



Taronga Wildlife Hospital, Sydney - Nutrition Centre

30/11/2021

Environmentally Sustainable Design Strategy

Prepared for

Taronga Conservation Society Australia

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1 Introduction

This Report has been prepared by LCI for the Taronga Conservation Society Australia (Taronga). This Report provides an overview of the Ecological Sustainable Design (ESD) initiatives considered for The Wildlife Hospital (TWH), Sydney, Nutrition Centre (NC), and to address the Requirement 7 (Ecologically Sustainable Development (ESD) and Climate Change) of the Secretary's Environmental Assessment Requirements (SEARs). The project will be delivered in two stages, consisting of the Nutrition Centre (Stage 1) and Wildlife Hospital (Stage 2). This report focuses on the ESD initiatives proposed for the Nutrition Centre. This report will be included within the Environmental Impact Statement (EIS) that will accompany a State Significant Development Application (SSDA).

Taronga is proposing to construct a new Wildlife Hospital and Nutrition Centre to enable Taronga to respond to an emerging wildlife crisis and provide new educational wildlife experiences to Taronga Zoo's guests and students. This centre will replace existing facilities.



Figure 1: Regional Context (source: Urbis)

2 Site Description

Taronga Zoo is located at Bradleys Head Road, Mosman and is situated in the Mosman Local Government area (LGA). The site is bounded by Bradleys Head Road to the east, Athol Wharf Road and Sydney Harbour to the south, Little Sirius Cove to the west and Whiting Beach Road to the north. Taronga Zoo is legally described as Lot 22 on DP843294 and is Crown Land managed by Taronga (the Zoological Park Board).



3 Overview of Proposed Development

The proposed works will increase the capacity of Taronga to save endangered animals through wildlife rescue with a particular focus on marine turtles and species impacted by natural disasters such as bushfires. Overall, the new facilities will provide support to the 5,600 volunteer wildlife carers in NSW and cement Taronga as global leaders in animal welfare, rehabilitation and conservation.

The Taronga Wildlife Hospital, Sydney will be delivered in 2 stages, reflecting the 2 key components of the project.

- **Stage 1:** the Taronga Wildlife Hospital, Sydney – Nutrition Centre is located back of house and will replace several standalone buildings currently providing animal food preparation and storage.
- **Stage 2:** will incorporate the main wildlife treatment, teaching and rehabilitation spaces. The facility will be linked to the Stage 1 Nutrition Centre via a tunnel and will be located on the footprint of the existing Serpentaria exhibit following the construction of a new Reptile & Amphibian Conservation Centre (currently under SSDA Assessment). Stage 2 – Hospital will be delivered under a separate State Significant Development Application (SSDA).

Stage 1 – Nutrition Centre incorporates the following:

- New animal food and meat preparation facilities to serve the Taronga site
- Open plan offices and meeting spaces to serve the Nutrition Centre and Stage 2 Hospital
- New tunnel under the back of house service road to link to the Stage 2 Hospital

The Nutrition Centre which will provide storage and preparation of food for Zoo animals, as well as areas for research and development for nutrition. This area will generally not be accessible to Zoo visitors but will continue to provide back of house facilities with improved connections to the Wildlife Hospital and other key areas of the Zoo. The new facilities will integrate with Taronga Zoo’s guest circulation and existing facilities within the Zoo to create a new visitor experience which provides a range of interactive education spaces, including back of house tours and the display of wildlife care/veterinary activities in operation.



Figure 2: Concept Site Plan (source: Troppo)



4 Assessment Requirements and Project Responses

4.1 SEARs

The Department of Planning and Environment have issued Secretary’s Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the SEARs as follows:

SEAR 7 Ecologically Sustainable Development (ESD) and climate change	Report Reference
<p>Identify how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated into the design, construction and ongoing operation of the proposed development.</p>	<p>See Section 5.0 regarding Clause 7(4) of the Schedule 2.</p> <p>See Section 6.0 for the Sustainability strategies considered in the project.</p> <p>See Section 7.0 for Design for Resilience to Climate Change.</p>
<p>Demonstrate how future buildings will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.</p>	<p>See Section 5.3 for details regarding designing and constructing to achieve recognised building sustainability and environmental performance standards.</p> <p>See Section 6.0 for the Sustainability strategies considered in the project.</p>

5 SEAR 7 | Ecologically Sustainable Development (ESD) and Climate Change

5.1 Clause 7(4) of Schedule 2

The ESD principles that are to be incorporated into the proposed development must be aligned with Clause 7(4) – Schedule 2 – Environmental Planning & Assessment Regulation (2000).

