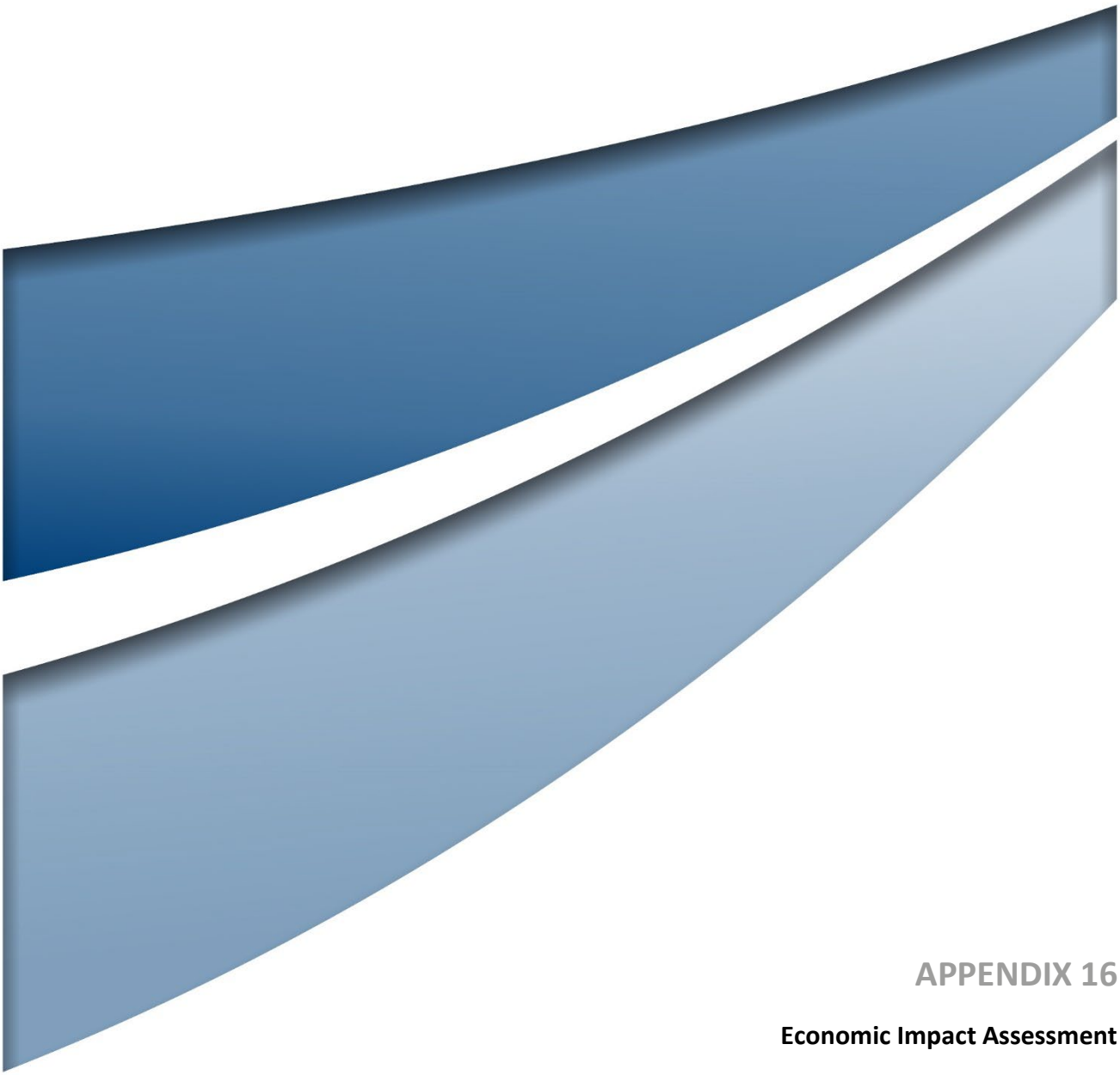

APPENDIX 16

Economic Impact Assessment

Liverpool Range Quarry Project

Economic Assessment

Prepared for

ARDG Deans Quarry Pty Limited

By

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Introduction

ARDG Deans Quarry Pty Limited (ARDG) is seeking planning approval for a new hard rock quarry, known as Liverpool Range Quarry (the Project), located approximately 10 km north of Cassilis township within the Upper Hunter LGA. The Project is seeking to access a high quality, hard rock resource suitable for producing a range of quarry products solely for the purpose of supplying quarry products to support the construction of the recently approved Liverpool Ranges Wind Farm (LRWF) Project (SSD-6696). An Environmental Impact Statement (EIS) is required to support the development application for the Project. This Economic Assessment has been prepared as part of the EIS.

From an economic perspective, there are two important aspects of the Project that can be considered:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Project) which is evaluated using cost benefit analysis (CBA); and
- its effects on the local economy, which is evaluated using local effects analysis (LEA) and input-output (IO) analysis.

Cost Benefit Analysis

Under the base case, it is assumed that the demand for quarry projects generated by the LRWF would be met from existing quarries in the region, all located between 90 km and 160 km from LRWF. With the Project, these quarries would continue to supply their existing customers and the LRWF demand for hard rock products would be met by the Project.

A CBA of the Project indicated that it would have net quarry production benefits to Australian and NSW of $6M and $4M (present value at 7% discount rate), respectively. The adverse environmental impacts of the proposed quarry are not material from an economic efficiency perspective, and the main potential impacts of the quarry are internalised into the production costs of the Project through mitigation measures, biodiversity offsets and payments for water. The positive externalities from reduced quarry haulage result in net externality benefits of $36M, present value to Australia and $10M, present value to NSW. Consequently, the Project is estimated to have net social benefits to both Australia ($41M) and NSW ($14M), and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than approximately $41M and $14M for the Project to be questionable from an Australian and NSW economic efficiency perspective, respectively.

The Project's predicted net social benefits to NSW remain robust under a range of different sensitivity scenarios considered.

Local Effects Analysis

The local area used for the Local Effects Analysis comprises the Local Government Areas (LGAs) of Dubbo Regional, Mid-Western Regional, Warrumbungle Shire and Upper Hunter. The Project will provide direct economic activity, including jobs, to the local area economy, and indirect economic activity to the local area via both wage and non-wage expenditure. A summary of local economic effects of the Project is provided in **Table ES1**.

The Project will provide six FTE direct quarry jobs, for approximately four years. Assuming that those that already reside in the local area would have otherwise been already employed and that job vacancies created by these people filling the Project jobs remain unfilled (i.e. no job chain effects), the incremental disposable wages accruing to the region from the Project is $0.2M per annum. This is equivalent to two direct full time equivalent (FTE) jobs. This is a minimum estimate as it assumes full employment in the region and hence the jobs from which people come to fill the Project jobs remain vacant.

Standard regional economic impact assessment using IO analysis, is not restricted to a focus on the existing labour force in the local area and does not assume an absence of job chain effects. In this framework, the Project is estimated to provide the following annual direct and indirect annual effects to the local economy:

- $31M in output;
- $10M in value-added;
- $4M in gross wages; and
- 51 jobs.

The main local environmental impacts are internalised into the production costs of ARDG via mitigation, offset and compensation costs. Residual local environmental impacts after mitigation, offset and compensation are likely to be immaterial.

Table ES1 - Summary of Effects on the Local Community

Annual Local Effects	**Direct Total**	**Direct Already Resident in the Local Area**	**Net**
Employment FTE	6	5	2
Net Income ($M)			0.2
Non-labour expenditure in the Local Area ($M)	7.1		
Annual Regional Impacts	**Direct**	**Flow-on**	**Total**
Output ($M)	17	13	31
Value-added ($M)	4	6	10
Income ($M)	1	3	4
Employment	6	45	51
Other Local Economic Impacts			
Displaced agricultural activities	No material impact*		
Wage rise impacts	No material impact*		
Housing impacts	No material impact*		
Demand on local infrastructure and services	No material negative impact*		
Local Environmental Impacts			
Road Transport	Reduced road transport impacts on local and arterial roads		
Biodiversity	Impacts on local biodiversity are offset		

* Materiality refers to whether valuation of these impacts would have any bearing on the estimated net social benefits of the Project. NSW Government (2012) identified that if a Project has an NPV of say "$20 million, costs or benefits valued at less than $1 million are unlikely to be material."

*** Unless otherwise specified monetary amounts are in 2024 dollars.

1 INTRODUCTION

1.1 Background

ARDG Deans Quarry Pty Limited (ARDG) is seeking planning approval for a new hard rock quarry, known as Liverpool Range Quarry (the Project), located approximately 10 km north of Cassilis township within the Upper Hunter LGA. The Project is seeking to access a high quality, hard rock resource suitable for producing a range of quarry products solely for the purpose of supplying quarry products to support the construction of the recently approved Liverpool Ranges Wind Farm (LRWF) Project (SSD-6696).

The Project will include the following works:

- Construction of a site access off Rotherwood Road.
- Clearing and earthworks for site preparation and to enable access to the resource and development of the quarry extraction area.
- Installation of on-site processing plant and associated equipment.
- Extraction and processing of material to enable the transport of approximately 0.7 Mt per annum
- (Mtpa) of extractive materials from the site. Based on current LRWF engineering designs, total quarry product requirements are estimated at up to 2 Mt.
- Transport of quarry products to the various work fronts of the LRWF Project.
- General site maintenance.
- Stabilisation of disturbed areas and rehabilitation following quarry closure.

The Project is State significant development (SSD) and requires approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A development application will be lodged with the NSW Department of Planning, Housing and Infrastructure (DPHI). An Environmental Impact Statement (EIS) will be prepared to support the development application.

Umwelt (Australia) Pty Ltd (Umwelt) has been engaged to prepare an Environmental Impact Statement (EIS) for the Project. Gillespie Economics was engaged to prepare an Economic Assessment of the Project for incorporation into the EIS.

1.2 Economic Assessment Requirements

Economic Assessment requirements arise from the EP&A Act and the Secretary's Environmental Assessment Requirements (SEARs). While there are no specific economic assessment guidelines for extractive industries, the *Guidelines for Economic Assessment of Mining and Coal Seam Gas Proposals* (NSW Government, 2015) and the *Technical Notes Supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (NSW Government, 2018), provide guidance on the economic assessment techniques that are appropriate for addressing the requirements under the EP&A Act. The requirements are briefly outlined below.

Environmental Planning and Assessment Act 1979

Section 4.15 of the EP&A Act requires the following two matters to be taken into consideration by the consent authority in determining a development application:

- the public interest (taken as the collective public interest of households in NSW).
- the likely impacts of the development, including environmental impacts on both the natural and built environments, and social and ***economic impacts in the locality***.

