LA TROBE UNIVERSITY

LA TROBE UNIVERSITY CLIMATE ADAPTATION PLAN

DECEMBER 2018

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La Trobe University Climate Adaptation Plan

Client: La Trobe University

WSP
Level 15, 28 Freshwater Place
Southbank VIC 3006

Tel: +61 3 9861 1111
wsp.com

REV	DATE	DETAILS
-	30/10/18	Issued for La Trobe University review and comment
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	NAME	DATE	
Prepared by:	Jenny Lewis	30/10/18	
Reviewed by:	Brenda Kingston	30/10/18	
Approved by:	Jenny Lewis	30/10/18	

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ABBREVIATIONS

AHD	Australian Height Datum
AR4	The IPCC Fourth Assessment Report (2007)
AR5	The IPCC Fifth Assessment Report (2013)
AR6	The IPCC Sixth Assessment Report (due 2022)
AS	Australian Standard
BoM	Bureau of Meteorology
CAP	Climate Adaptation Plan
CRP	Climate Resilience Plan
CSIRO	Commonwealth Scientific and Industrial Research
ENSO	El Niño–Southern Oscillation
FRM	Floodplain Risk Management
GBCA	Green Building Council of Australia
GCM	Global Climatic Models
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
ITS	Information Technology Systems
RCPs	Representative Concentration Pathways

EXECUTIVE SUMMARY

THE PROJECT

This Climate Adaptation Plan (CAP) has been prepared to support La Trobe University to become more resilient to the impacts of a changing climate and natural disasters. The CAP relates to the University's Bundoora campus in Melbourne, and aligns with the University's Green Star Communities rating commitment to develop a CAP for the campus.

CLIMATE TRENDS AND PROJECTIONS

Climate change is having worldwide impacts on society, the economy and the environment. In Australia, the *CSIRO Climate Change in Australia 2015* publication, states that: "Observed climate information indicates that Australian average surface air temperature has increased by 0.9°C since 1910, and many heat-related records have been broken in recent years. Sea level has risen about 20cm over the past century."

Across Australia the upward trend in temperature and sea level together with an increased intensity of rainfall and cyclonic activity pose an increasing humanitarian and financial risk to business over time.

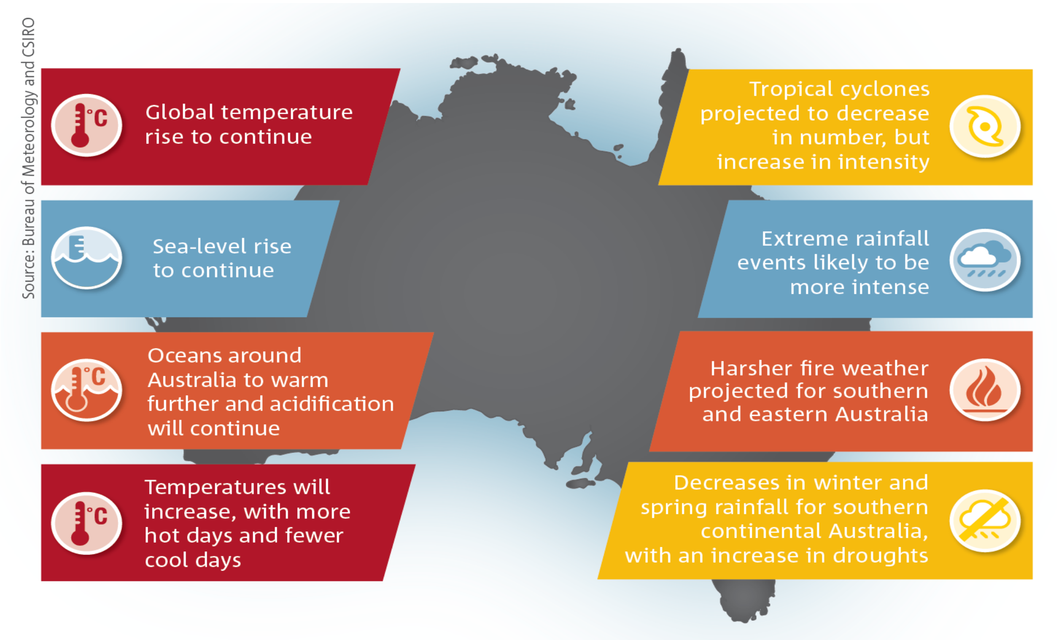


Figure 1 BoM and CSIRO General Synopsis

The climate projections for this Climate Adaptation Plan were selected using a worst-case climate modelling pathway (representative concentration pathway (RCP) 8.5), to support long-term planning for a changing climate. The near future (2030) and far future (2090) climate projections cover 5 key climate variables: rainfall, temperature, wind speed, sea level rise, and bushfire. Consideration is also given to natural hazards, rainfall intensity, solar radiation and drought. The objective of this research is to better understand the climate trends, which in turn will set the foundation for risk management decision making.

RISK ASSESSMENT PROCESS

The purpose of the risk assessment is to understand potential exposure of an asset to the impacts of climate change for informed mitigations to be adopted as part of an adaptation strategy. The assessment process involves identification of initial risks without adaptation controls. These risks are then reassessed by developing adaptation or mitigation measures. The ultimate objective of this process is the design, construction and operation of climate resilient communities.

Adaptation measures to address climate change vulnerability can include both design measures, such as physical changes to achieve or facilitate adaptation, or operational measures, such as changes to contracts or implementing an emergency management plan. Adaptations may also be implemented on a timescale basis to respond to increasing impacts of climate change in the near and long term.

SUMMARY OF REASSESSED CLIMATE RISKS

The climate risks identified for the La Trobe University Melbourne campus within the scope of this CAP – both prior to and after the incorporation of adaptation measures, are summarised in table below.

Table 1 Summary of initial and reassessed risks

RISK RATING	E EXTREME	H HIGH	M MEDIUM	L LOW	TOTA L
NUMBER OF RISKS	0	11	17	0	28
NUMBER OF REASSESSED RISKS	0	0	19	9	28

The 28 potential climate change risks identified in the risk assessment component of the Climate Adaptation Plan have been addressed by specific design and operational adaptation measures, as detailed in Section 4.6.

Adaptation measures to mitigate and reduce the likelihood of that risk event occurring were applied to all 28 of the identified potential climate change risks. There were no extreme risks and 11 high risks which have been mitigated to a medium level risk. Nine of the medium risks have been mitigated to low level risks.

The 11 high risks and their risk mitigation strategies are summarised in the table below:

Risk	Proposed Adaptation Measure
1. Risk due to increased frequency and intensity of hot days: Ability to cool critical infrastructure may be affected by extreme heat, leading to system failure or service interruptions.	Increase infrastructure insulation and/or thermal mass for extreme heat. Timetable to be designed to avoid extreme days/ hours, and remote learning facilities implemented during heatwaves where possible.
2. Increased mean maximum temperature creates risk to buildings and structure of greater structural fatigue	Use materials with tolerance for higher heat stress. Develop emergency plans for evacuation and keep all building users informed.
3. Longer and more severe heatwaves combined with drought this could cause structural damage from footing movements in dry soil	Design concrete pavements and other structures to withstand shrink-swell changes in underlying soil during design development. Regular maintenance to be performed to identify weak areas. Develop emergency plans for evacuation and keep all building users informed.
4. Inundation of civil drainage infrastructure/ catchments with resulting flood damage and safety risk. Impact on flood immunity levels. Lakes/reservoirs north of main drive could flood water bodies passing through campus	Increase the water storage in moats to hold more water during intense rainfall and increase resistance to flooding. Design drainage to ensure the pipe network is running full in a storm event.
5. Flooding causing access restrictions to buildings and for emergency vehicles.	Identify probable areas and inform student and staff of alternate routes to use. Develop disaster plans for emergency vehicles access.
6. Buildings located close to the moats at risk of flooding and flood damage.	As per 4: Increase the water storage in moats to hold more water during intense rainfall and increase resistance to flooding. Design drainage to ensure the pipe network is running full in a storm event.
7. Water damage to substations and electrical circuitry resulting in disruption to electricity supply and safety risk.	Protect electrical equipment with waterproof materials that can withstand heavy rainfall. Ensure all gaps are sealed. Substations to be set above critical level.
8. High wind speeds causing branches, building façade elements, or other loose debris to blow from buildings and become a safety risk to people in the vicinity	Evacuate buildings and campus during high wind events. Create safety shelters for the users in protected areas. Proactive management of trees and vegetation to protect people and infrastructure in storm events. Issue warnings to stay indoors and indicate safe passages for users
9. Wind damage to electrical circuitry (overhead wiring) resulting in disruption to services and increased maintenance requirements	Move services underground where feasible. Regular maintenance of open services Warnings issued to users in case of severe storms
10. Bushfires encroaching on campus from surrounding bushland putting human life at risk.	Maintain surrounding bushland to reduce fire load through removing fallen branches and planned burns when necessary. Implement fire evacuation procedures. Ongoing review/updates of Bushfire Management Plan by LTU
11. Fire damage to campus buildings and infrastructure.	Ensure buildings and infrastructure comply with the current relevant Australian Standards. Perform maintenance before bushfire season to investigate locations of vulnerability. Ongoing review/updates of Bushfire Management Plan by LTU

1 INTRODUCTION

1.1 PURPOSE OF THIS PLAN

This Climate Adaptation Plan (CAP) has been developed to assist La Trobe University to become more resilient to the impacts of a changing climate and natural disasters.

The purpose of this CAP is to:

- Define the climate change projections for the campus;
- Define the risk assessment process;
- Define the direct and indirect risks to the campus associated with climate change;
- Outline the project management approach to demonstrate compliance with the Green Star Communities Climate Resilience credit;
- Manage risk through:
    - identification of climate change and associated natural hazard related risk and assign risk rating;
    - where necessary mitigate risk though adaptation measures and re-assess risk;
- Enhance resilience through design and operational action; and
- Define roles and responsibilities associated with the achievement of adaptation responses.

1.2 CLIMATE CHANGE RISK CONTEXT

Climate change is having worldwide impacts on society, the economy and the environment. In Australia, the *CSIRO Climate Change in Australia 2015* publication, states that: "Observed climate information indicates that Australian average surface air temperature has increased by 0.9°C since 1910, and many heat-related records have been broken in recent years. Sea level has risen about 20cm over the past century."

