risk, or both. The objective is to develop cost-effective options for treating/controlling each identified risk and minimise its impact to the project.

Table 10.. Risk management.

Show	**Matrix Score**				
Risk Rating Number + Name	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Critical	Critical
Likely	Medium	Medium	High	Critical	Critical
Possible	Low	Medium	Medium	High	Critical
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	High

9.2.2 Risk Assessment outcomes

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increase in hot days	Accelerated structural material fatigue and degradation of facades leading to increased maintenance and repair costs	Rare	Catastrophic	High	Select materials which have a higher temperature tolerance if required. Review material datasheets for in-service temperature range and allow for increase in peak temperatures.	Rare	Moderate	Low
Increase in hot days	Brownouts/ Blackouts leading to failure of critical electrical equipment	Possible	Major	High	Ensure that existing plans to add to backup generation based on demand is followed through. Consider use of Solar Energy with Battery Energy Storage Systems (BESS).	Possible	Minor	Medium
Increased rainfall variability	Parapet roof retains water due to blockage in syphonic drainage system leading to structural failure.	Possible	Major	High	Check the design includes overflow outlets in parapet. Add to design if required.	Rare	Major	Medium
Increased rainfall variability	Parapet roof retains water due to insufficient capacity in the syphonic drainage system leading to structural failure.	Possible	Major	High	Overflow systems in place in the form of overflow slots. The capacity of these can be increased if required to allow for increased rainfall intensity.	Rare	Major	Medium

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increased rainfall variability	Onsite Water Detention Tank (OSD) cannot deal with increased flows leading to overflow and flooding of adjacent areas.	Possible	Major	High	If necessary, overflow system to be provided. Hydraulic engineers to check if systems can manage the increased flows and implement further measures if required.	Rare	Major	Medium
Increased rainfall variability	Overland flow of water leads to pooling around the electrical infrastructure, causing electrical failure and power outage.	Possible	Catastrophic	Critical	Primary storm water drainage system to be designed to cater for a minimum of a 100-year storm. System to also have full backup of either piped overflow or overland flow designed to a higher storm intensity.	Rare	Major	Medium
Increased intensity of storm events	Mechanical plant on the roof (if any) are damaged by extreme hail event leading to failure of ventilation system.	Possible	Major	High	Consider options for protecting the mechanical plant in design. Implement if required.	Rare	Major	Medium

Climate variable	Risk Statement	Likelihood	Consequence	Level of Risk	Adaptation actions	Residual Likelihood	Residual Consequence	Residual level of Risk
Increased intensity of storm events	Severe hail blocking roof drains causing increased water ingress into building envelope and potential structural impacts, leading to increased maintenance costs	Possible	Major	High	Screen outlets with hail guards. Planned overflow slots should allow rain to overflow for all but the most severe hail events.	Rare	Major	Medium
Increased intensity of storm events	Airborne debris causing damage to exterior building elements and increased maintenance costs.	Possible	Major	High	Check wind load thresholds in engineering for façade and glazing. If required, adopt heat treated glazing for greater impact strength.	Rare	Major	Medium
Increased intensity of storm events	Wind driven rain penetrates the building, creating slip hazards for circulation spaces	Likely	Moderate	High	Consider in design and highlight risk for building managers. Include wet weather management plan in facilities management contract.	Rare	Moderate	Low
Increased fire weather	Smoke ingress into facility via HVAC system causing increased health risks for the occupants.	Almost certain	Major	Critical	Evacuation plan to be developed by FM company, including use of link to nearby hospitals for particularly vulnerable occupants. Consider use of non-latching outside air smoke detectors to shut down outside air systems in the event of a bushfire situation.	Almost certain	Insignificant	Medium

9.2.3 Recommendations

Many of the potential risks to the building are already addressed by existing design features of the building or are being explored as an immediate consequence of this process. All those identified through the workshop and subsequent discussions as requiring additional action are set out in table below, along with responsibility for those actions.

Summary of adaptation actions required to achieve revised risk rating is presented in Table 11:

Table 11. Adaptation Actions Required to Achieve Revised Risk Rating.

