



Appendix A10

Climate Change Monitoring and Adaptive Management Framework

M12 Motorway West

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Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this plan is reviewed and approved. The Project Director is responsible for updating this plan to reflect changes to construction, legal and other requirements, as required.


Amendments

Any revisions or amendments must be approved by the Project Director and/or client before being distributed / implemented.

Revision Details

Rev	Date	Reviewed By	Details
A	18/02/2022	C. Mueller	First draft
B	20/05/2022	G. Bolton	2nd Draft following TfNSW/Arcadis review and comment
C	28/06/2022	G. Bolton	3rd Draft following TfNSW/Arcadis review and comment
D	19/07/2022	A. Zvirzdinas	4 th Draft following TfNSW/Arcadis/ER review and comment on Rev C
00	27/07/2022	A. Zvirzdinas	First Controlled Issue
01	08/05/2023	A. Brajliah	Second Controlled Issue
02	22/10/2024	T. Chezzi	Annual Review

Document Review

Position	Name	Signature	Date
Project Director	Nick Fryday		22/10/2024
		<small>Digitally signed by Nick Fryday Signature DN: cn=Nick Fryday Signature 2 gm=Nick Fryday Signature 2 m=AU Australia o=AU Australia o=CPB Contractors ou=NSW email=Nick.Fryday@cpb.com.au Reason: I am the reviewer and approver of this document Location: Sydney, Australia Date: 2024.10.22 14:10+11:00</small>	

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Acronyms and Abbreviations

Abbreviations	Expanded text
AR5	IPCC 5 th Assessment Report
AR6	IPPC 6 th Assessment Report
ARSR	Amendment Report to the Submissions Report
BoM	Bureau of Meteorology
CCMAMF	Climate Change Monitoring and Adaptive Management Framework
CCRA	Climate Change Risk Assessment
CO₂	Carbon dioxide
CoA	Conditions of Approval
Construction	Includes all activities required to construct the CSSI as described in the documents listed in Condition A1, including commissioning trials of equipment and temporary use of any part of the CSSI, but excluding Low Impact Work which is carried out to complete prior to the approval of the CEMP, works approved under a Site Establishment Management Plan, demolition of acquired residential houses, structures and sheds, and works specified in Appendix B and approved under an environmental management plan(s) in accordance with Condition A24.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSWMP	Construction Soil and Water Management Sub-plan
DPE	Former NSW Department of Planning and Environment
DPHI	NSW Department of Planning, Housing and Infrastructure (formerly NSW DPE which has now been split into NSW DCCEEW and NSW DPHI, with all planning functions falling to DPHI)
DPIE	Former NSW Department of Planning, Infrastructure and Environment
EAD	Environmental Assessment Documentation
EES	Environment, Energy and Science (a group within DPE)
EIS	Environmental Impact Statement
Environmental Assessment Documentation	<p>The set of documents that comprise the Division 5.2 Approval:</p> <ul style="list-style-type: none"> • Roads and Maritime Services (October, 2019) M12 Motorway, Environmental Impact Statement (EIS) • Transport for NSW (October, 2020) M12 Motorway, Submissions Report (the Submissions Report) • Transport for NSW (October, 2020) M12 Motorway, Amendment Report (AR) • Transport for NSW (December, 2020) M12 Motorway, Amendment Report submissions report (ARSR) • Transport for NSW (March, 2021) The M12 Motorway Amendment Report Submissions Report – Amendment (ARSR amendment) • WSP (October, 2021) M12 Motorway – West Package Detailed Design Consistency Assessment



Abbreviations	Expanded text
	<ul style="list-style-type: none"> GHD (October, 2021) M12 Motorway – Central Package Detailed Design Consistency Assessment Arcadis (June, 2022) M12 Motorway – Sydney Water Crossings Consistency Assessment Arcadis (July, 2022) M12 Motorway – Design Boundary Changes Consistency Assessment Arcadis (August, 2022) M12 Motorway Minor Consistency Assessment for Proposed Change to the M12 Motorway Project (M12 Central) Arcadis (September, 2023) M12 Motorway – Devonshire Road Temporary Roundabout Consistency Assessment WSP (September, 2023) M12 Motorway - Elizabeth Drive Connections Consistency Assessment TfNSW (September, 2023) M12 Motorway – Minor Consistency Assessment M12 West demolition of structures as 752 Luddenham Road TfNSW (October, 2023) M12 Motorway – Minor Consistency Assessment M12 East AF9 Power Supply TfNSW (October, 2023) M12 Motorway – Minor Consistency Assessment M12 East Cecil Road Laydown Area TfNSW (October, 2023) M12 Motorway – Minor Consistency Assessment M12 East Temporary Construction Signage Arcadis (December, 2023) M12 Motorway – East Site 48, 50 and 51 Boundary Changes Minor Consistency Assessment Arcadis (January, 2024) M12 Motorway – Minor Consistency Assessment M12 Central Water Tower Access Road <p>The documents that comprise the EPBC referral:</p> <ul style="list-style-type: none"> Submission #3486 – The M12 Motorway Project between the M7 Motorway, Cecil Hills and The Northern Road, Luddenham, NSW <p>Notification of referral decision and designated proponent - controlled action; date of decision 19 October 2018; ID: 2018-8286.</p>
Environmental Representative	A suitably qualified and experienced person independent of project design and construction personnel employed for the duration of construction. The principal point of advice in relation to all questions and complaints concerning environmental performance.
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESM	Environment and Sustainability Manager
ESR	Environmental Site Representative
Framework	All activities related to this CCMAMF
IPCC	Intergovernmental Panel on Climate Change
IS	Infrastructure Sustainability
ISC	Infrastructure Sustainability Council



