APPENDIX 8

Greenhouse Gas and Energy Assessment

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GLENCORE

ULAN WEST MODIFICATION

Greenhouse Gas and Energy Assessment

February 2015

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Greenhouse Gas and Energy Assessment

February 2015

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Ulan Coal Mines Limited

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Report No. **3363/R08/Final**
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TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 Introduction

The Ulan Coal Complex is a joint venture between Glencore Coal Assets Australia Pty Limited (Glencore) (90 per cent) and Mitsubishi Development (10 per cent) operated by Ulan Coal Mines Limited (UCML). Operations at the Ulan Coal Complex are located approximately 1.5 kilometres east of the village of Ulan and entirely within the Mid-Western Regional Council Local Government Area (LGA). The Ulan Coal Complex is located approximately 38 kilometres north-north-east of Mudgee and 19 kilometres north-east of Gulgong in New South Wales (refer to **Figure 1.1**).

Coal mining has been undertaken in the Ulan area since the 1920s. UCML was granted Project Approval (PA) 08_0184 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 November 2010 for the *Ulan Coal – Continued Operations Project* (UCCO Project). This Project Approval provides a single, modern project approval for continued operations, which has enabled UCML to surrender a number of historical development consents and other approvals that the site has previously operated under. Approved mining operations within the Ulan Coal Complex consist of underground mining in the Ulan No.3 and Ulan West areas as well as open cut mining, and associated coal handling and processing, and transport through to August 2031. UCML also has an existing approval (EPBC No 2009/5252) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) which was granted on 30 November 2010.

UCML is seeking to modify the approved Ulan West underground operations to provide access to additional coal resources within existing mining titles and allow for a realignment of approved longwall panels as a result of previous modifications.

UCML has an existing exploration licence (EL 7542) which covers an area south-west and an area to the north of the currently approved Ulan West mine plan (refer to **Figure 1.2**). Since the approval of PA 08_0184 in 2010, exploration activities have been undertaken within existing mining leases and the southern portion of EL 7542. This exploration process has further characterised the coal resource as well as provided additional detailed information on other geological features within this area. At Ulan West a fault had previously been interpreted close to the western boundary of the existing mining lease. The location of this east-west trending fault was previously interpreted to limit the ability to mine south of the currently approved main headings of Ulan West. Further exploration activities completed in the southern portion of EL7542 have more accurately mapped the location of the fault and determined that the feature lies further south than previously interpreted.

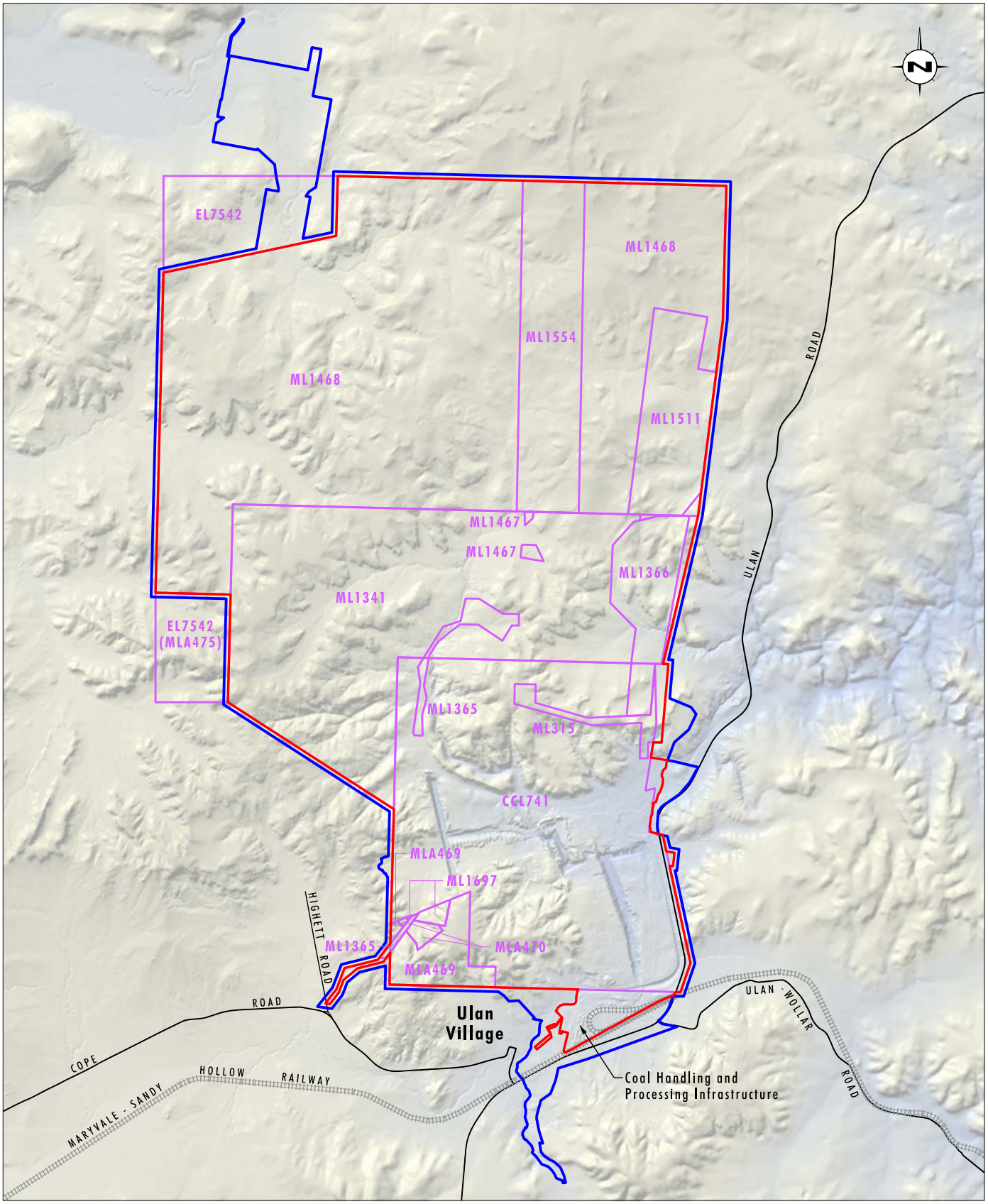
UCML has determined that there is a valuable minable resource within the southern portion of EL 7542, now MLA475, and seek to modify the current project approval to enable access to this coal resource by extending the longwall panels in this area.

