HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

14 Greenhouse Gas Emissions and Climate Change

Section 14 Greenhouse Gas Emissions and Climate Change

14.1 Introduction

This section of the Environmental Impact Statement (EIS) describes the greenhouse gas and climate change legislative framework, the potential impacts of the proposed mining operations, and mitigation measures associate with the Project.

14.2 Greenhouse Gas Emissions

14.2.1 Legislative Framework

14.2.1.1 International Policy

In 1997, the United Nations Framework Convention on Climate Change (UNFCC) produced the Kyoto Protocol aimed at limiting the greenhouse gas (GHG) emissions of countries that ratified the protocol (United Nations, 1997). It entered into force in 2005. The protocol was designed to work by setting limits to individual mandatory GHG emission targets using a ratifying country's 1990 GHG emissions as their baseline.

The Kyoto Protocol sets out three "flexibility mechanisms" to allow GHG targets to be met:

- The Clean Development Mechanism;
- Joint Implementation; and
- International Emissions Trading.

These three mechanisms effectively allow GHG reductions to be made at the point where the marginal cost of that reduction is lower. Essentially, an industrialised country sponsoring a GHG reduction project in a developing country can claim that reduction towards its Kyoto Protocol target and those GHG reductions can be traded.

Australia ratified the Kyoto Protocol in December 2007 and has committed to meeting its Kyoto Protocol target of 108% of 1990 emissions by 2012.

14.2.1.2 Australian Policy

The Australian policy on climate change was released in July 2007 and is managed by the Commonwealth Government Department of Climate Change and Energy Efficiency (DCCEE). It sets out the Commonwealth Government's focus on reducing GHG emissions, encouraging the development of low emissions and emission reduction technology climate change adaptation, and setting national policies and response to climate change within a global context.

Garnaut Review

The Commonwealth Government commissioned the Garnaut Climate Change Review (Garnaut Review) as an independent study to examine the impacts, challenges and opportunities of climate change for Australia. The Garnaut Review's Final Report was released on 30 September 2008 (Garnaut, 2008). The Garnaut Review considered the potential impacts that climate change will have on Australia's environment and economy, and proposed medium to long-term policies and policy frameworks to improve the prospects for sustainable prosperity.

Carbon Pollution Reduction Scheme (CPRS)

In December 2008, the Commonwealth Government released its White Paper on the design of the Carbon Pollution Reduction Scheme (CPRS) (DCCEE, 2008). The CPRS will comprise a cap on Australia's GHG emissions as well as implement a carbon emissions trading scheme so that affected industries can purchase credits to reduce their GHG emissions.

As a minimum, the Rudd/Gillard Commonwealth Government has committed to an unconditional 5% reduction below 2000 levels of GHG emissions by 2020. In the event there is a global agreement and advanced economies take on commitments comparable to Australia, the Commonwealth Government has committed to reducing Australia's GHG emissions by up to 15% below 2000 levels by 2020. The CPRS will cover stationary energy, transport, fugitive emissions, industrial processes, waste and forestry sections, and all six GHGs counted under the Kyoto Protocol from the time the scheme begins.

Under the CPRS, entities in covered industries that directly emit more than a specified threshold amount of GHG will be required to surrender permits at the end of each compliance period to match their GHG emissions. If a covered entity fails to surrender sufficient permits, it will be subject to penalties. The Proponent will be required to obtain and surrender permits with respect to the covered GHG emissions from the Project.

In February 2010, the Commonwealth Government introduced to parliament the CPRS package, which included providing assistance to the coal mining sector through the Coal Sector Adjustment Scheme (CSAS). The aim of this scheme is to provide assistance for particularly emissions-intensive mines to transition to a low emissions economy under the CPRS. Assistance would be available to existing coal mines that have a fugitive emission intensity above a threshold of 0.1 tonnes of carbon dioxide equivalents (CO_2-e[1]) per tonne of saleable coal produced.

On 27 April 2010, the Prime Minister announced that the Commonwealth Government has decided to delay the implementation of the CPRS until after the end of the current commitment period of the Kyoto Protocol (2012) and only when there is greater clarity on the action of other major economies, including the United States of America (USA), China and India.

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[1] Different greenhouse gases have varying potentials to impact on global temperatures (Global Warming Potential) due to the ability of the species to prevent infrared radiation being lost to space, thus heating the atmosphere, and the lifetime of the species in the atmosphere. The unit CO2-e is used to combine the global warming potentials (GWP) of emitted species as an equivalent emission of CO_2.

National Greenhouse and Energy Reporting Act 2007 (NGER Act)

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) established a national framework for Australian corporations to report GHG emissions, reduction removals and offsets, and energy consumption and production. It is designed to provide robust data as a foundation to the CPRS.

From 1 July 2008, corporations have been required to register and report if:

- They control facilities that emit 25 kilo tonnes or more of GHG (CO_2 equivalent), or produce/consume 100 tera joules or more of energy; or
- Their corporate group emits 125 kilo tonnes or more GHG (CO_2 equivalent), or produces/consumes 500 tera joules or more of energy.

