Premise

BETTERGROW

DA FOR EXTRACTIVE INDUSTRY 2152 GOOLMA RD, TWO MILE FLAT

GREENHOUSE GAS ASSESSMENT

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Prepared By		**Reviewed By**		**Authorised By**	
Hugh Shackcloth Bertinetti	[redacted]	David Walker	[redacted]	David Walker	[redacted]

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1. INTRODUCTION

1.1 Overview

Premise has been commissioned by Bettergrow Pty Ltd to prepare a Greenhouse Gas Assessment (GGA) to accompany a Statement of Environmental Effects (SEE) for the construction and operation of a hard rock quarry on land 1988 and 2152 Goolma Road (Lot 1 DP1083951 and Lot 1 DP1096542), Two Mile Flat.

The proposed development is to be known as Two Mile Flat Quarry and is located approximately 23.5 kilometres west of Gulgong within the Mid-Western Local Government Area (LGA).

As detailed in the SEE the proposed quarry is to consist of an approximate average production capacity of up to 30,000 tonnes per annum.

The potential for future expansions to the production capacity would be determined following the initial establishment of the quarry and market. Future expansions, if pursued, would be subject to a separate development application including an updated assessment of GHG emissions.

1.2 Scope

This assessment has been prepared to support the preparation of the SEE and provides an assessment of GHG emissions with the potential to result from the construction and operation of the proposed project.

Estimations of GHG emissions have been categorised, calculated and quantified in accordance with the methods contained in relevant standards and guidelines detailed in **Section 4.4** of this report. The significance of estimated emissions, generated by the project, is assessed with reference to the emission levels at state and national levels.

The scope of this GGA includes:

- An estimation of direct and indirect GHG associated with the proposed project
- An estimation of energy use associated with the proposed project
- An evaluation of the proposed project's GHG emissions in comparison to emissions and policies implemented at state, national and international levels.
- Recommendations for reasonable measures to ensure efficient energy use and to minimise the greenhouse gas emissions of the proposed project.

1.3 Report Structure

This report is set out in the following format:

- **Section 1** provides an overview of the project, defines the scope of this assessment and details the report structure.
- **Section 2** provides a description of the proposed project.
- **Section 3** provides a background d to the assessment of GHG including a consideration of the greenhouse effect, the categorisation of GHG emissions and their relationship to climate change and global warming.
- **Section 4** outlines the legislative context and guidance applying to GHG emissions including responses at the International, National and State levels together with guidance documentation on the estimation of GHG emissions.

- **Section 5** details the methodology used to quantify and assess the generation of GHG emissions resulting from the proposed project.
- **Section 6** presents the estimated GHG emissions resulting from the construction and operation of the project. It contains a comparison to existing state and national emission levels together with an assessment of GHG impacts with respect to the environment, climate change and policy objectives.
- **Section 7** presents recommendations for the management and mitigation of GHG emission sources associated with the project.
- **Section 8** provides a conclusion for the assessment.

2. PROJECT DESCRIPTION

2.1 The Site

The subject site is identified as Lot 1 DP 1083951 and Lot 1 in DP 1096542, 2152 & 1988 Goolma Road, Two Mile Flat. The subject site is located in a rural setting approximately 6.4km from the village of Goolma with the quarry area 8.1km from Goolma. Vehicular access to the quarry site is available from Goolma Road, a classified road which traverses the subject site.

The vast majority of the subject site is for agricultural purposes including livestock grazing and cropping.

The confine of the quarry is positioned in the south-western extent of Lot 1 in DP 1096542. The nearest unrelated residential receiver is located approximately 1.2km west.

The site is depicted in **Figure 1**.

The following site features are noted and are further assessed as part of the SEE:

- The site is zoned RU1 – Primary Production, pursuant to the *Mid-Western Regional Local Environmental Plan 2012 (LEP)* and the carrying out of extractive industries is permitted with consent;
- 2152 Goolma Road contains a local heritage item, being Morrowolga Homestead
- 2152 Goolma Road is bounded to the north and west by the Cudgegong River, which is mapped as containing biodiversity values;
- The site contains areas of mapped sensitive terrestrial biodiversity, including a small area in proximity to the nominated quarry footprint;
- The site is mapped as groundwater vulnerable.

2.1 Development Description

The proposed development entails the purposes of extractive industry. The footprint of the proposed quarry is identified within the attached development plans provided in Appendix A of the SEE. The remainder of the subject site will continue to be used for extensive agricultural purposes.

The development is formed of one distinct quarry pit which accounts for the overall extraction volume of approximately 30,000 tonnes per year. The extracted material would provide material suitable for road base with the stockpile and processing area encompassed within the quarry boundaries.

The layout of the proposed development is depicted in **Figure 2.**

2.2 Construction

An assessment of impacts posed by construction activities is provided within the SEE.

Typical with existing quarry operations of similar production capacities, the construction of the proposed quarry is expected to include the following activities:

- Clearing of vegetation and topsoil.
- Establishment of temporary construction compounds and workforce accommodation where necessary.
- Utility relocation, adjustments and/or connections.
- Construction of new access tracks roadways and water crossings or upgrades to existing access arrangements.
- Road improvement works.
- Implementation of environmental management measures and security fencing.
- Construction of site office and buildings ancillary to ongoing operation.

2.3 Operations

As detailed in the SEE the proposed quarry is to consist of an approximate average production capacity of up to 30,000 tonnes per annum. This GHG assessment has considered that the quarry will operate for a minimum period of at least 10 years. The minimum 10-year period has been applied as the approximate lifespan of the quarry project.

Typical with existing quarry operations of similar production capacities, the operation of the proposed quarry is expected to include the following activities:

- Quarried Materials are to be extracted by excavators, loaded onto a dump truck within the pit and transported to an onsite laydown area
- Quarried materials would be crushed and screened within the laydown area prior to stockpiling.
- Wheeled loaders would collect stockpiled material and load it onto trucks for offsite transport.
- No waste materials are generated, and no blasting is performed as part of the quarries operation.

Figure 1 – The Subject Site (Source: Premise)