Risk Statement	Initial Risk	Residual Risk	Action requiring implementation	Design / Operations	Proposed Responsibility
Brownouts/Blackouts leading to failure of critical electrical equipment.	High	Medium	Where possible, Solar PV with Battery Energy Storage System (BESS).	Design and operations	Electrical Engineer
Accelerated structural material fatigue and degradation of façades, leading to increased maintenance and repair costs	High	Low	Review material datasheets for in-service temperature range and allow for a nominal tolerance on peak temperatures based on today's values. Select materials which have a higher temperature tolerance if required.	Design	Façades Engineer, Structural Engineer
Water restrictions during prolonged droughts leading to inability to deliver core services.	High	Low	Develop a Drought Management Plan. Water restrictions would likely be signposted well in advance. Consider alternative water supply.	Operations	Facilities Manager
Parapet roof retains water due to blockage in symphonic drainage system leading to structural failure.	High	Medium	Check the design includes overflow outlets in parapet. Add to design if required.	Design	Hydraulic Engineer
Parapet roof retains water due to insufficient capacity in the symphonic drainage system leading to structural failure.	High	Medium	Check whether capacity of overflow slots and drainage system is sufficient to allow for increased rainfall intensity. Increase either/both if required.	Design	Hydraulic Engineer, Architect

Onsite Water Detention Tank (OSD) cannot deal with increased flows leading to overflow and flooding.	High	Medium	Ensure secondary overflow system provided and check if systems can manage increased flows. Implement further measures if required.	Design	Civil Engineer
Overland flow of water leads to pooling around electrical infrastructure, causing electrical failure and power outage.	Critical	Medium	Primary storm water drainage system to be designed to cater for a minimum of a 100- year storm. System to also have full backup of either piped overflow or overland flow designed to a higher storm intensity. Consider other feasible mitigation measures as required.	Design	Hydraulic Engineer, Architect, Electrical Engineer
Mechanical plant on the roof (if any) are damaged by extreme hail event leading to failure of ventilation system.	High	Medium	Consider options for protecting the mechanical plant in design. Implement if required.	Design	Mechanical Engineer
Severe hail blocking roof drains causing increased water ingress into building envelope and potential structural impacts, leading to increased maintenance costs	High	Medium	Screen outlets with hail guards.	Design	Hydraulic Engineer
Airborne debris causing damage to exterior building elements and increased maintenance costs - particularly discussed potential increase in wind loadings due to CC.	High	Medium	Check wind load thresholds in engineering for façade and glazing. Adopt heat treated glazing for greater impact strength if required.	Design	Façades Engineer, Structural Engineer

Wind driven rain penetrates the building, creating slip hazards for circulation spaces	High	Low	Consider in design and highlight risk for building managers. Include wet weather management plan in facilities management contract.	Design and operations	Architects and Facilities Manager
Smoke ingress into facility via HVAC system causing increased employee health risks	Critical	Medium	Evacuation plan to be developed by FM company, including use of link to nearby hospitals for particularly vulnerable occupants. Consider use of non-latching outside air smoke detectors to shut down outside air systems in the event of a bushfire situation.	Design and operations	Mechanical Engineer, Facilities Manager, Owner

10. Conclusion

Based on the assessment presented in this report, the proposed development is considered acceptable from an Ecologically Sustainable Development (ESD) perspective, subject to the implementation of the sustainability initiatives outlined in this report and confirmation at detailed design stages where applicable.

Key mitigation measures supporting this conclusion include the delivery of the ESD initiatives outlined in Section 8, implementation of the climate change adaptation measures described in Section 9, and incorporation of relevant construction and operational controls identified in Section 7 to minimise environmental impacts and support long-term sustainability outcomes.

11. Disclaimer

This report is prepared using the information described above and inputs from other consultants. Whilst IGS has endeavoured to ensure the information used is accurate, 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 IGS for detailed advice which will take into account that party's particular requirements.

Computer performance assessment provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone. IGS and its employees and agents shall not be liable for any loss arising because of, any person using or relying on the Report and whether caused by reason or error, negligent act or omission in the report. The draft assessment has been prepared indicatively and using the limited architectural and building services design with the view to conduct a detailed assessment once the design is further developed.

Performance of the completed building may be significantly affected by the quality of construction; the quality of commissioning, ongoing management of the building, and the way the building is operated, monitored, and maintained.

