CrossRiverRail

6. Climate Change and Sustainability

Cross River Rail

CHAPTER 6

CLIMATE CHANGE AND SUSTAINABILITY

JULY 2011

Contents

6 Climate change and sustainability

This assessment of climate change and sustainability issues for the Project addresses Section 3.2 and Section 9 of the Terms of Reference (ToR). It includes a description of the vulnerability of the Project to seasonal conditions, extremes of climate and natural or human-induced hazards. A risk assessment and management plan detailing the potential threats from climate change to the construction and operation of the Project is provided in **Appendix E1**. The chapter also provides an overview of how the Project to date has addressed sustainability and how sustainability considerations would be incorporated into detailed design, construction and operation.

6.1 Introduction

South East Queensland is a growing region, with the population expected to increase from approximately three million now to approximately 4.4 million by 2031 (*draft Connecting SEQ 2031: An Integrated Regional Transport Plan for South East Queensland* [Connecting SEQ 2031]). To maintain the liveability of the region, governments are investing in better public transport, particularly the rail network.

Climate change is receiving increased recognition within Queensland's planning system as a critical aspect of sustainable development. There is the need to plan and operate public transport to adapt to the impacts of climate change from extreme weather events, sea level rise, increased rainfall and increased temperatures. Climate change has begun to have measurable impacts on many communities and is increasingly likely to affect physical infrastructure, as well as human behaviour, including travel behaviour in the future.

Climate change is a key consideration for the planning of transport infrastructure, with urban transport systems and inefficient settlement patterns a major contributor to greenhouse gas (GHG) emissions. This Project has the capacity to manage the carbon footprint of urban transportation systems by moving people more efficiently over longer distances.

Sustainable transport infrastructure is critical to the prosperity and functioning of Brisbane. The design and construction approach for the Project would influence transport choices, mobility patterns, access and connectivity, land use and economic development for decades, and future generations. If planned, designed and delivered with sustainability in mind, the Project can enhance its contribution to the economic, environmental and social well-being and prosperity of neighbourhoods across Brisbane and the wider region. The assessment and mitigation of impacts in each chapter of the EIS contributes to achieving the overall sustainability outcomes for the Project.

The Project would facilitate increased social interactions and mobility across many suburbs of Brisbane. A key challenge and significant opportunity for the Project is to ensure its design and operation contributes towards sustainable outcomes over the long term. Many of these outcomes require viewing the Project within its broader social and economic context and understanding the connections and relationships between the social, economic and environmental elements at the neighbourhood, suburb, city and regional scale.

The process of embedding sustainability into the Project aims to realise achievable and tangible benefits that contribute towards a more sustainable outcome than would be achieved without this process.

This chapter provides the following:

- policy and legislative overview for climate change
- discussion of climate change in Australia and in South East Queensland (particularly development of the Project's climate change adaptation strategy), including the climate change risk assessment undertaken for the Project
- development of the Project's energy consumption and GHG emissions management strategy
- policy and legislative overview for sustainability
- the development of a sustainability assessment framework for the Project
- sustainability outcomes for the Project.

6.2 Policy and legislative overview – climate change

The following section provides an overview of relevant policy and legislation for climate change, predominantly focusing on the last fifteen years of policy debate and change.

6.2.1 International

The United Nations Framework Convention on Climate Change (UNFCCC 1994) sets the overall framework for intergovernmental efforts to tackle the challenges of climate change. In 1997, the Kyoto Protocol was signed, setting legally binding targets for signatory industrialised countries to reduce their combined GHG emissions to a level that would reduce impacts on the world's climate. Australia ratified the Kyoto Protocol in 2007, agreeing to limit GHG emissions to an 8% increase over 1990 levels. Further, the Australian Government has set targets in 2010 to reduce emissions to 25% below 2000 levels by 2020, "if there is a fair contribution from all emitters around the world to take strong action to reduce the risk of dangerous climate change by restraining atmospheric concentrations of GHG to 450 parts per million'' (DCCEE 2010a). If the world is unable to reach agreement on a 450 parts per million target, Australia will still reduce emissions by between 5% to 15% by 2020 (DCCEE 2010a).

6.2.2 National

Previously, the Australian Government identified the Carbon Pollution Reduction Scheme (CPRS) as an effective mechanism to address climate change and to commit to emissions reductions targets. However, legislation to implement the scheme from 2011 was rejected in the Australian Parliament twice, in August and December 2009. The legislation was reintroduced into Parliament with amendments on 2 February 2010. On 27 April 2010, the former Prime Minister, the Hon Kevin Rudd MP, announced that implementation of the CPRS would be deferred.

In September 2010, the Australian Government announced the establishment of the Multi-Party Climate Change Committee, with the directive of consulting, negotiating and reporting to Cabinet, through the Minister for Climate Change and Energy Efficiency, on agreed options for the implementation of a carbon price in Australia, and to provide advice on, and participate in, building community consensus for action on climate change (DCCEE 2010a).

On 24 February 2011, the Prime Minister Julia Gillard announced the climate change framework outlining the broad architecture for a carbon price mechanism which has been considered by the Multi-Party Climate Change Committee (DCCEE 2011). All members of the committee have agreed to release the proposal for the community's consideration. Further discussions will be required in relation to a starting price for the carbon price mechanism, assistance arrangements for households, communities and industry, and support for low emissions technology and innovation (DCCEE 2011).

It has been recommended by the Multi-Party Climate Change Committee that the carbon price mechanism could commence with a fixed price and then convert to a cap-and-trade emissions trading scheme (ETS).

The Australian Government proposes the carbon price to commence on 1 July 2012, subject to the ability to negotiate agreement with a majority in both houses of Parliament and pass legislation this year. An initial fixed carbon price will provide businesses with a stable platform to transition to a 'cap and trade' ETS that will be linked to international carbon markets.

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) provides for the reporting and dissemination of information relating to GHG emissions, projects, energy production and consumption. The objectives of the NGER Act are to:

- inform government policy and the Australian public
- help meet Australia's international reporting obligations
- assist Australian, state and territory government programs and activities
- avoid the duplication of similar reporting requirements in the states and territories
- underpin the introduction of an emissions trading scheme.

The first annual reporting period began on 1 July 2008. The NGER Act will underpin future carbon pricing schemes (the ETS) by providing the emissions data on which to base reporting obligations on (DCCEE 2011).

6.2.3 State

The Queensland Government launched a revised climate change strategy – *ClimateQ: toward a greener Queensland* (ClimateQ)(DERM 2009), which sets out steps to move to a lower carbon future. Transport is Queensland's fourth largest and fastest growing contributor to GHG emissions, contributing 12.1% to Queensland's total emissions, predominantly from private vehicles. The ClimateQ report identifies the need to respond to the challenge of reducing these emissions by managing congestion and providing sustainable transport options.