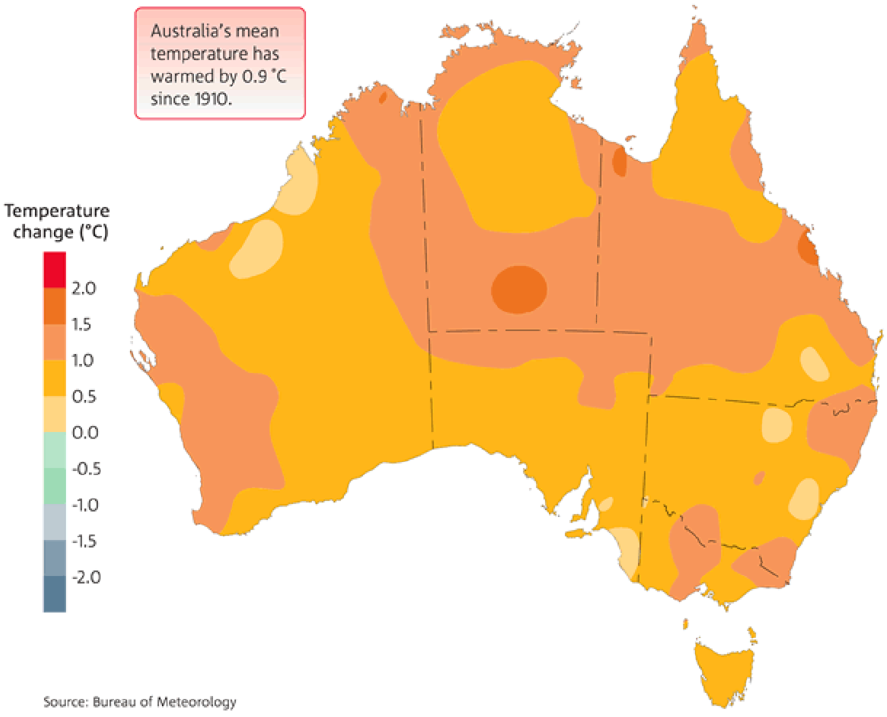


Figure 2 BoM Mean Temperature Increase since 1910

Climate risks are reduced through Climate Change Adaptation Plans (CAPs), which advise planning, design, construction and business operations, using traditional risk management techniques to classify risk and to develop adaptation strategies, with the aim of futureproofing developments.

1.3 CLIMATE ADAPTATION PLAN PROCESS

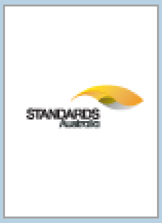
This Climate Adaptation Plan (CAP) is the result of a collaborative and iterative risk management process as presented below in Figure 3 CAP Process.

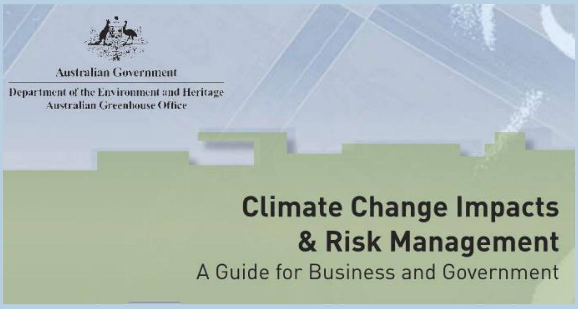
Figure 3 CAP Process

The purpose of the risk assessment is to help mitigate the potential for climate change induced risks through informed decision making, which in turn enables the design and operation of climate resilient infrastructure.

The CAP has followed guidance from the standards listed below (Table 2). It also supports and aligns with the sustainability benchmarking frameworks listed in the table:

Table 2 Standards and sustainability benchmarking frameworks

STANDARDS AND SUSTAINABILITY BENCHMARKING FRAMEWORK	DESCRIPTION
	Australian Standard AS 5334-2013 ‘Climate change adaptation for settlements and infrastructure’ provides guidance on managing climate change risks.
 STANDARDS Australia AS/NZS ISO 31000:2009 Risk management— Principles and guidelines	ISO 31000-2009 – Risk Management – Principles and Guidance (adopted in Australia and New Zealand as AS/NZS ISO 31000:2009), provides a set of internationally endorsed principles and guidance on how organisations can integrate decisions about risks and responses into their existing management and decision-making processes.

STANDARDS AND SUSTAINABILITY BENCHMARKING FRAMEWORK	DESCRIPTION
	AGO, Climate Change Impacts & Risk Management: A Guide for Government and Business The purpose of this Guide is to assist Australian businesses and organisations to adapt to climate change
Australian Government Geoscience Australia — Australian Rainfall and Runoff	Australian Rainfall and Runoff (ARR) 2016 is a national guideline document, data and software suite that can be used for the estimation of design flood characteristics in Australia.
greenstar COMMUNITIES	The Green Star Communities rating tool rewards climate adaptation planning and management.

1.4 BASELINE DATA UPDATES

The intent of this Climate Adaptation Plan is to clarify the priorities and requirements of La Trobe University in response to the anticipated effects of climate change to inform a campus-wide strategy moving forward. The CAP is a process document which La Trobe University is expected to use as a basis for their climate adaptation response. As a minimum, the CAP should be updated whenever the base information required to develop the relevant climate change scenarios is updated. The sixth assessment review (AR6) by the IPCC is due 2022, at which point the projections and scenarios in this report should be reviewed and updated as necessary.

2 PROJECT DETAILS

2.1 CAMPUS DESCRIPTION

La Trobe University's Bundoora campus is located in Bundoora, 14 kilometres north of Melbourne city centre. The University's current masterplan has been considered within the risk assessment in identifying the climate risks and developing mitigation strategies. The masterplan was developed in 2014, with a planned completion of 2040. The University's 30-hectare Wildlife Sanctuary, developed on the site in 1967, plays an important role in the masterplan development and a commitment has been made to develop the eco-corridor along the existing water bodies that traverse the campus (moats).

Figure 4 La Trobe University masterplan

2.2 OTHER LA TROBE UNIVERSITY CAMPUSES

La Trobe University has an additional six campuses in Australia: Albury-Wodonga, Bendigo, Melbourne City, Mildura, Shepparton, and Sydney. While this CAP does not extend to other campuses, the process undergone and the strategies and approaches to risk mitigation in this report may be applied to site-specific CAPs for other University campuses.

3 CLIMATE PROJECTION DATA

3.1 CLIMATE CHANGE PROJECTIONS CONTEXT

The climate change projections used in this assessment have been derived and collated in accordance with the AS 5334-2013 ‘Climate Adaptation for Settlements and Infrastructure’. This is illustrated in Figure 5 below as six consecutive steps to determine the climate change context.

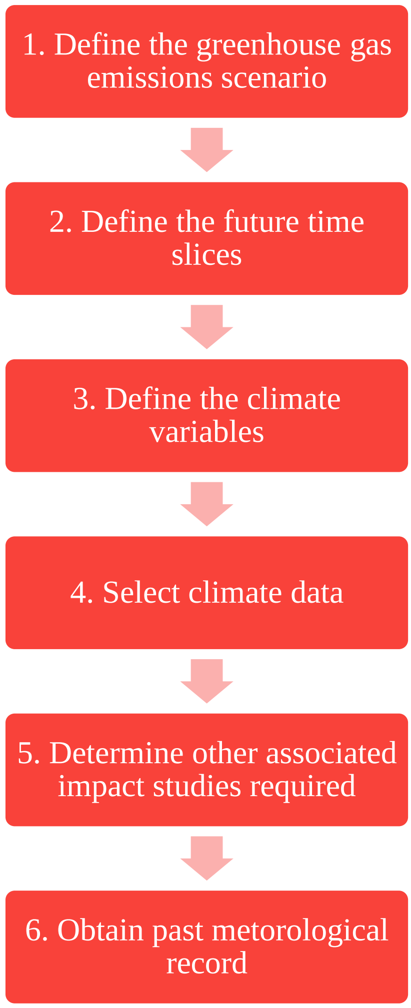


Figure 5 Steps to determine the climate change context

These steps should be applied to determine the climate change context that will inform the climate risk assessment and subsequent adaptation responses.

3.2 CLIMATE MODELLING

The Intergovernmental Panel on Climate Change (IPCC) has published four greenhouse gas concentration trajectories, known as Representative Concentration Pathways (RCPs,) which are used for climate modelling and research as detailed in Table 3.

The CSIRO and the State Governments use the IPCC greenhouse gas concentration pathways for climate projection modelling at a regional scale within Australia.

Table 3 RCPs and Global Warming

SCENARIO		GLOBAL WARMING MEAN AND LIKELY RANGE °C
RCP 2.6	Emissions peak 2010-2020, then decline substantially	1.0°C (0.3 to 1.7)
RCP 4.5	Emissions in RCP 4.5 peak around 2040, then decline	1.8°C (1.1 to 2.6)
RCP 6.0	Emissions peak around 2080, then decline	2.2°C (1.4 to 3.1)
RCP 8.5	Emissions continue to rise throughout the 21st century	3.7°C (2.6 to 4.8)

RCP 4.5 is generally used to represent the expected climate change scenario, aligning with current global emissions targets. Locally, this scenario is recommended by Australian Rainfall and Runoff (AAR) 2016 and aligns with the Australian Government's commitment under the United Nations Climate Change Agreement - Paris (2015) to cap global warming below 2°C by the end of the 21st century, compared to pre-industrial levels.

The decline in emissions from 2020 (RCP 2.6) is considered unlikely while the RCP 4.5 predictions of emissions decline from 2040 is considered reasonable at this point in time. The RCP 8.5 scenario is considered a worst case scenario. In performing the climate adaptation assessment, it has been agreed with La Trobe University that both an RCP 4.5 and an RCP 8.5 scenario will be considered, to provide a likely and worst case scenario for consideration in the both the identification and mitigation of risks. For the purpose of the risk register, the worst case RCP 8.5 scenario has been utilised. Mitigation strategies also take into account the design life of the asset under consideration.

It should be noted that this exercise is a risk management process and like any other risk management process will be subject to review, adjustment and update over time.

3.3 CLIMATE PROJECTION TIMEFRAMES

It is important to select a timeline relevant to the design life of the project and one that is appropriate to cover the asset investment horizon, as this will affect the climate projections used, the level of climate risk the asset may potentially be exposed to and the climate adaptation response.

Design life is defined as the period within which an element of the works must continue to meet the performance and technical requirements and remain within specified limits of reliability, availability and maintainability without major renewal beyond normal cyclic maintenance activities. It also benchmarks the requirements for durability.

The two future time slices which have been selected for the La Trobe University Climate Adaptation Plan are 2030 ("near future") and 2090 ("far future"). The 2030 timeframe allows consideration of a near timeframe which will see a large proportion of the University's existing assets remaining plus new assets being built as part of the current Masterplan. The 2090 timeframe allows for a more distant consideration of the future of the campus climate and how this may influence long-term Campus planning, as well as being relevant to the current planning of long-design life assets.

The 2030 and 2090 timeframes also correlate to the commonly used benchmarks for near and far climate projections by the CSIRO, and therefore projection data for these points in time is generally readily available.

3.4 CLIMATE PROJECTION DATA SOURCES

Climate projection data used in this risk assessment has been sourced from the CSIRO Climate Futures climate modelling projections – RCP 4.5 and RCP 8.5.

Historical data has been derived from the following sources:

- Bureau of Metrology reporting on historical changes to Australia's climate.
- Australian Rainfall and Runoff (AAR) 2016.

The following climate projection variables (Figure 6 & Table 4) are initially covered for potential risk consideration, however the geographical and topographical site context together with the findings of the risk workshop have ultimately determined the salient risks to the project.