Lower thresholds for corporate groups will be phased in by 2010-2011. Companies must register by 31 August, and report by 31 October, following the financial year in which they meet a threshold.

Energy Efficiency Opportunities (EEO)

The Commonwealth Government's Energy Efficiency Opportunities (EEO) program came into effect in July 2006, and mandates large energy users (over 0.5 petajoules [PJ] of energy consumption per year) to participate in the program. The objective of this program is to drive ongoing improvements in energy consumption amongst large users. Businesses are required to identify, evaluate and report publicly on cost-effective energy saving opportunities.

The EEO program is designed to lead to:

- Improved identification and uptake of cost-effective energy efficiency opportunities;
- Improved productivity and reduced greenhouse gas emissions; and
- Greater scrutiny of energy use by large energy consumers.

The EEO program will be incorporated into the National Framework for Energy Efficiency.

Being the sole Proponent of the Project will trigger the requirements under the EEO. Therefore, as a large energy user, the Proponent is a mandatory participant in EEO. Consequently, the minimum requirements of the scheme will need to be met by the Project.

As the program's Assessment Framework takes a whole-of-business approach to assessing energy use and energy saving opportunities, the framework involves corporations looking at the many factors influencing energy use, including leadership, management and policy; the accuracy and quality of data and analysis; the skills and perspectives of a wide range of people; decision making; and communication outcomes. Participants are expected to meet minimum requirements in each of these areas.

14.2.1.3 State Policy Initiatives

In October 2007, the Queensland Government created the Office of Climate Change in order to lead an effective climate change response. The strategy adopted is ClimateSmart 2050.

ClimateSmart 2050 aims at reducing greenhouse gas emissions by 60% from 2000 levels by 2050, in line with the national target, by building initiatives into the Queensland Energy Policy (2000). It includes the introduction of:

- Smart Energy Savings program, which targets large energy users and requires them to undertake energy efficiency audits and implement energy savings measures that have a three-year or less payback period;
- Queensland Future Growth Fund for development of clean coal technologies; and
- Changes to the Queensland Gas Scheme, which will oblige major industries to source 18% of all power form Queensland-based gas-fired generation.

ClimateQ: toward a greener Queensland presents the next phase in Queensland's response to the challenge of climate change. The revised strategy presents investments and policies to ensure Queensland remains at the forefront of the national climate change response. One of the key policies in this strategy is that the approval of new coal-fired power stations will be conditional on meeting criteria relating to greenhouse gas emissions. These conditions include no approval for a new coal-fired power station unless:

- It uses world's best practice low emission technology in order to achieve the lower possible levels of emissions; and
- It is carbon capture and storage (CCS) ready and will retrofit that technology within five years of CCS being proven on a commercial scale.

14.2.2 Inventory Methodology

14.2.2.1 Accounting and Reporting Principles

This inventory follows the accounting and reporting principles detailed in the National Greenhouse and Energy Reporting System Measurement Technical Guidelines (Technical Guideline), June 2010 (DCCEE, 2010a). The main principles of the Technical Guideline (DCCEE, 2010a) are described below:

- Transparency – emission estimates must be documented and verifiable;
- Comparability – emission estimates using a particular method and produced by a registered corporation in an industry sector must be comparable with emissions estimates produced by similar corporations in that industry sector using the same method and consistent with the emission estimates published by the Department in the National Greenhouse Accounts;
- Accuracy – having regard to the availability of reasonable resources by a registered corporation and the requirements of the guideline, uncertainties in emission estimates must be minimised and any estimates must neither be over nor under estimates of the true values at a 95% confidence level; and
- Completeness – all identifiable emission sources within the energy, industrial process and waste sectors as identified by the National Inventory Report must be accounted for.

14.2.2.2 Inventory Boundaries

In preparing a GHG Assessment, there are two forms of boundaries to be specified: organisational boundaries and operational boundaries.

The Proponent is the sole owner of the Project. The organisational boundary is delineated by the physical mine area comprising Mining Lease Application (MLA) 70426, and includes all the greenhouse gas emissions controlled or influenced by the Project.

The operational boundary for the GHG assessment includes both direct and indirect emissions from the Project.

The Technical Guideline further defines direct and indirect emissions through the concept or emission "Scope" as follows:

- Scope 1: Direct GHG emissions. Emissions released from a facility as a direct result of the activities of the facility. For example:
  - Emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.;
  - Emissions from on-site power generators; and
  - Coal Seam Gas (CSG) released to atmosphere.
- Scope 2: Indirect GHG emissions. Scope 2 emissions are activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility. They occur principally at electricity generators as a result of electricity consumption at another facility. They are recorded principally as a measure of what might happen to national emissions as a result of the consumption of electricity from facilities.

14.2.2.3 Calculation Approach

A spreadsheet model has been specifically developed in accordance with the Technical Guideline (DCCEE, 2010a) for the Project and uses the data sources and emission factors detailed below in order to calculate Project emissions for every year of construction and operation.

