554-562 RESERVOIR ROAD PROSPECT, NSW (SOUTH EXPANSION)

ESD & Energy Efficiency Report

Prepared for:

BECA
Level 11, 44 Market Street
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Revision History

Reference	Date	Details	Prepared	Authorised
-R01-v1.0	10 January 2023	Final	DS/HC	HC

EXECUTIVE SUMMARY

ESD Scientific has been commissioned by BECA to carry out the ESD & Energy Efficiency assessment for the proposed new expansion of the warehouse at 554-562 Reservoir Road Prospect, NSW (South Expansion).

The report has been prepared in accordance with the State Significant Development – Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development SSD-9577613.

As part of the EIS for the development, the project is required to address the following SEARS requirements for ESD & Energy Efficiency:

- *An assessment of how the development will incorporate ecologically sustainable development principles in all phases of the development;*
- *Consideration of the use of green walls, green roof and/or cool roof into the design;*
- *Climate change projections developed for the Sydney Metropolitan area and how they are used to inform the building design and asset life of the development; and*
- *An assessment of the energy uses onsite, and demonstrate the measures proposed to ensure the development is energy efficient.*

The proposed development will incorporate passive and active energy-saving measures to enhance building operating performance where appropriate. Overall, positive Ecologically Sustainable Design (ESD) and energy efficiency features are currently in place in a number of design areas, incorporating the following:

- High-performance thermal envelope with roof, floor and external wall insulations;
- All windows, doors, exhaust fans and pipe penetrations will be constructed to minimise air leakage as required by the provisions outlined in Section J3 of the 2019 NCC;
- Select energy-efficient air conditioning system;
- Energy Recovery Ventilator (ERV) is proposed for the ventilation of the locker/amenities area below the lunchroom;
- Increase the temperature set-points for battery recharge and switch room to save energy;
- LED lighting to all areas with advanced controls (daylight and motion sensors have been proposed to different locations);
- Sub-metering to record the energy consumption of air conditioning plant, lighting and appliance power individually;
- Light coloured roofing (cool roof) with high reflectivity and appropriate insulation to reduce solar heat gain into the warehouse;
- Thermal bridging to all structural steel passes through the insulation envelope (wall, roof, ceiling floor);
- All joints to roof panels shall be fully sealed and weathertight;
- Windows between ambient and refrigerated spaces are to be double glazed with PVC frames;
- Select water-efficient fixtures and dishwashers;
- Incorporate water-sensitive urban design principles;

EXECUTIVE SUMMARY

- Existing bicycle racks with new proposed locker rooms to encourage active transport; and
- The waste management plan has been prepared to minimise operational and construction waste going to landfills.

The following recommendations have been made to improve upon the existing key sustainability features during the detailed design stage:

- Appropriate glazing selection in accordance with NCC Section J to cut excess solar heat gains;
- Energy Efficient air conditioning system to new offices and tenancies;
- Consider solar hot water system or heat pump for domestic hot water;
- Select minimum 4 stars energy rating air conditioning system for new offices and lunchroom;
- Select minimum 4- star water-efficient dishwashers;
- Select minimum 5- star water-efficient urinals;
- Select minimum 4-star energy-efficient refrigerators; and
- Maximise the predicted construction waste arising from development can be reused (onsite or at another development) or recycled offsite.

These features will help significantly reduce the energy and water required by the development from construction and operation. It is recommended that ESD initiatives continue to be developed and implemented during the detailed design stage of the project.

This report has been made based on our best engineering judgment and the experience gained from the past. ESD Scientific recommends that quantitative analysis (energy modelling) be conducted during the detailed design stage of the project to confirm assessments made within this report.

DOCUMENT REFERENCES

TABLES

FIGURES

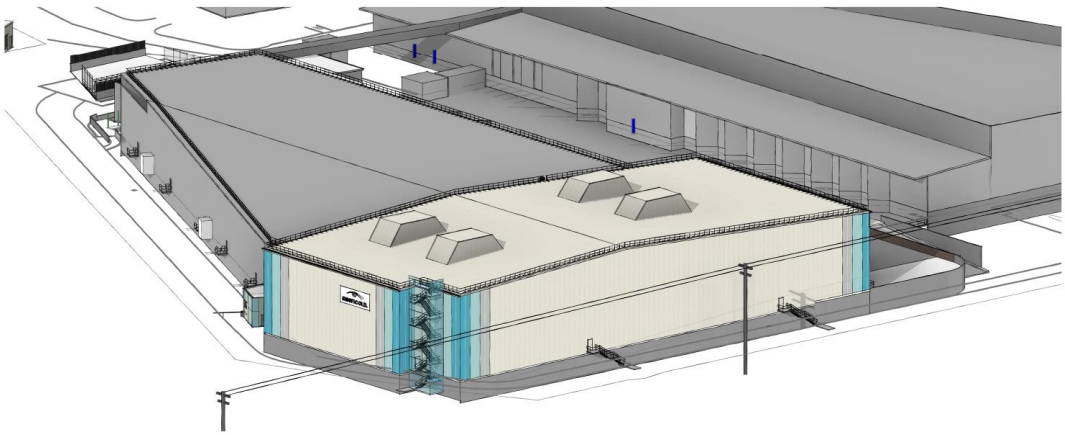
1 Introduction

1.1 Site and Project Description

The site is bounded by Reservoir Road from the northwest and Prospect Hwy from the southwest. The development is predominantly surrounded by industrial warehouses and vacant lands. An aerial image of the subject site and the local surroundings is shown in Figure 1 and Figure 2.