Economic Assessment Guidelines

The NSW Government (2015) Guideline provides information to assist proponents with providing the necessary economic information to meet the abovementioned requirements of section 4.15 of the EP&A Act. The Guideline identifies that:

- Cost Benefit Analysis (CBA) is used to assess the public interest by estimating the net present value of the project to the NSW community.
- Local Effects Analysis (LEA) is used to assess the likely economic impacts of the development in the locality. The Guideline identifies a specific method for assessing the direct local effects of a mining project. However, it also states that "*a range of techniques are available for estimating second round or flow-on effects. These include CGE (computable general equilibrium) modelling, Input-Output (IO) or multiplier analysis.*"

The NSW Government (2018) Technical Notes provides guidance on including environmental, social, and cultural impacts in the CBA.

Secretary's Environmental Assessment Requirements

The SEARs for the Project require:

"a detailed assessment of the likely economic impacts of the development, paying particular attention to:

- the significance of the resource;
- the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates (sic); and
- the demand on local infrastructure and services."

Proposed Economic Assessment Methods

To meet the above requirements, two types of economic assessment of the Project are needed:

- a CBA.
- a LEA.

1.3 Structure of the Report

This report is structured as follows:

- Section 2 identifies the significance of the resource.
- Section 3 provides a CBA of the Project.
- Section 4 provides an overview of the regional economy.
- Section 5 provides a LEA of the Project.
- Section 6 identifies measures to manage economic impacts.
- Conclusions are provided in Section 7.

The individual SEARs requirements relevant to this Economic Assessment and where they are addressed in this report are provided in Table 1.1.

Table 1.1 SEARs Relating to the Economic Assessment

Assessment requirement from SEARs	Section of report where addressed
• the significance of the resource;	Section 2.0
• the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates[1]	Section 3.0
• the demand on local infrastructure and services	See the Social Impact Assessment

[1] All products will be sold domestically and hence consideration of exchange rate fluctuation is not required.

2 SIGNIFICANCE OF THE RESOURCE

2.1 Resource Quality

A geological and geotechnical investigations undertaken onsite by ARDG included 20 percussion drill holes (each up to 25 m deep), followed by six (6) diamond core holes (each up to 35 m deep).

Quarry resources within the 'Main Pit' were found to be dominated by a volcanic flow sequence of basalt and dolerite, whereas resources within the 'Borrow Pit' are predominantly clay and weathered volcanic rock. Resources from both pits are ideally suited to producing the typical range of blended, in-specification quarry products required to support the construction of the LRWF Project, including:

- Significant volumes of durable wind-farm specification road base and sub-base products, required for creation of access tracks, hardstand areas, construction compounds and substation / transformer pads.
- Coarse rubble and crushed rock products required for drainage mitigation works.
- Densely graded base and sub-base products for targeted use within the wind farm development corridor and for use on public road upgrades (in accordance with the requirements of RMS3151 – Granular Base and Subbase Materials for Surfaced Road Pavements).
- Aggregates required for use in concrete for the construction of wind tower footings (in accordance with the requirements of AS2758.1 – Aggregates and Rock for Engineering Purposes – Part 1 Concrete Aggregates).

Investigative work is ongoing to determine the potential suitability of fine manufactured sand (crusher dust up to 5 mm) produced from processed basalt, for use in concrete (as a replacement for natural sand) and for backfilling of electrical cable trenches.

2.2 Resource Quantity

The geological and geotechnical investigations confirmed a quarry resource of approximately 2 Mt within the Project Area from both a 'Main Pit' and 'Borrow Pit'. Additional resources in excess of this approximately 2 Mt proven resource are likely though would require additional drilling to confirm.

2.3 Demand and Supply

The quantity and price for quarry products in the region reflect the interaction of supply from existing quarries and demand from general construction activities in the region. Based on first principles, the LRWF Project will create a demand shock. In the short-term supply of hard rock products is generally fixed (mainly due to limits on extraction, time frame of planning approval processes etc.), unless there is spare capacity in existing approved operations i.e. quarries are not operating at peak approved production rates and have available resource. Where spare capacity is limited and supply adjustment is sticky, a demand shock results in an increase in the price of quarry products and can "crowd out" those who currently purchase quarry products i.e. the demand shock results in price increases and shortages for other construction uses with consequent delay effects.

The ability (spare capacity and available resource) of existing quarries in the region to supply the LRWF Project without impacts on other users would appear to be limited, but in any case, would involve extensive transportation costs and associated externalities.

The Project can be characterised as a supply shift that, compared to the base case, would ensure that the LRWF has access to quarry products at a lower delivered cost and lower transportation externalities. The Project would also negate price increases and shortages for other quarry product users that would apply under the base case scenario from increased demand created by the LRWF.

3 COST BENEFIT ANALYSIS

3.1 Introduction

CBA of the Project involves the following key steps:

- identification of the "with" and "without/base case" Project scenarios.
- identification and valuation of the incremental benefits and costs of the Project relative to the "without" scenario or 'base case".
- consolidation of value estimates using discounting to account for temporal differences.
- application of decision criteria.
- sensitivity testing.
- consideration of non-quantified benefits and costs.
- consideration of the distribution of costs and benefits.

What follows is a CBA of the Project based on technical, financial, and environmental information provided by ARDG and Umwelt.

3.2 Identification of the "Without" Project Scenario

A starting point for CBA is to establish the "without" Project scenario for the land impacted by the Project. This becomes the base case against which to assess the potential economic, social, and environmental impacts of changes due to the Project.

The land the Project Area is zoned RU1 Primary Production und the Upper Hunter Local Environmental Plan 2013. Without the Project, the land impacted by the Project would continue to be used for grazing (sheep and cattle).

Under the base case, it is assumed that the demand for quarry projects generated by the LRWF would be met from existing quarries in the region, with associated crowding out, quarry product price increases, and transport costs.

3.3 Identification of the "With" Project Scenario

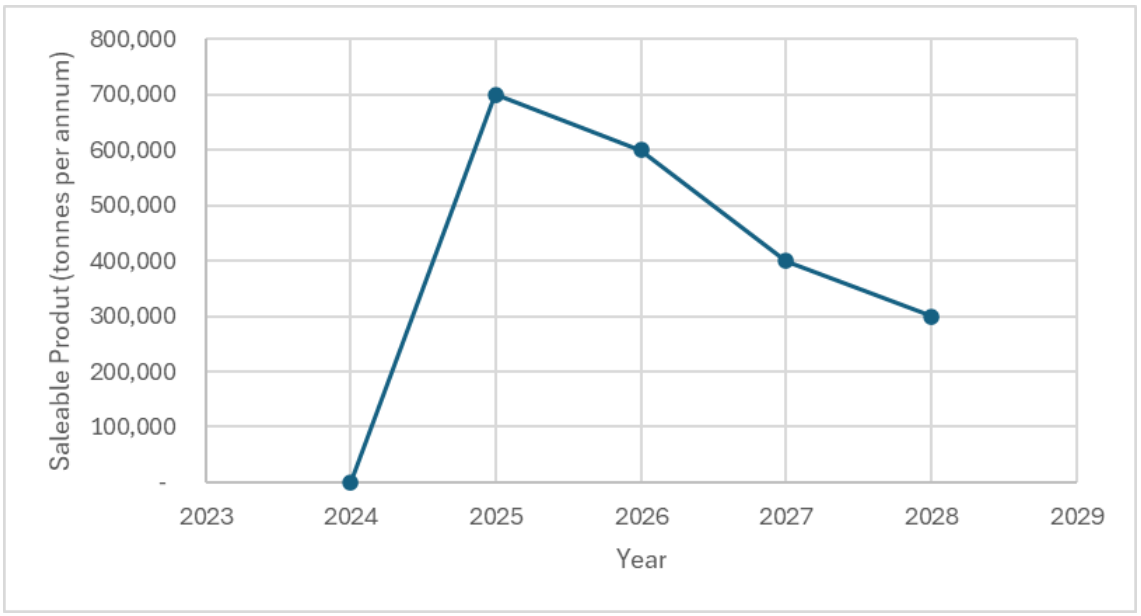
"With" the Project, extraction of up to 0.7 Mtpa would continue for approximately four years. A summary of the key aspects of the Project are provided in Table 3.1.

Table 3.1 Summary of Key Project Aspects

Aspect	Proposed for the Project
Project Life	4 years
Production	Up to 2Mt with annual production limited to 700,000 tpa
Main extraction area ("Main Pit)	Covering an area of approximately 3.2 ha from where a high-quality basalt resource would be drilled, blasted and extracted, prior to processing. The Main Pit would be developed to a floor level of approximately 675 m AHD, with extraction undertaken as two benches with nominal height of 12.5 m.
Satellite extraction area ("Borrow Pit")	Covering an area of approximately 1.9 ha, 250 m to the southeast of the Main Pit. Highly weathered rock and clay would be extracted from the Borrow Pit by dozer / excavator, prior to being transported by truck to the main processing area for blending with rock from the Main Pit. The Borrow Pit would be developed to a floor level of approximately 660 m AHD.
Processing and stockpiling	Covering an area of approximately 2 ha adjacent to the southern edge of the Main Pit. Processing of extracted rock would be undertaken in this area using mobile crushing and screening equipment, with finished quarry products transferred to discrete stockpiles. As the pit face progresses, processing / stockpiling will occur in pit (i.e. below the ground surface), further shielding operations.
Operational areas (peripheral to the above areas)	Covering an area of approximately 7.1 ha. These areas would accommodate internal temporary administration (mobile crib room/toilet facilities), peripheral topsoil bunds, access tracks, light vehicle parking, and surface water management controls.
Access Road	Covering an area of approximately 5.4 ha. All-weather sealed access road linking the operational areas with Rotherwood Road for use by road haulage trucks.
Extraction method	Drill, blast, and haul
Product transport	Via approved haulage routes for the LRWF Project Area (both public roads and internal access tracks of the LRWF and Ancillary Works).
Construction Employment	**Operators/Mobile Plant and Equipment:** 3–4 operators and 1–2 supervisor/ general hand **Drill and blast crew:** 2–3 (prior to initial blast and commencement of operations for a period of 7–10 days weather dependent), 8–10 crew will be present on the day for loading and firing of the shot**.**
Operation Employment	**Operators/Mobile Plant and Equipment:** Approximately 4, and 1–2 supervisor/general hand **Drill and blast crew:** 2–3 (prior to initial blast and commencement of operations for a period of 7–10 days weather dependent), 8–10 crew will be present on the day for loading and firing of the shot**.**
Rehabilitation	The site will be rehabilitated in consultation with the landowner to determine an appropriate, safe and stable landform(s) that can facilitate and/or support ongoing rural activities.
Stabilisation of the processing and stockpiling area.	To be returned to pre-disturbance existing condition in consultation with the landowner (e.g. re-seeded with appropriate pasture grass).

Figure 3.1 illustrates the indicative production profile for the Project.

Figure 3.1 – Indicative Incremental Production from the Project



Source**:** ARDG Deans Quarry Pty Limited

3.4 Identification of Benefits and Costs

Relative to the base case, or "without" Project scenario, the Project may have the potential incremental economic benefit and cost categories shown in **Table 3.2**. The scope of the CBA is to the quarry gate as the quarry is within the LRWF Project Area and the LRWF Project will be responsible for transport of quarry material from this point to where it is required. All material haulage can be managed along existing approved LRWF haulage routes and the conditions of consent for the LRWF include a requirement to 'make good' any damage to public roads caused by construction activities which includes potential damage associated with quarry material haulage.

