APPENDIX F

Economic Impact Assessment

Coalpac Proposed Modifications to Invincible Colliery and Cullen Valley Mine

Economic Assessment

Prepared for

Coalpac Pty Ltd
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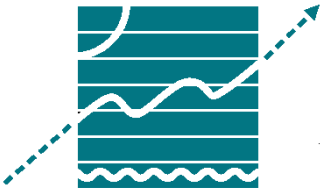
By



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EXECUTIVE SUMMARY

Gillespie Economics was commissioned by Hansen Bailey Pty Limited, on behalf of Coalpac Pty Ltd (Coalpac) to complete an economic assessment of proposed Modifications to Coalpac's existing development consents for the Invincible Colliery and Cullen Valley Mine (the Modifications). This assessment is to form part of an Environmental Assessment (EA) being prepared to support an application under Section 75W of the *Environmental Planning and Assessment Act 1979* (EPA Act) to allow for the extension to the existing approved mining areas via open cut and highwall coal mining methods as well as the orderly rehabilitation of the final landform in the area.

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

- the economic efficiency of the Modifications (i.e. consideration of economic costs and benefits of the Modifications using benefit cost analysis (BCA)); and
- the economic impacts of the Modifications (i.e. the economic activity that the Modifications would provide to the regional economy).

A BCA of the Modifications indicated that it would have net production benefits to Australia of $219M. Provided the residual environmental, social and cultural impacts of the Modifications that accrue to Australia are considered to be valued at less than $219M, the Modification can be considered to provide an improvement in economic efficiency and hence are justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified an attempt was made to qualitatively consider and where possible quantify the main environmental, cultural and social impacts. However, it is evident that the most of the potential impacts of the Modification are largely immaterial from an aggregate economic efficiency perspective.

The main potential impact from an economic efficiency perspective is the clearing of native vegetation in Ben Bullen State Forest. However, a BOS is proposed that aims to offset lost conservation values. There may also be non-market benefits from the employment provided by the Modifications. Overall, the Modifications are estimated to have net social benefits to Australia of between $219M and $227M, and hence are desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been qualitatively considered and where possible quantified in the Modifications BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $219M and $227M for the Modifications to be questionable from an Australian economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Modifications to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- The Commonwealth Government in the form of any Company tax payable ($11M present value[1]) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties ($29M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area;
- Coalpac and its shareholders in the form of after tax (and after voluntary contributions) profits ($25M present value); and
- The operator of the Mount Piper Power Station (MPPS) in the form of lower cost coal (and ultimately electricity consumers in NSW in the form of lower electricity prices)($155M);

[1] Using a 30% company tax rate.

- The local community in the form of any voluntary contributions to community infrastructure and services.

The residual environmental, cultural and social impacts of the Modification, after mitigation and offsetting, while considered immaterial from an aggregate economic efficiency perspective, may potentially accrue to a number of different stakeholder groups at the local, State, National and global level.

Any residual noise costs will occur at a local level. Surface water and groundwater use will impact at the local level but have been paid for through the acquisition of water entitlements. Greenhouse gas costs will occur at the local, state, national and global level. The clearing of native vegetation will potentially impact households at the local, State and National level who hold values for the impacted flora and fauna. However, compensation will be made in the form of a compensatory BOS. Other potential environmental, cultural and social impacts would largely occur at the local level and were found to be insignificant from an aggregate economic efficiency perspective. Any non-market benefits associated with employment provided by the Modifications would largely accrue at the local or State level[2].

With the application of appropriate management and mitigation measures, the residual non-market costs that accrue to NSW are likely to be immaterial from an aggregate economic efficiency perspective and consequently would be less than the net production benefits that directly accrue to NSW through royalties ($29M) and lower cost coal for MPPS ($155M). In addition NSW will obtain infrastructure and services provided with a share of Commonwealth Government Company tax. Part of the profit to Coalpac from the Modifications may also accrue to NSW depending on the residential location of Coalpac shareholders. There are also additional benefits to NSW from the Modifications in the form of potential non-market employment benefits ($8M). Consequently, as well as resulting in net social benefits to Australia the Modification would result in net social benefits to NSW.

An economic impact analysis, using input-output analysis, estimated that the Modifications would make up to the following direct and indirect average annual contribution to the regional economy[3] for approximately 3 years, with lessor impacts when the incremental production associated with the Modification is ramping up and ramping down:

- $149M in annual direct and indirect regional output or business turnover;
- $46M in annual direct and indirect regional value added;
- $19M in annual direct and indirect household income; and
- 245 direct and indirect jobs.