Figure 1 Site Location

Figure 2 3D View of the Proposed Development



1.2 Development Description

The existing site comprises three main buildings: Administration Building, North Cold Storage and South Cold Storage/Freezer, as illustrated in Figure 3. The South cold storage facility will be extended towards the east to accommodate the additional storage required, with related support infrastructure. The expanded facility is intended to store approximately 13,450 frozen pallets on double deep, nine high racking, providing Americold with sufficient additional capacity to meet existing and future predicted storage capacity requirements.

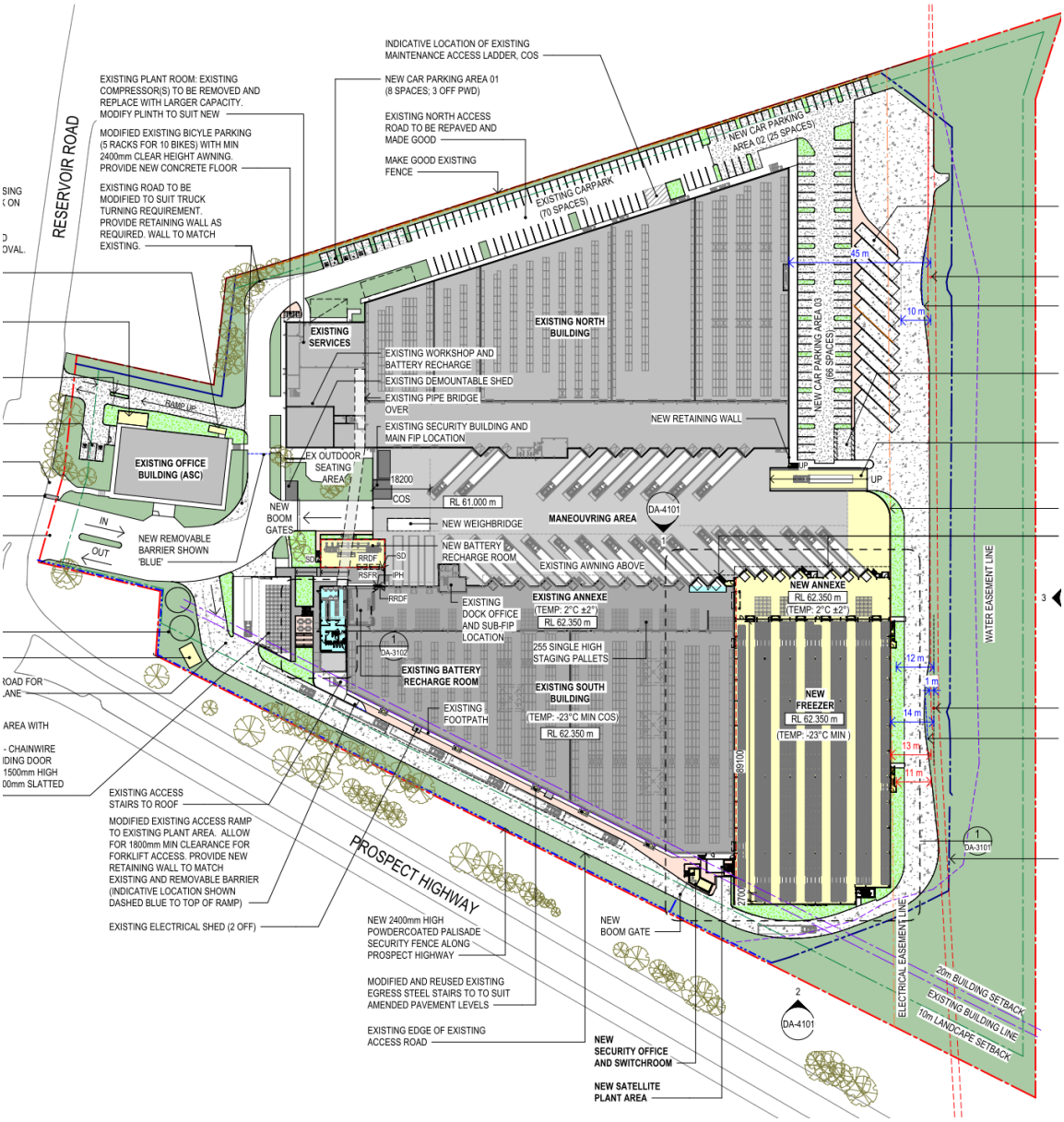
As part of this expansion, a new battery charging room shall be constructed to house the battery charging system, which will charge, store and change over existing and new batteries used for MHE (Material Handling Equipment). The South building amenities and lunchroom will also be upgraded to accommodate the increased number of staff on site.

Alterations to the site access, parking and loading arrangements, including:

- Construction of a new staff and visitor site access to eliminate traffic conflicts between heavy and passenger vehicles.
- Construction of 93 new staff/visitor vehicle carparks (including three accessible spaces) to the north and east of the existing northern warehouse.
- Construction of two new accessible carparks adjacent to the existing office building.
- Upgrade of the existing site access road, including:
- Sealing of the southern and eastern portions of the site access road with heavy duty pavement;
- Construction of new Armco barriers protecting the power poles to the east of the site;
- Repaving of the existing car parking access.
- Minor corner modifications to enhance truck turning and manoeuvrability.
- New boom gates.
- Construction of new loading docks.
- Construction of a new heavy vehicle turnaround and 12 new trailer parking spots to the east of the existing northern warehouse.
- A new pump house and two new firewater tanks.
- A new timber pallet storage area with 3m high masonry walls.
- A new staff outdoor seating area with awning.
- A new security office with boom gates
- A new weighbridge
- A new satellite plant area.
- Internal refurbishment of the existing staff amenities, lunchroom/outdoor eating area, locker room and transport office, located in an existing building to the immediate west of the southern warehouse.

The site is proposed to be operated 24 hours, 7 days a week.

