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Ecologically Sustainable Design Report

1005965 The Ribbon, 31 Wheat Road

Prepared for:

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Draft	Draft for Comments	30/05/2012
B	Updated project description	07/06/2012
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D	Updated address	18/12/2012
E	Revised DA Submission	19/07/2013
F	Final report for DA submission	26/07/2013
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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.

Contents

Executive Summary

This report outlines the key Ecologically Sustainable Design (ESD) initiatives for the proposed mixed commercial and retail development, 31 Wheat Road, Darling Harbour, NSW.

In the early stages of the project design, a series of sustainability workshops were held in order for the project team to set a vision for the project that met the objectives of the owner, design team and prospective tenant. During concept design development, each design option was 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.

The development is being designed to exceed minimum requirements in terms of Ecologically Sustainable Design (ESD), and is targeting the following green building ratings:

- 6 star Green Star - Office Design (v3) rating;
- 6 star Green Star –Office As-Built (v3) rating; and
- 5 star NABERS Energy base building rating.

The Green Star rating scheme awards an environmental performance rating based on a range of environmental indicators, including management, indoor environmental quality, energy, transport, water, ecology, materials and emissions to land, water and air. Key strategies that have been adopted cover a broad range of environmental performance criteria, including:

- Energy conservation including high efficiency hybrid displacement air-conditioning, low energy lighting design and sophisticated building controls;
- An innovative closed-cavity facade system with automated internal blind for solar control, which rejects excess heat gains, provides good daylight with minimal glare, and has a carbon footprint significantly lower than other design options incorporating a large number of fixed external shading elements;
- Mains potable water conservation is ensured through high-efficiency fittings and fixtures, hybrid cooling towers which drastically reduce the water consumption, and rainwater capture and storage for reuse;
- Provision of a high quality indoor environmental quality for occupants, a thermally comfortable environment with good air quality and low levels of indoor pollutants;
- Environmentally responsibly material selection and diversion of waste from landfill during construction and operation;
- Low-emissions transport alternatives will help reduce private car use;
- Investigation of the potential for on-site, low-carbon energy generation such as tri-generation, photovoltaics or an alternative technology.

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

1 Introduction

This report outlines the key Ecologically Sustainable Design (ESD) initiatives for the proposed development, The Ribbon, at 31 Wheat Road, Sydney, which is committed to a high level of environmental performance. The scope and systems described within this report cater for these performance requirements, and will be further developed through the detailed design stage.

The development is being designed to exceed minimum requirements in terms of Ecologically Sustainable Design (ESD), and is targeting the following green building ratings:

- 6 star Green Star - Office Design (v3) rating;
- 6 star Green Star –Office As-Built (v3) rating; and
- 5 star NABERS Energy base building rating.

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, shops and restaurants. Commercial buildings are responsible for approximately 10 per cent of Australia's greenhouse gas emissions and those emissions have grown by 87 per cent between 1990 and 2006.

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 consists of an underfloor air distribution (UFAD).

The UFAD system provides a higher indoor environment quality (IEQ) to the occupants as the air is supplied through the floor void to swirl diffusers at low velocities to cause minimal induction and mixing. The intent of the air distribution is for the supply air to flow smoothly across the floor, until it reaches a heat source (such as people, lighting, computers, electrical equipment, etc.) whereby by the air temperature increases so does its buoyancy. The rising air stream entrains air contaminants and heat from the occupied zone to the exhaust grilles at high level. Only the occupied zone is air conditioned with the temperature of regions above it allowed to drift. The UFAD will give individuals control over their environment where they can manually adjust air flows to suit their requirements.

The system is to be split into a floor by floor solution with 2 air handling units situated on each level. By incorporating this design it allows specific control and operation on a floor by floor basis, thereby reducing energy consumption in partial operation. Also potential contaminants are restricted to a floor rather than mixed throughout the building.

To further improve the IEQ, higher than normal rates of outside air will be provided within the building, with a target of 200% improvement above AS1668 minimum ventilation rates.

Each air handling unit shall be provided with chilled and hot water from a central system. The chiller plant room is to be located on lower ground level, and the central hot water and heat rejection plant to be located at roof level.