5.1.1 The Precautionary Principle

The proposed Nutrition Centre will be constructed on a previously developed site, consisting of existing animal exhibits, supporting buildings and hardscaping. This will not have an adverse environmental impact and therefore alleviates concern of serious or irreversible environmental damage. Proactive measures to prevent environmental degradation have been included within the design, construction and operational phases of the proposed development. During the design and construction phases the main contractor will implement an Environmental Management System that follows NSW Environmental Management System Guidelines. Taronga has several ambitious sustainability targets that will drive efficient operation of the building, as well as and Environmental Protection Licence which ensures environmental risks are actively managed across the site.

5.1.2 Inter-Generational Equity

To uphold inter-generational equity, the proposed development minimises the consumption of energy and water resources while reducing waste.



The ESD principles incorporated into the proposed Nutrition Centre facilitates the conservation of energy and water resources through energy and water efficiency measures. Energy reduction has been considered in the design of the building, through passive and active measures. The reduction in water use has been considered through high WELS equivalent water fixtures and fittings, low water demand landscaping and use of non-potable water sources where appropriate.

Waste generated during the construction and operational phases will be diverted from landfill to be recycled. An Environmental Management System (EMS) will be utilised to throughout construction. Operational waste streams will be separated to maximise recycled waste in accordance with ongoing Taronga environmental management practices.

Reducing energy, water and waste ensures that the health, diversity and productivity of the environment is maintained for the benefit of future generations.

5.1.3 Conservation of Biological Diversity and Ecological Integrity

The project's ESD principles to reduce energy, water and waste consumption have an indirect impact to conserve biodiversity and ecological integrity to the surrounding area. By minimising demand on energy and water resources, the need for land-clearing and the pollution generated from new Nutrition Centre to support the surrounding area will be minimised.

5.1.4 Improved Valuation

The valuation of the project's assets and services consider environmental factors through the implementation of various ESD initiatives. An Environmental Management System will be adhered to during construction to ensure that contractors are responsible for costs associated with generating excessive pollution and waste. The project team will bear the extra cost of providing recycling and landfill waste streams during construction and operational phases. This creates a system where the polluter pays and creates an incentive to reduce pollution and waste.

The design of the project will be benchmarked against NCC, Taronga Environmentally Sustainable Design Checklist and Green Star rating which will provide environmental goals for the project. Project requirements stipulate design teams are contractually required to deliver targeted ESD initiatives for the project.

Furthermore, Taronga Conservation Society Australia has achieved Carbon Neutral Status under the Climate Active Certification and will continue to maintain this certification. The new Nutrition Centre will seek to firstly reduce carbon emissions through sustainable design followed by offsetting remaining operational emissions as part of their Climate Active Certification.



5.2 Sustainability at Taronga

Taronga’s sustainability commitment is to showcase best practice across their Zoos by embedding environmental sustainability into all aspects of the organisation. Taronga strives to lead in the areas of resource efficiency, emissions reduction, recycling, behaviour change, and socially and environmentally sustainable supply chains.

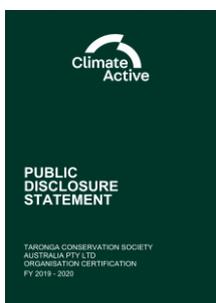
The following are several exemplary practices in Environmental Sustainability implemented at Taronga Zoo. These practices will be continued into the Nutrition Centre.