Figure 3 Site Plan of the Proposed Development



The proposed development floor areas are listed below:

- New south building expansion (5140 m^2)
- New docks to existing annexe (36 m^2)
- New security office and switch room (24 m^2)
- New battery charging room (175 m^2)
- New pump house (30 m^2)

When the project is completed, there will be a total of 171 car parking and 10 bicycle parking.

2 Sustainability Legislation and Guidelines

2.1 National Construction Code – Section J Energy Efficiency

Section J of the NCC outlines energy efficiency provisions required for Class 2 to 9 of building. The provisions of the NCC Section J are designed to reduce greenhouse gas emissions by efficiently using energy in buildings.

There are Deemed-to-Satisfy subsections from J1 to J8 that focus on separate aspects of energy efficiency as follows:

- J1 - Building Fabric and Glazing
- J2 – Glazing provisions are now included in J1
- J3 - Building Sealing
- J4 – Removed
- J5 - Air Conditioning and Ventilation Systems
- J6 - Artificial Lighting and Power
- J7 - Heated Water Supply and Swimming Pool and Spa Pool Plant
- J8 - Facilities for Energy Monitoring

2.2 Secretary's Environmental Assessment Requirements

The report has been prepared in accordance with the State Significant Development – Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development SSD-9577613. The Department of Planning has set the following conditions:

- *An assessment of how the development will incorporate ecologically sustainable development principles in all phases of the development;*
- *Consideration of the use of green walls, green roof and/or cool roof into the design;*
- *Climate change projections developed for the Sydney Metropolitan area and how they are used to inform the building design and asset life of the development; and*
- *An assessment of the energy uses onsite, and demonstrate the measures proposed to ensure the development is energy efficient.*

3 ESD & Energy Efficiency Measures

3.1 Documentation

This report has been prepared based on the documentation provided by the project team and listed in Table 1 below.

Table 1 Project documentation Sources

Type	Document	Issue Date
Architectural drawing	Architectural drawing set (Issued for pricing)	May 2022
Principal's Project Requirements	Prospect South Expansion Principal's Project Requirements	10 May 2022
Waste Management Plan	Waste Management Plan	27 May 2022

3.2 Ecologically Sustainable Development Approach

To achieve a holistic approach to ESD, a series of indicators and strategic goals have been identified for the development through the design, construction and operation phases.

The ESD & Energy Efficiency objectives, proposed targets related to the objective and measures that have been recommended or have already been implemented to meet these targets are listed in Table 2. The final ESD & Energy Efficiency measures have been assessed and approved for project implementation for the proposed development are outlined in this Section too.

