17 Roberts Road Data Centre

SSD–10330 ESD Report for SSDA

Canberra Data Centres

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Contents

Glossary and Abbreviations

Table 1: Glossary

Term	Definition
The Site	Canberra Data Centres Pty Ltd owns the site at 17 Roberts Road, Eastern Creek and is legally known as Lot 2 in Deposited Plan 1159804.
The Project	The construction of a new Data Centre and ancillary office space to expand the operation of the existing Data Centre to the east of the site.

Table 2: Abbreviations

Acronym	Definition
BDCP	*Blacktown Development Control Plan 2015*
BLEP	*Blacktown Local environmental Plan 2015*
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
WSEA	*Western Sydney Employment Area*
ha	*Hectare*
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
LEP	Local Environmental Plan
LGA	Local Government Area
NSW	New South Wales
NABERS	National Australian Built Environment Rating System
kWh	Kilowatt Hour
RMS	NSW Roads and Maritime Services
SEPP	*State Environmental Planning Policy*
SEPP 55	*State Environmental Planning Policy No. 55 - Remediation of Land*
SEPP SRD	*State Environment Planning Policy (State and Regional Development) 2011*
sqm	Square Metres
SSD	State Significant Development
SSDA	State Significant Development Application
SEAR	Secretary's Environmental Assessment Requirements
ESD	Ecologically Sustainable Development
GBCA	Green Building Council of Australia
PV	Photovoltaic
HVAC	Heating, Ventilation and Air Conditioning
LED	Light Emitting Diode
WELS	Water Efficiency Labelling and Standards
VOC	Volatile Organic Compounds

PVC	Polyvinyl Chloride
SRI	Solar Reflectance Index
FSC	Forest Stewardship Council
PEFC	Programme for the Endorsement of Forest Certification
IEQ	Indoor Environment Quality
RCP	Representative Concentration Pathways
IPCC	Intergovernmental Panel on Climate Change
CMIP5	Coupled Model Intercomparison Project Phase 5
CSIRO	Commonwealth Scientific and Industrial Research Organisation
NRM	Natural Resource Management
the Department	Department of Planning, Industry and Environment
the Minister	the Minister for Planning
the Region Plan	*A Metropolis of Three Cities – the Greater Sydney Region Plan* (2018)
the Strategy	*The Future Transport Strategy 2056* (2018)

1.0 Introduction and Description of Site

Cundall has been commissioned by Canberra Data Centres Pty Ltd (the applicant) to prepare this report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the SSD-10330 for the development of a Data Centre at 17 Roberts Road, Eastern Creek within the Western Sydney Employment Area (WSEA).

The site is located at 17 Roberts Road, Eastern Creek and comprises land known as Lot 2 in Deposited Plan 1159804. The site is identified in Figure 1 below.

Figure 1: Project Site

Key features of the site are as follows:

- The site is approximately 14.52ha and is an irregular shape. The site is bound by Roberts Road to the south and Capicure Drive to the north (refer to Figure 1).
- The site is located within the suburb of Eastern Creek, which falls within the Blacktown Local Government Area. The site is located with the Eastern Creek Precinct of WSEA and is surrounded by general and light industrial land uses.
- The majority of the site is cleared with scattered vegetation around the peripheral of the site.
- Vehicular access to the site is from the local road network available from Roberts Road and Capicure Drive. New internal road will be established as part of the SSDA for internal connection and vehicular access.

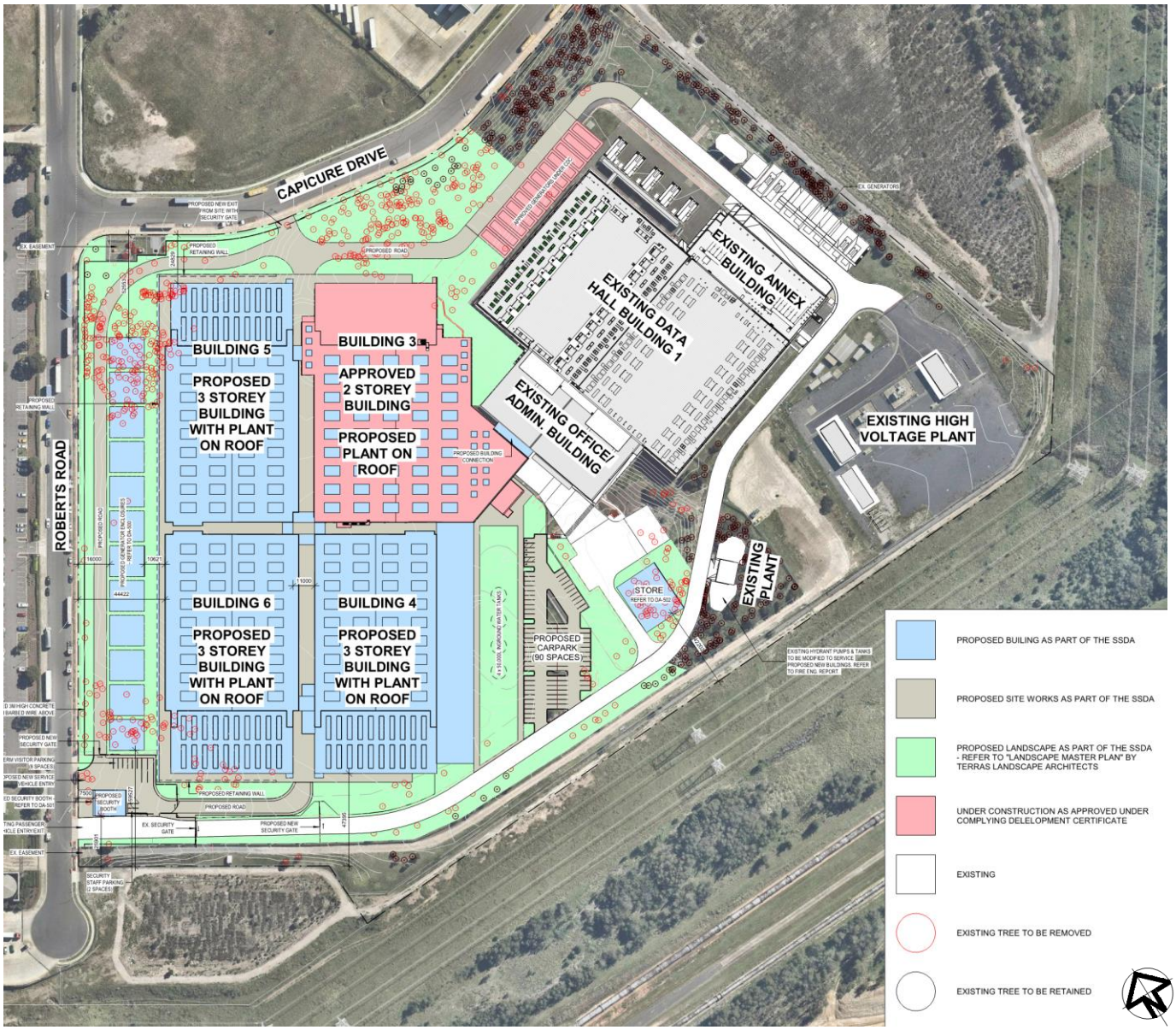

Figure 2: Project Site Plan

Key development features of the site are as follows (refer to Figure 2).

- An existing Data Centre with associated office building and plant is located to the east of the site. This Data Centre is to be retained and does not form part of this SSDA.
- Building 3 is currently under construction under a series of Complying Development Certificates. These comprise of Early Works, Base Build, Fit Out and installation of 12 generators. These works do not form part of the SSDA scope. Additional rooftop plant and equipment for Building 3, forms part of the proposed SSDA scope.

