Chapter 22

Sustainability, climate change and greenhouse gas

22 Sustainability, climate change and greenhouse gas

This chapter provides an assessment of the potential sustainability, climate change and greenhouse gas impacts as a result of this proposal, and identifies mitigation measures to minimise these impacts.

22.1 Overview

Sydney Metro's Environment and Sustainability Statement of Commitment articulates its commitment to sustainable outcomes.

Sydney Metro West would be managed in accordance with a Sydney Metro West Sustainability Plan, which is currently being developed. The Plan will set out sustainability principles, objectives and performance targets to be adopted across the lifestyle of the project. This would include the planning, procurement, design, construction, operation and end of life phases of this proposal. Six principles within the Sustainability Plan govern environmental and socio-economic outcomes and performance for the proposal and include demonstrating leadership, tackling climate change, managing resources efficiently, driving supply chain best practice, valuing community and customers, and respecting the environment. Sustainability objectives, targets and initiatives would be developed to support these sustainability principles.

Sydney Metro West would achieve an equivalent or improved level of sustainability performance compared to previous Sydney Metro projects. This would include achieving a minimum Infrastructure Sustainability Council of Australia (ISCA) IS rating of 75 – Version 1.2 (or equivalent). A climate change risk assessment was carried out based on the most up to date climate change projections and identified five medium climate change risks (pre-risk treatment), predominantly concerning infrastructure damage due to projected extreme heat and rainfall events during the operation of the proposal. These risks would be reduced to low following the implementation of risk treatments.

Greenhouse gas emissions were predicted based on the available design and construction program information available. The construction of the proposal has been predicted to generate approximately 110,000 tonnes of carbon dioxide equivalent (tCO_2-e), which is approximately 0.08 per cent of total NSW emissions.

The Secretary's Environmental Assessment Requirements relating to climate change adaption and greenhouse gases, and where these requirements are addressed in this Environmental Impact Statement, are outlined in Appendix A.

22.2 Sustainability

A sustainability assessment for the approved Concept is presented in Section 8.20 of *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a).

Sydney Metro's Environment and Sustainability Statement of Commitment replaced Sydney Metro's Environment and Sustainability Policy in December 2020 and confirms that Sydney Metro is committed to:

- Minimising impacts and leaving a positive environmental and social legacy
- Delivering a resilient asset and service for customers
- Collaborating with stakeholders to innovate and drive sustainable outcomes
- Embedding sustainability into their activities.

Sydney Metro West is developing the Sydney Metro West Sustainability Plan which sets out sustainability principles, objectives and performance targets which will be adopted across the lifestyle of the project, including for the planning, procurement, design, construction, operation and end of life phases for this proposal.

The Sustainability Plan is underpinned by six principles to govern environmental and socio-economic outcomes and performance for the project and include demonstrating leadership, tackling climate change, managing resources efficiently, driving supply chain best practice, valuing community and customers and respecting the environment. Sustainability objectives, targets and initiatives would be developed to support these sustainability principles for this proposal.

The following sustainability targets have also been considered throughout the proposal:

- Source at least 33 per cent of the water used in construction from non-potable water sources (refer to Chapter 15 (Soils and surface water quality))
- Beneficial reuse of 100 per cent of usable spoil (refer to Chapter 20 (Spoil, waste management and resource use))
- Recycle or reuse 95 per cent of recyclable construction and demolition waste (refer to Chapter 20 (Spoil, waste management and resource use))
- Offset 25 per cent of the electricity needs for construction (refer to Section 22.5).

22.3 Climate change risk and adaptation

22.3.1 Climate change risk assessment methodology

The climate change risk assessment and adaptation planning process methodology for this proposal is based on the *Australian Standard AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk-based approach* (Standards Australia, 2013). This standard follows the *International Standard ISO 31000, Risk Management – Principles and guidelines* (ISO, 2018). Based on these standards, a Sydney Metro West Climate Change Risk Register has been prepared for the Sydney Metro program of work. This has been designed to standardise risk register fields and allow the traceability of risks throughout the proposal design and includes a gap analysis based on common risks linked between Sydney Metro and similar large-scale Sydney infrastructure projects.