Table 2 Summary of Assessment

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Design & Management	• Enable and support best practice sustainability outcomes throughout the different phases of a project's design, construction and its ongoing operation.	• Coordinated sustainability approaches and operations among stakeholders. • Set and document sustainability targets for the project. • Quarterly adjustments and measurement for the first 12 months after occupation and a review of building system manufacturer warranties.	• Documentation of nominated building systems and sustainability targets in Principal's Project Requirements. • Provide Operating and Maintenance Manuals for the building, including the electrical, fire, refrigeration and air conditioning/ventilation system and other services. • Infrared scanning survey to identify any leaks or cold bridging to all conditioned spaces. • Independent consultant to perform quarterly tuning for all nominated building systems.	✓ ✓ ✓ ✓	• ESDS recommends an independent consultant/contractor will be engaged to maintain the facility in accordance with the operations and maintenance manuals during the 12-month defects liability period.
Building Fabrics Performance	• Optimise building thermal envelope performance to reduce heating and cooling loads	• Achieve minimum performance requirements under NCC Section J1 to J3. • Reduce heat gain and heat lose through the building thermal envelope.	• Meet or exceed NCC Section J1 to J3 façade performance for conditioned spaces. • Light-coloured roofing with high reflectivity and appropriate insulation to reduce solar heat gain into the warehouse. Colorbond ® Surfmist roof sheeting which has a low solar absorptance is proposed. • Thermal bridging to all structural steel passes through the insulation envelope (wall, roof, ceiling floor). • All joints to roof panels shall be fully sealed and weathertight. • Windows between ambient and refrigerated spaces are to be double glazed with PVC frames.	✓ ✓ ✓ ✓ ✓	• NCC Section J report needs to be prepared by a qualified ESD consultant. • All new glazing systems within the conditioned spaces need to comply with NCC Section J requirements. • This warehouse will comply with all the requirements specified within the report during the construction stage.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Indoor Environment Quality	• Initiatives that enhance the comfort and well-being of occupants. • Improvements to air quality through appropriate ventilation. • The provision of high levels of thermal and acoustic comfort. • Optimise natural light to the work environment. • The creation of low-toxicity environments through reductions to pollutants. • Reductions to occupant stress.	• Provide sufficient fresh air and ventilation for indoor space. • Provide thermal and acoustic comfort environment to occupants • Finishes: Use low-VOC paints, adhesives & sealants, carpet and flooring; use low-formaldehyde wood products • Use flicker-free lighting system • Reduce visual glare. Lighting illuminance meets the levels recommended in AS1680.2.4 • Reduce visual glare.	• Mechanical/natural ventilation to comply with AS 1668. • CO2 modulation in Lunchroom • Acoustic to comply with AS 2107 recommendations for internal spaces. • Thermal comfort: Office and lunch room envelope and HVAC system designed to meet thermal comfort requirements. • Natural light to offices and lunchroom • Provide sufficient roof and wall insulation to the air-conditioned spaces; • Select low-VOC paints, adhesives, sealants and carpets. • Select low-formaldehyde emission-engineered wood products. • Provide pleasant indoor and outdoor breakout spaces with plants. • Lighting levels comply with AS 1680. • Glare is reduced through a combination of blinds, screens and fixed devices.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	• High-performance glazing to all air-conditioned areas to satisfy Section J requirements • LED lighting and lighting controls to warehouse, offices and lunch room. • Adequate ventilation will be supplied in accordance with AS1668.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Energy Efficiency	• Design and construct energy-efficient buildings and reduce greenhouse gas (GHG) emissions associated with using energy in building operations • Well-designed systems, aimed at lower operating emissions • The selection of high efficiency equipment over less energy efficient alternatives • Onsite renewable energy sources	• High efficiency lighting and controls. • High Efficiency domestic hot water system. • Integrated building management system. • Optimise insulation for energy and thermal comfort. • Reduce solar heat gain through the roof by providing a highly reflective roof. • Energy sub-metering and link to BMS for all major energy uses for energy monitoring. • Consider onsite renewable energy generation	• High performance thermal envelope with roof, floor and external wall insulations. • All windows, doors, exhaust fans and pipe penetrations will be constructed to minimise air leakage as required by the provisions outlined in Section J3 of the 2019 NCC. • Select energy efficient air conditioning system. • Energy Recovery Ventilator (ERV) is proposed to ventilate the locker/amenities area below the lunchroom. • Increase the temperature set-points for battery recharge and switch room to save energy. • Consider solar hot water system or heat pump. • LED lighting to all areas with advanced controls (daylight and motion sensors have been proposed to different locations). • Sub-metering: for a building with a floor area of more than 2,500 m2 must have the facility to record individually the energy consumption of air conditioning plant, lighting and appliance power. • Use roofing material that has a high Solar Reflective Index. • Consider onsite renewable energy generation.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ -	• ESDS recommends selecting minimum 4 stars energy rating air conditioning system. • ESDS recommends solar/heat pump hot water system. • ESDS recommends installing PV system on roof. • Submeters for major energy uses. • Colourbond roof sheeting which has a higher solar reflectivity is proposed.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Potable Water Reduction and Reuse	• Reduce the consumption of potable water through measures such as the incorporation of water-efficient fixtures and building systems and water reuse	• Select water-efficient toilets, taps and showers • Select equipment that is more water efficient than comparable standard practice Equivalents. • The use of water-efficient supplementary equipment. • Utilise rainwater and/or recycled water for irrigation • Water-sensitive landscape design. • Monitoring of meters to track use.	• Toilets - Minimum 4 stars WELS rating and Watermark certified. • Urinals - Minimum 3 stars WELS rating and Watermark certified. • Taps - Minimum 6 stars WELS rating and Watermark certified. • Water efficient and drought tolerant landscaping. • Water-efficient dishwasher. • Rainwater/stormwater collection for toilets, irrigation and truck wash down.	✓ ✓ ✓ ✓ ✓ -	• ESDS recommends water efficient urinals (Minimum 5 star WELS) • Selection of endemic and low maintenance landscaping species • ESDS recommends water efficient dishwashers (Minimum 4 star) • ESDS recommends rainwater/stormwater collection for toilets, irrigation and truck wash down.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Construction & Operational Waste	• Minimising operational and construction waste going to landfill • Reuse, upcycling or conversion of waste into energy.	• Reduce construction waste going to landfill by reusing or recycling waste. • Contracted to builder as a requirement on site for construction waste. • Reduce operational waste going to landfill. • Staff education • Ongoing monitoring • Consider a design that can be disassembled at the end of the building's life.	• Management of waste in accordance with the NSW Waste and Sustainable Material Strategy 2041. • Waste Management Plan has been prepared for the demolition, construction and operation of the building • Management practices to prevent stormwater pollution. • Management of wastewater during construction including possible Reuse on site for dust suppression. • Waste storage and recycling facilities to be provided for different operational recycling streams such as paper, glass, plastics, metals, food waste etc. • Consider operational waste plans and training for staff to provide incentive to reduce waste. • Ongoing management to improve avoidance of waste generation.	✓ ✓ ✓ ✓ ✓ ✓	• Maximise predicted construction waste arising from development can be reused (onsite or at another development) or recycled off-site

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Green walls/roof or cool roof into the design	• Reduce the contribution of the project site to the 'heat island effect'.	• Use cool roof to reflect more sunlight than a conventional roof • Retain existing vegetation and add more Landscaped areas	• Light-coloured (high reflectivity) roofing with appropriate insulation to reduce solar heat gain into the warehouse. • Colorbond ® Surfmist roof sheeting has a low solar absorptance (high reflectivity) is proposed. • New Landscaped areas have been proposed along the perimeters of the new expansion warehouse, existing office building, new battery recharge room, outdoor seating and parking area. • Existing landscape zone along the eastern perimeter will be retained.	✓ ✓ ✓ ✓	
Materials	• Use of products and materials with lower environmental impact.	• Building materials are responsibly scoured or have a sustainable supply chain. • Reduce steel and cement in slab • Minimise the environmental impacts of refrigeration and air conditioning equipment.	• Structural and reinforcing steel is sourced from a responsible steel maker (hold ISO 14001 Environmental Management System). • Structural steelwork is supplied by a steel fabricator/steel contractor accredited to the Environmental Sustainability Charter of the Australian Steel Institute (ASI) • Use pre-cast concrete panels with recycled content. • Use FSC-certified timber products, such as joinery. • The refrigerant is noted to be R410A which has an ozone depletion potential of zero.	✓ ✓ ✓ ✓ ✓ ✓	