There are several GHGs, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). In order to simplify inventory accounting, a unit called carbon dioxide equivalent (CO_2-e) is used. This accounts for the various global warming potentials of non-CO_2 gases. The global warming potential is a measure of the amount of infrared radiation captured by a gas in comparison to an equivalent mass of CO_2, over a fixed lifetime. Following this convention, GHG inventories in this report are expressed as mass of CO_2-e released.

Activity Data Sources

Data from the following sources have been utilised in the formation of the inventory:

- Activity data used to assess Scope 1 fugitive emissions (extraction of coal) are based on information provided by the Proponent, and are broken down into annual consumption from 2013 to 2042. This includes:
  - Estimated Run of Mine (ROM) coal for the mine area as a whole for each year of operation of the mine; and
  - Estimated Product Coal (tonnes) for each year of operation of the mine.
- Activity data used to assess Scope 1 emissions from diesel usage are based on information provided by the Proponent, and are broken down into annual consumption in litres from 2011 to 2042. For the purposes of this assessment, equipment has been divided into stationary and transport usage.
- Activity data used to assess Scope 2 emissions from electricity usage are based on information provided by the Proponent, and are broken down into annual consumption from 2011 to 2033. Assumptions made when using these data included:

– Years 2011 and 2012 construction, 2013 onwards operation; and

– For years 2034 to 2042, electricity usage has been assumed to be that of year 2033.

Emission Factors

Direct measurement of GHG at the emission source provides the most accurate and precise assessment of GHG emissions. This is typically not feasible at a mine because of the cost and disruption to production involved, and the typically large number of trucks and items of plant and equipment used. Emission factors remove the need for site-specific testing of emissions. Emission factors are expressed as the amount of GHG emissions per unit of activity, which can be used to determine inventories for a site. This is more feasible than testing each source individually, and it is one of the few ways that inventories for proposed sites can be calculated.

The emission factors used in this report have been sourced from the Technical Guideline (DCCEE, 2010a) and are presented in Table 14-1.

Table 14-1: Emission Factors used in the formation of the Alpha Coal Project (Mine) GHG Inventory

Emission Source	**Units**	**Emission Factors**			**Energy Content**	**Technical Guideline Reference**
		CO2	CH4	N2O		
Scope 1 Emissions						
Extraction of Coal (Fugitive Emissions)	T CO_2-e /t ROM	0.017				Section 3.20
Diesel (Stationary Energy)	T CO_2-e /kL fuel	69.2	0.1	0.2	38.6	Section 2.41
Diesel (Transport Energy)	T CO_2-e /kL fuel	69.2	0.2	0.5	38.6	Section 2.41
Explosives (Ammonium Nitrate Fuel Oil)	T CO_2-e /kL fuel	72.9	0.03	0.2	39.7	Section 2.41
Scope 2 Emissions						
Electricity	T CO_2-e /kWh	0.89				Section 7.2

Materiality

Materiality is a concept used in accounting and auditing to minimise time spent verifying amounts and figures that do not impact a company's accounts or inventory in a material way. The exact materiality threshold used in GHG emissions accounting and auditing is subjective and dependent on the context of the site and the features of the inventory. Depending on the context, the materiality threshold can be expressed as a percentage of a company's total inventory, a specific amount of GHG emissions, or a combination of both.

All emissions that are found within the boundary are included in the inventory unless they are excluded on materiality grounds. Information is considered to be material if, by its inclusion or exclusion it can be seen to influence any decisions or actions taken by users. A material discrepancy is an error (for example, from an oversight, omission or miscalculation) that results in a reported quantity or statement being significantly different to the true value or meaning.

Within this report, emissions are assumed to be immaterial if they are likely to account for less than 5% of the overall emissions profile. This materiality threshold has been chosen on the basis of the author's experience of coal mine GHG inventories and work reviewed in other coal mine EIS's. The following emissions are not included on the inventory on the basis of materiality:

- Consumption of unleaded fuel (ULP) or Liquefied Petroleum Gas (LPG) in site vehicles. Most site vehicles run on diesel fuel, which is included in the inventory. Only small vehicles such as cars belonging to site personnel will consume unleaded fuel and are typically immaterial; and
- The inventory does not consider emissions arising from land use, land use change and forestry such as rehabilitation and clearing.

Aggregation

Aggregation refers to the combining of several inventories, typically of different sites or operations, into an overall inventory. This report is specific to the Project and does not contain an aggregated inventory of all the Proponent's GHG emissions.

Uncertainty Analysis

A measure of the uncertainty for Scope 1 emissions within the inventory is a standard part of a GHG inventory as indicated by the Technical Guideline (DCCEE, 2010a). Uncertainties associated with the GHG inventory are either related to scientific uncertainty or estimation uncertainty.

Analysing and quantifying scientific uncertainty is extremely problematic as it often involves, for example, estimating uncertainty in the global warming potential values and as a consequence, an estimate of scientific uncertainty is beyond the capacity of this inventory.

Estimation uncertainty can be classified further into two types: model uncertainty and parameter uncertainty. Model uncertainty refers to the uncertainty associated with mathematical equations used to calculate the emissions. This is also beyond the scope of the inventory.

