Transport for NSW/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Major Development Plan

Chapter 25 Sustainability
Chapter 26 Climate change and greenhouse gas

2020

Contents

Tables

Figures

Chapter 25

Sustainability

This chapter provides the sustainability assessment of the project. It identifies a target rating for the project according to the Infrastructure Sustainability Council of Australia's sustainability rating scheme and considers the application of relevant sustainability principles and guidelines to the project.

The SEARs relevant to sustainability are listed below. There are no MDP requirements specifically relevant to sustainability. However, there is a requirement under section 91(1) of the Airports Act to assess the potential environmental impacts associated with a development (section 91(1)(h)), and to specify how those impacts may be dealt with (section 91(1)(j)). Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
17	**Sustainability**	
17.1	The Proponent must assess the sustainability of the proposal in accordance with the Infrastructure Sustainability Council of Australia (ISCA) *Infrastructure Sustainability Rating Tool* and recommend an appropriate target rating for the proposal.	Section 25.2.1
17.2	The Proponent must assess the proposal against the current guidelines including targets and strategies to improve Government efficiency in use of water, energy and transport.	Section 25.2.2

25. Sustainability

25.1 Assessment approach

Sustainability (or sustainable development) has been defined in different ways depending on application and context. In 1987, the Brundtland Commission defined sustainable development as ‘development that meets the needs of the present, without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development, 1987).

In the context of infrastructure projects, ‘infrastructure sustainability’ is defined by the Infrastructure Sustainability Council of Australia (ISCA) as ‘infrastructure that is designed, constructed and operated to optimise environmental, social and economic outcomes of the long term’. Using a tool such as ISCA’s infrastructure sustainability rating tool (the ‘IS rating tool’), an assessment of the sustainability performance of an infrastructure asset can be undertaken.

The sustainability assessment for the project considered the application of sustainability principles, and the opportunities to achieve sustainability targets and outcomes aligned with best practice infrastructure projects. The sustainability targets and initiatives outlined have been developed in response to various guidance documents and will be integrated into the design, construction and operation of the project. An overview of the approach to the sustainability assessment is provided below, including key relevant guidelines and policies and a summary of the assessment methodology.

25.1.1 Legislative and policy context to the assessment

The assessment was undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations
- *2030 Agenda for Sustainable Development* (United Nations, 2015)
- *Environment and Sustainability Policy* (Transport for NSW, 2015)
- *Transport Environment and Sustainability Policy Framework* (Transport for NSW, 2013)
- *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime, 2019b)
- *Infrastructure Sustainability rating scheme v1.2* (ISCA, 2017)
- *Sustainable Design Guidelines* (Transport for NSW, 2017)
- *Sydney Airport Sustainability Policy* (SACL, 2016)
- *NSW Government Resource Efficiency Policy* (OEH, 2019b)
- *NSW Waste Avoidance and Resource Recovery Strategy 2014-21* (NSW EPA, 2014b)
- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

25.1.2 Methodology

The *Environmental Sustainability Strategy 2019-2023* (Roads and Maritime, 2019b) and associated policies and frameworks provide direction to embed sustainability initiatives into the project. The sustainability assessment used an infrastructure sustainability rating scheme and tool developed and administered by ISCA. This scheme provides a comprehensive system for evaluating sustainability across the design, construction and operation of new infrastructure.

Version 1.2 of the rating scheme would be applied to the project. Using the rating scheme, credit points are allocated for providing verified evidence of sustainability actions across different performance categories which are then totalled to achieve an overall project score. The 'Design' and 'As Built' ratings would be applied to the project. The 'Design' rating is an interim verification step after detailed design is completed. This interim rating is later replaced with the 'As Built' rating, which covers both the design and construction stages. The themes and associated performance categories are shown in Figure 25.1.

Figure 25.1 IS rating scheme version 1.2 themes and categories

Key steps in the assessment process are set out in Figure 25.2.

The first step in the assessment process involves an initial assessment of category weightings, followed by analysis of credit requirements. This provides a project-specific context for identifying a target rating level that the project should seek to achieve.

Project information relevant to each category of sustainability initiatives would be reviewed in conjunction with relevant subject matter experts to provide an evidence base for determining the potential performance of the project. Project information was subsequently analysed using the IS rating tool to determine the project's potential score against each sustainability credit. A total potential score was calculated and a project target rating level identified.

Under the rating scheme, each project is allocated a calculated rating based on a score out of 100, with an additional 10 points available for innovation.

Figure 25.2 Infrastructure sustainability rating scheme methodology

25.2 Assessment results

25.2.1 Target rating

During the initial stages of the assessment, the weighting of potential credit scores was adjusted based on their relevance to the project. Each credit in the IS rating scheme has a default weighting shown in the IS scorecard and in the IS Technical Manual. Each default credit weighting reflects the importance and contribution set for the credit to the sustainability performance of a typical infrastructure project or asset.

Through the weightings assessment the default weightings are adjusted based on the importance of each credit for that specific project. The weightings assessment may retain, raise or lower the predetermined weighting of each credit in regard to its relative importance in the project. The credit categories: ‘energy and carbon’, ‘discharges to air’, ‘land and water’ and ‘innovation’ were considered to be most relevant to the project, and were therefore given higher weightings. This was, as outlined above, determined through answers to specific weightings assessment questions provided by the IS scorecard.

Key sustainability initiatives considered included:

- Climate change resilience - including initiatives to improve the resilience of the project to future extreme climate events and sea level rise
- Resource use and waste management including:
  - Initiatives for achieving efficiencies in water management
  - The management and re-emplacement of landfill waste at the former Tempe landfill as required
- Heritage – Aboriginal and non-Aboriginal - including initiatives for the preservation of heritage values
- Liveable communities – including the proposed active transport link
- Natural landscape and environment, including initiatives to minimise the construction boundary where practicable to protect sensitive areas (eg Tempe Wetlands) and design initiatives that minimise impacts to sensitive areas (eg Alexandra Canal).

By implementing initiatives linked to the identified sustainability targets in the sustainability assessment, the project would be designed, constructed and operated to maximise sustainability outcomes.

Based on the results of the assessment, a target rating level of ‘excellent’ was identified as appropriate for the project. The construction contractor(s) will be required to propose project-specific sustainability initiatives and implementation protocols to support achievement of the project’s target excellent ‘Design’ and ‘As Built’ rating. This will ensure ongoing consistency with the *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime, 2019b).

25.2.2 Consistency with relevant guidelines and policies

The SEARs require an assessment of the project against current sustainability guidelines, including targets and strategies to improve government efficiency in the use of water, energy and transport.

The project’s consistency with relevant guidelines is considered below. The project’s consistency with strategic plans and policies relating to transport, freight planning and urban development is considered in Chapter 5 (Strategic context and project need).

A justification of the project in accordance with the principles of ecologically sustainable development (defined by Schedule 2 of the EP&A Regulation) is provided in Chapter 28 (Project justification and conclusion).

