APPENDIX 15

Greenhouse Gas and Energy Assessment

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Greenhouse Gas and Energy Assessment

Mount Owen Continued Operations Project

FINAL

October 2014

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Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Mt Owen Pty Limited

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Executive Summary

The Mount Owen Continued Operations Project (the Project) will seek approval to continue mining of the North Pit to the south of the current approved pit limit to extract identified new coal resources; as well as continued mining at Ravensworth East Mine, in the Bayswater North Pit (BNP) and the proposed Ravensworth East Resource Recovery (RERR) Mining Area.

As the Project is a development for the purposes of coal mining, the Project is State Significant Development (SSD) as defined under Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011. Approval for the Project is being sought under Part 4 of the *Environmental Planning and Assessment (EP&A) Act 1979*. This report has been prepared as part of the environmental assessment process required under the EP&A Act, and it includes greenhouse gas emission projections, an evaluation of the climate change impacts and mitigation options. The scope of the greenhouse gas and energy assessment (GHGEA) includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the Project;
- estimating energy use directly associated with the Project;
- qualifying how the Project's greenhouse gas emissions may impact the environment;
- estimating the impact of the Project's emissions on national and international greenhouse gas emission targets; and
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency.

The GHGEA found that the Project's major operational component can be associated with the following greenhouse gas emission classes.

	Life of Mine Emissions	
	(t CO_2-e)	(%)
Scope 1	5,085,000	3.7
Scope 2	811,000	0.6
Scope 3	131,759,000	95.7
TOTAL	137,655,000	100

The Project is forecast to produce approximately 339,000 t CO_2-e Scope 1 emissions per annum, which is comparable to other Hunter Valley open cut coal mining operations of similar size. The majority of Scope 1 emissions are generated by fugitive emissions and diesel combustion. Mount Owen Pty Limited (Mount Owen) (the proponent) has a direct influence over Scope 1 emissions and these emissions will be subject to management and mitigation plans. Based on the current Commonwealth *Clean Energy Act 2011*, a large proportion of Scope 1 emissions will also be subject to a carbon price. The Project is also likely to be subject to carbon pass through costs associated with the purchase of consumables such as diesel and electricity.

The Project is forecast to consume approximately 225,000 GJ of electricity per annum, which will generate approximately 55,000 t CO_2-e of Scope 2 emissions. Mount Owen can influence reductions in Scope 2 emissions by driving electricity reduction and efficiency initiatives.

Approximately 8,784,000 t CO_2-e of Scope 3 emissions per annum are estimated to be associated with the Project. The majority of Scope 3 emissions associated with the Project will be generated by third parties who transport and consume coal products. Mount Owen has no operational control over Scope 3 emissions, as these emissions are generated by the activities of other organisations.

The Project's greenhouse gas inventory is dominated by Scope 3 emissions. Approximately 96 per cent of the Project's greenhouse gas emissions will occur either upstream or downstream of the Project and outside the direct operational control of Mount Owen. Approximately 4 per cent of the greenhouse gases associated with the Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions) (refer to **Figure 1**).

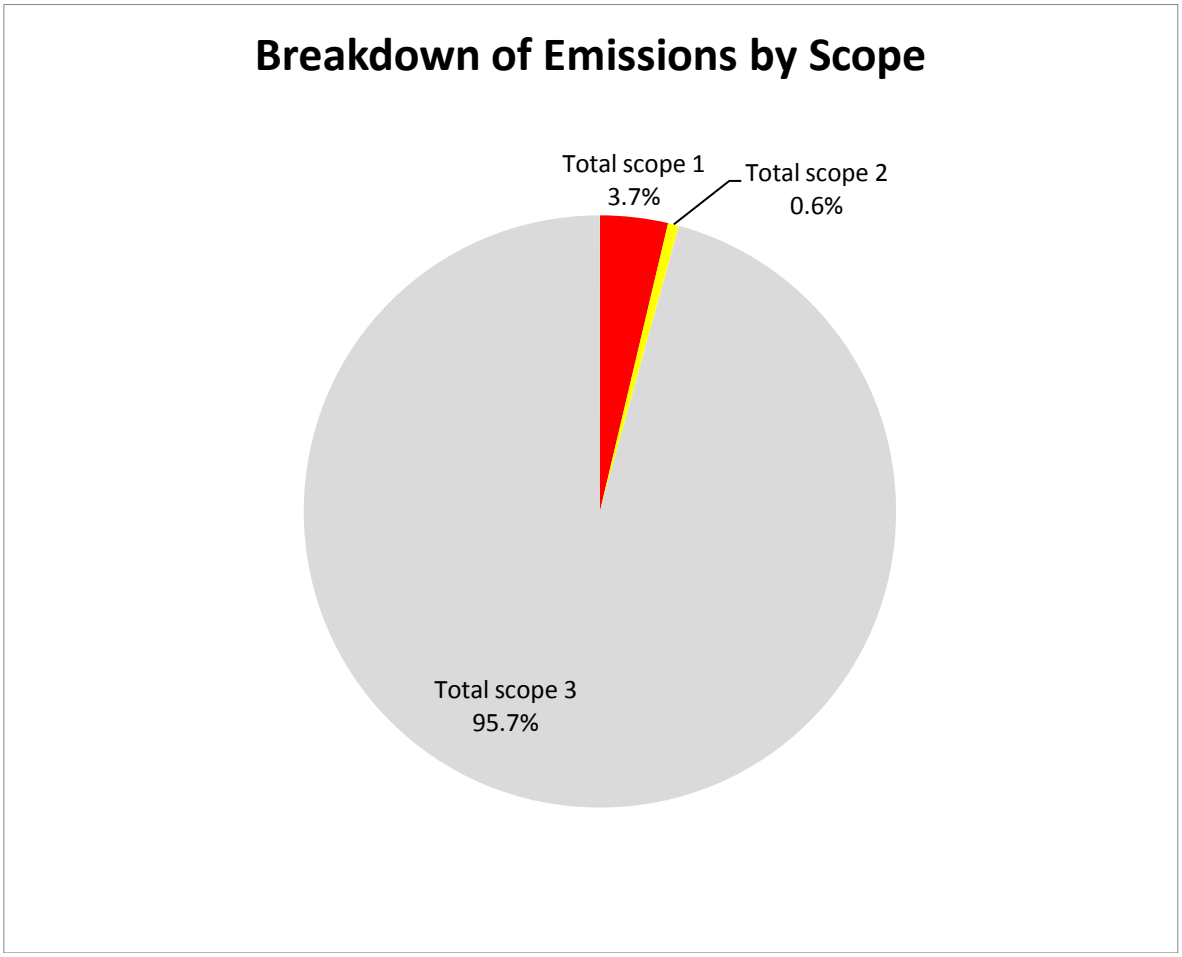

Figure 1 – Breakdown of Emissions by Scope

The GHGEA found that the Project is unlikely to impact national greenhouse gas policy objectives due to the relatively small contribution the Project will make to national emissions on an annual basis.

The Project will mitigate greenhouse gas emissions through ongoing energy efficiency initiatives, utilising alternative fuel sources and optimising productivity.

The Project will contribute to global emissions, however, the extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions which includes all major emission sources and sinks.

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1.0 Introduction

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres north-west of Singleton, 24 kilometres south-east of Muswellbrook and to the north of Camberwell village (refer to **Figure 1.1**).

Mount Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (formerly Xstrata Coal Pty Limited (Xstrata)), currently owns and operates the three existing open cut operations in the Mount Owen Complex; Mount Owen (North Pit), Ravensworth East (West Pit and Glendell (Barrett Pit). Mount Owen anticipate that mining will commence in the northern portion of the Ravensworth East in an area known as the Bayswater North Pit (BNP) in 2015. The mining operations at the Mount Owen Complex include the integrated use of the Mount Owen coal handling and preparation plant (CHPP), coal stockpiles and the rail load out facility.

Mount Owen (North Pit) has an approved production rate of 10 million tonnes per annum (Mtpa) of run of mine (ROM) coal, and blended with Ravensworth East (approved 4 Mtpa) and Glendell (approved 4.5 Mtpa) ROM coal, feed the Mount Owen CHPP and associated infrastructure, which has a total approved processing capacity of 17 Mtpa of ROM coal. Processed coal, both semi soft and thermal, are transported via the Main Northern Rail Line to the Port of Newcastle for export, or by conveyor for domestic use as required.