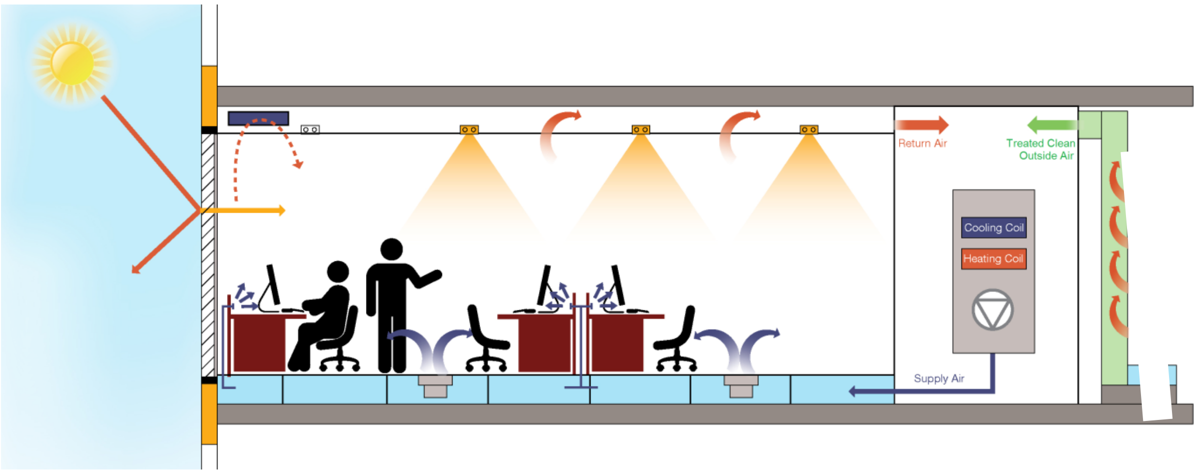


Figure 1: Floor by floor air handling system suppling UFAD

2.1.2 Lighting Systems

The lighting systems will provide adequate illumination to allow building users to function whilst minimising the energy consumption. The buildings commercial areas and car parks will be lit by high efficiency T5 fluorescent lamps whilst all back of house spaces will be lit by LED luminaires. In association with the efficient lighting sophisticated controls will be installed to ensure that minimal energy is wasted, these controls may included:

- Time clocks with occupancy sensors to commercial building areas;
- Daylight sensors to all perimeter lighting spaces;
- Small lighting zones to ensure that the controls benefits are maximised;
- Occupancy sensors which default to off for all back of house spaces; and
- Occupancy zoning functions to car park lighting.

2.1.3 Vertical Transportation

Vertical transportation within the building will 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 will 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 back of house areas).

2.1.5 Retail Integration

The retail and cinema components of the development may be integrated into the base building systems. The use of the larger commercial systems will ensure that the efficiency of the building always remains high and can capitalise on the centralised services and systems.

2.1.6 Low Carbon Energy Systems

The development will be implementing a low carbon energy generation to reduce the developments carbon emissions. In each case the development will also aim to provide the low carbon energy to the tenant of the building to aid the overall carbon impact. As new technologies are being developed continuously it is not possible to commit to a single technology at this stage, however the development will be implementing a low carbon generation system. The main systems to be investigated for a full life cycle review and cost analysis to determine the most appropriate solution are detailed below.

Trigeneration/Fuels Cells

A trigeneration system utilises low carbon intensity natural gas burnt in an engine. The engine will produce electricity and waste heat. The waste heat is utilised to heat water for domestic water heating or HVAC heating purposes or can be used as energy input into an absorption chiller to create chilled water for the air conditioning system.

As an alternative to a gas engine the potential to install a fuel cell will be investigated. A fuel cell provides a similar function to the gas engine however as a chemical process drives the system the efficiencies can be higher and the emissions of the system lower. The localised emissions of gas fired engines will become significant in the near future.

It is expected that the trigeneration or fuel cell system will reduce the operational carbon emissions of the development by 30% to 50%. In order to maximise the potential of the system, smaller modular units are likely to allow for operation independent of the total building thermal or electrical load.

An example of a tri-generation system is shown below outlining the key components, the cogeneration unit which converts gas into electricity and heat, the absorption chiller converting the heat into chilled water and the domestic hot water unit.

