Transport for NSW

Chapter 21
Climate change

NSW GOVERNMENT

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21. Climate change

This chapter and Appendix I (Climate change assessment – additional information) provide the results of the climate change risk assessment for the project. The chapter identifies potential climate change risks that could affect the project, and how these risks have been, and would continue to be, managed.

21.1 Approach

Climate change has the potential to alter the frequency, intensity, and distribution of extreme weather-related natural hazards, including more intense and frequent heat waves, droughts, floods, and storm surges. As structures need to be designed to last for many years, they need to be resilient to climate change and the risk of climate change impacts on infrastructure needs to be considered as part of the design process.

A climate change assessment has been carried out to determine climate change scenarios and potential risks to project infrastructure. Risks that require further action have been prioritised. The assessment was carried out in accordance with relevant climate change guidelines and policies, including:

- *Transport for NSW Climate Risk Assessment Guidelines* (version 4.1) (Transport for NSW, 2021a) (the 'Climate Risk Assessment Guidelines')
- Australian Standard *AS 5334–2013 Climate change adaption for settlements and infrastructure – A risk based approach* (Standards Australia, 2013) (AS 5334)
- *Infrastructure Sustainability Rating Scheme Technical Manual Design & As-Built* (v2.1) (Infrastructure Sustainability Council, 2021).

In addition, Transport for NSW's climate risk tools 1 and 2 were used to obtain climate projection data and assess climate change risks.

21.1.1 Study area

The study area for the assessment is the project site, as described in Chapter 2 (Location and setting), and surrounding suburbs.

21.1.2 Key tasks

The assessment followed a typical risk assessment process in accordance with AS 5334 and the Climate Risk Assessment Guidelines. It included the following tasks:

- reviewing information on the project and its geographic context, including historical climate conditions and data sourced from the closest Bureau of Meteorology automatic weather station (see Appendix I (Climate change assessment – additional information))
- developing projections of future climate conditions for the study area
- determining climate projection scenarios for the assessment using Transport for NSW's climate risk tool 1, with the following three climate projection scenarios identified:
  - 2021 to 2050

  - 2051 to 2080
  - 2071 to 2100

- assessing the risks of climate change through desktop assessment and multidisciplinary workshops, and prioritising risks using Transport for NSW's climate risk tool 2
- identifying potential adaptation measures and/or design strategies for priority climate change risks (medium, high and very high risks).

Climate change is already affecting transport infrastructure within Australia through increased heat and increased intensity of rainfall. However, the long-term nature of the effects of climate change means that potential impacts in the short-term can be relatively minor or less frequent in comparison to long-term effects. Therefore, the focus of the climate change assessment is on the potential risks over the operational life of the project and not construction phase risks.

The assessment approach followed AS 5334 with key tasks summarised in Figure 21.1.

