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Chapter 15.0 - Climate Change Assessment

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15.1 Overview

The KBP will contribute to climate change through the release of greenhouse gas (GHG) emissions during construction and operation. The impacts of climate change on the KBP will also be a relevant consideration throughout its operation.

Both globally and nationally, climate change continues to grow as an issue of critical importance. As such, governments are responding through a range of new policies. The introduction of a Carbon Pollution Reduction Scheme (CPRS) by the Commonwealth Government represents the most significant policy action to date to reduce GHG emissions. The CPRS, and the new reporting requirements under the legislation, represent major changes to how GHG emissions will be managed by organisations into the future.

The Queensland Government is also responding to the climate change challenge. In July 2008, Climate Change Impact Statements (CCIS) became a new requirement for all submissions to the Queensland Cabinet. A CCIS requires that two assessments be undertaken; a GHG emissions assessment and a climate change adaptation assessment. DMR will need to provide a CCIS each time a relevant submission is presented to Cabinet.

This assessment provides a high level overview of the climate change issues likely to be of relevance for the KBP. This information can be used to inform more detailed investigations at later stages of the project. These more detailed investigations will be required to comply with the *Guidelines for Preparing a Climate Change Impact Statement*.

15.2 Approach and Methodology

A desktop assessment was undertaken to identify how the project may affect and be affected by climate change. A review of current climate change science was completed to identify risks and opportunities. Key references included:

- *Climate Change in Australia* (CSIRO & BOM 2007);
- *Climate Change in Queensland* (OCC 2008);
- *Garnaut Climate Change Review* (COA 2008);
- *IPCC Fourth Assessment Report* (2007); and
- *Infrastructure and Climate Change Risk Assessment for Victoria* (CSIRO *et al* 2007).

The VicRoads' (2009) *Framework to Calculate Greenhouse Gas Emissions from Road Construction* and *Potential for Reducing Greenhouse Gas Emissions in the Construction Sector* published by the United States Environmental Protection Agency (2009) were used to inform the GHG assessment. The literature review highlighted potential critical issues to the project and management options.

15.3 Greenhouse Gas Assessment

15.3.1 Greenhouse Gas Emissions

GHG are gases in the atmosphere that absorb and emit radiation. These gases, including carbon dioxide (CO_2), carbon monoxide (CO) and sulphur dioxide (SO_2), maintain the ambient temperature of the atmosphere, making earth habitable. Although GHG are naturally occurring, human activities such as the burning of fossil fuels are causing GHG concentrations to rise above natural levels, resulting in further heating of the planet and changes to the global climate.

The KBP is expected to generate a moderate amount of GHG emissions. The majority of emissions are likely to occur through the burning of fossil fuels during construction and operation. The following sections identify likely sources of GHG emissions and potential reduction strategies.

15.3.2 Potential Impacts and Mitigation Measures

15.3.2.1 Construction Activities

During construction, the majority of GHG emissions are likely to occur through the use of fuel and electricity. Fuel will be used to power construction vehicles and equipment. When fuel is burnt in an engine, it reacts with oxygen to form CO_2 and water. Other GHG such as nitrous oxide and sulphides are also released (DEWHA 2008). It is estimated that for every litre of petrol used in a motor vehicle, an average of 2.3 kilograms of CO_2 is released from the exhaust (DEWHA 2008). In diesel vehicles, an average of 2.7kg of CO_2 is released for each litre of fuel used. It is important to note that although GHG emissions/litre from diesel vehicles are higher than petrol vehicles, diesel engines are designed to be more fuel efficient. It is also important to note that GHG emissions from vehicles vary depending on a range of factors including vehicle type, vehicle age and engine specifications.

Electricity use during the construction phase will also contribute to GHG emissions. GHG are released through the burning of fossil fuels, such as brown and black coal, to generate electricity. Electricity will be used for lighting (site office(s) and flood lighting) and cooling (site office(s)).

During the construction phase GHG emissions will also be released from vegetation clearing (loss of carbon sequestration potential) and the use of construction materials (embodied energy).

There are a number of options to manage fuel and electricity consumption and hence reduce GHG emissions. Potential options for reducing GHG emissions are discussed in Table 15.1.

