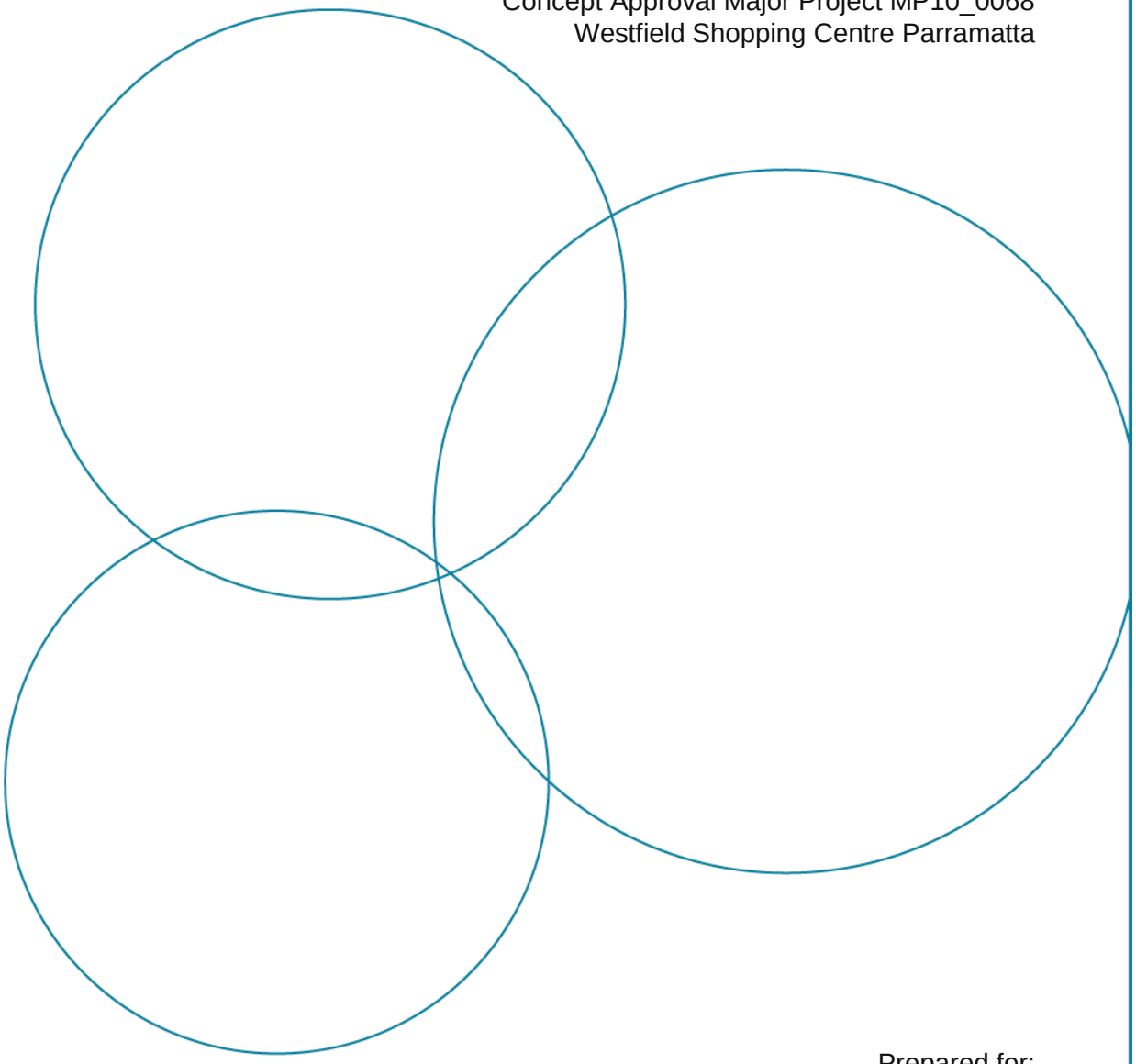
17/05/2018

Sustainable Design Report

Section 75W Modification (MOD 1) to the
Approved Commercial Tower Building Envelope
Concept Approval Major Project MP10_0068
Westfield Shopping Centre Parramatta



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Draft	Draft for Comments	20/04/2018
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C	Final for submission	17/05/2018

The success and realisation of the proposed initiatives will be dependent upon the commitment of the design team, the development of the initiatives through the life of the design and also the implementation into the operation of the building. Without this undertaking the proposed targets may not be achieved.

Executive Summary

This report outlines the key sustainable design initiatives for the proposed commercial office development above the Westfield Parramatta retail centre bound by O'Connell, Argyle, Church and Campbell Streets in Parramatta.

The development will be designed to PCA 2017 Grade A requirements. The design will focus on achieving excellence around energy and water efficiency, as well as providing tenants with the best amenities through implementation of best practice design initiatives.

During this early stage of the project design, a series of sustainability initiatives have been developed for the project team to set a clear sustainability strategy for the project and allow for complete analysis of the options to be considered. During concept design development, each design option will be considered in terms of total life-cycle impact, including embodied energy and water, value of material resources and likely future trends. The design will be evaluated at key project stages to ensure that the best outcome is achieved in terms of total carbon and environmental impacts.

Key strategies that will be considered cover a broad range of environmental performance criteria throughout the design, construction and operational phases of the building, as follows:

Design Phase	
Built Form	• Analysis and understanding of solar heat loads within the building to optimise the facade, reducing energy consumption whilst maximising the benefits of natural daylight and external views • Optimised built form and facade to minimise embodied energy into the development • Optimised built form to maximise indoor environment quality
Mechanical Design	• Selection and design of efficient air conditioning plant • Implementation of variable operation components to control the building efficiently and high and low loads • Enhanced controls to automatically control plant and equipment for optimum efficiency • Consideration of additional systems and capacity to enhance indoor environment quality. Ventilation rates may be increased above the minimum requirements to improve indoor air quality of the occupied building.
Electrical Design	• Selection and design of lighting systems which provide high light levels with low energy consumption • Enhanced controls to automatically control plant and equipment for optimum efficiency • Design of electrical systems to enable monitoring of energy and water consumption in association with building plant and equipment. • Consideration of systems that enhance indoor environment quality including appropriate lighting levels and reduction of lighting flicker associated with fluorescent lighting • Consideration to low carbon electricity sources such as photovoltaics