Abbreviations	Expanded text
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water (formerly NSW DPE which has now been split into NSW DCCEEW and NSW DPHI)
M7 Motorway (MOD 6 Widening)	Refers to the State Significant Infrastructure project (SSI-663-MOD 6) to construct and operate an additional lane in both directions within the existing median of the M7 Motorway, south of the Kurrajong Road overhead bridge at Prestons to the M7 Motorway bridge at Richmond. This project interacts with the M12 East stage at the M7 interchange.
M7 Widening	Shorthand term for M7 Motorway (MOD 6 Widening)
M7-M12 Integration Project	The M7-M12 Integration project incorporates the following: <ul style="list-style-type: none"> • M7 Motorway (Mod 6 Widening) (SSI 663 Mod 6) – modification (mod) to the M7 Motorway approved on 17 February 2023 under Division 5.2 of the Environmental Planning and Assessment Act 1979 (EP&A Act) • M12 Motorway (CSSI 9364) – approved on 23 April 2021 under Division 5.2 of the EP&A Act and split into separate stages or packages of work (West, Central (main construction), Central (temporary roundabout) and East). The M12 Motorway is also subject to a federal approval under the Environment Protection and Biodiversity Conversation Act 1999. The M7-M12 Integration project incorporates the M12 East package only.
NSW CoA	NSW Conditions of Approval
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water (formerly NSW DPE which has now been split into NSW DCCEEW and NSW DPHI)
OCEMP	Overarching Construction Environmental Management Plan
OEMP	Operational Environmental Management Plan
Planning Secretary	Secretary of the NSW Department of Planning and Environment, or delegate
Ppm	Parts per million
Primary CoA/REMM	CoA/REMM that are specific to the development of this Framework
RCP	Representative Concentration Pathway
REMM	Revised Environmental Management Measure
RMS	Former Roads & Maritime Services (now Transport for NSW)
Secondary CoA/REMM	CoA/REMM that are related to, but not specific to, the development of this Framework
SM	Sustainability Manager
TfNSW	Transport for New South Wales
WHS	Workplace Health and Safety
Work	Any physical work to build or facilitate the building of the CSSI, including low impact work, environmental management measures and utility works.



Abbreviations	Expanded text
	However, it does not include activities that inform or enable detailed design of the CSSI and generate noise that is no more than 5 dB(A) above the rating background level at any sensitive receiver.
WSIA	Western Sydney International Airport

1 Introduction

1.1 Context

This Climate Change Monitoring and Adaptive Management Framework (CCMAMF) forms part of the Construction Environmental Management Plan (CEMP) for the M12 Motorway (West project (the Project)). The CPB Contractors and Georgiou Group Joint Venture (CPBGG JV) has been awarded the M12 West stage which is a construct only contract between The Northern Road, Luddenham and about 250 metres east of Badgerys Creek.

The new M12 Motorway will provide direct access to the Western Sydney Airport (WSA) at Badgerys Creek and connect to Sydney's motorway network. The Motorway's east-west alignment consist of 16-kilometres of dual carriageway between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham.

The Motorway will be built as a four-lane divided road and designed to be readily widened to six lanes to meet future demand. It will be designed to 110km/h and posted at 100km/h. The Motorway will provide increased road capacity and reduce congestion and travel times in line with future needs. It will also improve the movement of freight in and out of Western Sydney while serving the Western Sydney Priority Growth Area and the Western Sydney Employment Area.

This report covers the Western Section of the M12 between The Northern Road, Luddenham and approximately 250m east of Badgerys Creek. It is proposed to be four-lane dual-carriageway motorway with a central median for future six lanes, including a new grade separated interchange with the Airport Access Road to provide connection to the WSIA. See figures Figure 1-1 to Figure 1-3 outlined details of the M12 West Stage.

1.2 Background

An EIS was prepared to describe and assess the Project and recommend management measures to address impacts.

Additional assessments have since been undertaken:

- M12 West Minor Consistency Assessment for the demolition of structures as 752 Luddenham Road required to address the need for the demolition of structures within Ancillary Facility 11. Whilst this ancillary facility is already located within the construction footprint and was previously assessed in the M12 Motorway Amendment Report, the demolition and disposal of structures in this location required assessment; approved in September 2023.
- M12 West Minor Consistency Assessment for the temporary amendment to the construction footprint to facilitate the construction of Variable Message Sign (VMS) infrastructure scope on The Northern Road (TNR), Luddenham NSW. While the VMS scope had been previously assessed in the M12 Motorway Amendment Report, the works area had not been included as a part of the M12 West construction footprint and required inclusion; approved in August 2024.

The Project must be carried out generally in accordance with the EIS, Submissions Report, AR, ARSR and the ARSR – Amendment, M12 West and Central CA, M12 West Demolition of Structures as 752 Luddenham Road CA. These documents are collectively referred to as the Environmental Assessment Documentation (EAD). The CSSI must also be carried out in accordance with all procedures, commitments, preventative actions, performance outcomes and mitigation measures set out in the EAD as required by NSW CoA A2.

This Framework document builds upon the work presented in Chapter 8.6 of the Environmental Impact Statement (EIS) (2019) as revised by the Submissions Report (June, 2020) and Chapter 6.16 of the Amendment Report (July, 2020). Specifically, as a part of detailed design, the climate change work conducted during planning has been updated to incorporate risks associated with additional climate change data and validate the risks and their ratings for the M12 West section specifically. This report builds on the TfNSW CCMAMF template and the plans as listed in section 1.3 developed during design phase.

1.3 Scope of this Framework

The scope of this Framework is to describe the climate change monitoring and adaptive management measures to be adopted for the Project during construction in accordance with REMM CC02.

This Framework does not take into account climate change monitoring and adaptive management measures for design and operation.

This CCMAMF was developed to align with the Overarching CCMAMF and will be reviewed and approved by the TfNSW and the ER. Refer to Section 2 of the CEMP that details the overall revision process of CEMP and Sub-plans.

1.3.1 CCMAMF preparation, endorsement and approval

This CCMAMF was approved by the CPBGG JV Project Director and ESR prior to submission to TfNSW.

The CEMP and Sub-Plans will go through a review and update process as described in section 3.1 of TfNSW Specification G36 to ensure the CEMP and associated documents have been developed in accordance with the OCEMP. TfNSW will provide the CEMP to the ER for approval.

A hold point shall be submitted in accordance with G36 Section 3.1 - Preparation and submission of CEMP. TfNSW shall consider the documents prior to authorising the release of the Hold Point. TfNSW may request additional information for inclusion in the CEMP before authorising the release of the Hold Point. Construction will not commence until release of the Hold Point.