15.3.2.2 Operational Activities

Once the KBP is operational, the majority of GHG emissions will be from vehicle exhaust. The use of electricity for street lighting will be another source of emissions during this phase.

Although DMR cannot control how much fuel is used by cars travelling on the KBP, steps can be taken to reduce congestion (stop-start) and improve fuel efficiency (fuel consumption/kilometre). Table 15.1 also identifies options to reduce operational GHG emissions.

Table 15.1: Potential Impacts and Mitigations Measures for Reducing GHG Emissions

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC01	Design	Increased GHG emissions	Develop a detailed carbon management plan detailing goals and targets. Reduce fuel and electricity use.
CC 02	Construction	Exhaust emissions from construction vehicles and machinery.	Consider replacing conventional fuel types (petrol and diesel) with bio-fuels.
CC 03	Construction		Use high-efficiency motors in equipment that is continuously operated.
CC 04	Construction		Ensure that vehicles and equipment are mechanically sound, regularly serviced and fitted with appropriate emission control equipment.
CC 05	Construction		Implement work scheduling and methods that: • Minimise equipment idle time and double handling of material; • Optimise machinery use to avoid unnecessary fuel usage.
CC 06	Construction		Minimise haul distances.
CC 07	Design	GHG emissions from electricity used for lighting and cooling of the site.	Design energy efficient site offices.
CC 08	Construction		Purchase accredited GreenPower for site offices.
CC 09	Construction		Procure and install energy efficient fixtures and fittings (e.g. energy efficient lights in the site office(s)).
CC 10	Construction		Construct during the day to reduce the need for floodlighting during night works.
CC 11	Design	Production processes (embodied energy of construction materials) resulting in GHG emissions.	Identify local sources of recycled materials.
CC 12	Construction		Use recycled materials where possible (e.g. recycle wastes from demolition of existing structures where possible).
CC 13	Construction		Use locally produced materials.
CC 14	Construction		Give preference to products with low embodied energy.
CC 15	Design		Consider adopting a design that requires fewer materials.
CC 16	Design	Loss of carbon sequestration potential.	Implement government policies with respect to “net loss” of vegetation
CC 17	Design		Develop a re-planting strategy.

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC 18	Construction		Plant/re-establish vegetation with high carbon sequestration potential (carbon sink)
CC 19	Construction		Plant vegetation that occurs naturally in the location
CC 20	Construction	Cumulative GHG emissions from the construction process.	Purchase accredited carbon offsets
CC 21	Construction		Work with third parties (suppliers, distributors and contractors) to reduce emissions (e.g. through recycling materials)
CC 22	Design	Exhaust emissions from vehicles travelling on the KBP.	Optimise the road design to promote steady and constant traffic movement (reduce stop/start).
CC 23			Minimise gradient changes along the alignment.
CC 24	Operation		Regularly monitor and maintain the infrastructure.
CC 25			Ensure signals are adequately timed to reduce delays.
CC 26	Design	GHG emissions from electricity used for lighting (streetlights).	Investigate energy efficient street lighting options
CC 27	Operation		Install the most energy efficient lighting technology suitable for the road requirements.

15.4 Climate Change

Along with considering the contribution the KBP will make to climate change in terms of GHG emissions, it is also important to consider how the KBP may be impacted by future changes to the global and local climate.

15.4.1 Climate Change Science

Climate scientists now generally agree that human activity has influenced, and will continue to influence, our planet's climate. The increased presence of GHG in the atmosphere results in climatic changes, changes that are expected to continue. Current research indicates that climate change is already being observed in Queensland. Observations show:

- Queensland has experienced an increased in annual average temperature of 0.9°C since 1950;
- Queensland has been warming faster than the national average, with four of the State's seven hottest years on record having occurred since 2002;
- Average annual rainfall along Queensland's east coast south has substantially declined since 1950; and
- A greater proportion of total rainfall falls in extreme events, with longer periods between events.