2030 Agenda for Sustainable Development

The 2030 Agenda for Sustainable Development was endorsed by the United Nations and the 193 Member States (including Australia) at the United Nations Sustainable Development Summit held in September 2015. The agenda, which responds to challenges faced by the world today and into the future, aims to integrate the social, environmental and economic dimensions of sustainable development. The agenda consists of 17 sustainable development goals and 169 targets.

The project would contribute to the following seven goals, shown in Figure 25.3:

- Goal 8: Decent work and economic growth – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. The project would provide direct and indirect employment as well as contribute to the economic growth through direct procurement and better flow of people and freight
- Goal 9: Industry, innovation and infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation. Innovative sustainable technologies and resilience to climate change have been, and would continue to be key considerations in the design development
- Goal 11: Sustainable cities and communities – Make cities and human settlements inclusive, safe, resilient and sustainable. One of the key benefits of the project is that it would reduce heavy vehicles and cars on local roads, making the city more sustainable and safer for local communities
- Goal 12: Responsible consumption and production – Implement responsible sourcing practices and policies and engage with suppliers. The project has the potential to apply responsible sourcing practice through active screening of, and engagement with, suppliers on sustainability issues.
- Goal 13: Climate action – Take urgent action to combat climate change and its impacts. A climate change risk assessment has been undertaken to ensure that resilience to climate change is embedded into design and construction. The assessment included identifying risks and adaptation measures to ensure that the project can withstand future climate change impacts (see Chapter 26 (Climate change and greenhouse gas)).
- Goal 15: Life on land – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. While the project site is largely located within a disturbed environment, potential impacts to biodiversity, soils and water have been assessed and mitigation measures provided to ensure impacts are minimised.
- Goal 17: Partnerships for the goals – Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. This project involves stakeholders from state, local and federal government, private sector, industry and community members, all of whom are contributing to advance this project’s sustainability outcomes.

Figure 25.3 2030 Agenda for Sustainable Development – goals relevant to the project

Transport for NSW Environment and Sustainability Policy and Framework

The NSW Government has obligations under the *Transport Administration Act 1988* (NSW) 'to promote the delivery of transport services in an environmentally sustainable manner'. To meet these obligations, Transport for NSW developed an *Environment and Sustainability Policy* (Transport for NSW, 2015), which states that Transport for NSW and associated agencies are 'committed to delivering transport services, projects, operations and programs in a manner that balances economic, environmental and social issues to ensure a sustainable transport system for NSW.'

The *Transport Environment and Sustainability Policy Framework* (Transport for NSW, 2013) provides a collective and coordinated approach to implement the *Environment and Sustainability Policy* and deliver the NSW Government's environmental and sustainability agenda across the transport network. The framework outlines a number of indicators and targets across eight themes. These themes and relevant actions have been incorporated into *Environmental Sustainability Strategy 2019-2023* and are considered below.

Roads and Maritime Environmental Sustainability Strategy

The *Environmental Sustainability Strategy 2019-2023* outlines ten sustainability focus areas for integrating sustainability into the design and construction of road projects. The focus areas are shown on Figure 25.4. A review of the project's consistency with these focus areas and associated objectives is provided in Table 25.1.

Figure 25.4 Environmental Sustainability Strategy 2019-2023 sustainability focus areas

Table 25.1 Consistency with the Environmental Sustainability Strategy 2019-2023 sustainability focus areas

Sustainability focus area	Objectives	Project consistency
Energy and carbon management	Minimise energy use and reduce carbon emissions without compromising the delivery of services to our customers.	A greenhouse gas assessment was undertaken to quantify the project's potential emissions during construction and operation. Mitigation and management measures are provided to minimise energy use and reduce carbon emissions (see Chapter 26 (Climate change and greenhouse gas)).
Climate change resilience	Design and construct transport infrastructure to be resilient or adaptable to climate change impacts.	A climate change risk assessment was undertaken to ensure that resilience to climate change is embedded into design and construction. This assessment included identifying risks and adaptation measures to ensure that the project can withstand future climate change (see Chapter 26).
Air quality	Minimise the air quality impacts of road projects and support initiatives that aim to reduce transport-related air emissions.	The potential impacts on air quality have been assessed and measures are provided to minimise the identified impacts (see Chapter 12 (Air quality)).
Resource use and waste management	Minimise the use of non-renewable resources and minimise the quantity of waste disposed to landfill.	As part of construction planning, the potential for unnecessary resource use would be avoided by making accurate predictions of the quantities of materials that would be required for construction. The management of construction and operation waste would include reuse and recycling of waste, where possible. This is discussed further in Chapter 24 (Waste management).
Pollution control	Minimise noise, water and land pollution from road and maritime construction, operation and maintenance activities	Potential noise, contamination, groundwater, soils and water quality impacts have been assessed and measures are provided to minimise the identified impacts (see Chapters 10 (Noise and vibration), 13 (Contamination and soils), 15 (Groundwater) and 16 (Surface water)).
Biodiversity	Improve outcomes for biodiversity by avoiding, mitigating or offsetting the potential impacts of road and maritime projects on plants, animals and their environments	The potential impacts on biodiversity have been assessed, and measures are provided to avoid, mitigate or offset the identified impacts (see Chapter 22 (Biodiversity)).

Sustainability focus area	Objectives	Project consistency
Heritage – Aboriginal and non-Aboriginal	Manage and conserve cultural heritage according to its heritage significance and contribute to the awareness of the past.	The potential impacts on Aboriginal and non-Aboriginal heritage have been assessed and measures are provided to minimise the potential impacts, including providing opportunities to contribute to an awareness of the heritage significance of the study area (see Chapters 17 (Non-Aboriginal heritage) and 18 (Aboriginal heritage)).
Liveable communities	Provide high quality urban design outcomes that contribute to the sustainability and liveability of communities in NSW.	The project would contribute to reducing congestion on the existing road network and improving connectivity in the surrounding area through faster travel times and reliability along many key arterial roads. The project would also improve the overall amenity of Tempe Lands and enhance opportunities for passive recreation for residents of Tempe. All of this would contribute to the sustainability and liveability of communities in NSW. Additional information is provided in Chapter 20 (Socio-economic impacts). An urban design strategy has been developed to guide future design stages, and considers the surrounding environment, place making and community considerations. Further information is provided in Chapter 21 (Landscape character and visual amenity).
Sustainable procurement	Procure goods, services, materials and works for infrastructure development and maintenance projects that over their lifecycle deliver value for money and contribute to the environmental, social and economic wellbeing of the community.	Goods, services and materials would be procured in accordance with Transport for NSW's procurement policies, which incorporate sustainability considerations to deliver value for money and contribute to the environmental, social and economic wellbeing of the community.
Corporate sustainability	Communicate our sustainability objectives to employees, contractors and other key stakeholders, and foster a culture which encourages innovative thinking to address sustainability challenges.	Sustainability objectives would continue to drive design and construction. These objectives would be incorporated into the project's construction and operation environmental management plans and would be communicated to all project employees, contractors and stakeholders.