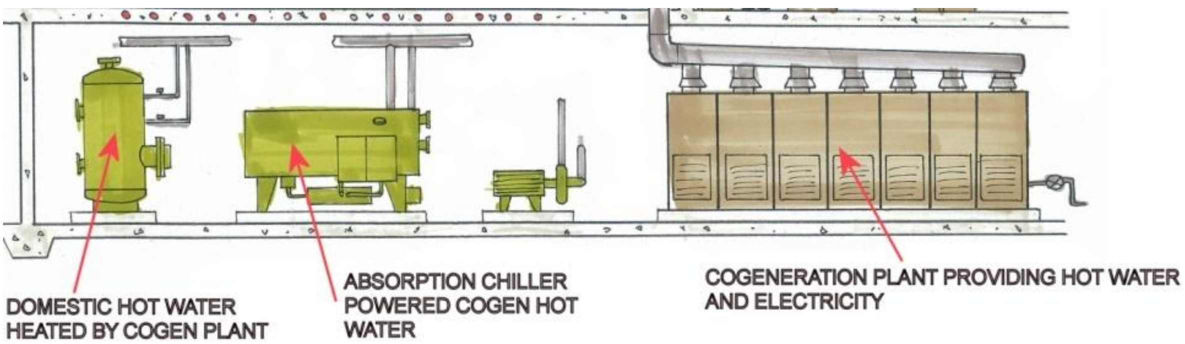


Figure 2: Trigeneration system example showing electricity, hot water and cold water generation

On-site Solar

A façade integrated and roof mounted photovoltaic (PV), solar electric, system will be investigated. Due to the large amount of façade and roof space available the system has the potential to deliver significant energy to the building and tenants. The PV system has the added benefit of providing the largest amounts of energy when the building requires the most energy, during the day and during the summer months.

The potential to integrate the PV system into the building will be explored to allow for the reduction in building materials used.

An example of the potential energy generation of a roof mounted PV system is shown below, this equates to more than 20% of the building electrical requirements.

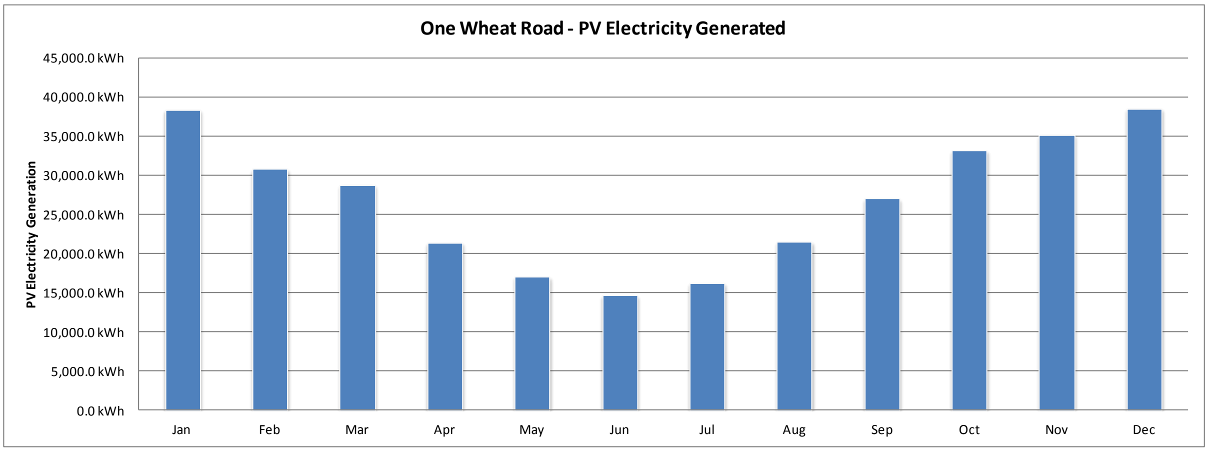


Figure 3: Potential energy generation of a roof mounted PV system

Off-site Solar and Wind

An alternative to installing the low carbon energy systems on the site the option for investing the capital in an off-site solar energy or wind power station will be examined. Due to the scales of economy involved it may be possible to provide far greater amounts of renewable energy to the building and much better rates, providing enhanced sustainability for the building and the tenant.