1.3.2 Interactions with other management plans

This Framework has the following interrelationships with other management plans and documents:

- M12 Sustainability Strategy (TfNSW, 2021) which outlines the sustainability objectives and targets and Infrastructure Sustainability Council of Australia (ISC) rating tool credit requirements. The Sustainability Strategy will be developed in accordance with REMM SU01 and NSW CoA E91 and E92 and implemented during detailed design and construction. Targets to reduce greenhouse gas emissions during construction will also be detailed in the Sustainability Strategy.
- M12 Motorway West Package 100% Detailed Design Report: Climate change monitoring and adaptive management framework (WSP, 2021)
- M12 Motorway – West Package Detailed Design, Sustainability Management Plan (WSP, 2021)
- Construction Environmental Management Plan (CEMP) and Sub-plans specifically relating to management measures and monitoring requirements during construction
- The Workplace Health and Safety Management Plan will apply an adaptive management approach to workplace health and safety during construction
- Construction Environmental Management Plan (CEMP) and Sub-plans specifically relating to management measures and monitoring requirements during construction
- Construction Flora and Fauna Management Plan (CFFMP) including the minimisation of vegetation removal
- Construction Soil and Water Management Plan (CSWMP) including site inspection prior, during and following storm events
- Construction Waste and Resources Management Plan (CWRMP) specifically addressing greenhouse gas emissions and resource and energy use
- Construction Air Quality Management Plan (CAQMP) specifically monitoring vehicle and plant emissions during construction
- Construction Flood Management Plan (FMP) addresses flood management protocols and response
- Site Establishment Management Plan (SEMP) addresses the construction of ancillary facilities away from high risk areas
- Sustainability Management Plan (SMP) address ISC rating requirements including Climate Change aspects and the overall sustainability strategy for the project.