Design Phase	
Hydraulic Design	• Selection and design of systems with a low potable water consumption requirement • Dual water pipe work, with one set connected to end uses requirement potable water (taps and showers) with the other set used for non-potable water (WCs, urinals and cooling towers)
Transport	• Promotion of alternative forms of transportation including cyclist facilities, public transport and low emission vehicles

Construction Phase	
Commissioning	• Detailed commissioning of the buildings mechanical, electrical and hydraulic system to ensure efficient operation • A 12-month building tuning process to optimise the systems through differing weather events and occupancy rates
Construction Practices	• A comprehensive environmental management plan will be implemented to minimise the impact on the immediate environment • 80% of construction waste will be either reused or recycled • Construction energy and water consumption will be monitored to minimised wastage
Materials Selection	• Materials installed in the building during construction will be low in volatile organic compounds and low in formaldehyde emissions to improve the indoor air quality of the finished building • PVC and timber will be sourced from lower environmental impact manufacturing and plantation • A Life Cycle Assessment of the buildings environmental impacts will be conducted to assess the operation for replacing materials to reduce impact

Operational Phase	
Knowledge Transfer	• A detail transfer of knowledge from the construction team to the buildings operational team to ensure all sustainable design initiative are fully coordinated into the operation • After project handover all building systems will be continuously tuned and monitored to ensure efficient operation • A building users guide will be provided to the building operator and the occupants to explain the correct management of the building
Ongoing Management	• The energy, water and waste monitoring system will be monitored monthly to identify and rectify areas of wastage and to drive continual improvement • A NABERS Energy rating of 4.5 stars for the will be achieved monthly.
Fitout and Refit Considerations	• A detailed guide to tenancy fitout and re-fit will be developed to provide information to tenants to minimise their environmental impact and ensure appropriate integration. This guide will include: ○ Lighting types and maximum power allowances ○ General equipment maximum power allowances ○ Requirements for lighting and equipment controls ○ Materials usage guidelines for reduced embodied energy ○ Waste reduction techniques and requirements

The design response to sustainability is explained in more detail in the following sections.

Contents

1 Introduction

This report outlines the key Ecologically Sustainable Design (ESD) initiatives for the proposed commercial office development above the Westfield Parramatta retail centre bound by O'Connell, Argyle, Church and Campbell Streets in Parramatta. The project is a 112,000m² GFA, 42 storey commercial office scheme sitting above the existing Westfield Shopping Centre.

The development is being designed to exceed minimum requirements in terms of Ecologically Sustainable Design (ESD) and is aiming to achieve the requirements of PCA Grade A Commercial Office space, reflecting best practice design practices in the industry.

Several sustainability requirements have been defined during the previous consultations, which are defined below.

Source	Requirement	Included
Secretary's Environmental Assessment Requirements Section 75W of the Environmental Planning and Assessment Act 1979	9 Ecologically Sustainable Design Identify how best practice ESD principles will be incorporated in the design of the development and include innovative and best practice proposals for environmental building performance.	Best practice ESD principles which will be considered for the project are defined throughout this report. Innovative concepts, technologies and initiatives will be investigated when the project progresses to a sufficient level of detail.
Modification 1 of SEARs – MP10_0068 - Concept Plan for Westfield Shopping Centre Parramatta Retail and Commercial Development	5. Energy and water targets (clause 7.17) supported by ESD Statement / Strategy	The energy targets in clause 7.17 are consistent with or lower than the NABERS targets set for the project. The water targets in clause 7.17 are in line with the Green Star strategy for the project.
	6. Provision of dual water systems (clause 7.18) supported by ESD Statement / Strategy	Dual water pipework will be provided, separated for potable and non-potable sources.

The project is also required to comply with the Building Code of Australia Section J for Energy Efficiency. These commitments are outlined in more detail in the following sections.

This report has been developed in three key sections as noted below. Each section will focus on a key concern for the development and provide an insight as to how these items will be addressed throughout the design process.

- Resource Consumption - this section of the report provides information into the methodologies to be investigated to ensure that energy, water and materials consumption is minimised throughout construction, operation and demolition.
- Creating Spaces for People - this section of the report outlines how the internal spaces will be optimised for occupant health, well being and comfort.
- Codes and Ratings - an outline of how the building will comply with relevant voluntary and mandatory codes and rating schemes will be outlined.

2 Resource Consumption

Buildings consume considerable natural resources in their construction, operation and demolition. This section of the report will provide details as to the potential impacts caused by the building and how these impacts have been reduced when compared to typical buildings of this nature. The building will aim to reduce the total embodied energy and carbon considered in the construction and then aim to maximise the operational efficiency of the buildings services to provide and enhance tenant provisions for the minimum amount of energy and water. Furthermore, methods for maintaining operational efficiency over the life of the building will be investigated to ensure that the benefits are maximised over the life of the building.

2.1 Energy Reduction Strategies

A substantial part of Australia's employment and economic activity is centred on construction and occupation of commercial buildings such as offices. As can be ascertained from the chart below commercial buildings are responsible for approximately eight and a half million tonnes of carbon dioxide per annum. These emissions continue to rise as the demand for commercial space increases.

