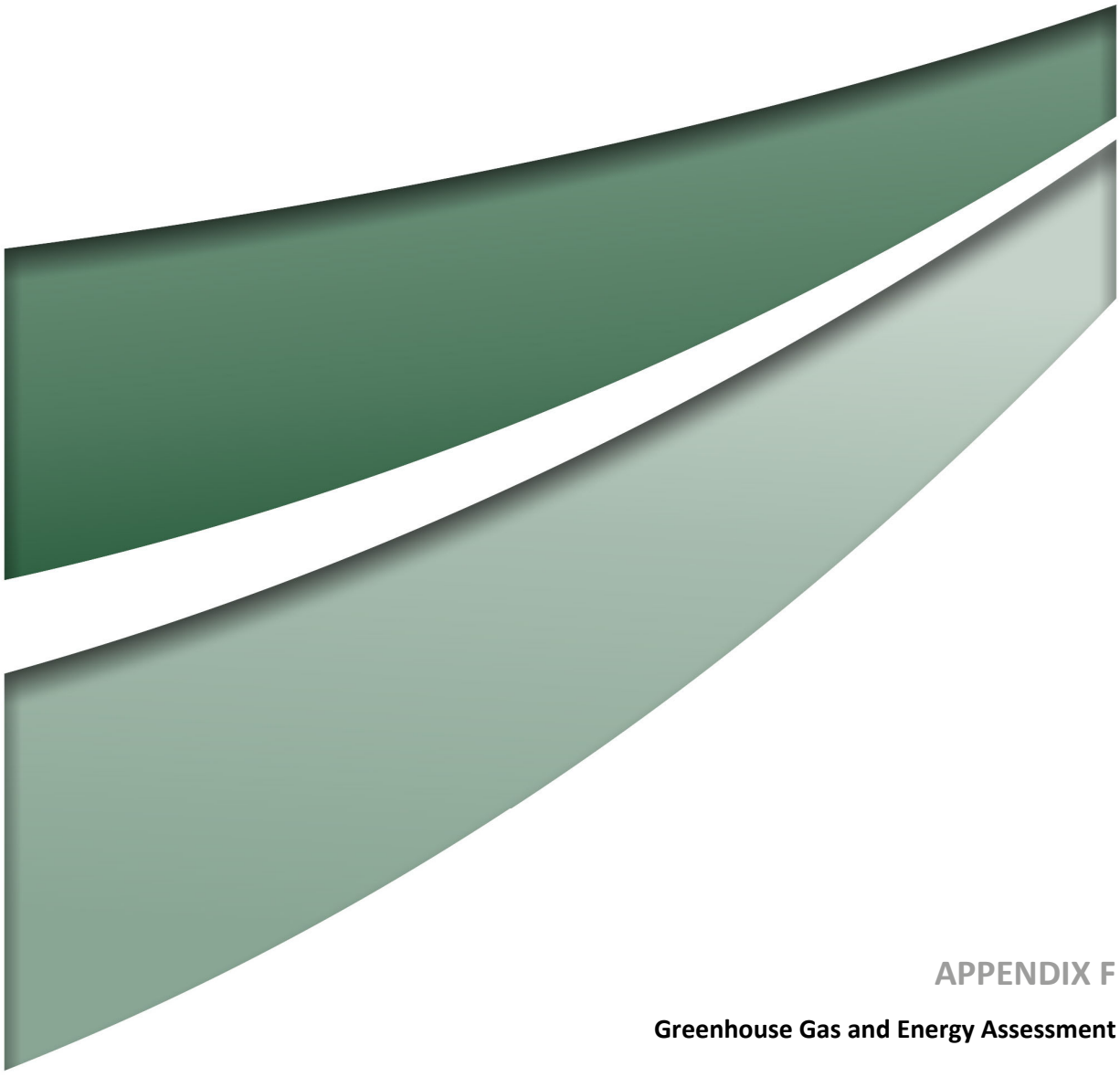

APPENDIX F

Greenhouse Gas and Energy Assessment

umwelt
Environmental & Social Consultants

DARACON Group

REVISED MARTINS CREEK QUARRY EXTENSION PROJECT

Greenhouse Gas and Energy Assessment

FINAL

May 2021

REVISED MARTINS CREEK QUARRY EXTENSION PROJECT

Greenhouse Gas and Energy Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Daracon Group

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Report No. 3957C/R08
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Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Malcolm Sedgwick	4/5/21	Barbara Crossley	4/5/21

Executive Summary

The Martins Creek Quarry (the quarry) is an existing hard rock quarry situated within the Dungog Local Government Area (LGA), approximately 7 kilometres (km) north of Paterson and 28 km north of Maitland, New South Wales (NSW).

In December 2012, Daracon secured a long-term lease of the quarry and have been extracting Latite Tuff to produce high quality aggregates, roadbase, ballast, gabion and other specified materials used in road, railway, concrete and civil construction. In 2014, Daracon submitted a development application in for the Martins Creek Quarry Extension Project. An Environmental Impact Statement (EIS) was prepared and exhibited during late 2016 (Monteath & Powys, 2016).

In response to the public and government agency concerns, Daracon redesigned key operational parameters and reduced the extraction limits, operational hours and truck movements (the Revised Project). An updated environmental assessment has been commissioned to support an Amended Development Application (ADA) and Response to Submissions (RTS).

This Greenhouse Gas and Energy Assessment (GHGEA) was prepared to inform the Revised Project's ADA and RTS. The GHGEA found that the Revised Project can be associated with the following greenhouse gas emissions.

Greenhouse Gas Emissions over the life of the Revised Project		
	(t CO_2-e)	(%) of total emissions
Scope 1	122,000	36%
Scope 2	45,000	13%
Scope 3	170,000	51%
TOTAL	**336,000**	**100%**

The Scope 1 greenhouse gas emissions generated by the Revised Project over 25 years are approximately 122,000 t CO_2-e. Operating on-site equipment and transporting products is the primary source of direct greenhouse gas emissions. On an annual basis, the Revised Project could generate up to approximately 5,000 t CO_2-e Scope 1 emissions per annum. The Revised Project's annual emissions are well below National Greenhouse Gas and Energy Act reporting thresholds (25,000 t CO_2-e pa) and Safeguard Mechanism thresholds (100,000 t CO_2-e pa). The Scope 1 emission intensity of the Revised Project is similar to other hard rock quarries approved for operation in NSW.