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Minimising Transport Impact	• Reduction of carbon-intensive modes of transport • Consider the traffic impact on local community	• Facilitating and encouraging alternative transport options, such as bicycles or electric vehicles. • Provide active transport facilities such as bicycle racks and locker rooms. • Provide support the uptake of low-emission vehicles. • Reduce operational fuel consumption through close proximity to major arterial roads.	• Existing bicycle racks with new proposed locker rooms to encourage active transport. • Parking spaces for fuel-efficient and electric vehicles are clearly designated (different coloured line marking and signage). • The site is close to M4 Western Motorway, Great Western Hwy and Prospect Hwy. • The roads linking the site to the motorways are predominantly used for industrial traffic, as such the traffic is unlikely to impact on local areas.	✓ ✓ ✓ ✓	• 10 bicycle parking spaces are provided. • Car park numbers and provision for disabled parking are provided suitable for anticipated traffic volume as per the Traffic Impact Assessment.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Land Use & Ecology	• Reduce the negative impacts on sites' ecological value.	• Selecting site for development on 'previously developed land'. • Minimise light pollution from the site. • Minimise peak stormwater outflows from the site and reduce pollutants entering the public sewer infrastructure and natural watercourses.	• Install native species appropriate to the area • Design external lighting to avoid emitting light into the night sky or beyond the site boundary. The minimum requirement is met where the project complies with AS 4282:1997 Control of the obtrusive effects of outdoor lighting • An OSD tank is to be provided to limit the discharge leaving the property to a pre-developed flow for storms up to the 1% AEP event.	✓ ✓ ✓ ✓	• Selection of endemic and low maintenance landscaping species • LED lights have been proposed for all external lights to avoid emitting light. • The warehouse sustainability objectives include: Reducing the impact of stormwater runoff and improving the quality of stormwater runoff • Achieve best practice stormwater quality outcomes. • Incorporate water-sensitive urban design principles.

4 Climate Change Projections and Adaptation

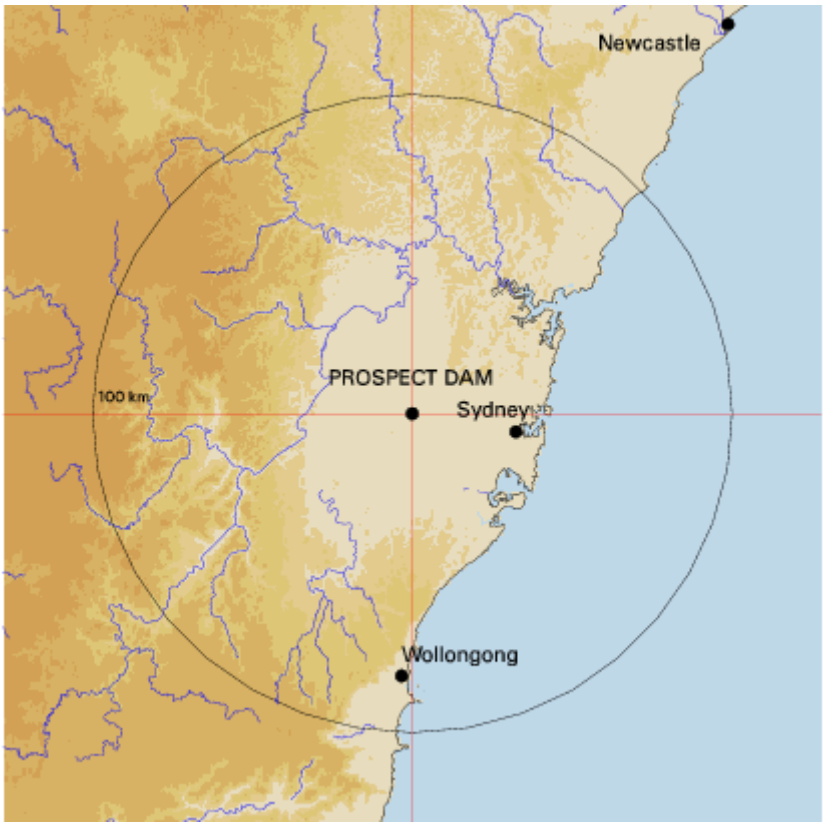
The project will incorporate initiatives to adapt to a changing climate and natural disasters. The risks and consequences of climate change have been assessed for the proposed development, considering its location and local climatic characteristics.

4.1 Local Climatic Characteristics

The climate of Sydney region is humid subtropical, shifting from mild and cool in winter to warm and hot in the summer. During summer it is warmer in Western Sydney than near the coast. In winter, more cold nights were observed in the Western Sydney area. Temperature extremes, both hot and cold, occur infrequently but can considerably impact health, infrastructure and our environment. Western Sydney sees more extreme conditions, which should be considered in assessing this proposed development.

The Bureau of Meteorology weather station selected for this project is Prospect Reservoir (ID: 067019), located next to the project site. Refer to Figure 4 for the weather station location.

Figure 4 Location Map of Bureau of Meteorology Weather Station



Key long-term climate statistics obtained at BoM 067019 are provided in Table 3.

Based on this data, Prospect's climate category would be classified as "Temperate", "No Dry Season" and "Hot Summers". In Western Sydney, rainfall is more uniform, ranging from 200–300 mm in summer, autumn and spring, to 100–200 mm in winter.