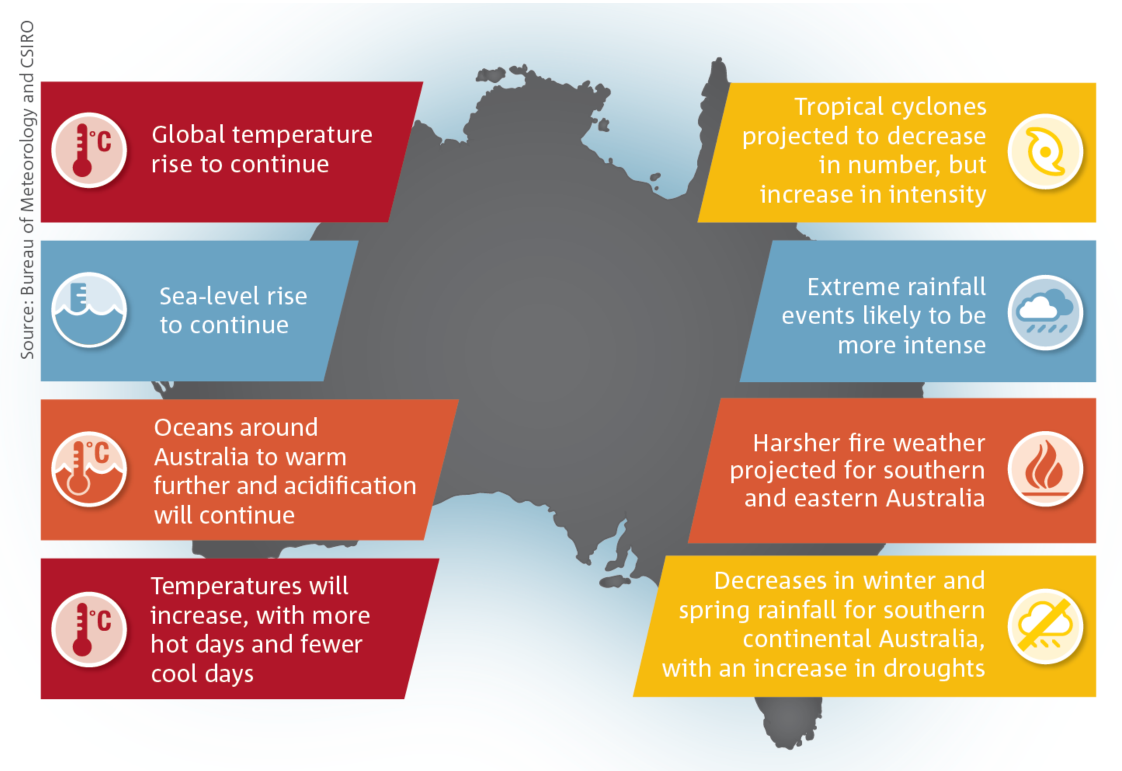


Figure 6 BoM and CSIRO general synopsis for Australia

The table below summarises the potential climate risk factors for the project which have been considered within this assessment.

Table 4 Potential climate risks

POTENTIAL RISK	DESCRIPTION
Precipitation	Changes in storm volume and rainfall intensity levels can impact via flooding and scour, or water penetration damage to infrastructure and buildings.
Sea level rise	Increases can periodic or permanent inundation to regular localised flooding of terrestrial infrastructure and buildings close to the sea.
Temperature	Changes in long term average temperatures or the temperature ranges can impact on structures and equipment operation, potentially leading to malfunction or premature failure. Sequential hot and very hot days can pose risks to habitability of buildings and to human health when adequate respite from the heat is not available.
Wind speed	Increases in sustained wind speeds or more localised gust fronts and microbursts from thunderstorm systems can cause considerable damage to exposed equipment.

POTENTIAL RISK	DESCRIPTION
Bushfire	The risk of bushfire in any given region depends on four ‘switches’. There needs to be enough vegetation (fuel), the fuel needs to be dry enough to burn, the weather needs to be favourable for fire to spread, and there needs to be an ignition source (Bradstock 2010). All four of these switches must be on for a fire to occur. The Forest Fire Danger Index (FFDI) is used to quantify fire weather. The FFDI combines observations of temperature, humidity and wind speed with an estimate of the fuel state.

Potential risks associated with the primary and secondary effects of climate change listed in Table 5 below have been addressed as part of this risk assessment.

Table 5 Primary and secondary effects of climate change

PRIMARY EFFECTS	SECONDARY EFFECTS
Air Temperature	Relative Humidity
Solar Radiation	Bushfire Weather
Precipitation	Cyclones
Humidity	Flood
Wind	Heatwave
	Drought

3.5 CLIMATE PROJECTION SNAPSHOT

The CSIRO has developed climate change projections using an Australian regionalisation scheme, with eight clusters informed by logical groupings of recent past climatic conditions, biophysical factors and expected broad patterns of climate change. The Greater Melbourne area is covered by the Southern Slopes Cluster, as shown in Figure 7 below.

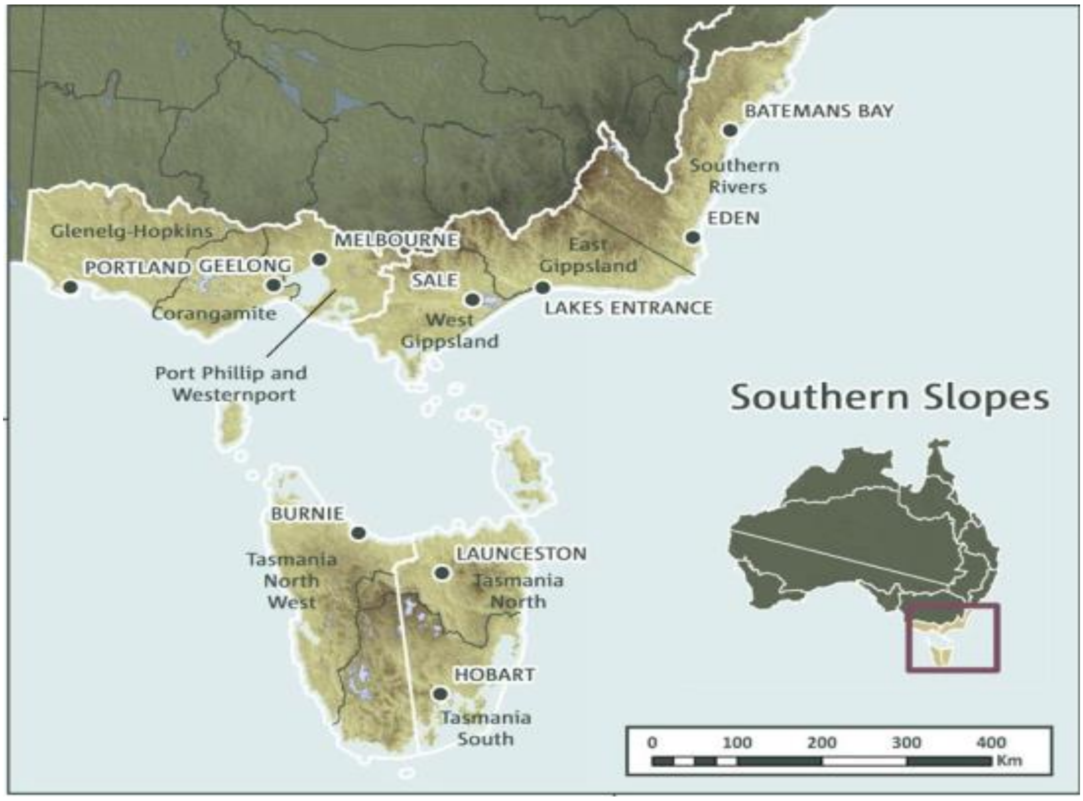


Figure 7 Climate projection changes

The following sections provide a climate projection snapshot summary for key climate variables. Refer Appendix A1 for full data projection details.

Climate projections for 2030 are described in this report as ‘Near future’, whereas climate projections for 2090 are described as ‘Far future’. In some instances, alternative dates have been used (such as 2050 for near future, 2100 for far future) where data for 2030 and/or 2090 is not available. Dates have been noted where this is the case.

3.5.1 AIR TEMPERATURE

Surface air temperatures in the Southern Slopes Cluster have been increasing since national records began in 1910, particularly since 1960. Overall, the warming rates are slightly lower than the majority of other clusters of Australia, and particularly lower than the inland regions. This is consistent with a global pattern of projections, where continental regions are projected to warm more than coastal regions.

Changes to temperature extremes often lead to greater impacts than changes to the mean climate. Heat related extremes are projected to increase at a similar rate as projected mean temperature, with a substantial increase in the number of warm spell days.

The below information may inform design responses, including building fabric design and urban heat island effect mitigation. Increases in air temperature due to climate change are expected to exacerbate the urban heat island effect in metropolitan centres, disproportionately impacting the elderly, children, people in low-socioeconomic areas, and people with existing health issues (Estrada et al., 2017).

Table 6 Climate projection snapshot

Projected temperature changes – RCP 8.5	
Near future (2030)	Far future (2090)
Maximum temperatures are projected to increase in the near future 2030 by 0.5–1.5°C	Maximum temperatures are projected to increase in the far future by 1.5–3+°C
The highest recorded temperature in the locality was 46.5°C in Bundoora on 7th February 2009	
Minimum temperatures are projected to increase in the near future by 0.5–1.5°C.	Minimum temperatures are projected to increase in the far future by 1.5–3°C
Days below 2°C decrease from 0.9 days to 0.6 days in the near future	Days below 2°C decrease from 0.9 days to 0.2 days in the far future
The number of hot days near future and far future will increase	The number of cold nights near future and far future will decrease
The number of days above 35°C is expected to increase from 11 to 13 days by 2030	The number of days above 35°C is expected to increase from 11 to 24 days by 2090

3.5.2 PRECIPITATION AND RAINFALL INTENSITY INCREASE

The following statements relating to precipitation and rainfall intensity in Australia are risk assessment considerations for the project, which may be used as the basis for flood modelling sensitivity analysis.

In a warming climate, heavy rainfall extremes are expected to increase in magnitude mainly due to a warmer atmosphere being able to hold more moisture.

The *Floodplain Risk Management Guidelines (DECC 2007)* Practical Consideration of Climate Change recommends hydraulic modelling sensitivity analyses for the following rainfall intensities: +10%, + 20%, and +30% in peak rainfall and storm volume. Climate change related sensitivity analyses should be in addition to the usual sensitivity analyses involved in flood and Floodplain Risk Management (FRM) studies undertaken in accordance with the guidelines.

The above parameters for modelling purposes are further supported by Book 1 of the ARR 2016 (Bates et al, 2016), where following the relationship between temperature and humidity a 5% increase in rainfall intensity per degree of projected surface temperature increase is recommended. Therefore, an average increase of approximately 2°C relates to 10% increase in rainfall intensity.

Table 7 Projected Rainfall Snapshot

Projected rainfall changes – RCP 8.5	
Near future (2030)	Far Future (2090)
Annual decrease of rainfall -15% to 5% range with the largest decrease in spring	Annual decrease of rainfall -15% to -5% range with the largest decrease in spring and summer
Peak rainfall intensity and storm volume is projected to increase in the near future 2030.	Peak rainfall intensity and storm volume is projected to increase in the far future. Maximum one-day rainfall is expected to increase by 17% over southern Australia, including Victoria, by the end of the century.