*Taronga Conservation
Annual Report 2019-2020*



*Taronga Conservation
Society Strategic Report
2019-2020*



*Taronga Conservation
Society Climate Active /
Carbon Neutral Certification*

Resource Efficiency

- Behaviour Change practices
- Socially and Environmentally Sustainable Supply Chains
- Water Conservation (Wastewater treatment and reuse)

Climate Mitigation

- Carbon Neutral in 2018 Taronga achieved Carbon Neutral status in December 2018 for both Taronga Zoo and Taronga Western Plains Zoo.
- Transition to renewable energy to power all operations.
- Resource Monitoring

Environmental Protection License

- Pollution prevention and monitoring, and cleaner production through recycling and reuse and the implementation of best practice
- Taronga construction environmental audit checklists for contractors

Diverting waste from Landfill

- 90% diversion from landfill (composting and litter prevention)
- Composting of food waste from public areas and kitchens, compostable packaging for use on Zoo pastures and gardens.
- Reuse of materials (End of Life Waste)

Sustainable Procurement

- Assessing social and environmental sustainability along the supply chain, including all business units, using a Sustainable and Ethical Supply Chain framework. Alignment of Taronga’s procurement processes and policies to ISO 20400 - Sustainable Procurement and meet the requirements of the Modern Slavery Act.
- Taronga is committed to sustainable purchasing and use of recycled materials, including purchasing 100% recycled paper for 95% of office paper supply at both Zoos.

Education

- Global conservation and education
- Showcasing Environmental Sustainability (evidence-based application and communication of science to the community)

Indigenous Reconciliation

- Reconciliation within their field; to respect, connect, consult and be led by the complex and vital knowledge(s) of First Nations Peoples
- Commitment to Country (Burbangana program)



5.3 Framework to Reflect Best Practice Sustainable Design Principles

5.3.1 Taronga Environmentally Sustainable Design Checklist

The Taronga has developed their Environmentally Sustainable Design Checklist to maximise sustainable design initiatives specific to Taronga's requirements and includes mandatory and commended measures related to the following categories.

- Water
- Energy Efficiency
- Passive Design
- Waste Management (Construction & Demolition) & Operational
- Materials
- Indoor Air Quality
- Other Considerations

The Environmentally Sustainable Design Checklist has been applied and considered in the design of the Nutrition Centre.

5.3.2 Green Star Design and As-built V1.3

The Nutrition Centre will target a 5 Star Green Star Certified Rating using the Design and As-built V1.3 rating tool in aligning with 'Australian Excellence' and targeting initiatives that exceed relevant sustainability performance standards, such as the National Construction Code 2019 Section J Energy Efficiency Provisions.

The Green Star Design and As-built rating system provides a framework to assess how a building reduces its impact on the environment while meeting the economic and social needs for its occupants and surrounding communities. Green Star's goal is to "lead the sustainable transformation of the built environment", by encouraging practices that:

- Reduce the impact of climate change.
- Enhance the health and quality of life of inhabitants and the sustainability of the built environment.
- Restore and protect the planet's biodiversity and ecosystems.
- Ensure the ongoing optimum operational performance of buildings.
- Contribute to market transformation and a sustainable economy.

The Green Star Design and As Built v1.3 rating system assessing buildings through the following categories:

- Management
- Indoor Environment Quality
- Energy
- Transport
- Water
- Materials & Construction Waste
- Land use and Ecology
- Emissions
- Innovation

Points are awarded for a building project's ability to secure as many credits as possible from each category. Each credit targets the environmental impact of a specific design feature. The total number of points awarded determines if the level of certification (star rating) as shown in 3.



Figure 3: Available Green Star Design & As Built Certification ratings

The Green Star Scorecard has been include in Appendix A for further information.

6 Sustainable Design Principles at the Wildlife Hospital, Sydney – Nutrition Centre

The following sustainable design principles have been proposed for the Nutrition Centre and can be addressed through the categories outlined within the Green Star Design and As Built v1.3 rating system. The following sections are structured as follows:

- 6.1 Management Practices
- 6.2 Indoor Environmental Quality
- 6.3 Energy Conservation
- 6.4 Transport
- 6.5 Water Conservation
- 6.6 Materials & Construction Waste
- 6.7 Sustainable Sites: Land use and Ecology, and Emissions

6.1 Management Practices

The following sustainable building design and construction management practices have been considered for the Nutrition Centre project. These strategies seek to implement process and practices to maximise sustainable design opportunities from project design through to construction and operation.