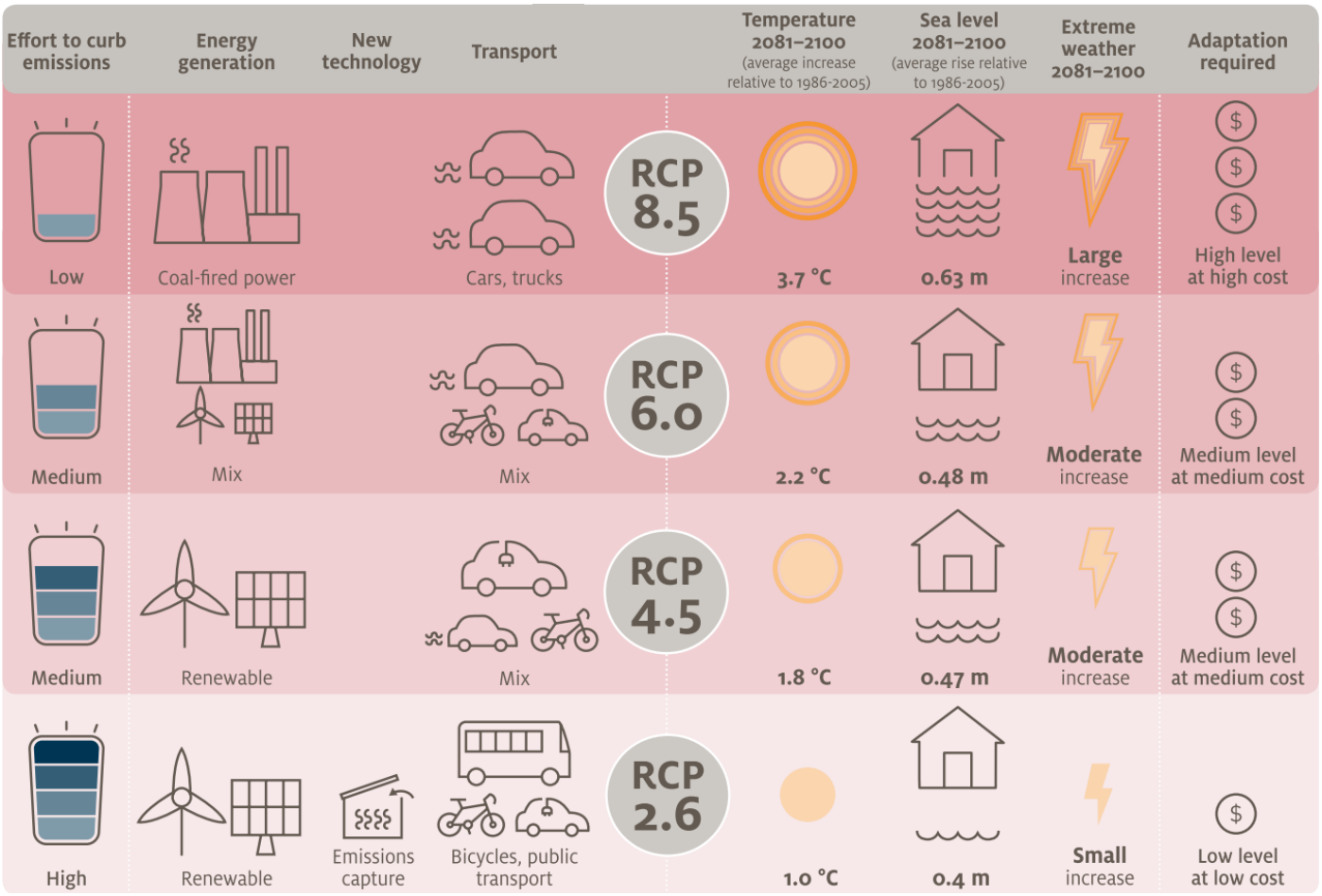
Table 3 BoM Station Prospect Reservoir (ID: 067019) Key Climate Statistics

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Maximum Temp (°C)	28.6	28.0	26.4	23.8	20.4	17.4	16.9	18.8	21.5	24.0	25.6	27.6	23.2
Mean Minimum Temp (°C)	17.7	17.8	16.2	13.0	9.8	7.5	6.1	6.8	9.4	12.1	14.4	16.4	12.3
Mean Rainfall (mm)	94.9	100.1	103.6	75.5	68.9	76.5	56.0	50.4	46.2	59.3	73.1	76.0	878.6
Mean Rel Hum (%) 9am	75	79	79	77	80	79	76	70	65	65	70	70	74
Mean Rel Hum (%) 3pm	52	54	55	52	57	55	50	45	45	46	50	49	51

4.2 Climate Change Scenarios

Within the Intergovernmental Panel on Climate Change (IPCC) context, the scenarios are referred to as "Representative Concentration Pathways (RCPs)". RCPs have prescribed pathways for greenhouse gas and aerosol concentrations, together with land use change, that are consistent with a set of broad climate outcomes used by the climate modelling community. Four RCPs have been commonly adopted in Australia and are listed in Figure 5.

Figure 5 RCPs with Different Key Factors and Predicted Outcomes by 2100



Source: www.coastadapt.com.au

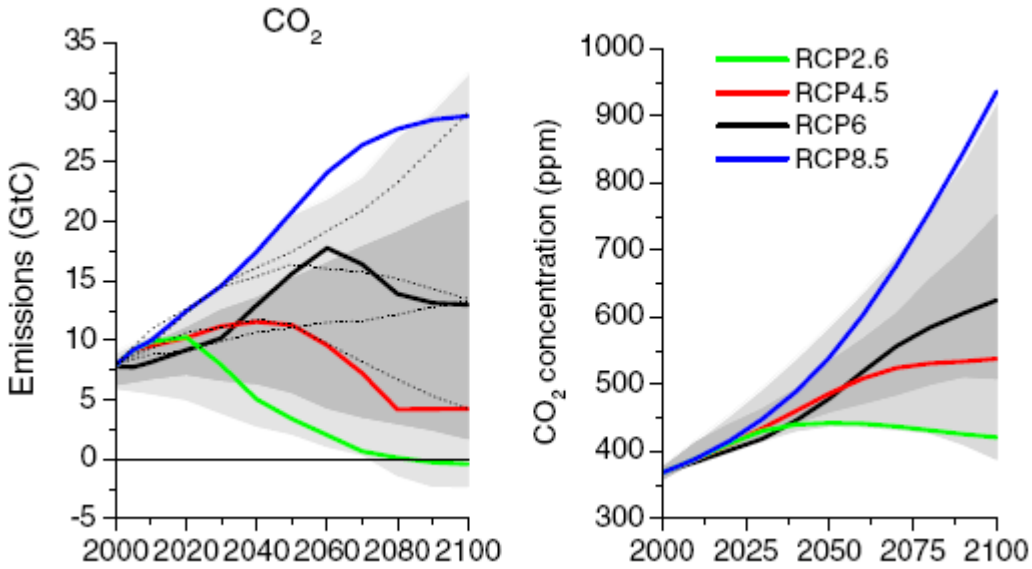
RCP8.5 - a future with little curbing of emissions, with a CO2 concentration continuing to rise rapidly, reaching 940 ppm by 2100.