Mount Owen expects, subject to market conditions, that mining will be completed within the currently approved area of the North Pit and the West Pit by 2018 and late 2014 respectively; and Glendell by 2022. Mount Owen has undertaken extensive exploration of its mining tenements and identified substantial additional mineable coal tonnes to the south of the currently approved North Pit. Further exploration verified economically viable reserves within an area located in the northern portion of the existing approved Ravensworth East Mine, referred to as the BNP. The proposed Ravensworth East Resource Recovery (RERR) Mining Area, is located immediately east of the West Pit and is proposed to be mined sequentially after mining has been completed in the BNP.

Mount Owen is seeking development consent for the Mount Owen Continued Operations Project (the Project) to extract these additional mineable coal tonnes through continued open cut mining methods. The Project proposes to continue the existing mining operations within the North Pit to the south beyond the current approved North Pit mining limit (the North Pit Continuation) in addition to undertaking mining operations within the BNP area, sequentially followed by the proposed RERR Mining Area (refer to **Figure 1.2**).

The Project seeks to maintain the current approved North Pit extraction rate of 10 Mtpa of ROM coal, extracting approximately 74 million tonnes (Mt) of ROM coal from the North Pit Continuation. The extraction of these additional mineable coal tonnes would continue the North Pit life to approximately 2030 (an additional 12 years). Additionally, the Project seeks to maintain the current approved Ravensworth East extraction rate of 4 Mtpa of ROM coal, and to extract approximately 12 Mt of ROM coal from the BNP. Subject to market conditions, mining within the BNP area would be undertaken from approximately 2015 to 2022, with the mining in the proposed RERR Mining Area to follow sequentially from approximately 2022 to 2027 and extract approximately 6 Mt of ROM coal.

The Project will enable the consolidation of the Mount Owen and Ravensworth East Operations to provide for further operational efficiency by providing a single development consent for continued operations. The Project does not include any aspect of the ongoing operations at Glendell Mine and it will continue to operate in accordance with its current development consent.

FIGURE 1.1

Locality Plan

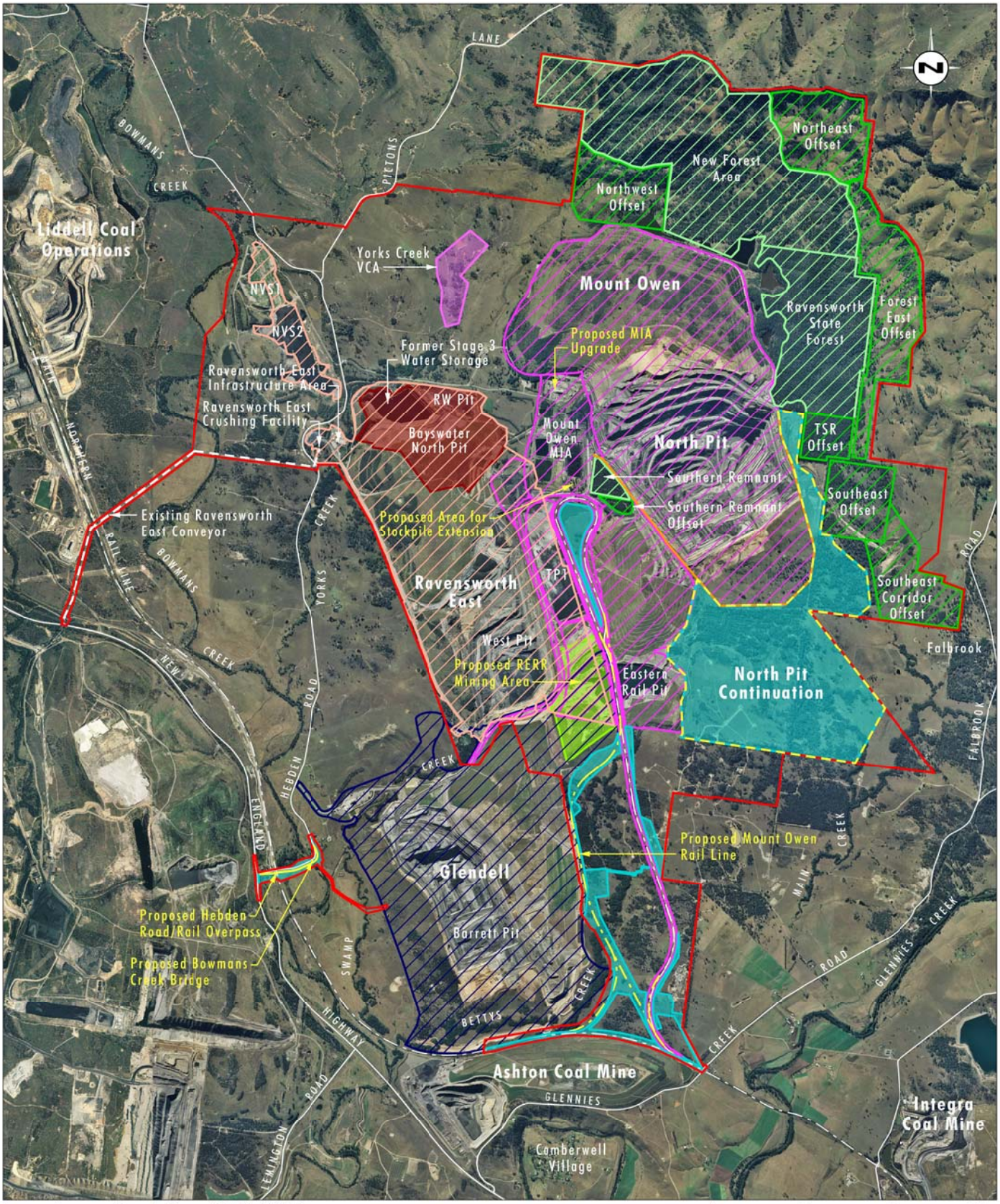

Image Source: Mount Owen (2012-2013)
Data Source: Mount Owen (2014)

0 1 2 3km
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Legend

- Project Area
- Approved North Pit Mining Extent
- Proposed North Pit Continuation
- Proposed Rail Upgrade Works
- Proposed Hebden Road Upgrade Works
- Proposed Disturbance Area
- Proposed RERR Mining Area
- Yorks Creek VCA
- Bayswater North Pit
- Mount Owen Operational Area
- Glendell Operational Area
- Ravensworth East Operational Area
- Existing Biodiversity Offset Area
- Ravensworth State Forest

FIGURE 1.2

Proposed Mount Owen Continued Operations Project

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The Project is State Significant Development as defined by the provisions of the State Environmental Planning Policy (State and Regional Development) 2011 and requires development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Minister for Planning is the consent authority for the Project.

An Environmental Impact Statement (EIS) has been prepared for the Project to accompany a Project Application following Department of Planning and Environment (DP&E) issuing Director-General's Requirements (DGRs) for the Project in March 2013. The following Greenhouse Gas and Energy Assessment (GHGEA) was prepared to meet the Director-General's EIS requirements in relation to greenhouse gas issues for the Project.

The key features of the Project are outlined in **Table 1.1**.

Table 1.1 – Key Proposed Features of the Project

Key Feature	Proposed Operations
Mine Life	• Consent will be sought for 21 years (from date of Project Approval) to provide for mining until approximately 2030 and contingency for other activities such as rehabilitation and capping of tailings emplacement areas.
Limits on Extraction	No change in approved extraction rates. • North Pit – up to 10 Mtpa ROM. • Ravensworth East – up to 4 Mtpa ROM.
Mine Extent	• Continuation of the North Pit footprint to the south of current approved North Pit mining limit. • Mining within the approved BNP, followed sequentially by mining within the proposed RERR Mining Area within the Ravensworth East Mine. • Mining depths to approximately 300 m (North Pit). • Total additional mineable coal tonnes of approximately 92 Mt ROM (comprising 74 Mt ROM (North Pit Continuation), 12 Mt ROM (BNP) and 6 Mt ROM (proposed RERR Mining Area). • Changes to mine water management system.
Operating Hours	• No change proposed - 24 hours per day, 7 days per week.
Workforce Numbers	• No significant change to workforce numbers is required. Current workforce required to operate North Pit and CHPP fluctuates and peaks at about 660 and the Ravensworth East development consent allows for a workforce of up to 260 to operate Ravensworth East operations. • Addition of approximately 330 personnel for construction phase for proposed infrastructure works (approximately 18 months).
Mining Methods	• No change to mining methods proposed.
Mount Owen CHPP and MIA	• No change to existing approved CHPP capacity of 17 Mtpa ROM. • product stockpile extension; • CHPP improvements (including operational efficiencies) to increase processing capacity and tailings management; • MIA extensions and improvements;
Existing Mine Infrastructure	• Continued utilisation of all existing mining infrastructure, including the existing crushing plant for the crushing of overburden.