Over the life of the quarry, the Revised Project can also be associated with 45,000 t CO_2-e and 170,000 t CO_2-e of Scope 2 and 3 emissions respectively. The Revised Project does not generate a large demand for electricity, and the majority of Scope 3 emissions are associated with product transport. Approximately 78% of total Scope 1 and 3 emissions are associated with product transport.

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1.0 Introduction

The Martins Creek Quarry (the quarry) is licensed by Buttai Gravel Pty Ltd, which is part of the Daracon Group. The quarry is an existing hard rock quarry situated within the Dungog Local Government Area (LGA), approximately 7 kilometres (km) north of Paterson and 28 km north of Maitland, New South Wales (NSW).

The quarry was established in 1914 by the NSW Government Railways for the purpose of supplying railway ballast and other quarry materials to both the NSW railway network and Hunter Valley/Newcastle construction projects. Until late 2012, the quarry has been operating continuously by various NSW Government transport departments, authorities and corporations.

In December 2012, Daracon secured a long term lease of the quarry and have been extracting Latite Tuff to produce high quality aggregates, roadbase, ballast, gabion and other specified materials used in road, railway, concrete and civil construction. In 2014, Daracon submitted a development application for the Martins Creek Quarry Extension Project. An Environmental Impact Statement (EIS) was prepared and exhibited during late 2016 (Monteath & Powys, 2016). The development application is being assessed as a State Significant Development (SSD) (SSD No. 6612), requiring approval under Part 4 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

Following detailed analysis of the EIS submissions, Daracon committed to key design changes and additional mitigation and management measures to minimise the Project's environmental and social amenity impacts. This included reductions in the proposed extraction limits, quarry operating hours and truck movements.

Following community engagement and feedback during 2018 and 2019, and the change to quarry operations in September 2019, Daracon has undertaken further quarry planning and design activities to optimise the use of the existing resource and minimise environmental and community impacts. As a result, the Revised Project now includes a number of additional amendments, including further reductions in road transportation volumes, peak hourly truck movements, operational hours, as well as a avoiding approximately 15.3 ha of native vegetation in the former East Pit (Lot 21 DP 773220).

This Greenhouse Gas and Energy Assessment (GHGEA) was prepared by Umwelt to inform the Revised Project's Amended Development Application and Response to Submissions (ADA & RTS).

1.1 The Revised Project

The quarry life for the Revised Project is 25 years. **Table 1.1** includes the other key features of the Revised Project that will impact greenhouse gas emissions.

Table 1.1 Key Features of the Revised Project

Project Component	Currently Approved	Revised Project
Limits of production	• 449,000 tonnes per annum (tpa)	• 1,100,000 tpa
Transport	• Transportation of product via road cannot exceed 30% pa (i.e. 134,700 tpa)	• Transporting up to 500,000 tpa of quarry product via public roads, with up to 600,000 tpa transported via rail. • Subject to market requirements at a later date, Daracon may seek approval to increase the amount transported by rail, on a campaign basis.

Project Component	Currently Approved	Revised Project
Infrastructure	• Rail spur and associated loading facilities • Road haulage loading facilities.	• Extension of the rail spur to facilitate longer trains to transport more quarry product • Construction and use of a new access road and bridge crossing from Dungog Road, over the North Coast rail line, to allow for all heavy vehicle movements via a new site access • Road improvements at the Dungog Road/Gresford Road intersection, the King Street/Duke Street intersection (within the village of Paterson) and an upgrade to the Gostwyck Bridge approach

2.0 Assessment Framework

The assessment framework ensures the GHGEA addresses the SEARs issued for the development application and complies with national and international assessment guidelines.

2.1 Objectives

This assessment has been prepared to meet the requirements set out in the SEARs, issued on 4 August 2016. The SEARs require an assessment of the likely greenhouse gas emissions of the development. **Section 3.0** of the GHGEA provides an assessment of the Revised Project's likely greenhouse gas emissions.

Contemporary GHGEA often also includes an assessment of the greenhouse gas impacts and an evaluation of potential mitigation measures. **Section 4.0** of the GHGEA provides an assessment of potential impacts and **Section 5.0** provides an evaluation of potential mitigation measures.

2.2 Scope

The scope of the GHGEA includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the Revised Project
- estimating energy use directly associated with the Revised Project
- qualitatively assessing how the Revised Project's greenhouse gas emissions may impact the environment
- estimating the impact of the Revised Project's emissions on State, national and international greenhouse gas emission targets/policies
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions of the Revised Project 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[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 • Sulphur hexafluoride.

[1] The GHG Protocol 2004

Concept	Definition
Scope 1 emissions	Direct emissions that occur from sources that are owned or controlled by the Revised Project (e.g. fuel use, fugitive emissions). Scope 1 emissions are emissions over which the Revised Project has a high level of control.
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the Revised Project.
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the Revised 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 Revised Project by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the Revised 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 2019. 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 2019 (DoEE 2019).

Scope 3 emissions associated with product transport were calculated based on fuel efficiency 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 2019 (DoEE 2019).

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 developed by the Daracon during the quarry 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
Construction materials	Assumptions - Refer to **Section 3.1.1**
Construction diesel use	Daracon estimate
On-site fuel consumption	Historical data use
Electricity consumption	Historical data use
Product transport	Assumptions – Refer to **Section 3.2.1.1**

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

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 Daracon's operational control and other emission sources associated with the Revised 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 Revised Project (GHG Protocol, 2004).

A quarry has a number of potential emission sources, however, the dominant emission sources, can be summarised as:

- diesel use
- electricity use
- product transport.

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.

Table 2.3 Data Exclusions

Emission 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.
Land use change	Scope 1	Emissions associated with clearing vegetation
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 Martins Creek site.