During 2013, UCML was granted approval by the NSW Department of Planning & Environment (DP&E) under the provisions of Condition 25 of PA 08_0184 and by the DRE to undertake first workings to widen longwall panels LW 3 and LW 4 from 300 metres to 400 metres wide. The proposed modification includes the repositioning of longwall panels LW 5 to LW12 which is required as a result of the previous changes to LW 3 and LW 4. Some minor changes to the northern extent of the Ulan West longwall panels are also required through this realignment process. The proposed repositioning to the west of LW 5 to LW 12 will generally be within the existing mining footprint and present minimal change to approved environmental impacts.

The changes to the Ulan West mine plan will also require repositioning of approved ventilation shafts and dewatering bores as well as the installation of additional ventilation

FIGURE 1.1

Locality Map



Data Source: Ulan Coal (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Existing Colliery Holding Boundary
- UCML Continued Operations Project Approval Area
- Mine Lease Boundary

FIGURE 1.2

Existing Mining and Exploration Lease Titles

shafts and associated infrastructure to provide ongoing support to underground mining operations.

The proposed modification is being sought under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Umwelt (Australia) Pty Limited (Umwelt) has prepared this Greenhouse Gas and Energy Assessment (GHGEA) as part of an Environmental Assessment (EA) on behalf of UCML to assess the potential impacts of the proposed modification to Ulan West (proposed modification).

1.1 Proposed Modification

As described in **Section 1.0**, UCML has determined that there is a viable coal resource within MLA475 that can be efficiently accessed through a change to the existing Ulan West mine plan.

UCML is proposing to modify PA 08_0184 to allow for mine plan changes to Ulan West to ensure efficient and optimised extraction of the coal resource (refer to **Figure 1.3**). In order to accommodate the proposed changes to the Ulan West longwall layout, the main headings need to be turned after longwall LW 5 (refer to **Figure 1.3**).

The proposed modification to the Ulan West mine plan includes extension of seven longwall mining panels in order to access additional resources, realignment of longwall panels to accommodate for previous modifications, and changes to the ventilation configuration (refer to **Figure 1.3**).

The proposed modification will produce approximately an additional 13 million tonnes of coal and extend the life of the UMCL Complex by approximately 2 years.

The key components of the proposed modification are outlined in **Table 1.2**.

Table 1.2 – Proposed Ulan West Modification

Aspect	Currently Approved	Proposed Modification
Mine Life	21 year life until 30 August 2031	Additional 2 years until 30 August 2033
Limits on Extraction	20 million tonnes of coal per annum (including maximum of 4.1 Mtpa ROM from Open Cut)	No change
Operating Hours	24 hours per day, 7 days per week	No change
Workforce Numbers	Approximately 931 people (Complex)	No change
Mine Plan	As shown in **Figure 1.3**	Realignment of LW 5 to LW 12 including a reduction of LW 5 by approximately 170 metres and an extension of LW 6 to LW 12 between 900 and 1300 metres as shown in **Figure 1.3**
Mining Method	Ulan West – retreat longwall method	No change