3.5.3 DROUGHT PROJECTIONS

The proportion of time in drought as well as the length, duration and intensity of meteorological droughts all increased in parts of south-east Australia over the period 1911–2009 (Gallant et al., 2013), with regional differences also evident across the Southern Slopes Cluster. Projected changes to meteorological drought share much of the uncertainty of mean rainfall change. The direction of any changes in drought is typically the same as that of the mean annual rainfall. Rainfall in some regions within the Southern Slopes is also influenced by the El Niño Southern Oscillation (ENSO), and there is some indication that these events will intensify under global warming, leading to an intensification of El Niño driven drying over much of Australia (Power et al., 2013).

3.5.4 SEA LEVEL RISE

The Victorian Coastal Strategy dictates the sea level projection for planning purposes. Sea level is projected to increase 0.8 m by 2100 relative to the 1990 mean sea level.

The campus location and elevation means that sea level rise will not have a direct impact on the campus assets or occupants, and therefore no sea level rise risks have been identified within this risk assessment.

3.5.5 WIND

For the southern and western regions of the Southern Slopes Cluster, projected changes to surface winds follow the projected changes to pressure and westerly circulation. As shown in Table 8, in the near future (2030), these changes are mostly small and are not evident.

Table 8 Projected wind speed changes

	Projected Wind Speed changes	
	Near future (2030)	Far future (2090)
	Little change in wind speed projected by 2030 Projected annual change in wind speed of 0.4% (range of -2% to 1.3% by 2030)	Mean wind speed projected to increase in winter and decrease other seasons. High uncertainty regarding the potential impact on extreme wind speeds in Victoria. Projected annual change of 0.6% (range of -2.1% to 1.5% by 2090)

3.5.6 BUSHFIRE

As outlined in Table 4, bushfire occurrence depends on four ‘switches’. The settings of the switches are determined by meteorological conditions across a variety of time scales, particularly the fuel conditions. Given this strong dependency on the weather, climate change will have a significant impact on future fire weather. In the study of Clarke et al., (2013), significant trends in fire weather for the period 1973 to 2010 are observed over most of the Southern Slopes Cluster. Table 9 outlines the projected changes in fire weather based on average annual cumulative Forest Fire Danger Index, with a 100 index representing the conditions of the Black Friday fires of 1939.

Table 9 Projected Forest Fire Danger Index (FFDI) changes

	Projected Forest Fire Danger Index (FFDI) changes – RCP 8.5	
	Near future (2030)	Far future (2090)
	Average annual cumulative Forest Fire Dangers Index to increase from 2553 (1979-2018) to 3057 by 2050	Average annual cumulative Forest Fire Dangers Index to increase from 2553 (1979-2018) to 3624 by 2090

4 CLIMATE RISK ASSESSMENT

4.1 STAKEHOLDERS CONSULTED IN THE DEVELOPMENT OF THE RISK ASSESSMENT

The stakeholder group engaged as a part of the CAP process and providing inputs to the risk allocation and adaptation actions are listed in Table 10 below:

Table 10 Climate adaptation stakeholders consulted

NAME	ROLE
Julie O'Brien	Manager, Sustainability & Quality Assurance
Bob Fynan	Environmental Advisor
Glenn Lyons	Risk Advisor
Adam Campbell	Senior Manager Accommodation Services
Vern Steele	Operations Manager, Wildlife Sanctuary
Mark Smith	CFO
Lawrence Chong	Engineering & Compliance Manager
Manjula Goonewardene	Mechanical & Automation Manager
Sam Wishart	Director, Operations and Maintenance
Andrew Vamvakaris	Director, Property Development
Owen Warlond	Director, Projects Delivery
Peter Hughes	GM, Student Union
Jeremy Wah	Estates Commercial Development Manager
Christine Findlay	Senior Manager LARTF
Ennis La Torre	Senior Manager Operations, O&M
Simone Jade Costa	Student Environment Officer
Simon Drew Ashby	Student Environment Officer
Tony Inglis	Contractor
Katie Holmes	Director for Study Inland
Ashley Franks	Director, Securing Food & Water (RFA)
Elissa Khoury	Campus Life
Richard Frampton	Executive Director Student Services

NAME	ROLE
Craig Appleton	Space Planner

Minutes from the Climate Adaptation Workshop are attached as Appendix B to this document.

4.2 LIST OF ASSET CLASSES

The following asset classes have been identified for the campus for inclusion in the risk assessment.

- Buildings including retail, teaching, student amenities, and residential
- Research facilities including laboratories and greenhouses
- Wildlife Sanctuary
- Public open space
- Electricity, gas, and communications infrastructure
- Sport fields and amenities
- Roads, pavements, and bicycle paths

4.3 UNDERTAKE RISK ASSESSMENT

In undertaking the risk assessment, La Trobe University's existing risk assessment criteria has been utilised to enable the risks to be evaluated within the University's existing Risk Management Framework. La Trobe University's Risk Management Framework aligns with ISO 31000 Risk Management. This framework has been utilised in conjunction with the Australian Greenhouse Office (AGO) Climate Change Impacts and Risk Management: A Guide for Government and Business 2006 to meet the requirements of the Green Star Communities Climate Adaptation Plan credit.

The following tables provide key risk assessment guidance for the Climate Adaptation Plan:

- Impact criteria in line with the qualitative description of consequence
- Qualitative description of likelihood
- Risk rating matrix

Table 11 La Trobe University impact criteria

Impact Level	Safety and Security	Financial Performance	Business Performance and Capability	Stakeholder	Reputation	Regulatory/Legal
Catastrophic	An incident resulting in multiple fatalities. Long term severe health impact on significant numbers of people. The majority of critical assets are destroyed or rendered unusable for several months.	Operating budget blow-out of >30%. Deterioration in external funding of >30%. Unanticipated costs or losses of > $20 million (University level figure)	University as a teaching & research institution is unsustainable requiring government intervention Majority of major goals, programs and or projects cannot be achieved. Major widespread and sustained industrial action for several months. Significant intervention by the Minister Severe and unmanageable disruption of major processes extending for several months. Deterioration in majority of key performance indicators >30%.	The Minister and/ or Council is severely compromised by the actions of the University or its officers. Severe and sustained long deterioration in staff morale occurs. The majority of stakeholders are severely disadvantaged by the policies or actions of the University. Extreme impact on stakeholders lasting for many months with continuing long term consequences.	Reputation and standing of the University affected nationally and internationally Serious public outcry and/or adverse international media coverage A long term irreconcilable loss of confidence in the University's capabilities and standing.	Breach of legislation, contract, rule or policy leading to significant and costly legal action with widespread potential impact for the University Litigation or criminal prosecution and/or substantial major negative sanction by a regulatory body Regulator or Government impose significant permanent onerous obligations
Major	An incident resulting in a single fatality. Long term severe health effects on multiple individuals. Majority of critical assets are destroyed or rendered unusable for several weeks.	An operating budget blow-out of 15-30%. Deterioration in external funding 15-30% Unanticipated costs or losses of $5-20 million (University level figure)	The continued capability of parts of the University are unsustainable One or more critical goals, programs or projects cannot be achieved. Major widespread and sustained industrial action for several weeks. Significant intervention by the Council and/or senior management is required. Severe disruption of major processes extending for several weeks. Deterioration in multiple key performance indicators of 15-30%.	The Minister and /or Council are compromised by the actions of the University. Substantial and prolonged deterioration in staff morale occurs. Multiple stakeholder groups are severely disadvantaged by the policies or actions of the university. Has a major impact on stakeholders lasting for several months.	Adverse and sustained national negative media Prolonged public disaffection with the policies or actions of the University. Loss of confidence in the University's capabilities and standing lasting for several months. Reputation impacted with significant number of stakeholders	Breach of legislation, contract, rule or policy leading to legal action Litigation or criminal prosecution and/or penalty External enquiry or regulatory review and/or negative sanction by a regulatory body Enforceable undertaking imposed

Impact Level	Safety and Security	Financial Performance	Business Performance and Capability	Stakeholder	Reputation	Regulatory/Legal
Moderate	A severe injury or multiple casualties requiring hospitalisation. Long term negative health effects on one or more members of the staff or public. A range of assets, including some critical, are destroyed or rendered unusable for several days.	An operating budget blow-out of 10- 15%. Deterioration in funding of 10-15%. Unanticipated costs or losses of $500K-$5 million (University level figure)	The efficiency and effectiveness of major elements of the University deteriorates. The achievement of objectives or delivery of outcomes for one more critical programs or projects is significantly impaired. Continuing program of industrial action for days to weeks. Substantially increased management intervention is required. Significant disruption to processes extending from days to weeks. Deterioration in key performance indicators of 5-15%.	The Minister and/or Council are significantly embarrassed by the actions of the University. Material deterioration in staff morale occurs. One or more stakeholder groups are significantly disadvantaged by the policies or actions of the University. Major impact on stakeholders lasting for several weeks.	Adverse capital city media coverage Public disaffection with the University's policies or actions lasting from days to weeks. Loss of confidence in the organisation's capabilities lasting for several weeks. Reputation impacted with some stakeholders	Breach of legislation, contract, rule or policy leading to escalated legal enquiries Damages or Penalties apply. Short term damage to relationship with third party or legislator
Minor	Injuries requiring medical attention. Short term negative health effects. A number of assets are destroyed or rendered unusable, but can be replaced within acceptable time frames.	An operating budget blow-out of 5-10%. Deterioration in external funding 5-10%. Unanticipated costs or loss of $50- 500K (University level figure)	The efficiency and effectiveness of isolated elements of the University are impaired. The ability to achieve objectives or deliver outcomes is affected. Limited industrial action occurs. Increased management involvement is required. Intermittent disruptions to processes. Deterioration in top key performance indicators of 1-5%.	The Minister and/or Council are inconvenienced by the actions of the University. Employee satisfaction deteriorates by 1-5% across major indicators. Detectable decrease in staff morale occurs. Has an impact on stakeholders lasting for a period of days.	Negative local public or media attention for one or two days. Public disaffection with the University's policies or actions is limited to a few days. Reputation is adversely affected by a small number of affected people Short term loss in confidence regarding the University's capabilities and/or standing lasting for several days.	Breach of legislation, contract, rule or policy impacting on the relationship with the third party or the legislator, but no long lasting effect No litigation or prosecution and/or penalty, but management remediation required. Regulatory consequence limited to standard inquiries

Impact Level	Safety and Security	Financial Performance	Business Performance and Capability	Stakeholder	Reputation	Regulatory/Legal
Minimal	Incident requiring simple first aid only. Transient or limited ill health impact. Assets receive little or minimal damage, or are only temporarily unavailable for use.	An operating budget blow-out of <5%. Deterioration in external funding of <5%. Unanticipated costs or loss of < $50K (University level figure)	There is a negligible impact on the efficiency and effectiveness of the University. There are minimal effects on the achievement of objectives or the delivery of outcomes. Insignificant levels of industrial unrest. Management can be undertaken within existing parameters. Potential disruptions managed as part of business as usual. Deterioration in top key performance indicators of < 1%.	Any impacts upon the Minister or Council are inconsequential. There is negligible effect on staff morale. Inconsequential disadvantage is experienced by stakeholders. Stakeholder dissatisfaction is minimal.	There is limited local public disaffection with the policies or actions of the University`. Minimal stakeholder interest	Regulatory breaches by are insignificant in nature with no disruption to performance of duties. Breaches confined to internal policies or procedures