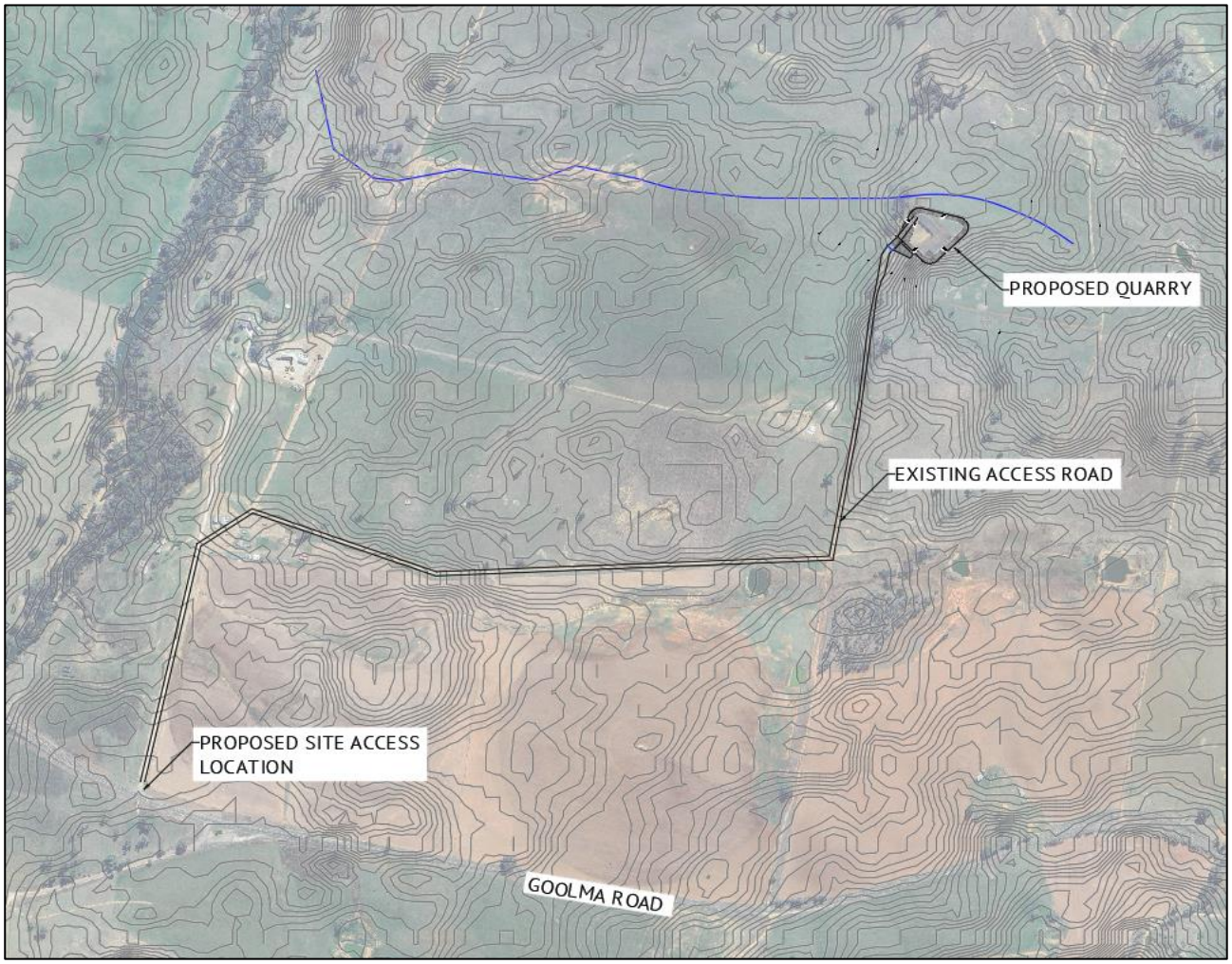
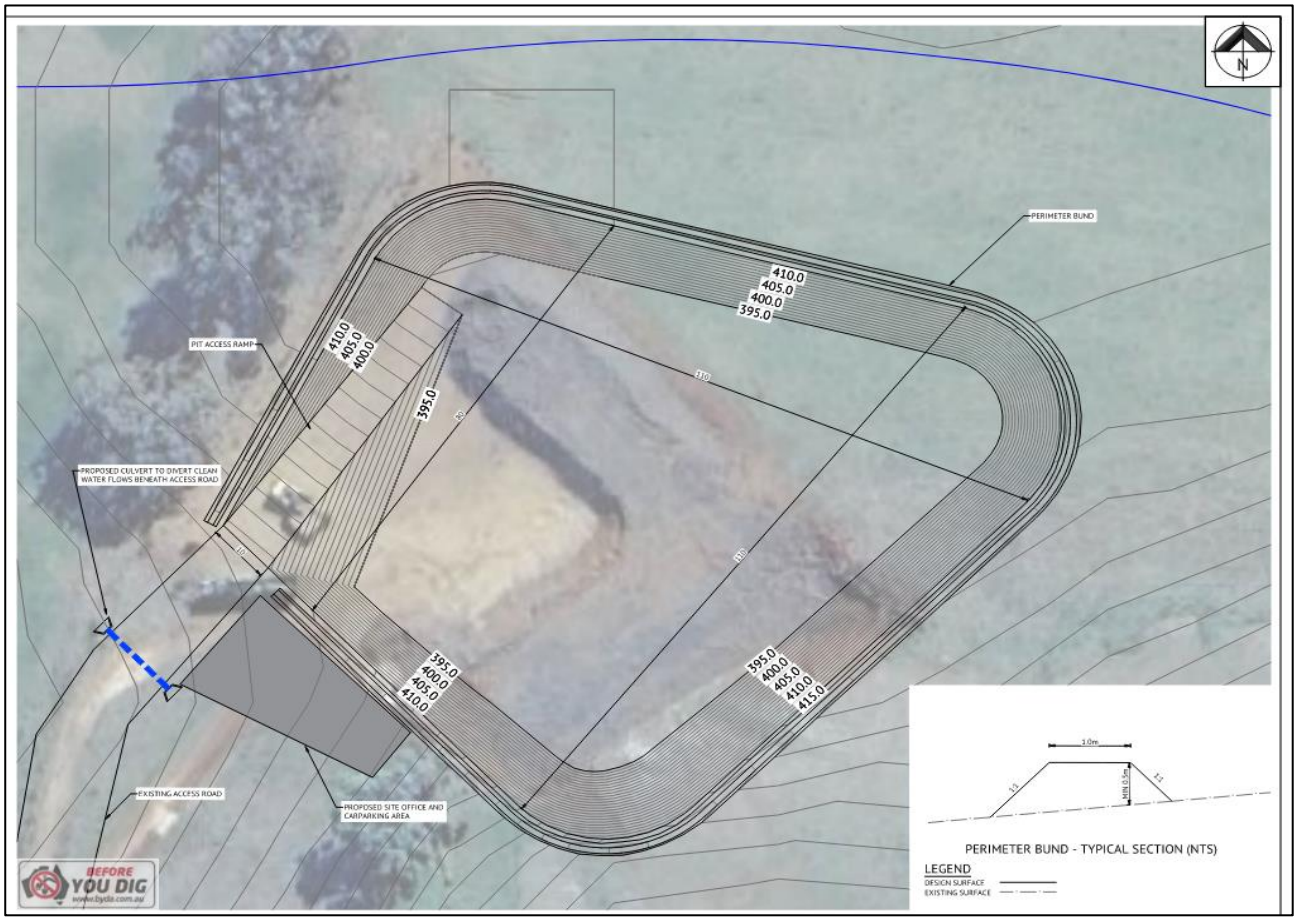


Figure 2 – Site Plan (Source: Premise)



3. BACKGROUND

3.1 Defining GHG Emissions

The *2023 National Greenhouse Accounts Factors Workbook* (NGA Factor Workbook) prepared by the Department of Climate Change, Energy, the Environment and Water (DCCEEW, 2023a) provides two (2) classifications for GHG emissions including direct and indirect emissions.

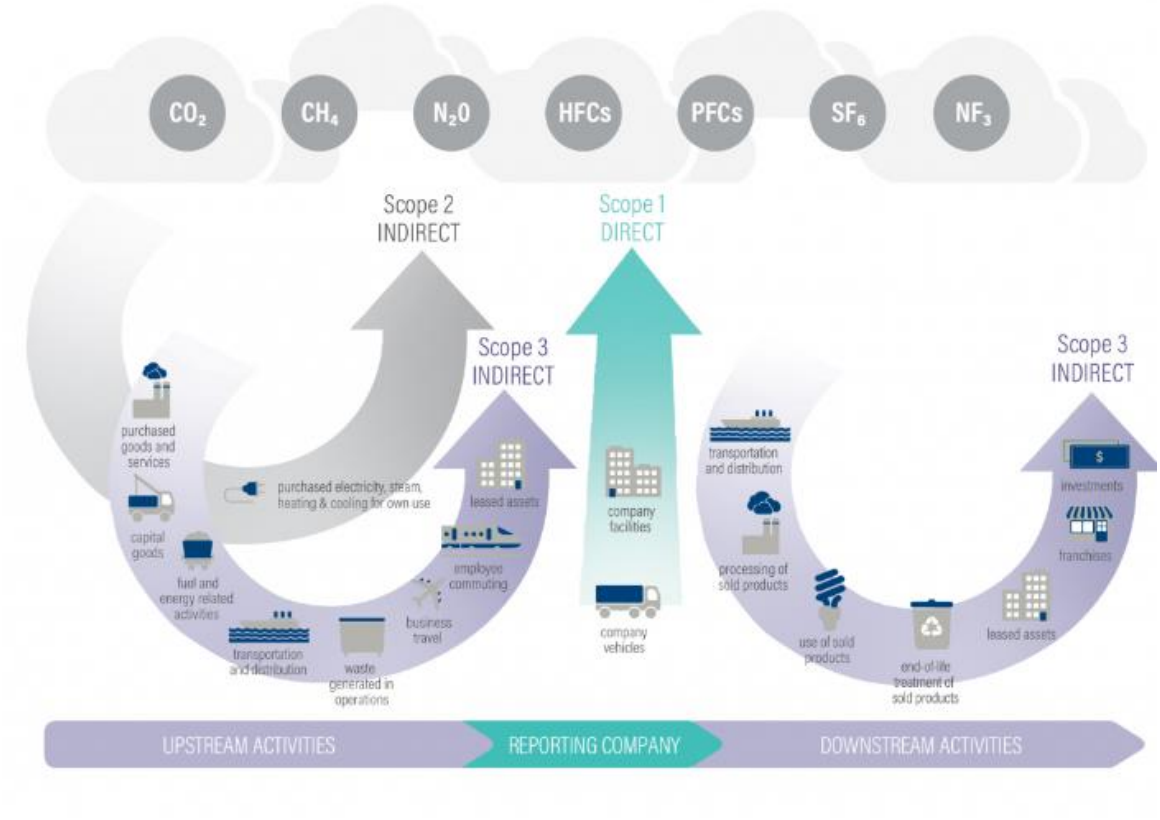
Direct and indirect emission types are further categorised via the NGA Factor Workbook and the GHG protocol into three (3) separate emission scopes. This categorisation allows for the determination of GHG emissions that can be directly controlled by a project and those that have a limited potential to be influenced. A description of emission types and scopes is provided **Table 1** and **Figure 3.**

This GHG assessment considers both direct and indirect GHG emissions resulting from the project and has been prepared to assess emissions within each emission scope. GHG emissions associated with the proposal have been categorised into scopes and estimated as far as practical in accordance with the GHG Protocol and NGA Factor Workbook.