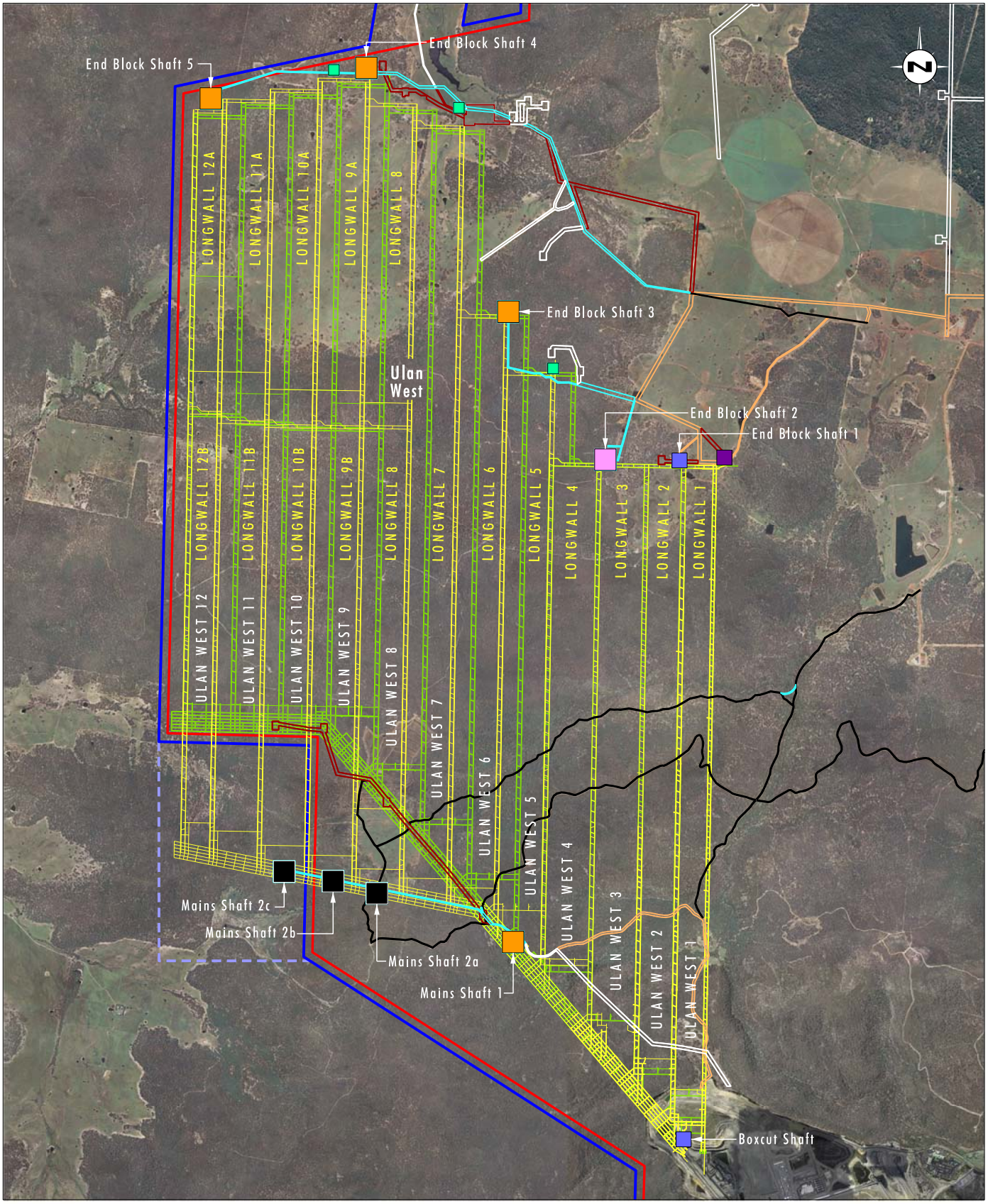


Image Source: Ulan Coal (2008, 2010, 2014)
Data Source: Ulan Coal (2014)

0 1.0 2.0 2.5km
1:50 000

Legend

- Existing Colliery Holding Boundary
- UCML Continued Operations Project Approval Area
- MLA 475
- Approved Ulan West Mine Plan
- Proposed Conceptual Ulan West Mine Plan
- Approved Infrastructure Corridor
- Approved Infrastructure Corridor Not to be Constructed
- Proposed Infrastructure Corridor
- Constructed Infrastructure Corridor
- Existing Access Road
- Existing Vent Shaft Compound
- Existing Dewatering Bore Compound
- Proposed Realigned Dewatering Bore Compound
- Proposed New Ventilation Shaft Compound
- Proposed Realigned Ventilation Shaft Compound
- Potential Location of Realigned Ventilation Shaft Compound