Figure 1-1 Project regional context

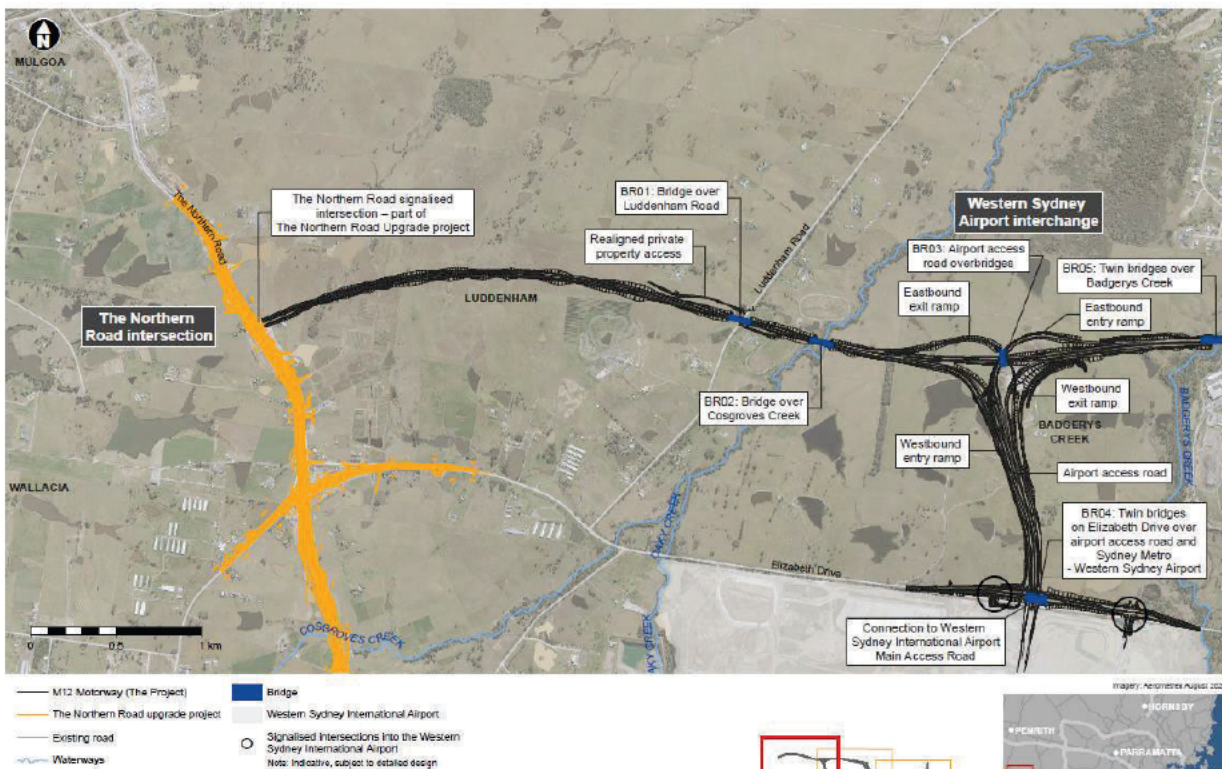


Figure 1-2 Key features of the Project

Figure 1-2 Key features of Project

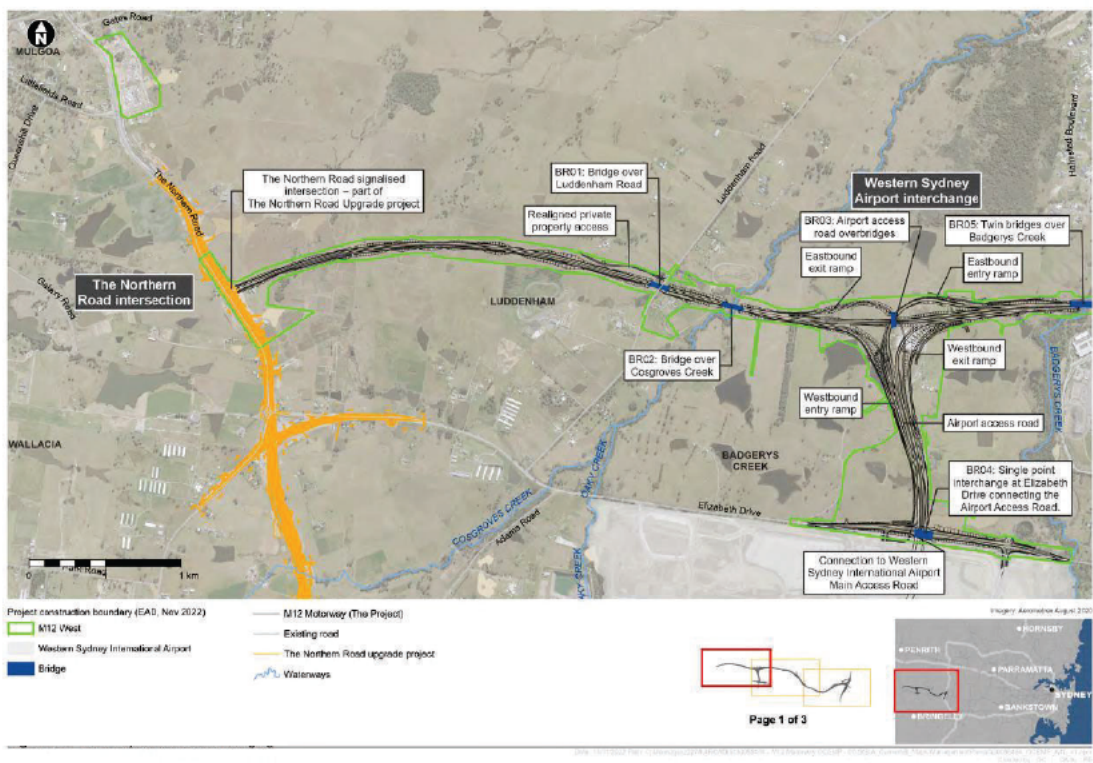


Figure 1-3 M12 Motorway Staging



M12WCO-CPBGJ JV-ML1-EV-PLN-000002_CCMAMF_Rev02
Commercial in Confidence

1.4 Purpose of this Framework

This CCMAMF provides an overarching management framework to enable CPBGG JV to establish and maintain best practice controls to manage potential climate change impacts during construction of the Project. This CCMAMF forms part of CPBGG JV's environmental management framework for the Project, as described in Section 1.5 of the CEMP. The strategies defined in this CCMAMF have been developed to address the REMM CC02. This CCMAMF includes specific requirements for implementation, monitoring and auditing during the project construction phase.

Implementing this CCMAMF effectively will enable the Project to meet regulatory and policy requirements in a systematic manner and continually improve climate change performance.

The CCMAMF provides:

- An overview of the Project's existing climate and relevant climate change projections
- Climate change impacts related to construction phase of the Project
- Climate change control measures during construction
- Monitoring procedures and criteria to evaluate effectiveness of climate change control measures during construction
- Procedures for periodic review of the Climate Change Risk Assessment (CCRA) and CCMAMF.

This CCMAMF will be available to all site personnel and sub-contractors via the Project document control management system and onsite.

EWMS will be prepared by the CPBGG JV Environmental Site Representative (ESR) and reviewed by the TfNSW Environment and Sustainability Manager (ESM) (or delegate) and independent Environmental Representative (ER) prior to the commencement of the construction activities to which they apply. Construction personnel undertaking a task governed by an EWMS will undertake the activity in accordance with the mitigation and management measures identified in the EWMS. Used together, the CEMP, strategies, procedures and EWMS form management guides that clearly identify required environmental management actions for reference by TfNSW and CPBGG JV. EWMSs will be developed and provided to TfNSW in advance of works under TfNSW G36 Hold point cl 3.2.4.

1.5 Objectives

The key objective of this CCMAMF is to ensure that all relevant requirements related to climate change mitigation and adaptive management are described, scheduled and assigned responsibility.

1.6 Targets

Targets for climate change mitigation and adaptive management during construction of the Project have been established to enable compliance with Project requirements and include:

- Ensure project personnel are informed via toolbox talks and the Project induction of this framework
- Manage extreme events during the construction of the Project through the implementation of feasible and reasonable management measures, such as those detailed in Section 5.

2 Sustainability Requirements

2.1 Relevant legislation and guidelines

Legislation, guidelines and policies relevant to the development of this Framework include:

- *Environmental Planning and Assessment Act, 1979*
- United Nations Sustainable Development Goals
- Transport Environment and Sustainability Policy Framework and Statement (TfNSW)
- TfNSW Sustainable Design Guidelines Version 4.0
- Infrastructure Sustainability rating tool Version 1.2 (Infrastructure Sustainability Council of Australia)
- Commonwealth Direct Action Plan including the Emissions Reduction Fund and Safeguard Mechanism
- National Climate Resilience and Adaptation Strategy
- NSW Climate Change Policy Framework
- Climate Change Fund Strategic Plan 2017-2022
- NSW Future Transport Strategy 2056
- A Metropolis of Three Cities – the Greater Sydney Region Plan (Greater Sydney Commission)
- Western City District Plan (Greater Sydney Commission)
- NSW Government Resource Efficiency Policy
- NSW Waste Avoidance and Resource Recovery Strategy 2014-21
- Technical Guide for Climate Change Adaptation for the State Road Network
- Australian Standard AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk-based approach
- Australian and New Zealand Standard AS/NZ ISO 31000:2018 Risk Management – Guidelines
- TfNSW Climate Risk Assessment Guideline SD-081.

2.2 NSW Conditions of Approval

There is no requirement under the NSW or Federal Conditions of Approval (CoA) to prepare and implement a climate change monitoring and adaptive management framework. Secondary CoAs relevant to this Framework have been listed in Appendix A. A cross reference is also included to indicate where the CoA is addressed in this document or other Project management documents.

2.3 Revised Environmental Management Measures

The primary REMM relevant to the development of this Framework is listed in Table 2-1. Secondary REMMs relevant to this Framework have been listed in Appendix A. A cross reference is also included to indicate where the REMM is addressed in this document or other Project management documents.

Table 2-1 Primary REMMS relevant to this Framework

REMM No.	Requirement	Document Reference
CC02	A climate change monitoring and adaptive management framework will be prepared and implemented for the Project.	This CCMAMF
	The framework will incorporate performance monitoring criteria and measures and the requirement for periodic review of the climate change risk assessment and framework against updated climate data to ensure currency.	Table 5-1 Section 6.5 Section 6.7.1

	The framework will incorporate the requirement for periodic review of the climate change risk assessment and framework against updated climate data to ensure currency.	Section 6.7.1
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2.4 TfNSW design documentation

Design development has progressed, providing additional environmental assessment, and where relevant, it has been included within this Framework. Specific documentation related to this Framework includes the following PS301 documents:

- M12 Motorway West Package 100% Detailed Design Report: Climate change monitoring and adaptive management framework (WSP, 2021)
- M12 Motorway – West Package Detailed Design, Sustainability Management Plan (WSP, 2021b).

2.5 Infrastructure Sustainability Council

The Project is targeting an 'Excellent' rating under the Infrastructure Sustainability (IS) Rating Scheme, administered by the Infrastructure Sustainability Council (ISC). The IS Rating is an assessment of a Project's sustainability performance across a number of categories, including climate change. A Sustainability Strategy has been prepared by TfNSW and submitted to DPE to achieve the rating under the Infrastructure Sustainability Council of Australia Infrastructure Sustainability rating tool. There are two climate change related IS rating credits requirements. Specifically Level 2 for Cli-1 'Climate change risk assessment', and Level 2 for Cli-2 'Adaptation measures' which are identified in Table 2-2.