The risk likelihood is designated for each risk identified in accordance with the table below, which forms part of the La Trobe University Risk Management Framework:

Likelihood	Criteria
Almost certain	• 86%-100% probability, or • "happens often", or • could occur within 'days to weeks'
Likely	• 51%-85% probability, or • "could easily happen", or • could occur within 'weeks to months'
Possible	• 10%-50% probability, or • "could happen, has occurred before", or • could occur within 'a year or so'
Unlikely	• 1%-10% probability, or • "has not happened yet, but could", or • could occur 'after several years'
Rare	• <1% probability • "conceivable but only in extreme circumstances" • "exceptionally unlikely, even in the long term future • a '100 year event' or greater

A combination of the qualitative descriptions and risk likelihood are used in the risk assessment to ultimately categorise risks as low, medium, high and extreme, as per the following Risk Rating Matrix:

	Category of Consequence				
	1	2	3	4	5
Likelihood	Minimal	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Medium	High	Very High	Very High
Likely	Low	Low	Medium	High	Very High
Possible	Very Low	Low	Medium	High	High
Unlikely	Very Low	Very Low	Low	Medium	High
Rare	Very Low	Very Low	Low	Medium	Medium

4.4 CLIMATE RISK ASSESSMENT – INITIAL

Table 12 Rainfall initial risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
Rainfall	Changes to rainfall (droughts and intense rainfall)	Inundation of civil drainage infrastructure/ catchment moat areas with resulting flood damage and safety risk. Impact on flood immunity levels. Lakes/ Reservoirs north of Main Drive near the golf course might cause flooding to the moat system passing through the campus.	Major	Likely	High
	Changes to rainfall (droughts and intense rainfall)	Flooding causing access restrictions to buildings and for emergency vehicles. Buildings located close to the moats are at higher risk.	Major	Likely	High
	Changes to rainfall (droughts and intense rainfall)	Water damage to substations and electrical circuitry resulting in disruption to electricity supply and safety risk.	Major	Possible	High
	Changes to rainfall (droughts and intense rainfall)	Flooding of service tunnels and culverts	Major	Possible	High
	Changes to rainfall (droughts and intense rainfall)	Increase in extreme rainfall and hailstorm events overloading roof drainage for buildings and result in roof damage and drain damage.	Moderate	Likely	Medium
	Changes to rainfall (droughts and intense rainfall)	Loss of plant species and less vigorous growth of surviving plants (combined with increased temperatures). This could result in greater erosion, landslips, increased fire risk, issues with management of pest plants and animals, loss of landscape amenity.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Decrease in annual total rainfall leading to a reduction in regional water storages (requiring water restrictions) and reducing campus stormwater harvesting reliability.	Moderate	Likely	Medium
	Changes to rainfall (droughts and intense rainfall)	Algae bloom increase in moat system, disrupting the ecosystem	Moderate	Likely	Medium
	Changes to rainfall (droughts and intense rainfall)	Sinkholes instances increasing on campus, creating safety issues	Moderate	Likely	Medium
	Changes to rainfall (droughts and intense rainfall)	Reduction in regional and campus water supplies during droughts	Moderate	Likely	Medium

Table 13 Temperature initial risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
Temperature	Increased annual mean temperature	Operations - Ability to cool critical infrastructure may be affected by extreme heat, leading to system failure or service interruptions.	Major	Likely	High
	Increased annual mean temperature	Buildings & Infrastructure - Increased mean maximum temperature and solar exposure may lead to greater material degradation of infrastructure assets such as roads, pavements and building finishes	Moderate	Possible	Medium
	Increased annual mean temperature	Landscape and Reserve/ Wildlife areas - Loss of plant species and less vigorous growth of surviving plants (combined with changes to rainfall). This could result in greater erosion, landslips, increased fire risk, issues with management of pest plants and animals, loss of landscape amenity. High temperatures impacting on health of local fauna due to heat stress and inability to adapt.	Moderate	Possible	Medium
	Increased annual mean temperature	Buildings & Structure - Increased mean maximum temperature leading to greater structural fatigue	Major	Possible	High
	Increased number of hot days over 35°C	ITS/ electrical assets - Extended high temperatures could have an adverse impact on the operation of some electrical equipment, such as components in plantrooms, ITS and/ or LED lights used in outdoor lighting.	Moderate	Possible	Medium
	Increased number of hot days over 35°C	Operations - Buildings not remaining habitable in the event of a power outage or uncomfortable temperatures occurring during a heatwave	Moderate	Possible	Medium
	Increased number of hot days over 35°C	Stakeholder - Heat stress may become a significant health issue for staff and students getting around campus, walking on uncovered pathways causing increased exposure. Outdoor events, visitor programmes and outside works might cause heat stress to stakeholders.	Moderate	Possible	Medium
	Increase in mean maximum temperature	Critical Infrastructure - Increase in temperature might cause fauna and flora stress in the Wildlife Sanctuary and the reserve areas.	Moderate	Possible	Medium
	Increase in mean maximum temperature	Critical Infrastructure - Sports grounds might have difficulty due to drying up and cracking to meet the standards for the required sports activities and agreements with other agencies using the space.	Moderate	Possible	Medium

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
	Increased annual mean temperature	Urban Heat Island Effect - Master plan development might lead to reduction in trees and vegetation cover adding to the UHI effect for the suburb.	Moderate	Possible	Medium
	Increased number of hot days over 35°C	Buildings & Structure - Increase in extreme temperatures will lead to longer and more severe heatwaves, combined with drought this could cause structural damage from footing movements in dry soil	Major	Possible	High

Table 14 Wind speed initial risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
Wind speed	Increased wind speeds	Increase in storm severity and high wind speeds impacting the structural integrity of building and infrastructure elements like parked cars, solar PV, roof and shading structures.	Moderate	Likely	Medium
	Increased wind speeds	High wind speeds causing branches, building façade elements, or other loose debris to blow from buildings and become a safety risk to people in the vicinity	Major	Possible	High
	Increased wind speeds	Wind damage to electrical circuitry (overhead wiring) resulting in disruption to services and increased maintenance requirements	Major	Possible	High

Table 15 Bushfire initial risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
Bushfire	Increase in risk of bushfires	Bushfires encroaching on campus from surrounding bushland putting human life at risk.	Major	Possible	High
	Increase in risk of bushfires	Fire damage to campus buildings and infrastructure.	Major	Possible	High
	Increase in risk of bushfires	Increase in number of severe fire weather risk days leading to exposure to smoke and particulate pollution for people on campus that may cause respiratory distress.	Moderate	Possible	Medium

Table 16 Radiation initial risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk
Solar radiation	Increased solar radiation levels	Increase in UV radiation can lead to degradation of building materials and infrastructure surfaces, leading to more maintenance and disruptions. Structural degradation will be caused due to higher UV exposure.	Moderate	Likely	Medium

4.4.1 SUMMARY OF INITIAL RISKS

The climate risks identified for the assets within the scope of this CAP are summarised in Table 17.

Table 17 Summary of initial risks

RISK RATING	E EXTREME	H HIGH	M MEDIUM	L LOW	TOTAL RISKS
Number of Risks	-	11	17	-	28

4.5 IDENTIFYING ADAPTATION ACTIONS

Once climate risk ratings have been applied to potential climate change risks, adaptation actions are identified to reduce the risk rating of extreme, high and medium rated climate risks.

Generally, there are four possible approaches in responding to climate change, which are presented below.

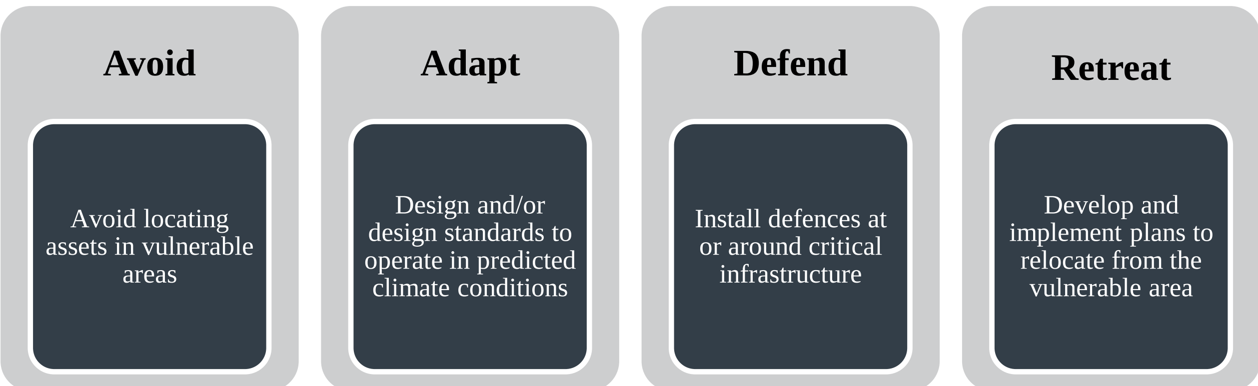


Figure 8 Responses to climate change

It should be noted that adaptations are a direct response to the climate projection over the design life of the building or infrastructure component. When the renewal of that component is required, the procurement team should consider climate risk alongside all the other risks associated with the renewal of that component.

This can mean for building and infrastructure components with a short design life, no adaptation action is currently required. For components with a long design life, the far future (2090) projections will be applicable and both design and operational adaptations may apply. Wherever possible, adaptation actions respond to the optimal scale and timing for when a specific climate threshold is likely to be triggered.

To address potential climate change impacts and inform further design development and operational considerations, the mitigation measures developed for the identified risks are summarised in the tables in following section. These tables include proposed Adaptation Actions and Reassessed Risk.