The *Draft South East Queensland Climate Change Management Plan 2009* proposes actions suited to the region's geographical, ecological, social and economic characteristics at regional and local government levels. These planning actions are designed to:

- reduce the regions GHG emissions – climate change mitigation
- help the region become more resilient to the impacts of climate change on South East Queensland's built environment, communities, infrastructure and natural ecosystems – climate change adaptation.

These draft actions were developed following preliminary consultation with government and non-government stakeholders. When finalised, these actions will be used to implement the climate change policies of the *South East Queensland Regional Plan 2009-2031* (SEQ Regional Plan).

6.2.4 Local

Brisbane City Council's Plan for *Action on Climate Change and Energy 2007* (BCC 2007) consists of thirty-one actions, divided into the following eight topic areas:

- leadership and partnering, particularly with other local Councils and business, industry and community groups
- decision-making processes to support the integration of sustainability principles into Council decisions

- communication and education, including community education and awareness raising
- strategic and land use planning, particularly towards more compact and mixed use development (featuring transit oriented development (TODs)) that are well integrated with public transport, cycling and walking networks
- sustainable transport and investment in public transport to achieve frequent, reliable, high quality, comfortable and attractive services
- preparedness for change, emergencies and surprises, including an ongoing and enhanced commitment to disaster management
- diversification and conservation of natural resources to enhance local energy security, reliability and self-sufficiency
- research on topics including sea level rise and storm surge impacts on Brisbane.

6.3 Climate change

6.3.1 How is the climate changing?

The Intergovernmental Panel on Climate Change (IPCC) provides a scientific view on the current state of climate change to guide policy makers (IPCC 2010a). The IPCC's Fourth Assessment Report (IPCC 2007b) provides a summary of the observed changes to the earth's climate over the past 150 years. These changes include:

- average global temperature rise
- ocean warming
- solar radiation, relative humidity and potential evaporation
- sea level rise and marine projections
- drought, wind and weather conducive to bushfire
- altered precipitation
- altered frequency and/or intensity of extreme weather events over the past 50 years
- ecosystem impacts.

The IPCC defines climate change as a change in the state of the climate that can be identified (eg using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC 2007b).

In contrast, the *United Nations Framework Convention on Climate Change* (UNFCCC 1994) defines climate change as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between:

- anthropogenic: climate change attributable to human activities altering the atmospheric composition
- natural: climate variability attributable to natural causes.

Any change, whether natural or as the result of human activity in the components of the climate system and their interactions, may result in climate variations. This includes the impact of changes in GHG. The nature and impact of GHGs, including their contribution to global warming are considered further in **Chapter 15 Air Quality and Greenhouse Gas Assessment**.

6.3.2 Climate change in Australia

In its assessment of Australia's vulnerability to climate change, the IPCC identifies the following probable impacts:

> *Risks to major infrastructure are likely to increase. By 2030, design criteria for extreme events are very likely to be exceeded more frequently. Risks include failure of floodplain protection and urban drainage/sewerage, increased storm and fire damage, and more heatwaves, causing more deaths and more blackouts (high confidence). The climate of the 21st century is virtually certain to be warmer, with changes in extreme events. Heatwaves and fires are virtually certain to increase in intensity and frequency (high confidence). Floods, landslides, droughts and storm surges are very likely to become more frequent and intense, and snow and frost are very likely to become less frequent (high confidence). Large areas of mainland Australia are likely to have less soil moisture (IPCC 2007b).*

The Garnaut Climate Change Review: Final Report (Garnaut 2008) also found that Australia is at risk of facing severe and costly climate change impacts as a result of climate change.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia's national science agency which is responsible for the interpretation of global climate change data as it relates to Australia. CSIRO state that the following climate change impacts are likely to be experienced in Australia (CSIRO, 2010a):

- Australian average temperatures are projected to rise by 0.6°C to 1.5°C by 2030 and by 1°C to 5°C by 2070
- water security problems are projected to intensify by 2030 in southern and eastern Australia as a result of reduced rainfall and higher evaporation
- it is very likely that extreme fire weather will occur more often in southern Australia, with longer, more intense fire seasons
- rising sea temperatures are almost certain to increase the frequency and intensity of mass coral bleaching on the Great Barrier Reef.

6.3.3 Climate change in South East Queensland

It is predicted in *Climate Change in Queensland: what the science is telling us* (QOCC 2010) that South East Queensland is likely to experience climate change effects such as increased inundation as a result of more intense weather systems, along with associated storm surges and higher sea levels. The Australian Bureau of Meteorology (BOM) and CSIRO also forecasts the potential for an increase in the number of days over 35°C, possibly affecting human health and peak energy demand (CSIRO & BOM 2007; QOCC 2010). Predictions also highlight that Queensland may experience reduced water availability to support urban activities, industry, agriculture and natural ecosystems and conditions may become more favourable for plant diseases, weeds and pests (CSIRO & BoM 2007; QOCC 2010).

The IPCC identified South East Queensland as one of the six hot spots in its assessment of the vulnerability of Australia to climate change impacts, noting that ongoing development is likely to be exacerbated by large losses to the built environment from rising sea levels, storm surges and flooding (IPCC 2007b).

A range of variables need to be considered when describing the dimensions of climate change, as shown in **Table 6-1**.

Table 6-1 Variable definition

Term	Definition
Variable category	These define the four major categories of variables that might change: • Water • Atmosphere • Soil • Biodiversity and ecosystems
Environmental variables	These are the weather or physical variables within each variable category that have an impact on infrastructure assets and systems.
Key parameters of environmental variables	These are the parameters which affect the degree of impact on assets, human resources and processes, which can be measured in terms such as: • Mean and extreme magnitude • Frequency/return period • Duration exceeding a critical level • Direction and consistency/gusts

Source: Yates & Mendis (2009)

The environmental variables can be further broken down into the following key parameters shown in **Table 6-2**, against which the impact on the Project can be considered.