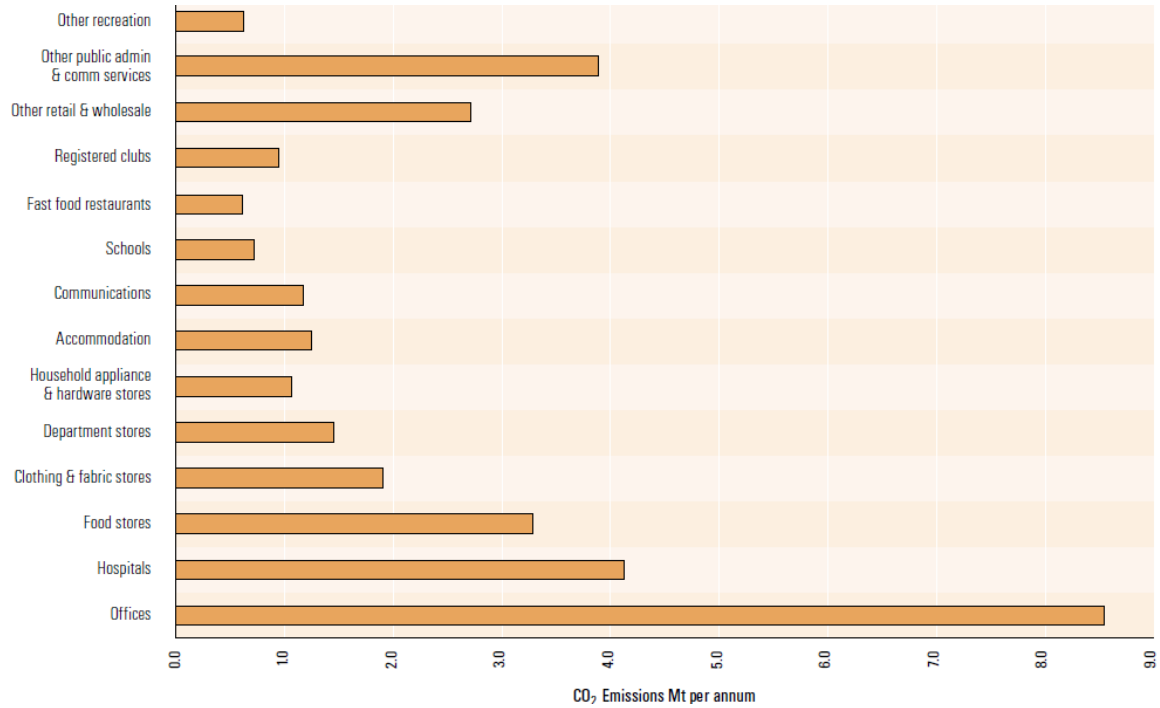


Figure 1: Greenhouse gas emissions by building type

(Source: Australian Commercial Building Sector Greenhouse Gas Emissions 1990-2012)

Improving the energy efficiency of commercial buildings has the potential to deliver savings on energy bills and building maintenance costs, happier and more productive workers and increased building value.

This section sets out possible strategies to reduce the buildings energy demand and greenhouse gas emissions.

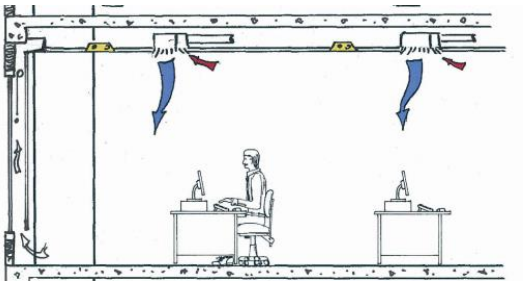
2.1.1 Air Conditioning Systems

The proposed building air conditioning system design will consider the following three options and the final system selection will be based on a life-cycle approach.

Variable Air Volume System:

A VAV system provides conditioned air through overhead supply ducts. The quantity of air is modulated to maintain comfort conditions in the space.

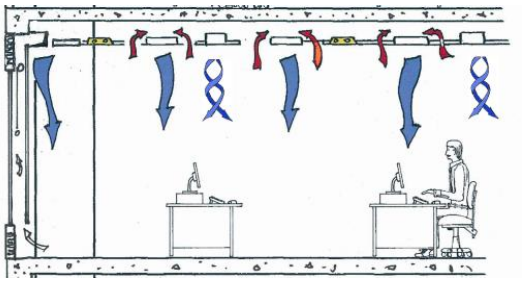
The primary benefit of a system of this type is the simplicity of the system whereby comfort is maintained in many zones which are operating differently. The system can be enhanced with energy saving features such as economy cycle, carbon monoxide control and optimum start.



Chilled Beam System:

A chilled beam system utilises chilled water running through radiators to provide cooling to the space. Fresh air is provided through separate air diffusers.

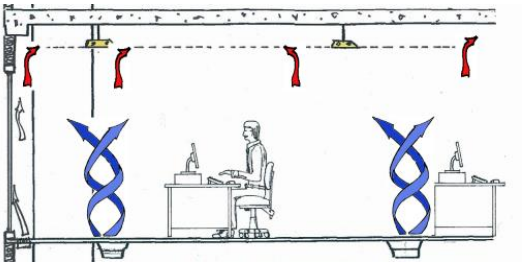
The primary benefit of a system of this type is that large quantities of air does not need to be transported through the building, relying on small quantities of chilled water being transported instead.



Underfloor Air Distribution System:

Underfloor air distribution acts similar to a VAV system however the air is distributed through floor mounted diffusers. The air is distributed at a higher temperature to maintain occupant comfort.

There are several primary benefits of an under floor system. The system provides a higher indoor environment quality as the air bourn containments are removed from the space without being re-distributed. Additionally, the lighting loads in the building do not need to be conditioned as they are outside of the occupied zone and the air supply temperature is higher, requiring less energy to cool the air.



2.1.2 Lighting Systems

Energy efficient lighting systems, including LED lighting, will be considered during the detailed design of the building. Smart control options, such as the following, will be considered:

- Time clocks with occupancy sensors to commercial building areas;
- Daylight sensors to space adjacent to glazing or under skylights;
- Small lighting zones to ensure that the controls benefits are maximised; and
- Occupancy sensors which default to off for all back of house spaces.

2.1.3 Vertical Transportation

Vertical transportation within the building may be split to service the high rise and low-rise sections of the building separately, this will provide enhanced trip time reductions and will increase the efficiency of the vertical transportation systems. In addition to the inherent benefits of the lift planning and design it is possible that the following technologies may be incorporated to reduce the energy consumption of the vertical transportation systems:

- Regeneration - utilising the potential energy stored in the system. When the lift is in free-fall or free-rise, depending on the balance of occupants and the counter weights, the regenerative drive can convert this energy into electricity rather than dissipating as heat.
- Dispatch control - Implementation of destination controls to optimise the pattern of passenger pick-ups and drop-offs. The system aims to reduce the number of stops and the distance travelled, therefore saving energy.
- The standby energy consumption will be reduced by incorporating energy efficient lighting and smart controls to switch equipment off when the lift is not in use.
- VVVF - Variable voltage, variable frequency drive enable consistent control with reduced currents, high power factors and increased energy efficiency.

2.1.4 Ancillary Systems

All ancillary systems in the development will be controlled via smart controls to either switch-off or reduce the impact of ancillary lighting, pumping and ventilations systems. The controls will be based on demand (such as carbon monoxide in the car park) or occupancy (such as plant room lighting).

2.1.5 Low Carbon Energy Systems

The development will be investigating the implementation of a low carbon energy generation system to reduce the developments carbon emissions.

As an alternative to using fossil fuels, such as gas fired generation, a roof mounted photovoltaic (PV), solar electric, system will be investigated.