Table 1 – GHG Emission Type and Scope

Emission Type	Emission Scope and Description[1]
Direct	*Direct (or scope 1) emissions are produced from sources within the boundary of an organisation and as a result of that organisation's activities. They are calculated at the point of emission release. These emissions include those from the following activities:* • *generation of energy, heat, steam and electricity, such as fuel combustion in generators;* • *manufacturing processes which produce emissions such as cement, aluminium and ammonia production;* • *transportation of materials, products, waste and people; such as the use of vehicles owned and operated by the reporting organisation;* • *intentional or unintentional GHG releases (fugitive emissions) such as methane emissions from coal mines, natural gas leaks from joints and seals; and* • *solid waste disposal and wastewater treatment including on-site waste management.*
Indirect	*Indirect emissions are emissions generated in the wider economy as a consequence of an organisation's activities but which are physically produced by the activities of another organisation. There are two classes of indirect emissions; electricity and other.* *Scope 2 emissions are indirect emissions which occur as a result of activities that generate electricity, heating, cooling or steam that is consumed by an organisation but which is generated outside that organisation's boundaries. They are physically produced by the burning of fossil fuels by the generator of the electricity* *Scope 3 emissions are indirect emissions, other than electricity (scope 2), which occur outside of the boundary of an organisation as a result of actions by the organisation. Scope 3 emissions may occur:* • *upstream, such as the emissions generated in the extraction and production of fossil fuels;* • *downstream, such as the emissions from transport of an organisation's product to customers, or the emissions from outsourced activities.*
[1]Adapted from NGA Factors (DCCEEW, 2023a)	

Figure 3 – Overview of GHG Protocol Scopes and Emissions (WRI, 2023)



3.2 Global Warming Potential

The Global Warming Potential is an index established by the Intergovernmental Pannel on Climate Change (IPCC) to allow for a comparison of non-CO2 GHGs based on their contribution to the greenhouse effect. GWPs are periodically reviewed by the IPCC in line with improvements to scientific knowledge on climate change and are used to calculate a CO_2-equivalenece (CO_2-e) for non-CO_2 GHGs.

The 100-year GWPs of potential relevance to the project, reported in IPCC's 4th (IPCC, 2007), 5th (IPCC, 2013) and 6th (IPCC, 2021) assessment reports (AR4, AR5 and AR6) and supplementary material are reproduced in **Table 2**.

GWP values reported in AR5 have been used in this assessment in accordance with the current National Greenhouse Energy Reporting (NGER) requirements adopted in Australia (CER, 2022).

Table 2 – GHG Emissions, 100 Year GWPs

Gas	Chemical Formula	IPCC Global Warming Potentials (100 year horizon)		
		AR4	AR5	AR6
Carbon Dioxide	CO_2	1	1	1
Methane	CH_4	25	28	27.9

Gas	Chemical Formula	IPCC Global Warming Potentials (100 year horizon)		
		AR4	AR5	AR6
Nitrous oxide	N_2O	298	265	273

No significant sources of other GHGs (such as perfluromethane, sulphur hexafluoride, chlorofluorocarbons, hydrofluorochlorocarbons hydrofluorocarbons etc,) have been identified as part of the project and no further consideration of other emissions is therefore provided as part of this assessment.

4. LEGISLATIVE CONTEXT AND GUIDANCE

4.1 International Framework

4.1.1 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

The Intergovernmental Panel on Climate Change (IPCC) is a united nations body that prepares comprehensive assessment reports about the state of scientific, technical and socio-economic knowledge on climate change, including its impacts and future risks, together with options for reducing the rate at which climate change is taking place. It seeks to establish an objective source of information for decision makers and other parties interested in climate change. The IPCC actively produce assessments on topics agreed to by member governments and publish methodology reports which provide guidelines for the preparation of greenhouse gas inventories.

4.1.2 UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 and entered into force on the 21 March 1994. It was established following the release of the firsts technical report written by the IPCC and sets an international framework to manage climate change, aiming to prevent dangerous human interference with the climate system. The UNFCCC currently has 168 signatories including Australia.

4.1.3 THE EQUATOR PRINCIPLES

The equator principles (EP) are a financial industry benchmark for determining, assessing and managing environmental and social risk in projects. They intend to serve as a common baseline and risk management framework for financial institutions to identify, assess and manage risks associated with financing a project.

Originally launched in 2003 the EPs were established based on the International Finance Corporations' (IFC) performance standards which provide comprehensive approach to managing environmental and social risks for private investments The EP Association periodically publishes reports to update the principles for financial institutes based on the implementation, expertise and learning by EP Financial Institutions and wider stakeholders, together with changes to the operating environment and emerging good practice.

The fourth iteration of the Equator Principles was published in July 2020 (Equator Principles Association,2020). Currently 140 financial institutions are registered as members of the EPs including but not limited to: ANZ Group Holdings Limited, the Commonwealth Bank of Australia and the National Australia Bank Limited.

Principle 10 of the EPs provides commitments for member institutions with respect to financing projects and their clients, including for Category A projects (meaning those with potential significant adverse environmental and social risks) and Category B projects (meaning those with potential limited adverse

environmental and social risk) (EP, 2020). The following reporting requirements are provided for clients of member institutions:

For all Category A and, as appropriate, Category B Projects:

- *The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online and that it includes a summary of Human Rights and climate change risks and impacts when relevant 11.*
- *The client will report publicly, on an annual basis, GHG emission levels (combined Scope 1 and Scope 2 Emissions, and, if appropriate, the GHG efficiency ratio12) during the operational phase for Projects emitting over 100,000 tonnes of CO2 equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting.*
- *The EPFI will encourage the client to share commercially non-sensitive Project-specific biodiversity data with the Global Biodiversity Information Facility13 (GBIF) and relevant national and global data repositories, using formats and conditions to enable such data to be accessed and re-used in future decisions and research applications.*

Emissions for the construction and operational phase of the project are not anticipated to exceed the annual threshold of 100,000 t CO2-e. Accordingly the project is not anticipated to require additional reporting responsibilities resulting from financing arrangements and the membership of a financing institute to the EP.

4.1.4 THE KYOTO PROTOCOL

The Kyoto Protocol (KP) is an international agreement on climate change developed under the UNFCCC and entered into force in 2005. The protocol establishing binding targets and commitments for member states to limit and reduce GHG emissions. There are 192 parties currently registered to the KP and regular meetings known as Conferences of the Parties (COPs) are held each year to promote the implementation of the UNFCCC and commitments of the KP.

Australia is registered as an Annex I Party and has committed to implementing domestic policy to meet national GHG emission reduction targets This has included commitments to meet national GHG emission reduction targets between 2008 and 2012 together with targets for a second commitment period between 2013 and 2020.

Australia met and exceeded the reduction target of 108% of 1990 emissions by 2012 for the first reporting period (Climate Analytics, 2019). The second commitment period established a target of 99.5% of 1990 emission levels by 2020. The CER has recently announced that Australia has met its emission targets under the second commitment period, with an international review process to confirm compliance planned for 2024 (CER, 2023).

4.1.5 THE PARIS AGREEMENT

The Paris Agreement (PA) is a legally binding international treaty on climate change. it was adopted by 196 parties at COP21 in 2015 and entered into force in 2016. The agreement aims to strengthen the global response to the threat of climate change with objectives to:

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

Australia is party to the PA and must submit emission reduction commitments known as Nationally Determined Contributions (NDCs) every five years to the UNFCCC. Australia submitted its first NDC in 2015 (DCCEEW, 2023b).