Transport for NSW Sustainable Design Guidelines

The *Sustainable Design Guidelines* (Transport for NSW, 2017), which are influenced by ISCA's IS rating scheme, seek to embed sustainability initiatives into the planning, design, construction, operation and maintenance of transport infrastructure projects. The guidelines do not specifically apply to road projects; however, the sustainability focus areas and objectives specified by the *Environmental Sustainability Strategy 2019-2023* are consistent with the sustainability initiatives of the *Sustainable Design Guidelines*. The *Sustainable Design Guidelines* are also similar to ISCA's sustainability initiatives.

NSW Government Resource Efficiency Policy

The aim of the *NSW Government Resource Efficiency Policy* (OEH, 2019b) is to reduce the NSW Government's operating costs and increase efficiency of resource use. The policy aims to drive resource efficiency by NSW Government agencies through specific measures, targets and minimum standards in four main areas – energy, water, waste and air emissions. These align with the sustainability focus areas in the *Environmental Sustainability Strategy 2019-2023* and would be achieved by implementing sustainability objectives and design strategies consistent with the target sustainability rating for the project.

Further information on the potential air quality, water, waste and energy impacts, and strategies to minimise these potential impacts and enhance the project's performance, consistent with the *NSW Government Resource Efficiency Policy*, are provided in Chapters 12 (Air quality), 14 (Flooding), 15 (Groundwater), 16 (Surface water), 24 (Waste management) and 26 (Climate change and greenhouse gas).

NSW Waste Avoidance and Resource Recovery Strategy

The *NSW Waste Avoidance and Resource Recovery Strategy 2014-21* (NSW EPA, 2014b) provides a framework for waste management in NSW. The goal of the strategy is to reduce the environmental impact of waste and use resources more efficiently.

The strategy provides long-term targets and key result areas for the management of waste. The potential impacts on waste and resources have been assessed and measures are provided to minimise the identified impacts (see Chapter 24). This includes measures to avoid, minimise or manage waste streams generated during construction and operation.

Sydney Airport Sustainability Policy

The *Sydney Airport Sustainability Policy* (SACL, 2016) aims to embed sustainability considerations into all of Sydney Airport's actions. The policy is further supported by the Sustainability Strategy and 2019-2021 Sustainability Commitments, which provide a framework for, and commitments to, sustainability at Sydney Airport.

The approach to sustainability at Sydney Airport is categorised into the three sustainability pillars shown in Figure 25.5.

Figure 25.5 Sydney Airport Master Plan 2039 – Approach to sustainability

The objectives and target areas defined by the policy have been incorporated into the *Sydney Airport Master Plan 2039* (SACL, 2019a) and *Sydney Airport Environmental Strategy 2019-2024* (SACL, 2019b) described below.

Sydney Airport Master Plan 2039

Sydney Airport Master Plan 2039 (the Master Plan) embeds sustainability considerations into planning for the future management and development of Sydney Airport. The Master Plan confirms a commitment to taking a sustainable approach to managing future growth at Sydney Airport, and delivering positive outcomes for customers, investors and the community.

The approach to sustainability, and the objectives and initiatives provided by the Master Plan, align with those in the *Environmental Strategy 2019-2023*. The project is consistent with the following sustainability strategies provided in the Master Plan:

- Community – making a positive contribution to the communities in which we operate
- Environmental efficiency – improving energy and water efficiency and reducing carbon intensity
- Climate change – building resilience and adapting to the physical impacts associated with climate change
- Materials and supply chain – sourcing responsible materials and managing the social and environmental impact of our procurement decisions

- Waste – minimising waste going to landfill
- Customer experience – enhancing customer experience through sustainability, including urban design.

Sydney Airport Environmental Strategy

The environmental action plans in the *Sydney Airport Environmental Strategy 2019-2024* include a sustainability and environmental management action plan. While the actions and initiatives in this plan are not specifically relevant to the project, the project is consistent with the broader objectives and policies that have guided development of the environment strategy, including '… adopting measures to use natural resources sustainably, including minimising our energy use and the generation of waste, doing our part to ensure the enduring wellbeing of the environment'.

25.3 Sustainability management

25.3.1 Approach and outcomes

Approach to sustainability management

A sustainability management plan would be developed to guide how the project would meet the target sustainability rating and how the project-specific sustainability initiatives would be implemented. The plan would establish governance structures, processes and systems to ensure that sustainability objectives and commitments continue to be implemented during detailed design, construction and operation. The aims of the plan would be to:

- Demonstrate sustainability leadership and continuous improvement
- Protect the natural environment and local heritage
- Contribute to liveable communities and facilitate urban revitalisation by easing congestion, connecting communities and integrating land use and transport planning
- Optimise resource efficiency (materials, energy, water and land) and waste management
- Increase resilience to the effects of future climate change
- Minimise and manage greenhouse gas emissions arising from construction, operation and maintenance (see Chapter 26 (Climate change and greenhouse gas))
- Procure sustainably, considering whole of life environmental, social and economic factors
- Maximise equitable/fair training and employment opportunities.

The plan would include objectives and actions to guide achievement of the targeted excellent rating. The plan would detail implementation protocols, including:

- The ISCA assessment and registration process and timeframes
- Proposed consultation and engagement with ISCA and other stakeholders
- The rating process and requirements for the provision of documentation to ISCA
- Key sustainability management roles and responsibilities
- Actions to achieve consistency with the objectives of the *Environmental Sustainability Strategy 2019–2023*.

The sustainability management plan would form part of the project's management system. The plan would be revised and updated regularly, including prior to the commencement of operation, to reflect changing designs and sustainability initiatives through each of the project phases.

Expected effectiveness

The proposed management measures provided in section 25.3.2 have been developed to provide a pathway to achieving the target sustainability rating. These are consistent with those implemented on similar infrastructure projects, and are expected to be effective.

25.3.2 List of mitigation measures

Measures that will be implemented to integrate sustainability considerations with the project and achieve the target rating are provided in Table 25.2.

Table 25.2 Sustainability mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Achieving the target sustainability rating	SU1	A sustainability management plan will be developed to ensure that sustainability considerations are implemented during the detailed design, construction and operation phases of the project. The plan will include project-specific sustainability initiatives and implementation protocols to support achievement of the project's target excellent 'Design' and 'As Built' rating under the Infrastructure Sustainability rating tool (v1.2) and to ensure ongoing consistency with the *Environmental Sustainability Strategy 2019–2023* (Roads and Maritime, 2019b).	Detailed design
	SU2	Prior to the commencement of operation, the sustainability management plan and sustainability initiatives will be reviewed and updated.	Operation

Chapter 26

Climate change and greenhouse gas

This chapter summarises the climate change and greenhouse gas assessments undertaken for the project. It identifies potential climate change risks, and how these risks have been and would continue to be managed. The chapter also provides preliminary estimates of the potential greenhouse gas emissions associated with the project and measures to manage these emissions.

