Appendix N

Economic assessment

Gunlake Quarry Extension Project

Economic Assessment

Prepared for

Gunlake Quarry Pty Ltd
C/- EMM Consulting Pty Limited

By

Gillespie Economics
Email: gillecon@bigpond.net.au

February 2016

TABLE OF CONTENTS

TABLES

FIGURES

BOXES

EXECUTIVE SUMMARY

This Economic Assessment for the Gunlake Quarry Extension Project (the extension project) has been prepared as part of an Environmental Impact Statement (EIS).

This Economic Assessment provides the following analyses for the extension project:

- A cost benefit analysis (CBA) which is the primary way that economists evaluate the net benefits of projects and policies, provide economic justification for a project and addresses the public interest;

- A local effects analysis (LEA) to assess the impacts of the extension project in the locality, specifically:

    - effects relating to local employment;
    - effects relating to non-labour project expenditure; and
    - environmental and social impacts on the local community.

- A supplementary LEA using input-output (IO) analysis to assess the direct and indirect economic activity project footprint in relation to output, value-added, income and employment.

Cost Benefit Analysis

A CBA of the extension project indicated that it would have net production benefits to NSW of $16M, present value at 7% discount rate. Provided the residual environmental, social and cultural impacts of the extension project that accrue to NSW are considered to be valued at less than $16M, the extension project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Adverse uncompensated environmental, social and cultural impacts of the extension project have been minimised through project design and mitigation, offset and compensation measures. The cost of implementing these measures have already been incorporated into the estimate of net production benefits, including the cost of using land and water resources, noise mitigation and acquisition costs in accordance with the Voluntary Land Acquisition and Management Policy, provision of biodiversity offsets and the cost of intersection upgrades and maintenance. No material impacts are envisaged in relation to blasting, air quality, surface water, historic heritage, visual amentiy public infrastructure or other industries. Eleven Aboriginal heritage sites will be impacted by the extension project with one of these being of medium archaeological significance and the remainder being of low archaeological significance.

There may also be some market and non-market benefits of employment provided by the extension project which are estimated to be in the order of $11M, present value at 7% discount rate. Overall, the extension project is estimated to have net social benefits to NSW of between $16M and $27M, present value at 7% discount rate and hence is desirable and justified from an economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the extension project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $16M and $27M, present value, for the extension project to be questionable from an Australian economic efficiency perspective.

Local Effects Analysis

As summary of local area effects is provided in Table ES1.

Table ES1 - Summary of Local Effects

	Project Direct	Project Direct: Local	Net Local Effect	Total Net Local Effect Including Flow-ons
Employment related				
Employment (FTE)	27	24	2	4.40
Income (per annum)	$1,175,931	$1,045,272	$86,753	$291,489
Other non-labour expenditure (per annum)	$7.3			
Second round and flow-on effects	Refer to section 6			
Contraction in other sectors	Immaterial			
Displaced activities	Not applicable			
Wage impacts	Immaterial			
Housing impacts	Immaterial			
Externality impacts	**Incidence of Impacts**	**Magnitude of Impact**		
Greenhouse gas impacts	Local and NSW households	$0		
Agricultural impacts	Gunlake Quarries	Included in opportunity cost of land		
Noise impacts	Adjoining landholders	Landholders impacted above criteria compensated		
Blasting	Adjoining landholders	No properties impacted by exceedances		
Air quality impacts	Adjoining landholders	No properties impacted by exceedances		
Surface water	Local surface water users	No material impacts		
Groundwater	Local groundwater users	If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact.		
Ecology	Local and NSW households	Some loss of values but offset by provision of biodiversity offsets		
Road transport impacts	Local residents	Impact mitigated by provision of road and intersection upgrades		
Aboriginal heritage	Aboriginal people and other local and NSW households	11 sites impacted. Costs of the AHMP included in capital and operating costs.		
Historic heritage impacts	Local and NSW households	No material impacts		
Visual impacts	Adjoining landholders	No material impacts		
Net public infrastructure costs	NSW Government and NSW households	No material impacts		
Loss of surplus to other industries	Local industries adversely impacted by the Project	No material impacts		

Supplementary Local Effects Analysis using Input-Output Analysis

Economic activity analysis, using IO analysis, estimated that the extension project would make up to the following annual incremental contribution to the regional economy[1] for up to 22 years:

- $40M in annual direct and indirect regional output or business turnover;
- $10M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the annual incremental contribution to the regional economy impacts would be up to:

- $68M in annual direct and indirect regional output or business turnover;
- $22M in annual direct and indirect regional value added;
- $6M in annual direct and indirect household income; and
- 150 direct and indirect jobs.

[1] The Local Government Area of Goulburn Mulwaree.

1 INTRODUCTION

1.1 Introduction

Gillespie Economics has been engaged by EMM Consulting Pty Ltd (EMM) on behalf of Gunlake Quarries Pty Ltd (Gunlake) to complete an Economic Assessment for the Gunlake Quarry Extension Project (the extension project). The purpose of the Economic Assessment is to form part of an Environmental Impact Statement (EIS) being prepared by EMM to support an application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the extension of the Gunlake Quarry.

1.2 Legislative Context and Guidelines

This Economic Assessment has been carried out in accordance with:

- the Secretary's Environmental Assessment Requirements (SEARs) for the Project that relate to economics i.e:

  - an assessment of potential impacts on local and regional communities including impacts on social amenity;
  - a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements, or contributions and/or voluntary planning agreement or similar mechanism; and
  - a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community;
  - the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.

- Clause 7(1)(f) of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* which requires environmental assessments to provide "the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations…" Note to Clause 7 (1) (f) states that "A cost benefit analysis may be submitted or referred to in the reasons justifying the carrying out of the development, activity or infrastructure."

- Section 79C of the EP&A Act which 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); and
  - the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and ***economic impacts in the locality***.

- the following standards, guidelines and policies:

  - NSW Government (2015) *Guideline for the economic assessment of mining and coal seam gas proposals*; and
  - NSW Treasury (2007) *NSW Government Guidelines for Economic Appraisal*.[2]

[2] Refer to Attachment 1 for the legislative context for economic methods in Environmental Impact Assessment (EIA) in NSW.

To meet the above requirements two types of analysis are needed:

- a cost benefit analysis (CBA) which is the primary way that economists evaluate the net benefits of projects and policies, provide economic justification for a project and addresses the public interest;

- a local effects analysis (LEA) to assess the impacts of the extension project in the locality, specifically:

    - effects relating to local employment;
    - effects relating to non-labour project expenditure; and
    - environmental and social impacts on the local community.[3]

Economic analysis tools of CBA and LEA are not mechanised decision-making tools, but rather a means of analysis that provides useful information for decision-makers to consider alongside the performance of a project in meeting other, often conflicting, government goals and objectives.

1.3 Report Outline

Section 2 outlines the scope of the extension project, a summary of the impacts of the extension project and the proposed mitigation measures, as assessed in the EIS[4]. This is the information on which the Economic Assessment is based. Section 3 provides an overview of the CBA and LEA approach used in this study. Section 4 and 5 document the CBA and LEA of the extension project, respectively. Section 6 provides a supplementary LEA. Conclusions are provided in Section 7.

[3] Refer to Attachment 2 for an introduction to economic methods.
[4] The reader should refer to the EIS for more detailed qualitative consideration of the scope of the extension project , project impacts and mitigation measures.

2 PROJECT DESCRIPTION

2.1 Economic Context

Gunlake Quarry is located on a proven rock resource of approximately 180 Mt of tuffaceous rhyodacite. The hard rock is suitable for uses in a range of quarry products including concrete and sealing aggregates, rail ballast, manufactured sand and road bases.

These are inputs to the NSW construction industry and hence demand for the resource is derived demand, dependent on the demand from:

- engineering construction (major infrastructure, mining and heavy industrial resource based projects);
- non-residential building (including offices, shops, hotels, industrial premises, hospitals, entertainment facilities) and;
- residential building (houses, flats, home units, townhouses).

Gunlake Quarry has been supplying hardrock for construction in both the Southern Highlands and the Sydney Metropolitan area. Gunlake is an independent NSW based quarry producer and provides aggregates to supply its three concrete plants in the Sydney region as well as other markets.

Gunlake Quarry provides Gunlake's concrete batching plants with secure, long-term supplies of aggregate and manufactured sand. The Gunlake Quarry is therefore part of a vertically integrated operation. From the perspective of Gunlake, this vertical integration has a number of advantages:

- it enables Gunlake to reduce its production and distribution costs by linking successive stages of production; and
- it ensures secure reliable supplies of inputs (of appropriate quality) in order to remain competitive.

This vertical integration of Gunlake's activities also has wider impact on the operation of market processes i.e. it promotes greater economic efficiency in resource use and maximises welfare gains for society. Various efficiency gains accrue through vertical integration, including:

- technical efficiencies from combining together successive production process – cost minimisation;
- stockholding economies through the reduction in intermediate and contingency buffer stocks;
- elimination of some purchasing expenses in negotiating outside supply contracts by internalising these transactions within the firm;
- managerial economies by having a single administrative system to handle several production activities; and
- financial economies through more advantageous bulk buying discounts and by lowering the cost of raising capital.

The net result of such economies of vertical integration is a reduction in the average costs of production of concrete and hence the ability to compete in the market place with other firms, most of which are also vertically integrated. The result for the consumer is an increase in the output available in the market and lower market prices.

If competitors were the only source of hard rock for Gunlake, competitors would be in a position to operate a price squeeze. That is, squeeze the profit margins of Gunlake. This is done by the competitor raising Gunlake's costs through charging them a higher price for the raw material than the price charged for its own use, while setting a relatively low final product price. Other vertically integrated competitors would therefore be in a position to injure a non-integrated competitor.

2.2 Project Description

2.2.1 Current Approval

Gunlake Quarry is located approximately 7 kilometres north-west of Marulan in the Goulburn Mulwaree local government area (LGA) on Lot 13 DP1123374 which is owned by Gunlake.

Project approval was originally granted in 2008 for truck movements equivalent to about 500,000 tonnes per annum of saleable product until 2038. Since that time three modifications have been approved to:

- alter transport routes and truck numbers related to the quarry;
- expand the quarry pit and overburden emplacement;
- increase truck movements equivalent to 750,000 tonnes per annum;
- alter the approved hours of operation.

Key components of the existing quarry include:

- a quarry pit providing hard rock resources;
- overburden and excess product emplacement areas;
- drilling and blasting to release the rock material;
- crushing and screening of the quarried rock;
- truck loading and transport of hard rock; and
- ancillary infrastructure to support the operations including offices, amenity buildings and other minor infrastructure.

2.2.2 The Extension Project

The extension project will increase the rate of extraction and associated activities at Gunlake Quarry and increase the project footprint as follows:

- 2 million tonnes per annum (Mtpa) of saleable products to be produced;
- an increase in truck movements to an average of 440 movements per day and a maximum of 690 movements per day;
- extension of the quarry pit footprint by 54 ha;
- an additional overburden emplacement to accommodate the increase in production;
- 24 hour per day primary crushing; and
- blasting twice weekly.

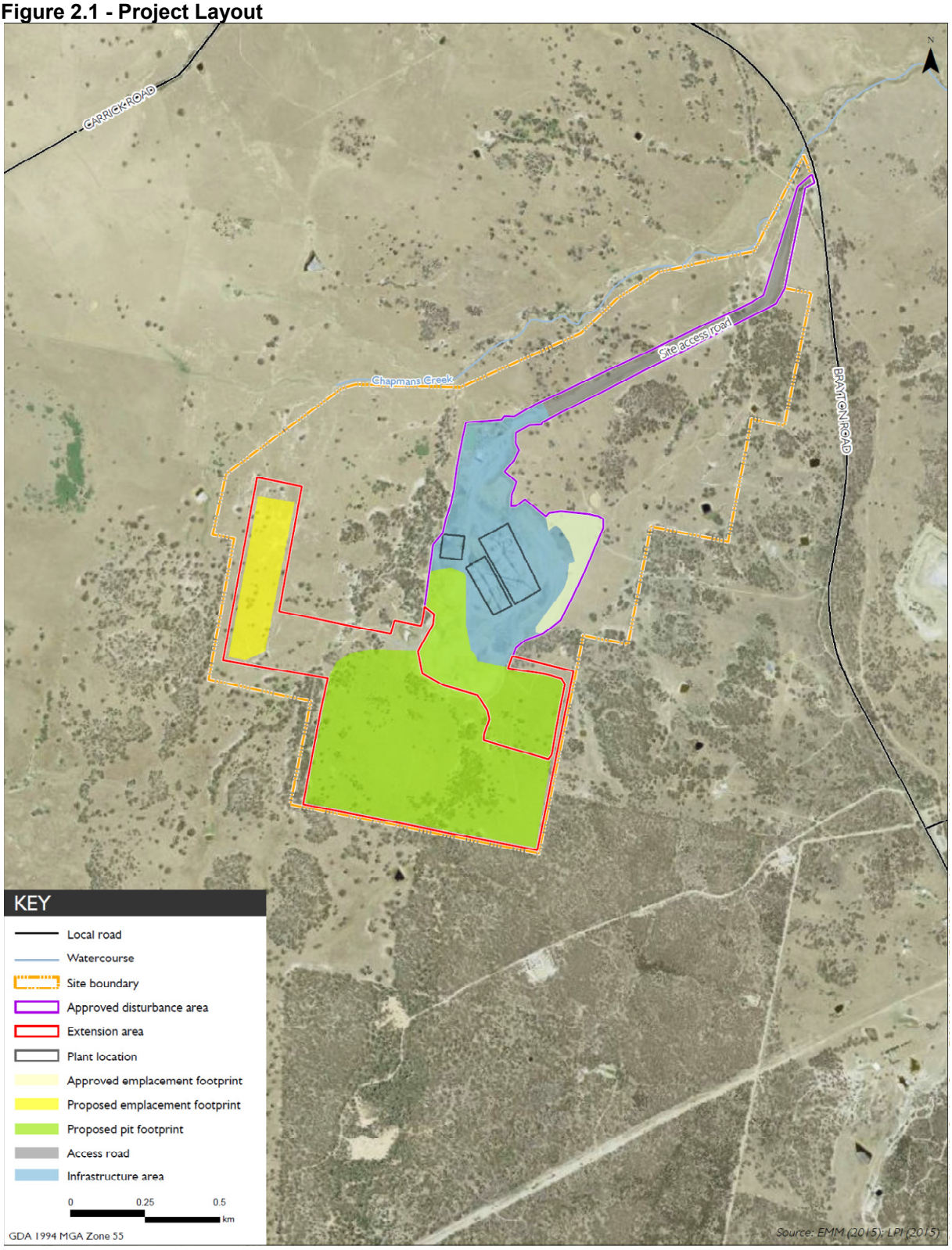
In addition, Gunlake seeks to maintain the approval for all aspects of the existing operations for Gunlake Quarry under Project Approval 07-0074. The proposed extension area is shown in Figure 2.1.

A summary of the extension project is provided in Table 2.1.

Table 2.1 - Project Description

Project element	Currently approved	Proposed project
Quarrying method	Hard rock quarrying by open cut methods.	No change.
Resource	Approximately 180 million tonnes.	No change.
Disturbance area	Approved project footprint of 45 ha, as shown in Figure 2.1.	Extension of project footprint by 54 ha to approximately 99 ha as shown in Figure 1.2.
Saleable product	750,000 tonnes per annum.	Increase to 2 Mtpa.
Quarry life	30 years.	30 years from approval. There is sufficient resource (180 Mt) for quarrying to continue at 2 Mtpa for 90 years.
Beneficiation	Onsite crushing and stockpiling of quarried rock.	No change.
Infrastructure	As outlined in Sections 2.3 and 2.8 of the EIS.	Upgrade infrastructure as required to produce 2 Mtpa of products.
Product transport	An average of 164 truck movements per day (averaged over each calendar month) with up to a maximum of 320 movements on any day in total on all routes. An average 25 truck movements per day (averaged over each calendar month) and a maximum of 38 truck movements on any day on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.	An average of 440 truck movements per day (averaged over each calendar month) with up to a maximum of 690 movements on any day in total on all routes. No change to truck numbers on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.
Operational workforce	25 on-site employees and 25 to 38 truck drivers (full-time equivalent).	Increase of approximately 27 employees to approximately 7 on-site site employees and 20 truck drivers.
Hours of operation	6:00 am Monday to 6:00 pm Saturday, including crushing between 7:00 am and 6:00 pm, Monday to Saturday and maintenance at any time, Monday to Saturday. See Table 2.2 of the EIS for details.	Modify existing hours of operation to allow crushing 24 hours a day (except Sundays and public holidays) and maintenance anytime (including Sundays and public holidays).
Capital investment value		$3.2 million

Figure 2.1 - Project Layout



2.3 Project Impacts

This section summarises the incremental biophysical impacts of the extension project relative to the current approval, based on the technical assessments in the EIS. It provides the basis for the economic consideration of impacts in latter parts of this report.

Biodiversity Impacts

The site is in a rural area, where the predominant land uses are grazing, agriculture, forestry and quarrying. The extension area has limited habitat due to the wide-spread removal of native vegetation for agriculture. However, some remnant vegetation occurs in the extension area, particularly along Chapmans Creek and its tributaries. In these areas, the vegetation is considered to meet the description of Box Gum Woodland, an Endangered Ecological Community (EEC) listed under the *NSW Threatened Species Act 1995* (TSC Act). The woodland form of this community meets the listing criteria for the Critically Endangered Ecological Community (CEEC) listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Remnant vegetation provides habitat for the threatened Speckled Warbler, Diamond Firetail, Square-tailed Kite, Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat, which were recorded during the surveys. It also contains potential habitat for the Little Lorikeet, Square-tailed Kite, Speckled Warbler, Diamond Firetail, Striped Legless Lizard, Little Eagle, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella.

During the project planning phase, Gunlake investigated a range of options to avoid and minimise impacts on remnant vegetation. The proposed emplacement will be located in an area which is predominantly pasture to minimise impacts on woodland vegetation.

The extension project will require the removal of 12.2 ha of woodland and 41.9 ha of grassland vegetation. This includes 8.4 ha of Box Gum Woodland (listed under the TSC Act and EPBC Act) and 7 ha of Box Gum Woodland derived native grassland (listed under the TSC Act).

Biodiversity mitigation and management measures have been proposed to minimise and/or mitigate potential biodiversity impacts from the extension project. These include:

- The landscape management plan (LMP) will be updated to include details on biodiversity management and rehabilitation for the extension project. The plan will be completed and implemented within 12 months of project approval.
- The LMP will include procedures to be applied for the management of the offset properties, the arrangements for conservation in perpetuity and regeneration works to be undertaken. This will include the procedures for:
    - assisting the revegetation and regeneration in the offset areas, including establishment of canopy, understorey and groundcover in areas of native pasture where required;
    - controlling weeds and feral pests;
    - fencing and access arrangements;
    - erosion control; and
    - bushfire management.
- An offset monitoring program will also be included within the LMP to monitor any changes to the condition of the offset areas.
- An offset package of 155.6 ha incorporating the offset requirements of the original approval, as modified, and the extension project to compensate for the extension project impacts.
- Offset areas will be secured where possible using a BioBanking agreement. Where this cannot be achieved, a suitable mechanism will be identified that follows the Policy's criteria.
- The offset areas will be managed in accordance with the LMP.

Operational Noise and Vibration

There are four residences within 1.5 km of the site, three residences to the east of the site on Brayton Road (R1, R2 and R3) and one residence to the north-west on Carrick Road (R4). Two of the residences to the east of the site (R1 and R3) are owned by Gunlake and, therefore, noise criteria do not apply at these residences. A topographic ridge lies between the quarry and residences on Brayton Road which provides an acoustic screen.

Four additional assessment locations (R5 to R8), further away from quarry operations, were assessed as quarry operations are moving further south and north-west of the currently approved footprint.

There are several residences along the primary haul route including on Brayton Road southbound of the quarry access road, and on Red Hills Road to the Hume Highway. These residences have the potential to be impacted by road traffic noise resulting from the proposed increase in transport volumes from the quarry. There will be no changes to transport volumes on Brayton Road through Marulan.

The operational noise assessment found that with the extension project:

- one property (R7) would go from no or negligible impacts (noise levels 0 to 2 dB above Project Specific Noise Levels (PSNLs)) to moderate impacts (noise levels 3 to 5 dB above PSNLs and entitled to mitigation in accordance with the Voluntary Land Acquisition and Mitigation Policy (VLAMP));
- two properties (R2 and R4) would go from moderate impacts (noise levels 3 to 5 dB above PSNLs and entitled to mitigation in accordance with the VLAMP) to significant impacts (noise levels >5 dB above PSNLs and entitled to mitigation and voluntary acquisition upon request in accordance with the VLAMP).

Sleep disturbance criteria were satisfied at all receptors.

Cumulative noise from the extension project and surrounding developments i.e. Johnniefelds Quarry and Lynwood Quarry is anticipated to satisfy the amenity criteria at all assessment locations.

Several privately owned lands were identified surrounding the Gunlake Quarry consent boundary that could potentially be exposed to noise from the extension project and other industrial developments in the area. Predicted noise levels over the entire privately owned land parcel including all contiguous lots is less than 25% and therefore does not trigger acquisition rights during worst case operational and meteorological scenarios. Nevertheless, Gunlake currently has negotiated agreements in place with the relevant landowners of these two properties and therefore complies with the requirements of the VLAMP.

The blast overpressure and vibration assessment identifies that the proposed MIC blast patterns will be designed specifically to ensure compliance with the relevant criteria at the closest privately owned residence.

The current project approval allows an average of 164 haul truck movements (82 truck loads) daily with a maximum of 320 daily truck movements (160 truck loads). The extension project will increase average daily truck movements to 440 (220 truck loads), with a potential maximum of 690 daily truck movements (345 truck loads). The future (total) road traffic noise levels are predicted to satisfy the Road Noise Policy day and night criteria at all nearest privately owned receivers on each section of the transport routes.

Management and mitigation measures include:

- continuation of the noise and blast monitoring program including night-time noise monitoring to quantify the 24 hour operation of the processing plant;

- reducing the mobile fleet during the evening and night periods;
- provision of voluntary mitigation upon request in accordance with the VLAMP at assessment location R7, unless an alternate amenity agreement can be made;
- voluntary acquisition upon request in accordance with the VLAMP for assessment locations R2 and R4. It is noted that an agreement has recently been negotiated between Gunlake and the landowner of assessment location R4, and therefore voluntary land acquisition is no longer relevant at this location**.**

Air Quality

The closest residences (receptors) are to the south-east along Brayton Road. Twelve receptor locations were assessed for air quality impacts. Ten of these residences are privately owned and two (R1 and R3) are owned by Gunlake.