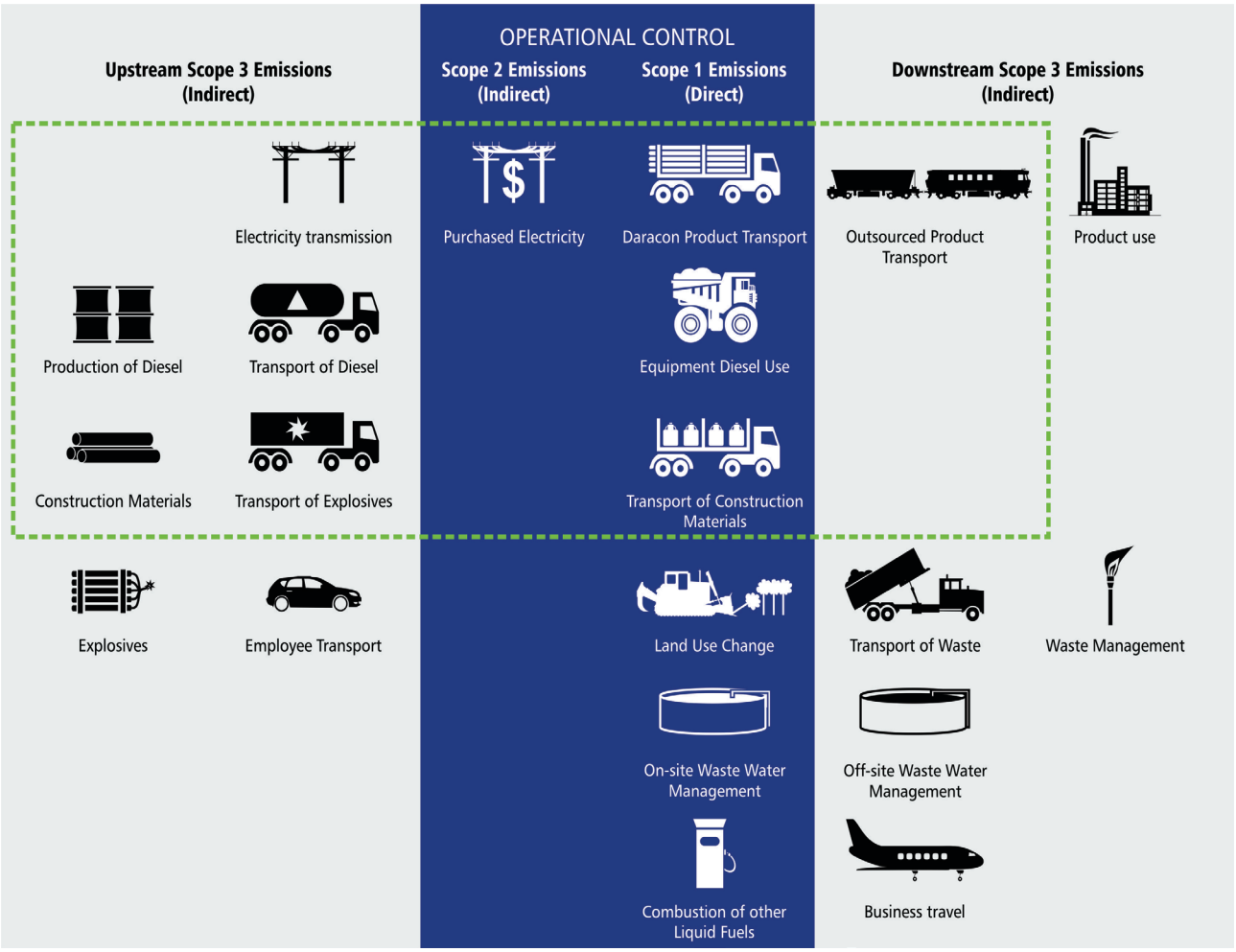

Figure 2.1 Greenhouse Gas Assessment Boundary

3.0 Impact Assessment Results

The Revised Project incorporates both construction and operational activities, which are assessed as separate phases.

The operational phase of the Revised Project is assessed at its proposed upper annual approval limits, to assess the potential annual greenhouse gas emissions associated with the Revised Project. The Revised Project is also assessed over its proposed operational life to assess the potential life of quarry emissions.

3.1 Revised Project - Construction

The Revised Project will require the construction of new infrastructure. Construction associated with the Revised Project will include:

- a new access road from Dungog Road
- a heavy vehicle bridge over the North Coast rail line
- upgrading the approach road to Gostwyck Bridge
- upgrading the intersection of Dungog Road and Gresford Road
- upgrading the intersection of King Street and Duke Street in the village of Paterson
- extending the rail spur to facilitate longer trains.

This section assesses the greenhouse gas emissions which can be associated with the construction phase of the Revised Project.

3.1.1 Assumptions

- The new access road from Dungog Road will be approximately 880 metres (m) long.
- The new rail spur will be approximately 360 m long (from the existing overhead rail loading structure inbound).
- Rail ballast and road base materials (e.g. CBR15, DGB20) will be sourced locally from the quarry.
- All construction activities will be completed by the proponent.
- Asphalt, steel and diesel will be sourced from Newcastle.
- Concrete will be sourced locally.

3.1.2 Emissions

The Revised Project's construction related greenhouse gas emissions are summarised in **Table 3.1**.

Table 3.1 Construction Greenhouse Gas Emission Summary

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Construction	Scope 1 (Direct)	Diesel use - Construction	234	247
		Diesel use - Materials transport	13	
	Scope 3 (Indirect)	Materials use	592	605
		Associated with energy extraction and distribution	13	
Total emissions for major construction activities				**852**

(Refer to **Appendix A** for further detail)

The construction of the Revised Project is forecast to be associated with approximately 250 t CO_2-e Scope 1 and 600 t CO_2-e Scope 3 emissions. The breakdown of construction related emissions in **Table 3.1** demonstrate that approximately 69% of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes 27% of construction emissions, while 4% of construction emissions are attributable to the transport of construction materials (refer to **Table 3.1**).

3.1.3 Energy Use

The construction related activities of the Revised Project are forecast to require approximately 3,600 Gigajoules (GJ) of energy from diesel.

3.2 Revised Project - Operations

This section assesses the greenhouse gas emissions which can be associated with the operational phase of the Revised Project. The section assesses the annual emissions of the Revised Project at its maximum annual approved limit, and the total emissions of the Revised Project over a 25 year project life.