The SEARs relevant to climate change are listed below. There are no SEARs relevant to greenhouse gas, and no MDP requirements relevant to climate change or greenhouse gas. However, there is a requirement under section 91(1) of the Airports Act to assess the potential environmental impacts associated with a development (section 91(1)(h)), and to specify how those impacts may be dealt with (section 91(1)(j)). Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
19	**Climate Change Risk**	
19.1	The Proponent must assess the risk and vulnerability of the proposal to climate change in accordance with the current guidelines.	Section 26.1
19.2	The Proponent must quantify specific climate change risks with reference to the NSW Government's climate projections at 10 km resolution (or lesser resolution if 10 km projections are not available) and incorporate specific adaptation actions in the design.	The climate projections used are summarised in section 26.1.2 Risks and actions identified are provided in sections 26.2 and 26.3
19.3	The EIS must include a qualitative assessment of changes to the heat island effect in the local area.	Section 26.2.1

26. Climate change and greenhouse gas

26.1 Assessment 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. The risk of climate change impacts on infrastructure therefore needs to be considered as part of the design process.

Greenhouse gas is a collective term for gases that absorb outgoing infrared radiation reflected from the earth. The process of absorbing infrared radiation in the atmosphere generates heat and gradually warms the atmosphere. This is known as the greenhouse effect, which is linked to climate change. Human activities, including the combustion of carbon-based fuels, increase the concentration of greenhouse gases in the atmosphere. This leads to greater absorption of infrared radiation and an increase in atmospheric temperature.

Identifying the likely scale of potential emissions associated with the project provides a baseline from which further greenhouse gas reduction measures can be developed.

Climate change and greenhouse gas assessments were undertaken to inform the development of the concept design. The risks that climate change poses to the project, and the project's potential contribution to future climate change were both considered. Risks that require further action were prioritised and the results of these assessments are summarised in this chapter.

An overview of these assessments is provided below, including the legislative and policy context and a summary of the methodologies.

It is noted that the SEARs for flooding also identify the need to assess impacts on flood behaviour for a full range of flood events, including taking into account sea level rise and storm intensity due to climate change. This is considered in Chapter 14 (Flooding).

26.1.1 Legislative and policy context to the assessment

The assessments were undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations, and the *National Greenhouse and Energy Reporting Act 2007* (Cth)
- *Climate Change Policy Framework* (OEH, 2016b)
- *Sea Level Rise Policy Statement* (DECCW, 2009)
- *AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach*
- Draft *Technical Guide: Climate Change Adaptation for the State Road Network* (Issue 1) (Roads and Maritime, 2015c) (the 'Technical Guide')
- *Climate Change Impacts and Risk Management – A Guide for Business and Government* (Australian Greenhouse Office, 2006)
- *National Climate Resilience and Adaptation Strategy* (Department of the Environment, 2015)
- *Climate Change in Australia Projections for Australia's NRM Regions - East Coast Cluster Report* (Dowdy et al., 2015)
- *National Greenhouse Accounts Factors* (Department of the Environment and Energy, 2017)
- *Greenhouse Gas Assessment Workbook for Road Projects* (Transport Authorities Greenhouse Group (TAGG), 2013)
- *Environmental Sustainability Strategy 2019-2023* (Roads and Maritime, 2019b)

- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

26.1.2 Methodology

Climate change

The climate change risk assessment followed the approach set out in the *Draft Technical Guide: Climate Change Adaptation for the State Road Network* (Roads and Maritime, 2015c) (the Technical Guide). A preliminary assessment was undertaken to consider climate change risks, opportunities and adaptations to inform the design process.

The assessment approach and key tasks are summarised in Figure 26.1.

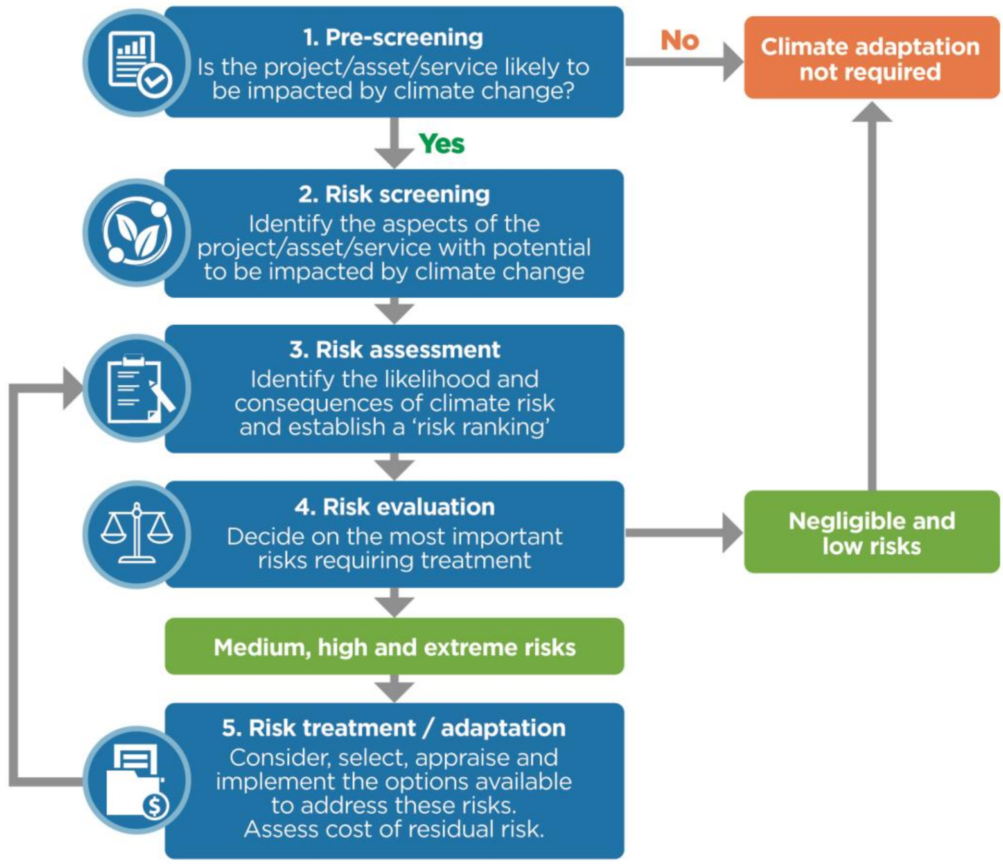

Figure 26.1 Climate change assessment – key steps

The long term nature of the effects of climate change makes it difficult to pinpoint potential impacts within relatively short duration and near term events such as those associated with construction of a project. Therefore, the focus of the climate change assessment was on the potential risks over the operational life of the project.