2.1.6 Energy Monitoring and Metering

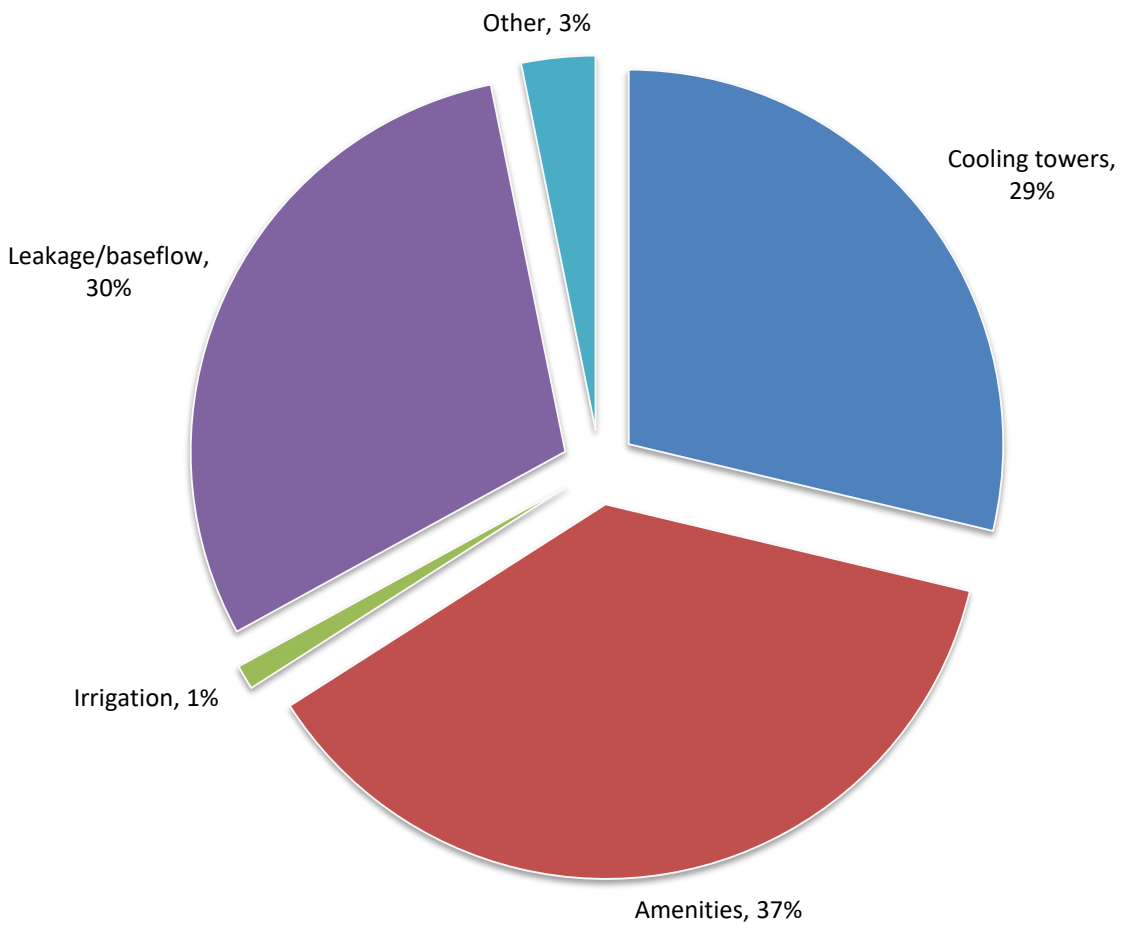
All major aspects of the building will have a real time energy monitoring system to enable the facilities management to investigate the buildings energy consumption in real time to provide enhanced building tuning and long term operational efficiency.

The commercial section of the building will be individually monitored to ensure all future sustainability rating tools can be applied.

2.2 Potable Water Reduction Strategies

The following table and chart provides an indication of the level of water consumption for commercial usage.

Benchmark	Commercial Office
Median market practice with no leaks	1.01 kL/m²/years
Economic best practice	0.844 kL/m²/years
Very well managed building	0.77 kL/m²/years



Reducing potable water consumption provides benefits such as, reduced utility bills and preservation of future water supply. Organisations that adopt strategies to reduce water consumption also portray an image of innovation and awareness to clients, staff and visitors. Incorporating pioneering initiatives often leads to improved communication, management and collaboration throughout an organisation.

This section sets out possible strategies to minimise potable water by building occupants and the operation of building services.

2.2.1 Amenities

Occupant consumption is a major contributor to potable water usage. The following ratings will be considered a minimum to ensure the efficient use of potable water by building occupants:

- WCs at 3L/flush (average) or better;
- Low flush (i.e. waterless or 0.8L/flush) urinals;
- Showerheads at 7.5 L/minute or better;
- Taps at 4.5 L/minute with automatic shut off.

2.2.2 Air Conditioning Systems

Air-conditioning systems and associated plant can be very water intensive. Cooling tower systems should be designed so that the number of cycles of concentration can be calculated by the BMS and will therefore limit the bleed-off flow to achieve a minimum set point of 6 cycles of concentration (or greater).

2.2.3 Non-Potable Water Usage

To reduce the consumption of potable water, a rainwater harvesting system will be considered to be used for non-potable water requirements such as irrigation, WCs/Urinals flushing and cooling tower make-up water.

The development will include dual water pipe work, with one set connected to end uses requirement potable water (taps and showers) with the other set used for non-potable water (WCs, urinals and cooling towers). This will enable future non-potable water sources captured at either a site or city level to be used in the building without significant changes to the building distribution pipework.

2.2.4 Fire Systems

Water from fire system testing procedures can be re-used within the building to offset water consumption. The fire sprinkler system is to be designed so that all test and drain down water is reduced and potentially captured.

2.2.5 Water Metering and Leak Detection

A system that both monitors and manages water consumption is to be installed. Water metering will be provided to all major water uses within the building, with connections to the BMS ensuring immediate and effective monitoring of water consumption and leakages for simple rectification.

2.3 Building Materials Resource Minimisation

2.3.1 Sustainable Building Products

The following initiatives may be followed with regards to building products:

- Ecologically sensitive products, such as scarce minerals and old-growth forest, will be avoided;
- Preference may be given to materials with a high recycled content and preferred source, including:
    - Where timber is used, it may preferentially be sourced from reclaimed or certified sustainable growth stock. As a minimum, at least 95% of timber must be sourced from either re-used, post-consumer recycled, FSC or AFS certified timber.
    - A proportion of portland cement may be replaced with fly ash or other industrial waste products, and recycled aggregate will be used.
    - Wherever feasible, PVC and steel may be sourced from sources capable of achieving the Green Star applicable credits.