RCP6.0 - lower emissions, achieved by application of some mitigation strategies and technologies. CO2 concentration rising less rapidly (than RCP8.5), but still reaching 660 ppm by 2100 and total radiative forcing stabilising shortly after 2100.

RCP4.5 - CO2 concentrations are slightly above those of RCP6.0 until after mid-century, but emissions peak earlier (around 2040), and the CO2 concentration reaches 540 ppm by 2100.

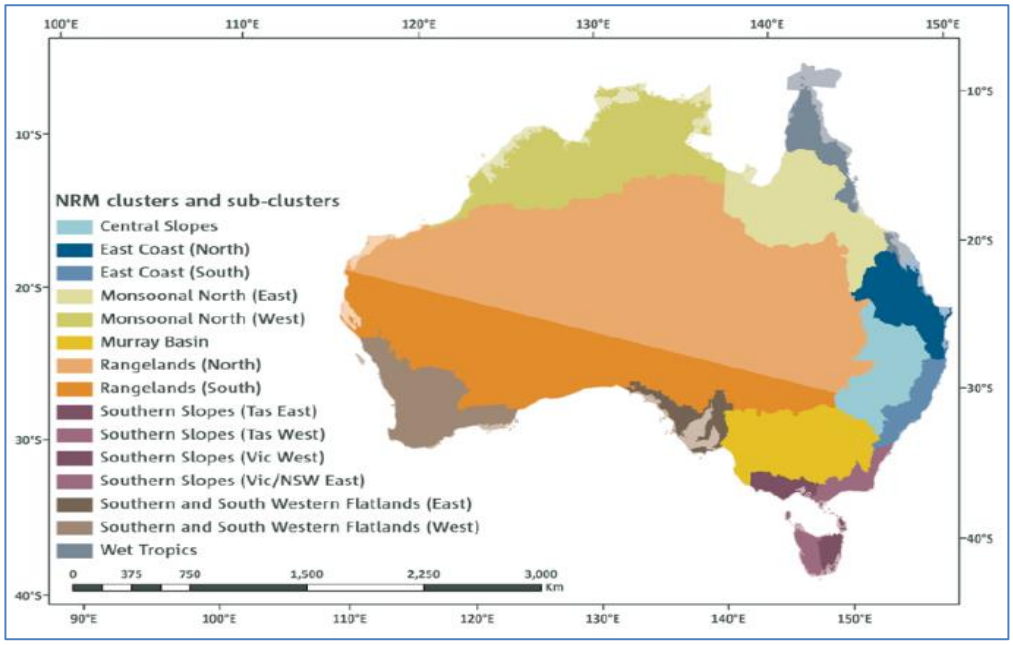
RCP2.6 - the most ambitious mitigation scenario, with emissions peaking early in the century (around 2020), then rapidly declining. Such a pathway would require early participation from all emitters, including developing countries, and actively applying technologies to remove carbon dioxide from the atmosphere. The CO_2 concentration will reach 440 ppm by 2040, then slowly declines to 420 ppm by 2100).

Figure 6 Emissions of CO_2 cross the RCPs (left), and Trends in Concentrations of Carbon Dioxide (right).



CSIRO and BoM have modelled the climate projections for Australia's Regional Natural Resource Management clusters for two future time scales: near future (2030) and far future (2090). These projects are considered in planning and adaptation option assessments.

Figure 7 Australia's Natural Resource Management (NRM) Clusters & Sub-Clusters



A summary of climate change projections applicable to the project site (NRM East Coast South) is given in Table 4 using the RCP8.5 scenario. Over the past decade, observed emissions have been tracking close to this most extreme emission scenario.

Table 4 East Coast – South Region Climate Projections (CSIRO & BoM, 2015)

Climate Variable	2030 RCP8.5	2090 RCP8.5
Mean Temperature	Median: **+1.0°C** Range: +0.7°C to +1.3°C	Median: **+3.7°C** Range: +2.9°C to +4.6°C
Maximum Temperature	Median: **+1.1°C** Range: +0.7°C to +1.4°C	Median: **+3.8°C** Range: +3.0°C to +4.9°C
Minimum Temperature	Median: **+1.0°C** Range: +0.7°C to +1.3°C	Median: **+3.8°C** Range: +2.9°C to +4.7°C
Rainfall	Median: **-1%** Range: -11% to +6%	Median: **-3%** Range: -20% to +16%
Solar Radiation	Median: **+0.8%** Range: -0.7% to +2.7%	Median: **+1.3%** Range: -1.2% to +3.4%
Relative Humidity	Median: **-0.6%** Range: -1.4% to +0.9%	Median: **-1.5%** Range: -3.8% to +1.3%
Soil Moisture (Budyko)	Median: **-4.1%** Range: -9.9% to +2.5%	Median: **-8.7%** Range: -15.4% to +2.4%
Wind Speed	Median: **-0.5%** Range: -2.3% to +1.9%	Median: **-1.1%** Range: -6.9% to +4.2%
Drought Factor	Median: **+0.2** Range: +0.1 to +0.3	Median: **+0.7** Range: +0.3 to +1.0
Severe Fire Danger Days (FFDI Index)	Median: **+0.45** Range: +0.4 to +0.5	Median: **+1.2** Range: +0.3 to +1.9

1. Projections are presented relative to the 1986-2005 baseline climate.

4.3 Adaptation and Resilience Response

From the climate change projections described previously, the relevant risks have been identified specifically for the project site. Table 5 indicates the adaptation strategies, implementation stage and the parties responsible for implementing these strategies.