A climate change workshop was undertaken in 2018 for the overarching Sydney Metro West project (the Sydney Metro West Concept), as described in *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a), where participants considered climate change projections for the region and the potential impact these would have on the long-term operation on a range of proposal aspects.

The identified key risks in the workshop applied to the whole project, as climate projections are applied at a macro spatial and temporal scale. As the workshop outcomes applied to the whole Sydney Metro West Project, the outcomes of that workshop were incorporated into this assessment through a comprehensive Climate Change Risk Register. The Sydney Metro Climate Change Risk Register has been designed to standardise climate change risk tracking and treatments throughout Sydney Metro projects. This risk register was reviewed and updated to assess climate change risks associated with the design of this proposal.

The identification and assessment of climate change risks for this proposal involved consideration of hazards, potentially affected project elements, likelihood and consequence. The approach is summarised below:

- Hazard – Climate or climate influenced attributes with potential to influence the operation and maintenance of Sydney Metro West
- Affected element – The component of the operation and/or maintenance of Sydney Metro West that would be impacted by the hazard. This may also include users of Sydney Metro West and affected elements of the surrounding environment
- Risk rating – Utilising a likelihood and consequence rating system, an assessment of the way hazards could influence the element is made and a risk rating assigned.

The severity or consequence of risks was assessed with reference to the following:

- Health and safety impact
- Environmental impact
- Customer experience and operational reliability impact
- Government, stakeholder and community trust
- Regulatory impact
- Managerial and organisational impact
- Impact on the benefit realisation
- Financial impact.

Risk likelihood was assessed cumulatively over the applicable asset life, rather than the chance of occurrence of the hazard-consequence combination in any given year.

Climate change risks were assessed by considering the implications of climate change projection scenarios, allowing for a business-as-usual risk control for natural hazards that would still apply in the absence of any consideration of climate change.

22.3.2 Climate change risks

To effectively manage potential climate change risks, each stage in the design and delivery of the proposal would consider the most up to date climate change projections and design guidelines and would be subject to ongoing review and response by designers and constructors.

Climate change projections relevant to Sydney Metro West (including this proposal) are outlined in Table 22-1. These have been based on climate change projections from the CSIRO and Bureau of Meteorology Climate Futures Tool for East Coast Cluster as accessed in 2021. The climate change projections are applicable to the region and, therefore, are applicable to all stages of Sydney Metro West (including this proposal) and include:

- Potential increases in absolute maximum temperature and potential increases in average temperatures and the frequency of heatwaves
- Potentially lower annual average rainfall, increased rainfall intensity during storm events and resultant surface water flooding
- Potential sea level rise in the order of 0.19 metres by 2030 and 0.88 metres by 2090
- Potential increased carbon dioxide concentrations in the atmosphere, together with increased temperature and periods of heavy rainfall.

Table 22-1 Summary of climate change projections – Sydney region

	Baseline (1986-2005)	2030	2070	2090
Temperature				
Average max temperature (^{0}C)	22.6	23.6	25.2 - 26.1	26.4 - 27.4
Average temperature (^{0}C)	18.6	19.6	21.3 - 22.0	22.2 - 22.3
Average minimum temperature (^{0}C)	14.6	15.6	17.4 - 18.0	18.0 - 19.3
Days per year, max temp over 35^{0}C	4.1	5.3	9.2 - 11.8	12.6 - 16.6
Rainfall				
Mean annual rainfall (millimetres)	1,276	1,380	1,135 - 1,173	836 - 890
2.5% annual exceedance probability daily rainfall event (millimetres)	328	346	379 - 392	397 - 413

While the assessment of this proposal has highlighted the major civil construction work impacts between The Bays and Sydney CBD, the climate change impacts of the proposal would potentially be realised at a time when the Sydney Metro West project is operational. Climate change is anticipated to have potential direct and indirect impacts on the Sydney Metro West project. The climate change risk assessment process identified a total of five risks for this proposal as presented in Table 22-2. No high (undesirable) or extreme (unacceptable) risks were identified.