2.3.2 Embodied Carbon

Embodied carbon comprises a major proportion of the total carbon footprint of a building. An option to provide an analysis of total carbon and environmental footprint may be considered at key design stages to ensure that design options are prioritised in terms of life-cycle impact and embodied energy/water rather than just day one impacts.

The following items will be considered throughout the design development:

- Sub-structure
    - Maximise recycled content of materials in structural components.
- Super-Structure
    - Maximise recycled content in concrete and formwork.
- Envelope
    - Adopt a low-carbon, lightweight approach;
    - Consider necessity of massing elements;
    - Consider composite materials or dual function elements.
- Internal Walls
    - Consider necessity of internal walls;
    - Consider recycled content or reused materials;
    - Consider low carbon steel framing.
- Internal Finishes
    - Consider setting a recycled content target for all finishes;
    - Consider long life and highly durable finished is areas of high foot traffic;

- Consider architectural expression of structure rather than needing additional finishes and materials.

- Services
  - Minimise high carbon intensity metals, extent of electrical cabling and ductwork, pipework and plant;
  - Ensure right-sizing of services;
  - Consider vertical transport as a critical element due to the scale of the development - reduce lift car weights and finishes;
  - Review maintainability at schematic design stage;
  - Implement sustainable procurement policy for maintenance and replacement.

2.3.3 Durability and Product Stewardship

All materials will be assessed to ensure that the selections are durable, flexible and recyclable. The manufacturers may be encouraged to implement comprehensive Environmental Management Plan to minimise the impact of their operations. In addition modular components and mechanical fixings will be encouraged to allow for ease of disassembly at the end of the building's life.

2.3.4 Emissions & Toxicity

The development will aim to specify materials with a low emissions content including low-VOC and low formaldehyde content, in order to avoid contaminating the indoor air.

2.3.5 Materials Sources

Localised manufacturing will be supported, reducing transport emissions and providing greater security of supply.

2.3.6 Waste Management

A dedicated storage area will be provided for the separation and storage of recyclable waste during operation, allowing for the following waste streams to be separated to match the local recycling schemes:

Throughout project design, operation and construction, principles of resource recovery will be applied, so that materials and products are recovered and reused where possible, reducing landfill and saving money.

Some strategies that will be investigated using full life cycle analysis include:

- Innovative waste separation and collection strategies to allow materials to be isolated for reuse;
- A purchasing policy which aims to minimise waste from products and packaging, encourage the use of products which have minimum environmental impact;
- Manufacturers and suppliers will be encouraged to take full responsibility for the life cycle impact of products including ownership at end of life.

3 Creating Spaces for People

With the development aiming to create a working environment for over 6,000 office workers, who spend considerable time within the building, it is essential that the building provides a comfortable and healthy environment for everyone. The development is investigating several initiatives to enhance the indoor environment through a multitude of different technologies and design features.

3.1 Daylight Improvement

Appropriate day lighting is essential for users' wellbeing and connection to the outdoors, and for energy efficiency. However excessive daylight can cause glare which is a major IEQ concerns and must be avoided.

The office will be aiming to achieve a minimum hourly illuminance value of 300 lux from daylight alone at task level for at least 50% of the hours between 8a.m. and 6p.m, for at least 30% of the NLA. External shading and/or internal blinds should be provided to eliminate direct glare to each workstation.

The following design opportunities will be considered throughout the detailed design process to maximise the daylighting potential:

- Glass selection: given the extent of proposed glazing, glass with a moderate VLT (0.4-0.6) should allow sufficient daylight to penetrate the space. Glass with a reflective coating will reduce glare.
- An open plan layout will allow deep daylight penetration. Limit enclosed spaces and high partitions (greater than one meter) near windows and open plan. Where possible glass partitions will be used in place of solid walls.
- Light internal colours improve daylight penetration.
- Blinds that can be adjusted to block glare, but still allow daylight penetration.

3.2 Connection to the Outdoors

Whilst it is difficult to achieve connection to the outdoors in a multistorey office building in an urban environment there are significant health benefits associated with providing access to views. There is increasing evidence that suggests improved access to external views can reduce health problems associated with working inside a commercial office building. Symptoms including eye strain and headaches are attributed to extended periods of time spent reading paperwork or in front of computer monitors. To combat these problems, occupants are encouraged to refocus their vision periodically throughout the day to the outdoor environment. As such, it's recommended that new office developments provide occupants with access to external views to improve occupant health and wellbeing.

The connection to the outdoors may be enhanced further by:

- Thin floor plates allow more work areas to be located close to windows. Locate core zones away from window.
- Internal plants provide the sensation of being connected to the outdoors.
- Other elements of biophilic design.

3.3 Further Indoor Environmental Quality

In addition to the building form based indoor environment quality improvements noted above the following items will be considered throughout the detailed design of the development.

3.3.1 Artificial Lighting

It is important that the right amount of light is delivered for building users to comfortably achieve their specific tasks. The spaces will be flexible and adaptable, and the lighting design must be too.

The artificial lighting system should deliver uniform light levels within individual spaces, be integrated with the daylight design, be energy efficient, and allow users a high degree of control. The main features to consider are shown in the following list:

- Occupant controlled dimming.
- Task lighting.
- Daylight linking.
- Motion sensors.
- Intuitive switching so users know which switches control which lights.
- Individually addressable / adaptable lighting system.
- Uplighting to improve light uniformity.

3.3.2 Controlling Indoor Pollutants

The key indoor pollutants are carbon dioxide (CO_2), formaldehyde, volatile organic compounds (VOCs), and moulds. Carbon dioxide is the main indoor pollutants emitted by humans and correlates with human metabolic activity. Carbon dioxide at levels that are unusually high indoors may cause occupants to grow drowsy, get headaches, or function at lower activity levels.

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short and long term adverse health effects. Concentrations of many VOCs are consistently higher indoors than outdoors. VOCs are emitted by a wide array of products numbering in the thousands (typically paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers).

Mould can occur when moisture is allowed to remain in building, this may cause mould mildew to propagate and release allergenic spores into the air. The primary hazard of mould growth, as it relates to indoor air quality, comes from the allergenic properties of the spore cell wall. Mould is known to trigger episodes in persons that already have asthma.

The design will investigate many items to improve the indoor air quality:

- CO_2 levels will be monitored and limited to 600ppm, at which point outside air levels will be increased.
- All materials installed in the building will be reviewed for formaldehyde and VOC emissions.
- External and internal dirt tracking mats at all entrances.
- Air filtration system based on indoor plants (e.g. Green Lung) and/or indoor plants to passively filter the air.