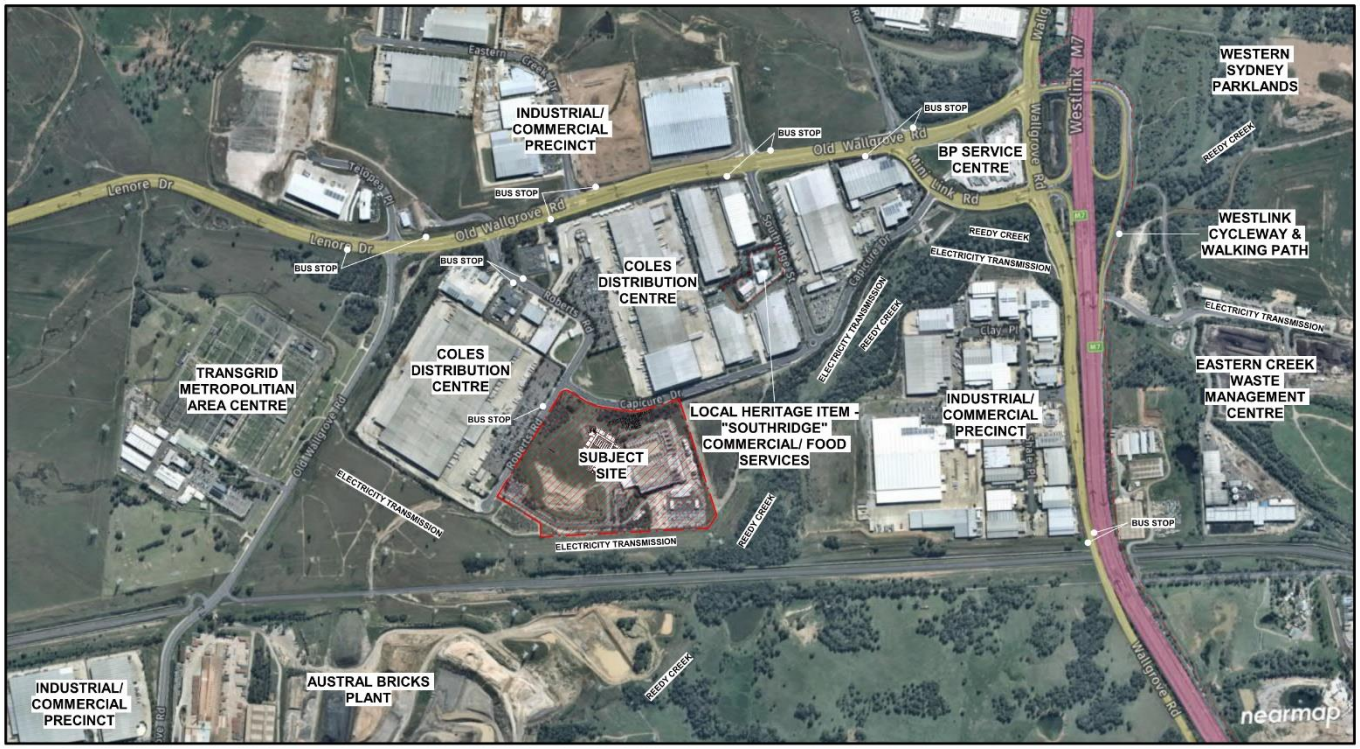

Figure 3: Project Locality

Key features of the locality are (refer to Figure 3):

North: The adjoining land to the north comprises large-scale warehouses, freight and logistics and light industrial activities with ancillary offices, all forms part of the Eastern Creek Business Park.

East: To the east is a parcel of vacant land and landscaped buffer between the light industry use land on the western side of M7 Highway. Western Sydney Park Land and SUEX Eastern Creek Resource Recovery Park is further to the east of the site, located on the eastern side of M7 Highway.

South:. Land immediately to the south is part of the TransGrid Eastern Creek site, which contains multiple high voltage transmission lines. Austral Bricks is located further south.

West: The land to the west of Roberts Road is Australian Personnel Solutions National Service Centre. Further to the west is Old Wallgrove Road and TransGrid Eastern Creek site, containing high voltage transmission lines and substations.

The nearest residential receivers are located in Horsley Park located around 1 km to the south of the site. Other nearby residential areas include Minchinbury to the north of the site beyond the M4 approx. 4km from the site); and Erskine Park to the west (approx. 2.8km from the site).

2.0 Project Description

The SSDA proposes the construction of a new Data Centre and ancillary office space to expand the operation of the existing Data Centre to the east of the site. The proposed Data Centre including three large warehouse buildings and ancillary office space, which will deliver economic benefits and employment generation for Western Sydney and the Greater Sydney Region.

Specifically, the SSDA seeks consent for:

- Site preparation works comprising:
  - Site preparation and mobilisation including clearing of land and importation of fill material;
  - Bulk and detail earthworks and support structures;
  - Estate stormwater management including construction of detention basins;
  - Construction of site access and estate internal roads;
  - Service and infrastructure augmentation;
  - Perimeter fencing;
  - Retaining wall;
  - Removal of trees and
  - Environmental protection and management measures.

- Staged construction of buildings for a Data Centre with 24 hour/day, seven day/week operation:
  - Construction of three 3 storey warehouse facilities (E4, E5, E6) including ancillary office spaces;
  - Additional rooftop plant and equipment for Building E3 in associated with Data Centre use;
  - Fit out of buildings;
  - Construction of plant rooms and a store room;
  - Security booth;
  - Generators;
  - Landscaping works; and
  - Construction of hardstand, loading area and a new car park.

The proposal does not involve the installation of any form of signage to the façade of the building.

The main focus of this report is to confirm design compliance with the relevant regulations and to provide guidelines on various sustainability opportunities that the project will incorporate. An ESD framework summary combines all applicable initiatives and targets set within the following categories:

- Energy efficiency
- Water
- Travel & Transport
- Ecology
- Management
- Health & Wellbeing
- Climate Risk & Adaptation
- Pollution
- Waste
- Materials & Supply Chain

3.0 Secretary's Environmental Assessment Requirements

This report supports a State Significant Development Application (SSDA) by responding to Secretary's Environmental Assessment Requirements (SEARs), dated 2 July 2019, and addressing the following key issues:

Ecologically Sustainable Development

- *a description of how the proposal will incorporate the principles of ecologically sustainable development in the design, construction and ongoing operation of the development*
- *consideration of the use of green walls, green roofs and/or cool roofs in the design of the data centre*
- *a description of the measures to be implemented to minimise consumption of resources, especially energy and water.*

Greenhouse Gas and Energy Efficiency

- *including an assessment of the energy use of the proposal and all reasonable and feasible measures that would be implemented on site to minimise the proposal's greenhouse gas emissions.*

Climate Change Projections for Sydney

- *the climate change projections developed for the Sydney Metropolitan area are used to inform the building design and asset life of the project*

4.0 ESD Initiatives

The proposed development will address multiple Ecologically Sustainable Development (ESD) initiatives during design, construction and ongoing operation. The initiatives are grouped into 10 key impact categories as follows:

- Energy efficiency
- Water
- Travel & Transport
- Ecology
- Management
- Health & Wellbeing
- Climate Risk & Adaptation
- Pollution
- Waste
- Materials & Supply Chain

The following initiatives and measures are being considered to minimise consumption of resources; in particular, energy and water. These will be further developed during detailed design and tracked throughout the project lifecycle.