The key climate change risks considered during operation in the near (2030) and/or far future (2070) were:

- Extreme rainfall combined with sea level rise – rainfall events are predicted to become more intense, increasing the likelihood of flooding, sea levels are anticipated to rise, and more frequent storm surges are anticipated to be experienced in coastal areas
- Temperature – average annual temperatures are predicted to rise and the number of extreme heat days (days over 35 degrees) are expected to increase

- Atmospheric carbon dioxide (CO_2) – increases in CO_2 are predicted to cause changes in the pH levels of saline water which has been linked to increasing the corrosive effects of intertidal waters
- Wind speed – wind speeds are projected to increase
- Bushfire – climatic changes such as changing rainfall patterns, extreme heat and wind speed are predicted to increase the likelihood of severe bushfires.

Climate projections

Table 26.1 outlines the key climate change projections used by the assessment. The timescales used in these projections are considered appropriate for the design life of project elements.

Table 26.1 Key climate change projections

Feature	2030	2070	Source
Projected temperature changes			
Maximum temperature	Maximum temperatures are projected to increase in the near future by 0.7°C (0.3 to 1.0°C)	Maximum temperatures are projected to increase in the far future by 1.9°C (1.6 to 2.5°C)	NSW and ACT Regional Climate Modelling project (NARCLiM) (OEH, 2014)
Minimum temperatures	Minimum temperatures are projected to increase in the near future by 0.6°C (0.4 to 0.8°C)	Minimum temperatures are projected to increase in the far future by 2.0°C (1.4 to 2.5°C)	NARCLiM
Hot days	The number of hot days will increase in the near future	The number of hot days will increase in the far future	NARCLiM
	Average change +3.9 hot days per annum above 35°C	Average change +10.4 hot days per annum above 35°C	NARCLiM
Cold days	The number of cold nights will decrease in the near future	The number of cold nights will decrease in the far future	NARCLiM
Projected rainfall changes			
Mean rainfall	Rainfall is projected to decrease in spring and increase in autumn	Rainfall is projected to decrease in spring and winter. Rainfall is projected to increase in summer and autumn	NARCLiM
Rainfall Intensity	The intensity of rainfall events are projected to increase in the far future		CSIRO projections (Dowdy, A et al, 2015)
Projected sea level rise changes[1]			
Sea level	Sea level is projected to increase 0.08 to 0.18 m above 1986-2005 levels in the near future	Sea level is projected to increase 0.4 to 0.55 m above 1985-2005 levels in the far future	CSIRO projections
Increase in atmospheric CO_2			
Atmospheric CO_2	Atmospheric CO_2 levels are projected to increase in the near and far future		CSIRO projections
Projected forest fire danger index changes			
Fire weather	Average fire weather is projected to increase in spring in the near future	Severe fire weather days are projected to increase in summer and spring in the far future	NARCLiM

Feature	2030	2070	Source
Projected wind speed changes			
Wind speed	Minimal change in mean surface wind speed in the near future	Minimal change in mean surface wind speed in the far future	CSIRO projections

Note: 1. To undertake the risk assessment the flood sensitivity analysis scenarios modelled for the flooding assessment (see Technical Working Paper 6 (Flooding)) have been adopted. These scenarios include 0.4 metres for near future projections and 0.9 metres for far future projections. These are considered to be a more conservative approach to assessing the potential impacts of sea level rise.

Greenhouse gas

The greenhouse gas assessment involved:

- Identifying potential sources of greenhouse gases (including carbon dioxide, nitrous oxide, methane, and sulphur hexafluoride) during construction and operation
- Estimating emissions for each source (carbon dioxide equivalent emissions) and the total greenhouse gas emissions attributable to the project, in accordance with the *Greenhouse Gas Assessment Workbook for Road Projects* (TAGG, 2013) (the TAGG Workbook) and a qualitative assessment in relation to NSW's annual greenhouse gas emissions
- Identifying measures to reduce greenhouse gas emissions.

Emissions were categorised into three different categories (known as 'scopes') to help differentiate between direct emissions from sources that are owned or controlled by a project, and upstream indirect emissions that are a consequence of project activities, but which occur at sources owned or controlled by another entity. The three categories are:

- Scope 1 emissions – direct greenhouse gas emissions into the atmosphere as a result of the project (such as from plant and equipment using fuel)
- Scope 2 emissions – indirect greenhouse gas emissions into the atmosphere from the consumption of energy (such as electrical lighting)
- Scope 3 emissions – other indirect emissions (not included in scope 2) due to upstream or downstream activities (such as emissions associated with road users or the embodied energy within a material used to construct the project).

Data obtained from (the then) Roads and Maritime's Strategic Travel Model was used to calculate scope 3 emissions from operational road users for the overall Sydney road network. Emissions were calculated for the 'without project' and 'with project' scenarios. The following scope 3 emissions were deemed to be immaterial (contributing less than five per cent of the total greenhouse gas emissions of a major activity) in accordance with the TAGG Workbook and therefore excluded from the assessment:

- Fugitive emissions (such as from intentional or unintentional leaks or evaporative sources)
- Employee travel to and from site
- International delivery of plant, equipment and materials
- Emissions from disposal of site waste other than spoil
- Transportation of maintenance materials.

The calculated emissions provide an indicative estimate of the project's greenhouse gas emissions and are appropriate to assess the significance of the emissions relative to sector, state and national emissions.

26.2 Assessment results

26.2.1 Climate change

The pre-screening assessment determined that the project has the potential to be impacted by climate change due to:

- Local topography and geographical location – including existing flooding characteristics in certain areas (see Chapter 14 (Flooding)) and the proximity of the project site to Botany Bay
- The design life of the project's key components (such as bridges, which have a design life of about 100 years).

The assessment determined that the major climate change risk variables relevant to the project are increases in the frequency and intensity of rainfall, and sea level rise. Potential risks were identified and rated.

As described in Chapter 14, the flood modelling undertaken for the project included an assessment of the impacts of increased rainfall intensity and sea level rise due to climate change. A number of risk scenarios were identified relevant to the flood impact assessment and these are included in Table 26.2. Existing characteristics associated with the site and surrounding area (described in Chapter 14) have constrained opportunities to incorporate significant flood mitigation in the design. For example, raising Qantas Drive and Airport Drive would have adverse impacts on flooding behaviour within Sydney Airport. The height of road infrastructure in places is also constrained by Sydney Airport's prescribed airspace.