Table 1.1 – Key Proposed Features of the Project – cont.

Key Feature	Proposed Operations
Infrastructure Construction Activities	• Infrastructure upgrades including: ▪ provision for a northern rail line turn-out and additional Mount Owen rail line; Hebden Road overpass over Main Northern Rail Line; and ▪ New Hebden Road bridge crossing over Bowmans Creek.
Tailings and Coarse Reject Emplacement	• Continued use of the Ravensworth East voids for tailings emplacement and co-disposal of coarse reject and overburden within the North Pit Continuation, the West Pit / BNP and the proposed RERR Mining Area as mining progresses. • Tailings cells may be constructed and filled within the North Pit Continuation area as required to allow time for consolidation and drying of tailings in the West Pit and the proposed RERR Mining Area. • Allowance for the receipt of tailings from other mines.
Coal Transportation	• No change to current export coal transportation with the exception of the use of the proposed additional rail line. • No change to capacity of 17 Mtpa ROM coal. • Use of existing rail line for Glencore train park up. • Transportation of up to 2 Mtpa ROM coal and crushed gravel on an as required basis via the existing overland conveyor to Liddell Coal Operations and the RCT in addition to maintaining the current approval to transport ROM coal to Bayswater and Liddell power stations.

2.0 Assessment Framework

2.1 Objectives

The objective of this assessment is to evaluate the greenhouse gas and energy use implications of the Project, in a manner that satisfies the DGRs for the Project. **Table 2.1** includes the DGRs, and the location where each requirement has been addressed in the GHGEA.

Table 2.1 - Checklist of the Director-General's Requirements

Objective	Director-General's requirements	Location in Assessment Report
1	a quantitative assessment of potential scope 1, 2 and 3 emissions	**Section 3.0**
2	a qualitative assessment of the potential impacts of these emissions on the environment	**Section 4.0**
3	an assessment of reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency	**Section 5.0**

2.2 Scope

The scope of the GHGEA includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the Project;
- estimating energy use directly associated with the Project;
- qualifying how the Project's greenhouse gas emissions may impact the environment;
- estimating the impact of the Project's emissions on national and international greenhouse gas emission targets; and
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency.

2.3 Definitions

Table 2.2 contains concepts and a glossary of terms relevant to this GHGEA.

Table 2.2 - Glossary of Terms[1]

Concept	Definition
Greenhouse gases	The greenhouse gases covered by the Kyoto Protocol and referred to in this GHGEA include: • Carbon dioxide; • Methane; • Nitrous oxide; • Hydrofluorocarbons; • Perfluorocarbons; and • Sulphur hexafluoride.
Scope 1 emissions	Direct emissions occur from sources that are owned or controlled by the Project (in this case, the proponent, Mount Owen) (e.g. fuel use, fugitive emissions). Scope 1 emissions are emissions over which the Project has a high level of control.
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the Project.
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the Project, but occur at sources owned or controlled by other entities (e.g. outsourced services). Scope 3 emissions can include emissions generated upstream of the Project by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the Project by transport providers and product use.

2.4 Impact Assessment Methodology

The GHGEA framework is based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013. The assessment framework also incorporates the principles of The Greenhouse Gas Protocol 2004.

The Greenhouse Gas Protocol (The GHG Protocol) provides an internationally accepted approach to greenhouse gas accounting. The Protocol provides guidance on setting reporting boundaries, defining emission sources and dealing with issues such as data quality and materiality.

Scope 1 and 2 emissions were calculated based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013 (DCCEE 2013). Fugitive emissions have been calculated using both the Method 1 and Method 2 approaches, as described in the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Clean Energy Regulator 2012). The Method 2 approach was used where gas quantity and composition data was available, however, the majority of fugitive emissions were calculated using the Method 1 approach.

Scope 3 emissions associated with product transport were calculated based on emission factors contained in the National Greenhouse Gas Inventory: Analysis of Recent Trends and Greenhouse Gas Indicators (AGO 2007). Other Scope 3 emissions were calculated using methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013 (DCCEE 2013).

Emission factors for the consumption of construction materials were sourced from the Inventory of Carbon and Energy, Version 2.0 (Hammond, G and Jones, C. 2011).

[1] The GHG Protocol 2004

All methodologies and calculations have been made assuming that all operations will continue as described in **Section 1.1**.

2.5 Data Sources

The calculations in this report are based on activity data projections developed by Mount Owen during the mine planning process.

Table 2.3 contains the source of activity data.

Table 2.3 - Source of Activity Data Used for the Assessment

Activity data	Source
Fugitive emissions	Mount Owen - forecast fugitive emissions
On-site fuel consumption	Mount Owen - forecast diesel consumption
Electricity consumption	Mount Owen - forecast electricity consumption
Construction materials	Mount Owen - forecast construction materials
Product consumption	Mount Owen - forecast mine production
Product transport	Mount Owen - haulage distances
Closure and Rehabilitation data	Umwelt estimates

A detailed schedule of closure and rehabilitation activities will not be available until the latter stages of the Project. In its absence, the scope and scale of closure activities have been estimated based on preliminary closure costs prepared for the North Pit and forecast rehabilitation areas for Bayswater North Pit and Ravensworth East Pit.

A detailed description of activity data and calculations are provided in **Appendices A**, **B** and **C**.

2.6 Assessment Boundary

The GHGEA boundary was developed to include all significant scope 1, 2 and 3 emissions. **Figure 2.1** demonstrates how the assessment boundary interacts with the potential emission sources under Mount Owen's operational control and other emission sources associated with the Project.

2.7 Data Exclusions

The GHG Protocol requires inventory data and methodologies to be relevant, consistent, complete, transparent and accurate. The relevance principle states that the greenhouse gas inventory should appropriately reflect greenhouse gas emissions and serve the decision-making needs of users – both internal and external [to the Project] (GHG Protocol 2004).