4.1 Energy Efficiency

Measures to minimise energy consumption include:

- Efficient heating, ventilation and cooling systems and controls;
- Closed loop system dedicated to IT equipment;
- Commissioning and tuning requirements to be incorporated into the design for nominated building systems;
- Energy efficient LED lighting with lighting control system including timers, photocells and dimming capabilities;
- Incorporating passive design measures such as appropriate shading, high performance glazing and insulation;
- Energy submetering for all major uses and sources;
- Building Management System and smart controls to monitor, control, and optimise energy usage during operation;
- Material specification to avoid heat island effect for roof and hardscape areas;
- Energy-efficient Information Technology (IT) systems and their environmental conditions, data centre air management, cooling and electrical systems, on-site generation;
- Investigate the purchase of Green Power.

4.2 Water

- Efficient fittings and fixtures with high Water Efficiency Labelling and Standards (WELS) rating, and sensor operated taps;
- Rainwater harvesting for use in landscape irrigation and toilet flushing;
- Submetering of major water uses and sources;
- Building Management System to monitor, control, and optimise water usage at the operational stage;
- Specify native and / or low water use landscaping with subsoil drip irrigation and moisture sensors;
- Fire protection system to be design as a closed loop with water recirculation during testing;
- Passive stormwater management through permeable pavements, vegetated filter strips and bioretention areas, where possible.

4.3 Travel & Transport

- Low Emission Vehicle Infrastructure including parking spots reserved for Fuel Efficient Vehicles and charging infrastructure for electric vehicles;
- Provide Green Travel Plan provided for the building occupants to identify and promote ways to encourage a range of sustainable, or less environmentally damaging transport modes such as car-pooling.

4.4 Ecology

- Passive stormwater management through permeable pavements, vegetated filter strips and bioretention areas, where possible.
- Material specification to promote a cool roof through increased reflectivity to minimise heat island effect.
- The incorporation of a green roof has been considered; however, it has not been deemed feasible for the following reasons:
    1. The risk of a hidden membrane, any damage will result in water ingress into the centre without a location for the issue. The project will already have a double roof to assist with waterproofing.
    2. Drainage of the roof requires falls and drainage over the data halls with other leaks from internal pipes a risk.
    3. The weight of the soil on the large spans would require significantly deeper structure increasing embodied energy and resource use.
    4. There is plant equipment on the roof.

4.5 Management

- Comprehensive Commissioning and Tuning will be undertaken for the nominated building systems;
- Comprehensive operations and maintenance information will be developed and provided to facilities management team;
- Environmental performance of the building (energy and water use targets) will be set and measured;
- Environmental impacts during construction will be managed by implementing a best practice environmental management plan.

4.6 Health & Wellbeing

- Ventilation systems to be designed to mitigate outdoor air pollutants and for ease of maintenance and cleaning, and cleaned prior to occupation and use, where required;
- Efficient heating, ventilating and air-conditioning (HVAC) system to assure high level of thermal comfort;
- Reduction of internal ambient noise level by appropriate HVAC design and acoustic insulation;
- Lighting fixtures providing good colour quality and equipped with high frequency ballasts and high-Intensity discharge, where relevant;
- Glare control through selected systems and devices, blinds, screen and fixed devices, where relevant;
- Relaxation zones, outdoor comfort & shelter initiatives will be incorporated across the development;
- IEQ monitoring solutions will be considered to track indoor environment quality and comfort.

4.7 Climate Risk & Adaptation

A Climate Change Assessment has been undertaken for the project. The project team will identify required protection against storms, drought, flooding and blackouts to be addressed during detailed design. Future proofing infrastructure will be introduced, where required.

4.8 Pollution

- Noise pollution will be reduced through acoustic insulation and/or selection of building services systems based on their acoustic performance
- Night sky pollution will be limited through appropriate lighting design and control
- Pollution to water bodies will be limited through appropriate treatment of stormwater discharged, where required

4.9 Waste

- A Waste Management Plan will be developed for construction to minimise, reuse and recycle construction materials;
- A minimum of 80% of construction waste will be diverted from landfill;
- An Operational Waste Management Plan will be developed to provide adequate solutions for waste segregation and recycling;
- Building occupants will be encouraged to participate in recycling programs through available educational campaigns, a ban of single-use plastics, and introduction of recycling hub.

4.10 Materials & Supply Chain

- Building materials will be selected considering the following qualities: durability, responsible sourcing, sustainable supply chain, low TVOC content, low formaldehyde emissions, high recycled content and third party environmental / social certification;
- Timber, if used, will be certified by a forest certification scheme (FSC or PEFC) or will be from a reused source;
- Modern Slavery will be addressed through requirement of supply chain transparency for major materials and products.

5.0 Green Star Design and As Built Initiatives

Green Star is a rating system developed and administered by the Green Building Council of Australia (GBCA), which delivers independent verification of sustainable outcomes throughout the life cycle of the built environment.

The GBCA's mission is to "*lead the sustainable transformation of the built environment*" and it aims to achieve this 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 & As Built** scheme assesses sustainability outcomes of the design and construction of new buildings or major refurbishments, and rates them on a scale from 4 (Best Practice) to 6 Stars (World Leadership).

Sustainability targets for the development of 17 Roberts Road, Eastern Creek include adhering to pre-selected Green Star requirements to achieve an equivalent 4 Star Green Star outcome without targeting formal certification.

The following credit requirements are being targeted for the development:

Table 3: Targeted Green Star Credits

Credit Code	Credit Category	Target Credit (Points)	TBC Credits (Points)
	Management		
1	Green Star Accredited Professional	1	
2	Commissioning and Tuning	3	
3	Adaptation and Resilience	2	
4	Building Information	1	
5	Commitment to Performance	2	
6	Metering and Monitoring	1	
7	Responsible Building Practices	2	
8	Operational Waste	1	
	Indoor Environment Quality		
9	Indoor Air Quality	2	2
10	Acoustic Comfort	2	1
11	Lighting Comfort	2	1
12	Visual Comfort	1	2
13	Indoor Pollutants	2	
14	Thermal Comfort	1	1
	Energy		
15	Greenhouse Gas Emissions & GreenPower	5	3
16	Peak Electricity Demand Reduction	1	
	Transport		
17	Sustainable Transport	4	1
	Water		
18	Potable Water	4	1
	Materials		
19	Life Cycle Impacts	2	2
20	Responsible Building Materials	2	1
21	Sustainable Products	2	1

Credit Code	Credit Category	Target Credit (Points)	TBC Credits (Points)
22	Construction and Demolition Waste	1	
	Land Use & Ecology		
23	Ecological Value		1
24	Sustainable Sites		1
25	Heat Island Effect	1	
	Emissions		
26	Stormwater		1
27	Light Pollution	1	
28	Microbial Control		1
29	Refrigerant Impacts		1
	Innovation		
30	Innovation Challenge	1	2

Green Star Rating Scale				
Best Practice	4 STAR: 45 – 59 points	CORE POINTS: 100 INNOVATION: +10	47	23
Australian Excellence	5 STAR: 60 – 75 points			
World Leadership	6 STAR: 75+ points			

The Green Star initiatives will be reviewed during schematic design and addressed in more detail during detailed design. A formal certified rating is not being targeted.

6.0 Climate Change Assessment

A Climate Change Assessment has been undertaken for the development. The analysis identifies the impacts and associated risks of climate change over the project lifetime and so they can be addressed using design responses and monitoring where necessary. A combination of literature analysis, climate change data analysis and risk assessment workshops will be undertaken, which will review the likely climate impacts, identify the potential risks to the scheme and develop adaptation actions required to respond to any significant risks (*refer to Appendix A for an overview of modelling and research method used*). The climate change projections developed for the Sydney metropolitan area have been used to assess the building design and asset life of the project.

6.1 Current Climate and Projections

The following information documents and depicts the forecasted climate change predictions for the Sydney metropolitan areas, which will ultimately form the basis of the Climate Change Adaptation Plan.