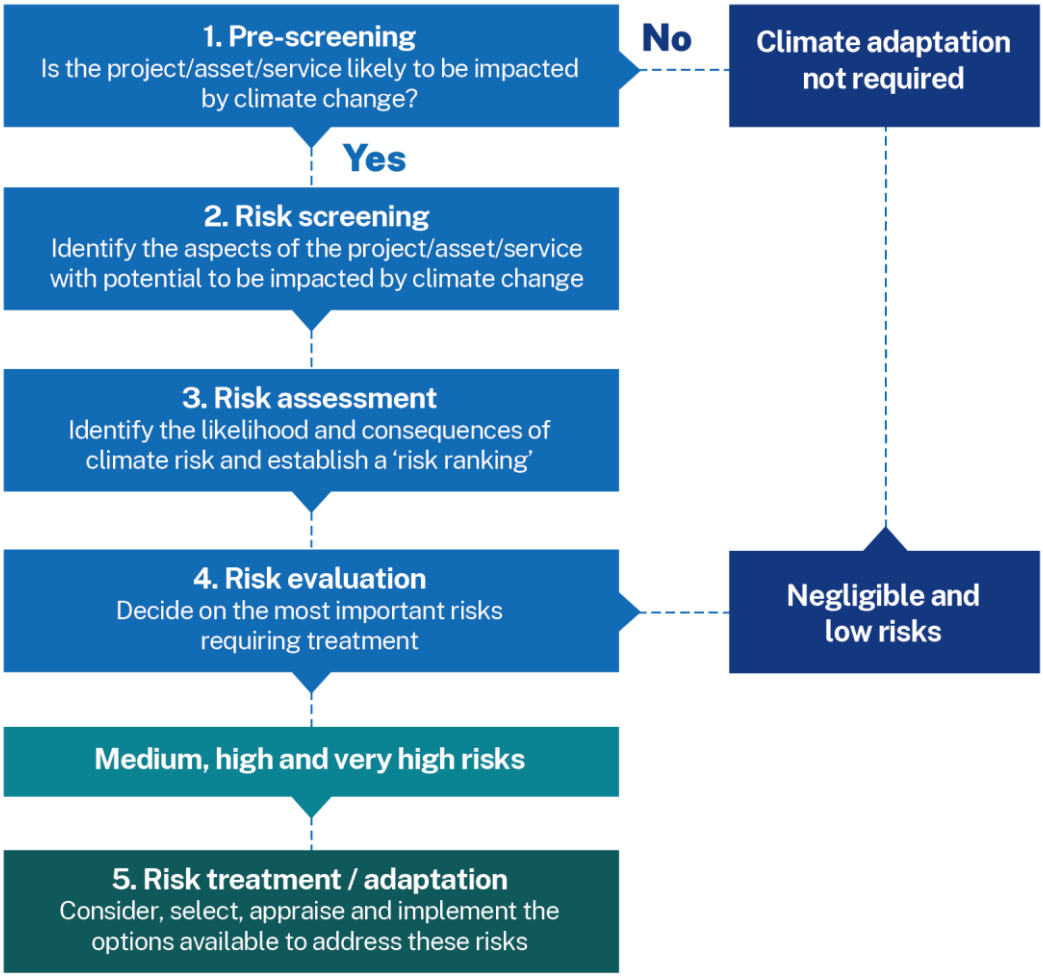

Figure 21.1 Climate change assessment – key tasks

21.2 Existing and future environment

21.2.1 Existing climate

Historic climate records indicate that the climate of the Parramatta region is a warm-temperate climate, with mild to cool winters (average July temperature is 17.5 degrees Celsius) and warm, hot summers (average January temperature is 29 degrees Celsius). Parramatta is slightly warmer than the Sydney CBD, as it does not generally experience coastal sea breezes. Rainfall is typically spread evenly throughout the year with between about 200 and 300 millimetres per season (about 970 millimetres annually) (Bureau of Meteorology, 2021b).

The Parramatta region has also been experiencing more regular heatwaves, with five significant heatwaves recorded since January 2013. Heatwaves experienced in May 2014 and March 2016 suggest that changing weather patterns are now leading to heat events outside the traditional summer months. Severe storms are also more prevalent, with the severity and impact on infrastructure increasing.

The likelihood of more extremes in weather makes the project vulnerable to climate change impacts.

21.2.2 Climate projections

A descriptive picture of future climate is helpful for those assessing climate risk to consider the broad differences between current conditions and what is projected to occur under a climate projection scenario of little or insufficient global response to mitigate climate change. Qualitative and quantitative projections developed for the study area using the Transport for NSW climate risk tool 1 are summarised in Table 21.1. Further information is provided in Appendix I (Climate change assessment – additional information).

Table 21.1 Overview of future climate

Attribute	Climate projection
Temperature	• Average temperatures would continue to increase in all seasons. • More hot days and warm spells are projected. Fewer frosts are projected. • Maximum temperatures are projected to increase by 3.8 °C by 2050 and by 6.3 °C by 2100. • The number of days over 35 °C Celsius is predicted to increase from the baseline (varies for each suburb) by up to 52 days (in West Ryde) by 2050 and by up to 114 days (in Sydney Olympic Park) by 2100. • The number of days over 40 °C is predicted to increase from the baseline (varies for each suburb) by up to 25 days (in Sydney Olympic Park) by 2050 and by up to 63 days (in Sydney Olympic Park) by 2100.
Rainfall	• Natural climate variability would remain the major driver of rainfall changes in the next few decades. • The intensity of heavy rainfall events would increase. • The total amount of rain during a maximum rainfall period (defined as a period of consecutive days when rainfall exceeded 30 mm/day) is predicted to increase from the baseline (160 mm) to 212 mm by 2050 and to 185 mm by 2100. • The baseline precipitation rate of 38 mm/hour is predicted to increase to 50 mm/hour by 2100. • The number of days with rainfall intensity over 25 millimetres per hour is predicted to increase from one day to two days by 2100.
Sea level rise	• Sea level is predicted to rise by up to 0.25 m by 2050 and by up to 2.44 m by 2100. These predictions are higher than those obtained from data from CoastAdapt, which predicts a median sea level rise of 0.78 metres by 2100, or the predicted sea level rise of 0.9 m by 2100 provided in the *NSW Sea Level Rise Policy Statement* (DECCW, 2009) which has been used in the flood model for the hydrology, flooding and water quality assessment (Technical Paper 10 (Hydrology, Flooding and Water Quality)).

Attribute	Climate projection
Other	• Climate change would result in a harsher fire-weather climate in the future. • Little change in mean surface wind speed is projected. • Intense low pressure systems off the eastern coast of Australia (known as East Coast Lows) may become more severe, generating an increase in heavy widespread rainfall, heavy hail and strong winds that can damage infrastructure.

Climate change variables

The following climate variables were identified to quantify climate risks to the project:

- rainfall – annual average rainfall, extreme rainfall (flooding) and drought
- temperature – annual average temperature, extreme temperature events
- wind – gales and extreme wind events, storms (snow, hail, dust, lightning)
- average humidity
- bushfire risk – fire danger index
- sea-level rise (including king tides)
- soil moisture.

21.3 Assessment results

A summary of the total climate change risk ratings for the three climate projection scenarios is provided in Table 21.2 and the full results of the risk assessment are provided in Appendix I (Climate change assessment – additional information).