Table 2-2 IS Rating climate change risk assessment credit criteria

IS credit	Level	Criteria
Cli-1 Climate change risk assessment	Level 1	A readily available climate change projection is identified and adopted for the asset region over the forecast useful life of the asset. AND Direct climate change risks to the asset over the forecast useful life are identified and assessed.
Cli-1	Level 2	The requirements of Level 1 are achieved. AND A number of readily available climate change projections are identified and adopted for the asset region over the forecast useful life of the asset. AND The climate change risk assessment also considered indirect climate change risks over the forecast useful life of the asset. AND A multi-disciplinary team participated in identifying climate change risks and issues.
Cli-1	Level 3	The requirements of Level 2 are achieved. AND Modelling is undertaken to characterise the likely impacts of the projected climate change for all High and Extreme priority climate change risks. AND A comprehensive set of affected external stakeholders participated in identifying climate change risks and issues.
Cli-2 Adaption measures	Level 1	Adaptation options to treat all extreme and high priority climate change risks are identified, assessed and appropriate measures implemented AND After treatment there are no extreme priority residual climate change risks.
Cli-2	Level 2	The requirements of Level 1 are achieved. AND

		Adaptation options to treat 25-50% of all medium priority climate change risks are identified, assessed and appropriate measures implemented.
Cli-2	Level 3	<p>The requirements of Level 2 are achieved.</p> <p>AND</p> <p>The optimal scale and timing of options is addressed (which may be triggered by when a specific climate threshold is likely to be achieved).</p> <p>AND</p> <p>Adaptation options to treat at least 50% of all medium priority climate change risks are identified, assessed and appropriate measures implemented.</p> <p>AND</p> <p>After treatment there are no high priority residual climate change risks.</p>

3 Existing Environment

Greenhouse gases (GHG) are gases that when released into the atmosphere effectively trap heat influencing global temperatures. The release of GHGs into the atmosphere is caused by both natural processes (such as bushfires) and human activities (e.g. burning fossil fuels and land clearing).

GHG (measured in parts per million (ppm)) have been rapidly increasing since the industrial revolution leading to an increase in the earth's average surface temperature and has contributed to the phenomenon of 'climate change'.

The term 'climate' refers to the typical weather conditions for a specific geographical area, usually averaged over at least 30 years. Climate variability represents the 'normal' day to day seasonal and year to year variability in the components of climate (e.g. temperature, rainfall). However, climate variability may also generate extreme conditions such as flooding, heatwaves and hail which require management. Climate change is likely to bring about changes in both average climate conditions and the frequency and severity of extreme events. This progressive change has implications for sea levels, ocean temperatures and the functionality of natural ecosystems. Climate change also means that asset owners and managers can no longer rely on prevailing assumptions that climate will be more or less the same as it was over the past 50 or 100 years.

The EIS summarises the key findings on climate change as outlined in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). The findings include:

- Warming of the climate is unequivocal; the atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea level has risen
- Surface temperature is projected to rise over the 21st century. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent. The ocean will continue to warm and acidify, and global mean sea level will rise
- In urban areas, climate change is projected to increase risks for people, economies and ecosystems, including risks from heat stress, storms, extreme rainfall, flooding, water scarcity, sea level rise, and storm surges
- Australia is currently experiencing the effects of climate change, including extreme temperatures, changes to rainfall, frequency and intensity of storm events, increases in bushfire weather, ocean warming and acidification, and sea level rise. Building adaptive capacity is crucial for effective selection and implementation of adaptation options.

In March 2023, the IPCC Sixth Assessment Report (AR6) was released (IPCC, 2023). This Framework has been reviewed upon the release of the AR6. The outcomes of the first part of the AR6 report contained similar climate change outcomes as AR5, with the following additions:

- There has been widespread and rapid changes to the atmosphere, ocean, cryosphere and biosphere with human-caused climate change leading to adverse impacts to nature and people. The most affected groups are vulnerable communities that have had the least impact upon climate change. These groups will continue to be the most vulnerable to climatic hazards.
- Climate change has resulted in considerable losses of species in terrestrial, freshwater, cryospheric, and coastal and open ocean ecosystems.
- Climate change has adversely affected food production and water security.



- Climate and weather extremes have resulted in increase to human mortality and morbidity with increases in climate related disease, increasing temperatures, trauma from extreme events, loss of livelihood and culture, and displacement of communities.
- Economic impacts have been detected including individual impacts as well as impacts to largest sectors such as agriculture, forestry, fishery, energy and tourism.

Since the development of the EIS, a gap analysis was performed on the Work conducted during the EIS to ascertain whether or not the IS rating criteria for the credits Cli-1 and Cli-2 had been sufficiently addressed (refer Section 0). This analysis identified the need for updates to the climate variables and climate change projections and associated identification and management of the risks. This updated information is included in the M12 Motorway – West Package 100% Detailed Design Report: Climate change monitoring and adaptive management framework and has been summarised in the following sections.

The existing climatic conditions (Appendix B) represents a historical trend of weather data obtained from an appropriate nearby weather station, expressed as an average value for different climate variables measured at that station. The Orchard Hill Treatment Works weather station (067084) was selected for the climate baseline data due to the dual factors of proximity as well as completeness of data. Notably, the availability of data at Orchard Hill Treatment Works weather station which was significantly higher than other (closer) weather stations in the area such as Badgerys Creek Automatic Weather station, which although used in the EIS was lacking data on key climate variables.

3.1 Climate change projections

As per AS 5334:2013, *Climate change adaptation for settlements and infrastructure – A risk based approach*, the climate change projections selected include a medium-term moderate emissions scenario and a long-term high emissions scenario. They include a 2050 projection under Representative Concentration Pathway (RCP) 4.5 and a 2090 projection under a more extreme RCP 8.5. AS 5334 states, this is preferable to provide a range in the data to guide the risk assessment. For comparison, all climate risks were also assessed using the climate baseline data collected from Prospect Reservoir Weather Station.

The RCPs are described according to atmospheric CO₂ concentration levels (in ppm) and may also be described by anomalies in global mean surface air temperatures for the period 2081-2100 relative to the average period 1986-2005 (refer Table 3-1). A summary of historical annual trends and projected changes to climate variables for each scenario is provided in Appendix B.