Average Temperature

Substantial increases in projected mean, maximum and minimum temperatures; this is in line with the understanding of the effect of further increases in greenhouse gas concentrations.

Confidence data: Very high

Average Air Temperature

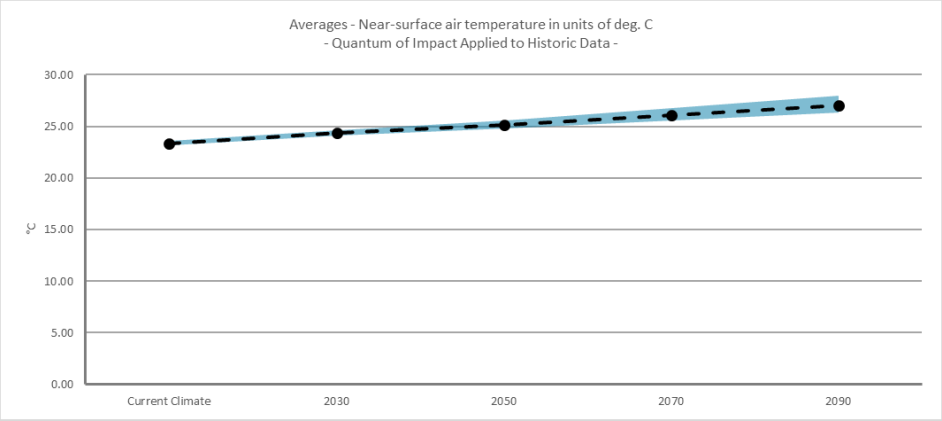

Figure 4: Projection of Average Air Temperature

Average Minimum Temperature

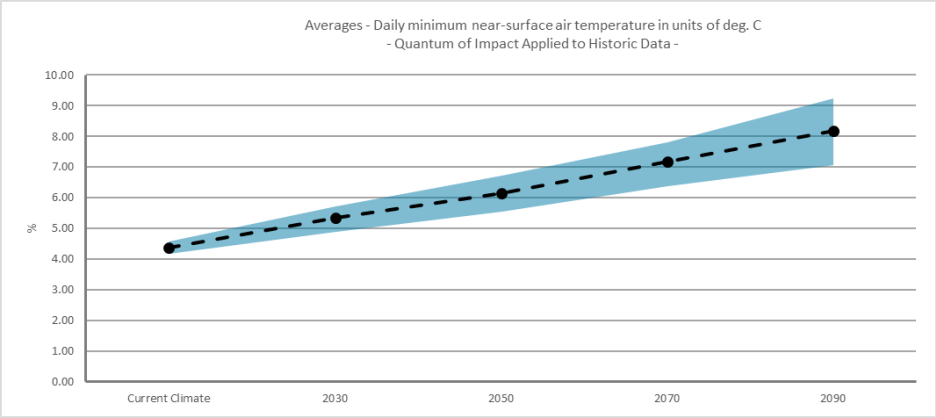

Figure 5: Projection of Average Minimum Temperature

Average Maximum Temperature

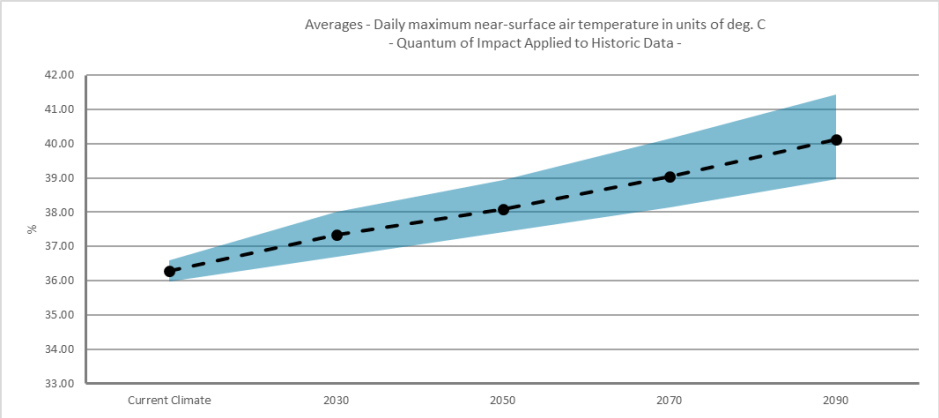

Figure 6: Projection of Average Maximum Temperature

Extreme Temperature

Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells. Frost risk are expected to decrease.

Confidence data: Very high

Extreme Minimum Temperature

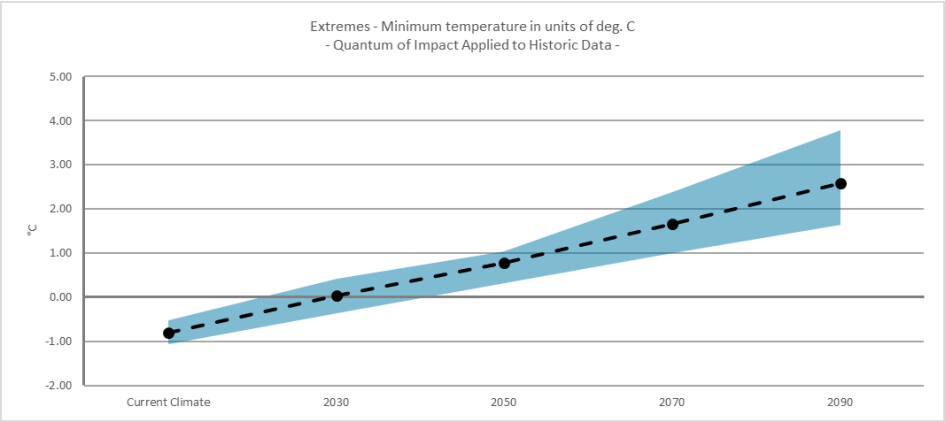

Figure 7: Projection of Extreme Minimum Temperature

Extreme Maximum Temperature

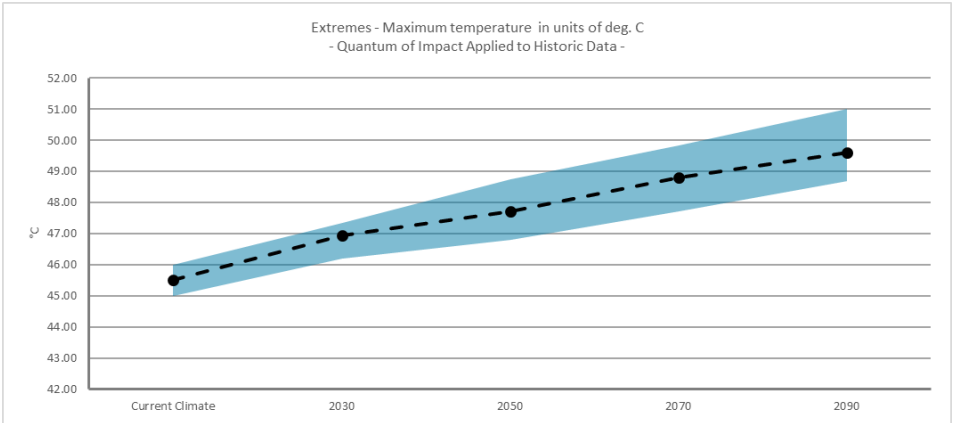

Figure 8: Projection of Extreme Maximum Temperature

Relative Humidity

Relative humidity is expected to gradually decrease by a very slight margin over the projected future time period.