Particulate matter consists of dust particles of varying size and composition, which are referred to as deposited dust, total suspended particulate matter (TSP), and particles which have a diameter of 10 micrometres (μm) or less (PM_{10}) or 2.5 μm or less ($PM_{2.5}$). Respirable crystalline silica (RCS) particles which are abundant in the earth's crust are also of interest because of their potential health effects. Air quality goals are benchmarks set to protect the general health and amenity of the community.

Sources of air pollution within 15 km of Gunlake Quarry include Holcim's Johnniefelds and Lynwood quarries and Boral's Marulan South and Peppertree quarries. A number of other background sources contribute to particulate matter emissions in the vicinity of the site such as vehicle movements generating dust and emissions (petrol and diesel), wind dust generated from exposed areas, and emissions from grass/bush fires and household wood burning.

Dispersion model predictions for the extension project predict that the proposed changes to operations will not result in any exceedances of the impact assessment criteria for key pollutants, including PM_{10}, $PM_{2.5}$, TSP, RSC and dust deposition. Current and proposed mitigation measures were incorporated into the modelling. These include:

- continuation of mitigation measures and practices that are currently in place to manage particulate matter emissions from Gunlake Quarry.
- continuation of the existing air qualilty monitoring network with monitoring results reviewed on an annual basis against the EPL and approval conditions to determine if additional monitoring is required due to production increases.

Greenhouse Gases

For accounting and reporting purposes, greenhouse gas (GHG) emissions are defined as 'direct' and 'indirect' emissions. Direct emissions (also referred to as Scope 1 emissions) occur within the boundary of an organisation and as a result of that organisation's activities. Indirect emissions are generated as a consequence of an organisation's activities but are physically produced by the activities of another organisation. Indirect emissions are further defined as Scope 2 and Scope 3 emissions. Scope 2 emissions occur from the generation of the electricity purchased and consumed by an organisation. Scope 3 emissions occur from all other upstream and downstream activities, for example the downstream extraction and production of raw materials or the upstream use of products and services.

The estimated annual GHG emissions are presented in Table 2.2. The extension project will result in an increase (approximately threefold) in annual GHG emissions from the current operations, due primarily to the related increase in diesel fuel consumption and electricity demand for processing.

At full production, the annual Scope 1 and Scope 3 emissions represent approximately 0.03% and 0.008% of total GHG emissions for NSW and Australia, respectively.

Table 2.2 - Summary of Estimated Annual GHG Emissions (tonnes CO_2-e/annum)

Scenario	Scope 1 emissions	Scope 2 emissions	Scope 3 emissions					
	On-site diesel	Electricity	On-site diesel	Electricity	Product transport (diesel)	Employee travel	Total	Total Emissions
1 - Current	2,549	109	194	17	12,387	553	13,152	15,810
2 - 1 Mtpa	4,292	118	327	18	16,516	664	17,526	21,936
3 - 1.5 Mtpa	6,036	127	460	19	24,775	885	26,140	32,303
4 - 2 Mtpa	7,780	137	593	21	33,033	1,151	34,798	42,715

Surface Water

The quarry is within the upper reaches of Chapmans Creek Catchment. Chapmans Creek is an ephemeral watercourse that drains to the north-east, flowing into Jaorimin Creek approximately 3 km downstream of the quarry. Jaorimin Creek then flows in a northerly direction to its confluence with the Wollondilly River, approximately 8.6 km downstream of the quarry. The Wollondilly River is the major river in the region and is one of the key tributaries to Warragamba Dam, which is 65 km north-east of the quarry.

The extension project will directly disturb two second order watercourses that are tributaries to Chapmans Creek and require increased use of process water. There are no licensed surface water users relying on extraction from either Chapmans or Jaorimin creeks, immediately downstream.

Water Quality

Runoff from dirty water catchments will be collected in either the Process Water Dam or one of the sedimentation dams. Water entering the pit area from rainfall runoff and groundwater inflows will be pumped to a Pit Dewatering Dam with controlled releases from this Dam during water surplus conditions. All released water will be treated by sedimentation in the dam and Gunlake will monitor the water quality of water prior to release. Additional treatment, such as pH adjustment or flocculation will be provided if required. No water quality impacts are anticipated.

Water Usage

The expanded quarry will require additional process water per year, largely for dust suppression on the haul road and in the processing plant. Water balance model results indicate that the quarry's process water requirements will be primarily met by the water management dams. The capture of runoff from this catchment is considered to be within Gunlake's available harvestable rights allocation and no water access licenses (WALs) will be required.

Post closure

The final void will continue to receive runoff from direct rainfall and a relatively small contribution from groundwater inflows and is expected to slowly accumulate water for the initial 60 to 70 years following closure of the quarry operation. Equilibrium between long term evaporation losses and runoff inflows is expected to be achieved when the lake level is at least 35 m below the final void spill point, indicating that the final void lake is unlikely to ever spill to receiving waters.

Runoff from the pit footprint will be permanently captured within the final void, resulting in a permanent reduction in stream flows in the downstream waterways in proportion the pit footprint compared to the total catchment under consideration e.g. at the confluence of Chapmans and Jaorimin Creek the reduction in flow will be less than 1.3%. No water quality impacts are expected as no spillage from the final void to receiving waters is likely to occur.

Mitigation measures include:

- Gunlake will seek any required water licences should water need to be imported during extended dry periods
- The current surface water monitoring program will be modified to include monitoring at:
    - two receiving water sites on Chapmans Creek, downstream of the quarry; and
    - the Process Water Dam and Pit Dewatering Dam prior to discharge.

Should the monitoring program indicate that the quarry is potentially adversely affecting water quality in Chapmas Creek, Gunlake will undertake an investigation to establish the likely cause and will implement necessary mitigation measures.

Groundwater

There are two groundwater sources relevant to the extension project. An alluvial system associated with Chapmans Creek and a fractured rock system within the Bindook Porphyry Complex - a hard rock aquifer. Nine springs have been identified within a 1.5 km radius of the centre of the extension area. The springs are associated with sub-vertical geological discontinuities which allow discrete groundwater discharge (fracture springs).

Groundwater is generally of poor quality and is suitable for stock purposes. There are 15 groundwater works within a 5 km radius of the extension area with five of these registered for private use (stock or domestic/stock purposes). The closest to the extension project is approximately 1.2 km east of the site boundary. Holcim's Lynwood and Johnniefields quarries are also groundwater users.

Groundwater impacts are predicted to be minor and confined to an area immediately surrounding the pit. A drawdown of 2 m is predicted to extend up to 1.5 km from the edge of the pit footprint by Year 30 of the extension project. Groundwater inflows to the pit of up to 37 ML/year are predicted and require licensing from within the unallocated water in the Goulburn Fractured Rock Groundwater Source under the Water Management (WM) Act. There is sufficient water volume within the market or within the next controlled allocation order to allow the required WAL (or WALs) to be obtained[5].

Possible impacts to springs include a declined flow rate at groundwater springs 5 and 8 and ceasing of flow at springs 6 and 7. The springs do not support Groundwater Dependent Ecosystems (GDEs) and are not considered to hold significant environmental value.

[5] The extension project is within the Goulburn Fractured Rock Groundwater Source (GFRGS) within the Groundwater WSP. This water source covers an area of approximately 8,175 km^2. Up to 53,074 ML/year is available for extraction with only 12% of this currently being allocated.

The Box Gum Woodland within the zone of predicted drawdown does not rely on groundwater from within the hard rock strata in this area and no impacts are predicted on the alluvial aquifer. Therefore, the Box Gum Woodland is not predicted to be impacted by groundwater drawdown as a result of the extension project.

Groundwater inflows to the pit are not predicted to reduce baseflows to the ephemeral watercourses in the area (Chapmans Creek and Jaorimin Creek). No impacts to registered groundwater works are predicted and a neutral impact on water quality in the hydrological catchment is predicted.

Mitigation measures updating of the water management plan to include:

- triggers values to facilitate the identification of groundwater impacts outside of predictions;
- the use of monitoring data to calibrate and update the model at significant project stages;
- quarterly groundwater quality and level monitoring to facilitate the early identification of adverse impacts and test model predictions;
- monitoring of spring flow in conjunction with the quarterly groundwater level and quality program;
- monitoring mapped areas of Box Gum Woodland;
- procedures for the re-use of site water; and
- response protocols and contingency mitigation measures to be implemented in the event of an unpredicted adverse impact.

Gunlake Quarry will also obtain a WAL for the predicted groundwater take over the lifespan of extension project (up to 37 ML/year).

Road Transport

The quarry is located on Brayton Road, north-west of Marulan. Brayton Road is part of the transport route linking the quarry to the Hume Highway. Products for markets north of the quarry are transported along Brayton Road and a purpose built Bypass Road that connects Brayton Road to Red Hills Road and then the highway (the primary haulage route). For transport of quarry materials to customers south of the quarry, trucks travel along Brayton Road, through the northern edge of Marulan and access the Hume Highway via the Brayton Road southbound ramp (secondary haulage route). All traffic returning to the quarry use Red Hills Road, the Bypass Road and Brayton Road.

The extension project would potentially increase traffic movements from an average of 164 truck movements (82 truck loads) each day and a peak hourly truck loading rate of 11 truck loads per hour, during either the morning or the afternoon peak hourly traffic periods on the surrounding roads to 440 (220 truck loads) and the maximum hourly truck loading rates during both the morning and afternoon peak hourly traffic of 29 truck loads per hour.

In the short term, the predicted daily traffic increases would not require any improvements to the road carriageway in order to accommodate the additional traffic. No level of service issues were identified in the short term for intersections apart from the Red Hills Road and Hume Highway intersection where the left turn from Red Hills Road movement will have increased traffic delays (Level of Service C or D).

In the longer term, the closure of Johnniefelds Quarry will reduce traffic volumes compared to the worst-case short-term volumes (i.e. assuming immediate ramp up to 2 Mtpa of product transport). No level of service issues were identified in the longer term for intersections apart from the Red Hills Road and Hume Highway intersection traffic delays at the left turn from Red Hills Road onto the Hume Highway would increase (Level of Service D or F) due to the growth in northbound traffic on the Hume Highway and project related traffic growth movement.

To mitigate impacts from increased project traffic the following road and intersection improvements are proposed to be implemented by Gunlake Quarry:

- construction of an additional 500 m long (including taper) left turn northbound acceleration lane at the intersection of Hume Highway and Red Hills Road, before 2025 in accordance with the relevant intersection design requirements.
- updating the existing traffic management plan, which incorporates the driver code of conduct, following project approval.
- continued payment of S94 contributions to Goulburn Mulwaree Council for the life of the project so that the Council can maintain and improve the haul routes.

Aboriginal Heritage

The Aboriginal cultural heritage values within the extension area were assessed through field survey, test excavation and consultation with Aboriginal people.

Field survey identified 15 Aboriginal sites within the extension area, all comprised of stone artefacts. The highest artefact frequencies were identified on a hill spur crest in the proposed emplacement area. The archaeological test excavation (eight test pit transects with 42 one metre square test pits) characterised the subsurface archaeological deposit of known surface sites and surrounding landforms in the extension area that had limited ground surface visibility.

All of Aboriginal sites identified were assessed to have low archaeological significance, except one which was assessed as having moderate significance. Eleven Aboriginal sites will be impacted to some degree by the extension project.

Mitigation and management measures include:

- avoidance of four Aboriginal sites that are outside the project disturbance boundaries;
- the salvage of Aboriginal objects that will be totally or partially impacted by the project and relocation to the same area as previously collected artefacts at the site;
- update of the Gunlake Quarry Aboriginal Heritage Management Plan (AHMP) to provide details of:
    - all Aboriginal sites identified for the project and those previously recorded in the broader project site boundary;
    - management measures and their progress towards completion;
    - continuing consultation and involvement of registered Aboriginal parties;
    - protocols for newly identified sites;
    - protocols for suspected human skeletal material; and
    - provisions for review and updates of the AHMP.

Historic Heritage

The Modification 2 archaeological assessment of the site identified the site as highly disturbed and unlikely to contain archaeological deposits. The assessment did not identify any historic heritage items as occurring in the vicinity of the work site. In addition, Schedule 5 of the Goulburn Mulwaree Local Environmental Plan 2009 does not identify any heritage items as occurring within the quarry site. The recent Aboriginal heritage site survey and test excavations were undertaken by EMM archaeologists with experience in Aboriginal and historic heritage site surveys. No historic heritage sites were identified within the project area so no impacts to historic heritage will result from the proposed extension project.

Visual Impacts

Gunlake Quarry is located in a rural setting and is surrounded by undulating terrain. The existing topography of the local area, together with areas of vegetation, generally screen quarry activities from

public viewpoints, including the local road network. Brayton Road to the north and Carrick Road to the west have some views of the quarry. However, vehicles on these roads only have transient views of the site.

Gunlake Quarry is generally not visible from adjacent properties other than from the residence approximately 1.2 km north-west of the infrastructure area (R2). Isolated parts of surrounding properties also have long distant views of the site. However, these views are generally from at least 5 km from the quarry.

Permanent lighting is currently installed at the infrastructure area to ensure safe operating conditions. This lighting is positioned to direct light downwards and away from sensitive receptors in order to minimise light emissions and nuisance impacts to surrounding landowners and road users. Lights are generally left off and only used as required.

The extension project includes an increase in the disturbance area of the quarry to approximately 99 ha. This will be in the southern portion of the quarry site that is furthest from public viewpoints and residences. Due to the topography and existing vegetation in the local area, it is unlikely that the extension project will have significant visual impacts for surrounding landowners and road users. In addition, continued progressive rehabilitation of the quarry and the use of overburden emplacement areas as visual screens will further shield the quarry from public viewpoints.

No additional lighting will be required for operation of the tertiary crusher so there will be no addition impacts from lighting.

The proposed extension project will not significantly alter the visual impact of the quarry on surrounding land uses. Gunlake will continue to consult with surrounding landowners regarding the visual amenity of the quarry and will implement any reasonable additional controls to further reduce their visual impact if necessary.

Public Infrastructure

No additional public infrastructure will be required apart from road requirements identified above.

2.4 Other Mitigation Measures

Gunlake proposes to work in partnership with Goulburn Mulwaree Council and the local community so that the benefits of the extension project to the region are maximised and impacts minimised, as far as possible. In this respect, a range of general and specific economic impact mitigation and management measures are proposed and would include:

Potential Environmental, Cultural and Social Impacts

- A range of measures to mitigate, offset and compensate for potential environmental, cultural and social impacts of the extension project, as summarised above and outlined in the EIS.

Local employment, training and engagement

- Gunlake will ensure that preference is given to local employees.
- Gunlake will provide ongoing training and certification opportunities for local community members to ensure they have the necessary skills to work in extractive industries.
- Gunlake will continue to actively engage with the local community and affected individuals and groups and address any complaints and feedback on quarry operations.

Potential Business Impacts

- Gunlake will use local or regional contractors and suppliers where this presents a cost effective and feasible option.

3 ECONOMIC ASSESSMENT METHODS

3.1 Introduction

The economic methods used to assess the extension project and its impacts (as summarised in Section 2) are outlined below.

3.2 Cost Benefit Analysis

3.2.1 Background

Economic assessment is primarily concerned with identifying changes in aggregate wealth, associated with alternative resource use patterns. CBA is the standard technique applied to estimate these wealth changes.

CBA has its theoretical underpinnings in neoclassical welfare economics. CBA applications in NSW are guided by these theoretical foundations as well as NSW Treasury (2007). CBA applications within the NSW EIA framework are further guided by the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals,* although strictly speaking the extension project relates to extractive industry rather than mining and hence this guideline does not apply. Nevertheless, the principles are the same. The Secretary's Environmental Assessment Requirements for the extension project do not require the use of these guidelines.

CBA is concerned with a single objective of the EP&A Act and governments, i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These benefits and costs are defined and valued based on the microeconomic underpinnings of CBA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), a project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

3.2.2 Definition of Society

CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

The most inclusive definition of society includes all people, no matter where they live or to which government they owe allegiance to (Boardman et al. 2001). However, in practice most analysts define society at the national level based on the notion that the citizens of a country share a common constitution that sets out fundamental values and rules for making collective choices and that the citizens of other countries have their own constitutions that make them distinct societies (Boardman et al. 2001).

While most applications of CBA are performed at the national level, "to incorporate national distinctions in a CBA is far easier said than done. Thus many CBAs end up estimating the net benefits for global society, if only implicitly" (Bureau of Transport Economics 1999, p. 2).

With respect to the application of CBA in relation to coal mining and coal seam gas proposals, NSW Government (2015) guidelines define the public interest, and hence society, as the households of NSW. The SEARs for the extension project also refer to the requirement to provide "a detailed assessment of the costs and benefits of the development **as a whole**, and whether it would result in a net benefit for the NSW community".

Consequently, the CBA is initially undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia and NSW.

3.2.3 Definition of the Project Scope

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a CBA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For extractive industry projects, typically only the costs and benefits from resource extraction and delivery to domestic customers, are relevant.

Hard rock quarry products are intermediate goods i.e. are inputs to other production processes such as production of concrete. However, these other production processes themselves require approval and, in CBA, would be assessed as separate projects (NSW Treasury, 2007). The extension project definition, including impacts and mitigation measures, is summarised in Section 2.

3.2.4 Net Production Benefits

CBA of extractive industry proposals invariably involves a trade-off between:

- The net production benefits of a project to society including company tax and net producer surplus; and
- The environmental, social and cultural impacts (most of which are costs of resource extraction but some of which may be benefits) including economic benefits to existing landholders, economic benefits to workers, net public infrastructure costs and economic benefits to suppliers.

Net production benefits can be estimated based on market data on the projected financial[6] value of the resource less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of the proponent. This is normally based on commercial-in-confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

3.2.5 Environmental, Social and Cultural Impacts

The consideration of externality impacts in CBA relies on the assessment of other experts contributing information on the biophysical impacts. The EIA process results in detailed (non-monetary) consideration of the environmental, social and cultural impacts of a project and the proposed means of mitigating the impacts.

At its simplest level, CBA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the EIS), for people's well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

At the next level of analysis, attempts may be made to value some of the environmental, social and cultural impacts. These environmental, social and cultural impacts generally fall into three categories, those which:

- Can be readily identified, measured in physical terms and valued in monetary terms;

[6] In limited cases the financial value may not reflect the economic value and therefore it is necessary to determine a shadow price for the resource.

- Can be identified and measured in physical terms but cannot easily be valued in money terms; and
- Are known to exist but cannot be precisely identified, measured or valued (NSW Treasury, 2007).

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In addition to biophysical externalities, payments to landholders or workers over and above their opportunity cost can represent an economic benefit to landholders and workers, respectively. Where this occurs it can be estimated using market data on payments to be made and opportunity costs.

Where a project imposes a cost on public infrastructure in excess of payments made for that infrastructure there is an additional social costs for inclusion in CBA. These costs can potentially be estimated based on analysis of infrastructure costs and payments.

In attempting to value the impacts of a project on the well-being of people, there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA (NSW Government, 2012). NSW Government (2012) suggests that values that are less than 5% of the quantified net present value of a project are unlikely to be material. Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury, 2007; NSW Government, 2015).

3.2.6 Consideration of Net Social Benefits

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts.

In combining these considerations, it should be noted that the estimates of net production benefits of a project generally includes accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust or experiencing visual impacts, the costs of providing ecological offsets, the cost of purchasing groundwater and surface water entitlements in the water market and the costs of public infrastructure impacts. Including these costs in the capital and operating costs of a project effectively internalises the respective and otherwise, non-monetary environmental, social and cultural costs of a project, because by including these costs, often larger social costs are minimised or avoided. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefits of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the EIS), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural or social costs that remain unquantified in the analysis[7] can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

3.2.7 Consideration of the Distribution of Costs and Benefits

While CBA, undertaken at different scales, can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and CBA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about intra and intergenerational equity are subjective and are therefore left to decision-makers.

Nevertheless, it should be noted that the costs and benefits in CBA are defined and valued based on the values held by individuals in the current generation. There is no way to measure the value that future generations hold for impacts of current day projects as they are not here to express it. However, as identified by Boardman *et al.* (2001) this is not considered a serious problem for CBA because:

- Few policies involve impacts that only appear in the far future. Consequently, the willingness to pay of people alive today can be used to predict how future generations will value them;
- Most people alive today care about the well-being of their children, grandchildren and great grandchildren, whether or not they have yet been born. They are therefore likely to include the interests of these generations to some extent in their own valuations of impacts. Because people cannot predict with certainty the place that their future offspring will hold in society, they are likely to take a very broad view of future impacts; and
- Discounting used in CBA also reduces the influence of costs and benefits that occur a long way into the future.

Furthermore, increased wealth (e.g. royalties and taxes) generated by projects that have a net benefit to the current society can be used to improve the services (e.g. health, school and community services) and environment (e.g. protected areas) that are passed on to future generations.

As identified by the Productivity Commission (2006), a policy option that provides the highest net benefit, as indicated by CBA, would also be consistent with the principles of ecologically sustainable development.

3.2.8 Consideration of other Objectives of Government

CBA does not address other objectives of the EP&A Act and governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by CBA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government.

[7] Including potential impacts that were unknown at the time of the preparation of the EIS or arise during the EIA process due to differences in technical opinions.

3.2.9 Key steps in Cost Benefit Analysis

The key steps in CBA are summarised in Box 1.

Box 1: Key steps in a CBA
Step 1: Establish the base case against which to assess the potential economic, social and environmental impacts of changes due to the project.
Step 2: Define the project including all significant inputs required to achieve the project's objectives.
Step 3: Quantify the changes from the base case resulting from the project. This will focus on the incremental changes to a range of factors (for example, environmental, economic, social) resulting from the project.
Step 4: Estimate the monetary value of these changes and aggregate these values in a consistent manner to assess the outcomes. Where market prices exist, they are a starting point for valuations of both outputs and of inputs used for production. For non-market goods, as for many environmental impacts and some social impacts, the aim is to value them as they would be valued in money terms by the individuals who experience them.
Step 5: Estimate the Net Present Value (NPV) of the project's future net benefits, using an appropriate discount rate.
Step 6: Undertake sensitivity analysis on the key range of variables, particularly given the uncertainties related to specific benefits and costs.
Step 7: Assess the distribution of costs and benefits across different groups.
Step 8: Report CBA results, including all major unquantified impacts so the appraisal addresses and incorporates all material relevant to the decision maker**.**

Source: NSW Government (2015)

Section 4 reports on the CBA of the extension project based on the financial, technical and environmental advice provided by Gunlake and its' specialist consultants.

3.3 Local Effects Analysis

3.3.1 Introduction

LEA aims to address the consequences of the proposal in its "locality" as required by Section 79C of the EP&A Act. It is intended to complement CBA by translating effects at the NSW level to impacts on the communities located near the project site. It also provides additional information to describe changes that are anticipated within a locality, such as employment changes. LEA is intended to inform the scale of change rather than being representative of costs and benefits to the local community.