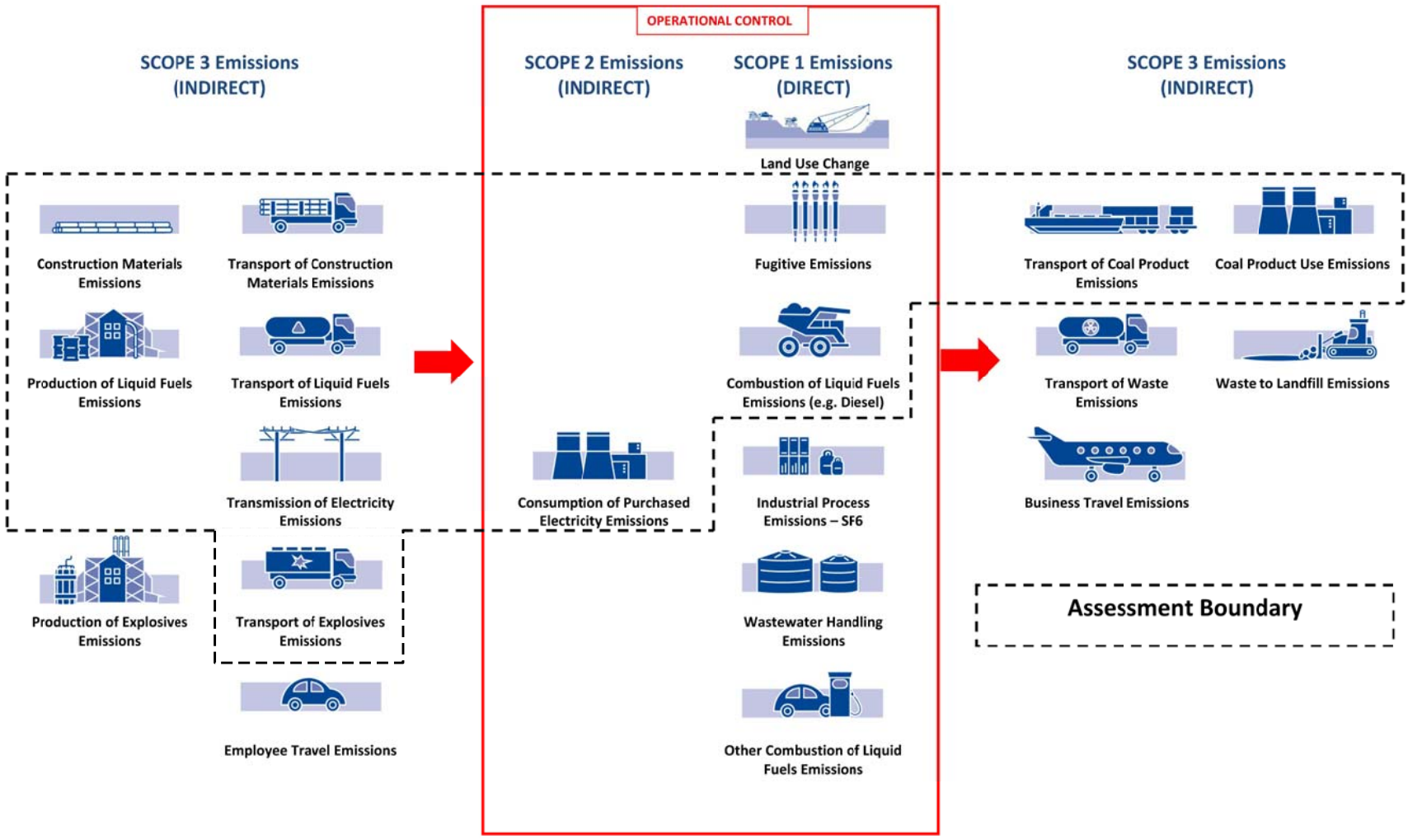

FIGURE 2.1

Greenhouse Gas Assessment Boundary

An open cut coal mine has a number of potential emission sources, however, the dominant emission sources, often targeted by mitigation measures and stakeholders can be summarised as:

- diesel use;
- fugitive emissions;
- electricity use;
- product transport;
- product use; and
- materials use.

The completeness principle states that all relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled (GHG Protocol 2004).

The emission sources listed in **Table 2.4** have been excluded from the GHGEA as activity data is not readily available, and modelling activity data is unlikely to generate sufficient emissions to materially change impacts or influence the decision making outcomes of stakeholders.

Table 2.4 – Data Exclusions

Emissions source	Scope	Description
Combustion of fuel for energy	Scope 1	• Small quantities of fuels such as petrol and LPG.
Industrial processes	Scope 1	• Sulphur hexafluoride (high voltage switch gear). • Hydrofluorcarbon (commercial and industrial refrigeration).
Waste water handling (industrial)	Scope 1	• Methane emissions from waste water management.
Solid waste	Scope 3	• Solid waste to landfill.
Business travel	Scope 3	• Employees travelling for business purposes.
Employee travel	Scope 3	• Employees travelling between their place of residence and the Mount Owen site.

Greenhouse gas emissions resulting from land use, land use change and forestry (LULUCF) were also excluded from the greenhouse gas assessment. While it is acknowledged that emissions resulting from LULUCF may be an important emission source for decision makers, the assessment made an assumption that all emissions generated during the land clearing process would be sequestered via rehabilitation plantings.

3.0 Impact Assessment Results

Greenhouse gas and energy use estimates have been calculated for the construction, operation and closure stages of the Project.

3.1 Construction Stage

A number of construction activities are planned to occur over the duration of the Project. The GHGEA only considers the major construction activities and does not include construction associated with operational activities.

Greenhouse gas estimates have been prepared for the construction of the following Project components that were described in **Section 1.1**:

- a northern rail line turn-out and rail link to the Mount Owen rail spur;
- MIA extensions and improvements;
- Hebden Road/Main Northern Rail Line overpass;
- Hebden Road/Bowmans Creek bridge crossing; and
- Product coal stockpile pad extension.

3.1.1 Greenhouse Gas Emissions

The Project's construction related greenhouse gas emissions are summarised in **Table 3.1**. The construction of the Project is forecast to be associated with approximately 11,300 t CO_2-e of Scope 3 emissions. Scope 3 emissions will be generated by third parties combusting energy and generating industrial emissions in the process of producing and transporting construction materials. Scope 3 emissions will also be generated by contractors consuming energy during these construction projects.

The breakdown of construction related emissions in **Table 3.1** demonstrates that approximately 63 per cent of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes 33 per cent of construction emissions, while 4 per cent of construction emissions are attributable to the transport of construction materials (see **Table 3.1**).

3.1.2 Energy Use

The construction activities are forecast to require approximately 50,000 Gigajoules (GJ) of energy. Diesel is forecast to be the primary energy source.

3.2 Operational Stage

The following information was used to estimate the greenhouse gas emissions from the operation phase of the Project:

- 93 per cent of product coal is thermal quality and will be combusted by electricity generators;
- 7 per cent of product coal is coking quality and will be consumed in coking plants;
- all product coal is transported approximately 92 kilometres to the port of Newcastle via train;
- all product coal is shipped an average of 9,500 kilometres to international markets;
- up to 2 million tonne per annum of ROM coal and gravel may be transported to Liddell and Bayswater Power Stations via conveyor; and
- The CHPP will process 17 Mtpa of ROM coal.

3.2.1 Life of Mine Greenhouse Gas Emissions

The Project's life of mine (LOM) greenhouse gas emissions are summarised in **Table 3.1**. LOM forecasts are based on the Project recovering approximately 92,000,000 ROM tonnes over 15 years.

The operational stage is forecast to be associated with approximately 137,653,000 t CO_2-e of greenhouse gas emissions over the 15 years of operation.

The operational stage is forecast to generate approximately 5,085,000 t CO_2-e of Scope 1 emissions from combusting diesel and releasing fugitive emissions. Annual average Scope 1 emissions are forecast at approximately 339,000 t CO_2-e per annum. Annual average Scope 1 emission estimates for the Project should not be used to benchmark annual performance, as annual emissions will vary significantly due to normal variations in annual activity.

The operational stage is forecast to be associated with approximately 811,000 t CO_2-e of Scope 2 emissions from consuming electricity. Annual average Scope 2 emissions are forecast at approximately 55,000 t CO_2-e per annum.

The operational stage is forecast to be associated with approximately 131,769,000 t CO_2-e of Scope 3 emissions. Scope 3 emissions will be generated by third parties who transport and consume coal products. Annual average Scope 3 emissions are forecast at approximately 8,784,000 t CO_2-e per annum.

Figure 3.1 demonstrates that the Project's greenhouse gas inventory is dominated by Scope 3 emissions. Approximately 96 per cent of the Project's greenhouse gas emissions occur downstream of the Project. Approximately 4 per cent of the greenhouse gases associated with the Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions).