3.2.1 Maximum Annual Production

The following sections assess the potential greenhouse gas emissions of the Revised Project, operating at its maximum approved limit.

3.2.1.1 Assumptions

The following information was used to estimate the greenhouse gas emissions from the Revised Project. The following assumptions are not supposed to represent future operations, but a conservative scenario under the Revised Project.

- annual production will average 1.1 Mtpa
- 500,000 tpa of product will be transported via truck. Truck transport will predominantly occur via truck and dog with a nominal average payload of 32 tonne. Trucks will be operated by the proponent.
- 600,000 tpa of product will be transported via rail

- trucks transport will service markets located 60 km from Martins Creek (on average)
- rail transport will service markets located 218 km from Martins Creek (on average)
- trucks will transport all products transported by rail a further 30 km (on average)
- diesel use will average 0.0007 kL per product tonne
- electricity use will average 2 kWh per product tonne
- ANFO use will average 0.00022 tonne per product tonne
- ANFO will be sourced 50 km from Martins Creek (on average).

3.2.1.2 Emissions

The maximum annual greenhouse gas emissions associated with the Revised Project are summarised in **Table 3.2**.

Table 3.2 Revised Project Maximum Annual Greenhouse Gas Emissions

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Operation	Scope 1 (Direct)	Diesel use – On site	2,087	4,873
		Diesel use – Product transport	2,786	
	Scope 2 (Indirect)	Electricity	1,782	1,782
	Scope 3 (Indirect)	Associated with energy extraction and distribution	447	6,766
		Outsourced transport	6,319	
Maximum annual greenhouse gas emissions - Revised Project				**13,421**

(Refer to **Appendix B** for further detail)

The Revised Project, at its maximum approval limits, is expected to generate approximately 5,000 t CO_2-e of Scope 1 emissions per annum. Operating on-site equipment and transporting products is the primary source of direct emissions. **Table 3.3** compares the Revised Project's annual Scope 1 greenhouse gas emissions against a range of other hard rock quarries in NSW. The variation in greenhouse gas intensity (i.e. emissions per product tonne) demonstrated in **Table 3.3** is largely driven by transport related strategies. Outsourcing product transport generates lower Scope 1 emissions intensities than owning and operating a trucking fleet.

Table 3.3 Comparison of Scope 1 Emissions Forecast for Hard Rock Quarries In NSW

Quarry	Annual Production rate (tpa)	Forecast Scope 1 emissions (tCO_2-e pa)	Reference
Lynwood Quarry	5,000,000	6,614	Umwelt 2005, Proposed Lynwood Quarry, Marulan, EIS
Cooma Road Quarry	1,500,000	3,516	Umwelt 2012, Cooma Road Continued Operations Project, EIS
Martins Creek Quarry	1,100,000	4,873	This assessment

Quarry	Annual Production rate (tpa)	Forecast Scope 1 emissions (tCO_2-e pa)	Reference
Oberon Quarry	400,000	4,862	Umwelt 2015, Proposed Extended Life of Operations and Development Changes to Oberon Quarry, EIS
Teven Quarry	235,000	300	Umwelt 2014, Teven Quarry Project, EIS
Jandra Quarry	225,000	822	Edge Environment 2014, Jandra Quarry Intensification Project Greenhouse Gas Emissions Assessment
Brandy Hill Quarry	1,500,00	9,869	Vipac Engineers & Scientists Ltd 2016, Brandy Hill Quarry Air Quality Assessment

The Revised Project's annual emissions are well below National Greenhouse Gas and Energy Act reporting thresholds (25,000 t CO_2-e) and Safeguard Mechanism thresholds (100,000 t CO_2-e).

At its maximum approval limits the Revised Project can also be associated with approximately 1,800 t CO_2-e Scope 2 emissions and 7,000 t CO_2-e Scope 3 emissions per annum. Scope 2 emissions are associated with electricity use, and the majority of Scope 3 emissions are associated with outsourced transport (i.e. transporting products to consumers).

3.2.1.3 Energy Use

The Revised Project is forecast to require approximately 77,200 GJ per annum when operating at its maximum approved limit. Energy will primarily be sourced from diesel and grid electricity.

3.2.2 Life of Revised Project

The following sections assess the potential greenhouse gas emissions of the Revised Project, if it operates at its maximum approval limits.

3.2.2.1 Assumptions

The following information was used to estimate the greenhouse gas emissions from the Revised Project. The following assumptions are not supposed to represent future operations, but a conservative scenario under the Revised Project.

- annual production will average 1,100,000 tpa
- production will continue for 25 years
- 500,000 tpa of product will be transported via truck. Truck transport will predominantly occur via truck and dog with a nominal average payload of32 tonne. Trucks will be operated by the proponent.
- 600,000 tpa of product will be transported via rail
- truck transport will service markets located 60 km from Martins Creek (on average)
- rail transport will service markets located 218 km from Martins Creek (on average)
- trucks will transport all products transported by rail a further 30 km (on average)
- diesel use will average 0.0007 kL per product tonne

- electricity use will average 2 kWh per product tonne
- ANFO use will average 0.00022 t per product tonne
- ANFO will be sourced 50 km from Martins Creek (on average).

3.2.2.2 Emissions

The life of Revised Project greenhouse gas emissions are summarised in **Table 3.4**.

Table 3.4 Life of Revised Project Emissions

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Operation	Scope 1 (Direct)	Diesel use – On site	52,175	121,825
		Diesel use – Product transport	69,650	
	Scope 2 (Indirect)	Electricity	44,550	44,550
	Scope 3 (Indirect)	Associated with energy extraction and distribution	11,175	169,150
		Outsourced transport	157,975	
Total life of Revised Project emissions				**335,525**

(Calculations are based on 25 times the maximum annual production)

The Revised Project is expected to generate approximately 122,000 t CO_2-e of Scope 1 emissions over 25 years. Operating on-site equipment and transporting products to consumers is the primary source of direct emissions.