FIGURE 1.3

Proposed Ulan West Modification

File Name (A4): R08/3363_072.dgn
20141210 15.30

Table 1.2 – Proposed Ulan West Modification (cont)

Aspect	Currently Approved	Proposed Modification
Surface Infrastructure	As per Continued Operations Project EA	Changes to Ulan West infrastructure including repositioning of approved dewatering bores and ventilation shafts, and additional shafts and associated infrastructure for Ulan West mine plan as shown in **Figure 1.3**
Ulan Complex Coal Handling and Preparation Plant	As per Continued Operations Project EA	No change
Coal Transportation	All coal transported from the site by rail. No more than 10 laden trains leave the site each day.	No change

As a result of the proposed changes to the mine plan, the location of approved ventilation and dewatering infrastructure will need to be modified to align with the proposed changes to the main headings and longwall locations. In addition, ventilation studies undertaken on the ongoing ventilation requirements of Ulan West have indicated that additional ventilation shafts will be required in order to safely operate Ulan West and have been included as part of the proposed modification.

There are currently seven ventilation shafts, five service boreholes and four dewatering boreholes approved for Ulan West. Approved ventilation shafts, service boreholes and dewatering boreholes yet to be constructed will require relocation as part of the proposed changes to the Ulan West Mine plan. The proposed modification includes the installation of up to an additional ventilation shaft to service Ulan West based on the review of ventilation requirements (refer to **Figure 1.3**). There will be no change to constructed ventilation shafts, service boreholes and dewatering boreholes.

There are currently five service boreholes and three upcast ventilation shafts approved in the southern portion of Ulan West, primarily situated along the main headings. One ventilation shaft has been constructed at the southern end of LW 1 (refer to **Figure 1.3**) to support the current Ulan West operations. The proposed modification will not require any additional ventilation shafts in the southern portion of Ulan West, rather realignment of two ventilation shafts that are yet to be constructed. One ventilation shaft is to be constructed at the southern end of LW 5, while there are three potential locations for the remaining ventilation shaft (refer to **Figure 1.3**). The final location of the third ventilation shaft will be dependent on ventilation requirements as Ulan West progresses. Service boreholes would be co-located with the proposed ventilation shafts where practicable to minimise surface disturbance.

There are currently four downcast ventilation shafts approved at the northern end of longwalls in Ulan West (refer to **Figure 1.3**). One ventilation shaft has been constructed at the northern end of LW 2 to support the current Ulan West operations. The proposed modification will require the remaining three ventilation shafts to be relocated to service the proposed realigned longwall panels as well as an additional ventilation shaft (refer to **Figure 1.3**).

End block ventilation shafts are proposed to be down-cast ventilation (passive) sites throughout the operating lifespan. Up-cast ventilation shafts will include the installation of fans and associated infrastructure. The fan modules will pull air from the underground mining areas via the ventilation shafts to maintain safe underground conditions. The down-cast sites

are proposed to be operated without fan infrastructure and will provide fresh air to the mine ventilation system to maintain suitable ventilation.

The duration of disturbance for each ventilation shaft will be relatively short and directly linked to the progression of underground mining in Ulan West. The number of ventilation fans operating at any one time as up-cast ventilation sites will be typically no more than two, with no more than an additional two down-cast ventilation shaft (End Block Shaft) operating in concurrence.

Other features of the proposed modification include realignment of an infrastructure corridor, access tracks, water supply and electricity transmission lines associated with the additional and relocated ventilation shafts.

2.0 Assessment Framework

2.1 Objectives

The objective of this assessment is to evaluate the greenhouse gas and energy use implications of the proposed modification.

2.2 Scope

The scope of the GHGEA includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the proposed modification;
- estimating energy use directly associated with the proposed modification;
- qualifying how the proposed modification's greenhouse gas emissions may impact the environment;
- estimating the impact of the proposed modification'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 2.1 contains concepts and a glossary of terms relevant to this GHGEA.

Table 2.1 - Glossary of Terms

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 proponent (UCML) (e.g. fuel use, fugitive emissions). Scope 1 emissions are emissions over which UCML has a high level of control.

Table 1 - Glossary of Terms (cont)

Concept	Definition
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the proponent.
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the proponent, but occur at sources owned or controlled by other entities (e.g. outsourced services). Scope 3 emissions can include emissions generated upstream of the proponent's operations by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the proponent's operations 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). Consistent with the National Inventory Report, ventilation fugitive emissions were forecast using an implied emissions factor, which was derived from site specific National Greenhouse and Energy Reporting data.

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).

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 UCML during the mine planning process.

Table 2.2 contains the source of activity data.