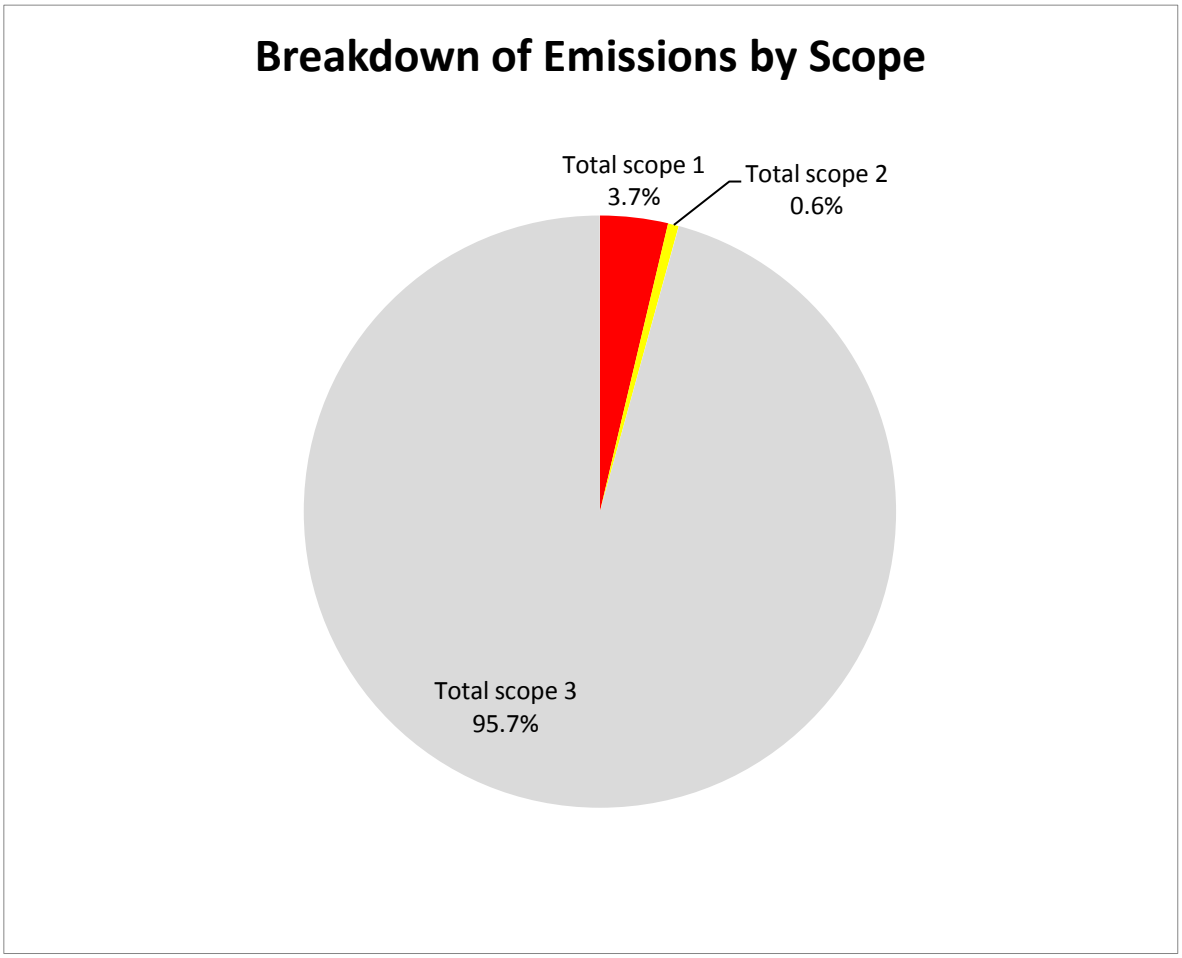

Figure 3.1 – Breakdown of Emissions by Scope

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the Project. All Scope 2 and 3 emissions identified in the GHGEA are attributable to, and may be reported by, other sectors.

3.2.2 Energy Use

The Project is forecast to require approximately 27,568,000 GJ of energy from diesel and grid electricity over 15 years of operation. Annual average energy consumption is forecast at 1,838,000 GJ per annum.

The industry average energy use for open cut coal mines in Australia ranges between 430 and 660 Megajoules (MJ)/Product tonne (AGSO 2000). The Project is forecast to operate with an average energy use intensity of approximately 531 MJ/Product Tonne. The forecast energy use intensity of the Project is within the normal operating range for Australian open cut coal mines.

3.3 Closure and Rehabilitation Stage

The following assumptions were made to estimate the greenhouse gas emissions from the closure phase of the Project:

- all areas not progressively rehabilitated will be rehabilitated on mine closure; and
- 30 per cent of all closure costs are attributable to diesel consumption.

3.3.1 Greenhouse Gas Emissions

The Project's total closure and rehabilitation emissions are summarised in **Table 3.1**.

The Project is forecast to generate approximately 5,600 t CO_2-e of Scope 1 emissions from combusting diesel during the closure phase. The closure phase is also expected to be associated with approximately 450 t CO_2-e Scope 3 emissions. Scope 3 emissions will be generated by third parties undertaking activities such as extracting, production and transporting diesel.

3.3.2 Energy Use

The Project is forecast to consume approximately 80,100 GJ during the closure phase. Electricity usage during closure will be negligible; accordingly it has been assumed that all energy will be sourced from diesel.

Table 3.1 – GHG Emission Summary for the Project
(See Appendix A, B and C for further detail)

Stage	Scope	Source	Source Totals ($t CO_2$-e)	Scope Totals ($t CO_2$-e)
Construction	Scope 3 (Indirect)	Materials	7,071	11,216
		Energy Use	3,725	
		Transport of Materials	420	
			Total GHG Emissions for Construction	**11,216**
Life of Mine	Scope 1 (Direct)	Diesel use[2]	1,682,263	5,084,389
		Fugitive emissions	3,402,126	
	Scope 2 (Indirect)	Electricity	810,223	810,223
	Scope 3 (Indirect)	Product use	125,188,563	131,758,131
		Associated with energy extraction and distribution	303,107	
		Product transport	6,242,423	
		Materials transport	24,038	
			Total GHG Emissions for LOM Operations	**137,652,743**
Closure and Rehabilitation	Scope 1 (Direct)	Diesel use	5,567	5,567
	Scope 2 (Indirect)	Electricity	0	0
	Scope 3 (Indirect)	Associated with energy extraction and distribution	425	425
			Total GHG Emissions for Closure and Rehabilitation	**5,992**

[2] Includes diesel used in explosives

4.0 Impact Assessment Summary

The greenhouse gas emissions generated by the Project have the potential to impact the environment and the greenhouse gas reduction objectives of national and international governing bodies. The following section makes the distinction between environmental impacts and impacts on policy objectives.

4.1 Environmental Impact

The Project's greenhouse gas emissions will have a disperse impact as they are highly mobile and are generated up and down the supply chain. The accumulation of greenhouse gases or carbon in "carbon sinks" is the primary impact of greenhouse gas emissions. Since the industrial revolution, anthropogenic greenhouse gas emissions have accumulated in three major carbon sinks - the ocean (30%), terrestrial plants (30%) and the atmosphere (40%) (BOM and CSIRO, 2014).

The accumulation of greenhouse gases in the atmosphere is an important driver of global warming; sea level rise and climate change (IPCC 2013). Sea level rise and climate change may have many ramifications for the natural and built environment.

The accumulation of greenhouse gases in the ocean is an important driver of ocean acidification (IPCC 2013).

The Project's direct emissions are forecast to be approximately 339,000 t CO_2–e per annum.

To put the Project's emissions into perspective, global greenhouse gas emissions are forecast to be 46,000,000,000 t CO_2-e by 2020 (Sheehan *et al*. 2008). During operation, the Project will contribute approximately 0.00074 per cent to global emissions per annum (based on its projected Scope 1 emissions). The Scope 2 and 3 emissions associated with the Project should not be considered in a global context, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources).

4.1.1 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation (IPCC 2007).

Climate change models forecast many different climate change impacts, which are influenced by future greenhouse gas emission scenarios. Climate change forecasts also vary significantly from region to region. Any increase in atmospheric greenhouse gas emissions can therefore generate many different climate change impacts, depending on future greenhouse gas scenarios and regional location.

The extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions that includes all major emission sources and sinks.

4.2 Impact on National Policy Objectives

The Australian Government has committed to reduce Australia's greenhouse gas emissions by 5 per cent from 2000 levels by 2020 irrespective of what other countries do, and by up to 15 or 25 per cent depending on the scale of global action.

If Australia is able to meet the 5 per cent reduction target by 2020, the nation will be generating approximately 525,000,000 t CO_2-e per annum (National Greenhouse Gas Inventory 2011). In year 2020 it is anticipated that the Project will generate approximately 375,000 t CO_2-e of Scope 1 emissions, if emissions are not mitigated. The Project's forecast emissions will represent approximately 0.071 per cent of Australia's annual national emissions by 2020. The Project's Scope 2 and 3 emissions are not considered against national objectives, as targets only relate to Scope 1 emissions.

The Project is unlikely to prevent the Federal Government achieving its national greenhouse gas objectives.

4.3 Impact on International Objectives

At present there is no comprehensive global agreement on greenhouse gas reduction targets that includes comprehensive commitments from all major emitters such as China, India and the United States of America.

The Seventeenth Conference of the Parties (COP17) climate change negotiations in Durban, however, provides some direction for international greenhouse gas objectives. Countries agreed in Durban to begin work on a new climate change agreement that will cover all countries. The intention is to develop an agreement, including emission reduction commitments, by 2015 to come into effect from 2020. Countries also agreed that there would be a second commitment period of the Kyoto Protocol from 1 January 2013 (DCCEE 2012a).

The United Nations Framework Convention on Climate Change (UNFCCC) conference held in Cancún 2010 achieved important progress towards a comprehensive post-2012 international agreement to address climate change (DIICCSRTE 2013). Under the Cancun Agreements, Australia has committed to reducing its 2020 national greenhouse gas inventory by 5 per cent (based on the 2000 inventory) (DCCEE 2012b).