Of the risks identified, three were rated as extreme, one risk was rated as high, and nine risks were rated as medium. These risks are summarised in Table 26.2. The approach to managing these risks is provided in section 26.3

Table 26.2 Climate change risks rated medium or above (prior to mitigation)

Project component	Risk statement / scenario	Risk rating
Extreme rainfall combined with sea level rise		
Roadway operation	Increase in rainfall intensity combined with sea level rise resulting in localised flooding of the roadway low points causing traffic delays, safety risks for road users and potential road closures.	Extreme
Roadway operation	Increase in rainfall intensity combined with sea level rise resulting in localised flooding at the upgraded sections of Airport Drive at Terminal 1 and the Freight Terminal, Qantas Drive upgrade and extension, Eastbound terminal link, northern lands access causing traffic delays, safety risks for road users and potential road closures.	Extreme
Roadway operation	Increase in rainfall intensity combined with sea level rise exacerbating the impacts of future development in the surrounding area, which may alter overland flow paths and drainage systems increasing the amount of floodwater on the road network or adjacent areas.	High
Roadway operation	Increase in rainfall intensity combined with sea level rise resulting in localised flooding at the access to Terminals 2/3, causing minor surface flooding and potential traffic delays.	Medium
Roadway operation	Increase in rainfall intensity and sea level rise causing flooding of the underpass on the active transport link (at Nigel Love bridge), causing a potential hazard to cyclists and/or an inconvenience due to closures.	Medium
Drainage	Reduced performance of surface drainage systems caused by increased rainfall intensity contributing to localised flooding.	Extreme

Project component	Risk statement / scenario	Risk rating
Drainage	Increased exposure of the outfalls at Alexandra Canal and the wider drainage system to inundation and saline conditions due to sea level rise resulting in increased risk of corrosion and increased deposit of sediments.	Medium
Road pavement	Sea level rise increasing the risk of storm surges causing scour damage to pavements and reducing the safety of road conditions.	Medium
Structures	Increase in rainfall intensity combined with sea level rise (and storm surges) resulting in overtopping of the terminal link bridge.	Medium
Electrical assets and power supply	Failure of electrical assets and power outages, caused by flooding as a result of an increase in rainfall intensity combined with sea level rise.	Medium
Temperature		
Structures / drainage	Increased mean maximum temperature and frequency and intensity of extreme heat events may lead to greater material degradation and structural fatigue due to thermal expansion of steel elements	Medium
Electrical assets and power supply	Extended periods of high temperatures may cause a high demand on the electricity grid causing blackouts and loss of traffic signals.	Medium
Wind speed		
Structures	Increase in wind speeds may impact the structural integrity of long span bridges.	Medium

Urban heat island effect

Development within cities such as Sydney can influence the surrounding atmosphere and interact with climatic processes resulting in their own microclimate. One aspect of these microclimates is the urban heat island effect where urban areas become warmer than surrounding areas due to the absorption of heat energy from the sun. The denser a city is, the higher its capacity to absorb and store heat and contribute to the urban heat island effect.

The heat island effect may be enhanced by heat produced by vehicles, public transport and mechanical plant. Conversely, vegetation can reduce the urban heat island effect by providing shading, reducing the footprint of absorptive materials such as asphalt, and providing evaporative cooling. Increases in temperature due to climate change are expected to exacerbate the urban heat island effect in urban areas. Land use changes can also impact the urban heat island effect.

The project site has the potential to experience a level of heat island effect due to the urbanised nature of the study area, including large expanses of paved areas associated with existing roads and Sydney Airport. The coastal nature of the study area means that sea breezes do and will continue to assist in cooling the local climate.

The project is located in an urbanised area with a large portion of the project either replacing existing roadways or industrial sites, which both contain absorptive materials that contribute to the urban heat island effect. The industrial areas consist mostly of concrete/gravel hardstand, warehouse-style buildings, and asphalt carparks with some areas used for storage of shipping containers.

There may be some changes to the urban heat island effect as a result of converting these areas to roadways due to the higher absorptive capacity of asphalt, however, the degree of change would not be as significant as those other areas which would be converted from vegetated areas to hardstand or roadway. During construction, about 24 hectares of vegetation would be removed (see Chapter 22 (Biodiversity)). The areas of vegetation that would be removed are small in comparison to the areas of the project that are already urbanised roadways or industrial sites. Additionally, some of the vegetated areas consist of open grasslands that provide fewer benefits (in terms of reducing the urban heat island effect) compared to areas of dense vegetated land.

New vegetation that provides shading would assist in reducing the urban heat island effect and provide localised relief for members of the public using surrounding public open space areas. New vegetation would be provided in accordance with the project's urban design and landscape plan.

As a result of the above, the project is expected to result in a minor change to the urban heat island effect within the local area.

Cumulative impacts

In terms of the potential for cumulative climate change impacts, the key projects are the Botany Rail Duplication project and the New M5.

While both projects are located within the same catchment, with the potential for cumulative impacts as a result of future increased rainfall intensity and sea level rise, modelling undertaken as part of the flooding assessment for the Sydney Gateway road project (see Chapter 14(Flooding)) concluded that the New M5 would result in negligible cumulative impacts.

The Botany Rail Duplication project is likely to include drainage and earthworks with the potential to impact on the rate of flow discharging to the drainage system that runs across Qantas Drive to Sydney Airport. The drainage systems for the Sydney Gateway road project and the Botany Rail Duplication project would be designed to minimise the potential for cumulative impacts. Further information is provided in Chapter 14.

Modelling undertaken as part of the flooding assessment for the Sydney Gateway road project (see Chapter 14) concluded that cumulative effects from the Botany Rail Duplication project would be minor. As a result, it is considered that the cumulative impacts of the Botany Rail Duplication project can be readily managed by implementing the mitigation measures provided in Chapter 14.

Other future developments and upgrades in the area surrounding the project site may result in changes to overland flow paths and drainage networks. Additionally, if the density of development increases and vegetation is removed, an increase in the urban heat island effect could result.

It is expected that the potential for cumulative impacts would be readily managed with the implementation of the measures provided in section 26.3.

26.2.2 Greenhouse gas

Construction

The estimated construction emissions by source and scope are provided in Table 26.3 and shown on Figure 26.2. The total greenhouse gas emissions for construction activities is estimated to be 422,970 tonnes of CO_2-equivalent (tCO_2-e) over a three-year period.

Scope 3 emissions account for the majority (80 per cent) of construction-related emissions, with the largest proportion of this coming from embodied emissions within materials used for the project. A total of 20 per cent of emissions come from plant and equipment that consume fossil fuels (scope 1 emissions). Vegetation removal accounts for less than one per cent of the project's construction emissions.

The project's structural elements (such as bridges and retaining walls) account for the majority of scope 1 emissions (from plant and equipment use) and scope 3 emissions (embodied emissions within materials). This is due to the amount of concrete and steel required and the number of bridges and retaining walls proposed.

Scope 1 emissions equate to an average of 27,020 tCO_2-e per annum, which accounts for less than two per cent of annual national greenhouse gas emissions associated with the construction industry in Australia.

Measures are provided in section 26.3 to reduce greenhouse gas emissions during construction.