Table 22-2 Climate change risks identified

Potential Risk	Pre-treatment risk rating	Risk treatment	Post-treatment risk rating
More extreme and frequent rainfall events combined with sea level rise leading to flooding events and stormwater flows beyond design stage predictions leading to flooding of tunnels	Medium	• Where a sensitivity analysis reveals additional impacts, the adoption of additional climate change allowances would be considered during detailed design, including alternative or additional flood control measures • Drainage backup would be considered as a potential strategy to address sea level rise	Low
Increased sea levels leading to sea spray travelling further inland, increasing the degradation of infrastructure not tolerant to salt water	Medium	• Future changes to proximity to sea and major water bodies would be considered during detailed design, based on sea level rise projections in durability assessments • Water proximity allowances would be made during detailed design to reduce the likelihood of accelerated deterioration of assets	Low

Potential Risk	Pre-treatment risk rating	Risk treatment	Post-treatment risk rating
Increased sea levels leading to changing groundwater levels, potentially altering pressures on retaining structures and underground waterproofing/ tanking as well as accelerating the degradation of infrastructure	Medium	• A retaining structure design and durability report would be prepared to consider exposure to future groundwater levels based on sea level rise projections • Future projected groundwater levels would be considered during detailed design	Low
Increased frequency and intensity of extreme heat and heatwave events lead to tunnel ventilation systems becoming unable to maintain temperatures below design criteria and increases in ambient temperature exposure for external assets	Medium	• A sensitivity analysis was undertaken to understand implications of projected mean and extreme temperatures and make allowance for future timed adaption (potentially including enabling the replacement of larger temperature control systems at the end of design life) • Consideration of the structural integrity and durability of the proposal during detailed design based on increases in temperature • Incorporation of heat absorbing and smart materials in detailed design • Improvement of the accessibility of parts to increase the ease of part replacement during maintenance	Low
Increased carbonation rate of concrete resulting in reinforced concrete structures not lasting their required lifespan	Low	• Standard mitigation measures contained within the Construction Environmental Management Framework (Appendix C) would be sufficient to manage this risk	Low

During construction, climate change risks would be associated with severe weather events, such as the increased frequency and severity of rainfall events, which could place increased pressure on erosion and sediment control measures and/or resulting in the flooding of tunnels and construction sites. Increased heatwave events may also have an impact on construction personnel, systems and equipment.

However, construction is likely to occur in the near future, at a time when climate change risks cannot be differentiated from the current climate. Climate range risks would be addressed by the mitigation and management measures described in Section 22.5.

22.4 Greenhouse gas

22.4.1 Greenhouse gas assessment methodology

Greenhouse gas emissions are reported as tonnes of carbon dioxide equivalent (tCO_2-e) and categorised into three different scopes (either Scope 1, 2 or 3), in accordance with the *Greenhouse Gas Protocol* (World Resources Institute, 2014), Intergovernmental Panel on Climate Change and Australian Government greenhouse gas accounting/classification systems.

These scopes 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 greenhouse gas scopes are:

- Scope 1 emissions – Also referred to direct emissions
- Scope 2 emissions – Those resulting from indirect electricity generation, also referred to as upstream or indirect emissions
- Scope 3 emissions – Includes all indirect emissions (not included in Scope 2) due to upstream or downstream activities.

The objectives of the greenhouse gas assessment are to:

- Identify the likely sources of greenhouse gas emissions associated with construction of this proposal
- Quantify the greenhouse gas emissions associated with each greenhouse gas source
- Identify opportunities (mitigation measures) to reduce greenhouse gas emissions.