Confidence data: Medium

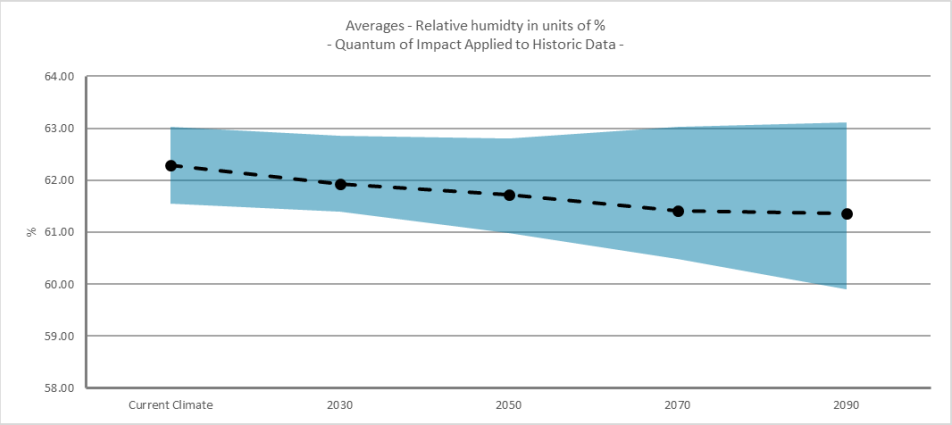

Figure 9: Projection of Relative Humidity

Rainfall

Natural climate variability is projected to remain the major driver of rainfall changes in the next few decades. Models show a range of results; with a slight decrease in rainfall during winter and spring, and slight increase during summer and autumn. An impact assessment in this region should consider both the potential risks of a drier and wetter climate.

Confidence data: Medium

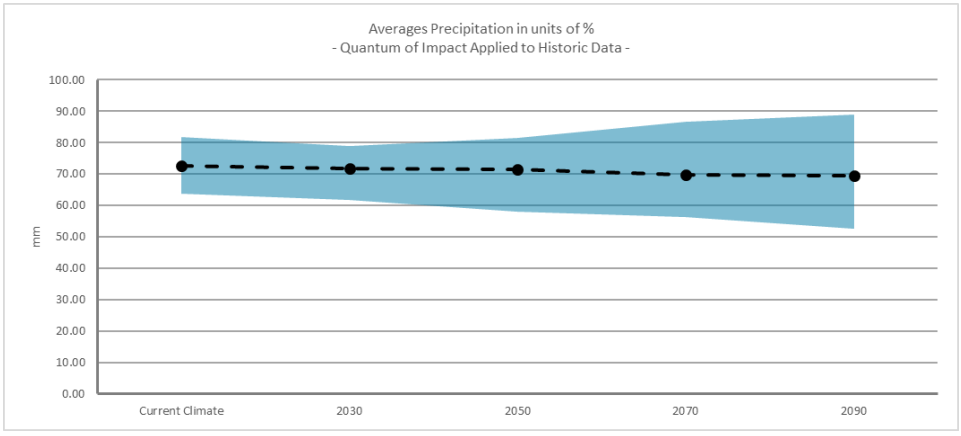

Figure 10: Projection of Average Precipitation

Extreme Rainfall

Increased intensity of extreme rainfall events is projected. The understanding of the physical processes that causes extreme rainfall, coupled with modelling projections, indicates a future increase in the intensity of extreme rainfall events (although the magnitude of the increases cannot be confidently projected).

Confidence data: High

Maximum 1-day rainfall

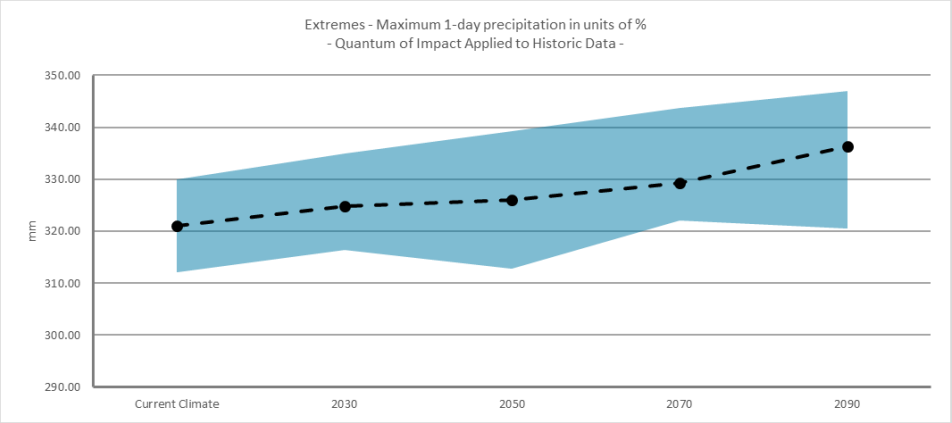

Figure 11: Projection of Extreme Maximum 1 Day Rainfall

Maximum 1 in 20-year daily rainfall

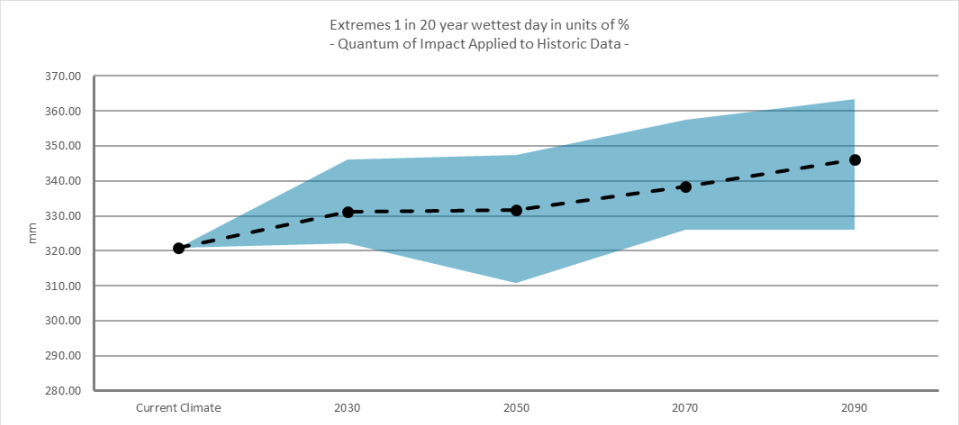

Figure 12: Projection of Maximum 1 in 20 Year Rainfall

Shortwave Radiation

An increase in solar radiation is projected particularly in cooler season.

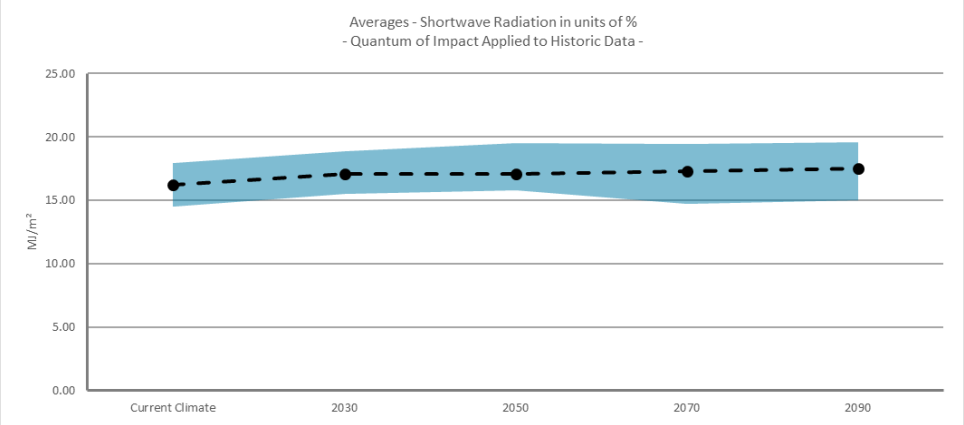

Figure 13: Projection of Average Shortwave Radiation

Evapotranspiration

Potential evapotranspiration is projected to increase in all seasons as warming progresses.