Table 5 Summary of Recommended Adaptation Actions and Responsibilities

Variable	Proposed Response, Adaptation & Resilience "Action"	Implement ation Stage	Team Member Responsible
Extreme heat	Include a range of green infrastructure (street trees, rain gardens) to provide canopy coverage and green roofs/cool roof to help minimise the surrounding heat impacts. Ensure existing mature trees (canopy coverage) will be retained within and around the development.	Design	Architect Landscape
	Further consideration or specification of building materials (light coloured roofing materials, concrete/asphalt colour selection, high reflectivity materials for building facades).	Design	Architect Americold
	Space should be allocated for onsite renewable energy system such as solar PV system for future consideration/expansion. Explore options for onsite battery storage to support decentralised energy solutions.	Design	Architect Electrical
	Ensure that selection of equipment (e.g. HVAC, mechanical systems, cables) caters to higher operating temperatures and extreme heat events (e.g. design to 2030 temperatures).	Design	Mechanical
	Natural (passive) ventilation should be integrated into the design of the offices, lunch room and battery recharge room to help reduce the burden of the HVAC systems.	Design	Architect
	Outdoor seating area should be designed for extreme heat days and include some shading.	Design	Architect
Solar radiation	Ensure that critical equipment/plant is not sited with direct solar exposure and if required, that they can account for projected future increases in ambient temperature (e.g. design rating for 2030 temperatures).	Design	Architect Mechanical Electrical
Extreme rainfall	Consideration is given to undertake a flood study as a part of detailed design, including a provision for flooding and stormwater plans to consider projected increase in rainfall (minimum 10% increase as per best practice). This should include a review of the performance and capacity of site stormwater infrastructure retention capacity.	Design	Civil Hydraulic
	Design is to adopt Water Sensitive Urban Design (WSUD) principles.	Design	Architect Hydraulic Civil
	Include space within the site envelope to provide rainwater/stormwater tanks for capture and Reuse.	Design	Architect Hydraulic
	Explore opportunities for plants that require irrigation to increase evaporative cooling and opportunities to reuse water on site for irrigation.	Design	Landscape

Variable	Proposed Response, Adaptation & Resilience "Action"	Implement ation Stage	Team Member Responsible
	Size all downpipes capable of withstanding high volumes of water flowing over the roofs, with eaves gutters designed for min 20-year ARI storm event, and surface drainage & box gutters designed for min 100-year ARI storm events.	Design	Hydraulic Civil
	Ensure that critical systems are housed either on the roof or if required in the basement that appropriate flood protection is provided (e.g. elevating critical infrastructure, providing flood barriers).	Design	Architect Mechanical Electrical Civil Hydraulics
Bushfire	Ensure landscaping plans include appropriate vegetation clearance zones around the development.	Design	Landscape
	Use low risk bushfire vegetation on planned greenspace.	Design	Landscape
Storms	Ensure that building materials (façade, roofing) are resistant to hail and can withstand high wind speeds (based on wind study during detailed design).	Design	Architect

5 Conclusion

The proposed development will incorporate passive and active energy-saving measures to enhance building operating performance where appropriate. Overall, positive Ecologically Sustainable Design (ESD) and energy efficiency features are currently in place in a number of design areas, incorporating the following:

- High-performance thermal envelope with roof, floor and external wall insulations;
- All windows, doors, exhaust fans and pipe penetrations will be constructed to minimise air leakage as required by the provisions outlined in Section J3 of the 2019 NCC;
- Select energy-efficient air conditioning system;
- Energy Recovery Ventilator (ERV) is proposed for the ventilation of the locker/amenities area below the lunchroom;
- Increase the temperature set-points for battery recharge and switch room to save energy;
- LED lighting to all areas with advanced controls (daylight and motion sensors have been proposed to different locations);
- Sub-metering to record the energy consumption of air conditioning plant, lighting and appliance power individually;
- Light coloured roofing (cool roof) with high reflectivity and appropriate insulation to reduce solar heat gain into the warehouse;
- Thermal bridging to all structural steel passes through the insulation envelope (wall, roof, ceiling floor);
- All joints to roof panels shall be fully sealed and weathertight;
- Windows between ambient and refrigerated spaces are to be double glazed with PVC frames;
- Select water-efficient fixtures and dishwashers;
- Incorporate water-sensitive urban design principles;
- Existing bicycle racks with new proposed locker rooms to encourage active transport; and
- The waste management plan has been prepared to minimise operational and construction waste going to landfills.

The following recommendations have been made to improve upon the existing key sustainability features during the detailed design stage:

- Appropriate glazing selection in accordance with NCC Section J to cut excess solar heat gains;
- Energy Efficient air conditioning system to new offices and tenancies;
- Consider solar hot water system or heat pump for domestic hot water;
- Select minimum 4 stars energy rating air conditioning system for new offices and lunchroom;
- Select minimum 4- star water-efficient dishwashers;
- Select minimum 5- star water-efficient urinals;
- Select minimum 4-star energy-efficient refrigerators; and
- Maximise the predicted construction waste arising from development can be reused (onsite or at another development) or recycled offsite.

These features will help significantly reduce the energy and water required by the development from construction and operation. It is recommended that ESD initiatives continue to be developed and implemented during the detailed design stage of the project.

This report has been made based on our best engineering judgment and the experience gained from the past. ESD Scientific recommends that quantitative analysis (energy modelling) be conducted during the detailed design stage of the project to confirm assessments made within this report.