Australia's international objectives align with its national objectives. As discussed in **Section 4.2**, the Project is unlikely to prevent the Federal Government achieving its national/international 5 per cent greenhouse gas reduction target.

5.0 Evaluation of Greenhouse Gas Mitigation Measures

The GHGEA is required to assess reasonable and feasible measures to minimise the Project's greenhouse gas emissions.

The term reasonable incorporates notions of costs and benefits, whereas the term feasible focuses on the more fundamental practicalities of the mitigation measures, such as engineering considerations and what is practical to build or operate (Hunter Environment Lobby Inc v Minister for Planning 2011).

5.1 Current Management Measures

All mining operations located within the Mount Owen Complex are owned by subsidiary companies of Glencore Coal Pty Limited (Glencore Coal). Mount Owen is committed to the Glencore Coal Code of Conduct, which specifically requires on-going consideration of greenhouse gas emissions and energy use. To assist Glencore Coal in meeting its Code of Conduct, Mount Owen must prepare Annual Sustainability Plans and adhere to Sustainable Development Standards and Protocols.

5.1.1 Climate Change Policy

The Glencore Code of Conduct on the issue of Environment states (Glencore Coal 2013):

> Our operations are geographically widespread and extremely diverse in nature, including prospecting, production, reclamation, processing, storage, transportation and marketing of natural resources. This means that our potential environmental impacts are complex and specific to different commodity groups or production sites.
>
> We are aware of the increasing regulatory pressure and societal demand for a low emission economy to address the global climate change situation. We are working to integrate this into our existing resource efficiency programmes at our operations. We comply with applicable laws, regulations and other requirements for environmental management. Where these are less stringent than our own standards we seek to exceed the statutory requirements wherever possible.
>
> We also participate in supply chains that are not under our direct control. Here we work in partnership with our customers, suppliers and service providers to limit the overall environmental impact along the entire supply chain, and promote environmental awareness.
>
> Our managers are required to:
> 1. Identify, assess and monitor environmental impacts
> 2. Comply with applicable regulatory requirements and monitor relevant regulations for changes
> 3. Implement appropriate environmental management programmes and controls, including appropriate measures for emergency preparedness
> 4. Ensure competent staff and sufficient resources for environmental management
> 5. Involve contractors and service providers where appropriate
> 6. Implement programmes and targets for continuous improvement of our:
>   - Efficient use of resources (eg energy, water and land)
>   - Protection of biodiversity
>   - Climate change impact

- Pollution prevention (by addressing management of fresh water and effluent, waste, air emissions, hazardous materials and rehabilitation of land)

7. Track actual environmental performance

Mount Owen's specific greenhouse gas mitigation measures are discussed in the following sections.

5.1.2 Energy Efficiency

Mount Owen will mitigate Scope 1 and 2 emissions through energy efficiency initiatives. The energy efficiency of mining operations is driven by energy use and productivity. Energy efficiency is maximised when highly efficient equipment is operated at optimal capacity. Mount Owen's mine planning process optimises operational productivity through scheduling; haul ramp design and equipment selection.

5.1.3 Scope 3 Emissions

Mount Owen lacks direct operational control over Scope 3 emissions, however, Glencore Coal manages a significant product stewardship and market development program which aims to mitigate the downstream impacts of its products.

The Glencore Coal Climate Change approach supports a broad range of low-emissions technologies projects, which include:

- supporting low-emission coal technology projects via the Australian coal industry's $1 billion COAL21 Fund. Projects supported by this fund include:
  - Callide Oxyfuel project – demonstrating carbon capture technology;
  - Otway Basin CCS project – demonstrating injection and storage of carbon dioxide;
  - Delta-Munmorah PCC project – demonstrating carbon capture technology;
- member of the Callide Oxyfuel project in Queensland;
- member of the FutureGen CCS project in the USA;
- investigating options for carbon capture and storage in Wandoan are in Queensland; and
- supporting a range of climate change and energy-related projects. These include:
  - **Direct Injection Coal Engine project** – collaborating with Glencore Technology, CSIRO and Man Truck and Bus AG (MAN) on developing a coal water fuel that can be directly injected into diesel engines to produce power. This project is in the early stages but has the potential to enhance energy security at remote and regional locations, and is potentially capable of utilising coal tailings from mining operations, effectively using a waste product for energy.
  - **Biochar Research project** – using coal tailings to create a biochar for soils to enhance rehabilitation performance and carbon storage, resulting in increased agricultural productivity.
  - **Chemical Looping project** – collaborating with University of Newcastle on chemical looping for combustion and gasification of coal used in power stations.
  - **Oxyfuel Technology project** – collaborating with the University of Newcastle to develop further knowledge of coal impurity and gas quality control for oxyfuel combustion technology.

- **Membrane Research project** – collaborating with the University of Queensland to develop ceramic capillaries from current hollow fibres for air separation, to produce oxygen for use in oxyfuel power generation.
- **Nanotechnology project** – collaborating with the University of Sydney to develop nano-structured absorbent material to use in post-combustion capture of CO_2.
- **International Energy Centre (IEC)** – being the Foundation Corporate Member of the IEC, an innovative network of leading Australian universities and industry collaborators. The IEC has developed a Masters of Energy Studies and a number of professional development short courses.

5.2 Assessment of Potential Management Measures

Mount Owen has incorporated a range of measures into the Project design, with the aim of minimising potential greenhouse gas emissions and improving energy efficiency. Energy efficiency was a key driver for the design of the mine plan as energy usage is a direct driver of cost as well as greenhouse gas emissions. The Project design inherently minimises greenhouse gas emissions from the mining operations. Key measures included in the Project design to minimise emissions include:

- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated fuel consumption;
- selecting equipment and vehicles that have high energy efficiency; and
- scheduling activities so that equipment and vehicle operation is optimised.

The following sections assess the Project's planned greenhouse gas mitigation measures against best practice greenhouse gas management.

5.2.1 Pre-draining Coal Mine Waste Gas

Fugitive emissions arise during the coal production/extraction process whereby methane and carbon dioxide gas trapped within the coal (coal mine waste gas) is released to the atmosphere. The volume and concentration of coal mine waste gas varies significantly from mine to mine.

In underground coal mines, mine waste gas is often drained from active coal seams and goaf environments (the fractured rock zone left once the coal has been extracted), to improve safety. Mine waste gas can be destroyed by flaring to reduce its greenhouse gas potential or combusted as a fuel source. Pre-drainage of open cut operations is not a common practice as seams targeted for open cut extraction typically have a lower gas content than deeper seams targeted for underground extraction.

Fugitive emissions are forecast to generate approximately 58 per cent of the Project's scope 1 and 2 emissions. **Table 5.1** includes the greenhouse gas mitigation measures assessed for fugitive emissions.

Table 5.1 - Fugitive Emission Mitigation Options Assessed

Fugitive emissions		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
1. Pre-draining and capturing coal mine waste gas for combustion	No	Mount Owen has calculated the total *in situ* stock of waste gas held within the Project's gas bearing strata. The stock of waste gas is expected to generate an equivalent emissions factor of approximately 0.034 t CO_2-e/ROM tonne, which is lower than the NSW default emissions factor of 0.045 t CO_2-e/ROM tonne. Glencore has developed three critical criteria for selecting suitable sites for pre-draining waste mine gas for combustion. Glencore has found that pre-draining waste gas is only economically viable when waste gas is extracted from an environment which meets the following criteria: 1. gas production is greater than 3-4 m^3 of waste gas per tonne; 2. methane percentage is greater than 70%; and 3. seam permeability is greater than 50 mD. The production and permeability parameters are important to ensure drainage wells can produce enough pressure to feed flares without using suction pumps or technologies to improve permeability. The methane percentage is an important parameter to ensure the waste gas will continue to burn under the range of normal weather conditions experienced in the Hunter Valley. The gas sampling program completed to calculate the total *in situ* stock of waste gas found that the majority of seams in the Project Area will produce less than 3-4 m^3/tonne. The permeability of seams in the Project area is also not suitable for free flowing gas wells. The permeability of the seams is likely to range from 1.4 – 77 mD, with only one seam expected to exceed the desired 50 mD. While it is technically possible to pre-drain and combust mine waste gas from the Project Area, the capital and operational costs required to extract gas from the low gas environment makes the mitigation measure economically not feasible.