An updated NDC commitment to reducing Australia's GHG emissions by 43% below 2005 by 2030 was submitted in 2022 and provided clarification that Australia would not carry over any overachievement on the 2020 target or the Kyoto Protocol to meet revised targets of the Paris Agreement (Australian Government, 2022). Australia has committed to submitting its second NDC to the UNFCCC in 2025 (DCCEEW, 2023)

4.2 National

The Australian Government Clean Energy Regulator (CER) administers schemes for measuring managing reducing and offsetting the generation of carbon Emissions within Australia.,

Schemes administered by the CER include:

- The Renewable Energy Target, under the *Renewable Energy (electricity) Act 2000*
- The National Greenhouse and Energy Reporting Scheme, under the *National Greenhouse and Energy Reporting Act 2007*
- The Australian Carbon Credit Unit (ACCU) Scheme (formerly known as the Emissions Reduction Fund), under the *Carbon Credits (carbon Farming Initiative) Act 2011*
- The Australian National Registry of Emission Units (ANREU), under the *Australian National Registry of Emissions Units Act 2011*

4.3 State

Several additional policies are implemented by the state government of NSW to support national commitments to reducing GHG emissions. This includes the net zero plan and electricity strategy initially implemented as part of the *NSW Climate Change Policy Framework* (OEH, 2016) which provides the following directions:

- *create a certain investment environment by working with the Commonwealth to manage transition*
- *boost energy productivity, put downward pressure on household and business energy bills*
- *capture co-benefits and manage unintended impacts of external policies*
- *take advantage of opportunities to grow new industries in NSW*
- *reduce risks and damage to public and private assets in NSW arising from climate change*
- *reduce climate change impacts on health and wellbeing*
- *manage impacts on natural resources, ecosystems and communities.*

Recent strategies jointly made by the State Government of NSW and the NSW Environment Protection Authority (EPA) under the publication of the *Climate Change Action Plan 2023-26* (EPA, 2023) and the *EPA Climate Change Policy* (EPA, 2023) are further seeking to establish obligations for premises undertaking licenced activities within NSW to commit to reducing GHG emissions, including measures to implement climate change mitigation and adaptation plans (CCMAPs), emission reduction targets, GHG emission monitoring and limits for activities requiring an EPL.

For the avoidance of doubt the proposed development is not anticipated to require a licence for extractive activities under Schedule 1 clause 19 of the *Protection of the Environment Operations Act 1997* (POEO Act). The operation of the proposed development would be restricted to an annual production capacity of 30,000 tonnes and is therefore below the threshold for licencing provided under Schedule 1 clause 19 of the POEO Act. Notwithstanding this, an evaluation of GHG emissions estimated to result from the proposed development, is compared to state and national objectives within **Section 6.3** of this GHG Assessment.

Measures to mitigate the generation of GHG emissions during the construction and operation of the proposed development are provided in **Section 7.**

4.4 Guidelines for the Estimation of GHG Emissions

The accounting and reporting principals adopted by this GHG, including the quantification of GHG emissions associated with the proposed project, are based on the emission factors and reporting methods available in the following documentation:

- The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) GHG Protocol: A Corporate Accounting and Report Standard (WRI and WBCSD, 2004)
- ISO 14064 including:
  - ISO 14064-1:2018 (Greenhouse Gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removal).
  - ISO 14064-2: 2019 (Greenhouse Gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of GHG emission reductions or removal enhancements).
  - ISO 14064-3: 2019 (Greenhouse Gases – Part 3: Specification with guidance for the validation and verification and validation of GHG statements).
- The National Greenhouse and Energy Reporting Scheme,
- The National Greenhouse Accounts Factors, and
- Guidance Documentation from the Clean Energy Regulator

5. METHODOLOGY

The quantification of GHG emissions resulting from the construction and operation of the project has been performed using the following process:

1. Identification of GHG emission sources within resulting from the construction and operation of the project
2. Identification of appropriate emission calculation methods and factors for each emission source.
3. Identification of Activity data for each emission source identified.
4. Estimation of GHG emissions resulting from the proposed project.

5.1 Emission Source Identification

A review of construction and operational activities proposed by the project has been undertaken to identify and categorise GHG emissions. The emission sources that have been considered in the estimation of GHG emissions are summarised in **Table 3.**

As detailed in **Section 5.4** some of the above emissions have been excluded from this assessment.

Table 3 – Project GHG Emissions Sources

Project Activity	Scope 1	Scope 2	Scope 3
Construction			
Land Clearing	• Emissions from fuel combustion (i.e. diesel) associated with land clearing	-	• Emissions associated with the extraction and refinement of fuels consumed.
Project Infrastructure Installation	• Emissions from fuel combustion (i.e. diesel) in construction equipment (i.e cranes, dozers, haul trucks and excavators etc.)	-	• Emissions associated with the extraction and refinement of fuels consumed and the generation of construction equipment and materials.
Vehicle movements transporting staff and equipment	• Emissions from fuel combustion (i.e. diesel/ petrol) in light vehicles and trucks located within the study area.	-	• Emissions associated with the extraction and refinement of fuels consumed. • Emissions from fuel combustion (i.e. diesel/ petrol) in private vehicles used to transport staff and equipment to and from the study area.
Oil and Grease Usage	• Consumption of non-combustible oils and greases (i.e for maintenance of project infrastructure).	-	-

Project Activity	Scope 1	Scope 2	Scope 3
Electricity Consumption	-	• Electricity used from the grid.	-
Waste Management	-	-	• Emissions from the decomposition of organic material in landfill
Operation			
Vehicle movements transporting staff and equipment	• Emissions from fuel combustion (i.e. diesel) associated with ongoing production and maintenance activities	-	• Emissions from fuel combustion in private vehicles used to transport staff and equipment to and from the study area.
Electrical Consumption	-	• Electricity used from the grid.	-
Waste Management	-	-	• Emissions from the decomposition of organic material in landfill

5.2 Emission Factors

5.2.1 SCOPE 1 FACTORS

Scope 1 emission factors used to estimate GHG emissions are summarised in **Table 4.**

Table 4 – GHG Emission Factors – Scope 1

Emission Source	Energy Content Factor (GJ/kL)	Scope 1 - Emission Factor				
		CO_2	CH_4	N_2O	Total	Units
Fuel Use – Stationary and Off-Road[1]						
Gasoline	34.2	67.4	0.2	0.2	67.40	kg CO_2-e/GJ
Diesel	38.6	69.9	0.1	0.2	70.20	kg CO_2-e/GJ
Fuel Use – Transport (on road vehicles, rail, marine, air)[2]						
Cars and light commercial vehicles						
Gasoline	34.2	67.4	0.02	0.2	67.62	kg CO_2-e/GJ
Diesel	38.6	69.9	0.01	0.5	70.41	kg CO_2-e/GJ
Heavy Duty Vehicles						
Diesel*	38.6	69.9	0.1	0.4	70.4	kg CO_2-e/GJ
Oils and Greases[1]						
Petroleum based oils	38.8	13.9	0.0	0.0	13.9	kg CO_2-e/GJ
Petroleum based greases	38.8	3.5	0.0	0.0	3.5	kg CO_2-e/GJ

[1]NGA Factors (2023), Table 8 -Direct (Scope 1) and indirect (scope 3) emission factors for the consumption of liquid fuels, including certain petroleum based products for stationary energy purposes.-

Emission Source	Energy Content Factor (GJ/kL)	Scope 1 - Emission Factor				
		CO_2	CH_4	N_2O	Total	Units
[2]NGA Factors (2023), Table 9 -Direct (scope 1) and indirect (scope 3) emission factors for the consumption of transport fuels in different transport equipment **Note: Diesel for Heavy Vehicle Use is based on the classification of diesel oil as Euro iii. This is consistent with fuel combustion emission factors presented under 'General Transport' in previous publications of the NGA Factors (see Table 4 of NGA Factors 2021)*						

5.2.2 SCOPE 2 FACTORS

Scope 2 emission factors used to estimate GHG emissions are summarised in **Table 5**.