The Revised Project is also expected to be associated with approximately 45,000 t CO_2-e Scope 2 emissions and 170,000 t CO_2-e Scope 3 emissions over 25 years. Scope 2 emissions are associated with electricity use, and the majority of Scope 3 emissions are associated with outsourced transport (i.e. transporting products to consumers).

3.2.2.3 Energy Use

The Revised Project is forecast to require approximately 1,929,000 GJ of energy from diesel and grid electricity over 25 years.

4.0 Impact Assessment Summary

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

4.1 Impact on the Environment

The Revised Project's greenhouse gas emissions will be highly mobile and generated up and down the supply chain. The accumulation of greenhouse gases in 'carbon sinks' is the primary impact of the Revised Project's greenhouse gas emissions. Anthropogenic greenhouse gas emissions accumulate 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 also an important driver of ocean acidification (IPCC 2013).

The Revised Project's direct emissions (Scope 1) are forecast to be approximately 5,000 t CO_2-e per annum.

To put the Revised Project's emissions into perspective, if Paris Agreement signatories achieve their intended Nationally Determined Contributions (INDCs), global greenhouse gas emissions are forecast to reach 53,000,000,000 t CO_2-e per annum by 2025 (UNEP 2016). During operation, the Revised Project may contribute approximately 0.0000094 % to global emissions per annum (based on its projected Scope 1 emissions). The relative environmental impact of the Revised Project is likely to be relative to its proportion of global greenhouse gas emissions.

The Scope 2 and 3 emissions associated with the Revised Project should not be compared against global emissions, as global emissions only represent Scope 1 emissions (i.e. the sum of all individual emission sources).

4.2 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) defines 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 emission scenarios. Climate change forecasts also vary significantly from region to region. A qualitative assessment of climate change requires a regional reference and future emission trajectory assumptions.

CSIRO has modelled Australian climate change projections for 2030 and 2090, using IPCC scenarios RCP2.6, RCP4.5 and RCP8. The Representative Concentration Pathway (RCP) scenarios represent a range of future emission pathways, which include a relatively low emissions future (RCP2.6) though to a relatively high emissions future (RCP8).

CSIRO modelling demonstrates that:

- By 2030, annual average temperature is forecast to increase under all three RCPs. The magnitude of warming by 2090 is strongly dependent on the RCP scenario.
- By 2030, the number of days over 35˚C is forecast to increase under all three RCPs. The increase in number of days by 2090 is strongly dependent on the RCP scenario.
- By 2030, rainfall in eastern Australia is likely to remain unchanged under all three RCPs. By 2090, the higher emission RCPs may drive average rainfall lower across eastern Australia.
- By 2030, there is a small tendency for annual maximum daily rainfall in eastern Australia to increase. By 2090, the higher emission RCPs will drive a marked increase in annual maximum daily rainfall in eastern Australia.
- By 2030, mean wind speed and extreme wind speed in eastern Australia is likely to remain unchanged under all three RCPs. There is evidence to suggest extreme wind speeds in Spring may decrease in eastern Australia.
- By 2030, annual evaporation is forecast to increase under all three RCPs. The magnitude of evaporation by 2090 is strongly dependent on the RCP scenario.

The Revised Project, in isolation, is unlikely to influence global emission pathways. Future emission pathways will largely be influenced by global scale issues such as technology, population growth and greenhouse gas mitigation policy.

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.

4.3 Impact on Policy Objectives

The United Nations Framework Convention on Climate Change (UNFCCC) is the leading international forum for setting climate change targets and objectives. The UNFCCC has been responsible for developing internationally accepted greenhouse gas emission reporting methodologies, and has led the development of:

- the Kyoto Protocol
- the Paris Agreement
- specific directives and guidance to improve the implementation of the UNFCCC.

The Kyoto Protocol became international policy in 2005, and it committed the European Union (EU) plus 37 other member states to manage greenhouse gas emissions between 2008 and 2012. A second round of the Kyoto Protocol (the Doha Amendment) committed the EU plus 191 other member states to manage greenhouse gas emissions between 2013 and 2020. Australia was a signatory to both rounds of the Kyoto Protocol and Australia will meet its obligations under the Kyoto Protocol in 2020 (DoEE 2018).

In 2015 the UNFCCC successfully negotiated an international climate change agreement between 195 countries (the Paris Agreement). The Paris Agreement aims to:

- hold the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels

- increase the ability [of nations] to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production

- make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

The Paris Agreement seeks to meet its objectives by developing programs and mechanisms that:

- require participating Parties to prepare and communicate greenhouse gas mitigation contributions. Parties are expected to set mitigation targets for 2020, and then develop new targets every five years. Each successive target is expected to represent a larger mitigation effort than the previous target

- promote climate change resilience and adaptation

- provide mitigation and adaptation funding to developing countries

- foster mitigation and adaptation technology transfer between Parties

- require participating Parties to report progress towards their mitigation contributions on an annual basis.

Australia signed the Paris Agreement on 22 April 2016, and Australia's obligations under the Paris Agreement will drive national greenhouse gas policy between 2020 and 2030. Under the Paris Agreement, Australia is obliged to:

- prepare, communicate and maintain a Nationally Determined Contribution (NDC). An NDC outlines the size and type of mitigation contribution each member state will make to the international effort

- pursue domestic mitigation measures, with the aim of achieving the objectives of its NDC

- communicate an NDC every 5 years

- quantify its NDC in accordance with IPCC methodologies, which promote transparency and avoid double counting.

4.3.1 Australian Targets

Australia's commitment to the Paris Agreement includes reducing greenhouse gas emissions by 26 - 28 %, on 2005 levels, by 2030 (Commonwealth of Australia, 2015). To meet the requirements of the Paris Agreement, Australia will also have to develop interim targets for 2020 and 2025. Australia's NDC is summarised in **Table 4.1**.

Table 4.1 A Summary of Australia's NDC

Emissions reduction target	Economy-wide target to reduce greenhouse gas emissions by 26 - 28 % below 2005 levels (612 $MtCO_2$-e) by 2030
Coverage	Economy-wide

Scope	Energy Industrial processes and product use Agriculture Land-use, land-use change and forestry Waste
Gases	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3

Australia's NDC prescribes an unconditional economy-wide target to reduce greenhouse gas emissions, and states that future policies will target emissions generated from:

- energy use
- industrial processes
- agriculture, land-use, land-use change and forestry
- waste.