This greenhouse gas assessment is a preliminary estimate based on current design information and construction methods. The assessment was based on an emissions model based on current design and construction methods and emission factors and default assumptions from the *National Greenhouse Accounts Factors 2020* (Australian Department of Industry, Science, Energy and Resources), and Transport for New South Wales Carbon Emissions Reporting Tool (2017).

22.4.2 Estimated greenhouse gas emissions

Greenhouse gas emissions were estimated for the range of construction emission sources and are summarised in Table 22-3.

In 2017/2018, NSW's annual greenhouse gas emissions were about 131.7 million tCO_2-e (Department of Planning, Industry and Environment, 2019), with the transport industry sector accounting for about 22 per cent of the total, at 29 million tCO_2-e.

Construction of this proposal would equate to about 0.3 per cent of the transport industry's 2017/2018 annual greenhouse gas emissions and about 0.08 per cent of total NSW emissions. While these percentage contributions are small within the NSW and national contexts, the management and mitigation measures outlined in Section 22.5 would further minimise and offset greenhouse emissions during construction.

Table 22-3 Estimated greenhouse gas emissions

Emission source	Emissions (t CO_2-e)			
	Scope 1	Scope 2	Scope 3	Total
Fuel consumption				
Generators, Plant and Equipment	42,533	-	2,181	44,704
Contractor Vehicles	527	-	27	554
Total				**45,257**
Electricity consumption				
Road Headers	-	11,979	1,331	13,310
Tunnel Boring Machines	-	16,107	1,790	17,896
Total				**31,206**
Construction materials				
Concrete (40 MPa)	-	-	6,445	6,445
Concrete (50 MPa)	-	-	14,536	14,536
Shotcrete	-	-	253	25
Steel reinforcement	-	-	7,556	7,556
Rock bolts	-	-	15	15
Total				**28,806**
Haulage				
Construction material delivery	-	-	271	271
Spoil haulage (incl. return trip)	-	-	3.905	3,905
Demolition waste haulage (incl. return trip)	-	-	55	55
Total				**4,231**
Total	**43,050**	**28,086**	**35,365**	**109,501**

22.5 Mitigation and management measures

The Construction Environmental Management Framework (Appendix C) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor in developing the Construction Environmental Management Plans, sub-plans, and other supporting documentation for each specific environmental aspect. This includes standard mitigation measures, including the preparation of the Sydney Metro West Sustainability Plan, which is currently being developed.

The environmental management approach for the project is detailed in Chapter 23 (Synthesis of the Environmental Impact Statement). Under these broad frameworks, a series of performance outcomes have been developed to define the minimum environmental standards that would be achieved during construction of the proposal (refer to Section 22.5.2), and mitigation measures that would be implemented during construction to manage potential identified impacts (refer to Section 22.5.3).

The environmental management approach has also considered the relevant Conditions of Approval for the Sydney Metro West Concept to ensure that this proposal would be carried out in accordance with relevant conditions.

22.5.1 Concept Conditions of Approval

The Conditions of Approval for the Sydney Metro West Concept were received on 11 March 2021. The Concept conditions that relate to sustainability, climate change and greenhouse gas are presented in Table 22-4, along with consideration of their relevance to this proposal.

Table 22-4 Concept Conditions of Approval – Sustainability, climate change and greenhouse gas