It should be noted that the potential environmental, social, and cultural costs of the proposed quarry that are listed in **Table 3.2** are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated, compensated, or offset to the extent where community wellbeing is insignificantly affected (i.e. costs are borne by the proponent), then no environmental, social or cultural economic costs should be included in the Project CBA apart from the mitigation, compensation or offsetting costs.

Table 3.2 - Potential Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Net production benefits from extraction and processing	• Opportunity cost of land • Opportunity cost of capital • Capital costs • Operating costs at quarry gate • Decommissioning and rehabilitation costs at cessation of the Project	• Sale value of quarry product at quarry gate • Residual value of capital and land at the end of the Project
Potential environmental, social and cultural impacts of extraction and processing after mitigation, offsetting and compensation	• Air quality impacts • Greenhouse gas generation • Noise and blasting impacts • Groundwater impacts • Surface water impacts • Biodiversity impacts • Aboriginal heritage impacts • Historic heritage impacts • Visual impacts • Adjoining land values • Net public infrastructure costs • Loss of surplus to other industries	• Reduced transport costs and externalities • Economic benefits to existing landholders • Economic benefits to suppliers • Wage benefits to employment • Nonmarket employment benefits

Framed in another but equivalent way, the potential incremental costs and benefits of the Project are as per **Table 3.3**.

Table 3.3 - Alternative Frame of Potential Economic Benefits and Costs of the Project

Costs	Benefits
Direct costs	***Direct benefits***
Nil	Net production benefits from extraction and processing • *Royalties*[2] • *Company tax* • *Net producer surplus*
Indirect costs	***Indirect benefits***
Environmental, social, and cultural impacts of extraction and processing after mitigation, offsetting and compensation	Reduced transport costs and externalities associated with the LRWF
Net public infrastructure costs	Economic benefits to existing landholders
Loss of surplus to other industries	Economic benefits to suppliers
	Wage benefits to employment
	Nonmarket employment benefits

3.5 Quantification/Valuation of Benefits and Costs

Consistent with NSW Government (2015), the CBA was undertaken in 2024 real values, with discounting at 7 percent (%) and sensitivity testing at 4% and 10%.

The analysis period is 6 years, coinciding with the proposed duration of the Project plus one year pre-commencement and one year post Project. Any impacts that occur after this period are included in the final year of the analysis as a terminal value.

[2] Because the proposed extraction occurs on private land, royalties will be paid to the landowner.

Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural, and social impacts have initially been left unquantified and interpreted using the threshold value method.[3]

Environmental, cultural, and social impacts were then estimated using market data and benefit transfer[4] and incorporated into an estimate of the net social benefit of the Project. This estimated net social benefit of the Project provides another threshold value that any residual or non-quantified economic costs would need to exceed to make the Project questionable from an economic efficiency perspective.

3.5.1 Production Costs and Benefits of Extraction and Processing[5]

Opportunity Cost of Land and Capital

All capital equipment required to the Project would be purchased or leased. The cost of this is included in the capital costs and operating costs of the Project, respectively.

Under the base case scenario, the subject land would continue to be used for cattle and sheep grazing. The value of this production is unknown. However, applying a gross margin for Merino Ewes (20 micron) with Terminal Rams i.e. $429.5/ha/yr (NSW DPI 2024), the opportunity cost of using 14.2 ha of project area for the Project is in the order of $6,100 per year.

On cessation of the Project there will continue to be an opportunity cost associated with the final void in the Main Pit and the Borrow Pit, the latter of which will be reshaped to form a small farm dam. The opportunity cost in perpetuity of this 5.1 ha area is $2,200/year.

Large changes to the assumed agricultural enterprise have little effect on the analysis.

Capital Cost of the Project

Capital costs of the Project include site preparation, roadworks, and fencing. Total capital costs are estimated at $3.1M[6] (Muller and Partnership, 2024) and are assumed to occur in the first year of the Project. In addition, the costs of biodiversity offsets estimated at $1.9M have been included as capital cost.

Annual Operating Costs of the Project

The quarry operating costs include those associated with labour costs, extraction, crushing and screening, rehabilitation, general costs (including overheads and administration) and ongoing environmental, social, and cultural management and mitigation costs. Operating costs are commercial in confidence.

Annual depreciation has been omitted from the estimation of operating costs since depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. The economic capital costs are included in the years in which they are proposed to occur.

[3]The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.

[4] Benefit transfer refers to transferring economic values that have been determined for other study sites.

[5] All values reported in this section are undiscounted unless specified.

[6] This is the total capital cost of the project (Muller and Partnership 2024) less the revegetation costs identified in that report, and a notional allowance of $70,000 for decommissioning assumed to be in unallocated contingency component of the CIV. These costs are included under Decommissioning and Rehabilitation.

Decommissioning and Rehabilitation Costs

No permanent extraction infrastructure will be established onsite. Consequently, final rehabilitation will comprise establishing a safe and stable landform that can facilitate ongoing rural activities. A final rehabilitation cost of $138,324 and decommissioning cost of $70,000 has been included in the final year of the analysis.

Revenues

The main direct economic benefit of the Project is the market value of the hard rock products produced. An average unit price at the quarry gate has been applied to the output of the quarry based on advice from ARDG. It has not been reported for reasons of commercial confidentiality. However, the assumed price is based on an agreement with the wind farm proponent.

Residual Value at End of the Evaluation Period

At the end of the Project, mobile capital will be redeployed elsewhere. Only annual land opportunity cost is included in in the analysis. Consequently, no residual values are appropriate for inclusion in the analysis.

3.5.2 External Costs and Benefits

The environmental, social, and cultural impacts of the Project are assessed in the EIS. This Section considers these impacts from an economic perspective.

Air Quality

The impact of the Project emissions can potentially be valued using the:

- the property value method, where the change in property value because of the air quality impacts are estimated.
- the cost of illness method where changes in health episodes as a result of emissions are estimated.;
- the willingness to pay of impacted people to avoid the impacts.
- the defensive expenditure method, where the costs of mitigation are estimated.

However, the Air Quality and Greenhouse Gas Assessment indicated that Project emissions would be well below the relevant Environmental Protection Authority (EPA) assessment criteria and so the Project is unlikely to cause any adverse air quality impacts at sensitive receptors.

Consequently, air quality impacts are considered to be immaterial from an aggregate economic efficiency perspective and no economic costs are included in the CBA apart from the costs of proposed general mitigation and monitoring measures.

Greenhouse Gas

Direct greenhouse gas emissions (scope 1) from the Project would be in the order of 2,198 t CO2-e per year i.e. 8,792 t CO2-e in total. In contrast, the Project is estimated to save in the order of 17,185 t CO2-e due to reduced transportation emissions compared to the base case of sourcing wind farm construction materials from existing, more distant quarries.

To place an economic value on CO_2-e emissions, a shadow price of CO_2-e is required that reflects the social cost of carbon to the referent group community the subject of the CBA, in this case the residents of NSW.

The NSW Treasury (2023) Guide recommends using prices from the European Union Emissions Trading Scheme (EUETS). The Technical Note to the Guide (NSW Treasury 2023b) provides an Australian dollar value estimate for the year 2023 of $123/t CO2-e increasing in real terms by 2.5% per annum. Under this shadow price the present value of greenhouse gas emission costs for scope 1 emissions over the life of the Project is $0.9M dollars, present value, and total transport emissions avoided is $1.8M, present value. This is a net benefit of $0.9M, present value.

However, the EUETS permit price is an "exchange price" that reflects the regulations and rules of the trading scheme. It is also a financial price rather than an economic value i.e. no real resources are exchanged for payment. This price is therefore far removed from the appropriate value for a NSW CBA which is the value of emission impacts to the households and businesses of NSW. Even if EUETS scheme were designed efficiently, the price of a permit would reflect the global damage cost of carbon (i.e. the cost of carbon emissions to the population of the whole world), not the damage cost to NSW residents.

Consistent with the NSW Government (2015) Guidelines, NSW Government (2018) Technical Notes, the focus of CBA is on costs and benefits to the population of NSW. In the absence of any studies that have focused on the social damage cost of carbon emissions to NSW residents, some means of apportioning global damage costs borne by Australians is required. For the Economic Assessment, this has been undertaken using Australia's share of the global population (around 0.32%) and NSWs share of the Australian population (32%). NSW DP&E has previously supported this approach (NSW DP&E, 2017).

On this basis, the present value of the cost of greenhouse gas emissions from the Project to NSW is estimated at $940 dollars, and the value of the GHG emission avoided is $1,840, present value. This is a net benefit to NSW households of $900.

Noise and Blasting

The impact of the Project noise and vibration can potentially be valued using the property value method, where the change in property value because of the noise impacts are estimated, or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The area surrounding the quarry is sparsely populated with only one non-associated residence identified within a 5 km radius. The closest (currently) non-associated residence is located approximately 3.1 km to the south-west on adjoining land.

A detailed Noise Impact Assessment has been prepared to assess the noise related impacts associated with operation of the quarry and associated traffic movements. Noise modelling results indicate all relevant criteria can be achieved at all non-associated residences in relation to both quarry operational noise and traffic noise through the implementation of appropriate management measures.

A Blast Impact Assessment has been prepared to assess the potential blast impacts associated with the Project. In relation to blasting, for a quarry of this scale, the impact of blasting (including ground vibration and airblast overpressure beyond a 3-4 km radius) is difficult to detect (i.e. beyond human perception levels). The Blast Impact Assessment indicates blasting can be appropriately managed to comply with all relevant blast vibration and overpressure criteria.

Consequently, noise and blasting impacts are immaterial from an aggregate economic efficiency perspective and no economic costs are included in the CBA apart from the costs of proposed general management and monitoring measures.

Road Transport Impacts

Haulage traffic for the supply of quarry materials to the LRWF formed part of the construction traffic for the LRWF project and was assessed as part of the EIS for that project. Any mitigation measures to manage quarry haulage and light vehicle (LV) traffic would be undertaken by the LRWF project.

Given its proximity to the LRWF Project, sourcing of construction materials from the proposed quarry (compared to sourcing from commercial quarries in the broader region) would reduce LRWF construction traffic on the local and regional road network. This would result in several economic benefits including:

- reduced quarry material haulage costs[7] for the LRWF.
- reduced accident costs.
- reduced GHG emission costs.
- reduced other externality costs – air pollution and WTT emissions and pollutions.

There are nine existing hardrock quarries within 165km of the wind farm that are each potentially capable of supplying some of the material required by the LRWF Project.[8] However, the increased demand for hard rock generated by the LRWF project will increase the price for hard rock materials and result in some crowding out of supply to existing users.

For the LRWF project this will mean a higher price paid for quarry material at the quarry gate, as well as higher direct financial transport costs (with associated externalities).