Figure 4: Offsite photovoltaic and wind energy plant

2.1.7 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.

In addition the commercial and retail section of the building will be individually monitored to ensure all future sustainability rating tools can be applied.

2.2 Predicted Energy Consumption and Greenhouse Gas Emissions

A preliminary building energy consumption simulation has been carried out for the development, with a focus on the commercial area office space. The following chart provides details of the predicted energy consumption breakdown by end use.

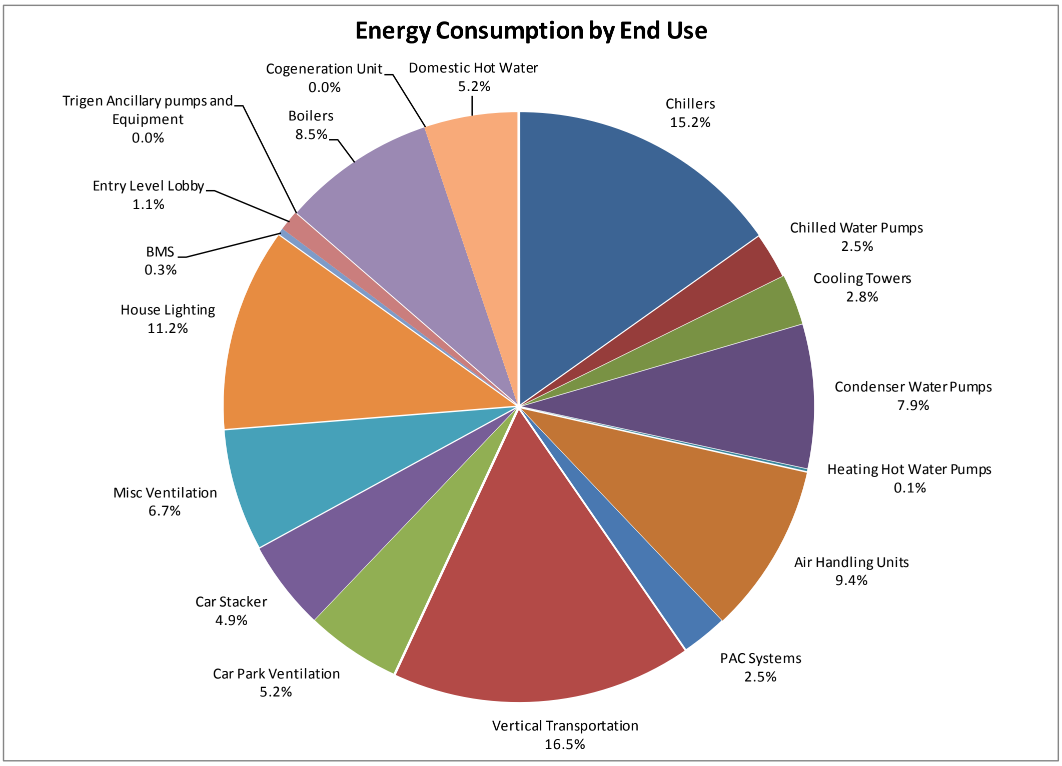


Figure 5: Energy consumption breakdown by end use

Additionally the following chart details the expected greenhouse gas emissions (based on current NSW scope 1 and 2 emissions) with and without the inclusion of low carbon energy generation systems. Where the roof mounted PV system and off-site renewable energy systems are shown the contribution has been blurred to reflect the current impact of the system at this early stage of design.