Sustainable Building Design and Construction Management Practices	Green Star Design & As-Built v1.3 Credit
Undertake Ecological Sustainable Design workshops to identify valuable and appropriate sustainable design initiatives for the project. Inclusion of building services design workshops and reviews with the Taronga Zoo facility management teams.	1.1 Accredited Professional 2.1 Services Maintainability Review
Establish environmental performance targets for energy and water conservation, and reporting and tracking of consumption. Inclusion of sub-metering and monitoring to facility tracking and monitoring of energy and water consumption.	2.0 Environmental Performance Targets 5.1 Environmental Building Performance



Sustainable Building Design and Construction Management Practices	Green Star Design & As-Built v1.3 Credit
	6.0 Metering and monitoring
Use durable and low maintenance materials which require very little energy to maintain over their life (such as painting, cleaning etc.)	5.2 End of Life Waste Performance
Implementation of building commissioning to ensure the building is operating efficiently as intended as per the established energy and water targets.	2.2 Building Commissioning
Building tuning practices during the first year of operation to rectify operation and efficiency issues from the building services.	2.3 Building Tuning
Inclusion of contractual requirements for the contractor to provide building information in the form of Operations and maintenance manuals, and the development of a building logbook for ongoing maintenance of the Nutrition Centre.	4.1 Building Operations & Maintenance Information
Contractual requirements for the head contractor to implement an Environmental Management Plan and management system in accordance with ISO14001 and adherence to Taronga's construction environmental audit checklists.	7.0 Responsible Construction Practices
Inclusion of adequate waste storage facilities to allow for waste separation, and collection to be further processed at the central waste storage facility.	8.0 Operational Waste

6.2 Indoor Environment Quality

The following Indoor Environment quality strategies have been considered to improve occupant comfort and wellbeing. The strategies seek to address visual comfort, thermal comfort, indoor air quality and acoustic comfort.

Indoor Environment Quality Strategies	Green Star Design & As-Built v1.3 Credit
Design and installation of mechanical services in line with best practice design to reduce pollutants from sources and dust/particulates during installation. Provision of increased outdoor air to appropriate spaces and exhaust of indoor pollutants / procurement of low emitting printers and photocopiers.	9.1 Ventilation System Attributes 9.3 Exhaust OR Elimination of Pollutants
Spaces designed in accordance with best practice noise levels.	10.1 Internal Noise Levels
High Colour Rendering Index for lighting, ballasts or drivers to reduce flicker in lighting and local occupant controls.	11.1 General Illuminance & Glare Reduction 11.3 Localised Lighting Control



Indoor Environment Quality Strategies	Green Star Design & As-Built v1.3 Credit
<p>External shading and internal blinds to assist with glare control. Views and daylight to existing tree canopies and/or the harbour through windows and façade openings.</p>	<p>12.0 Glare Reduction 12.1 Daylight 12.2 Views</p>
<p>Specification of low VOC paints, adhesives, sealants and carpets (where appropriate). Specification of low formaldehyde engineered wood products.</p>	<p>13.1 Paints, Adhesives, Sealants & Carpets 13.2 Engineered Wood Products</p>
<p>Design of building fabric to assist with improved thermal comfort, through appropriate window to wall ratios, insulation level, window U-values and solar control performance.</p>	<p>14.1 Thermal Comfort</p>
<p>Implement electrolysed water (E-water) dispenser to reduce chemical footprint (especially applicable to kitchens and food prep areas).</p>	<p>Green Star Innovation</p>
<p>Mixed mode ventilation has been proposed the level 1 staff areas. Mixed mode ventilation uses natural ventilation when external and internal conditions are favourable and supported by mechanical air-conditioning and ventilation when conditions are not suitable for natural ventilation.</p>	<p>Aligns with credit 9.2 Increased outdoor air.</p>



6.3 Energy Conservation

The Nutrition Centre has adopted the energy hierarchy approach in reducing energy use. The energy hierarchy approach seeks to systematically targeting building energy use through passive means first, then supported by efficient active systems and renewable energy. The energy conservation strategies considered for the Nutrition Centre are included below.