Parameter uncertainties within this inventory can be divided into two parts: uncertainty relating to activity data and uncertainty relating to emission factors. Activity uncertainties relate to measured quantities, such as production, consumption, monitored data etc. Emission factor uncertainty considers the conversion from measured activities to GHG emissions.

Fugitive Emissions

Under the Technical Guideline (DCCEE, 2010a), an aggregated (combined) uncertainty level of ± 50% has been given for open cut mines. This includes the uncertainty level for the emission factor, energy content factor, and the activity data.

Diesel Combustion

Following the process outlined in the Technical Guideline (DCCEE, 2010a), an uncertainty level for diesel is determined by a combination of uncertainties associated with the energy content factor, CO_2 emission factor and the quantity of fuel.

The Technical Guideline (DCCEE, 2010a) provides a standard uncertainty for diesel for the energy content factor and emission factor. For the estimation of the quantity of fuel, the Technical Guideline (DCCEE, 2010a) provides an uncertainty level based on the method the estimation was made. The levels of uncertainty for the method of estimation of the quantity of fuel have been outlined in Table 14-2. For this assessment, Criteria BBB has been adopted.

Table 14-2: Level of uncertainty for the method of estimation of the quantity of fuel

Criteria Letter	Criterion	Uncertainty Level (%)
A	The amount of the fuel delivered for the facility during the year as evidenced by invoices or delivery records issued by the vendor of the fuel.	1.5
AA	Indirect measurement at the point of consumption, based on the amount of fuel delivered for the facility and adjusted for changes in stock.	1.5
AAA	Direct measurement at the point of consumption, based on the amount of fuel combusted as estimated by measurement equipment that complies with specified standards.	1.5
BBB	Simplified measurement of consumption.	7.5

Table 14-3 outlines the uncertainties and how they have been derived.

Table 14-3: Uncertainties for diesel

Parameter	Percentage Uncertainty (%)	Source
Energy Content factor	2	As specified for Diesel in the Technical Guideline
Emission Factor	2	As specified for Diesel in the Technical Guideline
Quantity of Fuel Combusted	7.5	Criteria BBB per Table 14-2

Per Section 8.11 (1) of the Technical Guideline (DCCEE, 2010a), the aggregated uncertainty for diesel is calculated by:

Equation1: $$D = \pm\sqrt{A^2 + B^2 + C^2}$$

where:
D is the aggregated percentage uncertainty for the emission source
A is the uncertainty associated with the emissions factor for the source expressed as a percentage
B is the uncertainty associated with the energy content factor for the source expressed as a percentage
C is the uncertainty associated with the activity data for the source expressed as a percentage

The technique used for aggregating the uncertainty is known as the first order error propagation. There are four key assumptions that are made when this technique is used and should be considered.

- The error in each parameter is normally distributed;
- There are no biases in the estimator function (i.e. the estimated value is the mean value);
- The estimated parameters are uncorrelated; and
- Individual uncertainties in each parameter must be less than 60% of the mean.

It is considered reasonable to assume that the above conditions are satisfied and that the uncertainty calculation will be reasonable.

Per the methodology detailed in the Technical Guideline (DCCEE, 2010a), an aggregated uncertainty level of ± 8% has been calculated for diesel. This includes the uncertainty level for the emission factor, energy content factor, and the activity data.

14.2.3 Calculated Emissions

14.2.3.1 Scope 1 and Scope 2 Emission Summary

The GHG Scope 1 and Scope 2 emission sources from the Project that are included in this inventory are:

- Fugitive emissions of CSG from the mining of coal (Scope 1);
- Diesel combustion in vehicles (Scope 1);
- Diesel combustion for stationary energy (i.e. pumps) (Scope 1);
- Diesel combustion for explosives (Scope 1); and
- Electricity consumption (Scope 2).

The Scope 1 and Scope 2 emissions for the Project are summarised in Table 14-4. The average annual emissions from the Project are presented, as well as the total GHG emissions over the 30-year Life of Mine (LOM).

Table 14-4: Greenhouse Gas Emissions for the Project

Scope	Source	Minimum Emissions ($t\ CO_2$-e / yr)	Maximum Emissions ($t\ CO_2$-e / yr)	Average Emissions ($t\ CO_2$-e / yr)	Life of Mine Emissions ($t\ CO_2$-e / yr)	Uncertainty (± %)
1	Fugitive emissions	81,600	793,900	672,669	21,525,400	50
1	Diesel combustion (transport)	267,839	687,323	456,977	14,623,279	8
1	Diesel combustion (stationary)	2,378	6,385	5,694	182,211	8
1	Explosives - Ammonium Nitrate Fuel Oil (ANFO)	1,189	27,848	15,974	511,180	Not applicable
	Total Scope 1[1]	458,083	1,515,360	1,151,315	36,842,070	
2	Purchased electricity	58,797	1,183,140	884,691	28,310,116	Not applicable
	Total Scopes 1 and 2[2]	45,819	2,698,500	2,036,006	65,152,187	

[1] This row indicates the minimum, maximum, average and life of mine emissions of all the totalled Scope 1 emissions and hence will not equal the total of the Scope 1 emissions included in this table.