Australia's NDC does not contain sector or state based targets, nor does it make any reference to extractive industries.

Australia's current national greenhouse gas mitigation policy framework caps facility level emissions via the Safeguard Mechanism, and funds mitigation projects through the Emissions Reduction Fund. The Revised Project is not large enough to be regulated by the Safeguard Mechanism.

4.3.2 NSW Policy

The NSW Government has developed its NSW Climate Change Policy Framework, which aims to deliver net-zero emissions by 2050, and a State that is more resilient and responsive to climate change (OEH 2016).

Under the NSW Climate Change Policy Framework, NSW has committed to both follow the Paris Agreement and to work to complement national action. The key policy directions under the NSW Climate Change Policy Framework are summarised in the **Table 4.2**.

Table 4.2 A Summary of the NSW Climate Change Policy Framework

Policy Direction	Rationale/Goals
Creating an investment environment that manages the emissions reduction transition	Energy will be transformed and investment/job opportunities will be created in emerging industries of advanced energy, transport and carbon farming and environmental services
Boost energy productivity and put downward pressure on energy bills	Boosting energy and resource productivity will help reduce prices and the cost of transitions to net-zero emissions
Grow new industries and capitalise on competitive advantages	Capitalising on the competitive advantage and growth of industries in professional services, advanced energy technology, property management and financial services
Reduce risks and damage to public and private assets arising from climate change	Embed climate change considerations into asset and risk management as well as support the private sector by providing information and supportive regulatory frameworks for adaptation

Policy Direction	Rationale/Goals
Reduce climate change impacts on health and wellbeing	Recognise the increased demand for health and emergency services due to climate change and identify ways to better support more vulnerable communities to health impacts
Manage impacts on natural resources and communities	Coordinate efforts to increase resilience of primary industries and rural communities as climate change impacts water availability, water quality, habitats, weeds and air pollution

The policy framework is being delivered through:

- the Climate Change Fund
- developing an economic appraisal methodology to value greenhouse gas emissions mitigation
- embedding climate change mitigation and adaptation across government operations
- building on NSW's expansion of renewable energy
- developing action plans and strategies.

The Revised Project is unlikely to affect the objectives of the NSW Climate Change Policy Framework.

5.0 Evaluation of Greenhouse Gas Mitigation Measures

This GHGEA is required to assess reasonable and feasible measures to minimise the Revised 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] NSWLEC 221*).

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

5.1 Improving On-site Diesel Use Efficiency

Table 5.1 includes the mitigation measures assessed for minimising greenhouse gas emissions from on-site diesel use.

Table 5.1 Options Assessed for On-site Diesel Use

Potential Mitigation Measure	Planned for Project	Reason for Inclusion/Exclusion
1. Alternative fuels such as Biodiesel, CNG or Hydrogen	No	Daracon may investigate utilising alternate fuels where practicable.
2. Fuel efficient equipment	Yes	New equipment purchased will be assessed for fuel use efficiency. Hybrid or other technology will be considered as technology evolves.
3. Blasting strategies to improve extraction efficiency	Yes	Blast design will be focused around fragmentation efficiency and continuously updated from results of previous blasts.

Table 5.2 includes the mitigation measures assessed for minimising greenhouse gas emissions from haul trucks.

Table 5.2 Options Assessed for Haul Trucks

Potential Mitigation Measure	Planned for Project	Reason for Inclusion/Exclusion
4. Limiting the length of material haulage routes	Yes	Quarry development plan is designed to minimise the length of haul roads.
5. Optimising ramp gradients	Yes	Ramp gradients will be optimised within the quarry footprint for fuel use efficiency.
6. Fuel efficient haul trucks	Yes	New equipment purchased will be assessed for fuel use efficiency. Hybrid and other technology will be considered as technology evolves.
7. Increasing haul truck payload	Yes	Payloads will be maximised under the conditions imposed by OEM safety guidelines.
8. Improving rolling resistance of haul roads	Yes	Roads to be maintained to Daracon policy and consistently maintained.

Potential Mitigation Measure	Planned for Project	Reason for Inclusion/Exclusion
9. Reducing idling times	Yes	The number of haul trucks on site will be optimised for to eliminate queuing and minimise idle time. Loaders are selected to load in the most efficient time.
10. Alternative fuels such as Biodiesel, CNG or Hydrogen	No	Daracon may investigate utilising alternate fuels where practicable.

It is noted that fuel use is a key operating cost and there is therefore a financial incentive for the quarry to implement measures which improve fuel efficiency and reduce fuel use.

5.2 Improving Electricity Efficiency of Processing Equipment

Table 5.3 includes the mitigation measures assessed for minimising greenhouse gas emissions from consuming electricity.

Table 5.3 Options Assessed for Electricity Use

Potential Mitigation Measure	Planned for Project	Reason for Inclusion/Exclusion
11. Upgrade processing equipment to reduce electricity consumption	Yes	Energy efficiency will be an important selection criterion when purchasing new equipment. Daracon is committed to replacement of the existing tertiary crusher with new plant which is more efficient
12. High efficiency motors	Yes	Daracon is committed to implementing all economically reasonable energy efficiency opportunities
13. Variable Speed Drives	Yes	Daracon is committed to implementing all economically reasonable energy efficiency opportunities
14. Optimising motor size to load	Yes	Daracon is committed to implementing all economically reasonable energy efficiency opportunities
15. On-site renewable energy (solar)	Yes	Daracon is committed to implementing all economically reasonable energy efficiency opportunities

The Revised Project is planning to utilise many of the common greenhouse gas mitigation measures available for a hard rock quarry. The Revised Project will mitigate Scope 1 and 2 emissions through energy efficiency initiatives. The energy efficiency of quarry operations is driven by energy use and productivity. Energy efficiency is maximised when equipment is operated at optimal capacity. Daracon's quarry planning process optimises operational productivity through scheduling, haul road design and equipment selection.