APPENDIX A - TECHNICAL DATASHEETS FOR SAMPLE PV PANELS (600 W)

Vertex

BIFACIAL DUAL GLASS MONOCRYSTALLINE MODULE

PRODUCT: TSM-DEG20C.20

PRODUCT RANGE: 580-600W

600W	0~+5W	21.2%
MAXIMUM POWER OUTPUT	POSITIVE POWER TOLERANCE	MAXIMUM EFFICIENCY

High customer value

- Lower LCOE (Levelized Cost of Energy), reduced BOS (Balance of System) cost, shorter payback time
- Lowest guaranteed first year and annual degradation;
- Designed for compatibility with existing mainstream system components
- Higher return on Investment

High power up to 600W

- Up to 21.2% module efficiency with high density interconnect technology
- Multi-busbar technology for better light trapping effect, lower series resistance and improved current collection

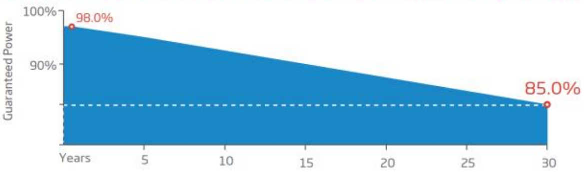
High reliability

- Minimized micro-cracks with innovative non-destructive cutting technology
- Ensured PID resistance through cell process and module material control
- Resistant to harsh environments such as salt, ammonia, sand, high temperature and high humidity areas
- Mechanical performance up to 5400 Pa positive load and 2400 Pa negative load

High energy yield

- Excellent IAM (Incident Angle Modifier) and low irradiation performance, validated by 3rd party certifications
- The unique design provides optimized energy production under inter-row shading conditions
- Lower temperature coefficient (-0.34%) and operating temperature
- Up to 25% additional power gain from back side depending on albedo

Trina Solar's Vertex Bifacial Dual Glass Performance Warranty



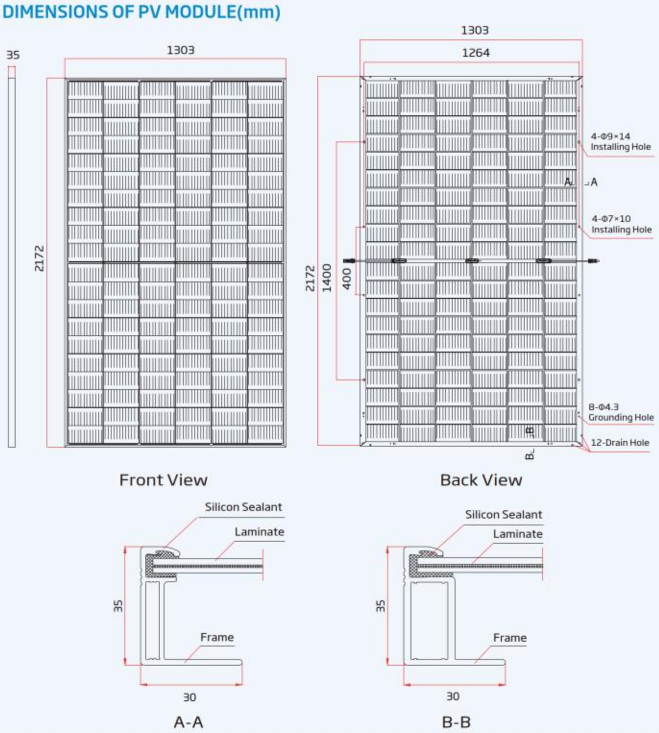
Comprehensive Products and System Certificates

IEC61215/IEC61730/IEC61701/IEC62716/UL61730
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System

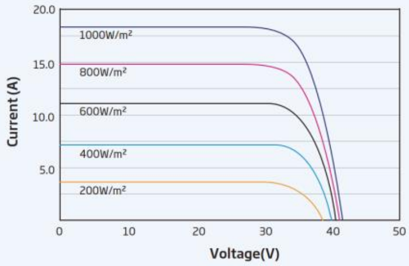
Trinasolar

Vertex BIFACIAL DUAL GLASS MONOCRYSTALLINE MODULE

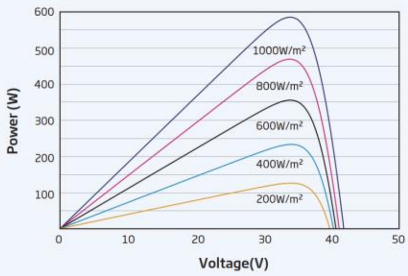
DIMENSIONS OF PV MODULE(mm)