Table 5 – GHG Emission Factors – Scope 2

Emission Source	Scope 2 - Emission Factor	
	Emission Factor	Units
Electricity Consumption[1]		
Scope 2 -Consumption from grid NSW	0.68 (188)	kg CO_2-e/kWh (kg Co2-e/GJ)
[1]NGA Factors (2023), Table 1 - Indirect (scope 2 and scope 3) emission factors from consumption of purchased or acquired electricity: Location based approach		

5.2.3 SCOPE 3 FACTORS

Scope 3 emission factors used to estimate GHG emissions are summarised in **Table 6**.

Table 6 – GHG Emission Factors – Scope 3

Emission Source	Energy Content Factor (GJ/kL)	Scope 3 - Emission Factor	
		Emission Factor	Units
Fuel Use – Stationary and Off-Road[1]			
Gasoline	34.2	17.2	kg CO_2-e/GJ
Diesel	38.6	17.3	kg CO_2-e/GJ
Fuel Use – Transport (on road vehicles, rail, marine, air)[2]			
Cars and light commercial vehicles			
Gasoline	34.2	17.2	kg CO_2-e/GJ
Diesel	38.6	17.3	kg CO_2-e/GJ
Heavy Duty Vehicles			
Diesel*	38.6	17.3	kg CO_2-e/GJ
Oils and Greases[1]			
Petroleum based oils	38.8	18.0	kg CO_2-e/GJ
Petroleum based greases	38.8	18.0	kg CO_2-e/GJ
Waste[3]			

Emission Source	Energy Content Factor (GJ/kL)	Scope 3 - Emission Factor	
		Emission Factor	Units
Municipal solid waste	-	1.6	t CO2-e/t
Commercial and industrial waste	-	1.3	t CO2-e/t
Construction and demolition waste	-	0.2	t CO2-e/t
Electricity Consumption[5]			
Scope 3 - Consumption from grid NSW	-	0.05 (15)	kg CO_2-e/kWh (kg CO2-e/GJ)
Embodied energy of Construction Materials[4]			
Steel	-	1.61	kg CO_2-e/kg
Concrete	-	0.95	kg CO2-e/kg
Copper	-	4.04	kg CO2-e/kg
Aluminium	-	10.00	kg CO2-e/kg
Asphalt	-	0.071	kg CO2-e/kg

[1]NGA Factors (2023), Table 8 -Direct (Scope 1) and indirect (scope 3) emission factors for the consumption of liquid fuels, including certain petroleum based products for stationary energy purposes.-

[2]NGA Factors (2023), Table 9 -Direct (scope 1) and indirect (scope 3) emission factors for the consumption of transport fuels in different transport equipment

*Note: Diesel for Heavy Vehicle Use is based on the classification of diesel oil as Euro iii. This is consistent with fuel combustion emission factors presented under 'General Transport' in previous publications of the NGA Factors (see Table 4 of NGA Factors 2021)

[3]NGA Factors (2023), Table 16 - Indirect (scope 3) waste emission factors for total waste disposed to landfill by broad waste stream category.

[4] Emission factors for materials associated with the construction of the project have been based on the GHG assessments for Martin's Creek (Umwelt 2021) and The Transgrid Humelink (SLR 2023) together with the factors provided from the University of Bath, Inventory of Carbon and Energy (ICE) v2.0, 2011.

[5]NGA Factors (2023), Table 1 - Indirect (scope 2 and scope 3) emission factors from consumption of purchased or acquired electricity: Location based approach

5.3 Activity Data

The emission factors provided in **Section 5.2** requires information on anticipated activity data (i.e fuel consumption) to project and estimate GHG emissions.

The activity data for this project has been informed by estimations made by the proponent together with a review of existing emission source values provided for other quarry projects across NSW. The following subsections outline the activity data and assumptions used to estimate GHG emissions during the construction and operation phase of the project.

A detailed description of activity data research and calculations is provided within **Appendix A** and **Appendix B.**

5.3.1 CONSTRUCTION

The activity data used to estimate GHG emissions during construction is summarised in **Table 7.**

Quantifying the GHG emissions for the project requires a number of assumptions to be made and are influence by factors including but not limited to the distances and trips of vehicles, material and product transport quantities, electrical consumption rates, and the hours for construction / operation.

The following assumptions have been used to estimate activity data during construction:

- All construction activities will be completed by the proponent.
- The project will represent similar emission source consumption rates to other quarry projects in NSW. For construction this includes the following average consumption rates:
  - Onsite / Stationary Diesel, 56 L per product tonne.
  - Transport Diesel, 4.55 L per product tonne.
- Activity Data outlined in **Section 5.4** has been excluded from emission calculations.

The activity values presented below have been informed by the average per tonne consumption rates of other quarry projects in NSW. These have been applied to the proposed 30,000tpa of the project to provide estimates of emission source use. The activity data research of other quarry projects in NSW is presented in **Appendix A.**

Table 7 – Activity Values during Construction

Scope	Emission Source	Activity Data Research[1]	Value	Energy (GJ)[2]
Scope 1 (Direct)	Diesel Use - Construction Stationary	Average Consumption rate for other projects is 56 L/t	1,680 kL	64,848.00
	Diesel Use - Material Transport	Average Consumption rate for other projects is 4.55 L/t	136.5 kL	5,268.90
Scope 3 (Indirect)	Associated with energy extraction and distribution	Value equal to sum of Scope 1 and 2 Emission Sources above.	1,816.50 kL	70,116.90

[1]Refer to Activity Data Research in **Appendix A.**

[2]NGA Emission Factors (DCCEEW, 2023a) The Energy Content Factor for diesel is 38.6 GJ/kL and the Energy Conversion Factor for kWH to GJ is 0.0036

5.3.2 OPERATIONS

The activity data used to estimate GHG emissions during operates is summarised in

Quantifying the GHG emissions for the project requires a number of assumptions to be made and are influence by factors including but not limited to the distances and trips of vehicles, material and product transport quantities, electrical consumption rates, and the hours for construction / operation.

The following assumptions have been used to estimate activity data during operation:

- The project will have an annual production capacity of 30,000 tpa.
- All products will be transported via truck (predominantly via truck and dog) operated by the proponent. Product transport shall generally consist of a nominal payload of 32 tonne.
- The project will represent similar emission source consumption rates to other quarry projects in NSW. For operation this includes the following average consumption rates:
  - Onsite / Stationary Diesel, 0.77 kL per product tonne
  - Transport Diesel, 1.26 kL per product tonne.

– Electricity, 2.17 kWh per product tonne

The activity values presented in below have been reviewed by the proponent and informed by the activity data average per tonne consumption rates for other quarry projects in NSW. The activity data research of other quarry projects in NSW is presented in **Appendix B.**

Table 8 – Activity Values during Operation

Scope	Emission Source	Activity Data Research[1]	Value	Energy (GJ)[2]
Scope 1 (Direct)	Diesel Use - Operation	Average Consumption rate for other projects is 0.77 L/t (excluding outliers)	23.1 kL	891.66
	Diesel Use - Product Transport	Average Consumption rate for other projects is 1.26 L/t (excluding outliers)	37.8 kL	1459.08
Scope 2 (Indirect)	Electricity	Average Consumption rate for other projects is 2.17 kWh/t	65,106 kWh	234.38
Scope 3 (Indirect)	Associated with energy extraction and distribution	Value equal to Scope 1 and 2 Emission Sources above.	60.90 kL and 65,106 kWh	2350.74 and 234.38

*[1]Refer to Activity Data Research in **Appendix B.***

[2]NGA Emission Factors (DCCEEW, 2023a) The Energy Content Factor for diesel is 38.6 GJ/kL and the Energy Conversion Factor for kWh to GJ is 0.0036

5.4 Limitations and Data Exclusions

The calculations provided in this assessment are based on activity data projections derived from existing quarry projects in NSW and the proponents review of expected emission sources. Average consumption rates per tonne produced have been calculated based on the following projects and used to inform the activity data for this GHG assessment:

- Cooma Road Quarry
- Jandra Quarry
- Lynwood Quarry
- Martin's Creek Quarry
- Oberon Quarry
- Sutton Forest Sand Quarry

For the purpose of this GHG assessment all activities where data was available have been estimated. **Table 9** outlines activity data that has been excluded from the assessment. Excluded activity data was not readily available and is considered unlikely to generate sufficient emissions that will generate material changes to impacts or significant influence to the decision-making outcomes of stakeholders. Data exclusions have been additionally been informed by the precedent set by other GHG assessments prepared for other approved quarry projects located across NSW (refer to **Appendix A** and **Appendix B**).