Table 26.3 Annual greenhouse gas emissions by emission source and scope - construction

Summary of activities	Scope 1 (tCO2-e/year)	Scope 2 (tCO2-e /year)	Scope 3 (tCO2-e /year)	Total (tCO2-e /year)	Percentage of total emissions (%)
Site office / general areas	250	-	20	270	0.2
Demolition and earthworks	1,910	-	100	2,010	1.4
Construction of pavements	350	-	3,050	3,400	2.4
Construction of structures	23,770	-	108,800	132,570	94
Construction of drainage	720	-	580	1,300	0.9
Construction of road furniture	20	-	1,420	1,440	1
Total (per year as an average)	**27,020**[1]	**-**	**113,970**	**140,990**	**100**
Total (3 years)	**81,060**	**-**	**341,910**	**422,970**	**100**

Note: 1. The *Carbon Gauge* calculator assumes all construction phase energy is from diesel sources such as generators. For this reason there are no scope 2 emissions from electricity use. The comparative greenhouse gas emissions between diesel fuel and electricity is a factor of about 3.5, with higher emissions associated per unit of grid electricity. Therefore if electricity was available for site offices, this would result in about a two per cent increase in total scope 1 and 2 emissions.

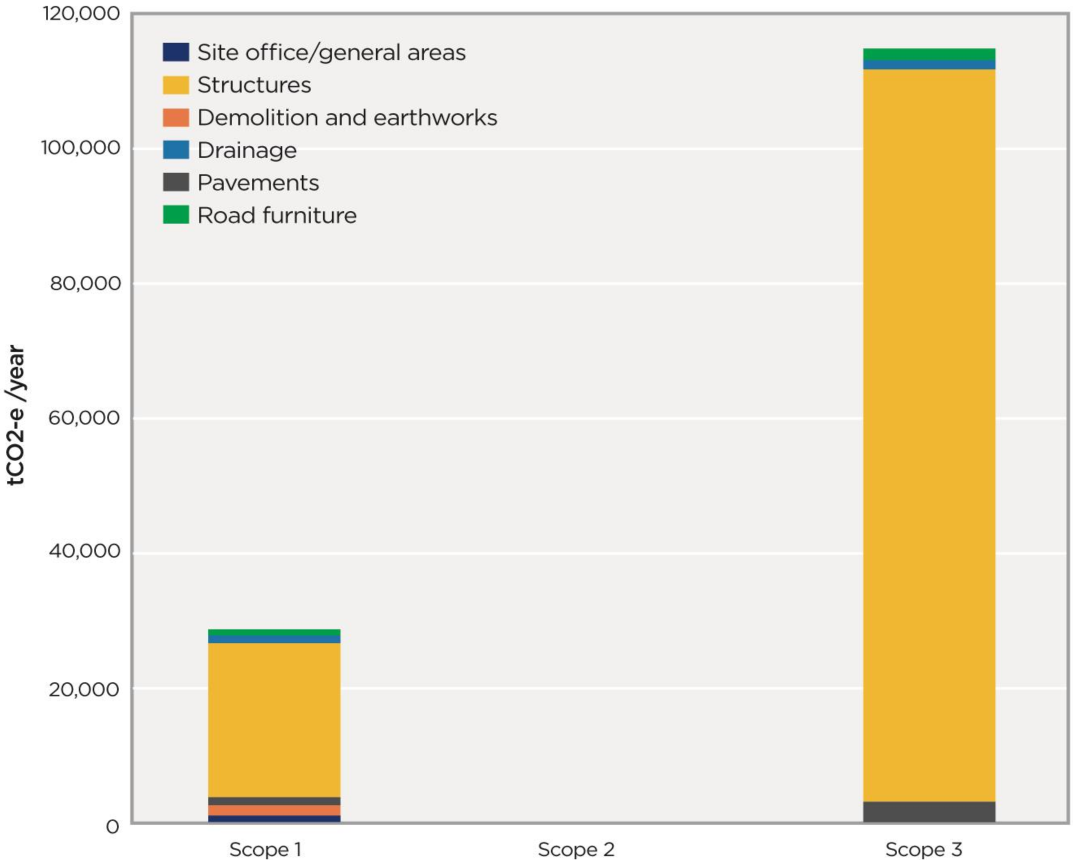

Figure 26.2 Annual greenhouse gas emissions by emission source and scope construction

Operation

Greenhouse gas emissions would be generated during operation of the project by activities including:

- Vehicles using the project
- Use of electricity (for street lighting, electronic signage, variable message signs and any other signalling and communication requirements)
- Maintenance of road infrastructure and pavement, including fuel use for the operation of maintenance equipment.

Greenhouse gas assessment results are provided in the following sections.

Emissions from road infrastructure operation and maintenance

Table 26.4 provides the estimated annual operational greenhouse gas emissions by source and scope. The total operational greenhouse gas emissions (including maintenance activities, but excluding road user emissions) is estimated to be 20,650 tCO_2-e over a 50-year operational period (prescribed period in the TAGG workbook). This is equivalent to 413 tCO_2-e per annum.

Table 26.4 Annual greenhouse gas emissions by emission source and scope - operation

Summary of activities	Scope 1 (tCO2-e/year)	Scope 2 (tCO2-e/year)	Scope 3 (tCO2-e/year)	Total (tCO2-e/year)	Percentage of total emissions
Lighting	-	260	50	310	75%
Traffic signals	-	10	3	13	3%
Maintenance of pavements	40	-	50	90	22%
Total (per year)	**40**	**270**	**103**	**413**	**100%**
Total (50 years)	**2,000**	**13,500**	**5,150**	**20,650**	**100%**

Emissions from operational road use

Table 26.5 provides the estimated operational greenhouse gas emissions from road users with and without the project. The results show that with the project in place, the following greenhouse gas emissions would be saved due to additional road infrastructure projects being completed:

- Up to 142,000 tCO_2-e (0.59 per cent of emissions without the project) would be saved annually during the first few years of operation (based on projected 2026 traffic data provided in Technical Working Paper 1 (Transport, Traffic and Access)
- Up to 180,000 tCO_2-e (0.61 per cent of emissions without project) in the future (based on projected 2036 traffic data provided in Technical Working Paper 1).

This saving is attributed to an increase in the average speed of vehicles across the network, which is most significant for improving the fuel consumption of heavy vehicles due to the reduced congestion and wait times.

The estimate of future traffic greenhouse gas emissions does not include changes in fuel efficiency or type of vehicle fuel used. Anticipated future improvements in fuel efficiency and vehicle type may further reduce greenhouse gas emissions throughout the transport system in NSW in the longer term.

Table 26.5 Summary of Sydney's road network user greenhouse gas annual emission

Year	Without project (tCO_2-e)	With project (tCO_2-e)	Change (tCO_2-e)	Change (%)
2026	24,163,790	24,021,600	-142,190	-0.59
2036	29,509,790	29,328,570	-181,220	-0.61

Cumulative impacts

Construction

The estimated construction emissions would only be generated during the construction period. However, emissions would contribute to the cumulative generation of greenhouse gases from the construction and manufacturing industries.

The total emissions (scope 1, scope 2 and scope 3) estimated to be produced during construction would account for about 0.5 per cent of NSW's manufacturing and construction sector emissions.

Operation

Direct scope 1 and scope 2, and embodied scope 3 greenhouse gas emissions associated with lighting, traffic signals and maintenance, are estimated to account for about 0.0003 per cent of NSW's total annual greenhouse gas emissions.