[2] This row indicates the minimum, maximum, average and life of mine emissions of all the totalled Scopes 1 and 2 emissions and hence will not equal the total of the Scopes 1 and 2 emissions included in this table.

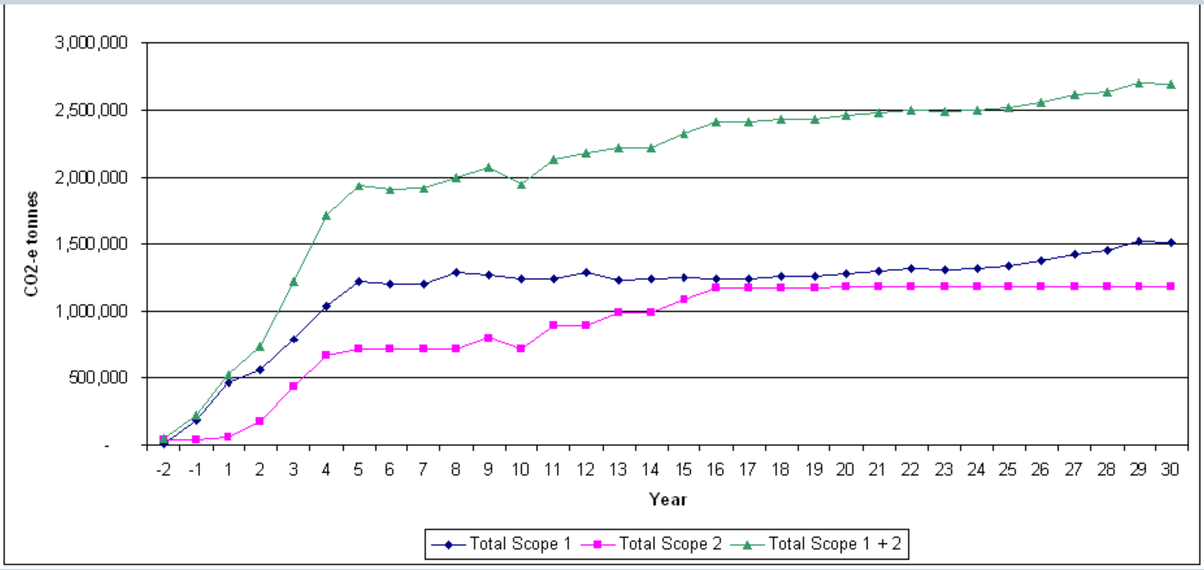
The GHG emissions presented are based on current knowledge about the mine operations, GHG emissions from CSG content, diesel, electricity consumption, and may in fact change over the life of the mine due to technology improvements.

Figure 14-1 shows the estimated GHG emissions for the Scope 1 and Scope 2 emissions throughout the life of the Project.

Analysis of the annual GHG inventory for all Scope 1 and Scope 2 emissions shows the GHG emissions are forecast to sharply increase in Operational Years 1 to 3 in line with commencement of coal production. From Year 4 onwards GHG emissions are forecast to remain relatively steady with small fluctuations, with the largest GHG emissions in Years 29 and 30. These peaks correspond with the years of higher run of mine (ROM) coal production, and the corresponding increase in fugitive emissions.

The Project will be obliged to report under the NGER Act given that emissions for the Project's Scope 1 and Scope 2 emissions will exceed the 25,000 tonne CO_2-e threshold from the first year of construction.

Figure 14-1 Total of Scope 1 and Scope 2 GHG emissions (tonnes CO_2-e)



14.2.3.2 Performance Measures

The performance of the greenhouse gas emissions efficiency can be measured as emissions intensity. Emissions intensity is defined as tonnes CO_2-e per tonne of product coal.

The emissions intensity of the Project based on Scope 1 and Scope 2 emissions ranges from 0.06 to 0.14 tonnes CO_2-e per tonne of product coal, averaging 0.08 tonnes CO_2-e per tonne of product coal. The 18 months of construction prior to the operational phase of the Project are not included in this comparison as no coal is produced and therefore no performance assessment can be made.

14.2.4 Emissions Comparison

14.2.4.1 Australian Emissions

The National Greenhouse Gas Inventory (DCCEE, 2010b) is the latest available national account of Australia's GHG emissions. The National Greenhouse Gas Inventory (DCCEE, 2010b) has been prepared in accordance with the Revised 1996 and 2006 Intergovernmental Panel on Climate Change (IPCC) Objectives for National Greenhouse Gas inventories (IPCC, 2007). The IPCC guidance defines six sectors for reporting greenhouse gas emissions, these include:

1. Energy Sector (including coal mining);
2. Industrial Processes;
3. Agriculture;
4. Waste;
5. Other; and
6. Land Use, Land Use Change and Forestry.

Australia's net greenhouse gas emissions across all sectors total 576 million tonnes (Mt) CO_2-e in 2008, with the mining sector emitting 71.3 Mt CO_2-e.

Table 14-5 shows total annual Scope 1 and Scope 2 emissions at different stages of the life of the mine as a percentage of Australian total and mining sector emissions taken from the National Greenhouse Gas Inventory 2008 (DCCEE, 2008a).