Table 2.2 - Source of Activity Data Used for the Assessment

Activity data	Source
Fugitive emissions	Umwelt – derived from Ulan West NGERS data
On-site fuel consumption	UCML - forecast diesel consumption
Electricity consumption	UCML - forecast electricity consumption
Construction materials	UCML - forecast construction materials
Product consumption	UCML - forecast mine production
Product transport	Umwelt - haulage distances from the Ulan Continued Operations EIS

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

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 UCML's operational control and other emission sources associated with the proposed modification.

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 proposed modification] (GHG Protocol 2004).

An underground 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 2.3** 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.

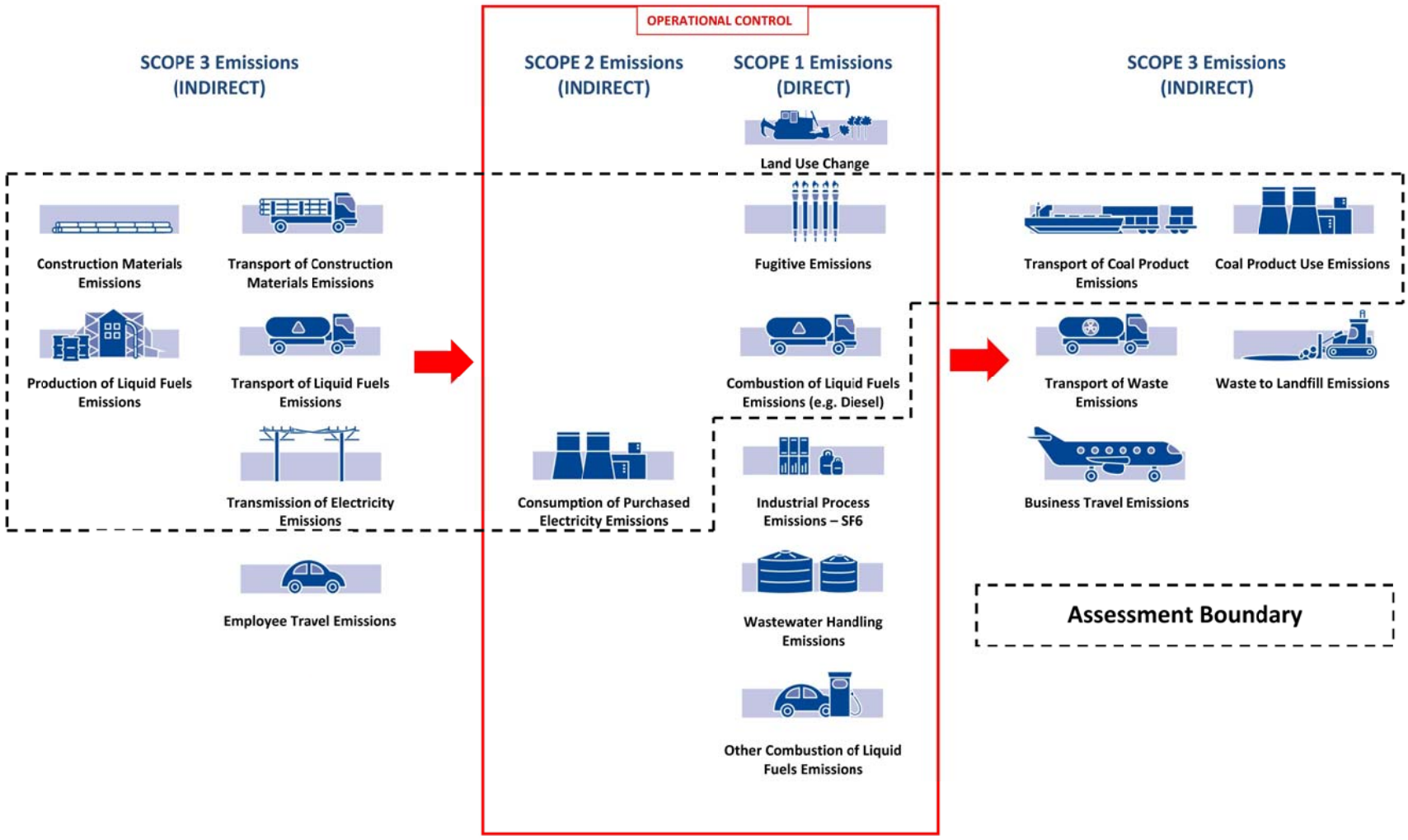


FIGURE 2.1

Greenhouse Gas Assessment Boundary

Table 2.3 – 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 Ulan Coal Complex.

3.0 Impact Assessment Results

Greenhouse gas and energy use estimates have been calculated for the construction and operation of the proposed modification.