Table 6-2 Environmental variables that may impact on the Project

Variable category	Environmental Variable	Key Parameters
Water	Sea water	• Sea level, storm surges and tidal prisms
	Rainfall and run-off	• Rainfall amount, intensity, frequency and duration • Run-off
Atmosphere	Physical and chemical properties of the atmosphere	• Mean and extreme air temperatures • Humidity • CO_2 concentration • Ionisation and ground level ozone
	Airborne particulates	• Aerosol marine salts • Acids, smokes and other industrial dusts, sand and soil dust • Ground level ozone
	Solar radiation	• Total solar radiation, global horizontal illuminance and sky cloud cover
	Wind	• Damaging and destructive winds
	Lightning	• Flash strength, polarity, type and multiplicity
	Hail	• Density, area and velocity of hail
Soil	Soil quality and health	• Soil temperature, permeability, compressibility and shear strength • Soil salinity and thermal resistance
Biodiversity and ecosystems	Plant and micro-organism biodiversity	• Plant distribution and life-cycles • Micro-organism distribution and life-cycles • Threatened plant species
	Animal biodiversity	• Animal biodiversity, animal distribution and life-cycles • Threatened animal species
	Ecosystems	• Ecosystems, ecosystem protection and resilience • Bushfires and grassland fires

Source: Yates & Mendis (2009)

These key parameters are also discussed in each relevant EIS chapter, including **Chapter 15 Air Quality and Greenhouse Gas Assessment**, **Chapter 14 Flood Management**, **Chapter 7 Topography, Geology, Geomorphology and Soils** and **Chapter 11 Nature Conservation**.

6.4 Project climate change adaptation strategy

Responding to climate change involves mitigation to address the cause and adaptation through planned responses to the changes. Mitigation of climate change refers to actions that aim to limit the amount of GHGs in the atmosphere, either by reducing emissions from human activities or by increasing the capacity of carbon dioxide storage in natural 'sinks' such as forests and soil.

Adaptation to climate change relates to the actions to adjust to the physical changes in the climate that are already underway or to plan and prepare for the risk of bigger changes in the future, such as sea level rise, due to ongoing GHG emissions worldwide.

The IPCC technical definition of climate change adaptation is: "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2007c).

The aim of climate change adaptation is to reduce the negative costs and impacts of climate change and take advantage of any new opportunities that may arise whilst adjusting to life in a changing climate. Climate change adaptation also aims to increase our resilience to the future impacts of climate change and improve our capacity to adapt continuously to an ever-changing climate. It includes actions to cope with the ongoing natural variability in the climate from month to month and year to year (CSIRO, 2010c).

Climate change considerations for the Project include offsetting GHG emissions through indirect means through implementing a carbon management plan for the operation of the Project. The Project design would be further refined to provide protection against the effects of extreme heat and increased intensity of storm events during the detailed design phase.

The objective of the climate change adaptation strategy is to identify the key risks that climate change poses to the long term success of the Project. The strategy aims to reduce GHG emissions through the promotion of public transport and to reduce the risk of climate change to the Project by identifying effective mitigation and adaptation actions whist maintaining consistency with Project requirements.

6.4.1 Background

Climate change presents a risk to rail network infrastructure and operations, both above ground and underground. While the location of a portion of the Project underground provides a level of protection from climate change, a suite of impacts are possible, including impacts on upstream infrastructure such as power supplies. By identifying climate risks as early as possible and systematically addressing them through design and operations, it should be possible to reduce the Project's vulnerability to climate change.

Climate change impacts are likely to manifest in different ways in different regions. As such, future appropriate adaptation options would need to be identified and tested to ensure that they are suitable for the Project.

6.4.2 Preliminary climate change risk assessment

A preliminary climate change risk analysis was undertaken to identify key risks to the Project and appropriate mitigation and adaptation options.

The following specific climate change risks were considered in the development of this risk assessment process:

- increased sea levels, storm surges and tidal prisms
- increased rainfall intensity, frequency and duration, hail, and associated run-off and flood levels
- mean and extreme air temperature increases and increased humidity
- total solar radiation
- damaging and destructive winds.

Table 6-3 summarises the projected climate change for Brisbane for the years 2030 and 2070 under three of the IPCC climate change scenarios (CSIRO & BoM 2007). The 'A1' scenario describes a future world of very rapid economic growth, a global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies.

There are two main scenario groups as part of A1, as illustrated in **Table 6-3.** These are:

- the A1B scenario, which involves the balanced use of both fossil intensive and non-fossil energy sources and technologies
- the A1F1 (worst case) scenario, which involves the intensive use of fossil fuels.

A third A1 scenario (A1T) involves the use of non-fossil energy sources which is not considered relevant in the short-term.

The 'B1' scenario describes a convergent world with the same global population as the 'A1' scenario, but represents rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource efficient technologies (CSIRO & BoM 2007).

The 10^{th} and 90^{th} percentiles are provided as a guide to the uncertainty range for the scenarios that have been considered. The 50^{th} percentile or median is considered to be the "best" or most central estimate of the projected change.

Table 6-3 Projected climate changes for Brisbane

Variable	Season	2030 A1B 10th	2030 A1B 50th	2030 A1B 90th	2070 B1 10 h	2070 B1 50th	2070 B1 90th	2070 A1F1 10th	2070 A1F1 50th	2070 A1F1 90th
Temperature (°C) increases	Annual	0.7	1	1.4	1.1	1.6	2.3	2.1	3.1	4.4
	Summer	0.6	0.9	1.4	1.1	1.6	2.3	2	3	4.4
	Autumn	0.6	0.9	1.3	1	1.5	2.2	1.9	3	4.3
	Winter	0.6	1	1.3	1.1	1.6	2.2	2.1	3.1	4.3
	Spring	0.7	1	1.5	1.1	1.7	2.5	2.1	3.2	4.8
No. of days over 35°C (current 1.0)	Annual	1.5	2	2.5	2.1	3	4.6	4	7.6	20.6
Rainfall (%)	Annual	-12	-3	+5	-18	-5	+9	-33	-9	+17
	Summer	-11	-1	+9	-17	-1	+15	-31	-3	+29
	Autumn	-14	-3	+10	-23	-5	+16	-39	-9	+31
	Winter	-15	-6	+4	-24	-10	+6	-42	-18	+11
	Spring	-17	-6	+6	-28	-10	+10	-47	-18	+18
Potential evaporation (%)	Annual	+2	+3	+5	+3	+6	+8	+7	+11	+16
	Summer	+2	+3	+5	+3	+6	+8	+6	+11	+17
	Autumn	+2	+4	+6	+3	+6	+9	+6	+12	+20
	Winter	+2	+4	+6	+4	+6	+10	+7	+12	+19
	Spring	+2	+3	+4	+3	+5	+7	+5	+9	+14
Wind speed (%)	Annual	-1	+2	+6	-1	+3	+10	-2	+6	+19
	Summer	-2	+2	+7	-3	+4	+11	-5	+7	+22
	Autumn	-3	+1	+5	-4	+2	+9	-9	+3	+18
	Winter	-6	0	+6	-10	-1	+10	-20	-1	+19
	Spring	0	+5	+12	0	+9	+19	0	+17	+37
Relative humidity (%)	Annual	-1.1	-0.1	+0.9	-1.9	-0.1	+1.5	-3.6	_02.	+3
Solar radiation (%)	Annual	-1.2	0.2	1.9	-2	0.4	3.1	-3.9	0.7	6

Source: Climate Change in Australia Technical Report 2007 (CSIRO & BoM 2007)

Note: *The spatial patterns of temperature change in the new report's projections are similar to those projected in 2001. The patterns include greater inland warming and lower coastal warming. The new projections are for a range of warming narrower than determined in 2001 – for 2070, 1 to 5ºC compared with 1ºC to 6ºC. The narrower range is partly due to improved consistency between models*.