With respect to the additional transport costs, the return distance of the nine existing quarries to the LRWF site range from 180 km to 322km. Relative to sourcing hard rock from the Project, the additional return vehicle km per year from sourcing material from each quarry is summarised in Table 3.4.

Table 3.4 – Return Delivery Km/Year from Alternative Suppliers

	2025	2026	2027	2028	% Arterial	% local
Assumed Production Schedule tonnes per annum	700,000	600,000	400,000	300,000		
Mudgee Dolomite and Lime	*3,961,944*	*3,395,952*	*2,263,968*	*1,697,976*	*0.72*	*0.28*
Biraganbil Quarry (Boral)	*4,136,580*	*3,545,640*	*2,363,760*	*1,772,820*	*0.83*	*0.17*
Bylong Quarry (Regional)	*4,652,550*	*3,987,900*	*2,658,600*	*1,993,950*	-	*1.00*
Kandos Quarry	*6,590,080*	*5,648,640*	*3,765,760*	*2,824,320*	*0.64*	*0.36*
Willow Tree Quary (Regional)	*6,549,760*	*5,614,080*	*3,742,720*	*2,807,040*	*0.34*	*0.66*
Sheraton Road Dubbo (Holcim)	*6,787,200*	*5,817,600*	*3,878,400*	*2,908,800*	*0.89*	*0.11*
Dubbo Quarry (Regional)	*6,787,200*	*5,817,600*	*3,878,400*	*2,908,800*	*0.89*	*0.11*
Talbragar Quarry (Boral)	*6,742,400*	*5,779,200*	*3,852,800*	*2,889,600*	*0.89*	*0.11*
Ardglen Quarry (Daracon)	*7,212,800*	*6,182,400*	*4,121,600*	*3,091,200*	0.40	*0.60*

Additional haulage costs range from $13.80 to $24.02 per tonne. In addition, there are a range of externalities of the additional truck movements on arterial and local roads. These have been calculated

[7] Heavy vehicle registration charges include an allowance for road damage on arterial roads. Any such externality costs of vehicle movements are therefore largely internalised into the operating costs of road transport. To the extent that local roads would have been used, avoided haulage costs may understate economic benefits of reduced longer distance haulage. Time costs are also a component of haulage costs.

[8] No single quarry is capable of supplying anticipated Project quarry materials

based on crash rates per km and crash costs (Table 3.5), greenhouse impacts per km for articulated trucks[9] and other externality impacts by freight transport (Table 3.6) (Transport for NSW, 2023).

Table 3.5 - Crash Rates and Crash Costs

Per 100,000,000 Km Crash Rates Rural	Divided Road	Single Lane Road	Crash Costs (Rural)
Fatal	0.41	0.9	$10,144,010
Injury	10.23	12.54	$252,192*

*Average of serious, moderate and minor injury costs.
Source: Transport for NSW (2023) Table 5.4 and Table 5.5.

Table 3.6 - GHG and Other Externalities Articulated Trucks

Externality	c/Km
GHG Emissions	10.35*
Air Pollution	5.84
WTT emissions and pollutions	1.6

*Escalating at 2.25% pa
Source: Transport for NSW (2023) Table 6.3 and Table 6.8

Based on these assumptions, the present value of reduced transport costs ranges from $25M to $44M, with an average across all potential alternative source of $37M (refer to Table 3.7).

Table 3.7 – Additional Transport Costs (Present Value at 5% Discount Rate)

Total Extra Costs	Haulage Costs	Crash Costs	GHG Costs	Other Externality Costs	Total
Mudgee Dolomite and Lime	$22	$1	$1	$1	$25
Biraganbil Quarry (Boral)	$22	$1	$1	$1	$25
Bylong Quarry (Regional)	$23	$1	$1	$1	$27
Kandos Quarry	$39	$1	$2	$1	$43
Willow Tree Quary (Regional)	$39	$2	$2	$1	$44
Sheraton Road Dubbo (Holcim)	$39	$1	$2	$1	$43
Dubbo Quarry (Regional)	$39	$1	$2	$1	$43
Talbragar Quarry (Boral)	$39	$1	$2	$1	$43
Ardglen Quarry (Daracon)	$39	$2	$2	$1	$44
Average	**$34**	**$1**	**$2**	**$1**	**$37**

Water Resources

The use of water resources for the Project has an opportunity cost i.e. the water is not available for some alternative use. Where a water market exists the tradeable value of water is indicative of its opportunity costs. Impacts on water quality can also impact community wellbeing via impacts on waterway health or via water usage e.g. reduced drinking water quality. The appropriate means of valuing water quality impacts would depend on the nature of the impact.

Operational water requirements will be met via:

[9] The value of avoided GHG from articulated truck is also discussed above under Greenhouse Gas. However, these values have only been included once in the CBA.

- the collection of water in onsite water storages – which will result in negligible reductions in rainfall runoff volumes reporting to downstream users (Engeny, 2024).
- a nearby licenced bore (Water Supply Work 80CA706124) and associated entitlement (WAL 27888 – 320 ML), both registered to the quarry site landowner. Modelling indicates a maximum yearly requirement from this source of 13 ML (Engeny, 2024). For the purpose of this analysis, the opportunity cost of this water is assumed to be $200/ML/yr (ARDG communications) i.e. a total opportunity cost of $2,600/yr.

Impacts on groundwater are considered unlikely as proposed extraction depth is shallower than the surrounding water table and as such will not intersect the water table during construction and operation - as such, no adverse impacts are predicted. In addition, there are no known groundwater issues (e.g. contamination) in the vicinity of the quarry site and the quarry is considered unlikely to present a groundwater contamination risk.

The potential for adverse water quality impacts on downstream receiving waters during construction and closure phases of the Project can be satisfactorily mitigated by the implementation of ESCs in general accordance with the Blue Book. The potential for adverse water quality impacts on downstream receiving waters during the operational phases are considered negligible (Engeny, 2024).

Biodiversity Impacts

The Project Area has been subject to extensive grazing and clearing with only grassland and scattered paddock trees remaining. Project siting and design (with <20 hectares of disturbance) has targeted areas which have experienced high levels of disturbance associated with historical and existing agricultural management practices. Areas with higher density tree coverage in the immediate vicinity of the quarry have largely been avoided.

Umwelt have prepared a Biodiversity Development Assessment Report (BDAR) which included on site Flora and fauna surveys in accordance with the Biodiversity Assessment Method (BAM) including vegetation mapping and threatened ecological community delineation, targeted threatened flora transects searches and species-specific fauna surveys.

No threatened species have been observed within the Project Area during surveys undertaken to date. One plant community type (PCT 483 - Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley) has been identified. Two threatened ecological communities (TECs) are associated with this PCT, those being i) White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (CEEC) listed under the *Biodiversity Act 2016* (BC Act); and ii) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A Biodiversity Management Plan will be developed and implemented to mitigate the impacts of the Project on biodiversity and appropriate offsets utilising the NSW Biodiversity Offset Scheme are to be developed to compensate for unavoidable biodiversity impacts associated with the Project.

From an economic perspective, the impacted vegetation, and associated fauna, is likely to have non-use values to the community that would be lost as a result of the Project. These values could potentially be estimated using non-market valuation methods. However, it is government policy that biodiversity offsets are provided that improve or at least maintain biodiversity values on a 'no net loss' principle. The provision of offsets is therefore likely to have non-use values to the community that would be gained because of the Project. On the basis that the NSW offset policy works on the principle of 'no net loss', no additional

economic costs warrant inclusion in the CBA apart from the costs of providing offsets. An allowance of $1.9M for biodiversity offset costs has been included in the capital costs of the Project.

Aboriginal Heritage

Impacts on Aboriginal cultural heritage can have use and non-use values to both Aboriginal and non-Aboriginal people that can be potentially estimated used nonmarket valuation methods such as choice modelling.

However, the Aboriginal Cultural Heritage Assessment identified that during the site survey no Aboriginal objects and/or sites and/or areas of potential archaeological deposit were identified. The Project will therefore not result in impact to known Aboriginal objects. Consequently, there are no material economic costs for inclusion in the CBA.

Historic Heritage

Impacts on historic heritage can potentially have non-use values to the community, that can potentially be estimated using nonmarket valuation methods such as choice modelling. However, the Historic Heritage Assessment concluded that the Project will not impact on any historic heritage. Consequently, there are no economic externality costs for inclusion in the CBA.

Visual Impacts

Visual impacts can potentially be estimated using the defensive expenditures method or property valuation method. However, the Visual Impact Assessment (VIA) identified that due to the quarry design, existing vegetation (particularly to the northeast) and intervening terrain, the visual impact rating for surrounding dwellings and from public vantage points is considered negligible/low.

Consequently, there are no material economic externality costs for inclusion in the CBA.

Adjoining Land Values

The value of properties is a function of the attributes of the property including structural, access and environmental attributes (Abelson, 1996), and the stream of benefits that the property can potentially provide over time (including income).

Impacts on adjoining property values from the Project are only likely to occur if structural, access, or environmental attributes of a property are adversely impacted for a sustained period by the Project. Where noise, dust, vibration, odour and visual impacts are contained, no measurable impacts would be expected to occur on adjoining properties.

Net Public Infrastructure Impacts

No net infrastructure costs to government are envisaged because of the Project. As identified above, haulage traffic for the supply of quarry materials to the LRWF formed part of the construction traffic for the LRWF project and was assessed as part of the EIS for that project. Any mitigation measures to manage quarry haulage and light vehicle (LV) traffic would be undertaken by the LRWF project and it is a condition of the LRWF project development consent that damage to roads caused by construction activities (which would include the haulage of quarry products from the Project) is fully repaired following the construction period.

Given that employment will likely be sourced from existing residents of NSW no additional demand for community infrastructure is envisaged.

Loss of Surplus to Other Industries

Under the base case (assuming a short run inelastic supply curve for quarry products), the increased demand for quarry products as result of demand from the LRWF would result in the price of quarry products (at the quarry gate) increasing with an increase in the producer surplus to existing quarries. This producer surplus to existing quarries would be lost because of the Project. However, the loss of producer surplus to existing quarries would be offset by the gain to existing consumers of quarry products from a reduction in price.

Economic Benefits to Existing Landholders

All land required for the Project is privately owned. There is an opportunity cost to the landowner from allowing the land to be used for quarrying instead of agriculture. This has been included in the analysis as discussed above. The Project will also share some of the producer surplus generated by the Project in form of royalties. This is part of the net production benefits of the Project identified below.

Economic Benefits to Suppliers

The focus of CBA is generally on primary costs and benefits i.e. first round impacts. In competitive markets, there are no real secondary benefits and costs either to suppliers to a project or purchasers of a project's output.[10] Conservatively, this convention is adopted and hence no secondary benefits to the economic are included in the CBA.

Market Benefits to Workers

The Project will result in direct employment 4-6 people during construction and operation and additional periodic employment for drill and blast crew.