Reference	Condition	Relevance to this proposal
C-B7	The CSSI must achieve a minimum Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability rating of 75 (Version 1.2) (or equivalent level of performance using a demonstrated equivalent rating tool) or a 5-Star Green Star rating (or equivalent level of performance using a demonstrated equivalent rating tool)	Relevant - Sydney Metro West would achieve an equivalent or improved level of sustainability performance compared to previous Sydney Metro projects. This would include achieving a minimum Infrastructure Sustainability Council of Australia (ISCA) IS rating of 75 – Version 1.2 (or equivalent) and a 5-Star Green Star rating. This condition replaces Sydney Metro's previous performance outcome on ISCA IS ratings as noted in Section 22.5.2. As this proposal does not include design of structures, a 5-Star Green Star rating would be considered as part of Sydney Metro West - Rail infrastructure, stations, precincts and operations (Stage 3 of the planning approval process).
C-B11	The CSSI must be designed to withstand known impacts associated with climate change to year 2100	Relevant - The proposal has been designed to withstand the known impacts associated with climate change to the year 2100, as identified by the consideration and treatment of the climate change risks described in Section 22.3.2.

22.5.2 Performance outcomes

Construction performance outcomes were developed for the project as part of the Concept approval. Performance outcomes identify measurable, performance-based standards for environmental management. Identified performance outcomes in relation to sustainability, climate change and greenhouse gas for construction of the proposal include:

- 25 per cent of the greenhouse gas emissions associated with consumption of electricity during construction are offset
- The construction of Sydney Metro West is consistent with the Sydney Metro Environment and Sustainability Statement of Commitment
- Sustainability initiatives are incorporated into the planning, detailed design and construction of the proposal
- Infrastructure Sustainability Council of Australia (ISCA) IS rating of 65 Gold – Version 2.0 (or equivalent) are achieved during design and construction for appropriate components.

The Concept Approval conditions for Sydney Metro West (as detailed in Section 22.5.1) include a requirement for the project to meet a minimum ISCA Infrastructure Sustainability rating of 75 (Version 1.2) (or equivalent level of performance using a demonstrated equivalent rating tool) (Condition C-B7). This condition would override Sydney Metro's performance outcome of IS rating of 65 Gold – Version 2.0 (or equivalent).

Chapter 23 (Synthesis of the Environmental Impact Statement) describes how the proposal addresses these performance outcomes. The construction of the proposal would be consistent with the Sydney Metro Environment and Sustainability Statement of Commitment and would include climate change risk treatments, sustainability initiatives and a commitment to offset 25 per cent of greenhouse gas emissions associated with consumption of electricity during construction.

22.5.3 Mitigation measures

Mitigation measures that would be implemented to address potential sustainability, climate change and greenhouse gas impacts are listed in Table 22-5.

Table 22-5 Summary of potential sustainability and climate change impacts and management measures

Reference	Impact	Mitigation measure	Location
SCC1	Sustainability implementation	Sustainability initiatives would be incorporated into the detailed design and construction to support the achievement of the Sydney Metro West sustainability objectives.	All
SCC2	Sustainability implementation	Best practice level of performance would be achieved using market leading sustainability rating tools during design and construction.	All
SCC3	Climate change risks	Climate change risk treatments would be confirmed and incorporated into the detailed design.	All
SCC4	Greenhouse gas emissions	An iterative process of greenhouse gas assessments and design refinements would be carried out during detailed design and construction to identify opportunities to minimise greenhouse gas emissions. Performance would be measured in terms of a percentage reduction in greenhouse gas emissions from a baseline inventory calculated at the detailed design stage.	All
SCC5	Greenhouse gas emissions	25 per cent of the greenhouse gas emissions associated with consumption of electricity during construction would be offset.	All

22.5.4 Interactions between mitigation measures

Mitigation measures in other chapters that are relevant to sustainability and management of potential climate change risk impacts include:

- Chapter 15 (Soils and surface water quality) – Specifically measures relevant to the management of potential surface water quality
- Chapter 17 (Hydrology and flooding) – Specifically measures which address detailed construction planning to consider flood risk at construction sites
- Chapter 20 (Spoil, waste management and resource use) – Specifically measures relevant to spoil and waste generation, management and mitigation.

Together, these measures would minimise the potential climate change risk impacts of this proposal and manage sustainability. A full list of mitigation measures is presented in Chapter 23 (Synthesis of the Environmental Impact Statement).