3.1 Construction Stage

The proposed modification will involve the construction of additional ventilation infrastructure. Greenhouse gas estimates have been prepared for the construction of the following components described in **Section 1.1**:

3.1.1 Greenhouse Gas Emissions

The proposed modification's construction related greenhouse gas emissions are summarised in **Table 3.1**. The construction of the ventilation system is forecast to be associated with approximately 920 t CO_2-e of Scope 3 emissions. Scope 3 emissions will be generated by third parties in the process of producing and transporting construction materials. Scope 3 emissions will also be generated by contractors consuming energy during the construction projects.

The breakdown of construction related emissions in **Table 3.1** demonstrates that approximately 93 per cent of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes 6 per cent of construction emissions, while 1 per cent of construction emissions are attributable to the transport of construction materials (refer to **Table 3.1**).

3.1.2 Energy Use

The construction activities are forecast to require approximately 900 Gigajoules (GJ) of energy. Diesel is forecast to be the primary energy source.

3.2 Operational Stage

The following assumptions were made to estimate the greenhouse gas emissions from the operational stage of the proposed modification:

- an additional 13 million tonnes of ROM coal will be extracted;
- Ulan West is a non-gassy mine (i.e. the CH_4 content of ventilation emissions will be less than 0.1%);
- product coal will be transported approximately 275 km by train;
- product coal will be transported approximately 9,507 km by ship; and
- diesel will be transported approximately 130 km from Dubbo.

3.2.1 Life of Mine Greenhouse Gas Emissions

The proposed modification's life of mine greenhouse gas emissions are summarised in **Table 3.1**, which are based on the proposed modification recovering an additional 13 million ROM tonnes. The proposed modification is expected to increase the previously approved (PA 08_0184) greenhouse emissions by approximately 31.6 million t CO_2-e.

To provide some context, the greenhouse gas assessment completed in 2009 for the Ulan Coal Continued Operations Project (UCCO Project), found that the Ulan Complex was associated with approximately 575 million t CO_2-e, from the recovery of approximately 214 million tonne of ROM coal.

The additional emissions associated with the proposed modification can be allocated as follows:

- approximately 369,000 t CO_2-e of Scope 1 emissions from combusting diesel and releasing fugitive emissions;
- approximately 126,000 t CO_2-e of Scope 2 emissions from consuming electricity; and
- approximately 31,082,000 t CO_2-e of Scope 3 emissions generated by third parties who transport and consume coal products.

It is noted that due to evolving greenhouse gas calculation methodologies and site based assumptions, the scope 1 and 2 emissions forecast for the proposed modification do not change proportionally from those estimated in 2009. This GHGEA provides a prediction of emissions that will result from the proposed modification however this assessment has not reassessed the emissions from the UCCO Project.

Scope 3 emissions dominate the greenhouse gas emissions attributable to the proposed modification. Approximately 98 per cent of the proposed modification's greenhouse gas emissions will occur either upstream or downstream of the Ulan West site and outside the direct operational control of UCML. Approximately 2 per cent of the greenhouse gases associated with the proposed modification are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions) (refer to **Figure 3.1**).

Scope 1 emissions are only expected to contribute 1.2 per cent of total emissions due to the relatively low diesel demands of an underground mine and the non-gassy nature of the Ulan West coal reserves. The Western Coalfield in NSW is characterised by a very low fugitive gas content, which is primarily carbon dioxide (National Inventory Report 2011).

Scope 2 emissions are expected to be relatively low compared with other Glencore underground operations due to the following:

- a large proportion of ROM coal is product quality and bypasses the coal handling and preparation plant;
- all underground equipment is new and inherently energy efficient; and
- Ulan West has very long panels, which reduces the inefficiencies associated with longwall change outs.