As identified in the NSW Government (2015) Guideline, there may potentially be wage benefits associated with employment. Notwithstanding, there is considerably controversy about the measurement and inclusion of these benefits in NSW CBAs. Consequently, for the purpose of the CBA analysis, wage benefits have conservatively been left unquantified. Wage benefits are considered further in the LEA.

3.6 Consolidation of Value Estimates

3.6.1 Net Production Benefits

The present value of production costs and benefits, using a 7% discount rate, is provided in **Table 3.8**.

Based on the assumptions in Section 3.5, the Project is estimated to have net production benefits of $6M (present value at 7% discount rate).

The net production benefits can be further apportioned to Australia and NSW based on ARDG being 100% NSW owned, and company tax benefits (at a rate of 27.5%) accruing to NSW based on its population share

[10] There are no net benefits to suppliers because in a competitive market, all resources are fully employed so increases in net benefits to suppliers will be offset elsewhere in the economy from the withdrawal of resource that allow the suppliers to increase their production. There are no net benefits to purchasers because in a competitive market, competition in the purchasing of the project output will result in no net income to the purchaser and the project fully capturing the marginal value product (Sinden and Thampapillai, 1995, p. 57).

i.e. 32%. On this basis, the net production benefits of the Project that accrue to Australia and NSW are estimated at $6M and $4M (present value at 7% discount rate), respectively.

The estimated net production benefits that accrue to Australia and NSW can be used as a minimum threshold value or reference value against which the relative value of the residual (net) environmental impacts of the Project, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Project. It is a minimum threshold value as it does not include any potential wage benefits, any potential benefits to suppliers, any allowance for real price rises for quarry product as future demand outstrips limited supply.

Provided the value of the residual environmental impacts of the Project, to Australian and NSW households, after mitigation, do not exceed the respective net production threshold values, then the Project will have net benefits to the Australian and NSW communities.

Table 3.8 - Net Production Benefits of the Project ($M Present Values at 7% Discount Rate)

	Quarrying
Costs	
Opportunity cost of land and capital	$0
Capital costs	$4
Operating cost	$46
Rehabilitation and decommissioning costs	$0
Sub-total	***$50***
Benefits	
Revenue	$56
Residual value of land and capital equipment	$0
Sub-total	***$56***
Global Net Production Benefits	***$6***
Royalties	$0^
Company Tax	$2
Residual Net Production Benefits	$4
Global Net Production Benefits	**$6**
Royalties	$0^
Company Tax	$2
Residual Net Production Benefits	$4
Australian Net Production Benefits	**$6**
Royalties	$0^
Company Tax	$0
Residual Net Production Benefits	$4
NSW Net Production Benefits	**$4**

*Differences in totals are due to rounding to the nearest $M.

^Included in producer surplus calculations

3.6.2 Quarry Externalities

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to qualitatively consider and where possible quantify the main environmental, cultural, and social impacts of the Project. **Table 3.9** summarises the results of the consideration of externalities in Section 3.5.3.

The main quantified benefit is reduced haulage costs of quarry materials to the LRWF and associated reduced externality costs. Reduced haulage costs essentially increase the net production benefits of the LRWF by an equivalent amount. This increase in net production benefits can be apportioned to Australia based on the proponent of the LRWF being 100% Australian owned, a company tax rate of 30%, and all company tax and residual net production benefits accruing to Australia. 32% of company tax is assumed to accrue to NSW (based on population share) and 19%[11] of residual net production benefits.

Table 3.9 – Externality Impacts of the Project ($M Present Values at 7% Discount Rate)

	Australia	**NSW**
Benefits		
Wage benefits to quarry employment	Unquantified	
Economic benefits to existing landholders	Existing landowner to share quarry producer surplus via a royalty payment	
Economic benefits to suppliers	Unquantified	
Road transport		
Reduced haulage costs	$34	$8
Reduced accident costs	$1	$1
Reduced GHG emissions	$0.006	$0.002
Reduced other externality costs	$1	$1
Sub-total	***$36***	***$10***
Quarry Externality Costs		
Greenhouse gas emissions (Scope 1)	$0.003	$0.001
Air quality	Meets relevant criteria - no material residual impact	
Noise and blasting	Meets relevant criteria – no residual material impact	
Surface water	Opportunity cost of water use - $0.008 No water quality impacts	
Groundwater	No impact	
Biodiversity	Impacts on biodiversity are offset – cost of offsets are internalised as capital costs	
Aboriginal heritage	No impact	
Historic heritage	No impact	
Visual	No material residual impact	
Adjoining land values	No impact	
Net public infrastructure costs	No impact	
Loss of surplus to other industries	Loss of surplus to other quarries offset by reduced price to purchasers	
Sub-total	***$0.011***	***$0.009***
Net Benefits	**$36**	**$10**

From Table 3.5, it is evident that the environmental impacts of the proposed quarry are not material from an economic efficiency perspective, and the main potential impacts of the quarry are internalised into the

[11] Tilt Renewables is 40% owned by QIC (0% NSW), 40% Australian Government Future Fund (32% assumed NSW based on population share, and 19% AGL Energy Ltd (32% assumed NSW based on population share).

production costs of the Project through mitigation measures, biodiversity offsets and payments for water. The positive externalities from reduced quarry haulage result in net externality benefits of $36M, present value to Australia and $10M, present value to NSW.

3.6.3 Net Social Benefits to Australia and NSW

The main decision criterion for assessing the economic desirability of a project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the project, because the community as a whole would obtain net benefits from the project.

The results from **Table 3.8** and **Table 3.9** are combined in **Table 3.10** to estimate the net social benefits of the Project to Australia and NSW.

Table 3.10 – Net Social Benefits of the Project ($M present value @ 7% discount rate)

	Australia	**NSW**
Benefits		
Net Production Benefits Quarrying		
Company Tax	$2	$0
Residual Net Production Benefits	$4	$4
Sub-total	***$6***	***$4***
Other Benefits		
Wage benefits to employment	Unquantified	
Economic benefits to existing landholders	Existing landowner to share quarry producer surplus via a royalty payment	
Economic benefits to suppliers	Unquantified	
Road transport		
Reduced haulage costs	$34	$8
Reduced accident costs	$1	$1
Reduced GHG emissions	$0.006	$0.002
Reduced other externality costs	$1	$1
Sub-total	***$36***	***$10***
Total Benefits	**$41**	**$14**
Quarry Externality Costs		
Greenhouse gas emissions (Scope 1)	$0.003	$0.001
Air quality	Meets relevant criteria - no material residual impact	
Noise and blasting	Meets relevant criteria – no residual material impact	
Surface water	Opportunity cost of water use - $0.008. No water quality impacts	
Groundwater	No impact	
Biodiversity	Impacts on biodiversity are offset – cost of offsets included in capital costs	
Aboriginal heritage	No impact	
Historic heritage	No impact	
Visual	No material residual impact	
Adjoining land values	No impact	
Net public infrastructure costs	No impact	
Loss of surplus to other industries	Loss of surplus to other quarries offset by reduced price to purchasers	
Total Costs	**$0.011**	**$0.009**
Net Social Benefits	**$41**	**$14**

Overall, the Project is estimated to have net social benefits to both Australia ($41M) and NSW ($14M), and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than approximately $41M and $14M for the Project to be questionable from an Australian and NSW economic efficiency perspective, respectively.

3.7 Distribution of NSW Costs and Benefits

CBA is primarily concerned with the single objective of economic efficiency. CBA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, CBA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed.

The costs and benefits of the Project to Australia and NSW are potentially distributed among a range of stakeholders as identified in **Table 3.11**.

Table 3.11 - Incidence of 1 Costs and Benefits

BENEFITS AND COSTS	INCIDENCE OF COSTS AND BENEFITS	AUSTRALIA ($M)	NSW ($M)
Extraction and Processing Net Production Benefits			
Company tax (ARDG Pty Ltd and Landowner)	Australian and NSW Government and households	$2	$0
Residual net producer surplus	ARDG Pty Ltd and Landowner	$4	$4
Additional benefits			
Wage benefits to employment	People employed in extraction and road transport	Not quantified	Not quantified
Economic benefits to suppliers	Suppliers of inputs to production	Not quantified	Not quantified
Economic benefits to existing landholders	Existing landholder	Existing landowner to share quarry producer surplus via a royalty payment	Existing landowner to share quarry producer surplus via a royalty payment
Reduced haulage costs	LRWF	$34	$8
Reduced accident costs	NSW households	$1	$1
Reduced GHG emissions	Australian and NSW households	$0.006	$0.002
Reduced other externality costs	NSW households	$1	$1

Table 3.11 (Cont'd) - Incidence of NSW Costs and Benefits

BENEFITS AND COSTS	INCIDENCE OF COSTS AND BENEFITS	AUSTRALIA ($M)	NSW ($M)
Environmental, social, and cultural costs of the quarry*			
Greenhouse gas emissions	Australian and NSW households	$0.003	$0.001
Air quality	Adjoining landholders	Meets relevant criteria - no material residual impact	
Noise and blasting	Adjoining landholders	Meets relevant criteria - no material residual impact	
Surface water	Other water users but compensated via payment	$0.008	
Groundwater	Groundwater users and Australian and NSW households	No groundwater impacts	
Biodiversity	Australian and NSW households	Impacts on biodiversity are offset – cost of offsets included in capital costs	
Aboriginal heritage	Aboriginal people and Australian and NSW households	No impact	
Historic heritage	Australian and NSW households	No impact	
Visual	Nearby landholders	No material residual impact	
Adjoining land values	Nearby landholders	No impact	
Net public infrastructure costs	Australian and NSW Government	No impact	
Loss of surplus to other industries	Other regional quarries	Loss of surplus to other quarries offset by reduced price to purchasers	

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset or compensate then no residual impacts occur, and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation are imperfect.

3.8 Risk and Sensitivity Analysis

The main areas of environmental risk associated with Project relate to:

- the financial viability of a project from unexpected downturns in prices and any consequent environmental impacts from premature cessation of operations.
- ecological risk associated with whether the biodiversity offsets will adequately compensate for the direct ecological impacts.
- other environmental, social and cultural impacts estimations and required mitigation measures.

The Independent Planning Commission (formerly the Planning Assessment Commission) has previously identified that the financial viability of projects is a risk assumed by the project proponents (NSW PAC, 2018). The Project is to solely meet the identified demand for hard rock materials from the LRWF project. This demand underpins the financial viability of the Project.

Any risks associated with funding rehabilitation costs in the event of early closure will be managed through a legally binding commitment between ARDG and the landowner.

Risks associated with achieving intended biodiversity offsets requirements are assumed to be managed though the legislative scheme under the *Biodiversity Conservation Act 2016* which is managed by the NSW Government.

There is some risk associated with the estimation of environmental, social, and cultural impacts of the Project and the level of mitigation measures proposed. However, it should be noted that impacts have generally been assessed based on the maximum annual levels of production and hence are likely to be overstated. Ongoing monitoring will ensure that appropriate mitigation measures are implemented as required.