For the purpose of a LEA the locality is defined as the Statistical Area Level 3[8] (SA3) that contains the proposed project. The relevant population group is defined as those people ordinarily resident in the locality at the time of the proposal.

The local effects required to be analysed in a LEA are:

- local employment and income effects
- other local industry effects, for example on suppliers; and
- environmental and social change in the local community.

3.3.2 Direct Effects Relating to Local Employment

The *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government 2015) identifies that only employment of people ordinarily resident in the region at the time of the proposal be included in the initial estimation of direct local employment increases.[9]

[8] In this case the Goulburn Mulwaree LGA has been chosen to represent the locality.

The guidelines assume that these people would otherwise be employed in the region and so the increased disposable wages for the region as a result of a project is the difference between the average net income of these people in the mining (in this case quarrying) industry and the average net income in other industries.[10]

The incremental full time equivalent direct employment from a project to the locality is estimated as the increase in net income divided by the average net income in the mining (in this case quarrying industry).

The aim of this approach is to gauge the incremental impacts for existing residents of the locality. However, as a direct measure of regional employment and wages for existing residents it is likely to understate effects because it assumes that:

- existing local residents employed by a project are already employed in the region i.e. they are not unemployed or coming from new participants in the labour force;
- jobs vacancies in the region created by those filling the positions in a project remain unfilled for the duration of the project i.e. it essentially assumes that the regional economy and the wider Australian economy is at full employment. Refer to Attachment 3 for a discussion of the trickle-down effect and a comparison to input-output (IO) analysis.

From a regional economy perspective (rather than focused on existing residents), it is also likely to understate effects since it does not take into account the income spending of those who migrate into the region to live during the life of a project.

3.3.3 Estimating Effects Related to Non-labour Project Expenditure

In addition to the incremental direct regional employment and wages generated by a project, the other major economic effect will be expenditure in the region on other, non-labour inputs. These can be estimated for construction and operation phases of a project. Identified local expenditure may not all accrue to the region, particularly for margin sectors such as wholesale and retail trade purchases where only the margin would accrue to the regional business entities unless products are also manufactured locally.

3.3.4 Second Round/Flow-on Effects

The guidelines (NSW Government 2015) identify that flow-on effects can also be extremely important for local communities and should therefore also be considered either qualitatively or using techniques such as IO analysis and for larger projects computable general equilibrium (CGE) modelling, provided the assumptions and limitations of the methods are identified. A comparison of IO analysis and CGE modelling is provided in Attachment 4.

3.3.5 Effects on Other Local Industries

The LEA should also give consideration to potential impacts such as:

- displacement of other land uses, where the project uses land that would otherwise be used for other purposes;
- where the project affects choices of external parties, particularly tourism and business travel; and

[9] Employment filled by those migrating into a region to live are excluded as are jobs filled by those who reside outside the region.
[10] Wages paid to those migrating into a region to live are excluded as a wages benefit to the region.

- where the project creates temporary effects on other industries that cause short run market adjustment sin the cost of living for local residents, particularly food and housing markets.

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

Finally, every LEA should assess positive and negative externalities created by the proposed project on the locality, with a focus on material, unmitigated effects. This information is available from the CBA.

3.3.7 Input-output Analysis

Section 5 undertakes a LEA as identified above and consistent with the NSW Government Guidelines (2015). In addition, an IO analysis (refer to Attachment 4) of the existing quarry and proposed quarry is undertaken to identify the gross incremental regional economic activity that the extension project will provide to the region. As identified in Attachment 3, incorporation of consideration of the "trickle down" effect means that the direct incremental employment and income to a region approximates the total income of those employed in the region who already reside in the region or migrate into the region to live i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect.

IO analysis essentially involves two steps:

- Construction of an appropriate IO table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the project (construction and/or operation) in a form that is compatible with the IO equations so that the IO multipliers and flow-on effects can then be estimated (West, 1993).

The IO method is based on a number of assumptions that are outlined in Attachment 5. Most notably IO analysis assumes that the regional economy has access to sufficient labour and capital resources (from both inside and outside the region) so that an individual project does not result in any regional price changes e.g. wages in other industries or house rentals, which would lead to contractions (“crowding out”) of economic activity in other sectors in the same region. Any "crowding" out is assumed to occur outside the region where the extension project is concentrated and the regional impact analysis is focused. A dynamic CGE approach may overcome the limitation of IO analysis but is unlikely to be warranted at local or regional scale or with small scale impacts.

The consequence of the assumptions of IO analysis, is that IO modelling results provide an upper bound economic activity impact estimate.

IO analysis identifies the economic activity of a project on the economy in terms of four main indicators:

- Gross regional output – the gross value of business turnover;
- Value-added – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output. These costs exclude income costs;
- Income – the wages paid to employees including imputed wages for self employed and business owners; and
- Employment – the number of people employed (including self-employed, full-time and part-time).

These indicators of economic activity are not equivalent to the economic measures of consumer and producer surplus that are relevant in the CBA framework.

Gross regional output is a measure of total revenue or turnover. All costs of production would need to be subtracted to make it approximate the measure of producer surplus. Value-added is an indicator of net value to producers, but unlike the producer surplus measure, it does not take account of all production costs – only non-labour costs are subtracted from revenue. Income or wages paid to employees is a cost to the producer in the CBA framework and is one of the costs subtracted from revenue or output to calculate the producer surplus or net benefit to producers. Employment is a non-financial indicator identifying the physical number of jobs associated with an activity.

Unlike CBA there are no decision rules to identify whether an increase or decrease in economic activity is desirable, although it is often implicitly assumed that more economic activity is good and less economic activity is bad. However, not all economic activity is desirable from a community welfare perspective since it may be associated with say environmental degradation, crime, etc.

As well as providing an indication of gross economic activity in a region, economic activity analysis can have important links to social impact assessment since changes in income and employment levels can impact population levels and their ability to maintain community infrastructure (schools, hospitals, housing etc), broader community and cultural value systems and inter-relationships.

4 COST BENEFIT ANALYSIS OF THE PROJECT

4.1 Introduction

This section reports on a CBA of the extension project based on financial, technical and environmental advice provided by Gunlake and its specialist consultants.

4.2 Identification of the Base Case and the Project

Identification of the “base case” or “without” extension project scenario is required in order to facilitate the identification and estimation of the incremental economic benefits and costs of the extension project.

Under the base case, Gunlake Quarry would operate under the current approval for a period of 30 years (to 2038) extracting 750,000 tonnes per annum of saleable product, with associated rehabilitation and site decommissioning. The extension area would continue to be used as vacant buffer land with associated remnant vegetation which is dominated by grassland with some woodland .

In contrast, the extension project is as described in Section 2 with quarrying of up 2 Mtpa for the remainder of the mine life (to 2046), including rehabilitation and site decommissioning. Refer to Table 2.1 for a comparison of the current approval and the proposed extension project.

An indicative comparison of the production profile with and without the extension project is provided in Figure 4.1

Figure 4.1 - Indicative Production Schedule With and Without the Project

4.3 Identification of Benefits and Costs

Relative to the base case or "without" extension project scenario, the extension project may have the potential incremental economic benefits and costs shown in Table 4.1. The main potential economic benefit is the producer surplus (net production benefits) generated by the extension project and any wage benefits to employment, nonmarket benefits to employment, economic benefits to existing landholders or benefits to suppliers, while the main potential economic costs relate to any environmental, social and cultural costs, including any net public infrastructure costs and loss of surpluses to other industries.

Table 4.1 – Potential Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Net production benefits	Opportunity costs of capital equipment Opportunity cost of land[1] Development costs including labour, capital equipment and acquisition costs for impacted properties and biodiversity offsets[1] Operating costs of quarry including labour and mitigation, offsetting and compensation measures Decommissioning and rehabilitation costs	Avoided decommissioning and rehabilitation costs Value of hardrock Residual value of capital and land
Potential environmental, social and cultural impacts of extraction, processing and transport to customers after mitigation, offsetting and compensation	Agricultural production Noise impacts Blasting impacts Air quality impacts Greenhouse gas impacts Surface water impacts Groundwater impacts Ecological impacts Road transport impacts Aboriginal heritage impacts Historic heritage impacts Visual impacts Net public infrastructure costs Loss of surplus to other industries	Wage benefits to employment Non-market benefits of employment Economic benefits to existing landholders Economic benefits to suppliers

[1] The value of foregone agricultural production is included in the value of land.

It should be noted that the potential environmental, social and cultural costs listed in Table 4.1 are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or nonuse. 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 extension project CBA apart from the mitigation, compensation or offsetting costs.

4.4 Quantification/Valuation of Benefits and Costs

Consistent with NSW Government (2015) and NSW Treasury (2007) the analysis was undertaken in 2015 real values, with discounting at 7 percent (%) and sensitivity testing at 4% and 10%.

The analysis period is 31 years, coinciding with the extension project life plus one year pre-Project commencement. Any impacts that occur after this period are included in the final year of the analysis as a terminal value.

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.

An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[11] and incorporate them into an estimate of the net social benefit of the extension project. This estimated net social benefit of the extension project provides another threshold value that any residual or non-quantified economic costs would need to exceed to make the extension project questionable from an economic efficiency perspective.

4.4.1 Production Costs and Benefits[12]

Production Costs

Opportunity Cost of Land and Capital

Currently all of the land required for the extension project is owned by Gunlake and required for operations under the base case and the extension project. Under the base case, quarrying would cease in 2038 and the residual value of the land after site decommissioning and rehabilitation could be realised for sale. Under the extension project case, this land would continued to be needed for quarrying until 2046. In 2038, there is therefore an incremental opportunity cost associated with continuing to use this land for the extension project. For the purpose of the analysis, the current market value of the land is used as an estimate of this opportunity cost i.e. $5.8M.

There is also a potential opportunity cost in 2038 associated with capital equipment that if it were not used in the extension project may otherwise be able to be sold. However, it is assumed that capital equipment under the base case would essentially have reached the end of its life by 2038 and have negligible residual economic value. Consequently, no opportunity cost of capital equipment is included in this CBA.

Development Cost of the Project

The incremental capital costs over the life of the mine (including contingencies) are estimated at $7.2M to be expended in years 2-5 and 8-10 of the analysis, primarily on capital equipment. In addition there is in the order of $5.5M of capital expenditure associated with road works, biodiversity offsets, noise mitigation, purchase of WALs and other mitigation measures.

Annual Operating Costs of the Project

The operating costs of the extension project include those associated with extraction, onsite crushing and stockpiling, transportation of product by road, general costs (including overheads and administration) and ongoing environmental, social and cultural mitigation costs. These costs include labour costs, which reflect the value of labour resources in their next best use. Unit operating costs are not reported for reasons of commercial confidentiality.

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 development costs of the extension project in the years in which they occur.

No royalties are payable on hardrock quarrying and hence no royalties to NSW Government accrue from the extension project.

[11] Benefit transfer refers to borrowing economic values that have been determined for other study sites.
[12] All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Rehabilitation and Decommissioning Costs

Under the extension project case, decommissioning and rehabilitation would occur at the end of the quarry life at an estimated cost of $2.5M. Other annual rehabilitation costs are included in the annual operating costs of the extension project.

Production Benefits

Avoided Rehabilitation and Decommissioning Costs

Under the base case, or "without" extension project scenario, decommissioning and rehabilitation costs of approximately $1.9M would be incurred in 2038. With the extension project, these costs in 2038 are avoided in that year and are a benefit of the extension project.

Value of Hardrock

The main economic benefit of the extension project is the market value of the hardrock products produced. 65% of the hardrock produced is sold internally with the remainder sold in the market. All sales are at market prices. An average unit prices has been applied to the output of the quarry based on advice from Gunlake. It has not been reported for reasons of commercial confidentiality.

There is uncertainty around future hardrock prices and hence assumed values have been subjected to sensitivity testing (see Section 4.6).

Residual Value at End of the Evaluation Period

At the end of the extension project, capital equipment and land (excluding offsets which are required to be protected in perpetuity) may have some residual value that could be realised by sale or alternative use.

The overall objectives of the rehabilitation strategy are to:

- stabilise all earthworks, drainage lines and disturbed areas no longer required for quarry-related activities to minimise erosion and sedimentation;
- reduce the visibility of the activities from surrounding properties and the local road network;
- provide a low maintenance, geotechnically stable and safe landform, which is commensurate with the future land uses on and around the project area;
- blend the created landforms within the project area with the surrounding landform as far as possible; and
- revegetate the disturbed areas in the project area with native tree, shrub and grass species and/or pasture species to a meet a final land use of light grazing.

For the purpose of the analysis it is assumed that capital equipment and land have no residual value at the end of the extension project life.

4.4.2 Environmental, Social and Cultural Costs and Benefits

The environmental, social and cultural impacts of the extension project, as assessed in the EIS, are summarised in Section 2. This Section considers these impacts from an economic perspective. Attachment 6 summarises the treatment of the environmental, social and cultural impacts of the extension project in the CBA.

Agricultural Production

The extension project will extend the disturbance footprint of the quarry into an area identified has having low agricultural potential (land and soil capability class 5 and 6) and predominantly limited to restricted grazing. Any foregone net returns from this potential land use is an economic cost of the extension project. In a competitive market, the gross economic value of agricultural production is reflected in the prices received for the goods that are produced and the economic costs of production are reflected in the costs of inputs.

In a properly functioning land market, the present value of the potential net financial benefits of future potential agricultural production is reflected in land prices. Unless there is a demonstrated failure in agricultural markets to adequately reflect the scarcity of agricultural products or a failure in land markets to adequately reflect the scarcity of agricultural land, then the market price of land reflects the opportunity cost of using that land for alternative uses.

In this analysis, the opportunity costs of foregone agricultural production, as a result of the extension project, has been incorporated in the CBA through inclusion of the full value of land required for the extension project (the opportunity cost of land already in Gunlake ownership).

Operational Noise

The impact of the Project noise on nearby properties can potentially be valued using the property value method, where the change in property value as a result of the noise impacts are estimated, or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The Noise and Vibration Assessment concluded that with the adopted noise mitigation measures, one property (R7) would go from no or negligible impacts to moderate impacts and two properties (R2 and R4) would go from moderate impacts to significant impacts. Two contiguous parcels of land would also experience some noise impacts and Gunlake has negotiated agreements with these owners. Road traffic noise levels are predicted to satisfy the Road Noise Policy day and night criteria at all nearest privately owned receivers on each section of the transport routes.

For properties significantly impacted by noise impacts, a condition of contemporary development consents is for the proponent to purchase the affected properties upon the request of the landowner. These acquisition costs are included in the capital costs of the extension project. So instead of the partial property value impacts being incorporated into the CBA, the full acquisition costs[13] are included. This will overstate the economic impact of noise amenity impacts for significantly impacted properties, particularly as these properties would be moderately impacted under the base case. The acquisition costs of these two properties are commercial-in-confidence and hence not separately reported.
#
Where properties are predicted to be moderately impacted by noise impacts, a condition of contemporary development consents is for at-receiver noise mitigation to be implemented upon request by the landholder. For noise impacts, this can include double glazing of windows and installation of air conditioning units. An allowance has been included in the capital costs of the extension project for mitigation at one property. While these mitigation costs are commercial-in-confidence some indication of the order of magnitude of cost can be gained by applying a notional amount of say $50,000 to the additional property that would be moderately impacted. Assuming these works occur in 2017 (the first year of incremental hard rock quarrying under the extension project), the present value of these measures would be in the order of $0.2M.

[13] Which is also likely to include the consumer surplus associated with the properties since acquisition costs tend to be higher than market values.

In addition, there is a cost to Gunlake from negotiated agreements for owners of the two privately owned land parcels potentially impacted by the extension project. The nature of these agreements is commercial-in-confidence but a cost of implementing the agreement is included in the capital cost of the project.

To the extent that these measures mitigate noise, then affected properties are no worse off than they were before and no additional material externality costs arise that warrant inclusion in a CBA. It is recognised that to the extent that any residual noise impacts occur, after mitigation, these externality costs of a project would not all be mitigated.

No material aggregate economic efficiency impacts are included in the CBA for receivers that were identified as being negligibly or not impacted under the VLAMP. While some residual noise impacts may be experience by these property owners they are unlikely to be material from an aggregate economic efficiency perspective.

Blasting

Blasting for the extension project has the potential to cause structural damage or human discomfort at properties surrounding the extension project. These impacts can potentially be valued using the property valuation method, defensive behaviour method or damage cost method. However, the Noise and Vibration Assessment concluded that blast patterns will be designed specifically to ensure compliance with the relevant criteria at the closest privately owned residence. Consequently, impacts are considered to be immaterial from an aggregate economic efficiency perspective and no economic costs have been included in the CBA for blasting impacts apart from the cost of proposed mitigation measures.

Air Quality

#

The impact of the extension project dust emissions can potentially be valued using the property value method, where the change in property value as a result of the noise impacts are estimated, the cost of illness method where changes in health episodes as a result of emissions are estimated and or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The air quality assessment indicated that no properties will be impacted by exceedances of the impact assessment criteria for key pollutants, including PM_{10}, $PM_{2.5}$, TSP, RSC and dust deposition as a result of the extension project. These criteria are set at levels to protect against health effects and nuisance dust effects (Department of Environment and Conservation 2005). Consequently, 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 mitigation measures.

It is recognised that for many pollutants, such as PM_{10}, while a threshold on health impacts (as reflected in the Department of Environment and Conservation 2005 guide) exists at the individual level[14] there is may be no threshold on health impacts at the population level. That is, even at low background concentrations, some vulnerable people are exposed to concentrations that adversely affect health (Department of Environment and Conservation 2005b). Hence, any increase in emissions may have some health effects. Following this approach, some studies have used benefit transfer to imply a per unit health cost associated with any increase in emissions.

However, there are a number of issues with this approach. Firstly, Government criteria are set at levels to protect against health effects and nuisance dust effects (Department of Environment and Conservation 2005). Secondly, for residual air quality impacts to be valued some dose-response function would be required between the below Government policy criteria particulate matter generated by the extension project, the level of local resident exposure and changes to health incidents. Once a

[14] Most people are not at risk of severe acute health effects at current background levels.

dose-response function is estimated, health incidents could be valued in economic terms. At a broad level no such dose-response impacts have been shown for residents in mining areas compared to other areas. For instance, Merritt, Cretikos, Smith, and Durrheim (2013) in an analysis of general practice data for rural communities in close proximity to coal mining and coal-fired power generation in the Hunter Valley region of NSW found that there is no significantly higher rates of problems managed or medications prescribed for Hunter region residents compared with the rest of rural NSW. It is therefore unlikely that a project that meets government air quality criteria at nearby properties will have any material health impacts. At a project level, the air quality assessment on which the Economic Assessment relies was undertaken in accordance with the Government policy and did not investigate dose-response functions for emissions below Government criteria, that could be used to value residual impacts.

Finally, studies such as PAE Holmes (2013) that suggest an economic value per tonne of $PM_{2.5}$ emissions, are based on values from other countries (which the benefit transfer literature would caution against using[15]) and only provide broad consideration of the nature of the receiving environment. As identified by the Productivity Commission (2006) "the existence and magnitude of externalities depends in part on where they occur". The extension project occurs in a rural environment with low density occupation. It is therefore difficult to conceive of material residual air quality impacts of the extension project.

Notwithstanding, applying the PAE Holmes methodology (using a per tonne damage cost of $360 for an area not in a significant urban area) to the incremental $PM_{2.5}$ emissions of the extension project (14.4 tpa) at full production over the project life, gives present value of $0.03M at 7% discount rate. This is clearly immaterial from an aggregate economic efficiency perspective.

Greenhouse Gases

GHG emissions of relevance to the scope of the extension project CBA are those attributable to the extension project i.e. the incremental site preparation, construction and operation of the quarry including the transport of quarry products to domestic customers. These are identified in Table 2.2. Often Scope 3 emissions relate primarily to downstream processing and hence are omitted from CBA. However, in this case Scope 3 emissions relate to truck haulage of quarry products which is part of the extension project. Consequently, for this analysis the CBA has included all incremental Scope 1, 2 and 3 emissions.

To place an economic value on CO_2-e emissions, a shadow price of CO_2-e is required that reflects its global social costs. The global social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the global social cost of CO_2-e with a wide range of estimated damage costs reported in the literature. An alternative method to placing a value on the global damage costs of CO_2-e is to examine the price of CO_2-e taxes, since an efficient tax should reflect the global social cost of CO_2-e. Again, however, there is a wide range of prices. For the central analysis, the global social damage cost of carbon reflected by the US EPA Social Cost of Carbon was used. Sensitivity testing was undertaken using the price path of the European Union Emission Allowance and the Australian Treasury Clean Energy Future Policy Scenario (NSW Government, 2015 - earlier report)[16].

This represents the global social cost of carbon i.e. the cost of carbon emissions to the population of the whole world. This value is relevant to a CBA undertaken at the global level. For a CBA undertaken

[15] Benefit transfer requires that the study and policy site should be ecologically similar; the environmental change under consideration at the policy site is similar to the proposed change at the study site; the policy contexts, including the range of substitute sites available need to be comparable between the source and the target sites; and the socioeconomic characteristics and preferences of the populations impacted by the source and the target sites' policies should be similar.

[16] It is noted that an alternative approach to valuation is based on the 'replacement cost' approach (Department of Industry (2014). However, this is considered an inferior approach to the application of estimated damage costs, adopted in this report.

at the national and NSW level some means of apportioning global damage costs to Australians is required (Gayer and Viscusi 2014). In the absence of any studies that have focused on the social damage cost of carbon emissions to Australians and residents of NSW, this has been undertaken using Australia and NSW's share of global population (around 0.3% and 0.1%, respectively).

Surface Water

Surface water is a potential input into numerous alternative production processes and so its use for quarrying has an opportunity cost, i.e. its value in the next best alternative use. In NSW the government has established a market framework to facilitate the allocation of water surface water. Water access and use is only permissible with possession of a WAL (except in the case of harvestable rights, native title rights and some stock and domestic rights). Water Sharing Plans that are prepared under the Water Management Act set the rules by which water is shared between all users, including the environment, in each water management area in NSW. These plans also set rules for water trading, that is, the buying and selling of water licences and also annual water allocations (Montoya 2010). Consequently, the market value for surface water can be considered to give a reasonable indication of its economic value in alternative uses such as agriculture, i.e. its opportunity cost

The extension project will require additional water but this will be primarily met by the water management dams whose capture of runoff from is considered to be within Gunlake's available harvestable rights allocation and no water access licenses (WALs) will be required. In addition, the extension project will not impact any licensed surface water users and no water quality impacts are expected. Consequently, no material surface water impacts are included in the CBA.