The operational road use assessment included a cumulative scenario, which estimated that about 198,750 tCO2-e (0.82 per cent of emissions without the project) would be saved annually during the first few years of operation (based on projected 2026 traffic data) and 180,000 tCO2-e (1.78 per cent of emissions without the project) would be saved in the future (based on projected 2036 traffic data).

It is expected that a net annual saving in greenhouse gas emissions would be realised across the overall Sydney network due to improved road network efficiency associated with the project and other future road projects.

26.2.3 Summary of impacts on Sydney Airport (Commonwealth) land

The potential climate change risks identified for Sydney Airport land would be similar to those identified for the project as a whole. The management measures in section 26.3 would also address potential impacts on Sydney Airport land.

Greenhouse gas emissions would be generated on or near Sydney Airport land during construction. During operation, greenhouse gas emissions would be generated by fuel consumption for maintenance activities, road traffic and electricity use.

Consistency with the Sydney Airport Master Plan 2039

The *Sydney Airport Master Plan 2039* (SACL, 2019a) (the Master Plan) and the *Environment Strategy 2019-2024* (SACL, 2019b) (the Environment Strategy) include an objective to proactively reduce greenhouse gas emissions and improve Sydney Airport's resilience to climate change.

The Environment Strategy notes that key climate change risks for Sydney Airport include inundation of critical systems, buildings and infrastructure leading to operational disruptions, and inundation of access roads to the airport. Undertaking the preliminary climate risk assessment at concept design stage (as described in this chapter) and undertaking a comprehensive climate change risk assessment during detailed design (see section 26.3), would ensure that potential climate change risks associated with the project are adequately considered. Implementing the measures provided in section 26.3 would increase the project's (and Sydney Airport's) resilience to climate change and is therefore consistent with the Master Plan.

The Environment Strategy identifies that the majority of the electricity consumed at Sydney Airport, and subsequently the scope 1 and scope 2 greenhouse gas emissions, result from operating the airport terminals (heating, cooling and lighting). The majority of scope 3 emissions are associated with the landing and take-off of aircraft and access to the airport.

While parts of the project would be located on Sydney Airport land, Sydney Airport Corporation would not construct the project. While greenhouse gas emissions as a result of construction are not directly attributable to Sydney Airport Corporation, emissions associated with operation of the road on Sydney Airport land would need to be accounted for in Sydney Airport Corporation's reportable emissions.

The predicted decreases in greenhouse gas emissions during operation, and the measures provided in section 26.3 to reduce emissions, are consistent with the objectives of the Master Plan.

26.3 Management of impacts

26.3.1 Approach

Climate change

Further consideration of the potential for climate change risks would be undertaken to support detailed design. This would include a detailed climate change risk assessment, considering both direct and indirect risks, conducted in accordance with *AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach* and the Technical Guide. The risks and potential adaptations identified by the preliminary assessment would be considered and adaptation measures implemented where reasonable and feasible.

The flood management approach for the project (see Chapter 14 (Flooding)) would include consideration of future climate change-related flood risks and take an adaptive approach to managing these issues with co-ordination between the various stakeholders involved.

Greenhouse gas

Potential greenhouse impacts during construction and operational maintenance activities would be managed by implementing the sustainability management plan for the project (see Chapter 25 (Sustainability)) during construction and operation. The sustainability management plan will include measures to minimise and manage greenhouse gas emissions during construction and operation and maintenance.

Expected effectiveness

Transport for NSW has experience in addressing potential climate change risks through the application of treatments and adaptation measures in the design and operation of road infrastructure. The proposed measures provided in section 26.3.2 are consistent with those implemented on similar infrastructure projects, and are therefore expected to be effective.

26.3.2 List of mitigation measures

Measures that will be implemented to address potential climate change and greenhouse gas impacts are listed in Table 26.6.

Table 26.6 Climate change and greenhouse gas mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Climate change risk assessment	CC1	A detailed climate change risk assessment, considering both direct and indirect risks, will be undertaken during detailed design in accordance with *AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach* and the draft *Technical Guide: Climate Change Adaptation for the State Road Network* (Roads and Maritime, 2015c). Adaptation measures will be confirmed and actions implemented to address extreme and high risks where reasonable and feasible. Adaptation measures for medium risks will be considered and implemented where reasonable and feasible. Progress against implementation of confirmed adaptation measures and actions will be tracked. The assessment will include further modelling to optimise the design and reduce the impacts of climate change scenarios.	Detailed design

Impact/issue	Ref	Mitigation measure	Timing
Climate change related flood risks	CC2	The flood mitigation strategy (measure HF1) will include consideration of future climate change related flood risks, the potential impacts of future climate change on flooding, and adaptive measures for implementation.	Detailed design
Urban heat island effect	CC3	The urban design and landscape plan for the project will include consideration of appropriate landscape designs and species to reduce the impacts of urban heat island effect. Other measures to mitigate the impacts of the urban heat island effect will be investigated during detailed design and included in the urban design and landscape plan. Measures will include using light coloured pavements and shading structures for public spaces.	Detailed design
Emergency management planning	CC4	Operational procedures for emergency planning and management will be prepared to consider the increased risk of flooding and storm surges on the road and active transport link.	Operation
	CC5	Emergency management planning will be undertaken in consultation and collaboration with other key agencies and surrounding stakeholders, including Sydney Airport Corporation.	Operation
Greenhouse gas emissions	GHG1	The sustainability management plan (measure SU1) will include measures and targets to reduce greenhouse gas emissions during construction and operation. The plan will include targets to reduce the project's carbon footprint during construction and operation, considering scope 1, scope 2 and scope 3 emissions.	Detailed design
	GHG2	The final design will incorporate LED lighting in preference to fluorescent fittings or high-pressure sodium lights where fit for purpose, feasible and cost-effective.	Detailed design
	GHG3	The surface road network will be designed for long term performance and durability of materials, increasing asset design lives and reducing the frequency of maintenance activities.	Detailed design
	GHG4	An appropriate portion of construction phase energy will be purchased from an accredited GreenPower provider.	Construction
	GHG5	A minimum of six per cent of operational phase energy will be purchased from an accredited GreenPower product.	Operation

26.3.3 Managing residual impacts

Residual impacts are impacts of the project that may remain after implementation of:

- Design measures to avoid and minimise impacts (see sections 6.4 and 6.5)
- Construction planning and management approaches to avoid and minimise impacts (see section 6.4 and 6.5)
- Specific measures to mitigate and manage identified potential impacts (see section 26.3.3).

Residual impacts would include:

- The emission of greenhouse gases from road vehicles using the project
- Ongoing emissions associated with the generation of electricity (eg to power signals and signs). It is noted that the assessment calculated these emissions based on emissions rates for current power generation. Future power generation is likely to be lower in emissions intensity, and as such, actual emissions may be lower than the rates adopted
- Emissions associated with maintenance activities.

It is expected that the residual impacts would be managed during operation via existing operation and maintenance protocols for similar road assets.