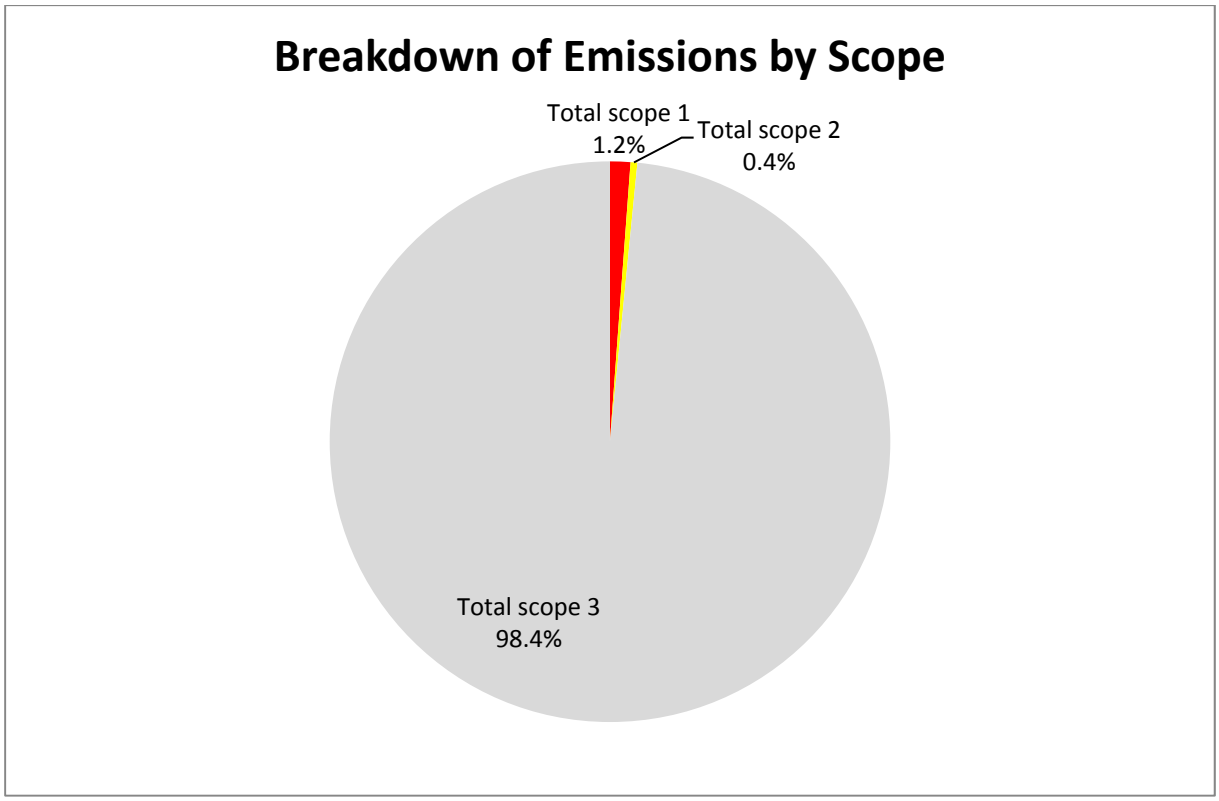


Figure 3.1 – Breakdown of Emissions by Scope

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the proposed modification. 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

In addition to the energy use approved for the UCCO Project, the proposed modification is forecast to require approximately 667,000 GJ of energy from diesel and grid electricity.

Table 3.1 – GHG Emission Summary for the Proposed Modification
(Refer to Appendix A and B for further detail)

Stage	Scope	Source	Source Totals ($t CO_2$-e)	Scope Totals ($t CO_2$-e)
Construction	Scope 3 (Indirect)	Materials	854	921
		Energy Use	58	
		Transport of Materials	9	
			Total GHG Emissions for Construction	**921**
Life of Mine	Scope 1 (Direct)	Diesel use	10,044	368,454
		Fugitive emissions	358,410	
	Scope 2 (Indirect)	Electricity	125,846	125,846
	Scope 3 (Indirect)	Product use	29,552,165	31,081,188
		Associated with energy extraction and distribution	27,920	
		Product transport	1,501,035	
		Materials transport	68	
			Total GHG Emissions for LOM Operations	**31,575,488**

4.0 Impact Assessment Summary

The greenhouse gas emissions generated by the proposed modification 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 proposed modification'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 proposed modification is expected to increase the emissions approved under the UCCO Project by approximately 185,000 t CO_2 –e per annum. To put the proposed modification'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 proposed modification will contribute approximately 0.000040 per cent to global emissions per annum (based on its projected Scope 1 emissions). The Scope 2 and 3 emissions associated with the proposed modification 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 (Australian Government 2013). The proposed modification is expected to increase the previously approved (PA 08_0184) emissions by approximately 185,000 t CO_2 –e per annum, if emissions are not mitigated. The addition of 185,000 t CO_2-e per annum, in the national context, is unlikely to prevent the Federal Government achieving its national greenhouse gas objectives.

The proposed modification's Scope 2 and 3 emissions should not be considered against national objectives, as national emissions only include Scope 1 emissions.

4.3 Impact on International Objectives

International policy makers are yet to reach a comprehensive global agreement on greenhouse gas reduction targets that includes 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 proposed modification 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 has assessed reasonable and feasible measures to minimise the proposed modification'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 Ulan Coal Complex are owned by subsidiary companies of Glencore Coal Pty Limited (Glencore). UCML is committed to the Glencore Code of Conduct, which specifically requires on-going consideration of greenhouse gas emissions and energy use. To assist Glencore in meeting its Code of Conduct, UCML 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 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

5.1.2 Energy Efficiency

UCML 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. UCML's mine planning process optimises operational productivity through scheduling and equipment selection.

5.1.3 Scope 3 Emissions

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

The Glencore 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

UCML has incorporated a range of measures into the proposed modification's 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 proposed modification's design inherently minimises greenhouse gas emissions from the mining operations.