Groundwater

Groundwater is a potential input into numerous alternative production processes and so its use for quarrying has an opportunity cost, i.e. its value in the next best alternative use. Groundwater can also provide base flows to watercourses and support GDEs. In NSW the government has established a market framework to facilitate the allocation of groundwater. Groundwater access and use is only permissible with possession of a WAL (except in the case of harvestable rights, native title rights and some stock and domestic rights). Water Sharing Plans that are prepared under the Water Management Act set the rules by which groundwater is shared between all users, including the environment, in each water management area in NSW. These plans also set rules for water trading, that is, the buying and selling of water licences and also annual water allocations (Montoya 2010). Consequently, the market value for groundwater can be considered to give a reasonable indication of its economic value in alternative uses such as agriculture, i.e. its opportunity cost

Groundwater impacts are predicted to be minor and confined to an area immediately surrounding the pit. Groundwater inflows to the pit of up to 37 ML/year are predicted and require licensing from the unallocated water in the Goulburn Fractured Rock Groundwater Source under the Water Management (WM) Act. There is sufficient water volume within the market or within the next controlled allocation order to allow the required WAL (or WALs) to be obtained. An indication of the opportunity cost of holding 37 ML/year of groundwater in perpetuity has been included in the CBA by applying an assumed market value of water from the Goulburn Fractured Rock Groundwater Source Water Sharing Plan of $800/ML[17] to the maximum predicted level of groundwater impact i.e. 37 ML, for perpetuity.

Groundwater inflows to the pit are not predicted to reduce baseflows to the ephemeral watercourses in the area (Chapmans Creek and Jaorimin Creek). No impacts to registered groundwater works are predicted and a neutral impact on water quality in the hydrological catchment is predicted. No impacts on GDEs are expected. Therefore no other groundwater costs are included in the CBA.

[17] This was based on the minimum price set by government for the 2014 controlled allocation order for the Goulburn Fractured Rock Groundwater Source Water Sharing Plan. This minimum price was set based on prices paid in other similar groundwater sources through water trading, auctions and other current market indicators.

Water Discharges

All water discharged from the site will be treated by sedimentation, in the Pit Dewatering Dam, and provided additional treatment as required to meet NSW EPA licensing requirements. Gunlake will also monitor the water quality of water prior to release. Consequently, water discharges are not expected to have an adverse impact on the environment. The costs associated with upgrading the existing mine water management system to include additional storages are included in the capital costs of the extension project.

Ecology

The extension project will impact an additional 54 ha of native vegetation. Impacted vegetation, and associated fauna, is likely to have non-use values to the community that would be lost as a result of the extension 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. The provision of offsets is also likely to have non-use values to the community that would be gained as a result of the extension project. Provided the values held by the community for the offsets are equal or greater than values that would be lost then no additional economic costs warrant inclusion in the CBA apart from the capital and operating costs of providing the offsets. These costs are included in the capital and operating costs of the extension project.

Road Transport

The project extension will result in increased traffic movements. These would result in increased wear and tear on local roads that are used and managed by Council. No improvements to the road carriageway would be required to accommodate the additional traffic and no level of service issues were identified for intersections apart from the Red Hills Road and Hume Highway intersection where the left turn from Red HIlls Road movement will experience traffic delays. No level of service issues were identified in the longer term for intersections apart from the Red Hills Road and Hume Highway intersection traffic delays at the left turn from Red Hills Road onto the Hume Highway would increase (Level of Service D or F) due to the growth in northbound traffic on the Hume Highway and project related traffic growth movement.

Increased traffic movements can have economic costs in the form of increased pavement damage to local roads and increased safety and congestion costs for road users.

To address these issues created by the extension project and reduce pavement, safety and congestion costs borne by third parties, Gunlake proposes to:

- continue payment of S94 contributions to Goulburn Mulwaree Council for the life of the project so that the Council can maintain and improve the haul routes; and
-
- construct an additional 500 m long (including taper) left turn northbound acceleration lane at the intersection of Hume Highway and Red Hills Road, before 2025 in accordance with the relevant intersection design requirements.

The cost of these upgrades is included in the capital costs of the extension project. The continuing contribution to Council for road maintenance is included in the operating costs of the extension project.

Aboriginal Heritage

The extension project will impact 11 Aboriginal sites, all comprised of stone artefacts, and assessed as having lowing archaeological significance, with the exception of one site assessed as being of moderate significance.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the preparation of the Aboriginal Heritage Management Plan.

Impacts on Aboriginal heritage sites have been shown in some instances to reduce the well-being of the broader community (Gillespie Economic 2009a, 2009b, 2010) while in other instances the impact on the community's well-being has been mixed (Windle and Rolfe 2003).

For the purpose of this analysis, the impacts on Aboriginal heritage remains unquantified although the cost of preparing and implementing an Aboriginal Heritage Management Plan is included in the capital and operating costs of the extension project.

Historic Heritage

Historic heritage can potentially have use and nonuse values to the community that can be valued using non-market valuation methods such as choice modelling. However, no historic heritage sites were identified within the extension project area so no impacts to historic heritage values will result from the proposed extension project.

Visual Impacts

The impact of the extension project on visual amenity at nearby properties can potentially be valued using the property value method, where the change in property value as a result of the visual impacts are estimated, the travel cost method where recreation amenity is impacted, or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The extension project includes an increase in the disturbance area of the quarry to approximately 99 ha. However, this will be in the southern portion of the quarry site that is furthest from public viewpoints and residences. Due to the topography and existing vegetation in the local area, it is unlikely that the extension project will have significant visual impacts for surrounding landowners and road users. Consequently, there are unlikely to be any material visual impact costs for inclusion in the CBA.

Market Benefits to Workers

In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus). Where labour resources used in a project would otherwise be employed at a lower wage or would be unemployed a shadow price of labour is included in the estimation of producer surplus rather than the actual wage (Boardman et al. 2005). The shadow price of labour is lower than the actual wage and has the effect of increasing the magnitude of the producer surplus benefit of a project.

Estimation of this economic value of employment from the extension project requires a number of assumptions such as what proportion of the extension project workforce that would otherwise be unemployed or underemployed, the duration of time that this would occur and the opportunity cost of labour in an unemployed or underemployed state i.e. the reservation wage rate.

Some indication of the potential magnitude of these benefits can be gained by making a number of assumptions. Following the approach of Streeting and Hamilton (1991)[18] if it were assumed that 50% of the additional direct and contractor workforce of the extension project[19] (27 jobs) would otherwise be

[18] Streeting and Hamilton (1991) *An Economic Analysis of the Forests of South-Eastern Australia*, Resource Assessment Commission, Research Paper Number 5.
[19] All sourced from NSW.

unemployed for three years and that the reservation wage for these people was $23,000[20] compared to a quarry wage of $52,000 then the market employment benefit in terms of income would be $1M present value, at a 7% discount rate. Values at alternate discount rates and percentages of unemployed are provided in the following table.

Table 4.2 - Potential Economic Benefits to Workers Under Alternative Assumptions

	Discount Rate		
% UE for 3 years	**4%**	**7%**	**10%**
50%	$1.0	$1.0	$0.9
25%	$0.5	$0.5	$0.4
75%	$1.6	$1.4	$1.3
Wage premium benefit	$2.4	$1.7	$1.2

If alternatively the economic benefit to workers is taken as the difference between the average wage in the region[21] $46,711 (ABS 2016) and the wage in the extension project i.e. $52,000 pa, over the life of the extension project, then the potential economic benefit to workers would be $1.7M, present value at 7% discount rate.

Non-market Value of Employment

This above treatment of employment in CBA relate to the market value or opportunity cost of labour resources. However, CBA also includes non-market values i.e. the values that individuals in a community hold for things even though they are not traded in markets. For example, people have been shown to value environmental resources even though they may never use the resource. These are referred to as existence values and are underpinned by the view in neoclassical welfare economics that individuals are the best judge of what has value to them. As identified by Portney (1994), the concept of existence values should be interpreted more broadly than just relating to environmental resources and may also apply to the employment of others. Refer to Attachment 7.

Empirical evidence for these values was found in three choice modelling studies of mining project in NSW. In a study of the Metropolitan Colliery in the NSW Southern Coalfields, Gillespie Economics (2008) estimated the value the community would hold for the 320 jobs provided over 23 years at $756M (present value). In a similar study of the Bulli Seam Operations, Gillespie Economics (2009a) estimated the value the community would hold for the 1,170 jobs provided over 30 years at $870M (present value). In a study of for the Warkworth Mine extension, Gillespie Economics (2009b) estimated the value the community would hold for 951 jobs from 2022 to 2031 at $286M (present value). These studies are considered reasonable for benefit transfer since they relate to resource extraction in NSW with the population sampled being NSW households.

The extension project will provide employment for the approximately 7 additional direct employees of Gunlake Quarry for a period of 30 years and additional employment for 25 employees for an additional 8 years. Using benefit transfer from the more conservative Bulli Seam Operation study and applying the employment value to the estimated incremental direct employment of the extension project[22] gives an estimated $10M for the non-market employment benefits of the extension project to NSW households.

In the context of a fully employed economy there may be some contention about the inclusion of this value. Consequently, the results are reported with and without these values.

[20] As estimated by the unemployment benefits plus income tax payable on a quarry wage, following the reservation wage rate approach used by Streeting and Hamilton (1991).
[21] ABS does no publish data on average wages by industry sector and therefore it is not possible to estimate the average wage of those not in the mining or quarrying industry.
[22] This is consistent with the non-market valuation studies which focused on direct employees.

Economic Benefits to Existing Landholders

Land required for the extension project is already owned by the proponent and has been for some time. Therefore there is no economic benefit to existing landholders from payments for the purchase of land that exceed the opportunity cost of the land.

Economic Benefits to Suppliers

The focus of CBA is generally on primary costs and benefits i.e. first round impacts. Secondary net benefits that accrue to firms that sell to or buy from a project are ignored. This is because in a competitive market, all resources are assumed to be fully employed, and so increases in the production of goods and services required as inputs to the project will withdraw labour and raw materials from other industries. The additional net benefits (surpluses) to suppliers to the extension project will be offset by decreases in net benefits in other industries and so there is no net secondary benefit to the economy as a whole.

For CBA undertaken at a sub-national perspective some secondary benefits to suppliers may accrue if net benefits that accrue to firms within say NSW are offset by a reduction in economic activity outside NSW. However, no economic benefits to suppliers are included in this analysis.

Net Public Infrastructure Impacts

Potential impacts of the extension project on infrastructure include increased maintenance costs on local roads - paid for by Section 94 contributions and use of utilities paid for by user fees. Consequently, no net infrastructure costs to government are envisaged as a result of the extension project.

Loss of Surplus to Other Industries

The land the subject of the extension has potential for agricultural uses, having previously been used for sheep (wool) grazing. However, the land has not be used for the purpose for over five years and under both the base case and extension project case there is no intention of using the land for grazing. The opportunity cost of using this land for quarrying instead of agriculture is reflected in the market value which is included as an opportunity costs as described earlier. This opportunity cost is borne by Gunlake, as owner of the land.

4.5 Consolidation of Value Estimates

The present value of costs and benefits, using a 7% discount rate, is provided in Table 4.3. The top half of the table identifies production costs and benefits of the extension project, which includes capital and operating costs associated with the mitigation, offset and compensation of environmental, social and cultural impacts. The bottom of the table summarises the residual environmental, social and cultural impacts of the extension project after mitigation, offset and compensation. Specific mitigation, offset and compensation costs are commercial-in-confidence and hence not separated out from the capital and operating costs of the extension project.

The extension project is estimated to have total net production benefits of $21M. Gunlake Quarries is 100% Australian (NSW) owned and hence all of these net production benefits would accrue to Australia. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the extension project, after mitigation, compensation and offset, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the extension project. The threshold value indicates the price that the Australian community must value any residual environmental impacts of the extension project (be willing to pay) to justify in economic efficiency terms the no development option.

For the extension project to be questionable from an Australian economic efficiency perspective, all incremental residual environmental impacts from the extension project, that impact Australia[23], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $21M.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantitatively consider the environmental, social and cultural impacts of the extension project. From Table 4.2 it can be seen that most of the potential impacts are internalised into the capital and operating costs of the proponent via mitigation, offset or compensation, and hence are incorporated into the estimate of net production benefits. Other quantified impacts to Australia are estimated at less than $1M, considerably less than the estimated $21M net production benefits of the extension project to Australia.

Overall, the extension project is estimated to have net social benefits to Australia of between $21M and $32M (the latter incorporating the benefits of employment), 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 extension project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $21M and $32M for the extension project to be questionable from an Australian economic perspective.

[23] Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis. This is mainly relevant to the consideration of greenhouse gas impacts.

Table 4.3 - Global and National Cost Benefit Analysis Results of the Project (Present Values @7% discount rate)

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land	$1	Avoided decommissioning and rehabilitation costs	$0
	Opportunity cost of capital	$0	Value of product	$195
	Development costs	$8	Residual value of capital	$0
	Operating costs	$166	Residual value of land	$0
	Decommissioning and rehabilitation costs	$0		
	Sub-total	***$175***	***Sub-total***	***$195***
	Net Production Benefits			**$21**
Environmental, social and cultural impacts	Greenhouse gas impacts	$5 ($0)	Wage benefits to employment	$1
	Agricultural impacts	Included in opportunity cost of land	Non-market benefits of employment	$10
	Noise impacts	Cost of mitigation works, acquisition and agreements included in capital costs	Economic benefits to existing landholders	$0
	Blasting	No properties impacted by exceedances	Economic benefits to suppliers	$0
	Air quality impacts	No properties impacted by exceedances		
	Surface water	No material impacts*		
	Groundwater	Cost of WALs included in capital costs ($0.03M)		
	Ecology	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs		
	Road transport impacts	Cost of upgrades and road maintenance included in capital and operating costs		
	Aboriginal heritage	11 sites impacted. Cost of AHMP included in capital and operating costs		
	Historic heritage impacts	No material impacts*		
	Visual impacts	No material impacts*		
	Net public infrastructure costs	No material impacts*		
	Loss of surplus to other industries	No material impacts*		
	Non-market impacts sub-total	**$5 ($0)**		**$11**
NET SOCIAL BENEFITS – including employment benefits				**$26($32)**
NET SOCIAL BENEFITS – excluding employment benefits				**$15 ($21)**

Note: totals may have minor discrepancies due to rounding. When impacts accrue globally, the numbers in brackets relates to the level of impact estimated to accrue to Australia

* "No material impacts" does not mean that there will be no impacts but impacts are not likely to amount to more than 5% of the quantified net production benefits of the extension project.

4.6 NSW Costs and Benefits

The NSW Government (2015) guidelines have a particular focus on the costs and benefits to NSW. Table 4.4 identifies the costs and benefits to NSW. Impacts that have a national or global dimension are apportioned to NSW, in particular:

- 32% of the estimated company tax generated from the extension project is attributed to NSW (NSW Guidelines 2015);
- all of the residual net producer surplus i.e. net production benefits minus company tax, is attributed to NSW based on 100% NSW ownership of Gunlake Quarries;
- it is assumed that all contributions to Council are required to mitigate impacts with a nexus to the extension project. However the contributions exceed Councils forecast expenditures as a result of the extension project;
- 100% of potential wages benefits are attributable to NSW based on an assumption that all incremental employment will be filled by NSW residents;
- 100% of the potential nonmarket values of employment are attributable to NSW based on benefit transfer from a study that surveyed the NSW population;
- greenhouse gas impacts (which accrue globally) are attributed to NSW based on NSW's share of the global population;
- all other potential environmental, social and cultural impacts would accrue to NSW households. However, in accordance with Government policy and regulation these impacts are largely mitigated, compensated or offset by the proponent.

On this basis, the costs and the benefits of the extension project to NSW are summarised in Table 4.4. The estimated Net Social Benefits of the extension project to NSW are $16M and $27M, present value at 7% discount rate (the latter including employment benefits). Consequently, as well as resulting in net benefits to Australia, the extension project would also result in net benefits to NSW.

Any unquantified residual impacts of the extension project after mitigation, offset and compensation would need to be valued at greater than $16M to $27M, present value for the extension project to be questionable from an NSW economic efficiency perspective.

Table 4.4 - Cost Benefit Analysis Results of the Project - NSW (Present Values @7% discount rate)

COSTS	VALUE ($M)	BENEFITS	VALUE ($M)
Environmental, social and cultural impacts		***Share of Net Production Benefits***	
Greenhouse gas impacts	$0	Company tax	$2
Agricultural impacts	Included in opportunity cost of land	Net producer surplus	$13
Noise impacts	Cost of mitigation works, acquisition and agreements included in capital costs	Contributions not linked to demand	$0
Blasting	No properties impacted by exceedances	***Sub-total***	***$16***
Air quality impacts	No properties impacted by exceedances	***Additional benefits***	
Surface water	No material impacts*	Wage benefits to employment	$1
Groundwater	Cost of WALs included in capital costs ($0.03M)	Non-market benefits of employment	$10
Ecology	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs	Economic benefits to existing landholders	$0
Road transport impacts	Cost of upgrades and road maintenance included in capital and operating costs	Economic benefits to suppliers	$0
Aboriginal heritage	11 sites impacted. Cost of AHMP included in capital and operating costs		
Historic heritage impacts	No material impacts*		
Visual impacts	No material impacts*		
Net public infrastructure costs	No material impacts*		
Loss of surplus to other industries	No material impacts*		
Total	**$0**	***Sub-total***	***$11***
NET SOCIAL BENEFITS – including employment benefits			**$27**
NET SOCIAL BENEFITS – excluding employment benefits			**$16**

* "No material impacts" does not mean that there will be no impacts but impacts are not likely to amount to more than 5% of the quantified net production benefits of the extension project.
Errors in total are due to rounding.

4.7 Distribution of NSW Costs and Benefits

As identified in Section 3, CBA is only 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 extension project to NSW are potentially distributed among a range of stakeholders as identified in Table 4.5.

Table 4.5 - Incidence of NSW Costs and Benefits

BENEFITS AND COSTS	INCIDENCE OF COSTS AND BENEFITS	MAGNITUDE OF IMPACT
Share of Net Production Benefits		
Company tax	NSW Government and NSW households	$2
Net producer surplus	Gunlake Quarries	$13
Contributions without a nexus	Goulburn-Mulwaree Council and residents of the LGA	$0
Additional benefits		***$16***
Wage benefits to employment	Some of the local and NSW labour force	$1
Non-market benefits of employment	NSW households	$10
Economic benefits to existing landholders	Local landholders who sell land required for Project including buffer land	$0
Economic benefits to suppliers	Regional and State suppliers of inputs to production	$0
Environmental, social and cultural costs*		
Greenhouse gas impacts	Local and NSW households	$0
Agricultural impacts	Gunlake Quarries	Included in opportunity cost of land
Noise impacts	Adjoining landholders	Landholders impacted above criteria compensated
Blasting	Adjoining landholders	No properties impacted by exceedances
Air quality impacts	Adjoining landholders	No properties impacted by exceedances
Surface water	Local surface water users	No material impacts
Groundwater	Local groundwater users	If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact.
Ecology	Local and NSW households	Some loss of values but offset by provision of biodiversity offsets
Road transport impacts	Local residents	Impact mitigated by provision of road and intersection upgrades
Aboriginal heritage	Aboriginal people and other local and NSW households	11 sites impacted. Cost of AHMP borne by Gunlake
Historic heritage impacts	Local and NSW households	No material impacts
Visual impacts	Adjoining landholders	No material impacts
Net public infrastructure costs	NSW Government and NSW households	No material impacts
Loss of surplus to other industries	Local industries adversely impacted by the Project	No material impacts

* 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 is imperfect.

4.8 Risk and Sensitivity Analysis

The main areas of environmental risks associated with quarrying projects 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 NSW Department of Planning and Environment has previously identified that the financial viability of projects is a risk assumed by the project owners. Nevertheless, it should be noted that it is highly unlikely that Gunlake would invest in the extension project if it were not financial viable. However, any risk that the extension project may commence and then cease operation for financial reasons leaving unmet rehabilitation liabilities is mitigated by the fact that Gunlake is required to pay a rehabilitation security deposit to the NSW DPE. This security deposit is held by the Department to ensure that legal

obligations in relation to rehabilitation and safety of the site can be met following quarry closure. If rehabilitation obligations are not met to the satisfaction of the Minister, then the security funds would be used by NSW DPE to meet the relevant requirements.

The provision of biodiversity offsets can be associated with a number risks, including in relation to the biodiversity benefits of additional management of offsets, success in reconstruction of ecological communities, time-lags between impacts and provision of offsets as well as between management actions and achievement of ecological outcomes. These risk are mitigated through offset ratio requirements in the provision of offsets and commitment to the offset actions prior to the commencement of works under approval. The biodiversity offset package, with an appropriate offset ratio to account for ecological risks is being developed in consultation with the NSW Office of Environment and Heritage, and will be committed to prior to the commencement of the extension project.

There is some risk associated with the estimation of environmental, social and cultural impacts of the extension 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 value of the extension project to NSW presented in Table 4.6 is 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[24].

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

- Opportunity costs of land;
- Development costs;
- Operating costs;
- Avoided decommissioning and rehabilitation costs;
- Decommissioning and rehabilitation costs;
- Value of quarry products;
- Company tax;
- Production and operating cost levels[25];
- Greenhouse costs.

Results are reported in Tables 4.5. What this analysis indicates is that CBA undertaken at the NSW level is most sensitive to the value of quarry products and unit operating costs.

In this respect, it should be noted that the extension project is an extension of an existing quarry operation and hence operating costs in this location and geological environment are known. Estimates of operating costs of the extension project are therefore likely to be a reasonable well known and a 20% increase over estimates for every year of the analysis as reported in the sensitivity analysis is highly unlikely.

[24] 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.
[25] If production levels reduced so would operating costs.

A decline in the value of quarry products is also unlikely given the recent closure of major sources of supply, such as the Penrith Lakes Development Scheme, and the forecast strong growth in demand for quarry products to help address a backlog of public infrastructure projects (Productivity Commission, 2014).

The sensitivity analysis indicated that the CBA results are not sensitive to changes in capital costs, opportunity costs of land, decommissioning costs, company tax rate or environmental costs that have not already been internalised into production costs, such as greenhouse gas costs and groundwater WAL costs. Since mitigation, offset and compensation costs are a small component the capital and operating costs of the extension project, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results.