As outlined below gasoline / petrol use, industrial processes, wastewater handling, oil and grease consumption land use change construction materials, waste, employee and business travel were excluded and are not anticipated to significantly impact or present a major source of GHG emissions for the purpose of this assessment.

Table 9 – Data Exclusions

Emission Source Excluded	Scope	Description
Combustion of fuel for energy	Scope 1	Small quantities of fuels such as petrol and LPG.
Industrial Process	Scope 1	Sulphur hexafluoride (high voltage switch gear). Hydrofluorcarbon (commercial and industrial refrigeration).
Wastewater handling (industrial	Scope 1	Methane emissions from wastewater management
Consumption of oils and greases	Scope 1	Use of Petroleum based oils and greases (i.e maintenance of construction and operational equipment)
Land use Change	Scope 1	Emissions directly associated with the impact of vegetation clearing
Construction Materials	Scope 3	Steel, concrete and other materials used to install infrastructure and equipment at the site
Solid Waste	Scope 3	Decomposition of solid waste generated during the construction and operation outside of the project site.
Business travel	Scope 3	Employees travelling for business purposes
Employee travel	Scope 3	Employees traveling between their place of residence and the quarry site.

6. GHG IMPACT ASSESSMENT

6.1 Quantification of GHG Emissions

The proposed project includes activities during construction and operation which have the potential to result in GHG emissions. Construction and operational activities are assessed as separate phases in the following sections.

The operation phase of the project is assessed at its upper annual production capacity, indicated by the proponent as 30,000 tpa, to provide an annual estimation of GHG emissions.

Estimations of GHG emissions are additionally projected over the expected minimum operational life of the project, 10 years, to provide an indication of total emissions over the project's lifespan (refer to **Section 6.1.3**).

6.1.1 CONSTRUCTION EMISSIONS

GHG Emission calculations for the construction phase are detailed within **Appendix A** and summarised in **Table 10.**

Table 10 – Predicted Annual GHG Emissions for Construction

Scope	Emission Source	Source Totals (t CO2 -e)	Scope Totals (t CO2 -e)
Scope 1 (Direct)	Diesel Use - Construction Stationary	4552.33	4923.26
	Diesel Use - Material Transport	370.93	
Scope 3 (Indirect)	Associated with Energy Extraction and Distribution	1213.02	1213.02
		Total Annual GHG Emissions	**6136.28**

6.1.2 OPERATIONAL EMISSIONS

GHG Emission calculations for the operation phase are detailed within **Appendix B** and summarised in **Table 11.**

Table 11 – Predicted Annual GHG Emissions for Operation

Scope	Emission Source	Source Totals (t CO2 -e)	Scope Totals (t CO2 -e)
Scope 1 (Direct)	Diesel Use – Operation Stationary	62.60	165.32
	Diesel Use - Product Transport	102.72	
Scope 2 (Indirect)	Electricity	44.06	44.06
Scope 3 (Indirect)	Associated with energy extraction and distribution	44.19	44.19
		Total Annual GHG Emissions	**253.57**

6.1.3 LIFESPAN EMISSIONS

GHG Emission calculations for the lifespan of the project are based on the emission calculations for operation detailed within **Appendix B**. These have been projected over a 10-year period and summarised in **Table 12.**

Table 12 – Predicted GHG Emissions for 10-year Lifespan

Scope	Emission Source	Source Totals Over Lifespan (t CO2 -e)	Scope Totals Over Lifespan (t CO2 -e)
Scope 1 (Direct)	Diesel Use - Operation Stationary	626	1653
	Diesel Use - Product Transport	1027	
Scope 2 (Indirect)	Electricity	441	441
Scope 3 (Indirect)	Associated with energy extraction and distribution	442	442
		Total 10-year Lifespan GHG Emissions	**2536**

6.2 Comparison to other Quarries in NSW

Table 13 provided a comparison of annual operational GHG emissions estimated for the proposed quarry against the GHG emissions forecasted for other quarries in NSW. The GHG emissions estimated for the project are significantly less than other approved quarry projects, predominantly due to the limit in annual production capacity. Variance in GHG emissions between other quarry projects is anticipated to predominantly reflect differences in transport arrangements together with the boundary of the project area and annual revisions to NGA emission factors.

Table 13 – Comparison of Annual Operational GHG Emissions to other NSW Quarry Projects

Project	Annual Production Capacity	GHG Emission Forecasts (t Co2 – e per year)			Reference
		Scope 1	Scope 2	Scope 3	
Two Mile Falt Quarry (This Project)	30,000	165.32	44.06	44.19	Refer to **Section 6.1** of this assessment.
Brandy Hill Quarry	1,500,000	296,073	85,427	41,243	Vipac Engineers & Scientists Ltd 2016, Brandy Hill Quarry Air Quality Assessment
Cooma Road Quarry	1,500,000	3,600	1,900	1,900	Umwelt 2012, Cooma Road Continued Operations Project, EIS
Jandra Quarry	475,000	1,782	905	318	Edge Environment 2014, Jandra Quarry Intensification Project Greenhouse Gas Emissions Assessment
Lynwood Quarry	5,000,000	6,614	28,518	49,254	Umwelt 2005, Proposed Lynwood Quarry, Marulan, EIS

Project	Annual Production Capacity	GHG Emission Forecasts (t Co2 – e per year)			Reference
		Scope 1	Scope 2	Scope 3	
Martin's Creek Quarry	1,100,000	4,873	1,782	6,766	Umwelt 2021, Revised Martins Creek Quarry Extension Project, EIS
Oberon Quarry	400,000	3,900	700	470	Umwelt 2015, Proposed Extended Life of Operations and Development Changes to Oberon Quarry, EIS
Sutton Forest Sand Quarry	700,000	2,954	2,752	1,721	Pacific Environment 2018, Sutton Forrest Sand Quarry, Air Quality and Greenhouse Gas Assessment
Tevan Quarry	500,000	3,746	-3,913	-587	Umwelt 2014, Teven Quarry Project, EIS

6.3 State and National Context

6.3.1 EXISTING GHG EMISSIONS

This section presents a summary of the most recent GHG emissions inventory data available for Australia and NSW to provide context for the GHG emissions estimated to occur as a result of the project.

The *National Greenhouse Gas Inventory* (DCCEEW, 2023c) and the *National Greenhouse Gas Inventory Quarterly Update: June 2023* (DCCEEW, 2023d) provide accounts of emissions produced in Australia and NSW.

The national GHG inventory records the latest available data made under the Paris Agreement and includes emission estimates prepared in accordance with the 2019 Refinement to the *2006 IPCC Guidelines for National Greenhous Gas Inventories* (IPCC 2019) and under the UNFCCC and Kyoto Protocol. The national GHG inventory provides emission estimates at a national scale and for each state and territory across Australia. Emissions are categorised into the following major sectors with additional subcategories provided according to the type of development and activity undertaken:

1. Energy
2. Industrial processes
3. Agriculture
4. Land use, land use change and forestry
5. Waste
6. Other

The proposed development of a quarry is most consistent with the subcategory of '2.A Mineral Industry' provided under the 'Industrial processes' sector (DCCEEW, 2023c)

Annual national and state emissions data available from the DCCEEW website for the period between 2018 to 2021 in million tonnes CO2-e (Mt CO2-e) are summarised in **Table 14.** No data is currently available for 2022 and 2023 via the website.

More recent data is available via the National Greenhouse Gas Inventory Quarterly Updates presented on the DCCEEW website. The quarterly updates are limited to national emission data and categorises emissions into the following eight sectors:

1. Energy - emissions from the combustion of fuel used to generate electricity for public use.
2. Stationary energy – excluding electricity.
3. Transport.
4. Agriculture.
5. Fugitive emissions.
6. Industrial processes.
7. Waste.
8. Land use, land use change and forestry.

The most recent quarterly update report for June 2023, compares annual national emissions from June 2021/22 and June 2022/23 (DCCEEW, 2023d). The quarterly report details that national emissions associated with industrial processes and product use have decreased by 0.6% from 32.6 Mt CO2-e during June 2021/22 to 32.4 Mt CO2-e during June 2022/23. Total emissions across Australia however increased by 0.8% from 461.6 Mt CO2-e to 465.2 Mt CO2-e.