Table 3-1 Climate change projection scenarios

Global climate response	RCP scenario	Project increase in global surface temperature by 2081-2100
Slower response, emissions peak around 2040, then decline.	RCP 4.5, atmospheric concentration of CO ₂ projected at approx. 540 ppm by 2100.	Mean projected increase 1.8 °C Anomaly range +1.1 – 2.6 °C
Little curbing of emissions, continuing rapid rise throughout the 21st century.	RCP 8.5, atmospheric concentration of CO ₂ projected at approx. 940 ppm by 2100 and continuing to increase.	Mean projected increase 3.7 °C Anomaly range +2.6 – 4.8 °C

4 Climate Change Risk Assessment

A risk assessment was undertaken taking into consideration the requirements of AS 5334:2013, *Climate change adaptation for settlements and infrastructure – A risk based approach* (which follows the risk principles and guidelines of AS 31000:2009, *Risk Management – Principles and guidelines*) and the RMS Technical Guide on *Climate Change Adaptation for the Road Network*.

The assessment built upon the initial climate risk work performed in the EIS, updates were made to the selection of climate variables, as well as baseline and projection data and climate change scenarios used.

The following section provides a summary of the risk assessment relevant to construction only.

4.1 Climate change impacts during construction

Climate change risks relevant to the construction of the Project were determined using climate change projections to the year 2050. A total of 37 risks were identified following the risk assessment completed for M12 West by WSP (2021) for the 100% detailed design. No 'very high' risks were identified, however two 'high' and 21 'medium' risks were identified based on 2030.

Using the risk assessments completed by WSP, it can be concluded that three main risks were identified for construction with a moderate or high risk rating. The risks are outlined in Table 4-1 have been reviewed by CPBGG JV for the construction of M12 West Stage and have been added to the Construction risk register. Adaptation measures associated with the identified risks are detailed in Section 6.

The CCRA was reviewed in November 2022 to ensure currency based on the latest scientific evidence and research. Where required, the CCRA will be updated, and this CCMAMF will be updated in response, as detailed in Section 6.7.1.

Table 4-1 Climate change risks during construction

Risk scenario	Likelihood	Consequence	Risk rating 2030 (WSP, 2021a)
Increased frequency, severity, and duration of extreme temperatures (days exceeding 35°C) leading to adverse health impacts for construction workers and potential health and safety incidents.	Possible	Serious	Medium
Increased frequency, severity and duration of extreme precipitation events leading to unsuitable and unsafe conditions for construction to proceed, resulting in an increase in 'stop work' days and subsequent delays to the construction program.	Possible	Serious	Medium
Increased frequency and severity of bushfires leading to smoke generation, resulting in potential health effects for construction workers and health and safety incidents, potential increase in 'stop work' days, and subsequent delays to construction program.	Possible	Major	Medium
Increasing wind speeds leading to dust and air quality issues.	Moderate	Unlikely	Medium

5 Climate Change Adaption and Mitigation Measures

The adaptation and mitigation options have been designed to control and minimise the risk of climate change during construction. These options are based on the relevant construction risk scenarios detailed in identified in the Environmental Assessment Documentation and Project CCRAs. The construction risk scenarios include:

- Extreme heat: Increased frequency, severity, and duration of extreme temperatures (days exceeding 35°C) leading to adverse health impacts for construction workers and potential health and safety incidents.
- Extreme precipitation: Increased frequency, severity and duration of extreme precipitation events leading to unsuitable and unsafe conditions for construction to proceed, resulting in an increase in 'stop work' days and subsequent delays to the construction program.
- Bushfires: Increased frequency and severity of bushfires leading to smoke generation, resulting in potential health effects for construction workers and health and safety incidents, potential increase in 'stop work' days, and subsequent delays to construction program.
- Wind – average wind speed and storm activity: Increased frequency of extreme storms and wind speeds leading to dust and air quality issues resulting in an increase in 'stop work' days and subsequent delays to the construction program.

Table 5-1 details the adaptive management options for workplace health and safety and environmental planning during construction that will be implemented by CPBGG JV.

Table 5-1 Climate Change mitigation and adaptation options during construction

ID	Management Measure	When to implement	Responsibility for implementation	Reference of source	Evidence of implementation
CC01	In locating ancillary facilities, the CPBGG JV will consider the risk of flood, strong winds, severe storm events and/or bushfires and consider the requirements detailed in NSW CoA A15-A20	Prior to construction	CPBGG JV ESR CPBGG JV Safety Manager	Section 5 CCRA WHS Protocol	Site planning SEMP FMP CAQMP CSWMP CFFMP
CC02	Prior to attending site, all personnel will undergo induction training detailing the procedures to be undertaken during extreme weather events ²	Prior to and During construction	CPBGG JV ESR CPBGG JV Construction Manager	Section 5 CCRA WHS Protocol	Induction material CEMP section 3.5 WHS Plan
CC03	Weather conditions will be monitored, and the construction program will be adapted wherever feasible during extreme events	During construction	CPBGG JV ESR CPBGG JV Safety Manager	Section 5 CCRA WHS Protocol	Induction material WHS Plan FMP CAQMP CSWMP
CC04	Stop work protocols will be incorporated into the CPBGG JV project documentation for extreme events and implemented during construction	During construction	CPBGG JV ESR CPBGG JV Safety Manager	Section 5 CCRA WHS Protocol	Induction material WHS Plan FMP CAQMP CSWMP
CC05	CPBGG JV supplied plant materials must be grown by a nursery in a local area of similar climate to the Works.	During construction	CPBGG JV ESR CPBGG JV Landscaping subcontractor	Landscape design and drawings TfNSW Landscape specification R179	Inspection Test plans for landscaping (ITP) Procurement records

² An extreme event can be referred to as extreme heat, extreme precipitation, severe storm or wind event and/or bushfire

6 Compliance Management

6.1 Roles and responsibilities

During construction, the Project's organisational structure and overall roles and responsibilities are outlined in Section 3.3 of the CEMP.

Specific responsibilities for the implementation of this Framework are detailed in Section 5.

6.2 Training

To ensure that this Framework is effectively implemented, all site personnel (including sub-contractors) will undergo site induction training that includes climate adaptation and mitigation management procedures to be undertaken during extreme weather events.

Training specific to this Framework will be focused on the adaption measures to be implemented including the Adaptive Management Procedure (EES, 2021) and Stop Work Procedures.

6.3 Communication

The CPBGG JV will adhere to the requirements as outlined in the Overarching Communication Strategy (OCS). The OCS identifies opportunities and tools for providing information and consulting with the community and stakeholders during the construction of the Project. Climate change management information will be communicated to the community and stakeholders in accordance with the principles and procedures outlined in the OCS where required. Further detail about the OCS is provided in Section 3.7.3 of the CEMP.

6.4 Monitoring and inspection

Monitoring of climate change adaptation measures is required to ensure the Project maintains resilience to climate change impacts to minimise adverse impacts on personnel's health during construction and operation, the public's health during operation and delays to construction program.