Table 4.6 - NSW CBA Sensitivity Testing (Present Value $Millions) (Excluding Employment Benefits)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$30	$16	$8
INCREASE			
Opportunity cost of land - 20%	$29	$15	$8
Development costs - 20%	$28	$14	$7
Operating costs - 20%	-$14	-$10	-$8
Avoided decommissioning and rehab costs - 20%	$30	$16	$8
Decommissioning and rehab costs - 20%	$30	$16	$8
Value of quarry products - 20%	$82	$47	$28
Groundwater WAL costs	$30	$16	$8
Australian Treasury Clean Energy Future Policy Scenario	$30	$16	$8

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land - 20%	$30	$16	$8
Development costs - 20%	$31	$17	$9
Operating costs - 20%	$74	$42	$25
Avoided decommissioning and rehab costs - 20%	$30	$16	$8
Decommissioning and rehab costs - 20%	$30	$16	$8
Value of quarry products - 20%	-$21	-$14	-$10
Company tax - 20%	$33	$17	$9
Groundwater WAL costs	$30	$16	$8
Forecast European Union Emission Allowance Units price	$30	$16	$8
Production levels and operating costs - 20%	$22	$11	$6

5 LOCAL EFFECTS ANALYSIS

5.1 Introduction

The CBA in Section 3 is concerned with whether the incremental benefits of the extension project exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the extension project compared to 'without' it. This section and Section 6 examines local effects using two different methods.

The Local Area is defined as the LGA of Goulburn-Mulwaree, within which the extension project is located.

5.2 Direct Effects Related to Employment

The extension project will provide incremental employment for 27 people, 7 direct employees at the quarry and 20 truck drivers. 90% of these are expected to already reside in the Goulburn Mulwaree LGA, with the remainder residing elsewhere in NSW.

Assuming that those residing in Goulburn Mulwaree LGA are already employed and that job vacancies created by these people filling the Quarry positions remain unfilled, the incremental disposable wages accruing to the region is $87,000 per annum. This is equivalent to two FTE jobs in the quarrying and truck driving sectors.

Table 5.1 - Analysis of Net Income Increase and FTE Job Increase

	Ordinarily reside in the locality
a) Direct employment during operations phase	24
b) Average net income in quarrying and truck driving sectors	$43,553
c) Average net income in other industries*	$39,983
d) Average increase in net income per job (b-c)	$3,570
e) Increase in net income per year due to direct employment	$86,753
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 total annual non-labour expenditure (after subtraction of wages to quarry workers and drivers) with and without the extension project is estimated at $9.3M and $30.1M respectively. Incremental non-labour expenditure is therefore in the order of $20.7M, per annum.

However, not all of this expenditure will accrue to the local area. From the location quotient analysis and allocation of margins and taxes undertaken for Section 6, $6.8M and $14.1M of non-labour expenditure is estimated to accrue to the local area under the base case and extension project case, respectively. An increment of $7.3 per annum.

5.4 Second Round and Flow-on Effects

The incremental expenditure by employees and non-labour expenditure that is captured by the local area provides flow-on economic activity to the local economy, which can be estimated in terms of economic activity indicators of output, value-added, income and employment. Section 6 provides a full assessment of flow-on effects arising from both labour expenditure and non-labour expenditure. From this analysis the Type 11A employment and income multiplier for incremental impacts is 2.22 and 3.36, respectively. Applying these multipliers to the direct net employment and net income effects calculated above in accordance with the NSW Guideline (2015) results in the extension project contributing $291,000 per annum in total local income and 4.42 local jobs.

While net non-labour expenditure would also provide flow-on effects there is no "expenditure multiplier". Its effects, estimated in terms of output, value-added, income and employment would need to be estimated using IO analysis or similar - refer to Section 6.

Table 5.2 - Flow-on Effects Associated with Net Direct Employment and Income

	Direct	Flow-on	Total
Employment	2	2.43	4.42
Net income	$86,752	$204,737	$291,489
Net non-labour expenditure	$7.3M pa		

5.5 Effects on Other Industries

5.5.1 Regional Economic Impacts of Displaced Agriculture

The extension project could potentially result in a reduction in agricultural activity from land directly impacted by the extension area, the biodiversity offset area and the purchase of groundwater WALs. However:

- the land affected by the extension area has low agricultural potential (land and soil capability class 5 and 6) and has not been used for agriculture in many years;
- land purchased for biodiversity offsets will also have low agricultural potential; and
- there is up to 53,074 ML/year available for extraction from the Goulburn Fractured Rock Groundwater Source with only 12% of this currently being allocated.

Consequently, agricultural impacts of the extension project are expected to be minimal.

5.5.2 Wage Impacts

In the short-run, increased regional demand for labour as a result of the extension project (relative to the situation of no extension project) could potentially result in some increases pressure on wages in other sectors of the economy. The magnitude and duration of this upward wages pressure would depend on the level of demand for labour, the availability of labour resources in the region and the availability and mobility of labour from outside the region. The incremental direct employment and income impacts of the extension project, as estimated in Section 6, will contribute in the order of 0.3% and 0.2% of direct regional employment and direct regional wages, respectively. The contribution is smaller using the approach above. As shown in Figure 4.6, the main employment sectors in the regional economy have on average 13% of their labour residing outside the region, reflecting the mobility of labour. Unemployment in the region was at 666 people or 4.6% in September 2015 (Department of Employment, 2015). Wage impacts are therefore not likely to be significant. Where upward pressure on regional wages occurs, it represents an economic transfer between employers and owners of skills and would attract skilled labour to the region leading to downward pressure on wages.

5.5.3 Housing Impacts

The extension project is a continuation of existing quarry operation. An additional workforce of 27 is anticipated with 90% of these already residing within Goulburn Mulwaree LGA. The remainder are expected to reside outside of the LGA and hence there are not expected to be any additional demand for housing or community infrastructure.

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

The main externalities that potentially accrue to the local area are summarised in Table 5.3.

Table 5.3 - Environmental and Social Impacts on the Local Community

Environmental, social and cultural costs	Incidence of Impacts	Magnitude of Impact
Greenhouse gas impacts	Local and NSW households	$0
Agricultural impacts	Gunlake Quarries	Included in opportunity cost of land
Noise impacts	Adjoining landholders	Landholders impacted above criteria compensated
Blasting	Adjoining landholders	No properties impacted by exceedances
Air quality impacts	Adjoining landholders	No properties impacted by exceedances
Surface water	Local surface water users	No material impacts
Groundwater	Local groundwater users	If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact.
Ecology	Local and NSW households	Some loss of values but offset by provision of biodiversity offsets
Road transport impacts	Local residents	Impact mitigated by provision of road and intersection upgrades
Aboriginal heritage	Aboriginal people and other local and NSW households	11 sites impacted
Historic heritage impacts	Local and NSW households	No impacts
Visual impacts	Adjoining landholders	No material impacts
Net public infrastructure costs	NSW Government and NSW households	No material impacts
Loss of surplus to other industries	Local industries adversely impacted by the Project	No impacts

5.7 Summary of Local Effects

A summary of local effects of the extension project is provided in Table 5.4.

Table 5.4 - Summary of Local Effects

	Project Direct	Project Direct: Local	Net Effect	Total Net Effect
Employment related				
Employment (FTE)	27	24	2	4.40
Income (per annum)	$1,175,931	$1,045,272	$86,753	$291,489
Other non-labour expenditure	$7.3 Mpa			
Second round and flow-on effects	Refer to Section 6			
Contraction in other sectors	No material impact			
Displaced activities	Not applicable			
Wage impacts	No material impact			
Housing impacts	No material impact			
Externality impacts	**Incidence of Impacts**	**Magnitude of Impact**		
Greenhouse gas impacts	Local and NSW households	$0		
Agricultural impacts	Gunlake Quarries	Included in opportunity cost of land		
Noise impacts	Adjoining landholders	Landholders impacted above criteria compensated		
Blasting	Adjoining landholders	No properties impacted by exceedances		
Air quality impacts	Adjoining landholders	No properties impacted by exceedances		
Surface water	Local surface water users	No material impacts		
Groundwater	Local groundwater users	If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact.		
Ecology	Local and NSW households	Some loss of values but offset by provision of biodiversity offsets		
Road transport impacts	Local residents	Impact mitigated by provision of road and intersection upgrades		
Aboriginal heritage	Aboriginal people and other local and NSW households	11 sites impacted		
Historic heritage impacts	Local and NSW households	No material impacts		
Visual impacts	Adjoining landholders	No material impacts		
Net public infrastructure costs	NSW Government and NSW households	No material impacts		
Loss of surplus to other industries	Local industries adversely impacted by the Project	No material impacts		

6 SUPPLEMENTARY LOCAL EFFECTS ANALYSIS

6.1 Introduction

This section uses Input-Output (IO) analysis to identify the gross economic activity footprint associated with the existing approval and the extension project on the local economy.

6.2 Structure of the Local Economy

For the purpose of the analysis, the local economy is defined as comprising the Goulburn Mulwaree LGA. This is the region where the extension project is located and the majority of the extension project operational workforce reside.

A 2011 IO table of the regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 8) using a 2011 IO table of the NSW economy (developed by the Centre for Agricultural and Regional Economics) as the parent table and a 2011 Census employment by industry data for the region. The 111 sector IO table of the regional economy was aggregated to 50 sectors and 8 sectors for the purpose of describing the economy.

A highly aggregated 2011 IO table for the regional economy is provided in Table 6.1. The rows of this table indicates how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD - which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Output for the regional economy is estimated at $4,078M. Value-added for the regional economy is estimated at $1,135M, comprising $496M to households as wages and salaries (including payments to self employed persons and employees) and $639M in OVA.

The employment total working in the regional economy was 9,795.

The economic structure of the regional economy can be compared with that for NSW through a comparison of results from the respective IO models (Figures 6.1 and 6.2). This reveals that the agriculture, trade/accommodation and public personal services sectors in the regional economy are of greater relative importance than they are to the NSW economy, while the mining, building and business services sectors are of less relative importance than they are to the NSW economy.

Figures 6.3 to 6.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the regional economy.

In terms of output and value-added, the retail trade sector and ownership of dwellings sector are the most significant sectors to the regional economy. The retail trade sector is the most significant sector for employment followed by the accommodation/restaurants sector, education sectors and health sectors. Education sectors, community services sectors, health sectors and public order and safety are the most significant sectors for income. The retail trade sector and accommodation/restaurants sectors are the largest sectors for imports while the mineral manufacturing sector and food manufacturing sector are the largest sectors for exports.

Table 6.1 - Aggregated Transactions Table: Regional Economy 2011 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Trade/ Accom	Bus. Srvcs	Public/ Pers. Srvcs	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	6,803	29	32,000	2	64	1,704	273	340	**41,215**	1,540	4,512	7,646	**54,913**
Mining	2	102	2,694	4	178	16	50	46	**3,092**	4	5,764	6,428	**15,289**
Manuf.	852	585	35,569	400	14,227	12,007	5,866	7,041	**76,547**	21,100	24,027	183,990	**305,664**
Utilities	226	93	4,228	23,340	1,674	3,421	2,402	2,521	**37,906**	9,282	9,812	21,111	**78,111**
Building	856	2,145	1,440	990	35,949	3,266	9,963	6,252	**60,861**	539	106,197	8,370	**175,967**
Trade/Accom	1,629	464	10,013	580	3,468	10,760	12,892	13,895	**53,700**	159,361	33,689	87,023	**333,774**
Bus.Srvcs	3,976	1,576	33,248	2,449	19,499	44,130	97,023	47,806	**249,707**	161,264	50,841	154,915	**616,726**
Public/Pers Srvcs	476	388	3,261	439	1,807	5,232	15,887	16,609	**44,099**	106,417	299,448	67,341	**517,305**
TOTAL	**14,819**	**5,383**	**122,452**	**28,205**	**76,866**	**80,536**	**144,356**	**94,511**	**567,127**	**459,507**	**534,291**	**536,824**	**2,097,750**
Household Income	8,377	2,733	38,674	11,881	29,702	84,069	107,582	212,984	**496,003**	0	0	0	**496,003**
OVA	20,000	2,979	46,182	26,692	22,213	77,817	235,839	112,693	**544,414**	64,587	16,657	13,751	**639,409**
Imports	11,717	4,194	98,356	11,334	47,186	91,352	128,950	97,118	**490,206**	272,059	82,482	0	**844,746**
TOTAL	**54,913**	**15,289**	**305,664**	**78,111**	**175,967**	**333,774**	**616,726**	**517,305**	**2,097,750**	**796,153**	**633,430**	**550,575**	**4,077,908**
Employment	**295**	**63**	**638**	**128**	**508**	**2,543**	**1,480**	**4,140**	**9,795**				

Figure 6.1 - Summary of Aggregated Sectors: Regional Economy (2011)

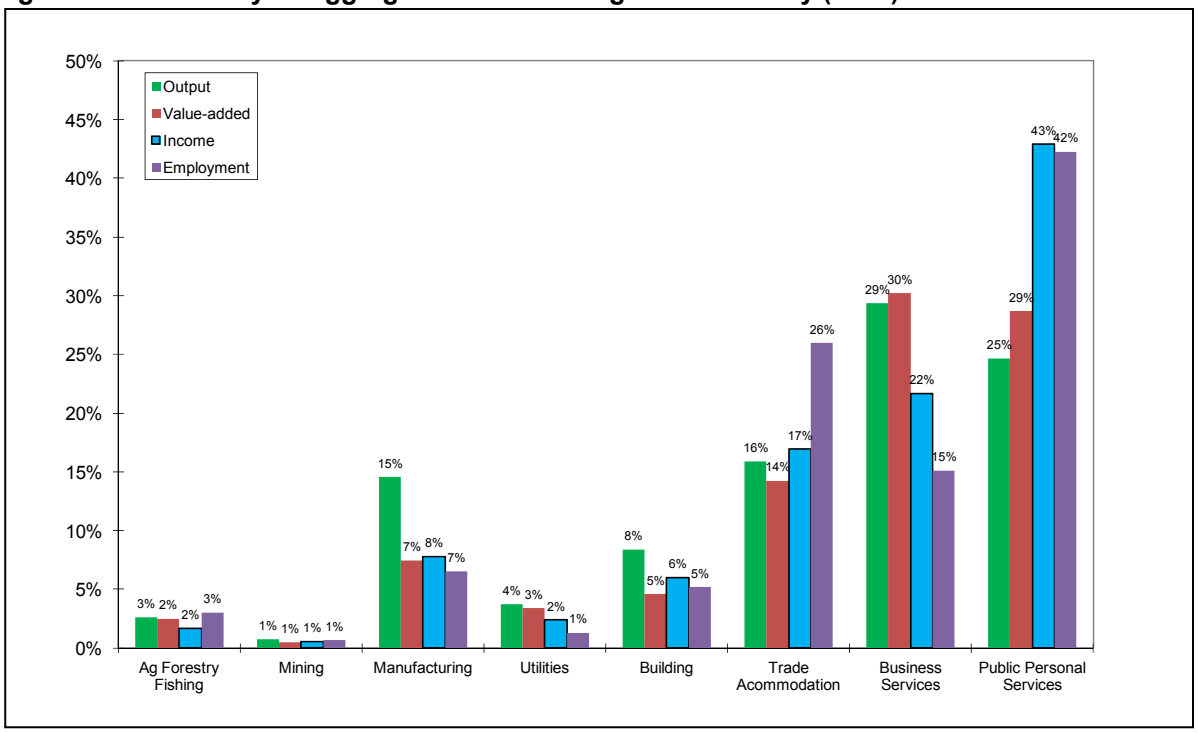


Figure 6.2 - Summary of Aggregated Sectors: NSW Economy (2011)

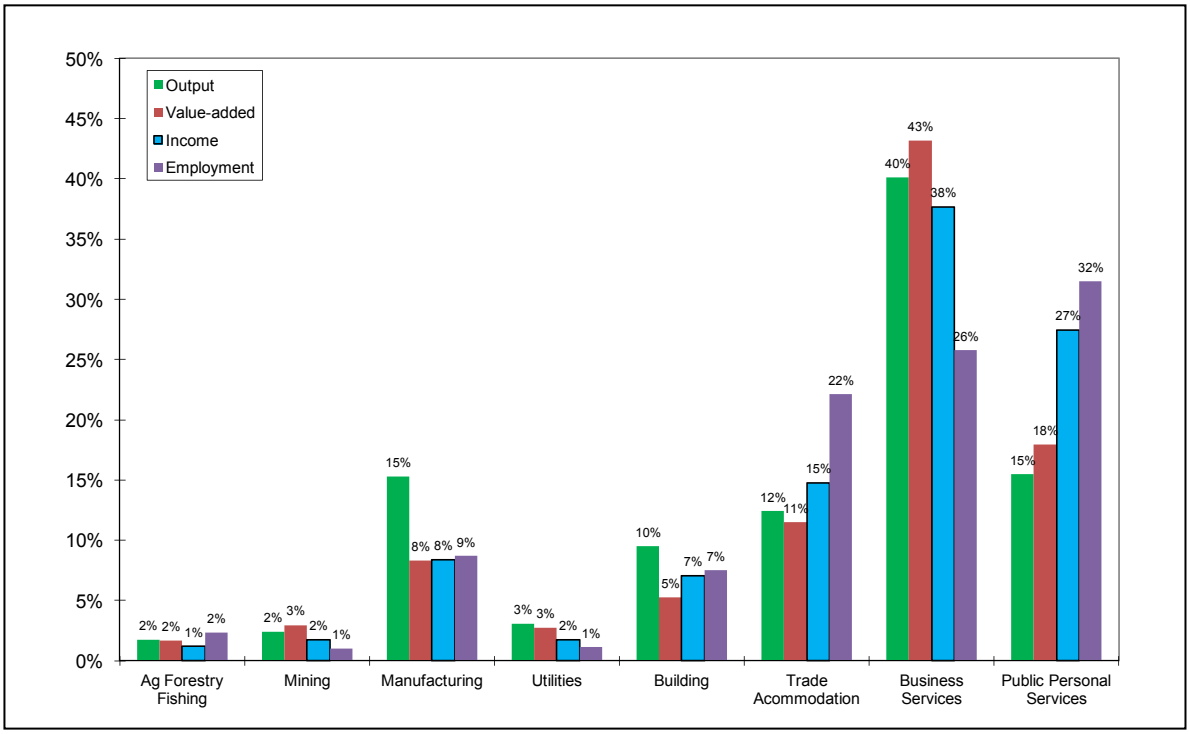


Figure 6.3 Sectoral Distribution of Gross Regional Output and Value Added ($'000)

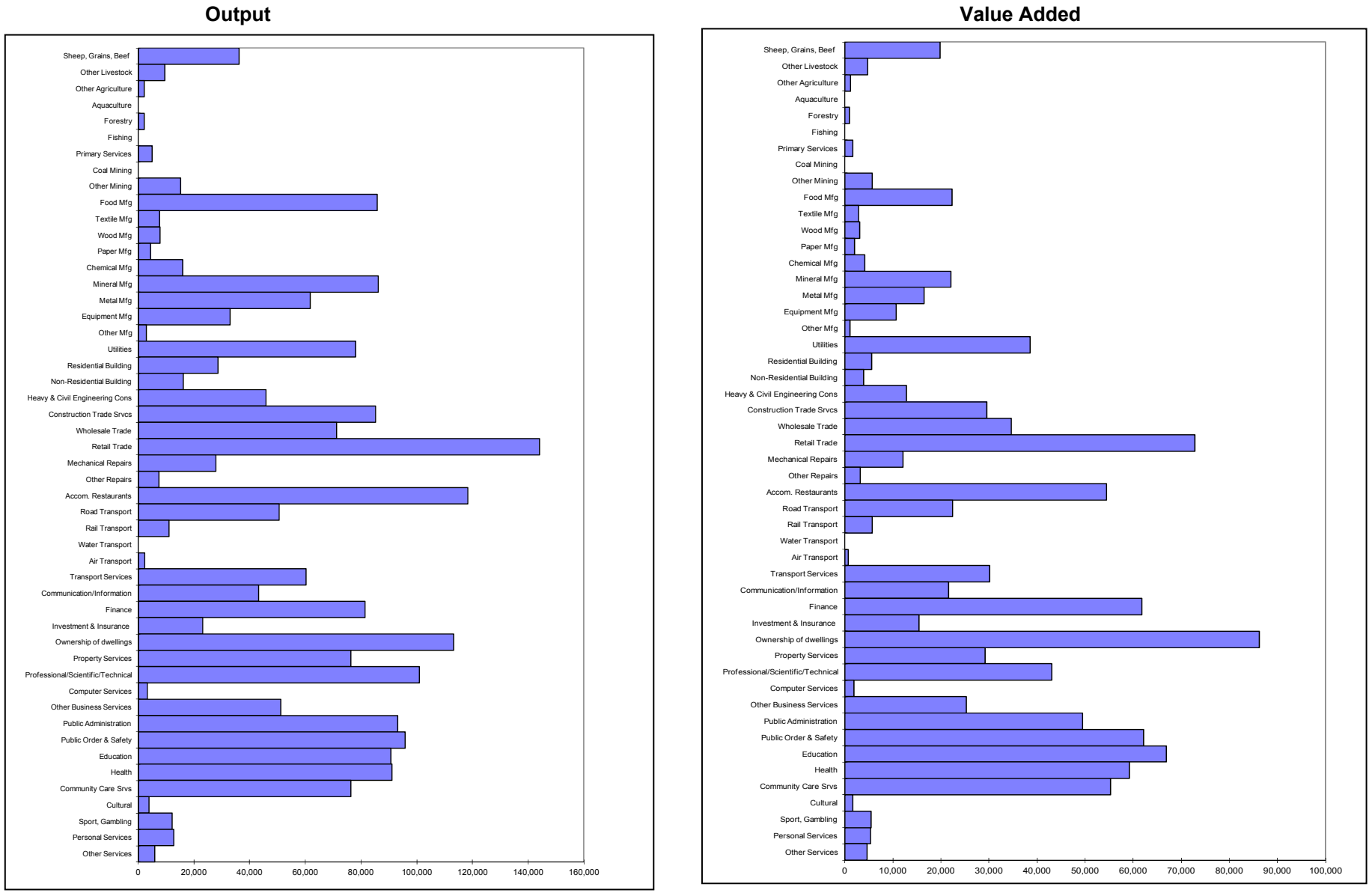


Figure 6.4 Sectoral Distribution of Income ($'000) and Employment (No.)