I-V CURVES OF PV MODULE(590 W)



P-V CURVES OF PV MODULE(590 W)



ELECTRICAL DATA (STC)

Peak Power Watts-PMAX (Wp)*	580	585	590	595	600
Power Tolerance-PMAX (W)			0 ~ +5		
Maximum Power Voltage-VMPP (V)	33.8	34.0	34.2	34.4	34.6
Maximum Power Current-IMPP (A)	17.16	17.21	17.25	17.30	17.34
Open Circuit Voltage-Voc (V)	40.9	41.1	41.3	41.5	41.7
Short Circuit Current-Isc (A)	18.21	18.26	18.31	18.36	18.42
Module Efficiency η m (%)	20.5	20.7	20.8	21.0	21.2

STC: Irrdiance 1000W/m2, Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%.

Electrical characteristics with different power bin (reference to 10% Irradiance ratio)

Total Equivalent power -PMAX (Wp)	621	626	631	637	642
Maximum Power Voltage-VMPP (V)	33.8	34.0	34.2	34.4	34.6
Maximum Power Current-IMPP (A)	18.36	18.41	18.46	18.51	18.55
Open Circuit Voltage-Voc (V)	40.9	41.1	41.3	41.5	41.7
Short Circuit Current-Isc (A)	19.48	19.54	19.59	19.65	19.71
Irradiance ratio (rear/front)			10%		

Power Bifaciality:70±5%.

ELECTRICAL DATA (NOCT)

Maximum Power-PMAX (Wp)	439	443	447	451	454
Maximum Power Voltage-VMPP (V)	31.5	31.7	31.9	32.0	32.2
Maximum Power Current-IMPP (A)	13.93	13.97	14.01	14.06	14.10
Open Circuit Voltage-Voc (V)	38.5	38.7	38.9	39.1	39.3
Short Circuit Current-Isc (A)	14.68	14.72	14.76	14.80	14.84

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

MECHANICAL DATA

Solar Cells	Monocrystalline
No. of cells	120 cells
Module Dimensions	2172×1303×35 mm (85.51×51.30×1.38 inches)
Weight	35.3 kg (77.8 lb)
Front Glass	2.0 mm (0.08 inches), High Transmission, AR Coated Heat Strengthened Glass
Encapsulant material	EVA/POE
Back Glass	2.0 mm (0.08 inches), Heat Strengthened Glass (White Grid Glass)
Frame	35mm(1.38 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm² (0.006 inches²), Portrait: 280/280 mm(11.02/11.02 inches) Length can be customized
Connector	MC4 EVO2 / TS4*

*Please refer to regional datasheet for specified connector.

TEMPERATURE RATINGS

NOCT (Nominal Operating Cell Temperature)	43°C (±2°C)
Temperature Coefficient of PMAX	- 0.34%/°C
Temperature Coefficient of Voc	- 0.25%/°C
Temperature Coefficient of Isc	0.04%/°C

MAXIMUMRATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1500V DC (IEC) 1500V DC (UL)
Max Series Fuse Rating	35A

WARRANTY

12 year Product Workmanship Warranty
30 year Power Warranty
2% first year degradation
0.45% Annual Power Attenuation

(Please refer to product warranty for details)

PACKAGING CONFIGUREATION

Modules per box: 25/36 pieces
Modules per 40' container: 549 pieces

Trinasolar

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Version number: TSM_EN_2021_B
www.trinasolar.com

APPENDIX B - TECHNICAL DATASHEETS FOR SAMPLE PV INVERTERS

SG15/17/20RT

Multi-MPPT String Inverter for 1000 Vdc System

HIGH YIELD

- Lower startup & wider MPPT voltage
- Compatible with bifacial modules
- Built-in PID recovery function

SMART MANAGEMENT

- Smart IV curve scanning
- 24 / 7 Live monitoring
- Over-the-air firmware updates

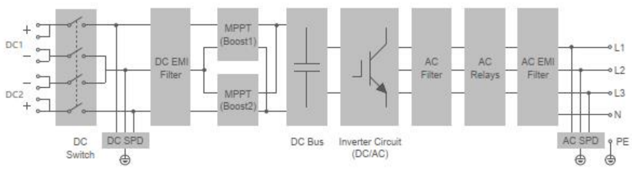
SAFE AND DURABLE

- Quick arc fault circuit interrupter
- Build-in Type II DC & AC SPD
- High anti-corrosion rating C5