As defined by the NSW Environment, Energy and Science (EES), "Adaptive management is a procedure for implementing management while learning about which management actions are most effective at achieving specified objectives. Adaptive management is often referred to as structured 'learning by doing'." ¹

A list of monitoring activities and evaluation criteria are specified in Table 6-1. These activities and criteria will be supplemented during construction by the measures outlined in the Construction Environmental Management Plan (CEMP) and Sub-plans, as well the Sustainability Management Plan.

By undertaking monitoring, and analysing and evaluating monitoring data, this enables the Project to plan, manage and evaluate the effectiveness of adaptation measures during construction and operation implement changes, as required.

¹ Adaptive Management definition sourced from NSW EES

<https://www.environment.nsw.gov.au/research/adaptive-management.htm>

Table 6-1: Monitoring activities

Performance monitoring criteria	Monitoring measures	Timing	Responsibility
Evaluate effectiveness of communicating upcoming extreme climate to personnel and planning for delays to program	Monitor weather forecast to check for upcoming days with predicted extreme heat, extreme precipitation, and bushfire warnings to enable wet weather procedures or stop works to be enacted	Daily	CPBGG JV ESR CPBGG JV Safety Manager
If construction ancillary facilities have been affected by severe storms, or have the potential of	Site inspection to be undertaken in accordance with the Construction Soil	Before, during and after rainfall	CPBGG JV ESR CPBGG JV Safety Manager

Performance monitoring criteria	Monitoring measures	Timing	Responsibility
flooding consider relocation or additional weather protection	and Water Management Plan (CSWMP) before, during and after rainfall events. Inspections and planning for potential flooding events to occur in accordance with the Flood Management Plan (FMP)		
Determine if the WHS practices are effective in preventing personnel health impacts, if not, implement improved protocols	Monitor effectiveness of workplace health and safety practices, including stop work protocols, to be reviewed after the event of extreme heat days	After days exceeding 35°C	CPBGG JV Safety Manager
Evaluate health and wellbeing of personnel on extreme heat days and determine if additional protocols shall be implemented to minimise health risk	Monitor the health and wellbeing of personnel on high heat days and determine whether stop work protocols should be implemented	Days exceeding 30°C but under 35°C	CPBGG JV Safety Manager

6.4.1 Stop Work Protocols

Stop works protocols associated with Climate Change Risks are contained within a number of project documents as detailed in table

Table 6-2 – Stop Work Protocols

Management Plan	Stop Work Protocol	Summary
Workplace Health and Safety Management Plan	<ul style="list-style-type: none"> Extreme Heat – risk to workers Hot works – Fire risk Wind speed – Crane activities 	Includes protocols to stop works when temperature and wind forecasts pose a significant risk to workers safety
Emergency Response Management Plan (ERMP)	Climate associated emergencies including; Flood, Fire	Includes requirements to stop works, ensure property and personnel safety and evacuation.
Construction Soil and Water Management Plan (CSWMP) and Pollution Incident Response Management Plan (PIRMP)	Storm and rainfall events – offsite water pollution risks	Includes requirements to stop activities that have the potential to cause pollution and implement mitigation measures to prevent material harm.
Construction Flood Management Plan (FMP)	Extreme rainfall and potential flood events – pollution and health and safety of workers	Includes requirements to stop works and prepare the construction site for potential flood events
Construction Air Quality Management Plan (CAQMP)	Wind conditions – offsite dust impacts	Includes requirements to stop dust generating activities during high winds when the dust cannot be controlled to prevent offsite impacts.

6.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of climate change management measures, in accordance with CEMP and other relevant approvals, licenses and guidelines. Audit requirements are detailed in Section 3.9.3 of the CEMP.

6.6 Reporting and identified records

Reporting requirements and responsibilities are documented in Section 3.9 of the CEMP.

This Framework forms part of the CEMP, as such the CPBGG JV will maintain accurate records substantiating all construction activities associated with the Project, including measures taken to implement this Framework.

6.7 Periodic review

6.7.1 Climate change risk assessment review

The IPCC Sixth Assessment Report (AR6) was released in August 2021 and the IPCC Synthesis Report was planned to be released in 2022. The CCRA was planned to be reviewed against this new climate change data upon release of these reports to identify any new climate change risks and determine additional adaptation measures to be implemented for design, construction, and operations. AR6 was not released until March 2023.

A Climate Change Risk Workshop was held in November 2022 as a CCRA review. The workshop included a multi-disciplinary team of CPBGGJV construction staff and TfNSW representatives. As the AR6 was not yet released at the time, the CCRA Workshop was instead based on the IPCC's *Climate Change 2022: Impacts, Adaptation and Vulnerability*.

Periodic review of the CCRA will be undertaken following any design changes that arise during construction to assess if changes will impact the risks or adaptation identified and generate new risks to the Project.

A copy of the updated CCRA identifying changes to the Project's climate change risks and adaptations shall be distributed to all relevant stakeholders. Relevant stakeholder are identified in the Overarching Communication Strategy (OCS) and they include;

- The NSW Department of Planning and Environment (DPE)
- Liverpool City Council
- Penrith City Council
- NSW Environmental Protection Agency (EPA)

Updates to the CCMAMF will follow any updates to the CCRA.

6.7.2 CCMAMF review

Periodic reviews (both annually and when required) will be undertaken and implemented for improvements to this Framework during construction. Continuous improvement will be achieved by the ongoing evaluation of climate change monitoring activities and updates to climate change data. Further detail on periodic review of this Framework can be found within the Sustainability Strategy.

Appendix A Secondary CoAs and REMMs

CoAs

CoA	Requirement	Document Reference
E91	A Sustainability Strategy must be prepared to achieve a minimum excellent 'Design' and 'As built' rating under the Infrastructure Sustainability Council of Australia infrastructure rating tool.	Section 1.3.2 Sustainability Strategy
E92	The Sustainability Strategy must be submitted to the Planning Secretary before the commencement of construction and must be implemented throughout construction and operation.	Section 1.3.2 Sustainability Strategy

REMM

REMM No.	Requirement	Document Reference
CC03	An adaptive management approach will be applied to workplace health and safety planning during construction and operation in line with the WHSMP. This will include use of TfNSW Work Health and Safety Procedures.	Section 5
SU01	A sustainability management plan for the project will be developed and implemented during detailed design, to give effect to the sustainability strategy for the project. The management plan will detail measures to meet the sustainability objectives and targets and Infrastructure Sustainability rating tool credit requirements.	Sustainability Strategy



Appendix B Climate baseline and projection data

The table below has been sourced from the M12 West 100% Detailed Design climate change monitoring and adaptive framework report (WSP, 2021).