Energy Reduction Hierarchy	Energy Conservation Strategies	Green Star Design & As-Built v1.3 Credit
Demand Reduction through high performance building envelope	Passive Design - Appropriate window to wall ratios - External solar shading - Appropriate thermal performance through insulation performance and window U-values and Solar Heat Gain Coefficients (SHGC) have been considered for the thermal zones.	15A.0 Conditional Requirement 15A.1 Building Envelope 15A.2 Glazing
	Active Design - High efficiency Air-conditioning (VRV) equipment such as Simultaneous heating and cooling equipment have been considered. - LED lighting throughout where appropriate including programmable lighting control system (intelligent lighting) - High efficiency domestic hot water technology (Heat Pumps) has been considered. - Energy efficient lifts have been considered. - Appliances must be a minimum of 4 energy star rating.	15A.3 Lighting 15A.4 HVAC 15A.5 Domestic Hot Water 15A.9 Vertical Transport
Onsite Generation and Renewable Energy	- Solar Photovoltaics (Electricity) and Solar Thermal (Solar Hot water) have been considered for the project.	15 Greenhouse Gas Emissions reduction
Building Networks	- Energy metering, Sub-metering of Air-conditioning, general power, lighting, domestic hot water will be considered to allow for waste energy use and peak electricity demand. Metering and monitoring do not reduce energy; however, they facilitate energy management practices. - Building Management System to track power and energy use for ongoing monitoring and reporting	6.0 Metering and Monitoring
Offsite Renewable Energy	- Offsite renewable energy has been considered.	15A.10 Off-Site Renewables
Electrification	- No fossil fuels (gas) equipment has been incorporated in the Nutrition Centre. Minor fossil fuel use for diesel generator backup may not be feasible to electrify. Diesel generators will be used infrequently for the purposes of backup power only.	15A.8 Fuel Switching



6.4 Transport

The Nutrition Centre has limited opportunities to provide low carbon transport initiatives as it is located within the Taronga Zoo site. The Zoo can be accessed via ferry, bus and driving. The Nutrition Centre has considered end-of-trip facilities such as showers and lockers for staff to encourage active transport commuting. Bicycle racks are provided at the entrance to the Zoo. No additional carparking will be included as part of this development which continues to support access by public transport.

6.5 Water Conservation

The Nutrition Centre has adopted the water hierarchy approach in reducing potable water use. The water hierarchy is similar to the energy hierarchy, and seeks to reduce potable water demand, then supported by efficient distribution systems and recycled water / non-potable water sources. The water conservation strategies considered for the Nutrition Centre are included below.

Water Reduction Hierarchy	Water Conservation Strategies	Green Star Design & As-Built v1.3 Credit
Demand Reduction	<ul style="list-style-type: none"> - Low flow fixtures, fittings and appliances rated to the WELS standard. - Native landscape species selection and design. - Weather and moisture sensing technology for landscape irrigation 	18B.1 Sanitary Fixture Efficiency
Efficient distribution	<ul style="list-style-type: none"> - Water efficient irrigation systems - Water metering of equipment. 	18B.4 Landscape Irrigation
Fit for purpose water sources	<ul style="list-style-type: none"> - Utilise water from onsite sources such as the Taronga Zoo Waste Water Treatment Plant for landscape irrigation and toilet flushing. 	18B.2 Rainwater Reuse 18A Reclaimed Recycled Water (performance pathway)
Water Recycling	<ul style="list-style-type: none"> - Site level treated waste water i.e. rain water, storm water (Taronga Zoo Waste Water Treatment Plant). 	18B.2 Rainwater Reuse 18A Reclaimed Recycled Water (performance pathway)
Discharge to Sewer	<ul style="list-style-type: none"> - Reduced discharge from low flow fixtures. 	18A Discharge to Sewer (performance pathway)

6.6 Materials & Construction Waste

The following materials and construction waste strategies have been considered for the Nutrition Centre to increase the uptake of environmentally preferable materials with a focus on reuse and recycle content, reduced embodied energy, greater transparency, and reduction of waste to landfill.