5.2.2 Improving the Diesel Use Efficiency of Haul Trucks and Equipment

Diesel consumption in haul trucks and equipment is forecast to generate approximately 28 per cent of the Project's combined scope 1 and 2 emissions. **Table 5.2** includes the greenhouse gas mitigation measures assessed for improving diesel use efficiency.

Table 5.2 - Diesel Use Efficiency Options Assessed

Energy use during extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
2. Limiting the length of material haulage routes	Yes	Length of haulage routes has been optimised to minimise dust, noise and fuel use.
3. Optimising ramp gradients	Yes	Ramp gradients have been optimised according to pit geometry parameters.
4. Fuel efficient haul trucks	Yes	Fuel use efficiency will be an important selection criteria when allocating trucks to operations. The fleet of trucks will all include modern engine management systems, which optimise fuel use efficiency. New fuel use technology will be adopted as new trucks are purchased over the life of the Project.
5. Payload Management	Yes	Payload will be constantly monitored and actively managed to maintain efficiency.
6. Increasing haul truck payload	Yes	DT HiLoad trays will be fitted on some truck models. HiLoad trays are a hard wearing, light weight tray, which are custom built to maximise payloads.
7. Improving rolling resistance of haul roads	Yes	Haul roads are planned to be constructed on solid rock rather than on soil or subsoil material where practical.
8. Reducing idling times	Yes	Reducing idle times is an on-going performance measure. Initiatives to reduce idle times will continue to be introduced over the life of the Project.
9. Scheduling activities so that equipment and vehicle operation is optimised	Yes	Scheduling activities to optimise plant and vehicle operation is a routine activity. Mount Owen will continue to prepare long, medium and short term plans to optimise production.
10. Alternative fuels	Yes	Mount Owen is currently using a biodiesel product and will continue to do so.
11. Replacing trucks with conveyors	No	The use of conveyors is not feasible or cost effective given the short haul distances.
12. Fuel efficient equipment	Yes	Fuel use efficiency will be an important selection criteria when allocating equipment to operations. Equipment will include modern engine management systems, which optimise fuel use efficiency. Proven new fuel use technology will be adopted as new equipment is purchased over the life of the Project.
13. Blasting strategies to improve extraction efficiency	Yes	Through seam blasting will be employed to minimise the need for ripping and parting.
14. Maximising resource recovery efficiency	Yes	Long, medium and short term operational plans will be developed to optimise the recovery of approved resources.
15. Working machines to their upper design performance	Yes	Glencore's business objectives support and promote effective equipment utilisation and performance rates.

Table 5.2 - Diesel Use Efficiency Options Assessed (cont.)

Energy use during extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
16. Electric drills	No	Electric drills are not used at Mount Owen due to the lack of availability of in-pit supply of electricity and small work areas requiring regular walking of the drills or relocations.
17. Preventing unnecessary water ingress	Yes	The surface water management system is designed to maximise separation of clean and dirty water systems. Clean water is diverted away from mining areas.
18. In-pit servicing	Yes	A current operational practice that will continue.
19. Replace lighting plants with LED	Likely	Glencore have conducted review of LED lighting plants and are currently considering the implementation of LED technology.
20. Use of chemical dust suppressants to reduce energy consumption by water carts	Yes	Dust suppressants will be used on light vehicle roads at Mount Owen and on haul roads at Ravensworth East.

5.2.3 Improving Electricity Efficiency

Electricity consumption is forecast to generate approximately 14 per cent of the Project's combined scope 1 and 2 emissions. **Table 5.3** includes the greenhouse gas mitigation measures assessed for the Coal Handling and Preparation Plant (CHPP).

Table 5.3 - CHPP Energy Use Options Assessed

Energy use during processing		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
21. Reducing reject percentage	Yes	CHPP density set points are monitored each shift and product coal scan ash analysers are used to extract highest yield and thus lowest amount of reject.
22. Automatically shutting down CHPP when not in use	N/A	CHPP runs 24 hours, 7 days per week other than for maintenance, Christmas and Boxing Days.
23. High efficiency motors	Yes	These are installed and will be maintained for the life of the Project.
24. Variable Speed Drives	Yes	These are installed and will be maintained for the life of the Project.
25. Optimising motor size to load	Yes	This has been implemented at the CHPP.

The Project is planning to utilise many of the common greenhouse gas mitigation measures available for an open cut operation. High impact mitigation measures such as utilising pre-drained coal seam methane will not be implemented as the North Pit, BNP and proposed RERR Mining Area do not generally exhibit high gas levels and accordingly it is considered financially unreasonable for the likely benefit gained.

6.0 Conclusion

The Project is a large scale operation that will produce significant energy commodities over 15 years. The Project's forecast energy use intensity is considered to fall within the normal range when compared with operations across Australia, however, given the nature and the scale of the Project, the Project is expected to generate approximately 5,895,000 t CO_2-e of Scope 1 and 2 emissions.

The Project is also forecast to be associated with approximately 131,759,000 t CO_2-e of Scope 3 emissions. The Project's Scope 3 emissions are beyond the operational control of Mount Owen, and the majority of Scope 3 emissions will be generated downstream of the Project, when coal products are combusted by electricity generators and/or coking plants.

The GHGEA found that the Project is unlikely to impact national greenhouse gas policy objectives due to the relatively small annual contribution the Project will make to national emissions.

A key aspect of the Project's objectives is to help meet an international demand for energy commodities. The International Energy Agency (IEA) World Energy Outlook 2012 found that coal met 45 per cent of the growth in global energy demand over the past decade. The IEA forecasts that global coal demand will grow by 1.9 per cent per year out to 2035 and will pass oil as the leading primary fuel by 2025. Given the predicted energy demand for coal, international coal consumers will continue to source coal, irrespective of Australian production.

Glencore's Coal business is contributing to global solutions for climate change by addressing greenhouse gas emissions at its operations, and up and down its supply chains. Glencore has a stated commitment to addressing energy efficiency and greenhouse gas emissions and supporting the development of new technologies to reduce emissions from the consumption of coal by its customers.

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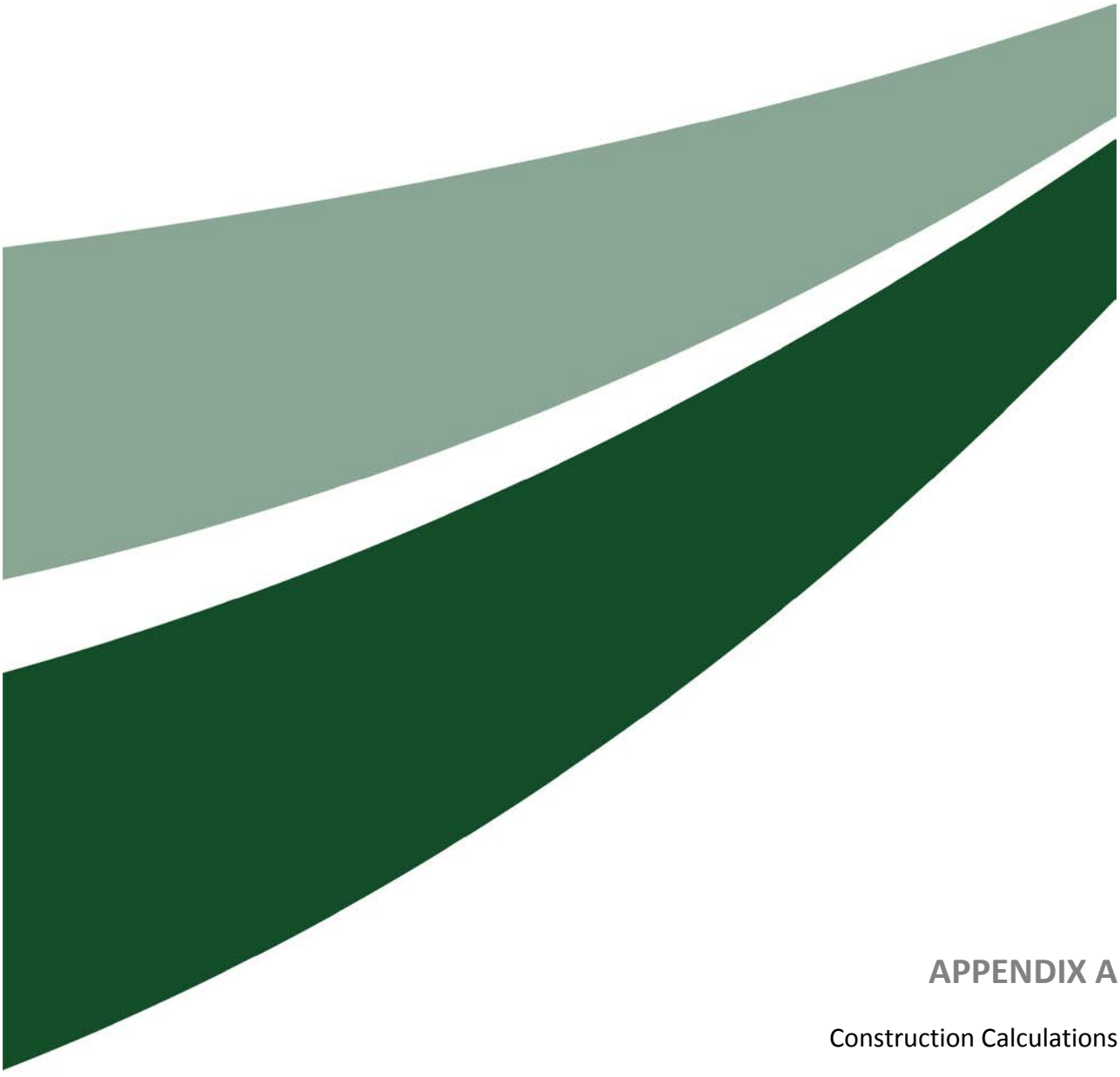