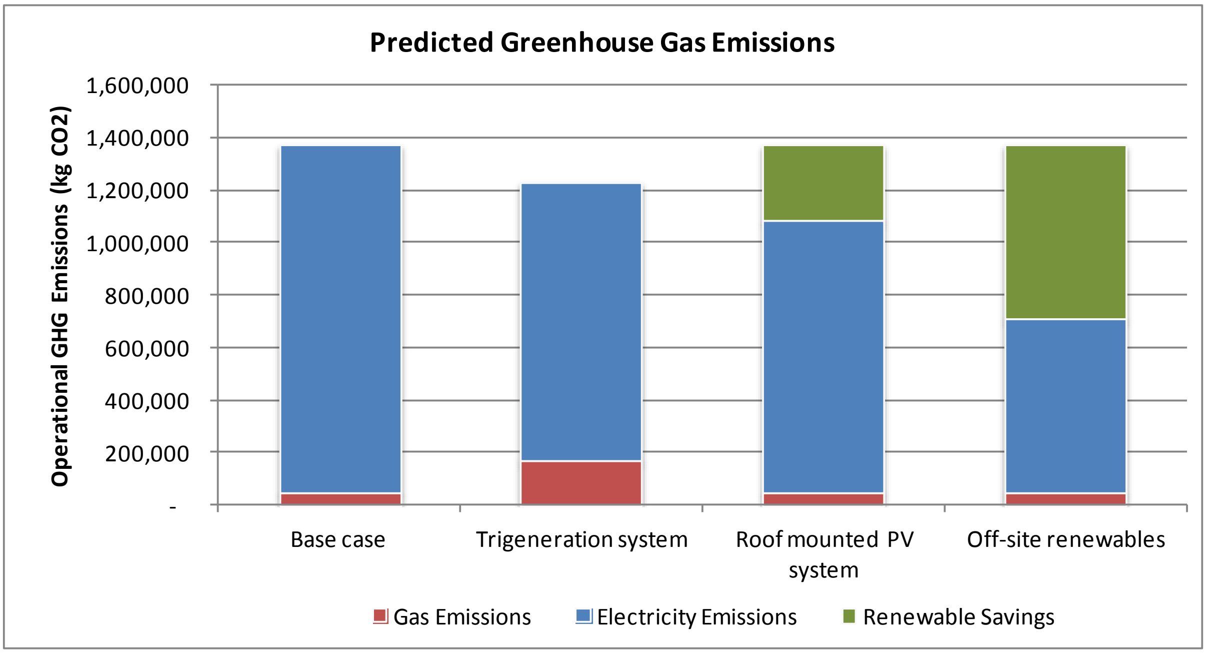


Figure 6: Predicted greenhouse gas emissions

2.3 Potable Water Reduction Strategies

Potable water use in commercial and retail buildings accounts for approximately 35% of all water used in Sydney's businesses. 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 both clients and staff. 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.

2.3.1 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.

2.3.2 Air Conditioning Systems

Air-conditioning systems and associated plant can be very water intensive. Typically the heat rejection plant is water based to improve the energy efficiency of the system; however this consumes significant amounts of water. An alternative to water based heat rejection is an air based system, which does not requiring water during its operation, however consumes significantly more energy. The likely compromise is to be a hybrid (adiabatic) cooling tower which alternates between water and air sourced heat rejection depending on the ambient conditions.

2.3.3 Rainwater Harvesting

Due to complications with ground works on the site it will not be commercially possible to provide in ground rain water storage.

2.3.4 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 harvested to a storage tank in the basement. This could be a sectional water tank in combination with the rain water storage system. The test and drain down water is to be treated and re-used within the development for non-potable water services.

2.3.5 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.

2.4 Predicted Water Consumption

A preliminary water balance has been carried out for the development. The commercial office and retail areas have been calculated separately. The following charts provide details of the predicted water consumption.