Indoor Environment Quality Strategies	Green Star Design & As-Built v1.3 Credit
Concrete mixes with Portland cement reduction, contains at least 50% captured or reclaimed water, and aggregates Reduction through course or fine aggregates.	19B.1 Concrete
Reduce reinforcing steel use, sourced from a Responsible Steel Maker, and at least 60% of all reinforcing bar and mesh is produced using energy-reducing processes.	19B.2 Steel 20.1 Structural and Reinforcing Steel
Timber products used are certified by a forest certification scheme such as Forest Stewardship Council (FSC) certified. Use rapidly renewable materials (eg. bamboo flooring) where possible.	20.2 Timber Products
All permanent formwork, cables, pipes, flooring and blinds do not contain PVC and have an Environmental Product Declaration (EPD) OR meet Best Practice Guidelines for PVC.	20.3 Permanent Formwork, Pipes, Flooring, Blinds & Cables
Preference for products and materials with sustainability credentials such as Reused Products, Recycled Content Products, Environmental Product, Declarations, Third Party Certifications (such as GECA) and Stewardship Programs.	21.1 Product Transparency
Commit to at least 90% of the waste generated during construction and demolition to be diverted from landfill for recycling. This includes re-use of onsite spoil where appropriate, or back fill aggregate with clean recycled content (e.g. Construction Demolition waste aggregate).	22.1 Demolition and Construction Waste
Minimise on site cutting noise and waste, standard size materials or prefabricated materials used, or materials cut to size at supplier's premises.	Not addressed in Green Star
Materials are sourced locally where possible to reduce emissions associated with transportation.	19A life Cycle Impacts

6.7 Sustainable Sites: Land use and Ecology, and Emissions

The following sustainable site strategies have been considered to:

- Reduce the negative impacts on sites as a result of construction and development and enhancing the local ecology.
- Reduce the negative impacts associated with buildings, such as refrigerant leaks, storm water peak discharge and pollution and light pollution disturbing native animals which is extremely important in context of Taronga Zoo.



Sustainable Site Strategies	Green Star Design & As-Built v1.3 Credit
<p>Water Sensitive Urban Design principles are incorporated Porous/permeable landscaping and ground surfaces where appropriate to reduce stormwater runoff.</p>	<p>26.1 Peak Discharge 26.2 Stormwater Pollution Targets 18B.4 Landscape Irrigation 25.1 Heat Island effect</p>
<p>Plant vegetation (animal feed) in landscaping Native planting cuttings used to feed animals).</p>	<p>23. Ecological Value Partially addressed in Green Star, provides further enhancement through productive landscape.</p>
<p>No critically endangered, endangered, vulnerable species or ecological communities were present on the site at the time of purchase. The site does not include old growth forest or wetland of 'High National Importance', or did not impact on 'Matters of National Significance'</p>	<p>23.0 Endangered, Threatened or Vulnerable Species 24.0 Conditional Requirement</p>
<p>Site contamination is identified with remedial steps undertaken to decontaminate site prior to construction</p>	<p>24.2 Contamination and Hazardous Materials</p>
<p>Consideration of site surface treatments to reduce heat island effect, such as vegetation and light-coloured roofs to reflect solar radiation.</p>	<p>25.1 Heat Island effect</p>
<p>Achieve a reduction in peak sewer discharge comparing pre-development to post-development discharge. Achieve a reduction in pollution levels.</p>	<p>26.1 Peak Discharge 26.2 Stormwater Pollution Targets</p>
<p>All outdoor lighting to comply with AS4282:1997 to reduce light pollution, downlighting for external light fixtures including external pathway.</p>	<p>27.0 Light Pollution Neighbouring Properties 27.1 Light Pollution Night Sky</p>
<p>Zero ozone depletion potential (ODP) and Low Global Warming Potential (GWP) refrigerant will be considered for all refrigerant based systems. Glycol Refrigerant (Zero ODP and Low GWP) has also been considered for animal feed and process cooling equipment. Glycol has been considered as a means of heat exchange reticulation between refrigeration compressors and cool room evaporators.</p>	<p>29.1 Refrigerants</p>
<p>Minimise on site cutting noise and waste, standard size materials or prefabricated materials used, or materials cut to size at supplier's premises.</p>	<p>Not addressed in Green Star</p>



7 Design for Resilience to Climate Change

The Nutrition Centre will be designed to future-proof itself from the potential impacts of climate change. A climate adaptation and resilience workshop has been proposed to address climate risks posed to the project.