Variable	Current Climate*		Climate Change Predictions		Source
	Prospect Reservoir Weather Station	Baseline Period	General Trend	Near term, moderate scenario 2030, RCP 4.5	
Temperature					
Mean maximum daily temperature (°C) – Annual	23.3	1986-2005	↑	+1.3 (1 to 1.9) i.e. 24.6°C (24.3 to 25.2)	1,2
Mean maximum daily temperature (°C) – Summer (DJF)	28.1	1986-2005	↑	+1.3 (0.8 to 2.2) i.e. 29.4°C (28.9 to 30.3)	1,2
Mean minimum daily temperature (°C) – Annual	12.2	1986-2005	↑	+1.3 (0.9 to 1.6) i.e. 13.4°C (13.1 to 13.8)	1,2
Days p.a. over 35°C	10.5	1986-2005	↑	16.3 days	1,2
Days p.a. over 40°C	1.0	1986-2005	↑	2.4 days	1,2
Days p.a. below 2°C	2.5	1986-2005	↓	0.45 days	1,2
Days p.a. below 0°C	0.1	1986-2005	↓	0 days	1,2
Highest temperature for baseline 1986-2005 (°C)	44.7 15 Jan 2001	Discrete event	↑	+1.8 (0.6 to 2.1) i.e. 46.5°C (45.3 to 46.8)	3
Highest temperature for years on record at AWS (°C)	45.3 7 Jan 2018	Discrete event		N/A	
Lowest temperature for baseline 1986-2005 (°C)	-0.5 13 August 2005	Discrete event	↑	+1.2 (0.5 to 1.4) i.e. 0.7°C (0 to 0.9)	3
Lowest temperature for years on record at AWS (°C)	-0.8 30 June 2010	Discrete event		N/A	
Precipitation					
Mean Rainfall (mm) - Annual	879.4	1986-2005	↑↓ Seasonal variation	+0.5% (-11.4 to 7.7) i.e. 883.4 mm (778.9 to 946.7)	1,2
Mean Rainfall (mm) – Spring (SON)	181.1	1986-2005	↓	-0.2% (-18.9 to 12.1) ie 180.7 mm (147 to 203.1)	1,2
Mean Rainfall (mm) – Summer (DJF)	289.5	1986-2005	↑	+4.1% (-9.9 to 19.4) i.e. 301.4 mm (260.8 to 345.6)	1,2
Mean Rainfall (mm) – Autumn (MAM)	245.1	1986-2005	↓	-2.6% (-17 to 18.3) i.e. 238.7 mm (203.3 to 289.8)	1,2

Variable	Current Climate*		Climate Change Predictions		Source
	Prospect Reservoir Weather Station	Baseline Period	General Trend	Near term, moderate scenario 2030, RCP 4.5	
Mean Rainfall (mm) – Winter (JJA)	163.7	1986-2005	↓	-5% (-19.6 to 8.3) i.e. 155.5 mm (131.7 to 177.3)	1,2
Highest daily rainfall event (mm) for baseline 1986-2005	321.0 06 Aug 1986	1986-2005	↑	+4.4% (-1.5 to 13.5) i.e. 335 mm (316.3 to 364.5)	3
Highest daily rainfall (mm) for years on record at AWS	321.0 06 Aug 1986	Discrete event		N/A	
Maximum 1 day rainfall for a 20 year ARI event	N/A	N/A		+9.8% (-1.7 to 22.9)	3
Extreme events					
Severe fire danger days per year	1.1	1986-2005	↑	1.2 to 1.5 days*	4
Lightning	20-25 thunder days per year	1990-1999	↑	5-6% increase per °C warming i.e. 7% to 8.4% increase in 6,7 lightning frequency	6,7
Soil					
Soil moisture	N/A	1986-2005	↓	-2.1% (-10.2 to 2)%*	1
Daily variables					
Evapotranspiration (%)	N/A	N/A	↑	+5.4% (3 to 6.9)	1
Maximum wind gust speed (km/h) for years 2003-2005	89.0	2003-2005	↑	N/A	5
Avg. 9 am wind speed (km/h)	9.6	1986-2005	↓	-1.3% (-4.6 to 0) i.e. 9.4 km/h (9.1 to 9.6)	1,2
Avg. 3 pm wind speed (km/h)	15.1	1986-2005	↓	-1.3% (-4.6 to 0) i.e. 14.9 km/h (14.4 to 15.1)	1,2
Avg. 9 am relative humidity (%)	73.5	1986-2005	↓	-0.4% (-1.6 to 1.3) i.e. 73.1 % (72.3 to 74.4)	1,2
Avg. 3 pm relative humidity (%)	50.5	1986-2005	↓	-0.4% (-1.6 to 1.3) i.e. 50.3 % (49.7 to 51.2)	1,2
Mean daily solar exposure (MJ/(m*m))	16.4	1990-2005	↑	+0.5% (-0.6 to 2.2) i.e. 16.5 MJ/(m*m) (16.3 to 1, 2 16.7)	1,2



Notes:

1 CSIRO BOM 2015, *Climate Change in Australia Projections Cluster Report - East Coast, Appendix Table 1c East Coast South*

2 CSIRO BOM 2015, *Climate Change in Australia Summary Data Explorer, East Coast Cluster Projections*

3 CSIRO BOM 2015, *Climate Change in Australia Extremes Data Explorer, East Coast Cluster Projections*

4 CSIRO BOM 2015, *Climate Change in Australia Projections Cluster Report - East Coast, Appendix Table 2, Projections and baseline for Canberra*

5 CSIRO BOM 2015, *Climate Change in Australia Projections Cluster Report - East Coast, Figure 4.4.2*

6 State of NSW and Department of Environment, *Climate Change and Water 2010, Impacts of Climate Change on Natural Hazards Profile, Sydney/Central Coast Region*

7 IPCC, 2013: *Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K.]

* Projection data was not available for RCP 4.5 2050 therefore RCP 4.5 2030 was used as the closest available proxy

NB: Severe fire danger days per year based on Forest Fire Danger Index >50. Based on three climate models given as range from lowest to highest value of 3 projections

NB: Highest temperature recorded in baseline period uses CSIRO projection for 'hottest day' for summer (DJF)

NB: Highest daily rainfall provides indication of change to most extreme annual rainfall event using CSIRO 'wettest day' projections (annual)

NB: all projections use global climate models from the IPCC's Fifth Assessment report, excepting hail and lightning projections