- Provide a dedicated exhaust system for pollution-generating spaces (e.g. photocopy rooms, kitchens and breakouts).

3.4 HVAC to Support Excellent IEQ

The HVAC system delivers and filters the internal air and its design is crucial to good IEQ. The system will provide:

- A healthy supply air
- A system easily controlled by users (temperature, air speed, air direction, having it on or off)
- Highly effective distribution of air within the spaces (air change effectiveness greater than or equal to 1).

Ideally, the air leaving the building will be cleaner than the air entering. To enable this to occur the building will incorporate the following features:

- Underfloor air distribution (displacement ventilation) systems which are most effective at removing pollutants and distributing air effectively. They are also less likely to cause draughts, and offer user control.
- High performance filters will need to be installed to filter outside air.
- Include a CO_2 monitoring and control system for all spaces, especially enclosed rooms.

3.5 Thermal Comfort

People's perception and idea of thermal comfort varies significantly, targeting a predicted mean vote (PMV) between -0.5 and +0.5 based on ISO 7730 will help ensure the majority of people (90%) are neither too hot nor too cold. The following initiatives will be included in the building:

- Underfloor displacement with user control provides exceptional thermal comfort.
- Manage people's expectations and connection to the outdoors by varying the internal temperature setpoints with external temperatures (also saves energy).
- Facade design and glass selection is very important; heat gains and losses must be moderated and thermal bridging should be avoided.
- The facade should be well sealed to avoid draughts and air leakage.

3.6 Acoustics

The office will be designed to be neither too quiet nor too noisy so that a level of privacy can be maintained and users are not distracted from their tasks.

The development will aim for a design where:

- Building services noise in general office spaces is less than 40dB(A)LAeq;
- The sound level does not exceed 40dB(A)LAeq within open plan office spaces
- Meeting rooms and enclosed offices have a sound transmission class (STC) rating of at least 50 (fitout consideration).
- Reverberation times (T60) no more than 0.8 and 0.6 are achieved for open plan offices and conference rooms / enclosed offices respectively (fitout consideration).

4 Codes and Ratings

The building will be subject to numerous voluntary and mandatory building codes and metrics to measure the performance of the rating. This section of the report will outline the main codes and ratings and identify the projects response.

4.1 Building Codes of Australia - Section J

The development is required to comply with the National Construction Code (NCC) Section J for Energy Efficiency. NCC Section J covers items including:

- Building fabric.
- External glazing.
- Building sealing.
- Air movement.
- Air conditioning.
- Artificial lighting and power.
- Hot water supply.
- Access to maintenance.

The building is being design with a high-performance facade and high-efficiency HVAC and electrical services. In order to take into account the complexities of the facade and building design, an alternative verification model will be undertaken during design development.

4.2 Green Star

The office development is targeting a 5 star Green Star rating. A s star rating requires a minimum of 60 points to be achieved. This may also require the development to achieve a 5 star NABERS Energy rating when modelled under the NABERS Energy Guide to Building Energy Estimation.

The following matrix summaries the targeted points. It should be noted that this is a guide only at this stage and will be further refined during detailed design development to achieve the Green Star target.

Green Building Council of Australia - Best Practice Design Initiatives Targetted

Project: **Westfield Parramatta - Commercial**

CUNDALL

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	COMPLIANCE REQUIREMENTS	AVAILABLE	TARGET
Management						
Green Star Accredited Professional	To recognise the appointment and active involvement of a Green Star Accredited Professional in order to ensure that the rating tool is applied effectively and as intended.	1.0	Accredited Professional	GSAP engaged through all stages of project from schematic design to certification	1	1
Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets	Document environmental performance targets for project (through a design intent report or similar).	-	Complies
		2.1	Services and Maintainability Review	Services and maintainability review prior to construction, led by contractor, ICA or owner's rep with input from the design team.	1	1
		2.2	Building Commissioning	Required to: - Include specific commissioning requirements in contracts (refer to submission guidelines); - Develop a commissioning plan; - Demonstrate commissioning was carried out in accordance with the plan and spec requirements; - Conduct air permeability testing	1	1
		2.3	Building Systems Tuning	Committment from the building owner to building systems tuning, 12 months post PC tuning, based on BMS data and occupancy surveys, also requires: - O&M manual to be prepared in accordance with standards; - Building tuning plan to be prepare in accordance with standards; - Building tuning team to be formed; and - Organisations have been engaged to tune nominated systems.	1	1
		2.4	Independent Commissioning Agent	ICA to be engaged throughout design and construction, can only be claimed if 2.1, 2.2 or 2.3 are also achieved.	1	1
Adaptation and Resilience	To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.	3.0	Implementation of a Climate Adaptation Plan	Climate adaptation plan generated and design solutions incorporated.	2	2
Building Information	To recognise the provision of building information that facilitates understanding of a building's systems, operation and maintenance requirements, and environmental targets to enable the optimised performance.	4.0	Building Operations, Maintenance and User Information	O&Ms and Building Log Book (reference directory on where to find building information, regularly updated) generated in accordance with standards. Must also include details regarding updating O&Ms. Building user information to be provided. Must be digital and editable by FM to stay up to date. Available in signage or information kiosks in building foyer, or via intranet/mobile devices.	1	1
Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Performance	Commitment to set min 2 environmental targets (for 80% of GFA) and monitor for building performance. GHG, Water, Waste, IEQ. Requires Lease or other formal agreement between tenant and owner.	1	1
		5.2	End of Life Waste Performance	Commitment to set waste targets and monitor for end of life of fitouts. Needs commitments between tenant and owner if applicable.	1	1
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	Conditional - metering provided for all major uses and sources of water and energy. To qualify for this credit, it is a minimum requirement that accessible metering be provided to monitor building energy and water consumption, including all energy and water common uses and major uses, and sources. All meters must be fully commissioned in line with the NABERS protocol and be capable of producing alerts if any inaccuracies in the meter network are found.	-	Complies
		6.1	Monitoring Systems	System (BMS) present to monitor and record data, with the ability to clearly present to the user.	1	1
Responsible Construction Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	Conditional - Comprehensive EMP in place complying with NSW EMS guidelines.	-	Complies
		7.1	Environmental Management System	EMS (formalised environmental strategy) required, e.g. ISO-14001 certification, BS 7750 or the European Community's EMAS.	1	1
		7.2	High Quality Staff Support	Promote positive mental and physical health outcomes of site activities and culture of site workers, through programs and solutions on site; and Enhance site workers' knowledge on sustainable practices through on-site, off-site, or online education programs.	1	1
Operational Waste	Performance Pathway	8A	Performance Pathway - Specialist Plan	Qualified waste auditor is to prepare an operational Waste Management Plan (OWMP) for the project in accordance with best practice approaches.	1	1
Total					**14**	**14**