4.6 CLIMATE RISK ASSESSMENT – REASSESSED

Table 18 Rainfall initial risks and reassessed risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
Rainfall	Changes to rainfall (droughts and intense rainfall)	Inundation of civil drainage infrastructure/ catchment moat areas with resulting flood damage and safety risk. Impact on flood immunity levels. Lakes / reservoirs north of main drive near the golf course might cause flooding to the moat system passing through the campus.	Major	Likely	High	University to review the Stormwater Management Plan Increase the water storage in moats to hold more water during intense rainfall and increase resistance to flooding. Design drainage to ensure the pipe network is running full in a storm event. Consider implementing raingardens and wetlands. Reuse moat water to irrigation, and possibly flushing and cooling towers. Explore other potential uses for this water.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Flooding causing access restrictions to buildings and for emergency vehicles. Buildings located close to the moats are at higher risk.	Major	Likely	High	Operations: - Identify probable areas and inform student and staff of alternate routes to use. - Develop disaster plans for emergency vehicles access. Design: - Increase the water storage in moats to hold more water during intense rainfall and increase resistance to flooding. - Design drainage to ensure the pipe network is running full in a storm event. - Consider implementing raingardens and wetlands.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Water damage to substations and electrical circuitry resulting in disruption to electricity supply and safety risk.	Major	Possible	High	Protect electrical equipment with waterproof materials that can withstand heavy rainfall. Ensure all gaps are sealed. Substations to be set above critical level.	Moderate	Possible	Medium

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
	Changes to rainfall (droughts and intense rainfall)	Flooding of service tunnels and culverts	Major	Possible	High	Water diversion from the tunnels to the moats to be reviewed in drainage design. Culverts to reviewed to meet the expected extreme storm events. Climate change flooding modelling will be undertaken to review this.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Increase in extreme rainfall and hailstorm events overloading roof drainage for buildings and result in roof damage and drain damage.	Moderate	Likely	Medium	Design - Ensure there is sufficient drainage on roof to withstand larger amounts of water from intense rainfall. Implement an overflow system to activate to enable flow to the civil stormwater system. Operations and Maintenance - At the end of lifecycle, reassess the surfacing materials to provide a better outcome.	Moderate	Unlikely	Low
	Changes to rainfall (droughts and intense rainfall)	Loss of plant species and less vigorous growth of surviving plants (combined with increased temperatures). This could result in greater erosion, landslips, increased fire risk, issues with management of pest plants and animals, loss of landscape amenity.	Moderate	Possible	Medium	For landscaped areas, choose plant species with higher tolerance for flooding to keep species alive during intense rainfall events.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Decrease in annual total rainfall leading to a reduction in regional water storages (requiring water restrictions) and reducing campus stormwater harvesting reliability.	Moderate	Likely	Medium	Increase water storage volume to capture maximum amounts of water during rainfall events. Consider capturing stormwater from a larger area of campus.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Algae bloom increase in moat system, disrupting the ecosystem	Moderate	Likely	Medium	Water Sensitive Urban Design strategies (such as filtration) to control the nitrogen and other pollutants in the moat systems to be implemented.	Moderate	Possible	Medium
	Changes to rainfall (droughts and intense rainfall)	Sinkholes instances increasing on campus, creating safety issues	Moderate	Likely	Medium	Strategies to identify the weak spots for sink holes on campus to be identified, and areas of concern to be secured for safety of users. Disaster Management Plan to address these concerns.	Moderate	Possible	Medium

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
	Changes to rainfall (droughts and intense rainfall)	Reduction in regional and campus water supplies during droughts	Moderate	Likely	Medium	Increase water storage volume to capture maximum amounts of water during rainfall events. Consider capturing stormwater from a larger area of campus. Reusing water on campus (example moats and rainwater tanks) for wider uses.	Moderate	Possible	Medium

Table 19 Temperature initial risks and reassessed risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
Temperature	Increased number of hot days over 35°C	Operations - Ability to cool critical infrastructure may be affected by extreme heat, leading to system failure or service interruptions.	Major	Likely	High	Design - Improve infrastructure insulation to withstand extreme heat. Naturally ventilated (Passively cooled) spaces will be designed, in most buildings on campus. Night Purging to be considered for most spaces. Operations - Timetable to be designed to avoid extreme days/ hours.	Moderate	Possible	Medium
	Increased annual mean temperature	Buildings & Infrastructure - Increased mean maximum temperature and solar exposure may lead to greater material degradation of infrastructure assets such as roads, pavements and building finishes	Moderate	Possible	Medium	Design and Construction - choose Building façade, road and pavement materials to endure higher temperatures for its material life by undertaking a full durability assessment. Operations and Maintenance - When resurfacing/ refurbishing, re-assessment of climate conditions and materials temperature endurance should be undertaken.	Minor	Possible	Low
	Increased annual mean temperature	Landscape and Reserve/ Wildlife areas - Loss of plant species and less vigorous growth of surviving plants (combined with changes to rainfall). This could result in greater erosion, landslips, increased fire risk, issues with management of pest plants and animals, loss of landscape amenity. High temperatures impacting	Moderate	Possible	Medium	Operations - For landscaped areas, choose plant species with higher tolerance for heat to keep species alive in higher temperatures.	Minor	Possible	Low

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
		on health of local fauna due to heat stress and inability to adapt.							
	Increased annual mean temperature	Buildings & infrastructure - Increased mean maximum temperature leading to greater structural fatigue	Major	Possible	High	Design and Construction - Use materials with the appropriate tolerance for higher heat stress. Operations and Maintenance - Regular maintenance to be performed to identify weak areas. Develop emergency plans for evacuation and keep all building users informed.	Major	Unlikely	Medium
	Increased number of hot days over 35°C	ITS/ electrical assets - Extended high temperatures could have an adverse impact on the operation of some electrical equipment, such as components in plantrooms, ITS and/ or LED lights used in outdoor lighting.	Moderate	Possible	Medium	Operations and Maintenance - At the end of life of the LED lighting and other equipment (i.e. around 10-20 years), assess use of better heat resistant technology. Currently emergency lighting lasts 90 mins, once more residential spaces are added on the campus this will be evaluated to suit the needs and emergency evacuation protocols.	Minor	Likely	Low
	Increased number of hot days over 35°C	Operations - Buildings not remaining habitable in the event of a power outage or uncomfortable temperatures occurring during a heatwave	Moderate	Possible	Medium	Design - Ensure buildings have sufficient insulation and glazing performance (double glazing for new builds, and potential retrofit of secondary glazing for existing buildings) so that mechanical systems can maintain thermal comfort conditions for the temperature rise and number of hot days within the building's life, and consider thermal mass / night purge where appropriate. New buildings to factor temperature increase and number of hot days during design. Solar microgrids and back-ups being considered as potential strategies to tackle power outages. Operations - Where feasible, utilise technology to provide remote learning during heatwave, or reschedule afternoon classes to the morning or evening during a heatwave.	Minor	Possible	Low
	Increased number of hot days over 35°C	Stakeholder - Heat stress may become a significant health issue for staff and students getting around campus, walking on uncovered pathways causing increased exposure. Outdoor events, visitor	Moderate	Possible	Medium	Operations - During a heatwave, aim to use remote learning technologies or reschedule afternoon classes to the morning or evening. Minimise movement between buildings by scheduling classes within the same building, where possible. Avoid scheduling any outdoor works events or site visits during extreme days. Provide best route, preferably covered, for	Minor	Possible	Low

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
		programmes and outside works might cause heat stress to stakeholders.				students to walk to transport and other buildings – natural shading through vegetation could be used to manage this while simultaneously improving biodiversity and habitat connectedness. Shading structures over pathways could be used for solar PV installation.			
	Increase in mean maximum temperature	Critical Infrastructure - Increase in temperature might cause fauna and flora stress in the Wildlife Sanctuary and the reserve areas.	Moderate	Possible	Medium	Operations and Maintenance - More maintenance and human intervention to save critical wildlife and plants might be required.	Moderate	Possible	Medium
	Increase in mean maximum temperature	Critical Infrastructure - Sports grounds might have difficulty due to drying up and cracking to meet the standards for the required sports activities and agreements with other agencies using the space.	Moderate	Possible	Medium	Operations and Maintenance - More maintenance will be required for the sports ground. Financial impacts will be considered relating to these.	Moderate	Possible	Medium
	Increased annual mean temperature	Urban Heat Island Effect - Master plan development might lead to reduction in trees and vegetation cover adding to the UHI effect for the suburb.	Moderate	Possible	Medium	Design - The University's design standards commit to achieving Green Star benchmarks to reduce the UHI effect by installing light-coloured roofs and / or green roofs. Maintaining the Green cover will be essential to reduce these impacts.	Moderate	Unlikely	Low
	Increased number of hot days over 35°C	Buildings & Structure - Increase in extreme temperatures will lead to longer and more severe heatwaves, combined with drought this could cause structural damage from footing movements in dry soil	Major	Possible	High	Design - Design concrete pavements and other structures to withstand shrink-swell changes in underlying soil during design development. Operations and Maintenance - Regular maintenance to be performed to identify weak areas. Develop emergency plans for evacuation and keep all building users informed.	Moderate	Unlikely	Low

Table 20 Wind speed initial risks and reassessed risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
Wind speed	Increased wind speeds	Increase in storm severity and high wind speeds impacting the structural integrity of building and infrastructure elements like parked cars, solar PV, roof and shading structures.	Moderate	Likely	Medium	Design structural elements to comply with Australian Standards and reliant wind loadings. Regular maintenance and inspection to monitor equipment and elements that are not performing efficiently or becoming degraded. Evacuate buildings and campus during extreme storm and high wind events.	Moderate	Possible	Medium
	Increased wind speeds	High wind speeds causing branches, building façade elements, or other loose debris to blow from buildings and become a safety risk to people in the vicinity	Major	Possible	High	Evacuate buildings and campus during high wind events. Create safety shelters for the users. Proactive management of Trees and Vegetation to protect people and infrastructure in storm events. Regular maintenance to clean up loose debris and branches on campus. Operations - Issue warnings to stay indoors and indicate safe passages for users	Moderate	Possible	Medium
	Increased wind speeds	Wind damage to electrical circuitry (overhead wiring) resulting in disruption to services and increased maintenance requirements	Major	Possible	High	Move services underground where feasible. Regular maintenance of open services Warnings issued to users in case of severe storms	Moderate	Possible	Medium

Table 21 Bushfire initial risks and reassessed risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
Bushfire	Increase in risk of bushfires	Bushfires encroaching on campus from surrounding bushland putting human life at risk.	Major	Possible	High	Maintain surrounding bushland to reduce fire load through removing fallen branches and planned burns when necessary. Implement fire evacuation procedures. Bushfire Management Plan already exists to manage bushfire risks for the campus, requires review/update by LTU	Moderate	Possible	Medium
	Increase in risk of bushfires	Fire damage to campus buildings and infrastructure.	Major	Possible	High	Ensure buildings and infrastructure comply with the relevant Australian Standards. Perform maintenance before bushfire season to investigate locations of vulnerability. Bushfire Management Plan already exists to manage bushfire risks for the campus, requires review/update by LTU	Moderate	Possible	Medium

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
	Increase in risk of bushfires	Increase in number of severe fire weather risk days leading to exposure to smoke and particulate pollution for people on campus that may cause respiratory distress.	Moderate	Possible	Medium	Implement smoke hazard management strategies so that people are warned and informed. Evacuate campus during bushfires to prevent inhalation of smoke and particulate pollution. Bushfire Management Plan already exists to manage bushfire risks for the campus, requires review/update by LTU	Minor	Possible	Low

Table 22 Radiation initial risks and reassessed risks

Climate Variable	Climate Risk	Potential Climate Change Impact	Consequence	Likelihood	Overall Risk	Proposed Adaptation Measure	Consequence	Likelihood	Reassessed Risk
Solar radiation	Increased solar radiation levels	Increase in UV radiation can lead to degradation of building materials and infrastructure surfaces, leading to more maintenance and disruptions. Structural degradation will be caused due to higher UV exposure.	Moderate	Likely	Medium	Design and Construction - Use materials with the appropriate tolerance for higher UV stress. For elements with shorter design life of 10-20 years, this should be reconsidered when being refurbished. The then current climate projects and new available materials should also be considered. Operations and Maintenance - Regular maintenance to be performed to identify weak areas. Develop emergency plans for evacuation and keep all building users informed.	Moderate	Possible	Medium

4.7 GREEN STAR COMMUNITIES ADAPTATION AND RESILIENCE CREDIT REQUIREMENTS

The aim of the Green Star Communities – Adaptation and Resilience credit is “to encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.” The credit is divided into two sub-credits: 4.1 Climate Adaptation, and 4.2 Community Resilience. The table below outlines the credit criteria for each sub-credit.