Table 21.2 Number of risks and rating identified across each climate projection scenario

Risk rating	Risks 2021-2050	Risks 2051 – 2080	Risks 2071-2100
Very high	1	2	3
High	18	16	19
Medium	58	50	46
Low	11	10	10
Total	**88**	**78**	**78**

In the shorter term, eighty-eight initial climate change risks for the 2021-2050 period were identified. Of these, 10 are relevant to construction, and the remaining risks (78) are relevant to operation.

Extreme rainfall events, flooding, extreme heat, and increase in bushfire and fire weather conditions are expected to present the highest risks in the future. Table 21.3 lists the risks rated as high or very high across the three climate projection scenarios prior to the implementation of mitigation.

Table 21.3 Summary of risks rated as high or very high across the climate projection scenarios

Climate hazard	Risk description – high and very high rated risks
Temperature	Heat wave during construction results in stop work and delays (one to seven days).
	Bushfire smoke blown onto the project site impacts the health of workers.
	Bridge structure between Melrose Park and Wentworth Point is exposed to extreme heat and would become over heated for workers and customers.
	Extreme temperatures and solar radiation degrade batteries, causing an explosion/fire risk and significant safety event.
	Bushfire smoke during operation impacts the health of customers or staff.

Climate hazard	Risk description – high and very high rated risks
	Heat wave during operation results in power outages, sag of overhead wire, or health impacts to workers and customers.
	Extreme temperatures and urban heat island effect impacts threatened fauna species.
Rainfall	Drought and low soil moisture causes erosion of batters and scouring in waterways (e.g., culverts slippage of tracks) and cost to repair/replace.
	High intensity rainfall creates a flood that damages project infrastructure, resulting in delay in light rail service and customer complaints.
	Changes in flooding and hydrological regime impacts threatened flora and fauna species and changes the extent and composition of communities.
	High intensity rainfall creates a flood or surface flows of water that exceed the capacity of drainage and stormwater infrastructure, resulting in damage and cost to repair/replace.
Other	Constructed bridges create shading that changes the composition of vegetation (mangroves and salt marshes), potentially impacting threatened flora and flora communities.
	Construction impacts mangroves and salt marsh vegetation, changing the extent and composition of flora and fauna communities (including threatened species).
	Impacts of sea level rise causing track movement and significant cost to repair/replace.
	Impacts of sea level rise causing track movement and delays to light rail services, resulting in customer complaints.
	Extreme wind during operation causes damage to electricity lines and other infrastructure (e.g., poles, electric wires and above ground distribution boards), resulting in a significant safety incident (e.g., electrocution).
	Extreme wind event coinciding with a heat wave during operation damages transmission lines and causes power outages of services (including signalling), resulting in significant safety incident (e.g., customers stranded on rail in high temperatures).

21.4 Mitigation and management measures

21.4.1 Approach to mitigation and management

The outcome of the climate change risk assessment is a priority list of risks and associated adaptation measures, which would be further developed. Some identified risks may require an immediate response or design modification, while others may require further investigation.

The suggested adaptation measures for the project, developed as an outcome of the climate change risk assessment, are listed in Appendix I (Climate change assessment – additional information). These measures, which would reduce the impact of climate change risks to the project, include a combination of risk avoidance measures, design considerations, and procedures to manage unavoidable risks.

Example adaptation measures include:

- accounting for climate change throughout the design process for critical assets and infrastructure
- ensuring specifications for temperature tolerance of electrical and electronic equipment allows for future climate change, taking into account intended lifespan
- investigating the potential to future proof the power supply to allow for replacement and upgrade to more resilient technology.

Further consideration of the potential for climate change risks would be undertaken during design development. This would include further modelling and updating the climate change risk assessment in accordance with AS 5334 and the Climate Risk Assessment Guidelines. Risks and potential adaptation measures identified by the preliminary assessment would be reviewed and prioritised, considering the initial capital investment and long-term costs, level of climate change risk mitigation, and other residual risks. Adaptation measures would be implemented (including incorporating them into the design and operating procedures) where reasonable and feasible.

21.4.2 List of mitigation measures

Measures that will be implemented to manage the potential for climate change risks are listed in Table 21.4. Measures to manage potential flooding impacts during construction and operation and the impacts of emergency situations such as fire and flood during construction are provided in Chapter 17 (Water) and Chapter 19 (Hazard and risk), respectively.

Table 21.4 Climate change mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Climate change risk assessment	CC1	The climate change risk assessment will continue to be refined in accordance with Australian Standard *AS 5334–2013 Climate change adaptation for settlements and infrastructure – A risk based approach* and the *Transport for NSW Climate Risk Assessment Guidelines* (Transport for NSW, 2021a). Adaptation measures will be confirmed, and actions implemented, to address very high, high and medium risks where reasonable and feasible.	Design
Emergency management planning	CC2	Operational procedures for emergency planning and management will be prepared and implemented to consider the increased risk of flooding, storm surges and heatwaves.	Operation
Climate change risk management	CC3	Operational procedures will be developed and implemented to appropriately respond to extreme climate events (temperature, winds or rainfall), as identified in the updated climate change risk assessment.	Operation