The net present values (NPVs)[12] of the Project presented in **Table 3.10** are based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a CBA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV[13].

In this sensitivity analysis, the CBA results for NSW were tested for a 20% change to the following variables[14] at a 4%, 7% and 10% discount rate:

- Opportunity costs of land.
- Quarry capital costs.
- Quarry operating costs.
- Quarry revenue.
- Transport costs.
- Transport externality costs.
- Greenhouse gas emission costs.
- Surface water costs.

In addition, the sensitivity analysis includes a scenario where 100% of the global social damage costs of GHG emissions from the Project are included in the analysis, rather than just the impacts on NSW households.

Results are reported in **Table 3.11**. What this analysis indicates, is that CBA results at the NSW level are most sensitive to reductions in the value of hard rock products and increases in operating costs.

The LRWF provides specific demand for hard rock products from the Project with the value of hard rock products from the Project determined contractually with the LRWF. Consequently, sustained reductions in the value of hard rock products from the Project will not occur.

Operating cost estimates are based on a detailed financial model of the business operations prepared by ARDG. The financial model draws on ARDG's experience in quarry operations at eight (8) different sites across NSW since 2018, as well as extensive experience in the resources sector over the last two decades. Consequently, sustained increases in modelled operating costs are unlikely.

The sensitivity analysis also indicated that the CBA results are not sensitive to changes in opportunity costs of land, capital costs, which includes mitigation, compensation, and offset costs. Since mitigation, offset and compensation costs are small components of the capital and operating costs of the Project, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results. The

[12] NPV is the present value of benefits less the present value of costs. Present values are calculated using a discount rate that reflects peoples time preferences.

[13] Quantitative risk analysis could also potentially be undertaken. However, this requires information on the probability distributions for input variables in the analysis. This information is not available and so the sensitivity testing is limited to uncertainty analysis.

[14] An assessment of sensitivity to exchange rate fluctuations as required by the SEARs is not applicable to this development as all product is sold for domestic use. Potential flow-on effects from exchange rates on supplies (e.g. fuel) or capital (e.g. equipment) are captured in the consideration of sensitivity to operating and capital costs

CBA results are also not sensitive to the inclusion of global social damage costs of GHG emissions from the Project instead of the costs to NSW households only.

Under all scenarios examined, the Project has net social benefits to NSW.

Table 3.11 - NSW CBA Results Sensitivity Testing ($M Present Value)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$16	$14	$13
INCREASE 20%			
Opportunity cost of land	$16	$14	$13
Quarry capital costs	$15	$14	$13
Quarry operating costs	$8	$7	$6
Rehabilitation and decommissioning costs	$16	$14	$13
Value of quarry products	$26	$24	$22
Transport cost savings	$18	$16	$15
Transport externalities savings	$16	$15	$13
Greenhouse gas emission costs	$16	$14	$13
Surface water costs	$16	$14	$13
DECREASE 20%			
Opportunity cost of land	$16	$14	$13
Quarry capital costs	$17	$15	$14
Quarry operating costs	$24	$22	$20
Rehabilitation and decommissioning costs	$16	$14	$13
Value of quarry products	$6	$5	$5
Transport cost savings	$14	$13	$12
Transport externalities savings	$15	$14	$13
Greenhouse gas emission costs	$16	$14	$13
Surface water costs	$16	$14	$13
	100% GLOBAL SOCIAL DAMAGE COST		
Greenhouse gas emission costs	$17	$15	$14

4 THE REGIONAL ECONOMY

4.1 Introduction

The Project is located at the western boundary of the Upper Hunter Shire Local Government Area. For this section the regional locality also includes the adjoining Warrumbungle, Mid-Western and Dubbo regional LGAs. These broader LGAs are included due to potential related impacts such as employment and procurement.

4.2 Characterisation of the Region

4.2.1 Residents of the Region

Table 4.1 provides some characteristics of the usual residents of the four LGAs comprising the regional economy based on the Australian Bureau of Statistics (ABS) 2021 Census of Population and Housing. In 2021, the region had a population of 104,089 and a labour force of 48,860, with the Dubbo Regional LGA comprising 53 per cent and 54 per cent of the total, respectively. In 2021, there were 1,861 people unemployed with the majority of these located in the Dubbo Region LGA and the highest unemployment rate (6.1%) being in Warrumbungle Shre LGA.

The main occupation in the region is Professionals (16.4%) followed by Technicians and Trades Workers (15.23%) and Managers (14.4%). Professionals are the largest occupation in Dubbo Regional LGA and the second largest occupation in Mid-Western Regional LGA, while Technicians and Trade Workers is the largest occupation in both the Mid-Western Regional LGA and Upper Hunter Shire LGA. Managers are the largest occupation in Warrumbungles Shire LGA.

The main industry sectors (4-digit) in which usual residents were employed in 2021 are provided in **Table 4.2**. For the total region the most significant sectors were *Coal Mining*, *Hospitals (except Psychiatric Hospitals), Other Social Assistance Services, Aged Care Residential Services* and *Primary Education*. However, there is some heterogeneity between LGAs with the most significant sector in the Upper Hunter Shire LGA and Mid-Western Regional LGA being *Coal Mining,* the most significant sector in the Dubbo Regional LGA being *Hospitals (except Psychiatric Hospitals)*, and the most significant sector in the Warrumbungle Shire LGA being *Beef Cattle Farming (Specialised)*.

Thirteen per cent of the working usual residents of the region work outside the region, with the main locations being No Fixed Address (NSW) (4%), Muswellbrook (3%), Narromine (1%) and Singleton (0.4%). The main industry sectors that people working outside the region are engaged in are *Coal Mining, Gold Ore Mining, Other Social Assistance and Hospitals (except Psychiatric Hospitals).*

Table 4.1 - Characteristics of Usual Residents

	Upper Hunter Shire		Warrumbungle Shire		Mid-Western Regional		Dubbo Regional		Total Region	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Demographics										
Population	14,229		9,225		25,713		54,922		104,089	
Median Age	42		50		42		36			
In Labour Force	7,009	49.3	3,619	39.2	11,895	46.3	26,337	48.0	48,860	46.9
Unemployed	224	3.2	221	6.1	470	4.0	946	3.6	1,861	3.8
Median household weekly income	1,429		1,068		1,486		1597			
Unoccupied private dwellings	850	13.4	721	17.5	1,704	15.0	1,623	7.8	4,898	
Median rent	270		200		330		300			
Occupations										
Technicians and Trades Workers	1,152	17	353	10.4	1,998	17.5	3,556	14.0	7,059	15.3
Labourers	1,136	16.7	526	15.5	1,298	11.4	2,692	10.6	5,652	12.3
Managers	1037	15.3	882	25.9	1,591	13.9	3,133	12.3	6,643	14.4
Machinery Operators and Drivers	892	13.1	238	7.0	1,473	12.9	1,580	6.2	4,183	9.1
Professionals	825	12.2	463	13.6	1,607	14.1	4,648	18.3	7,543	16.4
Community and Personal Service Workers	631	9.3	394	11.6	1,261	11.0	3,822	15.1	6,108	13.2
Clerical and Administrative Workers	575	8.5	277	8.1	1,110	9.7	3,158	12.4	5,120	11.1
Sales Workers	403	5.9	199	5.9	893	7.8	2,320	9.1	3,815	8.3

Source: ABS, 2021 Census of Population and Housing, Community Profiles

Table 4.2 - Top 5 Industry Sectors of Employment for Usual Residents

Upper Hunter Shire	No.	%	Warrumbungle Shire	No.	%	Mid-Western Regional	No.	%	Dubbo Regional	No.	%	Total Region	No.	%
Coal Mining	722	10.6	Beef Cattle Farming (Specialised)	291	8.6	Coal Mining	1676	14.7	Hospitals (except Psychiatric Hospitals)	1367	5.4	Coal Mining	2,484	5.3
Horse Farming	429	6.3	Local Government Administration	139	4.1	Primary Education	323	2.8	Other Social Assistance Services	967	3.8	Hospitals (except Psychiatric Hospitals)	1,910	4.1
Beef Cattle Farming (Specialised)	410	6	Grain-Sheep or Grain-Beef Cattle Farming	137	4	Supermarket and Grocery Stores	294	2.6	Aged Care Residential Services	749	3	Other Social Assistance Services	1,404	3.0
Meat Processing	270	4	Combined Primary and Secondary Education	133	3.9	Aged Care Residential Services	290	2.5	Primary Education	723	2.8	Aged Care Residential Services	1,328	2.8
Aged Care Residential Services	193	2.8	Hospitals (except Psychiatric Hospitals)	125	3.7	Other Social Assistance Services	288	2.5	State Government Administration	600	2.4	Primary Education	1,300	2.8

Source: Australian Bureau of Statistics, 2021 Census of Population and Housing, Community Profiles

An indication of the health of an economy can be gained from population changes. This theory of regional economic growth suggests that places that are able to attract population immigration[15] create increased demand for goods and services and thus more jobs. This growth leads to increasing local multiplier effects, scale economies and an increase in the rate of innovation and capital availability (Sorensen, 1990). Conversely, population losses can contribute to a 'vicious cycle' of decline whereby reduced populations results in closure of services, which in turn makes it difficult to attract new populations (Sorensen, 1990).

Trends in regional economies as a result of globalisation and associated structural adjustment include:

- loss of significant industries such as abattoirs and timber mills from many rural areas;
- increased mechanisation of agriculture and aggregation of properties, resulting in loss of employment opportunities in this industry;
- growth of regional centres, at the expense of smaller towns;
- preference of Australians for coastal living, particularly for retirement; and
- preference of many of today's fastest growing industries for locating in large cities (Collits, 2000).

The result is that there has been declining population in many rural LGAs that are in non-coastal areas. There has also been a decline in the population of smaller towns even in regions where the population has been growing.

Against this backdrop, it is evident that the population of the region has been growing, at an average annual rate of 0.9% since 2011, lower than the population growth rate for NSW (1.2%) (which is driven by the population growth rate for Greater Sydney). Population growth rate varied considerable between LGAs in the region with Mid-Western Regional LGA and Dubbo Regional LGA growing at a rate equal to and greater than the growth rate for NSW. While population growth was stagnant in Upper Hunter Shire LGA and negative in Warrumbungle Shire LGA.