Confidence data: High

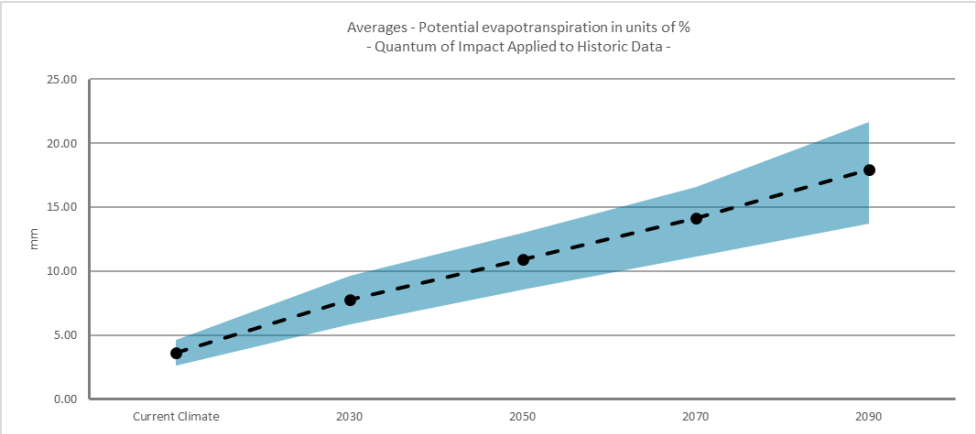

Figure 14: Projection of Average Evapotranspiration

Fire

A harsher weather climate is predicted; however, the development location does not fall within a bushfire risk zone.

Confidence data: High confidence in temperature changes combined with low confidence in rainfall changes.

Drought

Increased time spent in drought due to increased temperatures.

Confidence data: Medium confidence.

Sea Level Rise

The predicted sea level rise for the Sydney Metropolitan region is between 0.38m and 0.81m; however, this does not affect the development site as depicted in the mapping prediction below.

Confidence data: Very high

Figure 15: Location Sea Level Rise Map

Storm Events

The increase in temperatures is expected to see the severity of storms increasing, including high rainfall and wind periods.

Confidence data: Medium

6.2 Risks Identified

Derived from the climate projections, a project specific Climate Risk Register consisting of 25 weather-related risks will be created. These risks will be evaluated through an analysis of current conditions, and projected climatic changes for 2030, 2050, 2070 and 2090. The analysis will be comprised of a qualitative assessment consistent with AS/NZS ISO 31000:2009 *Risk Management–Principles and Guidelines* (Standards Australia 2009). The level of risk will be assessed by considering the potential impacts of the proposed development prior to application of any mitigation or management measures.

In assessing the risks, it will be assumed that the development will take a standard approach to building design. Identified risks will be comprised of the likelihood of an event occurring and the potential consequence. For the proposal, the following descriptors will be adopted for 'likelihood' and 'consequence'.

Table 4: Risk Descriptors

LIKELIHOOD		CONSEQUENCE	
A	Almost certain	**1**	Widespread and/or irreversible impact
B	Likely	**2**	Extensive but reversible (within 2 years) impact or irreversible local impact
C	Possible	**3**	Local, acceptable or reversible impact
D	Unlikely	**4**	Local, reversible, short term (<3 months) impact
E	Rare	**5**	Local, reversible, short term (<1 month) impact

Identified risks will be rated as: very low, low, medium, and high based on their likelihood and consequence as outlined in Table below. All high risk items will be mitigated by specific design responses.

Table 5: Climate Change Risks Evaluation Matrix

CONSEQUENCE	LIKELIHOOD A	B	C	D	E
1	High	High	Medium	Low	Very Low
2	High	High	Medium	Low	Very Low
3	Medium	Medium	Medium	Low	Very Low
4	Low	Low	Low	Low	Very Low
5	Very Low	Very Low	Very Low	Very Low	Very Low

The following table details the climate-based risks that are identified within the Climate Risk Register and the potential impacts that could adversely affect the proposed development.

Table 6: Climate Risk Register

Risk Reference	Climate Driver	Risk Description
1	*Increased average temperatures*	Increased cooling loads leading to increased maintenance and utility costs.
2	*Increased average temperatures*	Increased cooling loads leading to increased consumption; leading to a lower NABERS Energy rating.
3	*Increased average temperatures*	Urban heat island impacts become stronger causing localised additional temperature increases.
4	*Increased maximum temperatures*	Air conditioning system may not have capacity to maintain comfort conditions office spaces.
5	*Increased maximum temperatures*	Sustained periods of discomfort leading to installation of addition cooling units. Impact to electrical infrastructure.
6	*Increased maximum temperatures*	The local electricity infrastructure may be under capacity leading to brown/black outs.
7	*Increased maximum temperatures*	Higher rates of expansion of building materials, causing additional maintenance or failure.
8	*Increased maximum temperatures*	Increase in soil dryness could affect the buildings structure.
9	*Droughts*	Increased time in drought leading to water shortages impacting onsite water supply.
10	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building and damaging building fabric.
11	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing increased surface water and risk of injury.
12	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing disruption to building systems (electrical and ITC).

13	*Increased extreme rainfall*	Inundation of storm water system causing excessive overflow to adjacent waterways (Reedy Creek).
14	*Increased extreme rainfall*	Inundation of storm water system causing flooding of local environment, including car park and landscaping. Damage to external property and vehicles.
15	*Increased extreme rainfall*	Inundation of storm water system causing flooding of local environment, including car park and landscaping. Increased chance of injury and potential loss of life.
16	*Increased storm activity*	Increased wind speeds causing damage to building facade and roof.
17	*Increased storm activity*	Increased wind speeds causing damage or dislodgment of proposed roof top plant zone.
18	*Increased storm activity*	Hail causes an inundation of rainwater collection systems (roof, guttering, pipework) leading to water flowing into building and damaging building fabric.
19	*Increased storm activity*	Hail causes inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing increased surface water and risk of injury.
20	*Increased storm activity*	Hail causes damage to building elements including mechanical/electrical systems, glazing and signage. This could lead to severe injury.
21	*Increased storm activity*	Increased wind speeds causing non-fixed external components to move (if applicable). Potential for injury, damage to component or damage to the building.
22	*Increased storm activity*	Increased wind speeds causing neighbouring structures to dislodge debris that could damage the building.
23	*Fire*	Fire (bushfire) on site, or nearby causing damage to property or visitor injury.
24	*Sea Level Rise*	Sea level rise causing on-site flooding or stormwater discharge issues.
25	*Social Impacts*	Storms, floods or fires cause evacuation of the local neighbourhood/region and people look to the centre as a place of refuge.