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CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	COMPLIANCE REQUIREMENTS	AVAILABLE	TARGET
Indoor Environment Quality						
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	- Ductwork to be kept clean prior to installation or cleaned prior to occupancy. - Maintenance access to be provided to both sides of moisture and debris catching components. - Intakes located away from pollutants in accordance with ASHRAE Standard 62:2013.	1	1
		9.2	Provision of Outdoor Air	Mechanically ventilated and mixed-mode areas: - 1 point for 50% greater outdoor air than AS1668.2:2012 OR CO_2 concentrations kept below 800ppm. - 2 points for 100% greater outdoor air than AS1668.2:2012 OR CO_2 concentrations kept below 700ppm. Naturally Ventilated areas: - 2 points where requirements of AS1668.4-2012 are met.	2	1
		9.3	Exhaust or Elimination of Pollutants	Separate printing, cooking, vehicle exhaust.	1	1
Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.1	Internal Noise Levels	Appropriate Noise levels (outside and building systems), no more than 5dB above satisfactory in AS2107:2016 (10dB for nat vent buildings).	1	1
		10.2	Reverberation	Recommended reverberation times in table 1 of AS/NZS 2107:2016 are met.	1	1
		10.3	Acoustic Separation	Acoustic Separation requirements.	N/A	0
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	High frequency ballasts or LED, and minimum colour rendering index of 80 for all light fittings.	-	Complies
		11.1	General Illuminance and Glare Reduction	Two requirements for 1 point: - General lighting levels to meet maintained illuminance and uniformity requirements in AS1680 series (modelling representative areas or measurements, uses area weighted average, not points). - Glare from lamps to be reduced through either: >> all lamps having diffusers, baffles etc; >> Lighting system compliant with luminaire selection system in section 8.3.4 of AS1680.1-2006; OR >> Unified Glare Rating on a representative floor less than Table 8.2 of AS1680.1-2006	1	1
		11.2	Surface Illuminance	Combination of lighting and surfaces to be uniform to give visual interest through either: - Surface reflectance of ceilings to be at least 0.75; and an average surface illuminance of at least 30% of the lighting levels on the working plane. - Modelling is done to show: >> Average ceiling luminance is less than 0.5 kcd/m2; >> Ceiling area has an average surface illuminance of at least 30% of the lighting levels on the working plane; and	1	1
		11.3	Localised Lighting Control	Each occupant able to control lighting levels in their immediate environment.	1	1
Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	No direct sunlight penetration (blinds or modelling).	-	Complies
		12.1	Daylight	40% or 60% area has daylight for 80% nominated hours, DF 2.0%.	2	1
		12.2	Views	60% access to external view.	1	1
Indoor Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1	Paints, Adhesives, Sealants and Carpets	95% of Paints, Adhesives, Sealants, Carpets to be low VOC.	1	1
		13.2	Engineered Wood Products	95% of engineered wood to be low Formaldehyde, or no new engineered wood is installed.	1	1
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	80% occupant satisfied - ASHRAE 55 80% acceptability rate, +- 1 PMV.	1	1
		14.2	Advanced Thermal Comfort	90% occupant satisfied - ASHRAE 55 90% acceptability, +-0.5PMV.	1	1
Total					**16**	**14**

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CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	COMPLIANCE REQUIREMENTS	AVAILABLE	TARGET
Energy						
Greenhouse Gas Emissions	E. Modelled Performance Pathway	15E	Conditional Requirement: Reference Building Pathway	- NCC Classes 2 to 9 - Proposed building must be at least 10% improvement on reference building, which complies with minimum NCC Section J DTS provisions 5 Star project must achieve at least 3 points. 6 Star projects must achieve at least 6 points.	-	Complies
		15E	Comparison to a Reference Building Pathway	- Up to 4 points for improvement on building fabric against the GBCA reference building. - Up to 16 points for GHG emissions reductions against the GBCA reference building.	20	5
Peak Electricity Demand Reduction	Prescriptive Pathway	16A	Prescriptive Pathway - On-site Energy Generation	On site generation reduces peak electricity demand by 15%.	1	0
Total					**62**	**5**

Transport						
Sustainable Transport	Prescriptive Pathway	17B.1	Access by Public Transport	Public transport calculator determines points based on number of people that can access the site within a 45 minute period during peak hour.	3	2
		17B.2	Reduced Car Parking Provision	Points are awarded based on the number of cars per peak occupancy, taking into consideration the public transport accessibility of the site. Where there is low or no public transport available, more car parks are permitted.	1	0
		17B.3	Low Emission Vehicle Infrastructure	Point awarded for one of the following: - 15% of car parks are dedicated for fuel efficient vehicles (small cars, hybrids, motorbikes[max 5%]). - 5% of car parks are for electric vehicles and include charging stations. - Car share spaces and vehicles are provided at a rate of 1 per 70 occupants.	1	1
		17B.4	Active Transport Facilities	Bike parks and associated facilities are to be provided at the rates in the submission guidelines, depends on building size.	1	1
		17B.5	Walkable Neighbourhoods	Either: - 4 (NCC Class 7) or 8 (all others) amenities are within 400m of the development; OR - Site achieves a Walk Score of at least 70 (NCC Class 7) or 80 (all others).	1	1
Total					**7**	**5**

Water						
Potable Water	Performance Pathway	18A	Potable Water - Performance Pathway	Points awarded for reduction in water use, includes fixtures, appliances, HVAC, irrigation and swimming pools	12	5
Total					**12**	**5**