Sea level rise scenarios were also considered as follows:

- low sea level rise (0.5 m)
- medium sea level rise (0.8 m)
- high sea level rise (1.1 m).

These sea level rise scenarios are for the year 2100, relative to 1990 levels. The sea level rise values are based on the IPCC values listed in the *IPCC Fourth Assessment Report: Climate Change* (2007b).

While the quality of evidence for climate change is rapidly evolving, the following changes are likely to occur over the next 60 years:

- increased inundation as a result of more intense weather systems, associated storm surges and higher mean sea level
- reduced water availability and increased evaporation and wind speed
- an expected increase in high temperatures and the number of days over 35°C, potentially affecting human health and peak energy demand.

Based on the above information, the key potential climate change risks to the Project were identified to arise from:

- inundation of critical infrastructure due to higher intensity, frequency and duration of rainfall events
- the speed and direction of winds, affecting surface infrastructure
- impacts on power supply due to a range of possible high temperature related events
- heat impacts on mechanical and electrical systems, particularly for rail
- accelerated deterioration of facilities and infrastructure due to changed operating conditions – for example, the projected increase in numbers of days of extreme heat (days over 35°C)
- impacts of sea level rise and storm surges on critical infrastructure, particularly at Mayne Rail Yard, where there is a tidal creek (Breakfast Creek) that has the potential to be subject to sea level rise and intensification of storm tide events. Other creeks along the corridor could be similarly affected.

A number of smaller risks were also considered during the risk assessment process, which is outlined in **Appendix E1**. The climate change risk assessment process examines the potential hazards associated with the detailed design, construction and operation of the Project and assesses the likelihood and consequences of risks associated with each potential climate change hazard. In accordance with ISO31000 *Risk Management - Principles and Guidelines* 2009, climate change risks would be reviewed during detailed design and construction, to ensure that all key risks are captured and mitigation and adaptation options identified.

6.4.3 Design components, mitigation and adaptation strategies

The climate change risk assessment has been based on the reference design. It includes relevant design components that should be further developed during the detailed design process to ensure that the Project is well positioned to respond favourably to possible future climate change scenarios, as identified by the IPCC.

The risk assessment in **Appendix E1** has identified potential mitigation and adaptation options to be adopted to reduce the level of risk identified for each environmental variable.

The following design components were identified early on during the reference design and incorporated into the climate change risk assessment process:

- raised station entry points at the surface to protect underground stations against local flooding
- a protection system for intermediate flood events for low lying stations
- dedicated automatic flood gates for the protection of the Albert Street Station and the southern portal against extreme flood events
- station entries that are designed to respond to the existing warm climate with a combination of adjustable panels, louvres and shading
- entrance coverings for stations that can be progressively closed and secured in severe weather conditions

- the use of platform screen doors to maintain temperatures of 26°C at the platform level
- three new 25 kV feeder stations to provide the required power for the Project, including an independent supply for traction power in the event of a localised power failure.

Mitigation and adaptation strategies identified by the Project team during the climate change risk assessment process are detailed in **Appendix E1**. As noted above, key climate change issues have been addressed during the development of the reference design. Additional design refinements would be identified in the detailed design phase and ongoing review process through design, construction and operation to identify potential increased risks and alternative adaption strategies where appropriate.

6.5 Energy consumption and greenhouse gas emissions management strategy

6.5.1 Objective

The objective of the Energy Consumption and GHG Emissions Management Strategy is to reduce energy consumption and GHG emissions over the life of the Project. **Chapter 15 Air Quality and Greenhouse Gas Assessment** (**Section 15.6.4**) in also identifies a number of GHG mitigation measures.

6.5.2 Energy and GHG minimisation

The potential to minimise energy consumption and GHG emissions is greatest during the design phase of the Project. The Project would seek to reduce energy and GHGs in accordance with the following hierarchy:

a) reduce demand through energy efficient layout and design

b) reduce demand by designing energy efficient mechanical and electrical systems and technologies

c) develop and implement asset management strategies that encourage efficient use of energy.

A preliminary analysis of Project elements with high energy requirements and energy savings opportunities is provided in **Table 6-4**.

Table 6-4 Opportunities to minimise Project energy requirements

Project element	Energy and GHG minimisation opportunities
Lighting and security	Maximise use of day lighting, glass roofing, investigate potential for solar panels above ground stations, purchase of green power Underground stations maximise the use of natural lighting wherever possible
Station air conditioning	Limited to platform only cooling, limit to seasonal use, behavioural change (acceptance of temperatures)
Control systems	Component selection, investigate solar power, sophistication of systems, adoption of new technology
Vertical transportation	Operations strategy, investigate station management options
Tunnel venting	Maximise efficiency of train movement to capture venting effect of train movement, energy efficient design of ventilation systems
Network operations	Maximise efficiency of train movements, review annual energy use to identify potential energy efficiency opportunities

6.6 Policy and legislative overview – sustainability

6.6.1 National policy and legislation

Australia's *National Strategy for Ecologically Sustainable Development* (NSESD) (Ecologically Sustainable Development Steering Committee 1992) provides broad strategic directions and a framework for governments to work towards ecologically sustainable development. The Strategy defines ecologically sustainable development as:

> *Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The guiding principles identified for the NSESD include:

- decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations
- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised
- decisions and actions should provide for broad community involvement on issues which affect them.

The NSESD identifies four objectives in relation to urban and transport planning, including:

- promoting urban forms that minimise transport requirements and improve the efficiency of land supply and infrastructure provision
- encouraging the future development of urban transport systems which provide opportunities to limit the use of fossil fuels
- promoting subdivision and road design patterns that provide the greatest potential to utilise energy efficiency dwelling design, with provision for and use of public transport modes
- improving the amenity of local urban areas.

The Strategy aims to achieve more sustainable use of energy and natural resources through integrated urban and transport planning.

Other initiatives to progress sustainability in Australia include the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), discussed further in **Chapter 9 Land Use and Tenure** and in **Appendix D.**

The EPBC Act promotes ecologically sustainable development (ESD) through the conservation and ecologically sustainable use of natural resources, particularly in relation to matters of National Environmental Significance (NES) and Commonwealth land. The following ESD principles are defined in section 3A of the EPBC Act:

- decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation

- the principle of intergenerational equity (that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations)
- the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
- improved valuation, pricing and incentive mechanisms should be promoted.