Table 23 Green Star Communities Credit 4 – Adaptation and Resilience

4.1 Climate Adaptation	2 points are available where: • A **project-specific** Climate Adaptation plan (CAP) has been developed in accordance with a recognised standard; and • Solutions have been included into the plan for development that specifically address the risk assessment component of the adaptation plan
4.2 Community Resilience	2 points are available where, prior to the occupation of any habitable building on the project site, a project-specific Community Resilience Plan (CRP) has been developed that addresses preparation, during- and post-disaster communication, safety, and response.

This report will be used to demonstrate the requirements of the project-specific CAP as per Credit 4.1 Climate Adaptation. A separate Community Resilience Plan has been compiled to meet the requirements of Credit 4.2.

4.8 SUMMARY OF REASSESSED CLIMATE RISKS

The climate risks identified for the development within the scope of this CAP following the application of adaptation measures, are summarised below.

Table 24 Summary of initial and reassessed risks

RISK RATING	E EXTREME	H HIGH	M MEDIUM	L LOW	TOTAL
NUMBER OF RISKS	-	11	17	-	28
NUMBER OF REASSESSED RISKS	-	-	19	9	28

All 28 potential climate change risks identified received climate risk consideration and adaptation measures relative to that risk which help to mitigate and reduce the likelihood of that event occurring.

All 11 high risks have been mitigated to medium level risks and 9 of the 17 medium risks have been mitigated to low level risks through adaptation measures relevant to design life.

4.8.1 MANAGEMENT AND REVIEW OF THE CAP

In addition to the above, the CAP will be reviewed whenever the base information required to develop the relevant climate change scenarios is updated. The sixth assessment review (AR6) by the IPCC is due 2022, at which point the projections and scenarios in this report should be reviewed and updated as necessary. Any updates to the Campus Masterplan should also trigger a review of the CAP.

The indicative timetable below should be followed to ensure regular reviews of the CAP are undertaken:

- 2022: Review and update based on issue of IPCC AR6
- 2027: 5-yearly review moving forward, or sooner in the event of updates to the Campus Masterplan or climate projections

5 CONCLUSION

This Climate Adaptation Plan contains a risk assessment undertaken by La Trobe University and WSP in accordance with the University's Risk Management Framework, which aligns with ISO 31000-2009 – Risk Management – Principles and Guidance; and with AGO's Climate Change Risks and Impacts: A Guide for Government and Business.

The assessment of climate change impacts has addressed two time scales relevant to anticipated development lifespan for the primary effects of temperature and precipitation, near future: 2030 and far future: 2090. The risk assessment has also considered the secondary effects of drought, flood, wind, bushfire and radiation.

The 28 potential climate change risks identified in the risk assessment component of the Climate Adaptation Plan have been addressed by specific design and operational adaptation measures, as detailed in Section 4. All 28 potential climate change risks identified received adaptation measures which help to mitigate and reduce the likelihood of that event occurring. There were no extreme risks, 11 risks identified as high have been mitigated to a medium level risk, and 9 of the medium risks have been mitigated to low level risks through adaptation measures relating to governance, planning, design, construction and operation.

It is recommended that the Climate Risk Assessment is reviewed/repeated at appropriate periods throughout the masterplan implementation. The implementation of recommended adaption measures is the responsibility of the University.

6 ASSUMPTIONS & LIMITATIONS

The key assumptions underpinning this risk assessment are as follows:

- The purpose of the risk assessment is to highlight the potential for climate change induced risks and inform the decision-making process, which in turn enables the design and operation of a climate resilient campus.
- Risk assessment and mitigation is a dynamic and iterative process for the duration of a development’s life cycle.
- The assessment of risks and possible adaptation measures is qualitative and not quantitative.
- The climate change projections adopted are those that have been reasonably predicted for future climatic conditions. It should be noted that some projections currently involve a considerable degree of uncertainty.
- Available climate projections are regional, not localised, so their accuracy is limited and subject to the uncertainties of scientific and technical research. However, the available data is deemed sufficient for the purposes of this assessment, with recommendations representing professional judgement.

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APPENDIX A

CLIMATE MODELLING
AND PROJECTIONS

CLIMATE MODELLING

IPCC Emissions Scenarios

The Intergovernmental Panel on Climate Change (IPCC) has been collecting, managing and researching the potential impacts of climate change on a global scale. The IPCC Special Report on Emissions Scenarios (2000) provided four scenarios (A1, A2, B1 and B2) that explored alternative development pathways, covering a wide range of demographic, economic and technological driving forces and resulting greenhouse gas (GHG) emissions.

In 2007 the IPCC released the Fourth Assessment Report (AR4) (2007), which used the SRES scenarios to provide projections for climate change variables such as temperature, sea level, rainfall and extreme weather. The IPCC Fifth Assessment Report (AR5) (2014) provides updated global projections for a range of climate change models and shows that emissions are currently tracking above the high emission scenarios from AR4 at a global scale.

The IPCC AR5 adopted terminology for climate model scenarios based on Representative Concentration Pathways (RCPs). RCPs represent four greenhouse gas concentration scenarios (RCP2.6, RCP4.5, RCP6, and RCP8.5). The value represents the 2100 radiative forcing in Watts per square metre (W/m^2).

CSIRO Climate Futures

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BOM) have released climate change projections for Australia that provide updated national and regional information on how the climate may change to the end of the 21st century. The projections are based on results of the climate system, historical trends and model simulations of the climate response to global scenarios of greenhouse gas and aerosol emissions. Modelling groups from around the world co-ordinate through the Coupled Model Inter-comparison Project phase 5 (CMIP5). The simulations undertaken by these groups are stored in and can be accessed from the archive of global climate models (GCMs). For each climate variable, the projected change is accompanied by a rating.

The GCM model simulations represent a range of emissions scenarios (low, medium, high or very high) to provide the level of confidence in the projection, based on the type, amount, quality and consistency of the evidence from the models' output. These are quantified by the Representative Concentration Pathways (RCPs) used by the IPCC, with a particular focus on RCP4.5 and RCP8.5. A RCP4.5 scenario represents a low-level scenario where the carbon dioxide concentration is about 540ppm by the end of the 21st century. A RCP8.5 scenario represents a high-emissions scenario where the carbon dioxide concentration is about 940ppm by the end of the 21st century. This global co-ordination and model comparison underpins the science of the most recent report and findings in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014).

CSIRO 2015, Southern Slopes Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions provides projections for two 20 year periods:

- 2020–2039, which is referred to as 2030
- 2080-2099, which is referred to as 2090

Bureau of Meteorology

To provide an accurate baseline for current local weather conditions, the Bureau of Meteorology (BOM) historical data has been used from weather stations around the project are provided below.

Table A.1 Bureau of Metrology weather observation stations

Bureau of Meteorology Weather Observation Stations		
Bundoora (La Trobe University) ID 086351		
Lat: 37.72° S	Lon: 145.05° E	Elevation: 83 m

Figure 9 Melbourne area weather observation stations

CLIMATE PROJECTIONS

Temperature projections

Maximum temperatures are projected to rise by an average of 1.6 ºC by 2090 RCP4.5. All models show there are no declines in maximum temperatures across Metropolitan Melbourne.

Table A.2 Southern Slope Regional Climate Modelling Report - mean max. and min. temperatures

Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)						
		Baseline	**2030, RCP 4.5**		**2090, RCP 4.5**	
		BOM (local)	**Average Change**	**Range**	**Average Change**	**Range**
Mean Max Temperature (°C)	Period	20.2 °C	0.70°C	0.55 to 1.00°C	1.60°C	1.1 to 2.1°C
	Highest Outright	*46.5°C (7th February 2009)*				

Mean Min Temperature (°C)	Period	9.7°C	0.60°C	0.4 to 0.9°C	1.4°C	1 to 1.8°C
	Min Outright	*-3.6 °C (21st July 1982)*				

Table A.3 Southern Slopes Regional Climate Report - number of hot days and cold nights

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)					
		2030, RCP 4.5		**2090, RCP 4.5**	
		Average Change	**Range**	**Average Change**	**Range**
Number of Hot Days (Days max temp > 35°C)	Period yearly average	13 days	12 to 15 days	16 days	15 to 20 days
Number of Cold Nights (Nights min temp <2°C)	Period yearly average	0.9 days	0.8 – 0.4 days	0.2 days	0.3 to 0.1 days

Rainfall projections

Table A.4 Southern Slopes Regional Climate Report - mean monthly rainfall

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)						
		Baseline	**2030, RCP 4.5**		**2090, RCP 4.5**	
		BOM (local)	**Average Change**	**Range**	**Average Change**	**Range**
Rainfall (mm)	*Average yearly*	671.7mm	-1%	-7% to 2%	-3%	-10 to 3%
	Highest Daily	*104.8mm (3rd Feb 2005)*	*Maximum 1-day rainfall projected to increase by 2-23% by the end of the century for RCP 8.5*			

The table above shows the average change in rainfall volume of -1% by 2030 and -3% by 2090. The largest changes in rainfall are expected to occur in the eastern parts of Victoria and in western Tasmania.

Wind speed projections

As shown in table below, wind speed is projected to decrease for east coast south for RCP 4.5 for 2090 by an average of -0.6%. Projections show a range from -2.1% - 1.5%, however it is estimated that there will be little change by 2030 in wind speeds for Melbourne. The expected larger changes in wind speed is expected for other sub-cluster, such as Tasmania in which there is a low level of confidence in the projected winter wind speeds and direction.

Table A.5 Southern Slopes Regional Climate Report - Change in wind speed

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)					
	Baseline	**2030, RCP 4.5**		**2090, RCP 4.5**	
	BOM (local)	Average Change	Range	Average Change	Range
	mean 9am wind speed				

Wind Speed (%) Change	Annual	10.8 km/h	0.4 %	-2 to 1.3%	-0.6%	-2.1 to 1.5%

Solar radiation projections

Shown in the table below, solar Radiation projections show little change for 2030 and an increase of 1.90% for 2090. However, an Australian evaluation suggested that some models are not able to adequately reproduce the climatology of solar radiation. CMIP2 and CMIP5 models appear to underestimate trends in certain regions of south east coast. From this analysis, it is unlikely that there will be significant changes to solar radiation by 2030, however it is projected that by 2090 there will be increased winter and spring radiation. In 2090 the mean daily solar exposure will be approximately 17.96MJ/m^2 based on the local baseline.

Table A.6 Southern Slopes Regional Climate Report - Solar radiation projections

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)						
		Baseline	**2030, RCP 4.5**		**2090, RCP 4.5**	
		BOM (local) Mean daily solar exposure	Average Change	Range	Average Change	Range
Solar Radiation (%) Change	Annual	14.9 MJ/m^2	0.7 %	-0.1 to 2%	1.9 %	-0.1 to 3.5 %

Relative humidity projections

As shown in the table below, relative humidity projections show little to no change for 2030 and a slight decrease of 0.9% for 2090. There is a higher decease expected away from the coast because of warmer mean temperatures, though this will be offset by increases in rainfall. The relative humidity for the project area will have a slight decrease.