6.3 Climate Risk Assessment and Mitigation Measures

Table 7: Climate Risk Responses

Risk Reference	Climate Driver	Risk Description	Environment Impact	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Design team to propose possible Mitigation Strategy
1	*Increased average temperatures*	Increased cooling loads leading to increased maintenance and utility costs.	Yes	Yes	-	Medium (3)	High (B)	Medium	Main Contractor	It is assumed that the building façade envelope will be optimised through the implementation of thermally efficient construction materials and insulation to accommodate for predicted increases in average temperature.
2	*Increased average temperatures*	Increased cooling loads leading to increased consumption.	Yes	Yes	-	Medium (3)	High (B)	Medium	Main Contractor	It is assumed building services and systems will be designed to be as energy efficient as possible, with the capacity to accommodate for projected increases in average temperatures
3	*Increased average temperatures*	Urban heat island impacts become stronger causing localised additional temperature increases.	Yes	Yes	Yes	Medium (3)	Low (E)	Medium		
4	*Increased maximum temperatures*	Air conditioning system may not have capacity to maintain comfort conditions office spaces.	-	Yes	Yes	Medium (3)	Medium (C)	Medium		
5	*Increased maximum temperatures*	Sustained periods of discomfort leading to installation of addition cooling units. Impact to electrical infrastructure.	-	Yes	Yes	Medium (3)	Medium (C)	Medium		
6	*Increased maximum temperatures*	The local electricity infrastructure may be under capacity leading to brown/black outs.	Yes	Yes	Yes	Medium (3)	Medium (C)	Medium		
7	*Increased maximum temperatures*	Higher rates of expansion of building materials, causing additional maintenance or failure.	-	Yes	-	Low (4)	High (B)	Medium		

Risk Reference	Climate Driver	Risk Description	Environment Impact	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Design team to propose possible Mitigation Strategy
8	*Increased maximum temperatures*	Increase in soil dryness could affect the buildings structure.	-	Yes	-	Low (4)	High (B)	Medium		
9	*Droughts*	Increased time in drought leading to water shortages impacting onsite water supply.	Yes	Yes	-	Medium (3)	Low (E)	Medium		
10	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building and damaging building fabric.	-	Yes	Yes	Medium (3)	Low (E)	Medium		
11	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing increased surface water and risk of injury.	-	Yes	Yes	Medium (3)	Medium (C)	Medium		
12	*Increased extreme rainfall*	Inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing disruption to building systems (electrical and ITC).	-	Yes	Yes	Medium (3)	High (B)	High	Hydraulic / Civil Contractor	It is assumed the hydraulics design will take into account the capacity of the stormwater system and pipework to accommodate for the increased likelihood and severity of extreme rainfall events.
13	*Increased extreme rainfall*	Inundation of storm water system causing excessive overflow to adjacent waterways (Reedy Creek).	Yes	Yes	-	Medium (3)	Medium (C)	Medium		
14	*Increased extreme rainfall*	Inundation of storm water system causing flooding of local environment, including car park and landscaping. Damage to external property and vehicles.	-	Yes	-	Medium (3)	Medium (C)	Medium		

Risk Reference	Climate Driver	Risk Description	Environment Impact	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Design team to propose possible Mitigation Strategy
15	*Increased extreme rainfall*	Inundation of storm water system causing flooding of local environment, including car park and landscaping. Increased chance of injury and potential loss of life.	-	Yes	Yes	Medium (3)	Medium (C)	Medium		
16	*Increased storm activity*	Increased wind speeds causing damage to building facade and roof.	-	Yes	-	Medium (3)	Medium (C)	Medium		
17	*Increased storm activity*	Increased wind speeds causing damage or dislodgment of proposed roof top plant zone.	-	Yes	-	Medium (3)	Medium (C)	Medium		
18	*Increased storm activity*	Hail causes an inundation of rainwater collection systems (roof, guttering, pipework) leading to water flowing into building and damaging building fabric.	-	Yes	-	Medium (2)	High (B)	High	Hydraulic Contractor	It is assumed the hydraulics design will take into account rainfall design capacity of the stormwater system to accommodate for the increased likelihood and severity of extreme rainfall events; including mitigation of overflow caused by debris collection in the pipework.
19	*Increased storm activity*	Hail causes inundation of the rainwater collection systems (roof, guttering, pipework) leading to water flowing into building causing increased surface water and risk of injury.	-	Yes	Yes	Medium (3)	Medium (C)	Medium		
20	*Increased storm activity*	Hail causes damage to building elements including mechanical/electrical systems, glazing and signage. This could lead to severe injury.	-	Yes	Yes	Medium (3)	High (B)	Medium		
21	*Increased storm activity*	Increased wind speeds causing non-fixed external components to move (if applicable). Potential for injury, damage to component or damage to the building.	-	Yes	-	Medium (3)	Medium (C)	Medium		

Risk Reference	Climate Driver	Risk Description	Environment Impact	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Design team to propose possible Mitigation Strategy
22	*Increased storm activity*	Increased wind speeds causing neighbouring structures to dislodge debris that could damage the building.	-	Yes	-	Medium (3)	Medium (C)	Medium		
23	*Fire*	Fire (bushfire) on site, or nearby causing damage to property or visitor injury.		Yes	Yes	Low (1)	Low (E)	Low		
24	*Sea Level Rise*	Sea level rise causing on-site flooding or stormwater discharge issues.		Yes	Yes	Low (1)	Low (E)	Low		
25	*Social Impacts*	Storms, floods or fires cause evacuation of the local neighbourhood/region and people look to the centre as a place of refuge.		Yes	Yes	Low (1)	Medium (C)	Low		

7.0 Sustainability Framework

Table 8: Sustainability Framework

Impact		Green Star Design & As-Built Alignment	Potential Strategies / Sustainability Initiatives
	**Energy Efficiency**	**Energy** • 15 Greenhouse Gas Emissions • 16 Peak Electricity Demand Reduction **Management** • 2 Commissioning and Tuning • 6 Metering and Monitoring	• PUE under 1.5 • Energy-efficient servers • Energy efficient lighting • Energy efficient electrical appliances and equipment • Passive design for office spaces • Heat recovery ventilation • No fossil fuels on site (avoid natural gas) • Smart controls • Energy metering monitoring • Minimise urban heat island effect through more reflective roof surfaces providing a ‘ cool roof ‘ (either PV or high SRI materials) • Install PV system on the roof • Battery storage enabled • Consider purchase GreenPower in operation
	**Water**	**Water** • 18 Potable Water **Management** • 2 Commissioning and Tuning • 6 Metering and Monitoring	• Low flow fittings • Rainwater harvesting for reuse • Passive stormwater treatment • Water metering • Minimal irrigation • Water efficient appliances
	**Travel & Transport**	**Transport** • 17 Sustainable Transport	• Low Emission Vehicle Infrastructure • Green Travel Plan
	**Ecology**	**Land Use & Ecology** • 23 Ecological Value • 24 Sustainable Sites • 25 Heat Island Effect	• Landscaping designed to support indigenous flora, fauna and biodiversity • Minimise urban heat island effect through more reflective roof surfaces (either PV or high SRI materials

Impact		Green Star Design & As-Built Alignment	Potential Strategies / Sustainability Initiatives
			• Stormwater retention and filtration
	**Management**	**Management** • 2 Commissioning and Tuning • 4 Building Information • 5 Commitment to Performance • 7 Construction Environmental Management	• Comprehensive Commissioning and Tuning • Comprehensive operations and maintenance information • Set targets, monitor and reduce energy and water use • Responsible Construction Practices
	**Health & Wellbeing**	**Indoor Environment Quality** • 9 Indoor Air Quality • 10 Acoustic Comfort • 11 Lighting Comfort • 12 Visual Comfort • 14 Thermal Comfort	• High-quality indoor environment quality • Access to daylight and shading devices for glare control for the office areas • Relaxation zones, outdoor comfort & shelter • IEQ monitoring • Acoustic comfort • Provision of water bubblers for office areas
	**Climate Risk & Adaptation**	**Management** • 3 Adaptation and Resilience	• Coping with increasing extremes of heat, wind and rain • Protection against storms, drought, flooding and blackouts • Future proofing infrastructure
	**Pollution**	**Emissions** • 26 Stormwater • 27 Light Pollution • 28 Microbial Control • 29 Refrigerant Impacts	• Reduce air pollution • Reduce noise pollution • Reduce night sky pollution via lighting design and control • Manage stormwater
	**Waste**	**Management** • 8 Operational Waste **Materials** • 22 Construction and Demolition Waste	• Operational Waste Management Plan - set targets and reduce • Ban single-use plastics on-site • Recycling hub with space for separation and storage of different waste streatms • Divert at least 80% construction waste from landfill.