NARCLiM Climate Change Projections

The NSW Office of Heritage and Environment, now part of the NSW Department of Planning, Industry and Environment, has developed the NSW and ACT Government Regional Climate Modelling (NARCLiM) climate change projections to provide a dataset for detailed near future (2020-2039) and far future (2060-2079) projections. Generally, it determines that there will be:

1. more hot days and fewer cold nights;
2. an increase the number of heatwave events;
3. more hot days above 35°C; particularly in Spring and Summer;
4. an increase in rainfall in Summer and Autumn and a decrease in Winter and Spring; and
5. a change in rainfall patterns that will affect drought and flooding events.

CSIRO Climate Future Projections

In addition, the Intergovernmental Panel on Climate Change (IPCC) published four greenhouse gas (GHG) concentration trajectories known as Representative Concentration Pathways (RCPs) which are used by CSIRO for climate projection modelling at a regional scale within Australia. The four RCPs and its definitions include:

- **RCP 2.6** – Emissions peak 2010-2010, decline substantially – 1.0°C of Global Warming Mean and likely temperature range of 0.3°C – 1.7°C
- **RCP 4.5** – Emissions peak around 2040, then decline – 1.8°C of Global Warming Mean and likely temperature range of 1.1°C – 2.6°C
- **RCP 6.0** – Emissions peak around 2060, then decline – 2.2°C of Global Warming Mean and likely temperature range of 1.4°C – 3.1°C
- **RCP 8.5** – Emissions continue to rise throughout the 21st century – 3.7°C of Global Warming Mean and likely temperature range of 2.6°C – 4.8°C

The series of climate futures matrices representing the combination of time periods and greenhouse gas scenarios and classified by the combined changes of the climate variables identified above are provided in Table .

Table 1. Climate futures matrices for RCP 4.5 and RCP 8.5 at East Coast

East Coast Climate Futures		Year																																																																					
		Summer 2030	Summer 2070																																																																				
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Source: CSIRO and Bureau of Meteorology, Climate Change in Australia website (<http://www.climatechangeinaustralia.gov.au>)

These projections will have an impact on operational costs and occupancy comfort and safety. Hotter days with more heatwaves will particularly affect staff, visitors and wildlife and the operation of building services equipment. This will also require higher capacity and operational costs for mechanical services to maintain occupancy comfort. Increased drought events will require provisions to supplement shortages in potable water. Stronger and reinforced façade components will be required to withstand increased rainfall and wind gust events.

The design initiatives in the following table aim to mitigate the effect of future climate change while maximising efficiency in energy, water and material use. These measures should allow the project to meet the difficulties predicted by the CSIRO’s climate change projections while maintaining occupancy comfort and operational efficiency.



Climate Change Projections		Project Responses
 <p>Hotter days and more frequent heatwave events</p>	<ul style="list-style-type: none"> - Minimise unwanted solar heat gain into spaces through shading and glazing performance. - Improve efficiency of mechanical services. - Utilise translucent skylights to allow light, however reduce solar heat gains. 	
 <p>Extreme Heat</p>	<ul style="list-style-type: none"> - Utilise landscaping and trees to reduce surface temperatures for a cooler microclimate during warmer seasons - Improved thermal performance building fabric will be utilised to mitigate heat discomfort and heat stress. - Mechanical system will be designed to provide adequate thermal comfort to occupants and wildlife ensure safe operation of equipment during extreme heat events. 	
 <p>Extended drought periods</p>	<ul style="list-style-type: none"> - Centralised Recycled Water Treatment facility to support landscaping. - Landscaping with native low-water plant species. 	
 <p>More extreme rainfall events</p>	<ul style="list-style-type: none"> - Increase peak stormwater discharge capability. - Increase over-flow drainage from site. - Civil infrastructure design to prevent soil erosion. 	
 <p>Storms and Flooding</p>	<ul style="list-style-type: none"> - Increase peak stormwater discharge capability. - Increase over-flow drainage from site. - Centralised Recycled Water Treatment facility to capture stormwater for reuse. 	
 <p>Gustier wind conditions</p>	<ul style="list-style-type: none"> - Consideration of reinforced façade and drainage of the building, respite, and shelter areas. 	



8 Appendix A – Green Star Scorecard