Project response to national policy and legislation

To promote the achievement of NSESD objectives, the Project integrates short and long-term considerations through supporting the achievement of transport and transit outcomes for South East Queensland. The Project meets the NSESD objectives by creating urban transport hubs at targeted local economic development areas, such as Albert Street and Boggo Road. High density urban forms are to be encouraged in the urban development areas, and locating stations within the Bowen Hills (RNA Showgrounds) and Woolloongabba urban development areas would improve amenity of these sites and provide public transport access to these future high density development sites.

A key aspect of the Project and the broader South East Queensland rail network that the Project supports is to foster a compact urban form, through effectively connecting communities and supporting the ongoing role and function of the Brisbane CBD as the primary centre for commerce and employment in Queensland. The Project is the flagship initiative in the draft regional transport plan that accompanies the SEQ Regional Plan – draft Connecting SEQ 2031. This plan outlines how rail is an investment priority for the South East Queensland transport system to support compact urban form and emission targets within the SEQ Regional Plan and Climate Q: toward a greener Queensland. The Project would enhance the long-term viability of the rail network within South East Queensland.

The environmental values within the study corridor have been detailed in the relevant EIS chapters. Where potential impacts to environmental values were identified, mitigation measures have been proposed in the relevant EIS chapters to address adverse impacts.

The Project supports the economic diversity principles of the NSESD through supporting a number of regionally significant employment services and community uses that form the planned network of regional centres. These areas include Bowen Hills and the Royal Brisbane and Women's Hospital, Brisbane CBD, Queensland University of Technology (QUT) Gardens Point, Woolloongabba, Princess Alexandra Hospital, Boggo Road Ecosciences Precinct and the Queensland Tennis Centre.

The Project has implemented a community consultation program throughout the detailed feasibility phase to incorporate community values into the planning of the Project. A discussion of the community values identified during consultation, including sustainability, is included in **Chapter 20 Social Impact Assessment**.

The Project is likely to promote opportunities for consolidated living along the study corridor. The Project is located within the urban footprint and would integrate with a number of high growth areas. Intensification of uses is projected to occur within areas located along the study corridor, specifically the Brisbane City, Woolloongabba and Boggo Road areas within the central section of the study corridor and Albion and Bowen Hills within the northern section of the study corridor. Intensification of land uses within these areas will require frequent and efficient public transport connections which would be partly provided by the Project.

The Projects design and construction also supports the principles of the EPBC Act through seeking to protect heritage places and places of cultural significance. The proposed tunnel alignment would not be closer than 200 m from the boundary of any building identified as occurring on Commonwealth land and/or as a Commonwealth Heritage Listed place (as per the Referral Decision).

The majority of the potential nature conservation impacts which could occur from the Project are anticipated to be minimal and manageable due to the urban nature of the study corridor and the large portion of the alignment situated underground through the central section (refer to **Chapter 11 Nature Conservation**). One of the key waste materials from the Project is the disposal of spoil generated from the construction of the tunnel alignment. Spoil would be placed in areas which have been previously subjected to intensive mining activities (Swanbank), rather than impacting on other potential locations with possible biodiversity values.

6.6.2 State policy and legislation

Toward Q2: Tomorrow's Queensland (Toward Q2) sets out a vision for Queensland in 2020 based around five key themes to address future challenges. The key themes are:

- "Strong" – creation of a diverse economy powered by bright ideas
- "Green"– protection of lifestyle and environment
- "Smart" – delivery of world class education and training
- "Healthy" – make Queenslanders Australia's healthiest people
- "Fair" – support a safe and caring community.

The SEQ Regional Plan provides a summary of the characteristics of sustainable development to be achieved in South East Queensland. The Project would support the achievement of the transport and transit outcomes in the SEQ Regional Plan by fostering compact urban form and connecting communities. It would also support the on-going role and function of the Brisbane CBD as the primary centre for commerce and employment in Queensland.

The Regional Plan is supported by the *South East Queensland Infrastructure Plan and Program 2010 – 2031* (SEQIPP). The SEQIPP identifies the planning, design and construction of necessary infrastructure to 2031 in order to realise the preferred pattern of development projected by the SEQRP. The SEQIPP is a statement of the State Government's proposed investment commitments and timing for major infrastructure.

The key principles of the SEQIPP that underpin regional transport investment are:

- land use and planning – reducing the need for travel through integrated planning
- pricing and travel demand – applying travel demand management measures to reduce private vehicle transport
- travel options – creating a public transport and active transport network that is accessible, frequent and reliable
- efficiency – maximising the efficiency of existing transport infrastructure
- capacity – building on existing infrastructure investment through upgrades and extensions.

The SEQIPP seeks to build on additional infrastructure investment by providing more public transport. Priority infrastructure projects indicated in the SEQIPP include provision for improved rail services including new rolling stock and a program of station and line upgrades.

Project response to State policy and legislation

The Project would support the achievement of the transport and transit outcomes in the SEQ Regional Plan and SEQIPP by fostering compact urban form and connecting communities. The Project would also support the ongoing role and function of the Brisbane CBD as the primary centre for commerce and employment in Queensland. As explained previously, the Project is the flagship initiative of the draft regional transport plan Connecting SEQ 2031. It highlights that rail is a priority for the South East Queensland transport system to maximise the long-term viability of the rail network and support the development of a compact urban form.

The Project supports achievement of the 'strong' and 'green' targets in Toward Q2 as follows:

Strong – supporting economic growth by developing the rail network and fast commuter links to ensure people and goods can move more reliably and efficiently.

The Project supports a number of regionally significant employment services and community uses that form the planned network of regional centres. These areas include Bowen Hills and the Royal Brisbane and Women's Hospital, Brisbane CBD, QUT Gardens Point, Woolloongabba, Princess Alexandra Hospital, Boggo Road Ecosciences Precinct and Queensland Tennis Centre.

The Project would assist in managing capacity issues associated with the inner city rail network. Increased capacity would assist in promoting the viability of rail within South East Queensland as well as facilitating the continued growth and development of the region.

The Project would also increase the efficiency of rail freight by improving freight movement capacity through Brisbane.

The consequence of not addressing the existing rail network constraints would result in long term adverse economic, social and environmental impacts.

The Project would be integrated at key locations with a range of transport modes including other public transport such as bus and active transport networks. Additionally, rail would be integrated with the existing and proposed land use within the study corridor, with station locations being coordinated with major growth areas and high density precincts.

Green – the Project would support a cut in Queenslanders' carbon footprint through reduced motor vehicle use. The Project would support transport mode shift through increasing capacity on the inner city rail network and supporting increased densities within inner city areas. **Section 6.5** of this chapter details the Project's strategy regarding GHG emissions.