6.0 Conclusion

The Revised Project is expected to generate Scope 1 emissions of up to 122,000 t CO_2-e over the life of the quarry. On an annual basis, the Revised Project could generate up to 5,000 t CO_2-e Scope 1 emissions per annum. The Revised Project's annual emissions are well below National Greenhouse Gas and Energy Act reporting thresholds (25,000 t CO_2-e pa) and Safeguard Mechanism thresholds (100,000 t CO_2-e pa). The Scope 1 emission intensity of the Revised Project is similar to other hard rock quarries approved for operation in NSW.

Over the life of the quarry, the Revised Project can also be associated with 45,000 t CO_2-e Scope 2 emissions and 170,000 t CO_2-e of Scope 3 emissions. The Revised Project does not generate a large demand for electricity, and the majority of Scope 3 emissions are associated with product transport. Approximately 78% of total Scope 1 and 3 emissions are associated with product transport.

The Revised Project will mitigate greenhouse gas emissions through ongoing energy efficiency initiatives and optimising productivity.

7.0 References

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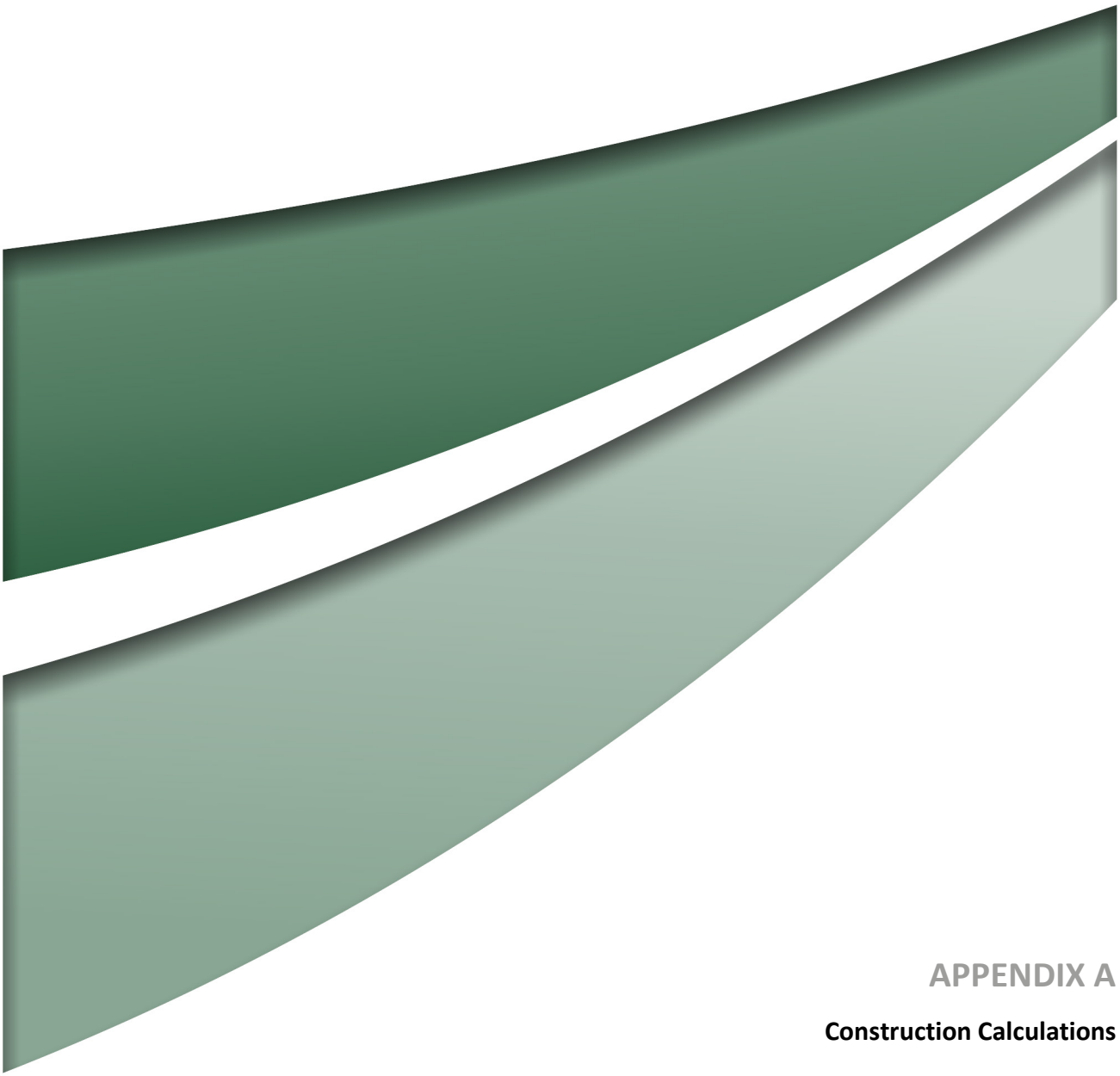


APPENDIX A

Construction Calculations

Construction Calculations

The greenhouse gas emissions for the construction phase of the Revised 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 Revised Project.

The assumptions are:

- The new road will be built 10 m wide and use 640 mm of CBR15, 150 mm of DGS40, 150 mm of DGB20 and 14 mm of AC14.
- The rail spur will consume 45 t of track steel, 90 t of concrete sleepers (N50), 10 t of concrete (N40) and 1,800 t of ballast.
- The heavy vehicle bridge will consume approximately 25 t of steel, 570 t of concrete (N40) and 56 m^3 of asphalt.
- Concrete will be sourced locally.
- Steel will be sourced from Newcastle.
- Road base will be sourced locally.
- Bulk density of concrete is 2,400 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.
- Nominal average payload of trucks is 32 t.