Table 14 – Annual GHG Emissions, NSW and Australia

Description	Year			
	2018	2019	2020	2021
Annual Emissions: Australia (Mt CO_2-e) [1]				
All sectors	514.2264	505.8571	494.2330	464.7707
2. Industrial Processes	31.8107	32.5497	31.8986	32.9923
2.A Mineral Industry	5.5221	5.5892	5.2307	5.5849
Annual Emissions: NSW (Mt CO_2-e) [2]				
All sectors	140.6054	134.5651	133.4944	132.0493
2. Industrial Processes	12.8624	13.0270	12.7993	13.0039
2.A Mineral Industry	1.3898	1.3853	1.3029	1.3791
[1]DCCEEW 2023c, Paris Agreement inventory. [2]DCCEEW 2023c, State and territory emissions.				

6.3.2 CONTRIBUTION TO STATE AND NATIONAL GHG EMISSIONS

The estimated GHG emissions for the project during the construction and operational phases are compared to the most recent GHG emission data estimates for NSW and Australia in **Table 15.**

Existing emission data, provided in **Section 6.3.1,** details that NSW produced approximately 132.05 Mt CO_2 -e worth of emissions during 2021, with Australia producing 467.77 Mt CO_2 -e.

The comparison in **Table 15** indicates that the proposal would contribute:

- Approximately 4923.26 t Co2 – e per year during construction, approximately 0.004% of state emissions and 0.001% of national emissions
- Approximately 209.38 t Co2 – e per year during operation, approximately 0.0002% of state emissions and 0.00005% of national emissions.

The project is not anticipated to result in a significant amount of GHG emissions in the context of state and national emissions and GHG emission impacts associated with the project are therefore considered to be negligible. No significant impact to the implementation of state or national objectives to reduce GHG emissions is anticipated to result from the proposed development.

Table 15 – Comparison to Annual GHG Emissions, NSW and Australia 2021

Phase	GHG Emission Forecasts (t Co2 – e per year)			Total Reportable Emissions (Scope 1 & 2)	Percentage of NSW's Emissions	Percentage of Australia's Emissions
	Scope 1	Scope 2	Scope 3			
Construction	4923.26	-	1213.02	4923.26	0.00373%	0.001052%
Operation	165.32	44.06	44.19	209.38	0.00016%	0.000045%
Total	**5088.58**	**44.06**	**1257.21**	**5132.64**	**0.00389%**	**0.001097%**

7. GHG MANAGEMENT AND MITIGATION MEASURES

This GHG assessment has indicated that emissions resulting from the proposed development are likely to be insignificant in the context of existing state and national emissions together with emissions made by other quarry projects with greater production capacities.

Emissions resulting from the development, while negligible, have the potential to be further minimised through the implementation of a suite of GHG mitigation measures. It is anticipated that several actions made by the operator of the development to improve the efficiency of extraction processes, such as the minimisation of haulage route distances, would be inherently beneficial for minimising the generation of GHG emissions.

Potential management measures to minimise the generation of GHG emissions include:

- Minimising transport route distances associated with the construction and operation of the project.
- Sourcing construction materials from on-site, or the local region where possible, avoiding GHG emissions resulting from transportation over long distances.
- Using recycled or low impact materials (with lower embodied energy) where possible to minimise emissions.
- Training of staff and contractors on efficient driving practices and practices to improve energy efficiency (i.e throttling down and switching machinery off when not in use).
- Regular maintenance and inspections of plant and machinery in accordance with manufacturer's specifications.
- The incorporation of energy efficient equipment and infrastructure into the design of the project (where practical) (i.e implementation of energy efficient lighting systems)
- Ongoing reviews on the efficiency of extraction processes during operation including measures to minimise double handling and to ensure that hauling activities are undertaken along efficient routes.

8. CONCLUSION

This assessment has quantified GHG emissions with the potential to result from the proposed development and has assessed their significance in the context of state and national objectives.

The assessment indicates that the construction of the proposed development would generate approximately 4923.26 tonnes of CO_2-equivalent per annum of Scope 1 emissions.

GHG emissions would reduce following the construction phase of the proposed development. The operation of the project is expected to generate approximately 165.32 tonnes of CO_2-equivalent per annum of Scope 1 and 44.06 tonnes of CO_2-equivalent per annum of Scope 2 emissions. The total emissions resulting from the operation of the project represents 0.0002% of state emissions and 0.00005% of national emissions made in 2021.

Emissions resulting from the proposed development are considered negligible and insignificant in the context of existing state and national emissions. While the actual annual emissions resulting from the operation of the project may be higher in some years than others, reflecting potential variances in the required electrical supply, transport routes and production volumes, only minor contributions to state and national GHG emissions are anticipated to result.

Notwithstanding the limited potential for impact, there remains capacity to implement a range of GHG management measures during the construction and operation of the project. The implementation of measures provided in **Section 7** of this assessment, including several measures associated with the operator improving the efficiency of extractive processes, would further assist to minimise the generation of GHG emissions.

Table 16 – Summary of Estimated GHG Emissions by Project Phase

Project Phase	Annual Emission Totals (t CO2 -e)			
	Scope 1	Scope 2	Scope 3	Total
Construction	4923.26	-	1213.02	**6136.28**
Operation	165.32	44.06	44.19	**253.57**

9. REFERENCES

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APPENDIX A

GHG EMISSION ESTIMATION – CONSTRUCTION

CONSTRUCTION PHASE GHG ESTIMATION

Table 18 – Construction – Energy Use (Scope 1)

Activity Data			Energy Use		Emission Factors		
					$C0_2$	CH_4	N_20
Purchased Energy	**Usage**	**Unit**	**GJ/kL**	**GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel- Construction Stationary (Scope 1)	1,680	kL	38.6	64,848.00	69.9	0.1	0.2
Breakdown of individual GHG emissions (t CO_2-e)					4532.88	6.48	12.97
Total GHG Emissions (t CO_2-e)							**4552.33**

Table 19 – Construction – Material Transport, Proponents Trucks (Scope 1)

Activity Data			Energy Use		Emission Factors		
					$C0_2$	CH_4	N_20
Purchased Energy	**Usage**	**Unit**	**GJ/kL**	**GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel – Material Transport (Scope 1)	136.5	kL	38.6	5268.90	69.9	0.1	0.4
Breakdown of individual GHG emissions (t CO_2-e)					368.30	0.52	2.11
Total GHG Emissions (t CO_2-e)							**370.93**

Table 20 – Construction – Extraction, Production and Distribution of Energy Purchased (Scope 3)

Activity Data		Energy Use	Emission Factors		
			$C0_2$	CH_4	N_20
Purchased Energy	**Unit**	**GJ (as above)**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel – Construction Stationary (Scope 3)	kL	64848.00	17.3	N/A	N/A
Diesel – Material Transport (Scope 3)	kL	5268.90	17.3	N/A	N/A
Breakdown of individual GHG emissions (t CO_2-e)			1213.02	N/A	N/A
Total GHG Emissions (t CO_2-e)					**1213.02**

Activity Data Research - Construction

Table 21 – Summary of Activity Data Research from other Quarry Projects in NSW used to estimate GHG emissions during Construction.

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
Fuel Use – Stationary and Off-Road						
Gasoline	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Diesel	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	56 L/t
	Jandra Quarry	350,000 Increased to 475,000	Construction required 15,698.9 kL	Included: 2,859kL - Site Preparation 12,840 kL – Construction of Heavy Vehicle Access Road	Consumption Rate of 33.05 L/t	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	Construction required 86840 kL	For Energy Use during construction	Consumption Rate of 78.95 L/t	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Fuel Use – Transport (on road vehicles, rail, marine, air)						
Cars and light commercial vehicles						
Gasoline	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Diesel	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Heavy Duty Vehicles						
Diesel*	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	4.55 L/t
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	Construction required 5005 kL	For Proponents Trucks	Consumption Rate of 4.55 L/t	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Oils and Greases						
Petroleum based oils	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Petroleum based greases	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Electricity Consumption						
Consumption from Grid NSW	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Waste						
Municipal solid waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Commercial and industrial waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Construction and demolition waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Embodied energy of Construction Materials						
Material Consumption	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Martin's Creek Quarry	449,000 Increased to 1,100,000	Construction required: Steel 70 t Concrete 1608 t Asphalt 403 t	*880 m long rail base and 360 m long rail spur. Road 10m wide using 640* *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 m3 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/m3.* *• Bulk density of road base and footings is 2,200 kg/m3.* *• Bulk density of asphalt is 2,250 kg/m3.* *• Nominal average payload of trucks is 32 t.*	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	