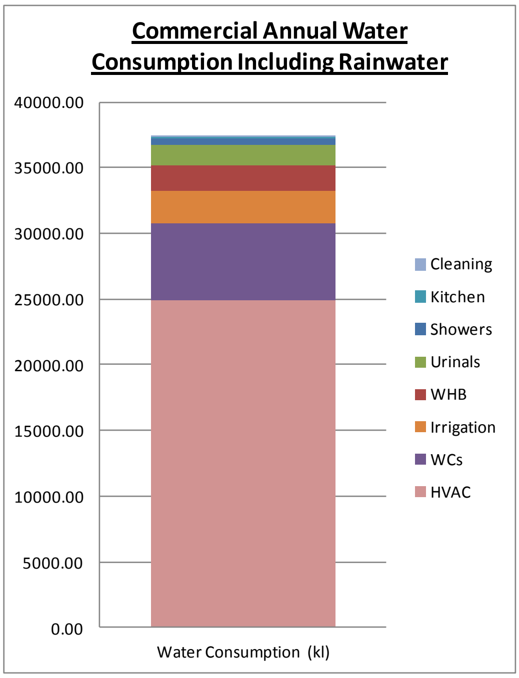


Figure 7 – Commercial water consumption

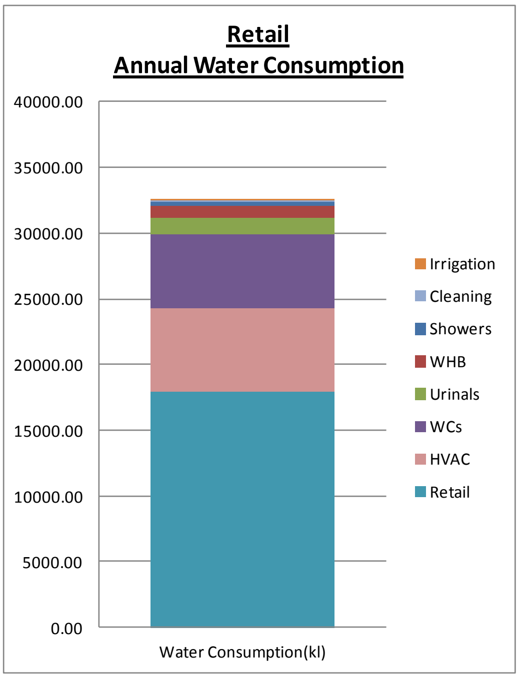
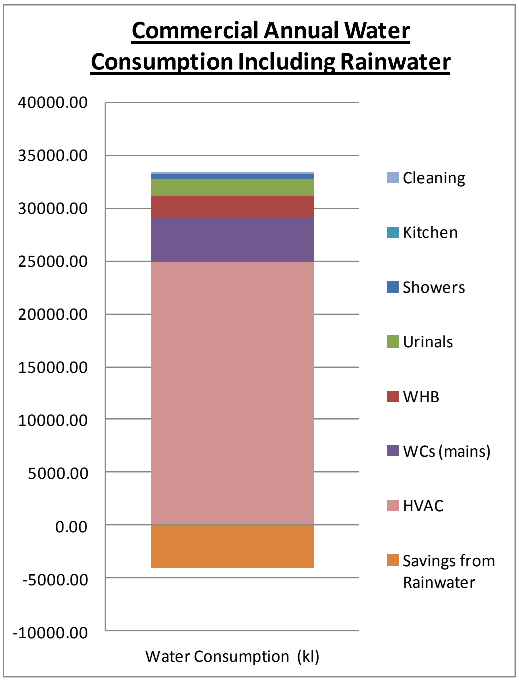


Figure 8 – Retail water consumption

The charts above show the predicted water consumption based on anticipated occupancy levels and operational profiles. The largest water consumer within the commercial office space is cooling tower water, which accounts for approximately 70% of the total consumption. It is expected that the retail component of the development will consist mainly of restaurant and bar facilities. The chart shows that this is the highest consumer in this part of the development, with a consumption of around 60% of the total.

The chart opposite shows the impact of collected rainwater on the total consumption of the commercial office space.



2.5 Building Materials Resource Minimisation

2.5.1 Sustainable Building Products

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

- Ecologically sensitive products, such as scarce minerals and old-growth forest, will be avoided;
- Preference will be given to materials with a high recycled content and preferred source, including:
  - Where timber is used, it will 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 will be replaced with fly ash or other industrial waste products, and recycled aggregate will be used.
  - Wherever feasible, PVC and steel will be sourced from sources capable of achieving the Green Star applicable credits.

2.5.2 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 will 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 epoxy or sealed vinyl finishes over vitrified and tiled surfaces;
  - 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.

2.5.3 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.

2.5.4 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.

Where alternative materials are available at comparable quality, performance and cost, the following materials should be avoided in construction:

- Asbestos;
- Cadmium;

- Chlorinated Polyethylene and Chlorosulfonated Polyethlene;
- Chlorofluorocarbons (CFCs);
- Chloroprene (Neoprene);
- Formaldehyde (added);
- Halogenated Flame Retardants;
- Hydrochlorofluorocarbons (HCFCs);
- Lead (added);
- Mercury;
- Petrochemical Fertilizers and Pesticides;
- Phthalates;
- Polyvinyl Chloride (PVC) and
- Wood treatments containing Creosote, Arsenic or Pentachlorophenol.