Projections indicate that changes to the climate will continue. In future, Queensland's climate is projected to be characterised by:

- Higher annual mean temperatures of around 0.9°C by 2030 and up to 3°C by 2070;
- More extremely hot (above 35°C) days;
- Accelerated evaporation;
- Reduced annual precipitation (rainfall) with decreases of between 2% to 5% by 2030 and up to 10% by 2070;
- Longer dry spells;
- More intense individual events (such as intense bursts of rainfall);
- More extreme weather events such as severe storms involving torrential rain, hail and lightning; and
- Drier El Niño (dry season) and wetter La Niña (wet season) events.

It is important to note that the nature, geographic scale and timing of climate change impacts will vary. Some impacts such as decreasing rainfall will occur gradually over many years, whereas others such as storms will be sudden and extreme.

15.4.2 Potential Impacts and Mitigation Measures

The main climatic changes likely to be relevant to the project are an increase in daily temperatures and the number of very hot days, an increase in the frequency and severity of extreme weather events (such as storms), a decline in average rainfall and prolonged drought conditions. As the road is not located near the coast, impacts from storm surges and sea level rise are not likely to have a direct effect on the KBP. However, the potential for more heavy rainfall events and associated flooding of Moggill Creek should be considered. The following sections provide more detail on projected changes to temperature and rainfall in Queensland and Brisbane.

By 2030, annual average temperatures in Queensland's coastal areas are projected to increase by approximately 1°C (range of 0.7–1.2 °C). Inland areas are projected to experience a slightly higher increase in annual average temperatures (range of 0.7-1.6°C). In the longer term (2070), annual average temperatures could be as much as 3°C higher than present.

The number of extremely hot days (days over 35°C) experienced in Brisbane is also expected to increase from the current number (1 day a year on average) to up to 14 days per year by 2070 (under a high emissions scenario).

Current projections indicate that annual rainfall is likely to decrease in Queensland, however, an increase in daily rainfall intensity (rain per rain-day) is likely. This means that Queensland is likely to experience longer dry spells interrupted by heavier rainfall events. More extreme rainfall events coupled with stronger winds and hail will be a further challenge.

The four to 40 year average recurrence interval (ARI)[1] is projected to increase in intensity, with the 1–in-40 year event to become the 1-in-15 year event by 2070. Shorter duration events will experience the greatest increase in intensity, with a 50% to 70% increase in intensity for the two hour rainfall event (Abbs *et al* 2007). It will be important that the KBP is designed to cope with these more extreme rainfall events.

Numerous reports and publications (AGO 2005 & 2007, COA 2008, CSIRO & BOM 2007, OCC 2008a & 2008b) highlight that infrastructure, such as roads, will be vulnerable to climatic changes such as those described above. The potential impacts of climate change on the KBP are listed in Table 15.2.

Table 15.2: Potential Impacts of Climate Change on KBP

Climate Variable	Impact
Increased temperatures and hot days	Impacts on the health and safety of construction workers from exposure to extreme heat (This is likely to be beyond the scope of influence at the project design stage).
	Impacts on the durability and suitability of materials, including the ability of materials to withstand more frequent high temperatures and the reflectivity of materials contributing to increased localised temperatures.
	Power (grid) failures occurring during times of extreme heat resulting in equipment failure (e.g. signals and streetlights).
	Loss of plants in landscaped areas due to lack of water or extreme heat.
	Increased risk of fire.
Decreased rainfall	Changes to the watertable/groundwater levels impacting on materials suitability and durability.
Increased rainfall intensity	Disruptions to the construction process; and Flooding of the KBP potentially impacting the infrastructure (damage from water and/or debris), access to and from the KBP and safety of road users.
More extreme weather events (e.g. storms involving high winds and heavy rain)	Damage to the construction site; Flooding of the KBP impacting accessibility and road user safety; and Loss of power during severe storms resulting in equipment failure.

Whilst it is not possible to predict exactly how the climate will change and how these changes will affect the KBP, it is possible to identify and implement strategies that will lessen the potential impacts of climate change on the infrastructure. Potential management strategies are identified in Table 15.3.

[1] A method of describing storm severities is by the frequency that a storm of a given intensity will occur (ARI). Fortunately, the greater the intensity of the storm, the less frequently it will occur. Therefore, the longer the ARI, the more intense the rainfall. Climate change projections indicate that more intense storms will happen more often as climate change influences Queensland's weather patterns.