Table 4.3 - Population Growth

	2011	2016	2021	Annual Growth Rate 2011 - 2016	Annual Growth Rate 2016 - 2021	Annual Growth Rate 2011- 2021
Upper Hunter Shire	14,206	14,344	14,254	0.2%	-0.1%	0.0%
Warrumbungle Shire	9,898	9,562	9,254	-0.7%	-0.6%	-0.7%
Mid-Western Regional	23,020	24,546	25,704	1.3%	0.9%	1.2%
Dubbo Regional	49,079	51,404	55,518	0.9%	1.6%	1.3%
Total Region	***96203***	***99856***	***104730***	***0.8%***	***1.0%***	***0.9%***
NSW	**7,218,529**	**7,732,858**	**8,093,815**	**1.4%**	**0.9%**	**1.2%**

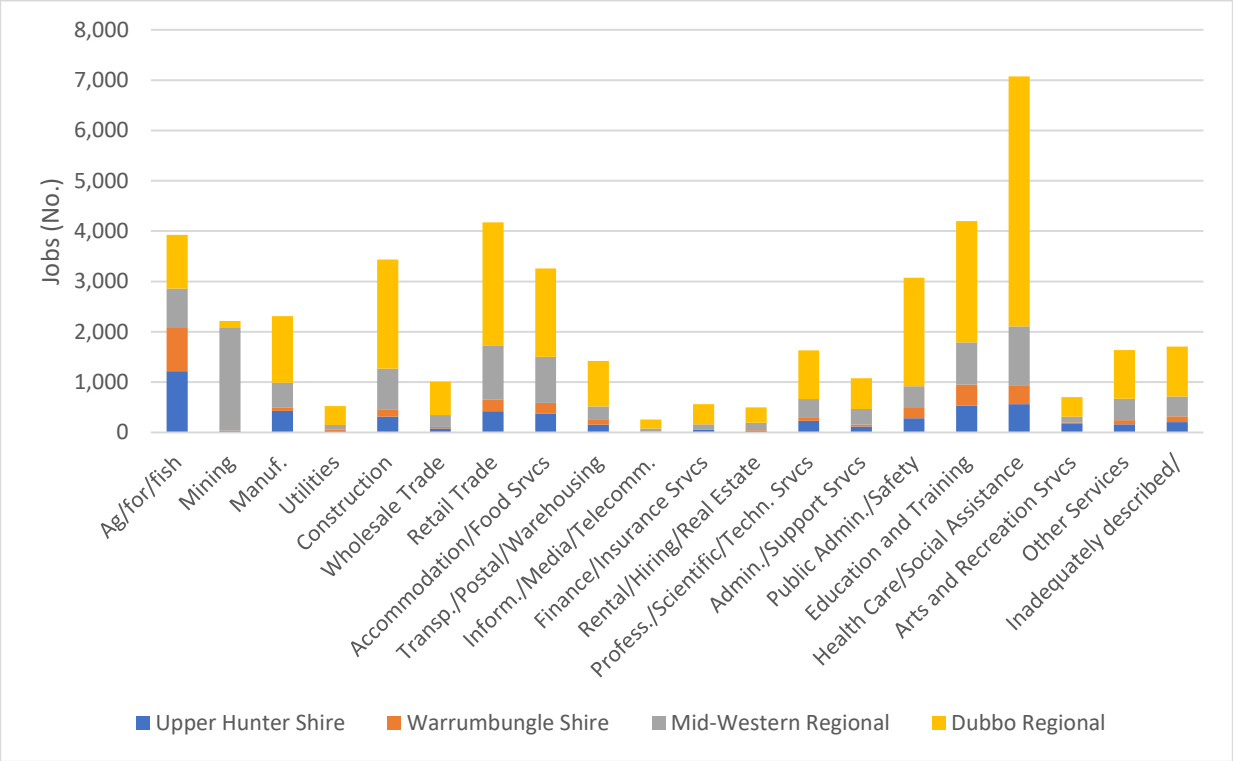
Source: Australian Bureau of Statistics, 2024 Population Estimates by LGA, significant Urban Area, remoteness Area and Electoral Division, 2001 to 2023.

4.2.2 Economic Activity in the Region

An indication of the nature of the regional economy can be gained by examining place of work employment by industry data - refer to Figure 4.1. This indicates the significance of the *Health Care and Social Assistance*, *Education and Training, Retail Trade, Agriculture, Forestry and Fishing, and Construction,* sectors. *Health Care and Social Assistance* is the largest employment sector in Dubbo Regional LGA, *Mining* is the largest employment sector in Mid-Western Regional LGA, and *Agriculture, Forestry and Fishing* is the largest employment sector in both the Warrumbungle Shire LGA and Upper Hunter Shire LGA.

[15] Mainly due to natural endowments and comparative advantage in certain industry sectors.

Figure 4.1 - Place of Work Employment by Industry (1-digit ANZSIC Sectors)



Source: Australian Bureau of Statistics, 2021 Census of Population and Housing, Working Population Profiles

Gillespie Economics has produced an Input-Output (IO) table for the regional economy using the Generation of Regional Input Output Tables (GRIT) procedure developed by the University of Queensland and recognised internationally - Refer to Attachment 1. The Gross Regional Product (GRP) of the regional economy was estimated at $6,598 million for 2020.

The region is a net importer, with exports out of the region of $4,921 million and imports into the region of $4,461 million. Using the IO industry classifications, the largest exporting industries by value are:

- *Coal Mining* ($2,334 million)
- *Sheep, Grains, Beef Cattle and Dairy Cattle* ($642 million)
- *Meat and Meat Products Manufacturing* ($346 million)
- *Primary and Secondary Education Services* ($260 million)
- *Basic Non-Ferrous Metal Manufacturing* ($181 million).

Exporting sectors are considered to be key drivers of regional economies and reflect a region's endowments and competitive advantages.

The following analysis uses the IO table data but reports the findings in terms of both the IO industry classifications and the ANZSIC One-digit industry classification.

Using the IO industry classifications, in terms of value-added, it is estimated that *Sheep, Grains, Beef and Dairy Cattle; Primary and Secondary Education Services*; *Residential Care and Social Assistance; Health Care*

Services; and *Public Administration;* had the highest value added - in total, equal to approximately 25 per cent of the regional economy and 36 per cent of regional employment – Table 4.4.[16]

Table 4.4 - Gross Value Added for the 5 Largest Industries in the Regional Economy (IO Sectors)

Industry	Gross Value Added ($m)	Proportion of Regional Economy (%)	Proportion of Regional Employment (%)
Sheep, Grains, Beef and Dairy Cattle	406	6%	7%
Primary and secondary education services (including preschool and special schools)	319	5%	8%
Residential Care and Social Assistance Services	318	5%	8%
Health Care Services	301	5%	9%
Public Administration	297	5%	5%
Total	**1,641**	**25%**	**36%**

Source: Gillespie Economics Input-Output Table

Based on the ANZSIC One-digit industry classification, in terms of value-added, it is estimated that *Mining; Rental, Hiring and Real Estate Services; Health Care and Social Assistance; Agriculture/Forestry/Fishing; and Construction;* had the highest value added - in total, equal to approximately 52 per cent of the regional economy and 40 per cent of regional employment - Table 4.5.

Table 4.5 - Gross Value Added for the 5 Largest Industries in the Regional Economy (ANZSIC One-Digit Sectors)

Industry	Gross Value Added ($m)	Proportion of Regional Economy (%)	Proportion of Regional Employment (%)
Mining	1,087	16%	5%
Rental, Hiring and Real Estate Services	717	11%	1%
Health Care and Social Assistance	619	9%	16%
Agriculture/Forestry/Fishing	559	8%	9%
Construction	480	7%	8%
Total	**3,462**	**52%**	**40%**

Source: Gillespie Economics Input-Output Table

[16] Gross Value Added (GVA) measures the value of goods and services produced in a region.

5 LOCAL EFFECTS ANALYSIS

5.1 Introduction

The CBA in Section 3 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Project compared to 'without' it. This section examines local effects. It focuses on the operational phase of the Project.

The local area is defined as the LGAs of Dubbo Regional, Mid-Western Regional, Warrumbungle Shire and Upper Hunter, within which the Project is located and is the region considered likely to be main source of labour and non-labour inputs for the Project.

5.2 Direct Effects Related to Employment of Existing Residents Only

The Project will generate employment for approximately six full time equivalent (FTE) quarry workers for approximately four years. Seventy six percent of quarry workers are assumed to reside in the local area,[17] with the remainder commuting from outside the local area.

In estimating the effects related to local employment, the LEA method focusses on net income (net wages) that a project provides to the local area. It does this by focusing on the projects employment that would ordinarily be resident in the locality and for these people estimating the net increase in income as the difference between income in the project compared to the average level of net income in the local area (i.e. what they might otherwise receive in an alternative job). The increase in net income is converted to net FTE jobs by dividing this incremental net income by the average net wage in the project. This is a minimum estimate as it assumes full employment in the region and hence employees ordinarily resident in the locality would always be employed in some capacity in the region, albeit at a lower wage, and the jobs in the region from which people come to fill the projects jobs remain vacant. On this basis, the net income to the local area and net jobs provided by the project are summarised in Table 5.1.

Table 5.1 - Analysis of Net Income Increase and FTE Job Increase Assuming Full Employment

Attribute	Quarry
a) Direct incremental employment	6
Number that already reside in the region	5
b) Average net income in sector	$90,573
c) Average net income in other industries*	$48,833
d) Average increase in net income per job (b-c)	$41,740
e) Increase in net income per year due to direct employment	$190,334
f) FTE (e/b)	2

*This information is not available from the ABS and hence average income across all sectors is used.

5.3 Direct Effects Related to Non-Labour Expenditure

The average annual non-labour expenditure (operating costs of the Project after subtraction of wages) is $13.4M.

[17] Based on ABS 2021 Census of Population and Housing 4-digti employment by industry by place of usual residence data.

However, not all this expenditure will accrue to the local area. From a 2020 input-output table of the local area economy developed by Gillespie Economics, the percentage of this non-labour expenditure accruing to the local area is estimated at 53% i.e. $7.1M.

5.4 Second Round and Flow-On Effects

The expenditure by employees who reside in the region, and non-labour expenditure that is captured by the local area, provides flow-on economic activity to the local economy.

Recognised methods for assessing second round and flow-on effects such as input-output analysis (but also computable general equilibrium analysis), do not utilise direct effects of employment and income effects as calculated above in accordance with the Guidelines (NSW Government, 2015). Instead, they use the total employment working in the region, with total wages (rather than net additional wages to existing employed people) divided between those who live in the region and those who reside outside the region. They do utilise estimates of non-labour expenditure, however multiplier effects are not estimated in terms of non-labour expenditure but in terms of how this and labour expenditure contribute to the local area economy in terms of direct and indirect output, value-added, income and employment. This type of assessment is reported in the following section.

5.5 Regional Economic Impact Assessment

Standard regional economic impact assessment using input-output analysis, is not restricted to a focus on the existing labour force in the local area and does not assume an absence of job chain effects. The presence of job chain effects in a region, means that to the extent that jobs from which people come, to fill Project jobs, are themselves filled and their jobs are also filled until the lowest paid jobs are filled by people from unemployment, new labour force participants, then new wages in the region will approximate the total incremental wages associated with the Project. Refer to Attachment 1.

In this framework, the annual direct and indirect economic activity impacts in the local area from the quarry operations, are summarised in **Table 5.2**. The large multipliers for income and employment arise from the capital-intensive nature of the quarry i.e. low relative direct employment and income, but large relative expenditures with associated flow-on employment.