Table 14-5: Comparison of Australia and Project GHG emissions

Year of Operation	Percentage of Australian Mining Sector	Percentage of Australian Total
Minimum GHG emissions (Year 1)	0.72	0.09
Peak GHG Emissions (Year 29)	3.78	0.47
Average GHG Emissions	2.86	0.35

14.2.4.2 Queensland Emissions

Table 14-6 shows total annual Scope 1 and Scope 2 emissions at different stages of the life of the mine as a percentage of Queensland total (160.3 Mt) and Queensland mining sector (15.9 Mt) emissions taken from the National Greenhouse Gas Inventory 2008 (DCCEE, 2008a).

Table 14-6: Comparison of Queensland and Project GHG emissions

Year of Operation	Percentage of Queensland Mining Sector Total	Percentage of Queensland Total
Minimum GHG Emissions (Year 1)	3.25	0.32
Peak GHG Emissions (Year 29)	16.97	1.68
Average GHG Emissions	12.81	1.27

When viewed in an Australian or Queensland context the Scope 1 and Scope 2 emissions from the Project are considered materially relevant given the Project emissions are 16.97% of the Queensland mining sector at the peak emission rate.

The Queensland Government has proposed to reduce GHG emissions by 60% by 2050 based on 2000 levels in line with the national target. This equates to a reduction of approximately 98 Mt CO_2-e.

Average Scope 1 and Scope 2 greenhouse gas emissions from the Project will be 2 Mt CO_2-e or 1.27% of the State inventory.

14.2.5 Abatement

The Proponent has committed to preparing an energy conservation and GHG management plan for the next phase of the Project, to ensure that all sources of emissions are identified and emissions levels are quantified during engineering and design. The objectives of the energy conservation and GHG management plan will be to:

- Reduce GHG emissions associated with the Project and all relevant emissions sources;
- Incorporate energy efficiency initiatives into Project design, engineering, construction and operation;
- Integrate GHG management and energy efficiency initiatives into business decision-making at all stages of the Project; and
- Provide consistent and accurate reports on GHG emission levels in compliance with relevant legislation.

Emissions of CSG are a significant component of the GHG footprint. The exploration drilling program plans to conduct gas testing to better quantify emissions factors and CSG emissions from coal. Strategies for CSG capture and use will be developed based on these results and will be considered for implementation during the detailed design phase of the Project.

Potential GHG offsetting and emission reduction opportunities will be assessed in detail during the detailed design phase of the Project. Such assessment will include the following potential offsetting and emission reduction opportunities:

- Carbon offset projects;
- Renewable energy sources and supply;
- Benchmarking components of the Project against international best-practice standards;
- Cleaner technologies; and
- Energy efficiency initiatives.

Initiatives currently being investigated include:

- Energy efficiency – Process design to accommodate energy efficient motors and control system. Design to incorporate interlocks and automatic sequencing shutdown of equipment not being utilised; and
- Natural resource use efficiency – Process design to incorporate recycling of oils and lubricants for re-use.

Detailed assessment of the most feasible offset and emission reduction technologies is not only necessary to minimise future operational costs but also will drive increased efficiency in Project operations.

14.3 Climate Change Impact Assessment

In 2007 Australia’s Commonwealth Scientific and Industrial Research Organisation (CSIRO) released the technical report ‘Climate Change in Australia’ (CSIRO, 2007), which provides the most up-to-date assessment of observed Australian climate changes and causes, and projections for 2030 to 2070. It is based upon international climate change research including the latest Intergovernmental Panel on

Climate Change (IPCC) (2007) conclusions, and builds on a large body of climate research that has been undertaken for the Australian region in recent years.

The purpose of this report was to provide an up-to-date assessment of observed climate change over Australia, the likely causes, global climate change projections, regional projections for Australia, and guidance on using projections in risk assessments.

In 2008, the Queensland Environmental Protection Agency (EPA) (now Department of Environment and Resource Management (DERM)) released the technical report ‘Climate Change in Queensland; what the science is telling us’ (EPA, 2008). This report elaborates on the findings of the CSIRO report specifically for Queensland.

The following section presents the Climate Change Impact Assessment for the Project using the climate change predictions made in the CSIRO (2007) report and EPA (2008) report, assesses the potential impact on the Project, and provides risk management measures, where appropriate.

14.3.1 Predicted Impacts

14.3.1.1 Model Limitations

It is important to understand the limitations of a model when interpreting the results. Uncertainties in climate change projections arise due to inaccuracies in the models, differences between models employed and the uncertainties in actual future emissions. This has led to the need to test a wide range of scenarios. Projections for the later decades of the 21st century are more uncertain as it is harder to predict global GHG emission rates that far into the future. Projections for 2030 show little variation between different emissions scenarios, as these near-term changes in climate are strongly affected by GHG that have already been emitted. For this reason, the projections for 2030 are usually based on a mid-range emissions scenario, whereas for 2070, low and high emissions scenarios are presented.

It is noted the 30-year life of the Project is due to conclude in 2042, and as such the extremes of climate change presented for 2070 will not affect the Project. The 2070 predictions have been included in order to indicate the trend of the change in climate over the life of the Project.