Impact		Green Star Design & As-Built Alignment	Potential Strategies / Sustainability Initiatives
	**Materials & Supply Chain**	**Indoor Environment Quality** • 13 Indoor Pollutants **Materials** • 19 Life Cycle Impacts • 20 Responsible Building Materials • 21 Sustainable Products	• Low VOC materials including paints, sealants, adhesives and flooring • Formaldehyde-freee materials • Best practice PVC • Portland cement replacement with industrial waste product • Third party certified materials and products • Local procurement of materials • Consider risk of Modern Slavery • Design for durability and resilience • FSC / PEFC certified Timber

8.0 Non-climate Specific Risk Assessment

Table 9: Non-climate Specific Risk Responses

Reference	Risk	Risk Description	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Possible Mitigation Strategy
1	*Electrical*	Rising cost of electricity.	Yes	-	High (1)	Low (D)	Medium	Building Services Engineers	Optimise energy usage efficiency.
2	*Electrical*	Power brown and black outs from power outage.	Yes	-	Low (4)	High (A)	Medium	Building Services Engineer	Sufficient back-up power generator.
3	*Electrical*	Electrical fault resulting in fire.	Yes	Yes	Medium (3)	High (A)	Medium	Electrical engineer	Regular maintenance of hardware and electrical systems.
4	*Security*	Prevent building penetration by vehicle.	Yes	-	Low (4)	High (A)	Medium	Structural / Security Engineer	Optimise building façade & landscaping to mitigate intentional damage.
3	*Security*	Restrict access of unauthorised personnel into the building.	Yes	Yes	Low (4)	High (A)	Medium	Security Engineer	Security monitoring system.
6	*Building Integrity*	Air leakage which reduces the ability for the room to be sufficiently cooled.	Yes	-	Low (4)	Medium (C)	Low	Main Contractor	Ensure enclosure of building envelope and façade integrity.
7	*Building Integrity*	Prevent sever processing errors through grounding and equipment protection	Yes	-	Low (4)	High (B)	Low	Electrical Engineer	Raised floor grounding.
8	*Building Integrity*	Damage to flooring as a result of moving server racks.	Yes	-	Medium (3)	Low (D)	Low	Architect	Consider durable flooring material.

Reference	Risk	Risk Description	Economic Impact	Social Impact	Likelihood	Consequence	Risk Rating	Responsible Party	Possible Mitigation Strategy
9	*Hardware*	Weakness of IT structural support resulting in damage to adjacent hardware.	Yes	-	Low (4)	Medium (C)	Low	Main Contractor / Tenant	Regular maintenance of hardware structural support (server racks etc).

Appendix A: Climate Modelling

Overview of Modelling and Research

Projections of the climate change impacts utilised in this report are based on data available on the 'Climate Change in Australia' as developed by the CSIRO.

CMIP5 is an internationally coordinated effort to use state-of-the-art Global Climate Models and Earth System Models to perform a set of pre-defined climate experiments. CMIP5 has taken datasets from a range of internationally recognised climate models and has built an archive that can be readily analysed because all datasets have a consistent format. The CMIP5 data archive provides an efficient means for locating and obtaining datasets for local analysis.

The CMIP5 climate model simulations used in 'Climate Change in Australia' are based on four greenhouse gas and aerosol emission scenarios, called Representative Concentration Pathways (RCP) RCP8.5, RCP6.0, RCP4.5 and RCP2.6.

The Intergovernmental Panel on Climate Change (IPCC) released greenhouse gas RCPs which are used in climate modelling. Global Climate Models (GCM) underpin the science of the IPCC's fifth Assessment report. Four RCPs (RCP2.6, RCP4.5, RCP6 and RCP8.5) are representations of future radiative forcing and greenhouse gas scenarios.

Table 10: Climate Change Projection Scenarios

Scenario	Description
RCP2.6	Developed by the IMAGE modelling team of the PBL Netherlands Environmental Assessment Agency. The emission pathway is representative of scenarios in the literature that lead to very low greenhouse gas concentration levels. It is a "peak-and-decline" scenario; its radiative forcing level first reaches a value of around 3.1 W/m² by mid-century and returns to 2.6 W/m² by 2100. In order to reach such radiative forcing levels, greenhouse gas emissions (and indirectly emissions of air pollutants) are reduced substantially, over time (Van Vuuren et al. 2007a). (Characteristics quoted from van Vuuren et.al. 2011)
RCP4.5	Developed by the GCAM modelling team at the Pacific Northwest National Laboratory's Joint Global Change Research Institute (JGCRI) in the United States. It is a stabilization scenario in which total radiative forcing is stabilised shortly after 2100, without overshooting the long-run radiative forcing target level (Clarke et al. 2007; Smith and Wigley 2006; Wise et al. 2009).
RCP6.0	Developed by the AIM modelling team at the National Institute for Environmental Studies (NIES) in Japan. It is a stabilisation scenario in which total radiative forcing is stabilised shortly after 2100, without overshoot, by the application of a range of technologies and strategies for reducing greenhouse gas emissions (Fujino et al. 2006; Hijioka et al. 2008).
RCP8.5	Developed using the MESSAGE model and the IIASA Integrated Assessment Framework by the International Institute for Applied Systems Analysis (IIASA), Austria. This RCP is characterised by increasing greenhouse gas emissions over time, representative of scenarios in the literature that lead to high greenhouse gas concentration levels (Riahi et al. 2007).

The RCP scenarios can be visualised based on the following emissions projections to 2100.

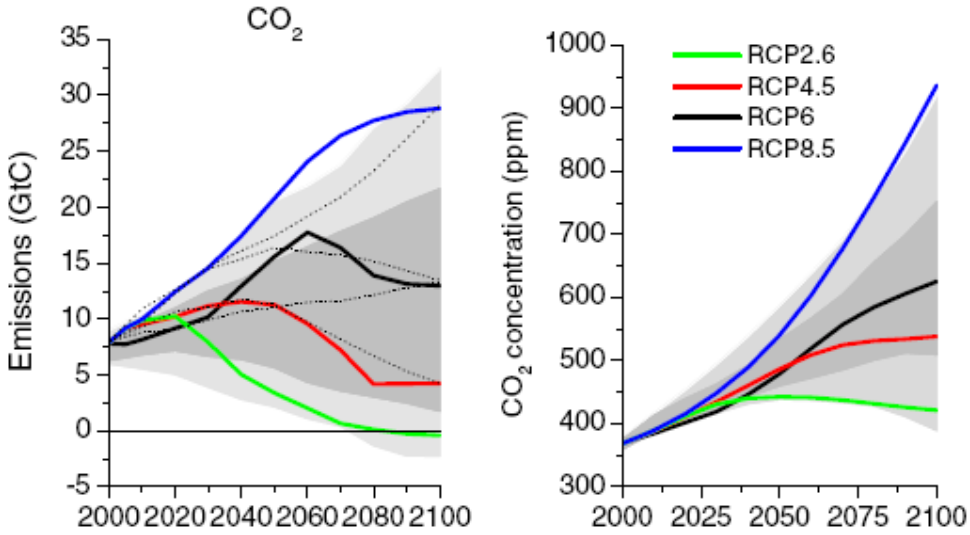

Figure 16: Emissions projection for various RCP scenarios

The 'Climate Change in Australia' website provides projections of future climate summarised into regional impacts, at Natural Resource Management (NRM) clusters and sub-clusters. The summary of the climate change impacts from the website has been combined with data from the nearest Bureau of Meteorology weather station to develop the current and future climate for 17 Roberts Rd, Eastern Creek.

Figure 17: NRM clusters and sub-clusters