Appendix A – Construction Calculations

Construction Materials

Activity Data			Emission Factors[2]	GHG Emissions
Material Type	**Usage**	**Unit**	**t CO_2-e/Unit**	**t CO_2-e**
Steel	70	t	1.95	137
Concrete (N40, N50)	1,608	t	0.265	426
Asphalt	403	t	0.071	29
			Total GHG emissions (t CO_2-e)	**592**

Energy Use during Construction

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
86.840	38.6	3,352	69.9	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)			233	0	1
				Total GHG Emissions (t CO_2-e)	**234**

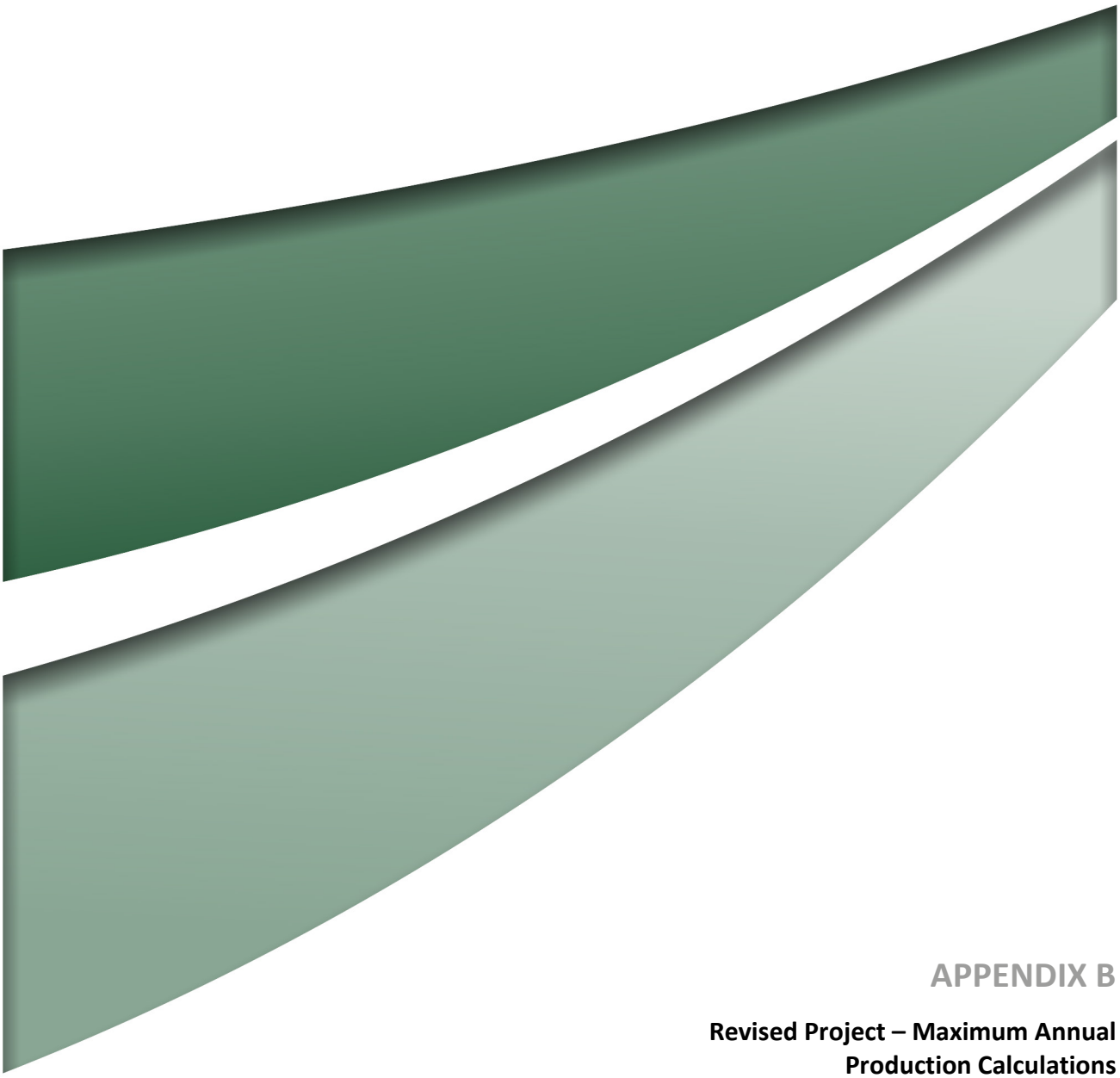
Transport of Materials – Proponent's trucks

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
5.005	38.6	193	69.9	0.1	0.5
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			13	0	0
				Total GHG Emissions (t CO_2-e)	**13**

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	3,545	3.6	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)		13	N/A	N/A
			Total GHG Emissions (t CO_2-e)	**13**

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



APPENDIX B

Revised Project – Maximum Annual Production Calculations

Appendix B - Revised Project – Maximum Annual Production Calculations

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
770	38.6	29,722	69.9	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)			2,078	3	6
				Total GHG Emissions (t CO_2-e)	**2,087**

Transport Diesel Use – Proponent's tucks

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
1,023.75	38.6	39,517	69.9	0.1	0.5
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			2,762	4	20
				Total GHG Emissions (t CO_2-e)	**2,786**

Electricity Use

Activity Data	Energy Use	Emission Factors		
		CO_2	CH_4	N_20
kWh	GJ	kg CO_2-e / GJ	kg CO_2-e / GJ	kg CO_2-e / GJ
2,200,000	7,920	225	NA	NA
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)		1,782	N/A	N/A
			Total GHG Emissions (t CO_2-e)	**1,782**

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	69,239	3.6	N/A	N/A
Electricity	7,920	25	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)		447	N/A	N/A
			Total GHG Emissions (t CO_2-e)	**447**

Product transport – 3rd party contractors

Activity Data				Emission Factors		
						Full Life Cycle – Scope 3
Transport mode	Usage	Units	GJ			kg CO_2-e/GJ
Truck	614.25	kL	23,710			74.1
						t CO_2-e
					Total GHG Emissions (t CO_2-e)	**1,757**

Product Transport - Rail

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	600,000	436	261,600,000	0.0174000	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)				4,552	N/A	N/A
					Total GHG emissions (t CO_2-e)	**4,552**

Materials Transport

Activity Data				Emission Factors		
						Full Life Cycle – Scope 3
Transport mode	Diesel use	Units	GJ			kg CO_2-e/GJ
Explosives – Truck transport	0.42	kL	16			74.1
Purchased diesel – Truck transport	3.08	kL	119			74.1
						t CO_2-e
					Total GHG emissions (t CO_2-e)	**10**

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