To provide the most accurate results possible, the 50th percentile has been presented.

Projections are relative to the period 1980-1999 (referred to as the 1990 baseline for convenience).

Results for three areas of Queensland have been extrapolated from the model; this includes Brisbane, Cairns and St George. The results for St George have been adopted as representative of the Project, as it best represents an inland area of Queensland.

14.3.1.2 Predicted Impacts

The following sections summarise the likely effects of climate change in the vicinity of the Project in terms of temperature, rainfall, potential evaporation, wind speed, relative humidity and solar radiation.

Temperature

As can be seen in Table 14-7, temperatures are predicted to trend upwards from the 1990 baseline.

Table 14-7: Temperature impacts of climate change in inland areas of Queensland

Variable	Season	2030 Emissions Scenario	2070 Low Emissions Scenario	2070 High Emissions Scenario
Temperature (ºC)	Annual	1.1	1.8	3.6
	Summer	1.1	1.9	3.6
	Autumn	1.1	1.8	3.5
	Winter	1	1.7	3.3
	Spring	1.2	2	3.9

Given that mine operations are planned to commence in 2013 and close in 2042, it is reasonable to expect an annual temperature increase in the proximity of 1ºC over the life of the mine. Seasons relative to each other will remain fairly consistent; however, winters will be slightly cooler and springs slightly warmer.

Rainfall, Evaporation, Relative Humidity and Solar Radiation

Rainfall is predicted to trend downward, evaporation upward, and the relative humidity overall to trend downward, relative to the 1990 baseline. Solar radiation is predicted to trend upward relative to the 1990 baseline. The relevant trend data are presented in Table 14-8.

Table 14-8: Rainfall, evaporation, relative humidity and solar radiation impacts of climate change in inland areas of Queensland

Variable	Season	2030 Emissions Scenario	2070 Low Emissions Scenario	2070 High Emissions Scenario
Rainfall (%)	Annual	-3	-5	-10
	Summer	-1	-1	-3
	Autumn	-3	-6	-11
	Winter	-6	-9	-17
	Spring	-6	-10	-18
Potential Evaporation (%)	Annual	3	5	9
	Summer	3	5	9
	Autumn	3	6	11
	Winter	4	7	13
	Spring	2	4	7
Relative humidity (%)	Annual	-0.5	-0.8	-1.6
Solar Radiation (%)	Annual	0.2	0.3	0.7

There is a greater uncertainty with rainfall projections than with temperature projections. This is because there is a direct relationship between GHG concentrations and temperature, whereas rainfall depends on what happens to general atmospheric circulation. For projections of rainfall, not all climate models agree on whether it is likely to increase or decrease.

An additional concern is the potential for changes in the frequency of El Niño events, as these have a major influence on Queensland's rainfall. Increased intensity of tropical cyclones is likely, but total numbers of cyclones may decrease. The number of tropical cyclones is related to the global El Niño/La Niña-Southern Oscillation (ENSO) phenomenon, so the impact of climate change on ENSO will also affect the number of tropical cyclones in the Queensland region.

Current projections indicate winter and spring rainfall is likely to decrease in central and southern areas of Queensland, but changes in summer and autumn rainfall are less certain. Extreme daily rainfall is expected to be less affected by the projected drying tendency and may increase, particularly in summer and autumn.

Wind Speed

Wind speed is predicted to trend upwards from the 1990 baseline, as demonstrated in Table 14-9.

Table 14-9: Wind speed impacts of climate change in inland areas of Queensland

Variable	Season	2030 Emissions Scenario	2070 Low Emissions Scenario	2070 High Emissions Scenario
Wind Speed (%)	Annual	2	3	5
	Summer	2	4	8
	Autumn	1	1	3
	Winter	0	0	0
	Spring	4	6	11

Over the life of the Project, annual wind speeds are predicted to increase by 1 to 2%; however, these increases will not be realised consistently over the year. Spring winds are predicted to increase most, with summer winds also to increase. Winter wind speeds are not predicted to measurably change.

Summary

Climate in inland areas of Queensland is predicted to change over the life of the Project (CSIRO, 2007). Annually, temperatures are predicted to increase, and rainfall decrease. Evaporation is predicted to increase, as is wind speed. This would likely result in a drier, windier landscape that has fewer cyclone events (a major influence on Queensland's rainfall), but the cyclone events that do occur are likely to be more intense and possibly destructive.

Given the predicted decline in rainfall and increased evaporation, soil moisture and availability and quality of water are predicted to be affected.

Temperatures are predicted to increase by 1ºC, rainfall is predicted to decrease from 2 to 3%, and wind speeds are predicted to increase on the order of 1% during the 30-year Project life.

14.3.2 Risk Assessment

14.3.2.1 Methodology

The following semi-quantitative risk assessment procedure was used to evaluate the risks as a result of the various potential climate change impacts on mining operations. This approach is consistent with the Australian Standards/New Zealand Standards (AS/NZS) ISO 31000:2009 for Risk Management. The key steps in undertaking the risk assessment involved:

- Identification of the potential climatic impacts on mining operations;
- Analysis of the risks in terms of consequence and likelihood; and
- Evaluation of risks, including risk ranking to identify priorities for their management.