The GHGEA estimates that the proposed modification's scope 1 and 2 greenhouse gas emissions will be generated from the following sources:

- fugitive emissions (73 per cent);
- diesel consumption (2 per cent); and
- electricity consumption (25 per cent).

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. In underground coal mines, mine waste gas can be captured from active coal seams and goaf environments (the fractured rock zone left once the coal has been extracted), to improve safety and manage greenhouse gas emissions. Captured mine waste gas can be destroyed by flaring to reduce its greenhouse gas potential or combusted as a fuel source.

Glencore has developed three critical criteria for selecting suitable sites for capturing waste mine gas for combustion. Glencore has found that capturing 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.

As discussed in **Section 3.2.1**, the mine waste gas generated at Ulan West is very low in methane and is unsuitable for flaring or combusting as a fuel source.

Energy efficiency measures remain the only reasonable and feasible mitigation options for Ulan West. UMCL will continue to implement the approved UCCO Greenhouse Gas Management Plan to ensure all reasonable and feasible measures are employed to minimise the release of greenhouse gas emissions.

6.0 Conclusion

The proposed modification is a relatively small scale amendment to an existing underground coal mine. The UCCO Project was forecast to generate approximately 4,720,000 t CO_2-e of scope 1 and 2 emissions from the recovery of 214 million tonne of ROM coal. The proposed modification will allow the extraction of an additional 13 million tonne of ROM coal and is expected to generate approximately 495,000 t CO_2-e of Scope 1 and 2 emissions, when assessed with current methodologies and assumptions.

Scope 1 emissions are only expected to contribute 1.2 per cent of total emissions due to the relatively low diesel demands of an underground mine and the non-gassy nature of the Ulan West coal reserves.

The proposed modification is also forecast to be associated with approximately 31,082,000 t CO_2-e of Scope 3 emissions. The proposed modification's Scope 3 emissions are beyond the operational control of UCML, and the majority of Scope 3 emissions will be generated downstream of the mine, when coal products are combusted by electricity generators.

The proposed modification is unlikely to impact national greenhouse gas policy objectives due to the relatively small annual contribution the proposed modification will make to national emissions.

The proposed modification will optimise the use of existing infrastructure, including coal handling and preparation, water management systems and infrastructure, offices and ancillary facilities, without requiring any further modifications to this existing infrastructure.

Glencore's 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.

7.0 References

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APPENDIX A

Construction Calculations

Appendix A - Construction Calculations

The greenhouse gas emissions for the construction phase of the Modification 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 Modification.

The assumptions are:

- Concrete will be sourced from Mudgee;
- Steel will be sourced from Newcastle;
- Bulk density of concrete is 2400 Kg/m^3;
- Payload of trucks is 33 tonne; and
- Contractors will consume 20,000 litres of diesel.

Construction Materials

Activity Data			Emission Factors[1]	GHG Emissions
Material Type	Usage	Unit	t CO_2-e / Unit	t CO_2-e
Steel	130	Tonnes	1.95	254
Concrete	960	Tonnes	0.188	180
Reinforced Concrete (N40)	1,584	Tonnes	0.265	420
Total GHG Emissions (t CO_2-e)				**854**

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	20	kL	772	69.5	5.3	74.8
						t CO_2-e
Total GHG Emissions (t CO_2-e)						**58**

[1] 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	3.04	kL	117	69.9	5.3	75.2
						t CO_2-e
Total GHG Emissions (t CO_2-e)						**9**

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
3,744	38.6	144,518	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)			10,001	14	29
Total GHG Emissions (t CO_2-e)					**10,044**

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
13,000,000	N/A	N/A	N/A	27.57	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	358,410	N/A
Total GHG Emissions (t CO_2-e)					**358,410**

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
522,184	522,184	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)		125,846	N/A	N/A
Total GHG Emissions (t CO_2-e)				**125,846**

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	12,377,300	27.0	334,187,100	88.2	0.03	0.2
Coking coal	0	30.0	0	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)				29,475,302	10,026	66,837
Total GHG Emissions (t CO_2-e)						**29,552,165**

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	144,518	5.3	N/A	N/A
Electricity	522,184	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)		27,920	N/A	N/A
Total GHG Emissions (t CO_2-e)				**27,920**

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	12,377,300	275	3,403,757,500	0.0054	N/A	N/A
Ship	12,377,300	9,507	117,670,991,100	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)				1,501,035	N/A	N/A
Total GHG Emissions (t CO_2-e)						**1,501,035**

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	3,744	130	486,720	0.14	N/A	N/A
Truck – Explosives	0	0	0	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)				68	N/A	N/A
Total GHG Emissions (t CO_2-e)						**68**

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