Table A.7 Southern Slopes Regional Climate Report - Change in relative humidity

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)					
		2030, RCP 4.5		**2090, RCP 4.5**	
		Average Change	Range	Average Change	Range
Relative Humidity (%)	Annual	-0.4 %	-0.9 to 0.1 %	-0.9 %	-1.7 to -0.1 %

Sea level projections

Table A.8 Southern Slopes Regional Climate Report - Sea level rise

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)					
		2030, RCP 4.5		**2090, RCP 4.5**	
		Average Change (m)	Range (m)	Average Change (m)	Range (m)
Sea level rise (m)	Annual	0.12 %	0.08 – 0.161	0.46	0.29 – 0.64
		IPCC & Victorian Coastal Strategy 2008			
		Sea level is projected to increase 0.8 m by 2100, relative to the 1990 mean sea level			

The Victorian Southern Slopes Regional Climate Modelling report outlines relative changes in sea level from a baseline measurement determined from historic data (from 1993 – 2010) at Stony Point, Victoria. There is a projected sea level rise up to 0.59m for RCP4.5 by 2090.

*Mean sea level and projections - Tides are generally measured relative to a low water reference or hydrographic chart datum, traditionally ISLW (Indian Springs Low Water) but more recently LAT (lowest astronomical tide). This is not the same as AHD (Australian Height Datum; AHD71). Elevation data is referenced to the AHD standard and therefore tide values need to be converted from the low water reference datum to AHD. To do this, the mean sea level (MSL - which is roughly equivalent to AHD) was subtracted from the highest astronomical tide (HAT) value to provide a new HAT value relevant to AHD.

Bushfire projections

Fire weather is classified as ‘severe’ when the FFDI is above 50, and most of the property loss from major fires in Australia has occurred when the FFDI reached this level (Blanchi et al. 2010). FFDI values below 12 indicate low to moderate fire weather, 12-25 high, 25-49 very high, 50-74 severe, 75-99 extreme and above 100 catastrophic.

Table A.9 Southern Slopes Regional Climate Report - severe fire weather risk

Victoria Southern Slopes Regional Climate Modelling (Australian Government Dept of Environment & Heritage)					
Severe Fire Weather Risk (FFDI >50)	**1995**	**2030, RCP4.5**		**2090, RCP4.5**	
	Baseline Average annual	**Average change**	**Range**	**Average change**	**Range**
	2.7 days in Melbourne	0.77	0.3 to 1.5	1	0.9 to 1.2

APPENDIX B

CAP WORKSHOP MEETING MINUTES

WORKSHOP MINUTES

PROJECT NAME	La Trobe University – Green Star Communities
PROJECT NUMBER	2304956U / PS108149
DATE	Friday, 17 August 2018
TIME	9:30am – 12:30pm
VENUE	La Trobe University Library – Room L-1.34 (Seminar room)
SUBJECT	Climate Adaptation Workshop Minutes
CLIENT	La Trobe University
ATTENDEES	**La Trobe University** Julie O'Brien – Manager, Sustainability & Quality Assurance Bob Fynan – Senior Environmental Officer Glenn Lyons – Risk Advisor Adam Campbell – Senior Manager Accommodation Services Vern Steele – Operations Manager, Wildlife Sanctuary Mark Smith – CFO Lawrence Chong – Engineering & Compliance Manager Manjula Goonewardene – Mechanical & Automation Manager Sam Wishart – Director, Operations and Maintenance **WSP** Brenda Kingston – Director Sustainability Jenny Lewis – Senior Sustainability Consultant Shivani Desai – Senior Sustainability Consultant
APOLOGIES	Andrew Vamvakaris – Director, Property Development Owen Warlond – Director, Projects Delivery Peter Hughes – GM, Student Union Jeremy Wah – Estates Commercial Development Manager Christine Findlay – Senior Manager LARTF Ennis La Torre – Senior Manager Operations, O&M Simone Jade Costa – Student Environment Officer Simon Drew Ashby – Student Environment Officer Tony Inglis – Contractor Katie Holmes – Director for Study Inland Ashley Franks – Director, Securing Food & Water (RFA)

Level 15, 28 Freshwater Place
Southbank VIC 3006

Tel: +61 3 9861 1111
Fax: +61 3 9861 1144
www.wsp.com

MEETING NOTES

	Elissa Khoury Sam Wishart Richard Frampton Craig Appleton	Campus Life Director, Operations and Maintenance Executive Director Student Services Space Planner

ITEM	DISCUSSION	ACTION
1.0 CLIMATE CHANGE OVERVIEW — Global perspective — Representative Concentration Pathways (RCPs) — Years 2040 and 2080 under consideration — Local climate change predictions — Design systems for university and Design life	RCP 4.5 (moderate scenario) and 8.5 (high emissions scenario) are both being considered for the LTU climate adaptation plan, based on the design life of the asset under consideration. The design systems were rated in the following order in the workshop - 1. Stakeholder – Staff and Students 2. Operations 3. ITS/ electrical assets 4. Drainage 5. Structures and Buildings 6. Landscape and other reserve areas 7. Road surfacing and pavement structure	N/A
2.0 RISK ASSESMENT	Risk assessment to adopt the current La Trobe University risk assessment matrix.	WSP to update the Climate Change Risk Matrix to adopt the University's risk matrix.
3.0 RISK IDENTIFICATION: TEMPERATURE — Predicted overall increase in temperature annually — Predicted increase in intensity and duration of heat waves	Risks identified included: - Buildings failing to remain habitable during heatwaves – inability to teach in certain class rooms - Heat stress for staff and students outside on campus – uncovered pathways causing increased exposure - Master plan development might reduce the Trees/vegetation cover on campus - Urban Heat Island impact – Check the Design standards addressing this. - Plant and Animal Stress in wildlife sanctuary - Buildings overheating during power outages/ Blackout - Summer classes scheduling / Time Tabling for outside works and visitor programmes - Emergency lighting lasts for 90 mins currently. Once more residential spaces are added to the campus this will need to be re-evaluated. - Sports grounds needing more maintenance - Buildings and equipment like chiller will not perform to the expected levels. Some buildings on campus are not conditioned – residences and wildlife sanctuary are too hot during summer.	LTU to explore Solar Micro-grids and back-ups Night Purging to be considered for all buildings.
4.0 RISK IDENTIFICATION: PRECIPITATION — Predicted reduction in annual rainfall	Risks identified included: - Inability of campus drainage systems to cope with extreme rainfall events	Flooding mitigation plan to be updated by LTU -

ITEM	DISCUSSION	ACTION
— Predicted increase in extreme rain event rainfall	- Overflowing of moats contribution to flooding and inundation of drainage - Flooding of service tunnels and culverts - Repeating of previous flooding scenarios during uni term - Causing plant death resulting to loss of biodiversity - Delay in emergency response and access restrictions - Damage to substations and electrical supply - Reduced regional and campus water supplies - Algae bloom in the moat system - Flooding is already an issue in some parts of the campus, and drainage to old part of campus needs upgrade. - Sink holes on campus are becoming common.	— Review into Moat Capacity increase. — Filtration for water reuse — Moat water reuse for Irrigation, Flushing and Cooling Towers
5.0 RISK IDENTIFICATION: STORMS/ WIND/ HAIL — Predicted overall annual reduction in wind — Potential for more extreme storms and hail events	In general, issues with damage or risk from extreme wind has not been experienced previously on campus. Risks identified included: - Potential risk for building elements to come loose and general flying debris and branches. - Trees maintained to reduce this risk, particularly unlikely to result from prevailing winds. Maintenance requirement might increase. - Damage to Cars, Structures, Solar PV, roof drainage - Overhead wiring damage might cause service interruptions - Safety risk to students, staff and other campus users	LTU – Proactive management of Trees and Vegetation to protect people and infrastructure in storm events.
6.0 RISK IDENTIFICATION: BUSHFIRE — Predicted increase in forest fire danger index	Risks identified included: - Safe access to university by staff and students during bushfire season - Inhalation of smoke on campus during bushfire season Existing Bushfire Management Plan generally considered to be sufficient for climate adaptation bushfire risk mitigation.	Bushfire Management Plan already exists to manage bushfire risks for the campus, requires review/update by LTU – WSP to note
7.0 RISK IDENTIFICATION: RADIATION — Predicted increase in radiation	Risks identified included: - UV damage to roads and pavements - Heating of hard surfaces and contribution to urban heat island - Heating of unshaded building thermal mass contributing to poor building thermal comfort during heat waves	
8.0 RISK IDENTIFICATION: CARBONATION — Predicted increase in radiation	Risks identified included: - Potential concrete deterioration when carbon levels reach beyond design levels of 500ppm - Structural fatigue - Reduction in air quality for staff and students	
9.0 CRITICAL INFRASTRUCTURE	Following critical infrastructure was identified in the workshop as being important specially when considering impacts –	LTU to analyse Financial impacts and Insurance Claims

MEETING NOTES

ITEM	DISCUSSION	ACTION
	- Research facilities like glass houses and labs might need better mitigation strategies in place. - Development of refugee areas and buildings offering emergency services being identified. - Services Tunnel - Moat - Wildlife Sanctuary	Reliance on Grid power needs to be re-evaluated.
10.0 INDIRECT IMPACTS	Risks identified included: - Public transport meltdown due to extreme events impacting people getting to and from campus -	
11.0 COMMUNITY RESILIENCE PLAN — Overview of CRP — What existing plans and procedures can be adopted / enhanced	- Discussion of existing processes and Emergency and critical incident procedures on website	WSP to review and consider how CRP will be incorporated by / enhance / consolidate existing procedures and processes
12.0 NEXT STEPS — Process for addressing risks identified in workshop	— Update risk register (attached with these meeting minuities) — All high or extreme risks identified, need to be addressed by the university to been the Green Star Communities Credit Criteria. — Discussion of potential external stakeholders to be involved in next workshop (Community Resilience) — Climate Adaption Plan and Community Resilience Plan to be issued for action and consideration by University	WSP to issue updated risk register incorporating workshop outcomes LTU to review if updated design standards are being implemented and consider updating the standards to incorporate Climate Risk Mitigations.

Workshop Images –


Flood
Drought
Relative Humidity
INFRASTRUCTURE
PEOPLE
OPERATIONS
LANDSCAPE + WILDLIFE
BUILDINGS
MATERIALS + STRUCTURES
Structural fatigue
Material + infrastructure degradation
Cooling of critical infrastructure
Heat stress getting around campus
Need to upgrade electrical grids.
Heat stress of plants + animals
Buildings not habitable
Sinkholes not uncommon
Water damage to substations + electrical supply
Flooding regular issue in res
Wind impact on structural integrity
Inundation of civil drainage + moat
Drainage in residential too old.
Structural degradation of building materials
Reduced regional + campus water supplies
Residential rooms too hot in summer.
MANY AREAS DON'T HAVE HEATING & COOLING
WILDLIFE SANCTUARY OFFICE & CLASSROOMS OVERHEAT
Floods happen.
Rainfall + hail overload roof drainage
Damage + safety risk from hailstones