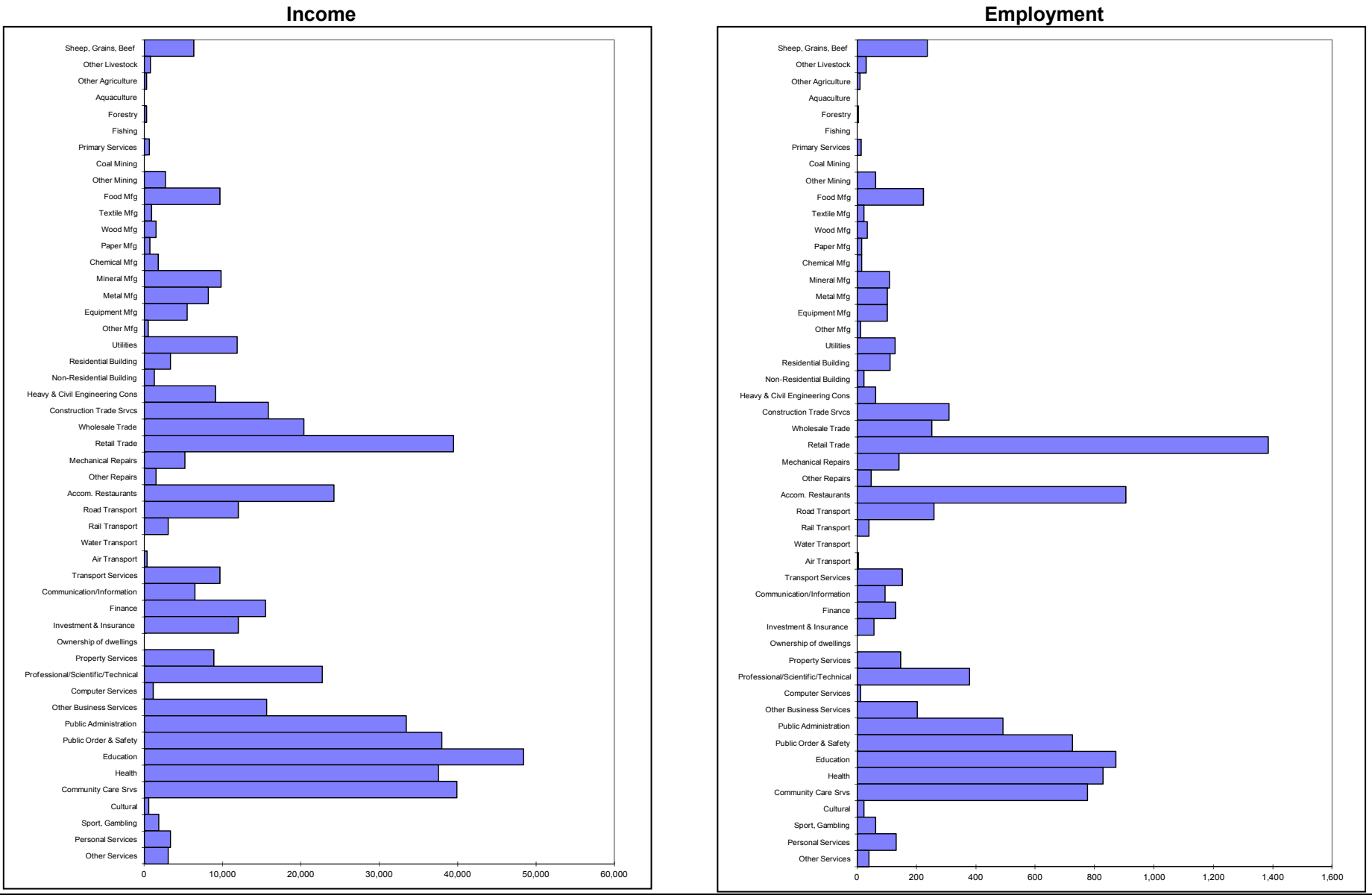


Figure 6.5 Sectoral Distribution of Imports and Exports ($'000)

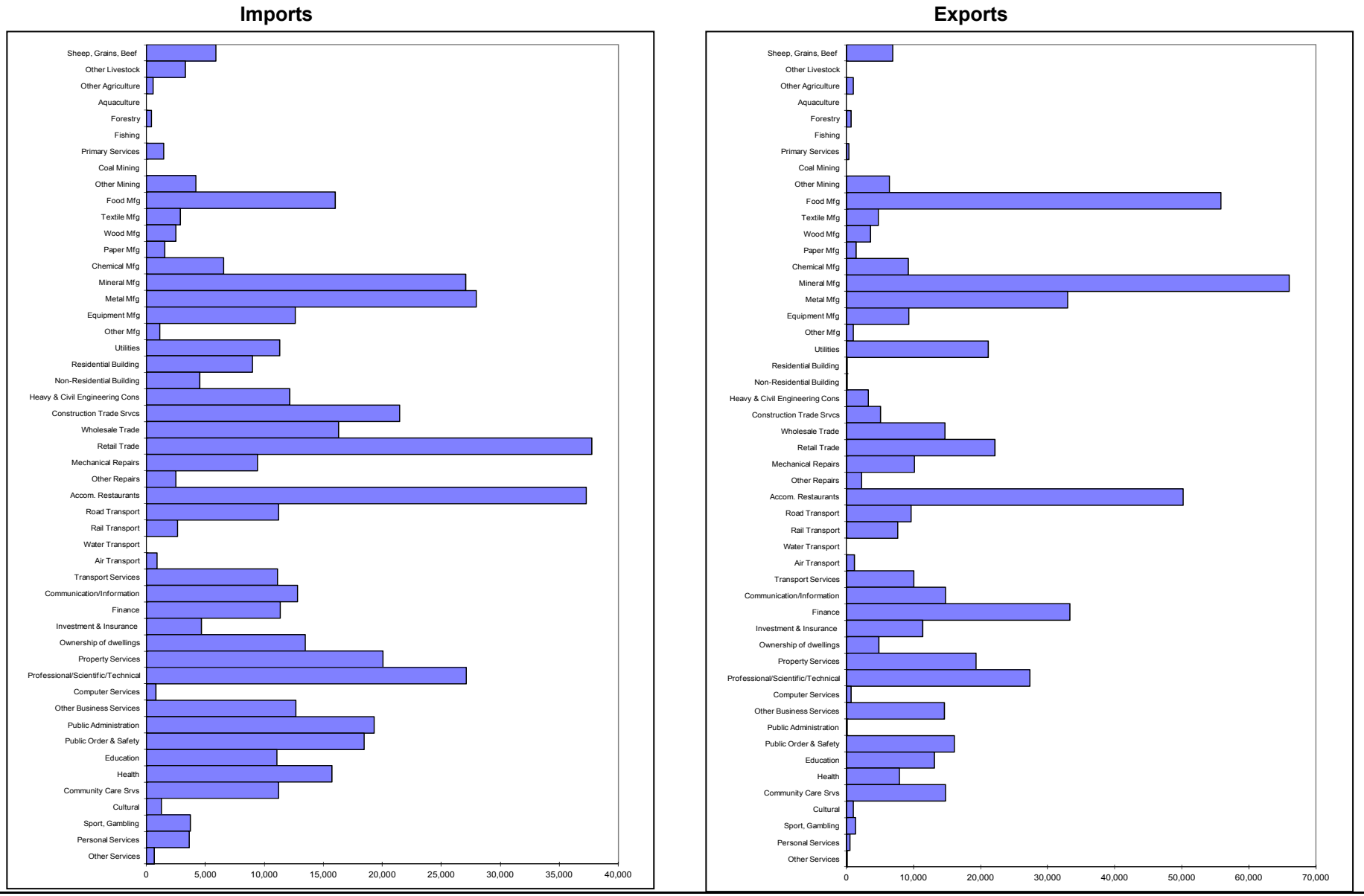
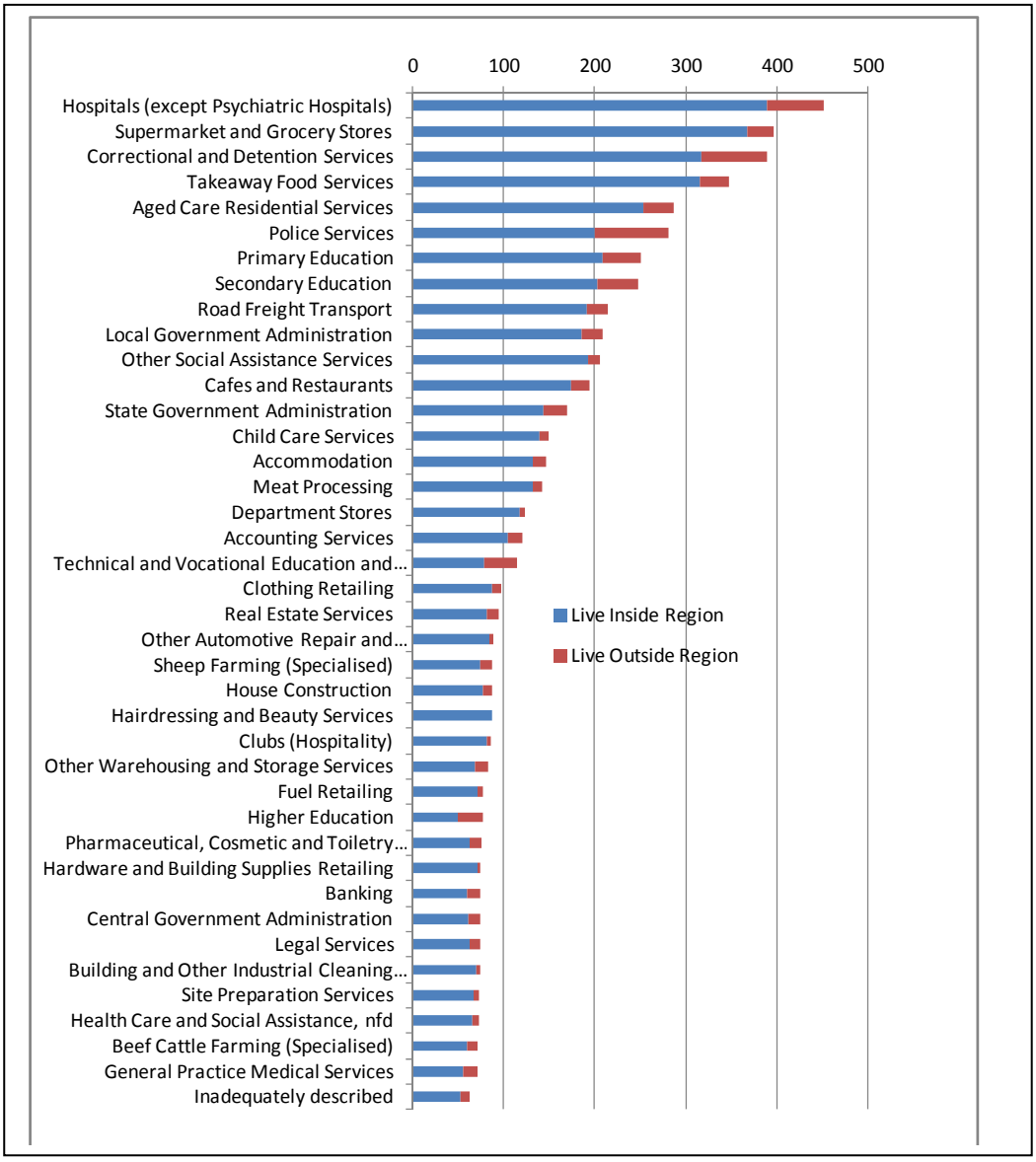


Figure 6.6 shows the top 40 individual industry sectors by employment number for the region. The five most significant employment providers in the region are the hospitals sector, supermarket and grocery stores sector, correctional and detention services sector, takeaway food services sector and aged care residential services sector. In the top 40 individual industry sectors by employment, 13% of the workforce resides outside the region.

Figure 6.6 - Main Employment Sectors in the Region (Job Numbers)



Source: Generated from ABS 2011 census 4 digit employment by industry by place of usual residence data.

6.3 Expenditure During Quarrying Operation

6.3.1 Introduction

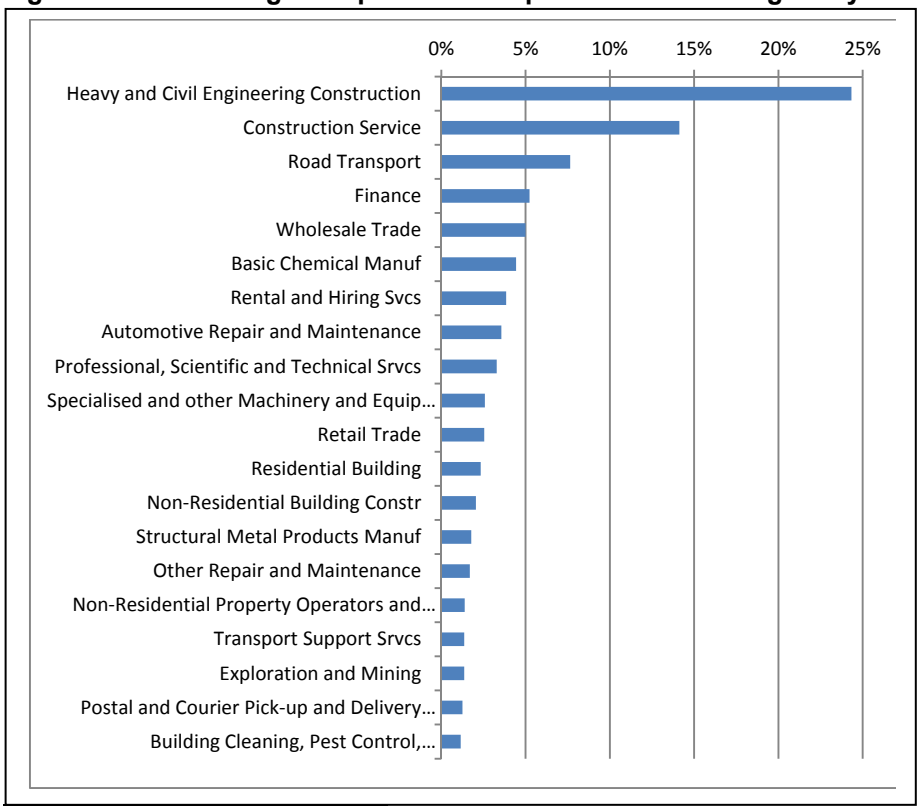
Quarrying projects provide direct economic activity to regional economies i.e. the output, value-added, income and employment associated with the quarrying operation. All other things being equal, the economic activity arising from a project will depend on:

- the expenditure profile in the regional economy that is associated with the project;
- the expenditure profile and residential location of the workforce; and
- the size of the regional economy and the ability of local businesses to supply inputs to production demanded by mine proponents and the workforce.

6.3.2 Quarry Operation Expenditure

The extension project is a continuation of an existing development. Some indication of the main sectors of the regional economy that may directly benefit from the extension project operation can be obtained by examining the regional expenditure pattern of the non metallic mineral mining sector[26] in regional IO table. This has been developed based on the expenditure pattern of the non metallic mineral mining sector in a NSW IO table and the application of location quotients[27] to assess the ability of sectors in the regional economy to supply the goods and services demanded. Based on this approach, the main sectors in the regional economy to benefit from direct operational expenditure are shown in Figure 6.7.

Figure 6.7 - Percentage of Operational Expenditure in the Region by Sector



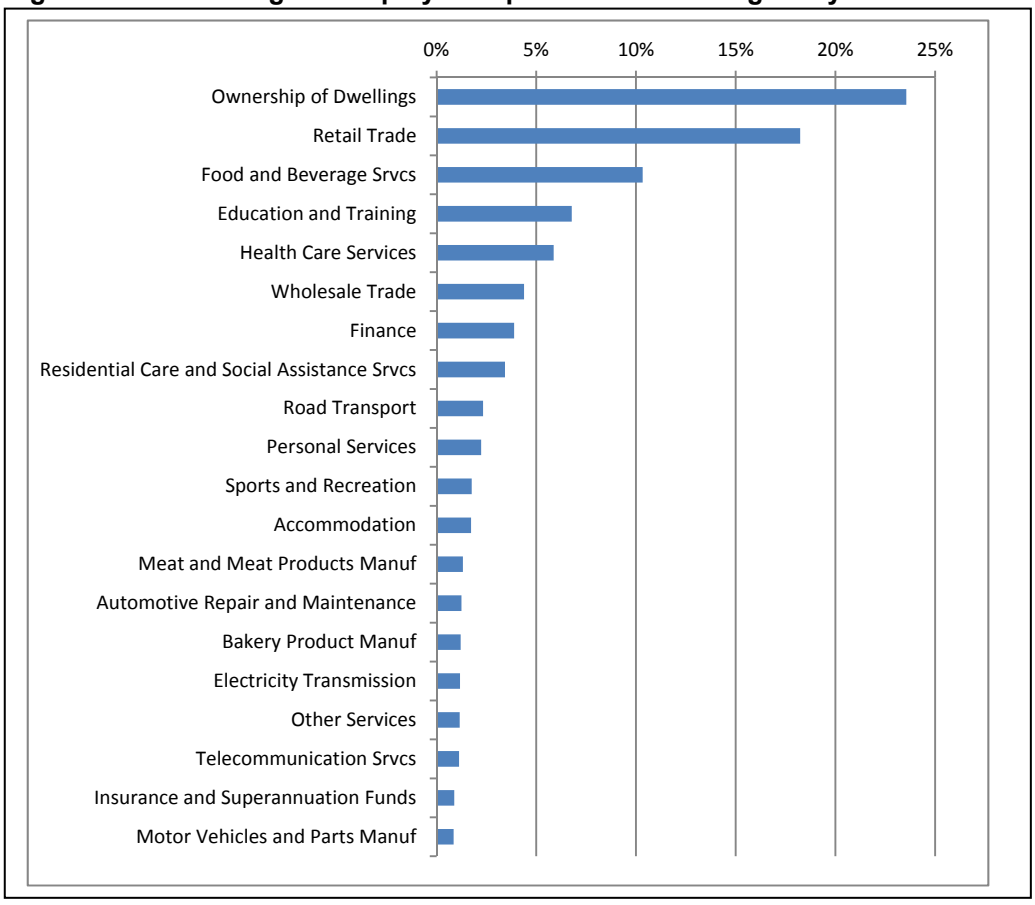
[26] Which includes hard rock quarrying.

[27] Location quotients are a way of quantifying how "concentrated" an industry is in a region compared to a larger geographic area, in this case NSW. They are calculated by comparing the industry's share of regional employment with its share of NSW employment. A LQ of one indicates that the concentration of an industry's employment in a region is the same as for the state. A LQ of greater than one indicates the region has a greater concentration of employment in an industry compared to NSW and hence the likelihood of this sector in a region being able to provide the goods and services demanded by a project are greater than where the concentration is less than one.

6.3.3 Quarry Employee Expenditure

Economic activity in the region will also arise from the expenditure of the quarry workforce in the region. It is estimated that the extension project will have 32 direct employees. Ninety percent are estimated to live in the region. An indication of the main sectors of the regional economy that may benefit from employee expenditure can be obtained by examining the expenditure pattern of the household sector in the NSW IO table adjusted to the region using location quotients. Based on this approach the main sectors in the regional economy to benefit from direct expenditure of wages in the regional economy are shown in Figure 6.8. The main sectors benefitting from workforce expenditure are the ownership of dwellings sector, retail trade sector, food and beverage services sector and the education and training sector.

Figure 6.8 - Percentage of Employee Expenditure in the Region by Sector



6.4 Local Impact of the Project

6.4.1 Introduction

There is no substantive construction phase associated with the extension project and hence this assessment focuses on the revenue, expenditure and employment associated with the operation of the extension project. This would provide economic activity for the regional economy, as well as for the NSW economy. The economic activity impacts are estimated for the indicators of output, value-added, income and employment.

For the analysis of the operational phase of the extension project, a new extension project sector was inserted into the regional IO table reflecting average annual production levels and expenditure. The average annual revenue, operating costs and gross profit for the new sector was obtained from financial information provided by Gunlake. For this new sector:

- the estimated gross annual revenue from the region was allocated to the *Output* row;
- the estimated wage bill of employees residing in the region was allocated to the *household wages* row (90% live in the region) with the remainder allocated to a secondary household wages row that does not get incorporated into flow-on effects;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added* based on expenditure information from Gunlake;
- allocation adjustment was then made between *intermediate sectors* in the regional economy and *imports* based on regional location quotients;
- purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the (2008-09) National Input-Output Tables;
- gross profit and depreciation were allocated to the *other value-added* row*;*
- direct employment by the extension project in the region was allocated to the *employment* row.

6.4.2 Economic Activity Impacts

The total and disaggregated annual impacts of the existing approved quarry and the extension project on the regional economy (in 2015 dollars) are shown in Table 6.2 and Table 6.3 respectively. The incremental impact (i.e. the difference between the extension project and the approved quarry) is reported in Table 6.4.

Table 6.2 - Economic Impacts of the Existing Approved Quarry on the Regional Economy ($2015)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	15,750	9,809	2,670	12,479	28,229
Type 11A Ratio	*1.00*	*0.62*	*0.17*	*0.79*	*1.79*
VALUE ADDED ($'000)	5,537	4,317	1,503	5,819	11,356
Type 11A Ratio	*1.00*	*0.78*	*0.27*	*1.05*	*2.05*
INCOME ($'000)	1,939	1,157	510	1,667	3,606
Type 11A Ratio	*1.00*	*0.60*	*0.26*	*0.86*	*1.86*
EMPL. (No.)	55	22	12	34	90
Type 11A Ratio	*1.00*	*0.40*	*0.22*	*0.62*	*1.62*

* Transport employment and income has been relocated from production-induced effects to direct effects for the purpose of the analysis.

Table 6.3 - Economic Impacts of the Project on the Regional Economy ($2015)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	42,000	21,220	4,760	25,980	67,980
Type 11A Ratio	*1.00*	*0.51*	*0.11*	*0.62*	*1.62*
VALUE ADDED ($'000)	10,341	8,694	2,679	11,373	21,714
Type 11A Ratio	*1.00*	*0.84*	*0.26*	*1.10*	*2.10*
INCOME ($'000)	2,780	2,740	909	3,649	6,429
Type 11A Ratio	*1.00*	*0.99*	*0.33*	*1.31*	*2.31*
EMPL. (No.)	82	46	22	68	150
Type 11A Ratio	*1.00*	*0.33*	*0.37*	*0.70*	*1.70*

* Transport employment and income has been relocated from production-induced effects to direct effects for the purpose of the analysis.

Table 6.4 - Incremental Economic Impacts of the Project on the Regional Economy ($2015)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	26,250	11,411	2,090	13,502	39,752
Type 11A Ratio	*1.00*	*0.43*	*0.08*	*0.51*	*1.51*
VALUE ADDED ($'000)	4,804	4,378	1,176	5,554	10,358
Type 11A Ratio	*1.00*	*0.91*	*0.24*	*1.16*	*2.16*
INCOME ($'000)	841	1,583	399	1,982	2,823
Type 11A Ratio	*1.00*	*1.88*	*0.47*	*2.36*	*3.36*
EMPL. (No.)	27	23	10	33	60
Type 11A Ratio	*1.00*	*0.87*	*0.36*	*1.22*	*2.22*

* Transport employment and income has been relocated from production-induced effects to direct effects for the purpose of the analysis.