APPENDIX A

Construction Calculations

Appendix A - Construction Calculations

The greenhouse gas emissions for the construction phase of the Project are based on the following assumptions. The following assumptions have been used for calculation purposes only, and are not meant to describe the exact specifications of the Project.

The assumptions are:

- Rail sleepers include 0.14327 m^3 of concrete.
- Steel cladding weighs 4.93 Kg/m^2.
- Concrete will be sourced from Singleton.
- Steel will be sourced from Newcastle.
- Road base will be sourced locally.
- Ballast will be sourced locally.
- Concrete sleepers will be sourced from Queensland.
- Rail will be sourced from Bathurst.
- Bulk density of concrete is 2,400 Kg/m^3.
- Bulk density of ballast is 2,200 Kg/m^3.
- Bulk density of road base and footings is 2,200 Kg/m^3.
- Bulk density of asphalt is 2,250 Kg/m^3.
- Payload of trucks is 33 tonne.

Construction Materials

Activity Data			Emission Factors[3]	GHG Emissions
Material Type	Usage	Unit	t CO_2-e / Unit	t CO_2-e
Steel	1,355	t	1.95	2,642.25
40/50 MPa reinforced concrete	15,140	t	0.265	4,012.10
32/40 MPa reinforced concrete	55.2	t	0.24	13.25
40/50 MPa concrete	120	t	0.188	22.56
Steel pipe	25	t	1.94	48.50
Asphalt	2,502	t	0.071	177.64
Galvanised steel / cladding	76	t	2.03	154.28
Total GHG Emissions (t CO_2-e)				**7,070.58**

Energy Use During Construction

Activity Data				Emission Factors		
				Scope 1	**Scope 3**	**Full Life Cycle**
Purchased energy	Usage	Units	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	1,290	kL	49,794	69.5	5.3	74.8
						t CO_2-e
Total GHG Emissions (t CO_2-e)						**3,725**

[3] Emission factors sources from the University of Bath, Inventory of Carbon and Energy (ICE) v2.0 2011

Transport of Construction Materials - Truck

Activity Data				Emission Factors		
				Scope 1	**Scope 3**	**Full Life Cycle**
Energy use	Usage	Units	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	144	kL	5,558.4	69.9	5.3	75.2
						t CO_2-e
Total GHG Emissions (t CO_2-e)						**417.99**

Transport of Construction Materials - Train

Activity Data				Emission Factor
Freight mode	Tonnes	Kms	TKm	t CO_2-e/TKm
Rail	814	275	223,850	0.0000054
				t CO_2-e
Total GHG Emissions (t CO_2-e)				**1.21**

APPENDIX B

Life of Mine Calculations

Appendix B – Life of Mine Calculations

LOM Stationary Diesel Use

Activity Data	Energy Use		Emission Factors		
			CO_2	CH_4	N_20
kL	GJ/kL	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
627,078	38.6	24,205,211	69.2	0.1	0.2
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			1,675,001	2,421	4,841
Total GHG Emissions (t CO_2-e)					**1,682,263**

LOM Fugitive Emissions

Activity Data	Energy Use		Emission Factors		
			CO_2	CH_4	N_20
ROM (t)	-	-	kg CO_2-e/ROM t	kg CO_2-e/ROM t	kg CO_2-e/ROM t
92,000,000	N/A	N/A	N/A	36.98	N/A
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			N/A	3,402,126	N/A
Total GHG Emissions (t CO_2-e)					**3,402,126**

LOM Electricity

Activity Data	Energy Use	Emission Factors		
		CO_2	CH_4	N_20
GJ	GJ	kg CO_2-e / GJ	kg CO_2-e / GJ	kg CO_2-e / GJ
3,361,920	3,361,920	241	N/A	N/A
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)		810,223	N/A	N/A
Total GHG Emissions (t CO_2-e)				**810,223**

LOM Product Use

Activity Data		Energy Production		Emission Factors		
				CO_2	**CH_4**	**N_20**
Product	Product (t)	GJ/Product t	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Thermal coal	48,210,789	27.0	1,301,691,303	88.2	0.03	0.2
Coking coal	3,724,230	30.0	111,726,900	90.0	0.02	0.2
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				124,864,594	41,285	282,684
Total GHG Emissions (t CO_2-e)						**125,188,563**

LOM Extraction, Production and Distribution of Energy Purchased

Activity Data		Emission Factors		
		CO_2	**CH_4**	**N_20**
Purchased energy	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	24,205,211	5.3	N/A	N/A
Electricity	3,361,920	52.0	N/A	N/A
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)		303,107	N/A	N/A
Total GHG Emissions (t CO_2-e)				**303,107**

LOM Product Transport

Activity Data				Emission Factors		
				CO_2	**CH_4**	**N_20**
Transport mode	Product (t)	Distance (km)	Tonne km (tkm)	kg CO_2-e/tkm	kg CO_2-e/tkm	kg CO_2-e/tkm
Rail	51,935,019	92	4,778,021,748	0.0054	N/A	N/A
Ship	51,935,019	9,500	493,382,680,500	0.0126	N/A	N/A
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				6,242,423	N/A	N/A
Total GHG Emissions (t CO_2-e)						**6,242,423**

LOM Materials Transport

Activity Data				Emission Factors		
				CO_2	**CH_4**	**N_20**
Transport mode	Materials (t)	Distance (km)	Tonne km (tkm)	kg CO_2-e/tkm	kg CO_2-e/tkm	kg CO_2-e/tkm
Truck – Diesel	627,078	230	144,227,940	0.14	N/A	N/A
Truck – Explosives	274,750	100	27,475,000	0.14	N/A	N/A
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				24,038	N/A	N/A
Total GHG Emissions (t CO_2-e)						**24,038**

APPENDIX C

Decommissioning and Closure Calculations

Appendix C – Decommissioning and Closure Calculations

The greenhouse gas emissions for the closure phase of the Project are based on preliminary closure costs prepared for the Mount Owen Mine prefeasibility assessment and forecast rehabilitation areas for Bayswater North Pit and Ravensworth east Pit. Diesel consumption activity data has been calculated from closure cost data, using a net diesel cost of $1.10/litre (after the Fuel Tax Credit).

Stationary Diesel Use

Activity Data	Energy Use		Emission Factors		
			CO_2	**CH_4**	**N_20**
kL	GJ/kL	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
2,075	38.6	80,095	69.2	0.1	0.2
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)			5,543	8	16
Total GHG Emissions (t CO_2-e)					**5,567**

Extraction, Production and Distribution of Energy Purchased

Activity Data		Emission Factors		
		CO_2	**CH_4**	**N_20**
Purchased energy	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	80,095	5.3	N/A	N/A
Electricity	N/A	52	N/A	N/A
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)		425	N/A	N/A
Total GHG Emissions (t CO_2-e)				**425**

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