Cessation of the mining under the Modifications will ultimately lead to a reduction in economic activity in the region and NSW. The significance of these cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if cessation of the Modifications takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

[2] It should be noted that the study from which the employment values were transferred, surveyed NSW households only.
[3] Comprising the Local Government Areas of Bathurst and Lithgow.

1 INTRODUCTION

Coalpac Pty Ltd (Coalpac) owns and operates the existing operations of Invincible Colliery and Cullen Valley Mine, located approximately 25 km north-west of Lithgow, NSW. Invincible Colliery has been owned and operated by Coalpac since 1988 and Cullen Valley Mine was acquired by Coalpac in 2007. Each mine operates as a separate entity with separate planning approvals under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Coalpac is seeking to modify both planning approvals under Section 75W of the former Part 3A of the EP&A Act. These Modifications are sought to facilitate the extension to the approved mining areas via open cut and highwall coal mining methods at each site as well as the orderly rehabilitation of the final landform in the area.

An Environmental Assessment (EA) of the Modifications is required in accordance with provisions of Section 75W of the NSW EPA Act. An economic assessment is required as part of the EA.

In this respect, consideration was given to the relevant aspects of the Department of Planning and Infrastructure's (DP&I) (James and Gillespie, 2002) *Draft Guideline for Economic Effects and Evaluation in EIA*) and the NSW Government (2012) *Draft Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

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

- The economic efficiency of the Modifications (i.e. consideration of the economic costs and benefits of the Modifications); and
- The economic activity impacts of the Modifications (i.e. the economic activity that the Modifications will provide to the regional or NSW economy).

The DP&I's draft guideline (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline (James and Gillespie, 2002) identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts. The NSW Government (2012) draft guideline also identifies BCA as the appropriate method for evaluating mining proposals. This latter guideline does not provide guidance on other forms of economic assessment.

The NSW DP&I's draft guideline considers that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. The draft guideline identifies that economic impacts of a proposal on the regional or State economy can be estimated by means of Input-Output (IO) analysis, Computable General-Equilibrium (CGE) models or macro-econometric simulation models.

It is important not to confuse the results of the economic impact assessment, which focuses on indicators of economic activity i.e. direct and indirect output (expenditure/revenue), value-added, income and employment, in a specific region, with the results of BCA which is concerned with the net benefits from the Modifications.

This study relates to the preparation of each of the following types of analyses:

- A BCA of the Modifications (Section 2); and
- An economic impact assessment of the Modifications using IO analysis (Section 3).

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Introduction

BCA has its theoretical underpinnings in neoclassical welfare economics. Applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW environmental assessment framework are further guided by the NSW DP&I draft guideline (James and Gillespie 2002) and the NSW Government (2012) draft guideline.

BCA is concerned with a single objective of the EP&A Act and government 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 costs and benefits are defined and valued based on the microeconomic underpinnings of BCA. In particular, it is the values held by individuals in the society that are relevant, including both values that are revealed in markets and non-market 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.

While BCA can provide qualitative and quantitative information on how economic efficiency costs and benefits are distributed, welfare economics and BCA 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 equity are considered subjective and are therefore left to decision-makers.

Similarly, BCA 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 BCA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government.

Definition of Society

BCA 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.

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different definitions of society such as a local area, State, nation or the world. However, most applications of BCA are performed at the national level. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spill overs between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, “where major impacts spill over national borders, then BCA should be undertaken from the global as well as the national perspective” (Boardman et al 2001). For mining projects, impacts that can spill over national borders include greenhouse gas costs and benefits to foreign owners.

BCA at a sub-national perspective is not recommended as it results in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers (Boardman et al 2001).

BCAs of mining projects are therefore often 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. A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to NSW and other regions.

However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

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 BCA 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 mining projects, typically only the costs and benefits from mining the coal and delivering it to Port or domestic users, are relevant.

Coal is an intermediate good i.e. it is an input to other production processes such as production of electricity and steel making. However, these other production processes themselves require approval and, in BCA, would be assessed as separate projects.

Net Production Benefits

BCA of mining proposals invariably involves a trade-off between:

- the net production benefits of a project; and
- the environmental, social and cultural impacts (most of which are costs of mining but some of which may be benefits).