6.6.3 Local government policy and legislation

BCC developed the *Green Heart Program*, which aims to make Brisbane a carbon neutral city by 2026 and links with several city-wide environmental outcomes including:

- cleaner and sustainable energy use
- green and active transport
- water smart city
- towards zero waste
- food in the city
- clean air
- green and biodiverse.

Sustainability is a key component to ensure the liveability of a city. Brisbane's Green Heart program aims to develop a culture of sustainability within the community to achieve a cleaner, greener city. A component of this is to provide accessible public transport infrastructure and to promote the use of public transport in Brisbane.

In late 2005, BCC released *Our shared vision - Living in Brisbane 2026*. Over 18,000 Brisbane residents provided feedback and input to this vision document for the city. The eight themes for the vision were driven by the overall desire to plan for a sustainable future for Brisbane that incorporates care for the environment, culture, society and future prosperity.

BCC's *Sustainable Built Environment Policy* seeks to facilitate Brisbane's international recognition for its contemporary, environmentally friendly subtropical urban form.

The Brisbane *CityShape Implementation Strategy* outlines a set of guiding principles to create a sustainable CityShape, including:

- using existing urban areas more efficiently
- making housing accessible to all
- growing a greener Brisbane – identifying 'no go' areas to support biodiversity and our subtropical character and lifestyle
- identifying new, well-serviced, Major Development Areas
- retaining the character of our neighbourhoods and strengthening our communities
- developing centres to support accessible living, efficient transport and employment
- implementing the TOD principles and integrating transport, land use and employment
- ensuring operation of a strong economy
- making moving around town easier and more sustainable
- establishing sound infrastructure, including efficient management of the water cycle to support a sustainable way of life
- matching CityShape development with an appropriate level of infrastructure provision.

Project response to local government policy and legislation

Specific design measures that seek to achieve the objectives of the Sustainable Built Environment Policy have been identified to:

- facilitate Brisbane's contemporary, environmentally friendly subtropical urban form through urban design features such as the "Green Way" between Roma Street and Albert Street, which includes neighbourhood improvements and street widening
- incorporate urban design features that are in keeping with the character of neighbourhoods and Brisbane's subtropical urban form.

The Project would support the strategies identified within the CityShape strategy, through facilitating improved transport and land use integration, and supporting increased densities within the inner city area, specifically surrounding the identified growth areas of Brisbane CBD, Bowen Hills, Woolloongabba and Boggo Road.

This intensification of development would be in line with the aims of the development schemes for the Bowen Hills and Woolloongabba urban development areas, the City Centre Neighbourhood Plan, the Boggo Road Urban Village and the Yeerongpilly TOD.

Future population and employment growth in these areas will need to be supported by frequent and efficient public transport connections.

6.7 Sustainability framework methodology

6.7.1 Introduction

A sustainability framework has been developed for the Project. The purpose of the sustainability framework is to enable the development of feasible, Project specific design measures which result in enhanced sustainability outcomes for the Project than would be achieved without the consideration of sustainability in the Project design.

The sustainability framework involved five key phases (**Figure 6-1**):

- Phase 1 – review of background information to identify current best practice for project sustainability assessments and rail infrastructure developments
- Phase 2 – development of the sustainability assessment tool including identification of sustainability themes, goals, objectives and indicators
- Phase 3 – implementation of the sustainability assessment tool
- Phase 4 – periodic review of the sustainability assessment tool in order to monitor progress
- Phase 5 – reporting.

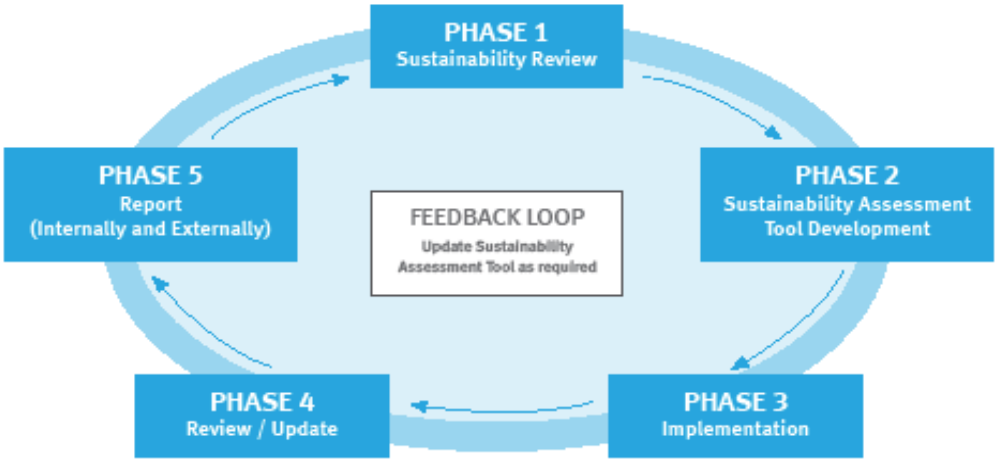

Figure 6-1 Five phase sustainability framework for the Project

6.7.2 Sustainability review

A review of international and Australian sustainability assessments and rail infrastructure developments has been undertaken to scope the key issues, potential impacts and opportunities for the Project. A summary of the International and Australian frameworks are provided as follows.

International frameworks

United Nations Commission on Sustainable Development

In 2001, the United Nations Commission on Sustainable Development published the Indicators of Sustainable Development: Guidelines and Methodologies report. This report informs nations on measuring sustainable development in a domestic context. The United Nations Commission on Sustainable Development suggests indicators to assess forms of sustainability.

Civil Engineering Environmental Quality Assessment and Award Scheme, UK

This is an awards scheme system which can be used to assess the environmental performance of a civil engineering project. The Civil Engineering Environmental Quality Assessment and Award Scheme uses a credit based self assessment framework to assess projects against specific environmental criteria. Consideration has been given to the Civil Engineering Environmental Quality Assessment and Award Scheme environmental categories for inclusion in the sustainability assessment model for the Project.

LEED for Neighbourhood Development Rating System

The US Green Building Council, the Congress for the New Urbanism and the Natural Resources Defence Council have developed a national set of standards for neighbourhood location and design based on the combined principles of smart growth, new urbanism and green building. These standards have been established to assess and reward environmentally superior development practices within the rating framework of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System. Some of the indicators suggested in the LEED system have been considered for inclusion in the Project sustainability assessment model.

FIDIC Project Sustainability Management Guidelines

The International Federation of Consulting Engineers (FIDIC) is an industry association based in Switzerland comprising member organisations which represent and promote the interests of technology-based intellectual services for the built and natural environments. *FIDIC's Project Sustainability Management Guidelines 2004* provide a framework through which to assess the sustainability goals of a project and measure the project's progress.