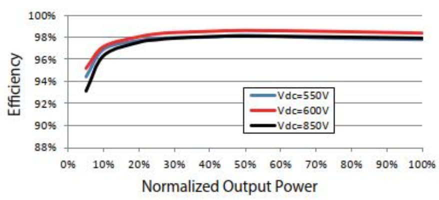
EASY AND USER FRIENDLY

- 21kg compact design
- Unique push-in connectors
- Fast and easy commissioning via App

CIRCUIT DIAGRAM



EFFICIENCY CURVE



SUNGROW
Clean power for all

Type designation	SG15RT	SG17RT	SG20RT
Input (DC)			
Recommended max. PV input power	22.5 kWp	25.5 kWp	30 kWp
Max. PV input voltage		1100 V *	
Min. PV input voltage / Start-up input voltage		180V / 180V	
Rated input voltage		600 V	
MPP voltage range		160V-1000V	
No. of independent MPP inputs		2	
No. of PV strings per MPPT		2 / 2	
Max. PV input current		50 A (25 A / 25 A)	
Max. DC short-circuit current		64 A (32 A / 32 A)	
Max. current for DC connector		30 A	
Output (AC)			
Rated AC output power	15000 W	17000 W	20000 W
Max. AC output apparent power	16500 VA**	18700 VA**	22000 VA**
Rated AC output apparent power	16500 VA**	18700 VA**	22000 VA**
Max. AC output current	25 A	28.3 A	31.9 A
Rated AC output current(at 230V)	21.7 A	24.6 A	29 A
Rated AC voltage		3 / N / PE, 220 / 380 V 3 / N / PE, 230 / 400 V 3 / N / PE, 240 / 415 V	
AC voltage range		180V – 276V / 311V - 478V	
Rated grid frequency		50 Hz / 60 Hz	
Grid frequency range		45 – 55 Hz / 55 – 65 Hz	
Harmonic (THD)		<3 % (at rated power)	
Power factor at Rated power / Adjustable power factor		>0.99/0.8 leading – 0.8 lagging	
Feed-in phases / Connection phases		3 / 3	
Efficiency			
Max. efficiency		98.5%	
European efficiency		98.1%	
Protection&Function			
Grid monitoring		Yes	
DC reverse connection protection		Yes	
AC short-circuit protection		Yes	
Leakage current protection		Yes	
Surge Protection		DC Type II / AC Type II	
Ground fault monitoring		Yes	
DC switch		Yes	
PV String current monitoring		Yes	
Arc fault circuit interrupter (AFCI)		Yes	
PID recovery function		Yes	
General Data			
Dimensions (W*H*D)		370*480*195 mm	
Weight		21 kg	
Mounting method		Wall-mounting bracket	
Topology		Transformerless	
Degree of protection		IP65	
Night power consumption		< 6 W	
Corrosion		C5	
Operating ambient temperature range		-25 ℃ to 60 ℃	
Allowable relative humidity range (non-condensing)		0% – 100%	
Cooling method		Smart forced air cooling	
Max. operating altitude		4000 m	
Display		LED	
Communication		WLAN / Ethernet / RS485 / DI / DO	
DC connection type		MC4 (Max. 6 mm²)	
AC connection type		Plug and play	
Grid Compliance		IEC / EN 61000-6-1/2/3/4, IEC 61000-3-2/3/11/12, IEC / EN62109-1/2, IEC 61727, IEC 62116, IEC 61683, IEC 60068-2-1/2/14/30/64/27,IEC TS 62910 , EN50530, AS/NZS 4777.2:2020, VDE-AR-N-4105, DIN VDE0126-1-1/A1, EN50549-1, DEWA, VFR 2019, UTE C15-712-1, PSE NC RfG, UNE 206006/7 IN, MEA/PEA, G98, UNE 217002:2020, NTS V2 TypeA	
Grid Support		LVRT, HVRT,active & reactive power control and power ramp rate control	

*: The inverter enters the standby state when the input voltage ranges between1,000V and 1,100V. If the maximum DC voltage in the system can exceed 1000V, the MC4 connectors included in the scope of delivery must not be used. In this case MC4 Evo2 connectors must be used.
** For Germany, max. AC output power: SG15RT is 15000VA,SG17RT is 17000VA, SG20RT is 20000VA.