2.5.5 Ozone Depleting Materials

Thermal insulation products which have a zero ozone depletion potential in their manufacture and composition will be preferred; this will reduce the impacts of insulation on the atmosphere.

Air conditioning refrigerants will be selected to have an ozone depletion potential of zero. Additionally the implementation of integrated refrigerant leak detection will be investigated to allow for early identification of leaks to avoid refrigerants leaking into the atmosphere.

2.5.6 Materials Sources

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

2.5.7 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:

- Glass
- Paper
- Plastics
- Cardboard
- Organics; and
- Metals.

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 approximately 2,400 office works and up to 1,000 visitors to the retail spaces 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 base building 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 50% of the NLA.

External shading and/or automated internal blinds should be provided to eliminate direct glare to each workstation. The following diagrams detail the expected levels of day light for a typical floor plan.

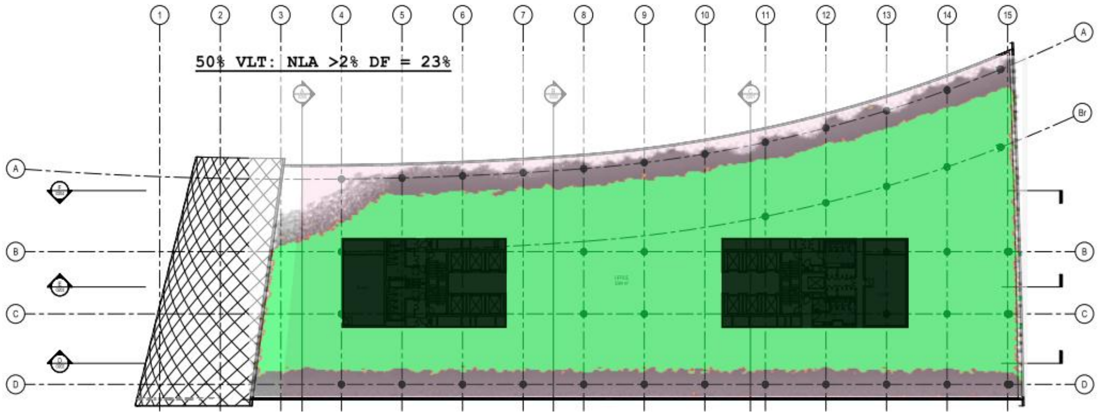


Figure 9: Level 7 daylight factors showing large areas with good daylight (based on 50% VLT)

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 building in a city 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 well being.

Calculations were completed for two of the office levels to determine the percentage of NLA that has access to external views. As prescribed by the Green Building Council of Australia (GBCA), the view must be uninterrupted for eight meters from the perimeter of the building to achieve compliance. Approximately 60% of the NLA has been determined to achieve external views, most of the working environment. The aim of these calculations is to work with the tenants to allow 100% of workstations to be located with the zones of external views.

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.
- Naturally ventilated pods provide a connection to outdoor conditions.

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. Mold 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.
- Incorporating naturally ventilated or mixed-mode “pods” or spaces into the design would be a way of providing users with the opportunity for natural ventilation when conditions are suitable, without adversely affecting the entire floor.
- Delivering the supply air via the workstation (e.g. UCI Task Air) will be a potential option for the tenant to allow for user control. This can be combined with underfloor displacement ventilation.
- High performance filters will need to be installed to filter outside air.
- Include a CO2 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 BCA Section J for Energy Efficiency. BCA 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 SHFA Green Building Guidelines

Where relevant and commercially viable the sustainability principles of the Sydney Harbour Foreshore Authority "Sustainable Development Fitout Guide" and the "Green Building User Guide" will be incorporated into the development.

4.3 NABERS Energy and Water

The National Australian Building Environmental Rating Scheme (NABERS) is a suite of tools designed to allow for buildings of a similar type to be rated in terms of its operational sustainability. The NABERS suite includes energy, water, waste and indoor environment quality.