The Project Sustainability Management guidelines set up categories and themes of sustainable development and use indicators under each category and theme to undertake a sustainability assessment. A self-assessment tool is provided in the guidelines to rank performance. Ranking is from low to high with low being compliance with legislative and regulatory requirements and high effectively setting the benchmark for future project sustainability performance. While developing the Project sustainability assessment model, consideration was given to the sustainability categories and indicators suggested by FIDIC.

Global Reporting Initiative

The Global Reporting Initiative is a multi-stakeholder, international organisation that has developed a Sustainability Reporting Framework to enable organisations to report on their environmental, economic and social performance. The guidelines contain principles and indicators to report against environmental, social and economic performance of a project. A number of the indicators from this model have been considered for inclusion in the sustainability assessment model for the Project.

Rail Express – Urban rail and the sustainability challenge

Recent research carried out by Scanlon (2010), defines the application of sustainability in the rail sector according to macro level and project level sustainability.

Macro level sustainability relates to how an urban rail project interfaces with the physical layout and design or 'urban form' of a city. According to Scanlon, the general consensus of a sustainable urban rail project is a project that connects with and complements an urban form in order to create more 'liveable communities'. Liveable communities are places with high social and environmental quality, where people have good access to transport, health services, employment and recreation.

Connections such as cycle paths, pedestrian access, cycling facilities and other initiatives that link a rail project with other transport modes are extremely important to sustainable urban rail projects. TOD can help achieve sustainable urban rail projects at the macro level. TOD involves the creation of compact, walkable communities centred around high quality transport systems. TOD is designed to encourage public transport, linking various transit options, and incorporating mixed-use residential and commercial development.

Sustainability at the project-level and more specifically, in design processes, needs to encourage 'life-cycle thinking'. Life-cycle thinking is about building resilience to future changes across the life of an asset. Future changes may include rising energy prices, more severe and frequent weather events as a result of climate change and changes to demographics. A way to achieve resilience is to build in flexibility during project delivery processes, and more specifically in design.

By building in flexibility and adaptability at the project level, future changes can present opportunity as opposed to risk. For example, accounting for climate change projections such as increased frequency and intensity of rainfall and storm surge through including flexible adaptation mechanisms into the detailed design of a project reduces the risk of damage to infrastructure. Life-cycle thinking also considers supply chain impacts and the social and environmental responsibility of suppliers when selecting materials for construction and operation.

Therefore, incorporating flexibility and adaptability into the Project is important to ensure that sustainability initiatives don't become redundant and opportunities for innovation are not restricted. Ideas surrounding macro level and project level sustainability, as discussed by Scanlon, have been incorporated into the sustainability framework for the Project and specific sustainability objectives have been devised in order to address both macro level and Project level sustainability.

Australian frameworks

Australian Green Infrastructure Council

The Australian Green Infrastructure Council (AGIC) is currently developing a Sustainability Rating Tool for infrastructure projects to promote a greater acceptance of sustainability practices in the development of Australian infrastructure. The assessment tool categorises the need for sustainability practices to be embedded in all aspects of project delivery including:

- project management and governance
- economic performance
- resource use
- emissions, pollution and waste
- biodiversity
- people and place
- workforce.

Once this tool has been completed, it could contribute to the assessment of the Project according to the efficiency of the sustainability practices being implemented throughout Project delivery. However, the tool is not expected to be available for the planning phase, but may be available during the delivery phase of the Project.

Urban Development Institute of Australia EnviroDevelopment

In 2006, the Urban Development Institute of Australia (Queensland Division) launched a voluntary scheme to independently certify developments which achieve high quality sustainability outcomes based on sound scientific benchmarks and principles. The purpose of the scheme is to promote the ESD benefits of particular developments to home buyers, government and environmental groups, and participants in the development industry. EnviroDevelopment comprises six separate and independent certification elements:

- water
- energy
- ecosystem
- community
- materials
- waste.

Each element has a specific logo that developers use in promotional branding of the development. The EnviroDevelopment standards are designed to be flexible to encourage innovation, and to consider project specific characteristics. These relevant attributes of EnviroDevelopment have been considered in the Project sustainability assessment model, particularly in the flexibility of the model, which enables changes to be incorporated as the Project develops.

Sustainability framework elements

The sustainability framework provides a tool that allows the development of feasible, Project specific design responses. The tool can track the progress of the responses and related design measures through the detailed design, development and operation of the Project.

A total of 14 themes and associated goals, and 42 indicators have been identified as being specific to the Project. The themes relate to three categories: environment, social and economic. The sustainability framework identifies implementation actions, project phase, implementation ownership and further actions required.

The sustainability framework for this Project is included in **Appendix E2**.

6.8 Sustainability outcomes for the Project

6.8.1 Project sustainability elements in the reference design

Sustainability elements in the reference design have been developed to help ensure that the sustainable performance of the Project is carried forward into the detailed design stage. This is of particular importance in those cases where detailed design or management measures cannot be specified at present.

This section describes the actions which have been committed to in the design process to date and those actions which require further investigation at a later stage of project delivery. Further detail on these actions is available in **Appendix E2**.

Agreed actions

Sustainability measures which have already been incorporated into the reference design include:

- measures which focus on reducing energy demand and minimise lifecycle energy consumption
  - single track tunnels for the river crossing allow tunnels to be as shallow as possible (rather than two track tunnels, which require a wider diameter tunnel and thus a higher level of energy consumption). Single track tunnels reduce the required gradient and therefore the level of energy consumption required for the construction of the tunnel and the operation of trains. This reduced gradient level allows for comparatively shallow stations, for example, at the Gabba and Boggo Road stations box or cavern construction methodologies can be used.
  - pressure changes are to be managed through platform screen doors, which physically separate the track from the platform station environment and improve air-conditioning efficiency at underground stations
- measures which incorporate water reduction/efficiency for the Project by minimising the use of potable water in the construction phase and protecting the quality of existing resources and reducing the risk of flooding through
  - waterproofing and water treatment proposed for the Gabba Station to avoid movement of contaminated groundwater (due to past industrial uses on the site)
  - use of prefabricated segments for tunnel boring machine minimises water leakage and therefore reduces the amount of seepage water pumping required