Table 5.2 – Gross Annual Direct and Indirect Regional Economic Impacts of the Quarry

Indicator	Direct Impacts	Production Induced Flow-ons	Consumption Induced Flow-ons	Total Flow-ons	Total Impacts
Value Added ($M)	3.84	4.56	1.77	6.33	10.17
Type IIA Multiplier	1.00	1.19	0.46	1.65	2.65
Income ($M)	0.57	2.44	0.71	3.15	3.71
Type IIA Multiplier	1.00	4.32	1.25	5.57	6.57
Employment (No.)	6.00	32.41	12.73	45.14	51.14
Type IIA Multiplier	1.00	5.40	2.12	7.52	8.52

5.6 Other Effects

5.6.1 Regional Economic Impacts of Agriculture

The subject land is used for sheep and cattle grazing. Some land will be temporarily unavailable for grazing during the Project while a small area will remain unavailable for grazing in perpetuity. The regional economic impact of this foregone grazing is immaterial.

5.6.2 Wage Impacts

The Project will create direct demand for six people. This will not have any observable impact on regional wages.

5.6.3 Housing Impacts

The Project will not result in any substantial in-migration of workers and their families and consequently the impact on housing prices is expected to be negligible.

5.6.4 Demand on Local Infrastructure and Services

Demand for local infrastructure and services arises from the production process as well as demands of the workforce and their families. The Project will not create any significant demand for local infrastructure and services for the production process. It will not result in any changes in population levels in the local area and therefore will not generate any additional community demand for local infrastructure and services.

The Project will reduce the use of local and arterial roads for haulage of quarry materials to the LRWF.

5.7 Environmental and Social Impacts on the Local Community (Externalities)

The distribution of costs and benefits of the Project are summarised in **Table 3.6**. The main potential effects on the local community are reduced transport impacts and biodiversity impacts. Biodiversity impacts will be offset at the proponent's cost.

5.8 Summary of Local Effects

A summary of local effects of the Project is provided in **Table 5.3**.

Table 5.3 - Summary of Effects on the Local Community

Annual Local Effects	**Direct Total**	**Direct Already Resident in the Local Area**	**Net**
Employment FTE	6	5	2
Net Income ($M)			0.2
Non-labour expenditure in the Local Area ($M)	7.1		
Annual Regional Impacts	**Direct**	**Flow-on**	**Total**
Output ($M)	17	13	31
Value-added ($M)	4	6	10
Income ($M)	1	3	4
Employment	6	45	51
Other Local Economic Impacts			
Displaced agricultural activities	No material impact*		
Wage rise impacts	No material impact*		
Housing impacts	No material impact*		
Demand on local infrastructure and services	No material negative impact*		
Local Environmental Impacts			
Road Transport	Reduced road transport impacts on local and arterial roads		
Biodiversity	Impacts on local biodiversity are offset		

* Materiality refers to whether valuation of these impacts would have any bearing on the estimated net social benefits of the Project. NSW Government (2012) identified that if a Project has an NPV of say "$20 million, costs or benefits valued at less than $1 million are unlikely to be material."

*** Unless otherwise specified monetary amounts are in 2023 dollars.

6 ECONOMIC MANAGEMENT MEASURES

It is evident from Section 5 that construction and operation of the Project will have net positive impacts on the level of economic activity in the regional economy and actually reduce road transport impacts associated with supplying quarry materials to the LRWF.

ARDG proposes to work in partnership with the local Councils and the local community to help maximise the projected economic regional benefits whist minimising any impacts. In this respect, a range of general economic management measures are proposed and would include for example:

- Employment of regional residents preferentially where they have the required skills and experience and can demonstrate a cultural fit with the organisation.
- Participating, as appropriate, in business group meetings, events or programs in the regional community.
- Locally sourcing non-labour inputs to production where local producers can be cost and quality competitive.
- Provision of community grants through various initiatives and programs within the local community, including the education, arts, sporting, and culture sectors.

7 CONCLUSION

A CBA of the Project indicated that it would have net production benefits to Australian and NSW of $6M and $4M (present value at 7% discount rate), respectively.

The negative environmental impacts of the proposed quarry are not material from an economic efficiency perspective, and the main potential impacts of the quarry are internalised into the production costs of the Project through mitigation measures, biodiversity offsets and payments for water. The positive externalities from reduced quarry haulage result in net externality benefits of $36M, present value to Australia and $10M, present value to NSW.

Consequently, the Project is estimated to have net social benefits to both Australia ($41M) and NSW ($14M), and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than approximately $41M and $14M for the Project to be questionable from an Australian and NSW economic efficiency perspective, respectively.

The Project's predicted net social benefits to NSW remain robust under a range of different sensitivity scenarios considered.

As well as providing net economic and social benefits to Australia and NSW, the Project will provide direct economic activity, including jobs, to the local area economy, and indirect economic activity to the local area via both wage and non-wage expenditure.

The Project will provide six FTE direct quarry jobs, for approximately four years. Assuming that those that already reside in the local area would have otherwise been already employed and that job vacancies created by these people filling the Project jobs remain unfilled (i.e. no job chain effects), the incremental disposable wages accruing to the region from Project is $0.2M per annum. This is equivalent to two direct full time equivalent (FTE) jobs. This is a minimum estimate as it assumes full employment in the region and hence the jobs from which people come to fill the Project jobs remain vacant.

Standard regional economic impact assessment using IO analysis, is not restricted to a focus on the existing labour force in the local area and does not assume an absence of job chain effects. In this framework, the Project is estimated to provide the following annual direct and indirect annual effects to the local economy:

- $31M in output;
- $10M in value-added;
- $4M in gross wages; and
- 51 jobs.

The main local environmental impacts are internalised into the production costs of ARDG via mitigation, offset and compensation costs. Residual local environmental impacts after mitigation, offset and compensation are likely to be immaterial.

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ATTACHMENT 1 – COMPARISON OF INPUT-OUTPUT ANALYSIS AND THE LEA METHOD

IO analysis begins with identification of the direct gross regional economic activity footprint of a project for the region. If a project provides 100 jobs at the quarry site then all these jobs are counted in IO analysis as a direct effect i.e. direct employment in the region, because the jobs are located in the region. All income paid to employment is also included as it is generated in the economy and IO tables are based on place of work. However, in assessment of the impacts of a project on the regional economy only the income of employees living in the region are counted as direct income effects since it is only wages expenditure of those living in the region that flows through the regional economy. In IO analysis, if 40% of a project's jobs are filled by people who already reside in the region then the **total** wages of these people is counted as a direct regional income effect of the project. Similarly, if 40% of the new jobs are taken by people who migrate into the region this is also counted as direct income for the region, as it is income that will accrue to people living in the region even though they are new residents. In impact assessment using IO analysis, the income of those residing outside the region is excluded as most of their income will be taken home after shift and spent where they live or elsewhere.

These direct employment and income effects for the region are those **associated** with the project i.e. the gross footprint, rather than specifically an assessment of **incremental** effects. This is partly because assessment of incremental effects becomes highly contentious and difficult. However, as will be shown below, these gross direct effects associated with a project can also be a reasonable approximation of incremental effects when "job chain" effects are considered.

However, first is a comparison between how IO analysis treats direct employment and income effects (as explained above) and that in the NSW (2015) guideline.

The guideline splits labour into those ordinarily resident in the region and those not ordinarily resident in the locality. For those ordinarily resident in the region the guideline suggests calculation of incremental income as the difference between a mining (income and the average level of income in other industries in the region. Incremental direct employment is then calculated by dividing this incremental income by the average wage in mining.

The guideline ignores workers who migrate into the region to work. However, using the rationale of the guideline, workers who migrate into the region to take jobs in a project provide a greater level of incremental income and spending in the region than those that take jobs in a project and who already reside in the region. The entire wage of those migrating into the region is additive to regional income in comparison to wage increments for those already residing in the region.

Table 1 provides an example of incremental wages using the guideline method and when income from those migrating into the region is counted. If only the incremental wages of those who already reside in the region are counted the incremental impact is $1.4M in annual wages. However, if the incremental wages to the region from those who migrate into the region are included, this increases to $5.4M.

Table 1 - Incremental Income when Immigrating Workforce is Included

Categories of Workers	Direct Empl	Current Wages @$65k	New Wages @$100k	Incremental New Wages for Workers	Incremental New Wages to the Region
Already Live in Region	40	2,600,000	4,000,000	1,400,000	1,400,000
Migrate into Region to Live	40	2,600,000	4,000,000	1,400,000	4,000,000
Commute from outside	20	1,300,000	2,000,000	700,000	0
Total Direct Empl	**100**	**6,500,000**	**10,000,000**	**3,500,000**	**5,400,000**

Even for those already living in the region who are already employed, the incremental income estimated using the guideline will substantially understate additional regional income effects. This is because new jobs in a region create a chain of job opportunities (referred to in the literature as the "job chain" - see Persky et al, 2004 What are jobs worth?, Employment Research Vol. 11 , p. 3).

An already employed person in the region moving into a mining (including quarrying) job, creates a job vacancy, which can be filled by those in the region (already employed, unemployed or attracted into the labour force) or by in-migration. Where this job is filled by those already employed in the region this in turn creates another vacancy etc. Following the entire chain through, the cumulative increase in wages to a region would approach the wages of the total direct mining jobs. It would only be discounted if the chain ends with employment of those from local residents in the unemployment pool (who are receiving an allowance and hence already are spending income in the region), if jobs remain unfilled or if jobs are filled by a commuter workforce. The latter is less likely for lower paying jobs down the job chain. In periods of higher unemployment rates, jobs along the job chain remaining unfilled is unlikely. If the chain ends with in-migrating employment or employment of those in the region that are new to the workforce then the incremental wages is equal to the total wages of the new jobs.

Table 2 demonstrates the "job chain" effect in relation to 40 new mining jobs filled by already employed local workers. It shows that the total annual wages of the new mining jobs is $4M. Under the job chain approach where all jobs are backfilled including ultimately by 40 local residents from the unemployment pool the incremental wages to the region are $3.5M. If some of these jobs filled from the unemployment pool are ultimately filled by in-migration the difference between the incremental wages to the region and the total annual mining jobs wages will lessen.

The guideline does not take account of the "job chain" effect and essentially assumes that the previous jobs of "job movers" in the region remain vacant for the life of the Project.

Incorporation of consideration of the "job chain" effect means that the direct incremental income to a region approximates that assumed in IO analysis (i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect).

Table 2 - Demonstration of the Job Chain Effect for 40 Jobs Filled by Locals Who are Already Employed in the Region

	Total wages	Increment Wages Gain to Region
1. New mining wage for 40 workers @$100k	$4,000,000	$1,400,000 (1-2)
2. Current Wages for 40 workers @$65k	$2,600,000	$1,000,000 (2-3)
3. Wage of people filling above 40 positions @$40k	$1,600,000	$800,000 (3-4)
4. Wage of people filling above 40 positions @$20k	$800,000	$ 255,664 (4-5)
5. Wages of the unemployed filling above 40 positions (Newstart - single no children)	$544,336	
	Total	**$3,455,664**