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CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	COMPLIANCE REQUIREMENTS	AVAILABLE	TARGET
Materials						
Life Cycle Impacts	Performance Pathway - Life Cycle Assessment	19A	Comparative Life Cycle Assessment	- Cradle to grave life cycle assessment to be carried out by a competent LCA practitioner and peer reviewed by second independent LCA practitioner - Points awarded based on the cumulative % impact reduction of the building vs a reference building, when considered across 6 impact categories: Climate change, Stratospheric ozone depletion, land and water acidification, eutrophication (algal blooms) and Mineral/fossil fuel depletion. Up to 6 points available, capped at 3 points for operational energy reduction impacts.	7	2
		19A	Additional Reporting	Where the LCA is used to inform the building's design process or as built outcome (1 point): - Additional life cycle impact reporting		1
		19A	Additional Reporting	Where the LCA is used to inform the building's design process or as built outcome (1 point): - Material selection improvement;		1
		19A	Additional Reporting	Where the LCA is used to inform the building's design process or as built outcome (1 point): - Construction process improvement		1
		19A	Additional Reporting	Where the LCA is used to inform the building's design process or as built outcome (1 point): - LCA Design Review.		1
Responsible Building Materials	To reward projects that include materials that are responsibly sourced or have a sustainable supply chain.	20.1	Structural and Reinforcing Steel	- If building is steel framed, point is awarded where 60% of the structural steel is supplied by an Australian Steel Institute (ASI) Environmental sustainability accredited contractor/fabricator. - If building is concrete framed, point is awarded where 60% of the reinforcing bar and mesh is sourced from a manufacturer which uses an energy reducing process (max 40 MJ/tonne annual average).	1	1
		20.2	Timber Products	95% of timber either reused or certified (AFS or FSC).	1	1
		20.3	Permanent Formwork, Pipes, Flooring, Blinds and Cables	90% (cost) of all permanent formwork, cables, pipes, floor and blinds either: - Contain no PVC and have a environmental product declaration; OR - Meet the GBCA best practice guidelines for PVC. Note products containing recycled PVC must comply with the best practice guidelines to be included.	1	1
Sustainable Products	To encourage sustainability and transparency in product specification.	21	Product Transparency and Sustainability	Points awarded for products not addressed in Mat-19 or Mat-20 which meet one or more of the following criteria: - Reused; - Recycled content; - Environmental Product Declaration publically available - Third party certified - Stewardship program (return to manufacturer at end of life) Applies to furniture, partitions, assemblies, joinery, flooring, wall coverings, ceilings, cladding, masonry, glazing, timber, steel, concrete.	3	1
Construction and Demolition Waste	Percentage Benchmark	22B	Percentage Benchmark	1 point is awarded where project teams can demonstrate that 90% of the waste generated during construction and demolition has been diverted from landfill.	1	1
Total					**14**	**11**

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CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	COMPLIANCE REQUIREMENTS	AVAILABLE	TARGET
Land Use & Ecology						
Ecological Value	To reward projects that improve the ecological value of their site.	23.0	Endangered, Threatened or Vulnerable Species	Conditional - Demonstrate that no species or ecological communities were present on site which have the status: critically endangered, endangered or vulnerable.	-	Complies
		23.1	Ecological Value	Points awarded for improving the site ecology (by site area) e.g. replacing hardscape with native vegetation. Uses GBCA calculator	3	0
Sustainable Sites	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate contaminate land.	24.0	Conditional Requirement	Site at purchase must not contain: - Old growth forest; - Prime agricultural land - Wetland of high importance (unless wetland protection measures in place); OR - Matters of national significance as per Environmental Protection and Biodiversity Conservation Act (1999).	-	Complies
		24.1	Reuse of Land	75% of site previously built on.	1	1
		24.2	Contamination and Hazardous Materials	Either: - Site is contaminated and a best practice remediation strategy is established; OR - Existing building hazardous materials survey is carried out and if asbestos, PCBs or lead are found they are removed and disposed of in accordance with best practice guidelines.	1	0
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the project site to the heat island effect.	25.0	Heat Island Effect Reduction	75% of site area has building or landscape that reduce the heat island effect e.g.: - Vegetation; - Green roof; - High Surface Reflectance Index (SRI) roof or hardscape; - Hardscape shaded by vegetation; - Water bodies; or - PV.	1	0
Total					**6**	**1**

Emissions						
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer infrastructure.	26.1	Reduced Peak Discharge	Post development peak discharge not to exceed pre-development peak discharge based on the Average Recurrence Interval.	1	1
		26.2	Reduced Pollution Targets	Discharge meets pollution reduction targets in column A of GBCA table	1	1
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies	Credit conditional - Site must comply with AS4282 Control of the Obtrusive Effects of Outdoor Lighting	-	Complies
		27.1	Light Pollution to Night Sky	Either: - No external luminaire to have an upward light output ratio above 5%; OR - Direct illuminance no greater than 0.5Lux at site boundary and 0.1 Lux beyond highest point of building into night sky.	1	1
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.0	Legionella Impacts from Cooling Systems	Either: - Building is naturally ventilated; - Heat rejection is waterless; OR - Heat rejection is water based but includes measures for Legionella control (System meets AS/NSZ 3666.1:2011, no water stagnation, water never between 20 and 50degC while still, no aerosol spray).	1	0
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.0	Refrigerants Impacts	1 point is awarded where one of the following criteria is achieved: - The combined Total System Direct Environmental Impact (TSDEI) of the refrigerant systems in the building is less than 15; or - The combined TSDEI of the refrigerant systems is between 15 and 35, AND a leak detection system (with automated refrigerant recovery is in place); or - All refrigerants in the project have an ozone depletion potential of zero, and a global warming potential of 10 or less; or - Where there are no refrigerants employed by nominated building systems, this point is awarded.	1	0
Total					**5**	**3**

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Innovation						
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or in the world.	30B	Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or in the world.	1	1
					1	1
					1	1
Innovation Challenge	Where the project addresses an sustainability issue not included within any of the Credits in the existing Green Star rating tools.	30D.1	High Performance Site Offices	To improve the sustainability performance of site offices thus increasing health and productivity outcomes of site workers.	1	1
		30D.2	Financial Tranparency	To increase the amount of information available to industry on the costs and benefits of sustainable building.	1	1
		30D.12	Occupant Engagement	To increase the availability of information on the benefits and outcomes of sustainable design practices and sustainable operation practices across the industry.	1	1
		30D.13	Reconciliation Action Plan	To encourage organisations to take formalised steps to provide opportunities for Aboriginal and Torres Strait Islander peoples.	1	1
Global Sustainability	Project teams may adopt an approved credit from a Global Green Building Rating tool that addresses a sustainability issue that is currently outside the scope of this Green Star rating tools.	30E.2	Green Cleaning	From Green Star Performance tool – implement a Green Cleaning policy.	1	1
		30E.3	Procurement & purchasing	From Green Star Performance tool	1	1
		30E.4	Groundskeeping practices	From Green Star Performance tool	1	1
Total					**10**	**10**