Table 15.3: Potential Impacts and Mitigation Measures, Climate Change

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC28	Design	Underestimation of the likelihood and consequences of identified impacts.	• Proactively consider climate change implications; • Undertake a more detailed climate change risk assessment to develop a better understanding of the likelihood and consequences of the identified impacts; and • Undertake a more detailed assessment of the design options available to address the identified climate change impacts.
CC 29	Design	Power failures occurring during times of extreme heat and extreme weather (storms).	Ensure there is adequate back-up power supply at the construction site. Develop contingency plans to be implemented in the event of a power failure.
CC 30	Design	Conditions being more suitable for fires.	Ensure access to construction sites and the KBP for emergency vehicles.
CC 31	Design	Flooding of the surrounding area and/or the KBP.	Ensure all planning and design work is based on a rainfall scenario that includes consideration of climate change.
CC 32			Consider the consequences and responses needed to cope with an event that goes beyond the planned scenario.
CC 33			Ensure access to and from the KBP can be maintained in extreme rainfall events.
CC 34			Develop emergency response plans to effectively evacuate the KBP during extreme weather/flooding.
CC 35	Construction	Damage to the construction site, injuries or fatalities and/or disruptions to the construction schedule.	Ensure the construction site can cope with more extreme weather events, heat and rainfall: • Ensure sediment and waste are securely stored in case of extreme weather events; • Develop an extreme heat policy and actions to reduce the impacts of severe temperatures on construction workers; and • Develop contingency plans to allow work to continue safely during extreme weather events such as torrential rain.
CC 36	Construction	Construction workers exposed to extreme heat. (This is likely to be beyond the scope of	Ensure work practices protect health and safety of workers in times of extreme heat (e.g. appropriate PPE, stop-work guidelines).

Reference Code	Project Phase	Potential Impact	Potential Mitigation Measures
CC 37		influence at the project design stage.)	Ensure temperature-critical construction practices (e.g. laying of concrete) occur when conditions are suitable.
CC 38	Operation	Impacts on the durability and suitability of materials.	Consider the long-term durability of the KBP over its design life (100 years). Consider the long-term durability of materials. Give preference to durable materials that perform well under increased stress (e.g. in hot conditions).
CC 39	Operation	Loss of plants in landscaped areas.	Use drought resistant plants in landscaping Maximise water harvesting opportunities to enable stormwater to be re-used to irrigate plants.
CC 40	Operation	Changes to the watertable/ groundwater levels.	Ensure construction materials can cope with wetting/drying cycle.

15.5 Summary

Climate change is a reality that will have an impact on the design life of the KBP. In particular, hotter temperatures and more intense rainfall events will impact the useability and durability of the KBP. Although the extent of climate change impacts are unknown, steps can be taken to reduce the consequences of climate change on the KBP

A high level assessment was undertaken to identify a range of potential impacts from climate change that need to be considered as part of the design of the KBP. The review also identified how the project may contribute to climate change through the release of GHG emissions. GHG will be released throughout the life of the KBP, primarily through the burning of fossil fuels to power vehicles and generate electricity (for lighting and cooling). At this stage of the project there is not adequate data to accurately quantify GHG emissions or detail site specific management options. At this point in the process, reducing fuel and electricity use wherever possible should be the key considerations. How much GHG emissions are reduced will depend on the number, extent and success of implemented management options.

Additionally, more detailed assessments are recommended to effectively reduce GHG emissions and manage climate change implications on the project. Recommended next steps include:

- Proactively considering climate change implications and implementing practical measures, such as selecting durable materials and developing contingency plans;
- Undertaking a more detailed assessment of GHG emissions to comprehensively identify and quantify GHG emissions from construction and operation;
- Developing a carbon management plan detailing strategies to reduce GHG emissions, targets and responsibilities to be completed during the detailed design phase;
- Undertaking a more detailed climate change risk assessment to develop a better understanding of the likelihood and consequences of the identified impacts; and
- Undertaking a more detailed assessment of the design options available to address the identified climate change impacts.

This information can then be used to inform the development of any future CCIS that is required to be completed for the project.