The extension project is estimated to make up to the following annual incremental contribution to the regional economy for up to 22 years:

- $40M in annual direct and indirect regional output or business turnover;
- $10M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the incremental contribution to the regional economy would be:

- $68M in annual direct and indirect regional output or business turnover;
- $22M in annual direct and indirect regional value added;
- $6M in annual direct and indirect household income; and
- 150 direct and indirect jobs.

6.4.3 Multipliers

Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc. The incremental type 11A ratio multipliers for the extension project impact on the regional economy range from 1.51 for output up to 3.36 for income.

6.4.4 Main Sectors Affected

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities would be generated by the extension project (Table 6.5).

Table 6.5 - Sectoral Distribution of Incremental Employment Impacts on the Regional Economy

	Regional Economy			
Sector	**Average Direct Effects**	**Production-induced**	**Consumption-induced**	**Total**
Primary	0	0	0	0
Mining	7	3	0	10
Manufacturing	0	2	0	3
Utilities	0	1	0	1
Wholesale/Retail	0	2	3	5
Accommodation, cafes, restaurants	0	1	1	2
Building/Construction	0	6	0	6
Transport	20	2	0	22
Services	0	7	4	11
Total	**27**	**24**	**10**	**60**

Note: Totals may have minor discrepancies due to rounding.

Table 6.5 indicates that direct, production-induced and consumption-induced employment impacts of the extension project on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in the services sectors, building/construction sectors and manufacturing sectors while consumption induced flow-on employment would be mainly in services sectors and the wholesale/retail trade sectors.

Businesses that can provide the inputs to the production process required by the extension project and/or the products and services required by employees would directly benefit from the extension project by way of economic activity. However, because of the inter-linkages between sectors, many indirect businesses will also benefit.

6.5 Potential Contraction In Other Sectors

Economic impacts for regional economies modelled using IO analysis represent only the gross or positive economic activity associated with the extension project. Where employed and unemployed labour resources in the region are limited and the mobility of in-migrating or commuting labour from outside the region is restricted, there may be competition for regional labour resources as a result of the individual project, that drives up regional wages. In these situations, there may be some 'crowding out' of economic activity in other sectors of the regional economy.

'Crowding out' would be most prevalent if the regional economy was at full employment and it was a closed economy with no potential to use labour and other resources that currently reside outside the region. However, the regional economy is not at full employment and is an open economy with access to external labour resources. Consequently, 'crowding out' of economic activity in other sectors as a result of the extension project would not be expected to be significant.

However, even where there is some 'crowding out' of other economic activities this does not indicate losses of jobs but the shifting of labour resources to higher valued economic activities. This reflects the operation of the market system where scarce resources are reallocated to where they are most highly valued and where society would benefit the most from them. This reallocation of resources is therefore considered a positive outcome for the economy not a negative.

6.6 Quarry Cessation

As outlined in Section 6.4, the extension project would provide direct and indirect economic activity in the regional economy for 30 years. Conversely, the cessation of the quarry operations in the future would result in a contraction in regional economic activity.

The magnitude of the regional economic impacts of cessation of the extension project would depend on a number of interrelated factors at the time, including:

- the movements of workers and their families;
- alternative development opportunities; and
- economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of extension project cessation on the regional economy would depend on whether the workers and their families affected would leave the area. If it is assumed that some or all of the workers remain in the region, then the impacts of extension project cessation would not be as severe compared to a greater number leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption, the regional economic impacts of extension project cessation would approximate the direct and production-induced effects in Table 6.3. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 6.3.

The decision by workers, on cessation of the extension project, to move or stay would be affected by a number of factors including the prospects of gaining employment in the regional economy compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the regional area (Economic and Planning Impact Consultants, 1989).

Ultimately, the significance of the economic impacts of cessation of the extension project would depend on the economic structure and trends in the regional economy at the time. For example, if the extension project cessation takes place in a declining economy, the impacts might be significant. Alternatively, if extension project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the extension project may have little impact.

Nevertheless, given the uncertainty about the future prospects in the regional economy it is not possible to foresee the likely circumstances within which extension project cessation would occur.

7 CONCLUSION

A CBA of the extension project indicated that it would have net social benefits to NSW of between $16M and $27M and hence is desirable and justified from an economic efficiency perspective. Environmental, social and cultural impacts of the extension project have been minimised through extension project design and mitigation, offset and compensation measures. The economic value of residual impacts are considered to be immaterial from an aggregated economic efficiency perspective.

Economic activity analysis, using IO analysis, estimated that the extension project would make up to the following annual incremental contribution to the regional economy[28] for up to 22 years:

- $40M in annual direct and indirect regional output or business turnover;
- $10M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the annual incremental contribution to the regional economy impacts would be up to:

- $68M in annual direct and indirect regional output or business turnover;
- $22M in annual direct and indirect regional value added;
- $6M in annual direct and indirect household income; and
- 150 direct and indirect jobs.

[28] The Local Government Area of Goulburn Mulwaree.

8 REFERENCES

Australian Bureau of Statistics (1995) *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*. Cat. No. 5246.0.

Bennett, J. (1996) *The Economic Efficiency of RACAC Resource Allocation Options a Conceptual Framework*. A Consultancy prepared for Resource and Conservation Assessment Council.

Boardman, A., Greenberg, D., Vining, A. and Weimer, D. (2001) *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall, USA.

Bureau of Industry Economics (1994) *Regional Development: Patterns and Policy Implications*. AGPS, Canberra.

Department of Environment and Conservation (2005) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales,* NSW EPA, Sydney.

Department of Environment and Conservation (2005b) *Air Pollution Economics Health Costs of Air Pollution in the Greater Sydney Metropolitan Region*

Department of Employment (2015) Small Area Labour Markets, September Quarter 2015, http://employment.gov.au/small-area-labour-markets-publication.

Department of Industry (2014) *Electric Storage Water Heaters, Consultation Regulatory Impact Statement*.

Economic and Planning Impact Consultants (1989) *The Economic Impact of the Woodchipping Industry in South Eastern NSW*. Report to the Wilderness Society.

Gayer, T. and Viscusi, W.K. (2014) *Determining the Proper Scope of Climate Change Benefits*, Working Paper of The George Washington University Regulatory Studies Centre, The George Washington University, Washington DC.

Gillespie Economics (2008) *Managing the Impacts of a Mine in the Southern Coalfield: A Survey of Community Attitudes*. Prepared for Helensburgh Coal Pty Ltd.

Gillespie Economics (2009a) *Socio-economic assessment: Bulli Seam Operations*. Prepared for BHP Billiton Pty Ltd.

Gillespie Economics (2009b) *Economic Assessment of the Warkworth Project*. Prepared for Coal and Allied Pty Ltd.

James, D. and Gillespie. R. (2002) *Draft Guideline for Economic Effects and Evaluation in Environmental Impact Assessment*, prepared for Planning NSW.

Jensen, R. and West, G. (1986) *Input-output for Practitioners: Theory and Applications*. Prepared for Department of Local Government and Administrative Services, Local Government and Regional Development Division, Australian Government Publishing Service.

Johnson, F. and Desvouges, W. (1997) Estimating Stated Preferences with Rated-Pair Data: Environmental, Health and Employment Effects of Energy Programs. *Journal of Environmental Economics and Management,* 34, 75-99.

Merritt, T., Cretikos, M., Smith, W. and Durrheim. D. (2013) The health of Hunter Valley communities in proximity to coal mining and power generation, general practice data, 1998-2010, N*SW Public Health Bulletin*, Vol 24(2), NSW Health.

NSW Government (2012) *Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

NSW Treasury (2007) *Treasury Guidelines for Economic Appraisal*. Website: www.treasury.nsw.gov.au Date Accessed: 1 October 2011.

PAE Holmes (2013) *Methodology for Valuing the Health Impacts of Changes in Particle Emissions – Final Report,* prepared for the NSW EPA.

Portney, P. (1994) The Contingent Valuation Debate: Why Economists Should Care. *Journal of Economic Perspectives* 8:4, 3-18.

Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.

Powell, R., Jensen, R. and Gibson, A. (1985) *The Economic Impact of Irrigated Agriculture in NSW*. A report to the NSW Irrigators' Council Limited.

Productivity Commission (2006) *Waste Management*, Productivity Commission Inquiry Report No. 38, Commonwealth of Australia.

Productivity Commission (2014) *Public Infrastructure*, Productivity Commission Inquiry Report No. 71, Commonwealth of Australia.

Resource Assessment Commission (1992) *Methods for Analysing Development and Conservation Issues: The Resource Assessment Commission Experience*, Research Paper Number 7.

Sinden, J. and Thampapillai, D. (1995) *Introduction to Benefit Cost Analysis*, Longman, Sydney.

Streeting, M. and Hamilton, C. (1991) *Economic analysis of the forests of south-eastern Australia*. Prepared for the Resource Assessment Commission.

West, G. (undated) *Notes On Some Common Misconceptions In Input-Output Impact Methodology*, Department of Economics, University of Queensland.

West, G. (1993) *Input-Output Analysis for Practitioners, Version 7.1, User's Guide*.

Windle, J. and Rolfe, J. (2003) Valuing Aboriginal cultural heritage sites in Central Queensland, *Australian Archaeology*, Number 56, pp. 35-41.

ATTACHMENT 1 – LEGISLATIVE CONTEXT FOR ECONOMIC ANALYSIS IN EIA

Environmental Planning and Assessment Act 1979 and Environmental Planning and Assessment Regulation

- The basis for economic analysis under the *Environmental Planning and Assessment* (EP&A) *Act 1979* emanates from:
  - the definition of the term "environment" in the EP&A Act which is broad and includes the social and **economic** environment, as well as the biophysical environment;
  - the "objects" of the EP&A Act which includes *"promoting the social and **economic welfare** of the community"*; and
  - Clause 7(1)(f) of Schedule 2 of the EP&A Regulations which requires environmental assessment to provide "*the reasons **justifying** the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, **economic** and social considerations…"*
  - *Section 79C 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); and
    - the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and ***economic impacts in the locality***.
- Objects of promoting economic welfare and requirements to justify a project having regard to economic considerations are consistent with the use of CBA. A Note to Clause 7 (1) (f) states that "A cost benefit analysis may be submitted or referred to in the reasons justifying the carrying out of the development, activity or infrastructure."
- A cost benefit analysis is consistent with the consideration of the public interest, although the limitation of public interest to NSW households requires consideration of the costs and benefits to NSW households, whereas CBA would normally be undertaken at the National level.
- Elements of CBA can provide information on the economic impacts in the locality, although CBA should not be undertaken at the local level. This can be supplemented by other forms of analysis to examine economic impacts in the locality such as the consideration of:
  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.

Secretary's Environmental Assessment Requirements

- The Project SEARs include a requirement for:
  - an assessment of potential impacts on local and regional communities including impacts on social amenity;

- a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements, or contributions and/or voluntary planning agreement or similar mechanism; and

- a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community;

- the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.

Other Economic Guidelines

- In 2015 the NSW Government prepared *Guidelines for the economic assessment of mining and coal seam gas proposals*. This provides an outline of how to undertake a CBA and local effects analysis of mining and coal seam gas proposals.

- NSW Treasury (2007) *NSW Government Guideline for Economic Appraisal*, provides guidance for Government agencies on how to undertake CBA of significant spending proposals, including proposed capital works, projects and new programs across all public sector agencies. However, many of the principles have broader application.

ATTACHMENT 2 – INTRODUCTION TO ECONOMIC METHODS

Benefit Cost Analysis

- Benefit Cost Analysis (CBA) is the primary way that economists evaluate projects and policies.

- CBA evaluates whether the well-being (**economic welfare**) of the community is in aggregate improved by a project. It does this by comparing the costs and benefits of a project to the community.

- The community whose welfare is included is broadly defined as anyone who bears significant costs and benefits of a project. However, in practice most CBA is undertaken at a national level. CBA at a sub-national level is not recommended however if undertaken at this level should provide decision-makers with estimates of all significant effects, including those to non-residents of the sub-national region.

- It is not possible to justify a project on economic grounds without doing a CBA.

Economic Activity Analysis

- Economists also often provide information to decision-makers on the **economic activity** that a project will provide to the regional, state or national economy. This is particularly relevant at the regional level since many regions and towns are experiencing long term decline as a result of structural change in the economy. Additional economic activity can help the prosperity of these regions.

- **Direct** economic activity provided by a project can be estimated from financial and labour estimates for a project. Methods that can be used to estimate **direct** and **indirect** economic activity include IO analysis and CGE modelling. Refer to Attachment 3 for a comparison of these methods and their assumptions.

- While economic activity measures from IO analysis and CGE modelling e.g. direct and indirect output, value-added and income, are generally not measures of benefits and costs relevant to a CBA this information can be of interest to decision-makers[29].

Economic Analysis and Decision-Making

- CBA and local effects analysis (including IO/CGE analysis) are not mechanised decision-making tools, but rather means of analysis that provide useful information to decision-makers.

- Decision-making is multi-dimensional. CBA is concerned with the single objective of **economic efficiency** (economic welfare) while IO analysis and CGE are concerned with the objective of **economic activity** (growth). They do not address equity and other objectives of government. Decision-makers therefore need to consider the economic efficiency and economic activity implications of a project, as indicated by CBA and IO/CGE analysis respectively, alongside the performance of a project in meeting other, often conflicting, government goals and objectives.

[29] It should be noted that it is possible to analyse industry benefits and costs within a general equilibrium framework where impacts are of a sufficient scale that they flow through into multiple sectors in the economy. However, for individual projects a partial equilibrium framework is the preferred approach for the estimation of costs and benefits (US EPA (2010) Guidelines for Preparing Economic Analyses, US EPA).

ATTACHMENT 3 – 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 mine 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. However, in IO analysis 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 projects 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 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 "trickle down" or "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 (including quarrying) 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 to 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

"trickle down" effect or "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) or if jobs remain unfilled. 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 "trickle down" 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 trickle down 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 "trickle down" 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 "trickle down" 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 Trickle Down 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**

ATTACHMENT 4 – INPUT-OUTPUT ANALYSIS AND COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

Input-Output Analysis

- IO analysis is a cost effective and simple method for estimating the gross market economic activity i.e. financial transactions and employment, in a specified region that is associated with a project.
- IO analysis is the most widely used model for regional impact assessment (West and Jackson 2005).
- IO analysis can be undertaken at the LGA or aggregation of LGAs level.
- IO analysis can provide disaggregation of economic activity impacts across many sectors – 111 sectors based on current National IO tables.
- IO analysis was developed by Wassily Leontief for which he received the Nobel Prize in Economics.
- IO analysis is a static analysis that looks at economic activity impacts in a particular year e.g. a typical year of a projects operation.
- IO analysis has historically been applied at the regional level to assess the economic activity impacts of individual projects.
- IO analysis involves the development of an IO table representing the buying and selling of goods and services in the economy. These fixed average ratios are used to estimate the direct and indirect impacts of a change in expenditure in a region.
- IO analysis identifies the gross direct and indirect additional (positive) regional economic activity associated with a project in terms of a number of indicators of economic activity – output, income, value-added[30] and employment.
- Economic activity measures used in IO are not measures of benefits and costs relevant to a CBA.
- IO analysis does not attempt to examine non-market environmental, social or cultural impacts.
- IO analysis does not depend on the assumption *"that there is a ghost pool of highly skilled yet unemployed people"* in a region as suggested by a Land and Environment Court Judgement.
- The estimation of economic activity impacts in IO analysis are based on a number of simplifying assumptions – most notable is that the regional economy has **access to** sufficient labour and capital resources (from both **inside** and **outside** the region) so that an individual project does not result in any regional price changes e.g. wages in other industries or house rentals, which would lead to contractions ("crowding out") of economic activity in other sectors in the region.
- For the assessment of the impacts of individual projects on small open regional economies, this is a reasonable assumption.
- Nevertheless, the results of IO modelling can be seen as representing an upper bound for the net economic activity associated with a project.

Computable General Equilibrium Modelling

- CGE modelling is an alternative more expensive, complicated but theoretically more sophisticated method for estimating the economic activity associated with a project.

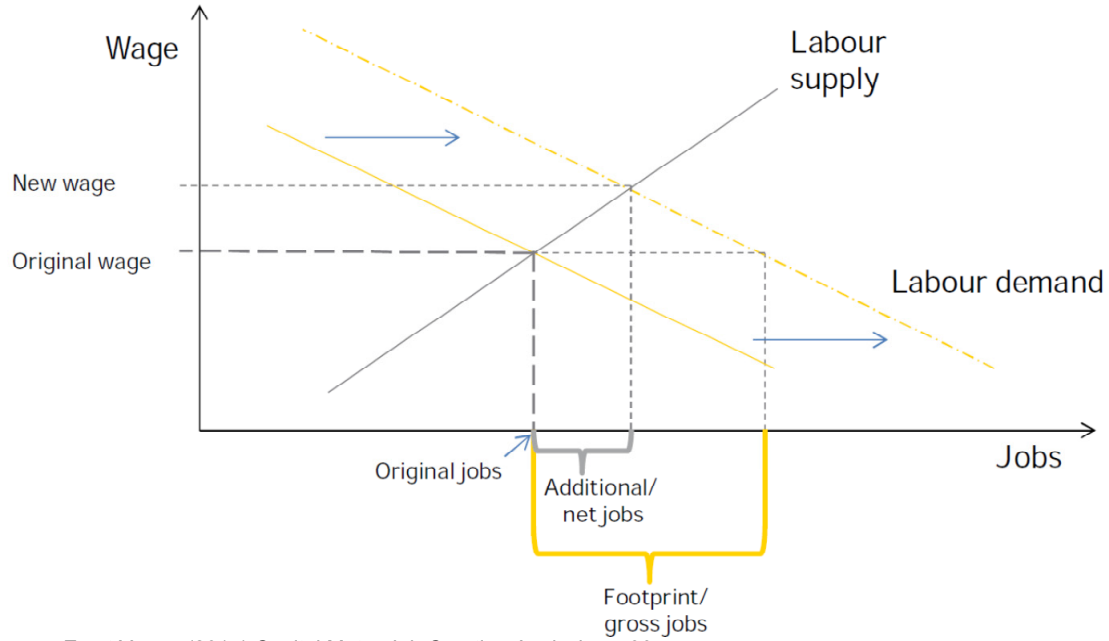
[30] Value-added is the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.

- CGE modelling can be dynamic or comparative static[31] and has historically been applied at the State and National level for determining the potential economic activity associated with the introduction of major government policy changes and investment in large infrastructure projects.
- CGE modelling can also be undertaken at a regional level but normally at no finer scale than the Statistical Subdivision level.
- CGE modelling estimates the additional net (positive and negative) economic activity associated with a project in terms of a number of economic indicators – including value-added and employment – but also real income, government tax revenue and components of value-added.
- Economic activity measures used in CGE modelling are not generally measures of benefits and costs relevant to a CBA, although CGE modelling can also be used to estimate market costs or market benefits, as part of a CBA, where the magnitude of a project will affect a large number of sectors and the effects will be spread more broadly throughout the economy.
- Economic activity impacts can be disaggregated by sector but this is not normally as disaggregated as in IO analysis.
- CGE modelling does not attempt to examine non-market environmental, social or cultural impacts.
- CGE modelling is underpinned by an IO database as well as a system of interdependent behaviour and accounting equations which are based on economic theory (but mostly without econometric backing at the regional level).
- The equations in CGE models ensure that any change in demand in a region, no matter how small, translates into some change in prices and hence there is always some 'crowding out' of other economic activity in the region.
- At the regional level, CGE results can be very sensitive to changes in these behavioural assumptions.
- 'Crowding out' of other economic activities estimated via CGE modelling does not reflect losses of jobs but the shifting of labour resources to higher valued economic activities.

[31] Comparative static models compare one equilibrium point with another but do not trace the impact path along the way. Dynamic models give year by year impacts of a shock.

Comparison of IO Analysis and CGE Modelling

Figure A4.1 – Comparison of Employment Estimates in IO Analysis and CGE Modelling



Source: Ernst Young (2014) Capital Metro Job Creation Analysis, p. 30.

- Figure A4.1 illustrates the difference between the output of IO analysis and the output of CGE with respect to employment. IO analysis estimates the employment footprint or gross jobs from a project. It can also be taken as an indicator of net jobs from a project where there is no or little upward pressure on wages for the region in question as a result of the individual project and hence no or little crowding out of other economic activity[32]. CGE modelling assumes upward pressure on wages and hence some crowding out of other economic activity in the region. Under this assumption CGE estimates additional net jobs as being less than the employment footprint/gross jobs.
- Which modelling approach best represents the true situation depends on whether and to what extent price changes occur at a regional level as a result of individual projects. This is an empirical issue and would depend on the migration of labour into the region, commuting of labour and timely management of land releases by Councils. Few studies exist that examine this issue.
- IO analysis provides decision-makers with information on the relative employment footprint/gross jobs of different projects, without going to the second and more complicated stage of trying to model wage rises and "crowding out" across all other sectors in the economy.
- Regional economic activity, estimated by IO analysis or CGE modelling, is just one piece of information that decision-makers may take into account in considering a project.

Guidelines

- Both IO analysis and CGE modelling are identified in the DP&I's *draft Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie 2002) as appropriate methods for examining regional economic impacts i.e. impacts on economic activity – the size and structure of an economy.
- Other guidelines to recognise the role of IO analysis include:
  - US Environment Protection Agency (2010) *Guidelines for Preparing Economic Analyses*;

[32] This is akin to the marginal assumption in CBA.

- Australian Bureau of Rural Science (2005) *Socio-economic Impact Assessment Toolkit: A guide to assessing the socio-economic impacts of Marine Protected Areas in Australia*.

- NSW Treasury (2007) identify that IO analysis is commonly used to assess the regional impacts of a project. However, IO analysis is concerned with measuring economic activity, and is not a tool for the evaluation of projects (in the way that CBA is).

Government Applications of IO Analysis

- Applications of IO analysis commissioned by Government agencies include:
  - Department of Sustainability, Environment, Water, Population and Communities (2011) *Assessing the Socio-Economic Impacts of Sustainable Diversion Limits and Water for the Future Investments: An Assessment of the Short-Term Impacts at a Local Scale*
  - NSW Natural Resources Commission (2009) *River Red Gum Assessment: Socio-economic impact assessment*;
  - Victorian Environmental Assessment Council (2007) *River Red Gum Forests Investigation – Socio-Economic Assessment.*
  - Resource and Conservation Division of the NSW Department of Urban Affairs and Planning (1999) Regional Impact Assessments as part of the NSW Comprehensive Regional Assessments under the National Forestry Policy.
  - Reserve Bank of Australia (2012) *Industry Dimensions of the Resource Boom: An Input-Output Analysis.*
  - DECCW (2009) Economic benefits of national parks and other reserves in New South Wales - Summary report, reports the results of numerous studies it and its' predecessors have commissioned on the regional economic impacts of national parks and protected areas.
  - DECCW (2006) *Socio Economic Assessment of the Batemans Bay Marine National Park*
  - DECCW (2006) *Socio Economic Assessment of the Port Stephens – Great Lakes Marine Park*
  - National Parks Service, US Department of the Interior (2014) *2012 National Parks Visitor Spending Effects: Economic Contribution to Local Communities, States and the Nation*.