The NABERS Energy tool is a rating of the performance levels of a building in relation to CO_2 emissions per m^2 per year. Emission are normalised for Net Lettable Area, occupancy hours and location, and then used to calculate a star rating. Six stars is currently the highest available rating, and represents exceptional building energy performance.

The NABERS Water tool is a rating of the performance levels of a building in relation to total potable water consumption per year. Emission are normalised for Net Lettable Area, occupancy hours and location, and then used to calculate a star rating. Six stars is currently the highest available rating, and represents exceptional building energy performance.

What do the star ratings mean?

- **6 stars - Market leading performance -** You have achieved the highest possible rating. Your rating indicates you have combined superior equipment selection, operation and management to demonstrate your commitment to energy/water conservation.
- **5 stars - Excellent performance -** This rating represents outstanding performance in the current market and ranks the building in approximately the top 20%. Your building demonstrates strong performance, reflecting good equipment and management practices.
- **4 Stars - Above average performance -** This rating represents above average performance. Your building probably has some energy/water efficient equipment and management practices and reflects an awareness of the importance of conserving water. Some improvements may still be possible.
- **2.5 – 3 Stars - Average performance -** This rating represents average building performance. Your building possibly has some elements of energy/water efficiency in place. There is still scope for significant improvement, and changes will have a notable impact on this building's energy/water use.
- **2 Stars - Below average performance -** This rating represents below average building performance. Your building is unnecessarily wasting energy/water. Changes to water efficiency will have a significant impact on water usage.
- **1 Star - Poor performance -** This is a poor rating, indicative of poor energy/water management and/or outdated equipment. Your building is using a lot of unnecessary energy/water. There are changes that can be implemented to reduce energy/water consumption, reduce operating costs and reduce the burden on resources.
- **0 Stars - Very poor performance -** Your building has poor energy/water efficiency and lies outside the rating scale. It is very likely that energy/water is being wasted and there will be a range of simple improvements that could bring your water use within the rating scale. This will reduce your operating costs and reduce the burden on resources.

4.3.1 NABERS Energy Results

The energy simulation will be performed using NABERS profiles in accordance with "NABERS Energy Guide to Building Energy Estimation" and includes energy consumption attributed to the commercial space and the associated areas including car park and back of house areas.

Based on the size, location, expected operation and predicted energy consumption of the building including a trigeneration system the expected NABERS Energy base building rating is 5.0 stars. A 5.0 star performance is equivalent to market leading performance in the Australian market. Further analysis will be performed on the HVAC and trigeneration system design to reduce the installed plant capacity and further improve associated energy consumption.

4.3.2 NABERS Water Results

Based on the predicted water consumption of the commercial areas of the building and the associated rainwater and reuse the expected NABERS Water rating is 3.0 stars. A 3 star performance is equivalent to average in the Australian market. A higher NABERS Water rating would be possible however a preference for lower energy consumption and quality indoor environment has been included. Further analysis will be performed on the water consuming systems to further reduce the potable water demand.

4.4 Green Star

The proposed development is committed to achieving a 6 star Green Star v3 rating for both design and delivery, which is considered 'World Leadership'.

Green Star is a comprehensive sustainability design tool which assesses the environmental impact of a building over a range of environmental indicators, from management and ecology to energy and water use, material selection and waste production. Categories are weighted according to their perceived environmental importance, which varies between building sectors and across States.

Points are awarded in the following categories:

- Management
- Indoor Environmental Quality
- Energy Conservation
- Transport
- Water Conservation
- Ecology
- Materials
- Emissions
- Innovation

A 6 star Green Star rating requires a total of 75 weighted credit points to be achieved in the aforementioned categories. Sufficient weighted credits have been selected to achieve this rating, with additional points identified for further development during the detailed design stage. Based on the proposed design response the predicted performance in each respective environmental category is graphically depicted in the figure overleaf.

Figure 10: Green Star total points targeted

Throughout the project, appropriate documentation will be collected to demonstrate that the chosen sustainability initiatives are incorporated into the design and delivery of the building.

A Green Star design submission can typically be produced after 90% detailed design documentation, at which point sufficient detail will be available. The As-Built submission must be made after Practical Completion, and the NABERS Energy rating assessed 12 months post-occupancy.