The measures used to assign levels of likelihood are presented in Table 14-10.

Table 14-10: Measures of likelihood

Level	Descriptor	Description
1	Rare	Occurs only in exceptional circumstances
2	Unlikely	Could occur but not expected
3	Possible	Could occur
4	Likely	Will probably occur in most circumstances
5	Almost Certain	Is expected to occur in most circumstances

The measures used to assist in the process of assigning levels of consequence are presented in Table 14-11.

Table 14-11: Measures of consequence

Level	Descriptor	Environmental Impact	Project Functionality	Financial Impact (per event or per year)
1	Insignificant	Consequence measured in weeks	No loss of use	<$50,000
2	Minor	Consequence <12 months	Short term loss of use (all/part) <1 week	$50,000 to $500,000
3	Moderate	Consequence 1-2 years	Loss of use (all/part) 1 week to 1 month	$500,000 to $1 million
4	Major	Consequence 2-5 years	Loss of use (all/part) 1 month to 1 year	$1 million to $10 million
5	Catastrophic	Consequence >5 years	Loss of use (all/part) >1 year	>$10 million

The risk assessment matrix in Table 14-12 was used to determine the level of risk based on likelihood and consequence scores. Scenarios with a combined score of 20 or greater are considered to pose an extreme level of risk. Scenarios with a combined score of between 10 and 16 are considered to pose a high level of risk. Scenarios with a combined score of between 5 and 9 are considered to pose a medium level of risk. Scenarios with a combined score of less than 5 are considered to pose a low level of risk.

Table 14-12: Risk matrix (Commonwealth Government, 2006)

Likelihood	Consequence				
	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
5 (Almost Certain)	5	10	15	20	25
4 (Likely)	4	8	12	16	20
3 (Moderate)	3	6	9	12	15
2 (Unlikely)	2	4	6	8	10
1 (Rare)	1	2	3	4	5

14.3.2.2 Results

The risks scenarios have been identified on the basis of the EIS teams' experience of mining operations, together with consultation with mining specialists. The results of the risk assessment are presented in Table 14-13.

Table 14-13: Risk assessment of the potential impacts of climate change on the Project

Risk Scenario	Likelihood	Consequence	Risk
Increased flood risk due to increased rainfall intensity.	Moderate (3)	Moderate (3)	Medium (9)
Reduced process water availability due to decreased rainfall and increased evaporation.	Moderate (3)	Minor (2)	Medium (6)
Decrease in soil moisture, increased winds and reduced availability of water, which increases generation of dust and reduces ability to manage dust.	Likely (4)	Minor (2)	Medium (8)
Increased maintenance costs for infrastructure due to more severe storm / cyclone events.	Moderate (3)	Minor (2)	Medium (6)
Unsuccessful rehabilitation planting due to reduced rainfall and more sever storm events.	Moderate (3)	Minor (2)	Medium (6)
Failure/overtopping of out-of-pit tailings storage facility	Rare (1)	Major (4)	Low (4)
Increased slope failure due to decreased soil moisture and increased rainfall intensity.	Unlikely (2)	Minor (2)	Low (4)
Health impacts on mine site staff from increased temperatures (e.g. heat stress).	Unlikely (2)	Minor (2)	Low (4)
Increased soil erosion due to decrease in soil moisture and increased rainfall intensity (including access tracks).	Moderate (3)	Insignificant (1)	Low (3)
Increased bushfire events due to increased temperatures and evaporation potential.	Moderate (3)	Insignificant (1)	Low (3)
Decrease in efficiency of equipment due to increased temperature resulting in increased operation costs.	Rare (1)	Moderate (3)	Low (3)
Community/workforce isolation due to higher risks of flooding events.	Rare (1)	Minor (2)	Low (2)

14.3.3 Risk Management Measures

The following risk management measures will be adopted by the Proponent in the development of the Project to address the High and Medium risk scenarios.

High Risk Impacts

- Increased flood risk
  - Apply appropriate risk assessment methods in design of storage dams, levees and diversion channels.
  - Protect the mine workings and infrastructure from floodwater inundation 3,000-year Average Recurrence Interval (ARI) event.

Medium Risk Impacts

- Reduced process water availability:
  - Use the minimum volume of water necessary in the process circuit;
  - Recycle waters in the process circuit or for other uses, such as dust suppression, as much as possible; and
  - Segregate water by quality or source.
- Increased dust generation:
  - Limit the extent of site disturbance; and
  - Undertake rehabilitation, including earthworks, drainage and revegetation, progressively.
- Unsuccessful rehabilitation planting:
  - Monitor rehabilitated areas on a regular basis to ensure that original objectives are achieved. Monitoring will include regular inspections for soil erosion, rehabilitation success, weed infestation, and integrity of water diversion drains, waterways and sediment control structures.
- Increased maintenance costs for infrastructure:
  - Regularly maintain and service all equipment per the technical specifications.