- measures which integrate facilities with existing transport nodes and other infrastructure to maximise efficiency in travel and patronage
  - connecting the Albert Street end of the CBD to the existing rail network
  - providing the opportunity for future upgrades to the Woolloongabba Busway Station
  - providing enhanced connectivity between other transport modes, for example, at Boggo Road (to Boggo Road Busway Station), Roma Street Station (to Roma Street Busway Station) and the Gabba Station (to Woolloongabba Busway Station)
  - providing underground pedestrian access across Alice Street improves access to the City Botanic Gardens, particularly for students at QUT
- measures which increase health and social wellbeing and contribute towards achieving a healthy environment for users of the Project:
  - as far as technically feasible, vertical station depth has been reduced, improving passenger access to the rail network
  - to avoid pedestrian overcrowding at the Gabba Station, the station has been designed to cope with 20,000 passengers per hour after events at the Gabba
- measures to ensure infrastructure compatibility with existing land uses and to further enhance their viability where possible through
  - Clapham Rail Yard has been proposed to be used for stabling
  - the opportunity to use trains for removal of spoil
  - new station facilities at Yeerongpilly
  - Albert Street and the Gabba Stations designed to support future high rise development at station surface
- measures which increase safety and security through design that promotes natural surveillance and reduces anti-social behaviour
  - the upgrade of Rocklea and Moorooka stations improves disability access and safety
  - access to stations has been better enabled through the use of lifts and elevators
  - positioning of Boggo Road Station entrance as close as possible to Annerley Road improves access and legibility for users
  - people accessing QUT and the City Botanic Gardens have improved access from the proposed Albert Street Station via an underground pedestrian access across Alice Street. This underground passageway allows people to cross safely underground, rather than making a potentially unsafe pedestrian crossing over busy streets
  - use of Crime Prevention through Environmental Design (CPTED) measures for station designs
- measures which minimise the Project's contributions towards climate change by reducing GHG emissions and incorporating latest climate change scenarios into the design of the Project through
  - undertaking a GHG emissions inventory in line with the GHG protocol for all stages of the Project (refer to **Chapter 15 Air Quality and Greenhouse Gas Assessment**)
  - track elevation at Mayne Rail Yard has been designed in response to the floodplain modelling undertaken in this area
  - undertaking a detailed climate change risk assessment (refer to **Section 6.4** and **Appendix E1**) to identify risks and risk management options
- measures which contribute towards economic growth in Brisbane through improvements in the public transport network and accessibility to areas with mixed land uses through
  - upgrading station facilities at Yeerongpilly to improve links and access between future Transit Oriented Developments and industrial areas.

Measures identified as part of the design process are not limited to those described in this section. A comprehensive list of sustainability measures incorporated into the Project design is provided in **Appendix E2** and in **Chapter 24 Draft Outline EMP**.

Future actions

Further actions to be considered and developed where viable in detailed design to enhance the sustainability aspects of the Project are as follows:

Detailed design

- investigate energy efficiency measures, including opportunities to improve air conditioning efficiency. Investigate the feasibility for energy efficiency measures to be incorporated into construction phase activities
- investigate feasible renewable energy alternatives to determine their suitability for implementation during construction and operation of the Project
- investigate water efficiency measures and review all designs in order to incorporate these measures
- develop a sustainable procurement strategy, including utilising supply contracts to source sustainably accredited materials and sourcing of materials as close as possible to the Project footprint, to minimise material transport distances
- identify potential waste streams and investigate the possible implementation of the waste management hierarchy
- explore opportunities to minimise spoil and opportunities for fill re-use where clean fill is available
- ensure biodiversity values incorporated into detailed landscape design and consider the use of native, endemic plants, where possible
- review neighbourhood plans and incorporate features into the design
- identify opportunities for community involvement in the design of public open spaces (at station entrances)
- investigate opportunities to create a link from the train stations to the existing cycle network and pedestrian network
- stations to be designed and constructed in accordance with Queensland Rail's *Rail Station Design Guide (2010)*, including factoring in requirements for water and energy efficiency
- water efficiency requirements
  - ensure that the Queensland Water Commission (QWC) provides a licensed plumber with a water compliance certification
  - all plumbing fittings are to comply with the *Water Efficiency Labelling and Standards Act 2005* (WELS Act)
  - include at least a 5,000 litre rainwater tank at each station and use for landscape irrigation
- energy efficiency requirements
  - energy efficiency including consideration of alternative energy supplies such as solar, eg solar panels or photovoltaic cells
  - energy efficient techniques such as motion activated lights and heat activated ventilation and air conditioning.

Construction

- as part of the implementation of a sustainability procurement strategy, the Construction Contractor should use supply contracts to source materials as close as possible to the Project and use supply contracts to source sustainably accredited materials
- Construction Contractor to implement the waste management hierarchy (beyond regulatory compliance) by applying the principles of the hierarchy in the order of waste avoidance, reuse, recycle, energy recovery from waste and waste disposal
- Construction Contractor to implement all fauna and flora protection measures presented in the EMP
- site supervision to minimise risk of damage to archaeological artefacts that may be present within the Project footprint and implement all archaeological artefact protection measures presented in the EIS
- ensure contingencies for power outages, including loss of grid power during construction.

Operation

- undertake an energy audit in first year of operation and develop an energy efficiency plan
- undertake a survey of passenger travel behaviours to determine the number of passengers likely to walk and/or cycle
- investigate and devise ways to increase the number of passengers using the Project, ie through provision of future commercial and development opportunities at stations, particularly at Albert Street and the Gabba Station to enable future high rise development at the station surfaces
- implement site security measures at stations such as fencing, locked gates, warning signs, CCTV and security guards after hours
- undertake an assessment of the profitability and/or wider economic gains of the Project during operation.

6.9 Sustainability review and reporting

The management of sustainability issues through the sustainability framework is an iterative and ongoing process and incorporates continual improvement. The future Project delivery phases should allow for review and refinement of the implementation actions and future actions in the sustainability framework at key stages throughout the design, construction and operation phases of the Project. The Environmental Management Plan (**Chapter 24 Draft Outline EMP**) refers to the various stages that sustainability measures are to be incorporated into the Project.

Ongoing review and development of the sustainability assessment framework would ensure that sustainability remains at the forefront of the detailed design, construction and operation of the Project. An important component of sustainability assessment and reporting is the evaluation phase. Continual Project evaluation is a central part of the planning and design process.

6.10 Summary

The climate change and sustainability assessment has identified a range of mitigation and adaptation responses and measures for the Project. These are recommended for inclusion as part of the detailed design, construction and operation phases of the Project. To ensure improved climate change and sustainability outcomes for the subsequent phases of the Project, the detailed designer, construction contractor and eventual operator are responsible for making final commitments to the climate change adaptation measures in **Appendix E1** and the sustainability measures identified in **Appendix E2**.

Research in climate change science and sustainability is continuously evolving as new data and trends become available. As a result, adaptation and mitigation responses and measures would need to be reviewed and updated over time. New technologies are likely to be developed in the future and the Project would need to be flexible enough to adapt to new technologies. The issues, mitigation measures and adaptation strategies presented in this chapter should be considered in combination, to recognise the opportunities for the Project to achieve a resilient and sustainable transport infrastructure solution for South East Queensland.