Criticisms Misrepresented

- The main concern that economists e.g. the Productivity Commission, NSW Treasury and ABS (as quoted by The Australia Institute in numerous submissions to mining projects in NSW) have with IO is its use as a substitute for CBA, not its use for estimating direct and indirect regional economic activity impacts.

  - NSW Treasury (2009) "*Model based economic impact assessment [such as IO analysis] is not a substitute for a thorough economic analysis of a policy. The appropriate method for analysing policy alternatives is benefit cost analysis (CBA)".*

  - The main "abuse" reported by the Productivity Commission is using IO analysis to *"make the case for government intervention"* when CBA is the appropriate method for doing this.

  - ABS's concerns with IO being "*biased*" refer to it being a "*biased estimator of the benefits or costs of a project"*. IO does not estimate benefits and costs but economic activity.

  - Concerns of the Warkworth Judgement with IO analysis being "deficient" related to the data (industry data from surveys undertaken in 2001 and assumptions used (see next dot point)), but more fundamentally for not *"assisting in weighing the economic factors relative to the various environmental and social factors, or in balancing economic, social and environmental*

factors". This is an inappropriate criticism of the IO method, since it does not pretend to do this.

- IO analysis does not depend on the assumption *"that there is a ghost pool of highly skilled yet unemployed people"* in a region as suggested in the Warkworth Judgement. It allows for labour to come from within or outside the region.

Latest Use of IO Analysis

- BAEconomics (2014) in its Economic Impact Assessment for Warkworth Continuation 2014 and Mt Thorley Operations 2014 justifies the use of IO analysis to estimate economic activity associated with the Project.

- Dr Brian Fisher, the Managing Director of BAEconomics is a highly respected resource economist who previously held the positions of Executive Director of the Australian Bureau of Agricultural and Resource Economics (ABARE) and Associate Commissioner of the Productivity Commission. He received an Order of Australia in the Queen's Birthday Honours List in 2007.

ATTACHMENT 5 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. "The *basic assumptions* in IO analysis include the following:

   - there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between IO tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
   - all products of an industry are identical or are made in fixed proportions to each other;
   - each industry exhibits constant returns to scale in production;
   - unlimited labour and capital are available at fixed prices; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); and
   - there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

2. The multipliers therefore describe *average effects, not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

3. The IO tables underlying multiplier analysis only take account of one form of *interdependence,* namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

4. The combination of the assumptions used and the excluded interdependence means that IO multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

5. The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

6. The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device" (ABS 1995, p.24).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS, 1995). Conventional output, employment, value-added and income multipliers show the output, employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

Initial effect - which is the initial output stimulus, usually a $1 change in output from a particular industry (Powell and Chalmers, 1995; ABS, 1995).

First round effects - the amount of output from all intermediate sectors of the economy required to produce the initial $1 change in output from the particular industry (Powell and Chalmers, 1995; ABS, 1995).

Industrial support effects - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers, 1995; ABS, 1995).

Production induced effects - the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial $1 change in output) (Powell and Chalmers, 1995; ABS, 1995).

Consumption induced effects - the spending by households of the extra income they derive from the production of the extra $1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers, 1995; ABS, 1995).

The *simple multiplier* is the initial effect plus the production induced effects.

The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

Conventional employment, value-added and income multipliers have similar components to the output multiplier, however, through conversion using the respective coefficients show the employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

For employment, value-added and income, it is also possible to derive relationships between the initial or own sector effect and flow-on effects. For example, the flow-on income effects from an initial income effect or the flow-on employment effects from an initial employment effect, etc. These own sector relationships are referred to as ratio multipliers, although they are not technically multipliers because there is no direct line of causation between the elements of the multiplier. For instance, it is not the initial change in income that leads to income flow-on effects, both are the result of an output stimulus (Jensen and West, 1986).

A description of the different ratio multipliers is given below.

$$\text{Type 1A Ratio Multiplier} = \frac{\text{Initial + First Round Effects}}{\text{Initial Effects}}$$

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial + Production Induced Effects}}{\text{Initial Effects}}$$

Type 11A Ratio Multiplier = $\frac{\text{Initial + Production Induced + Consumption Induced Effects}}{\text{Initial Effects}}$

Type 11B Ratio Multiplier = $\frac{\text{Flow-on Effects}}{\text{Initial Effects}}$

Source: Centre for Farm Planning and Land Management (1989).

REFERENCES

Australian Bureau of Statistics (1995) *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*. Cat. No. 5246.0.

Centre for Farm Planning and Land Management (1989) *Consultants report to State plantations impact study.* CFPLM, University of Melbourne.

Jensen, R. and West, G. (1986) *Input-output for Practitioners: Theory and Applications*. Prepared for Department of Local Government and Administrative Services, Local Government and Regional Development Division, Australian Government Publishing Service.

Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.

ATTACHMENT 6 – CBA AND ASSESSMENT OF EXTERNALITIES

Consideration of Externalities in the Economic Assessment

Introduction

- The "perfect" CBA is an ideal. Different situations call for different styles and depths of analysis.

- Valuation of all environmental impacts is neither practical nor necessary.

- In attempting to value impacts, there is the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA (NSW Government 2012). The guideline gives an example of impacts of less than $1M being immaterial for a project with an estimated net present value of $20M.

- The CBA of the extension project took three approaches to the consideration of environmental costs:

  - Threshold value analysis;
  - Qualitative consideration of impacts and valuation of the main impacts based on market data and benefit transfer; and
  - Additional threshold value analysis to recognise that some impacts may not have been fully valued and incorporated into the analysis.

Threshold Value Analysis

- The first approach used to consider the environmental impacts of the extension project was the threshold value method.

- Threshold value analysis is a recognised approach to CBA where it is not possible or pragmatic to attempt to value potential external impacts.

- Threshold value analysis was developed by Krutilla and Fisher (1975)[33]. It is specifically referred to as an appropriate approach in the DP&I's (2002) *Draft Guideline for Economic Effects and Evaluation in EIA,* and is a widely recognised approach.

- Threshold value analysis avoids the sometimes contentious matter of physically quantifying environmental impacts and then placing dollar values on them.

- Threshold value analysis leaves the trade-off between quantified economic benefits and unquantified environmental costs for the decision-maker.

- In the Economic Assessment of the extension project, the estimated net production benefits provides a threshold value or reference value against which the relative value of the residual environmental, social and cultural impacts of the extension project, after mitigation, offset and compensation, may be assessed. The threshold value indicates the price that the community must value any residual environmental impacts of the extension project (be willing to pay) to justify in economic efficiency terms the 'no development' option.

[33] Krutilla, J.V. and A.C. Fisher (1975) *The Economics of Natural Environments*, Johns Hopkins University Press, Baltimore.

Qualitative consideration of impacts and valuation of the main impacts based on market data and benefit transfer

- The second approach used was to qualitatively consider, and where possible value, the main environmental, cultural and social impacts of the extension project for the well-being of people.

- Qualitative consideration of potential impacts and any subsequent valuation of impacts relied on the assessment of biophysical impacts provided in the extension project EIS by technical specialists.

- The approach to valuing environmental impacts in the Economic Assessment of the extension project is summarised in Table A6.1.

Table A6.1 – Method for Valuing Environmental Impacts in the Economic Assessment of the Project

Impact	Potential Valuation Method	Comment
Greenhouse gas emissions	Damage cost method	Estimate of global social damage cost of carbon from literature and govt policy, adjusted to Australian and NSW damage cost.
Agricultural impacts	Property valuation method	Foregone agricultural production is reflected in land values. So opportunity costs of land reflect, among other things, foregone agriculture.
Noise impacts		
Significant	Property valuation method	Cost of acquiring properties encompasses property value impacts due to noise.
Moderate and low	Defensive expenditure	Noise mitigation costs included in capital costs of project.
Blasting		Vibration and air blast limits for human comfort and structural damage are met, minimal impact is likely to occur to humans or structures.
Significant air quality impacts	Property valuation method	Cost of acquiring properties encompasses property value impacts due to air quality impacts. However, no properties impacted by exceedances.
Use of surface water	Market value of water	Cost of Water Access Licences reflects marginal value product of water. No surface WAL required.
Use of groundwater	Market value of water	Cost of Water Access Licences reflects marginal value product of water.Cost of Water Access Licences included.
Groundwater drawdown	Defensive expenditure	No material impacts on private bores predicted.
Water discharges		Regulated under the Protection of Environment Operations Act 1997.
Flora and fauna	Replacement cost	Capital and operating costs of offsets included in capital and operating costs. Assumes that offsets levels are sufficient to compensate the community for values lost. This is a requirement of Govt. Policy.
Road transport impacts	Defensive expenditure	Cost of road investment required as a result of the extension project included in capital costs of project.
Aboriginal heritage	Defensive expenditure	11 sites impacted. Cost of preparation and implementation of an Aboriginal Heritage Management Plan included in the costs of the Project. Residual impacts unquantified.
Historic heritage	Defensive expenditure Benefit transfer of CM data	No impacts as a result of the extension project
Visual	Defensive expenditure	Costs of mitigation measures included in the economic analysis. No material impacts likely.

Additional Threshold Value Analysis

- To the extent that there may be some disagreement about the estimated economic values of the environmental impacts of the extension project, the estimated net benefits of the extension project provides another threshold value that the residual environmental impacts of the extension project after mitigation, compensation and offset would need to exceed to make the Project questionable form and economic efficiency perspective. This again allows the decision-maker to consider any material impacts that it identifies in the course of its consideration that were not valued in the Economic Assessment.

ATTACHMENT 7 – NON-MARKET BENEFITS OF EMPLOYMENT

- In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus).

- Where labour resources used in a project would otherwise be employed at a lower wage or would be unemployed a shadow price of labour is included in the estimation of producer surplus rather than the actual wage (Boardman et al. 2005[34]). The shadow price of labour is lower than the actual wage and has the effect of increasing the magnitude of the producer surplus benefit of a project. The analysis included consideration of the magnitude of these additional benefits if 50% of the direct labour force would otherwise be unemployed for three years. Results are reported with and without this value.

- These treatments of employment in CBA relate to the market value or opportunity cost of labour resources.

- However, CBA also includes non-market values i.e. the values that individuals in a community hold for things even though they are not traded in markets. For example, people have been shown to value environmental resources even though they may never use the resource. These are referred to as existence values and are underpinned by the view in neoclassical welfare economics that individuals are the best judge of what has value to them.

- As identified by Portney (1994[35]), the concept of existence values should be interpreted more broadly than just relating to environmental resources.

  "If I derive some utility from the mere existence of certain natural environments I never intend to see (which I do), might I not also derive some satisfaction from knowing that refineries provide well-paying jobs for hard-working people, even though neither I nor anyone I know will ever have such a job?. I believe I do. Thus, any policy change that "destroys" those jobs imposes a cost on me – a cost that, in principle, could be estimated using the contingent valuation method.... Since regulatory programs will always impose costs on someone – taking the form of higher prices, job losses, or reduced shareholder earnings – lost existence values may figure every bit as prominently on the cost side of the ledger as the benefit side (Portney 1994, p. 13).

- The utility (welfare) of individuals may therefore be affected by changes in their own well-being as well as changes in the well-being of others (Rolfe and Bennett 2004[36]). This is consistent with the observed behaviour of altruism (Freeman III 2003[37]).

- Whether people have existence values for the employment of others, as hypothesised by Portney, is an empirical issue. A number of non-market valuation studies have found evidence that people hold existence values for the employment of others:

  - Johnson, F. and Desvouges, W. (1997) Estimating Stated Preferences with Rated-Pair Data: Environmental, Health and Employment Effects of Energy Programs. Journal of Environmental Economics and Management, 34, 75-99, estimated the non-market value of employment effects of energy programs.

[34] Boardman, A., Greenberg, D., Vining, A. and Weimer, D. (2001) *Cost-benefit analysis: concepts and practice*, Prentice Hall, New Jersey.
[35] Portney, P. (1994) The Contingent Valuation Debate: Why Economists Should Care, *Journal of Economic Perspectives* 8:4, 3-18.
[36] Rolfe and Bennett (2004) *Assessing Social Values for Water Allocation with the Contingent Valuation Method,* Valuing Floodplain Development in the Fitzroy Basin Research Reports, Research Report No. 11, Central Queensland University, Emerald.
[37] Freeman III, A. Myrick. (2003) *Economic Valuation: What and Why*. In A Primer on Non-market Valuation, Eds Champ, P., Boyle, K. and Brown, T. Kluwer Academic Publishers, London.

- Adamowicz, W., Boxall, P., Williams, M. and Louviere, J. (1998) Stated Preference Approaches to Measuring Passive Use Values: Choice Experiments Versus Contingent Valuation, American Journal of Agricultural and Economics, 80, 64-75, in a study on the protection of old growth forests included an attribute for forest industry employment losses.
- Morrison, M., Bennett, J. and Blamey, R. (1999) Valuing improved wetland quality using choice modelling, Water Resources Research (Vol. 35, No. 9, pp. 2805-2814) valued irrigation related employment losses as a result of wetland protection.
- Blamey, R., Rolfe, J., Bennett, J., and Morrison, M., (2000) Valuing remnant vegetation in Central Queensland using choice modelling, The Australian Journal of Agricultural and Resource Economics(44(3): 439-56) in a study of broadscale tree clearing in the Desert Uplands of Queensland, Australia included an attribute for jobs lost to the region.
- Do, T.N. and Bennett, J. (2007) Estimating Wetland Biodiversity Values: A Choice Modeling Application in Vietnam's Mekong River Delta, Australian National University, Economics and Environmental Network Working Paper estimated values for the number of farmers affected by a change in wetland management of Tram Chim.
- Othman, J., Bennett, J., Blamey, R. (2004) Environmental values and resource management options: a choice modelling experience in Malaysia, Environ. Dev. Econ. 9, 803–824, valued local employment losses from different conservation management strategies for the Matang Mangrove Wetlands in Perak State, Malaysia.
- Marsh, D. (2010) Water Resource Management in New Zealand: Jobs or Algal Blooms? Presented at the Conference of the New Zealand Association of Economists Auckland 2 July 2010, valued employment losses as a result of improvements in water quality in a dairy catchment in Waikato region of New Zealand the catchment.
- Longo A, Markandya A, Petrucci M (2008) The Internalization of Externalities in the Production of Electricity: Willingness to Pay for the Attributes of a Policy for Renewable Energy, Ecological Economics 67:140-152, in the context of renewable energy projects valued additional electricity sector jobs.
- Colombo, S., Hanley, N., and Requena, J.C. (2005) Designing Policy for Reducing the Off-farm Effects of Soil Erosion Using Choice Experiments, Journal of Agricultural Economics, 56(1), 81-96, valued local employment generated from watershed policies to reduce soil erosion.
- Caparrós A, Oviedo JL, Campos P (2008) Would you choose your preferred option? Comparing choice and recoded ranking experiments. Am J Agricult Econ 90(3):843–855, valued increases in local employment from a NP reforestation program.
- Windle, J. and Rolfe, J. (2014) Assessing the trade-offs of increased mining activity in the Surat Basin, Queensland: preferences of Brisbane residents using non-market valuation techniques, Australian Journal of Agricultural and Resource Economics, 58, pp. 111-129, valued jobs generated by mining developments in the Surat Basin, as well as social impacts of mining developments such as increased housing prices and increase wages in non-mining sectors.

- Three non-market valuation studies have found evidence that people in NSW hold existence values for the employment of others in coal mining projects:

  - Gillespie, R. (2009) Bulli Seam Operations Socio-Economic Assessment, prepared for Illawarra Coal Holdings Pty Ltd.
  - Gillespie, R. and Kragt, M. (2012) Accounting for non-market impacts in a benefit-cost analysis of underground coal mining in New South Wales, Australia, Journal of Benefit Cost Analysis, 3(2): article 4.
  - Gillespie, R. and Bennett, J. (2012) Valuing the Environmental, Cultural and Social Impacts of Open Cut Coal Mining in the Hunter Valley of NSW, Australia, Journal of Environmental Economics and Policy, Volume 1, Issue 3, 1-13.

- The values from these studies are summarised in Table A7.1.

Table A7.1 – Existence Values for Mine Employment

	Mean Implicit Price ($) (95% CI)	Aggregate WTP per Job Year ($) (95% CI)	Coal Mine	Reference
WTP per household per year for 20 years for each year the mine provides 320 jobs	$5.94 $4.96 to $7.22	$8,157 $3,659 to $5,326	Metropolitan Colliery	Gillespie (2009)
WTP per household (once-off) for each year the mine provides 1,170 jobs	$36.21 $29.89 to $43.97	$1,299 $1,037 to $1,578	Bulli Seam Operations	Gillespie and Kragt (2012)
WTP per household (once-off) for each year the mine provides 975 jobs	$27.45 $17.52 to $36.95	$3,546 $2,263 to $4,773	Warkworth	Gillespie and Bennett (2012)

*Implicit prices are aggregated to 50% of NSW households.

- These values are public good values i.e. they are the sum of values held by individual households in NSW. Comparison of public good values to private good values such as wages are meaningless.

- The motivation behind people's willingness to pay for the employment of others is unknown. Split sample analysis undertaken by Gillespie (2009) providing different information to survey respondents on the re-employment prospects of impacted workers did not impact household willingness to pay for the employment provided by the mine. It is possible that respondents were not concerned so much with the prospects of re-employment elsewhere in the economy or net employment impacts but with the 'forced' change to other people's employment. However, further investigation is required to unpack respondent motivations in relation to attributes representing employment.

- Notwithstanding the above justification for the inclusion of non-market employment values in CBA, it is recognised that some people view this as contentious and so the results of the CBA for the Project are reported "with" and "without" the non-use values for employment being included.

ATTACHMENT 8 – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the other mining sector. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A8.1 (Powell and Chalmers, 1995).

Table A8.1
The GRIT Method

Phase	Step	Action
PHASE I		ADJUSTMENTS TO NATIONAL TABLE
	1	Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS
		(*Steps 4-14 apply to each region for which input-output tables are required*)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988).

REFERENCES

Bayne, B. and West, G. (1988) *GRIT – Generation of Regional Input-Output Tables: Users Reference Manual*. Australian Regional Developments No. 15, Office of Local Government, Department of Immigration, Local Government and Ethnic Affairs, AGPS.

Jensen, G. (1980) The concept of accuracy in regional input-output models. *International Regional Science Review*, 5:2, pp.139-54.

Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.

ATTACHMENT 9 – STUDIES ON THE FLOW-EMPLOYMENT OF THE MINING (INCLUDING QUARRYING) INDUSTRY

Mining and quarrying projects provide direct employment opportunities in regional economies. In addition, expenditure on inputs to production and by employees can provide flow-on employment in other sectors of the economy.

All other things being equal, the flow-on employment arising from a project will depend on:

- the expenditure profile associated with a project;
- the size of the regional economy and the ability of local businesses to supply inputs to production demanded by mine proponents;
- the residential location of employees and whether they migrate into the region or already live there and were previously employed or unemployed.

Estimated flow-on employment will also vary based on the modelling approach used i.e. whether primary IO analysis has been undertaken or whether multipliers have been obtained from other studies, and which type of multiplier has been used e.g. Type 1A, Type 1B, Type 11A or Type 11B.

A number of studies have examined the flow-on impacts of mining projects on regional economies and the NSW economy. The results are summarised in Table A9.1.

These studies indicate that:

- for every direct job in mine construction total regional employment impacts range from 1.5 to 1.89; and
- for every operational job total regional impacts range from 1.70 to 4.79.

Table A9.1 – Flow-on Employment of Mining Projects

Construction or operation	Full-time equivalents or Full-time/part time	IIA Multiplier	Method	Region	Project	Reference
Construction	Unspecified	2.73	Borrowed	NSW	Angus Place	Aegis Group (2014)
Construction	Unspecified	4.71	Borrowed	NSW	Bulga Optimisation	Economic Consulting Services (2012)
Construction	Unspecified	1.59	Borrowed	Broke/Bulga	Bulga Optimisation	Economic Consulting Services (2012)
Construction	Unspecified	1.89	Borrowed	Newcastle, Maitland, Cessnock, Singleton, Muswellbrook	Bulga Optimisation	Economic Consulting Services (2012)
Construction	FTE	1.50	IO	Hunter Region	Warkworth Extension Project	Hunter Valley Research Foundation (2009)
Construction	FTE	1.62	IO	Hunter Region	Warkworth Extension Project	Hunter Valley Research Foundation (2009)
Operation	FTE	6.05	IO	NSW	Warkworth and Mount Thorley	BAE (2014)
Operation	Unspecified	3.50	Borrowed	NSW	Bulga Optimisation	Economic Consulting Services (2012)
Operation	Unspecified	3.98	Borrowed	NSW	Angus Place	Aegis Group (2014)
Operation	FTE	4.79	IO	Upper and Mid Hunter	Warkworth and Mount Thorley	BAE (2014)
Operation	FTE	2.37	IO	Singleton LGA	Warkworth and Mount Thorley	BAE (2014)
Operation	Unspecified	1.49	Borrowed	Broke/Bulga	Bulga Optimisation	Economic Consulting Services (2012)
Operation	Unspecified	1.70	Borrowed	Newcastle, Maitland, Cessnock, Singleton, Muswellbrook	Bulga Optimisation	Economic Consulting Services (2012)
Operation	FTE	4.27	Borrowed	Hunter Region	Warkworth Extension Project	Hunter Valley Research Foundation (2009)
Operation	FTE	3.94	IO	Hunter Region	Warkworth Extension Project	Hunter Valley Research Foundation (2009)
Operation	FTE	2.94	IO	Hunter Region	Bloomfield Collieries	Hunter Valley Research Foundation (2008)

References:

Aegis Group (2014) Angus Place Colliery Extension Project, Economic Impact Assessment
Economic Consulting Services (2012) BCM Optimisation Project: Economic Impacts.
Hunter Valley Research Foundation (2009) An Economic Assessment of the Warkworth Coal Resource.
BAE (2014) Economic Impact of Warkworth Continuation 2014 and Mount Thorley Operations 2014,
Hunter Valley Research Foundation (2008) Client briefing: An economic assessment of Bloomfield Collieries, Hunter Region, NSW