APPENDIX B

GHG EMISSION ESTIMATION - OPERATION

OPERATION PHASE GHG ESTIMATION

Table 22 – Operation– Stationary Diesel Use (Scope 1)

Activity Data			Energy Use		Emission Factors		
					$C0_2$	CH_4	N_20
Purchased Energy	**Usage**	**Unit**	**GJ/kL**	**GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel – Construction Stationary (Scope 1)	23.1	kL	38.6	891.66	69.9	0.1	0.2
Breakdown of individual GHG emissions (t CO_2-e)					62.33	0.09	0.18
Total GHG Emissions (t CO_2-e)							62.6

Table 23 – Operation – Product Transport, Diesel for Proponent's Trucks (Scope 1)

Activity Data			Energy Use		Emission Factors		
					$C0_2$	CH_4	N_20
Purchased Energy	**Usage**	**Unit**	**GJ/kL**	**GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel – Product Transport (Scope 1)	37.8	kL	38.6	1459.08	69.9	0.1	0.4
Breakdown of individual GHG emissions (t CO_2-e)					101.99	0.15	0.58
Total GHG Emissions (t CO_2-e)							102.72

Table 24 – Operation – Electricity Use (Scope 2)

Activity Data			Energy Use	Emission Factors		
				$C0_2$	CH_4	N_20
Purchased Energy	**Usage**	**Unit**	**GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Electricity (Scope 2)	65,106	kWh	234.38	188	N/A	N/A
Breakdown of individual GHG emissions (t CO_2-e)				44.06	-	-
Total GHG Emissions (t CO_2-e)						44.06

Table 25 – Operation – Extraction, Production and Distribution of Energy Purchased (Scope 3)

Activity Data		Energy Use	Emission Factors		
			$C0_2$	CH_4	N_20
Purchased Energy	**Unit**	**GJ (as above)**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**	**kg CO_2-e / GJ**
Diesel – Operation Stationary (Scope 3)	kL	891.66	17.3	N/A	N/A
Diesel - Operation Product Transport (Scope 3)	kL	1459.08	17.3	N/A	N/A
Electricity (Scope 3)	kWh	234.38	15	N/A	N/A
Breakdown of individual GHG emissions (t CO_2-e)			44.19	-	-
Total GHG Emissions (t CO_2-e)					44.19

Activity Data Research – Operation

Table 26 – Summary of Activity Data assumptions from other Quarry Projects used to estimate GHG emissions during operation.

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
Fuel Use – Stationary and Off-Road						
Gasoline	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Diesel	Cooma Road Quarry	1,000,000 Increased to 1,500,000	904 kL	Use estimated by project proponent	Consumption rate of 0.60 L/t	1.18 L/t (0.77kl/t excluding Sutton Forest)
	Jandra Quarry	350,000 Increased to 475,000	180.71 kL Increased to 335.38 kL	Onsite consumption is calculated based on the current consumption rate of 0.71l/t;	Consumption rate of 0.71 L/t Consumption rate of 0.71 L/t	
	Lynwood Quarry	5,000,000	91,057 GJ	Equivalent to 2359 kL (Based on NGA 2023 Emission Factor of 38.6 GJ/kl):	Consumption rate of 0.47 L/t	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Martin's Creek Quarry	449,000 Increased to 1,100,000	770 kL	N/A	Consumption rate of 0.70 L/t	
	Oberon Quarry	192,127 Increased to 400,000	240.35 kL Increased to 400 kL	Use estimated by project proponent	Consumption rate of 1.25 L/t Consumption rate of 1.00 L/t	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	3,495 kL	N/A	Consumption rate of 4.06 L/t	
Fuel Use – Transport (on road vehicles, rail, marine, air)						
Cars and light commercial vehicles						
Gasoline	Cooma Road Quarry	1,000,000 Increased to 1,500,000	5 KL	N/A	0.001 L/t	0.001 L/t (negligible)
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Diesel	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Heavy Duty Vehicles						
Diesel*	Cooma Road Quarry	1,000,000 Increased to 1,500,000	Proponents Operations 400 kL (Excludes 14410.67 GJ of diesel use for contractors and material transport) (Toal of 773.33 kl of diesel use with contractors and material transport	(Contractors diesel use is equivalent to 373.33 kL (Based on NGA 2023 Emission Factor of 38.6 GJ/kl):	Consumption rate of 0.26 L/t (Consumption rate of 0.52 L/t with contractors)	1.98 L/t (1.26 L/t excluding Sutton Forest)
	Jandra Quarry	350,000 Increased to 475,000	176.20 kL 327.00 kL	Offsite consumption is calculated based on the current consumption rate of 0.69l/t;	Consumption rate of 0.69l/t; Consumption rate of 0.69l/t;	
	Lynwood Quarry	5,000,000	227,972 GJ	Equivalent to 5,906 kL (Based on NGA 2023 Emission Factor of 38.6 GJ/kl):	Consumption rate of 1.18 L/t	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
				Reported as Scope 3 (Road transport emissions) and based on following assumptions: 16% to Illawarra 260km return 15% to Local area 90km return 42% to Canberra 280km return 25% to Southern Sydney 300km return		
	Martin's Creek Quarry	449,000 Increased to 1,100,000	Proponents Operations 1023.75 KL (Total of 1641.5 kL with contractors and material transport)	Included: 1023.75 kL – Proponents Trucks 614.25 k l – 3rd Party Contractors 3.5 kL – Material Transport (explosives/diesel)	Consumption rate of 0.9 L/t (Consumption rate of 1.49 l/t including contractors)	
	Oberon Quarry	192,127 Increased to 400,000	18874.05 GJ based on product transport travelling 895,540.04 km for 192,127 tonnes. 39294.89 GJ based on product transport travelling 1,864,476.03 km for 400,000 tonnes.	Assumption that transport diesel use will average 0.546 L/km over distance travelled. Equivalent to annual use of 488.96 kL. Equivalent to annual use of 1018.00 kL	Consumption Rate of 2.55 L/t Consumption Rate of 2.55 L/t	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	6,058 kL	Use estimated by project proponent	Consumption rate of 7.04 L/t	
Oils and Greases						
Petroleum based oils	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Petroleum based greases	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Electricity Consumption						
	Cooma Road Quarry	1,000,000 Increased to 1,500,000	2,100,000 kWh	N/A	Consumption rate of 1.4 kWh/t	2.77 kWh/t (2.17 kWh/t

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
Consumption from Grid NSW	Jandra Quarry	350,000 Increased to 475,000	554,142 kWh Increased to 1,028,398 kWh	Electricity consumption is calculated based on the current consumption rate of 2.17kWh/t;	Consumption rate of 2.17 kWh/t Consumption rate of 2.17 kWh/t	excluding Lynwood Quarry)
	Lynwood Quarry	5,000,000	114,836 GJ	Equivalent to 31,898,914 kWh (Based on NGA 2023 Energy Conversion factor of 277.778l):	Consumption rate of 6.38 kWh/t	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	2,200,000 kWh	N/A	Consumption rate of 2.00 kWh/t	
	Oberon Quarry	192,127 Increased to 400,000	1709.68 GJ	Assumption that on electricity use will average 1.483 kWh per crushed tonne. (Equivalent to 592,000 kWh based on consumption rate assumption and approximately 474,911 kWh based on NGA 2023 Energy Conversion factor of 277.778l):	Consumption rate of 1.48 kWh/t	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	3,276,000 kWh	Use estimated by project proponent	Consumption rate of 3.81 kWh/t	
Waste						
Municipal solid waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Commercial and industrial waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	
Construction and demolition waste	Cooma Road Quarry	1,000,000 Increased to 1,500,000	N/A	N/A	N/A	N/A
	Jandra Quarry	350,000 Increased to 475,000	N/A	N/A	N/A	
	Lynwood Quarry	5,000,000	N/A	N/A	N/A	
	Martin's Creek Quarry	449,000 Increased to 1,100,000	N/A	N/A	N/A	

Emission Source	Project	Production Capacity	Usage Reported in GHG Assessment	Notes / Assumptions	Consumption Rate	Average Consumption Rate by Source
	Oberon Quarry	192,127 Increased to 400,000	N/A	N/A	N/A	
	Sutton Forest Sand Quarry	700,000 Increased to 860,000	N/A	N/A	N/A	

Premise