Net production benefits can be estimated based on market data on the projected economic[4] value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

Environmental, Social and Cultural Impacts

The consideration of non-market impacts in BCA relies on the assessment of other experts contributing information on the biophysical impacts. The environmental impact assessment 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, BCA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the EA), 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;
- 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).

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

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 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 BCA (NSW Government, 2012). In this context, the NSW Government (2012, p. 5) draft guideline identifies that if the "estimated NPV is say $20M, cost or benefits valued at less than $1M are unlikely to material.

Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury 2007).

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, as required by Government policy. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs in the operating cost of the Modifications effectively internalises the main non-monetary environmental, social and cultural costs. 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 EA), 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[5] 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.

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

Steps in BCA of the Modifications

BCA of the proposed Modifications involves the following key steps:

- identification of the base case (the "without" Modifications case);
- definition of the "with" Modifications case;
- identification and valuation of the incremental benefits and costs associated with the Modifications relative to the base case;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs.

What follows is a BCA of the Modifications based on financial, technical and environmental advice provided by Coalpac and its' specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND THE MODIFICATIONS

Identification of the "base case" or "without" Modifications scenario is required in order to facilitate the identification and estimation of the incremental economic benefits and costs of the Modifications.

The Invincible Colliery and Cullen Valley Mine are currently under care and maintenance. Under the base case, no more mining would occur at these sites and final rehabilitation of disturbance areas would occur. In contrast:

- The Invincible Colliery Modification (INV MOD4) will seek approval for the following activities that are not approved under its current Project Approval (PA 07_0127):
    - Extension to PA 07_0127 for four years from December 2016 to December 2020;
    - Extension of 88 ha to the area approved for open cut mining;
    - Extension of 86 ha to the area approved for highwall mining. These highwall mining operations will not result in additional surface disturbance;
    - Installation of a water pipeline which will result in the ability to transfer water between Invincible Colliery and Cullen Valley Mine. The pipeline alignment will largely remain on or adjacent to existing access tracks within the Ben Bullen State Forest; and
    - Backfilling of the residual final voids resulting from existing mining operations and the rehabilitation of areas affected by subsidence from historic underground mining operations within the Disturbance Boundary to create a free-draining final landform.

All other aspects of operations on site, including coal production and processing, coal transport, operational hours and employment would generally remain consistent with that approved under PA 07_0127.

- The Cullen Valley Mine Modification (CV MOD2) is seeking approval for the following activities that are not approved under its current Development Approval (DA 200-5-2003):
    - Extension of 62 ha to the area approved for open cut mining;
    - Extension of 80 ha to the area approved for highwall mining. These highwall mining operations will not result in additional surface disturbance;
    - The ability to benefit from the transfer of water to and from Invincible Colliery; and

- o Backfilling and rehabilitation of the residual final void resulting from existing mining operations to create a free-draining final landform.

All other aspects of operations, including coal production and processing, coal transport, operational hours and employment would generally remain consistent with that approved under DA 200-5-2003.

BCA is primarily concerned with the evaluation of the Modifications relative to the counterfactual of no Modifications. Where there are a number of alternatives to the Modifications then these can also potentially be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Modifications were considered by Coalpac in the development of the Modification description for each site. Section 3.4 in the Main Volume of the EA provides more detail on the consideration of alternatives to the Modifications.

The Modifications assessed in the EA and evaluated in the BCA are considered by Coalpac to be the most feasible alternative for minimising environmental, cultural and social impacts whilst maximising resource recovery and operational efficiency. It is therefore these alternatives that are proposed by Coalpac and were subject to detailed economic analysis.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or "without" Modifications scenario, the Modifications may have the potential incremental economic benefits and costs shown in Table 2.1. The main potential economic benefit is the producer surplus (net production benefits) generated by the Modifications and any non-market employment benefits it provides, while the main potential economic costs relate to any environmental, social and cultural costs.

Table 2.1 – Potential Incremental Economic Benefits and Costs of the Modifications

Category	Costs	Benefits
Net production benefits	Opportunity costs of capital Opportunity cost of land Development costs including acquisition costs for impacted properties and offsets Operating costs of mine including mitigation measures Rehabilitation and decommissioning costs at end of the Modification life	Avoided decommissioning and rehabilitation costs of current disturbed areas and infrastructure areas Value of coal production Residual value of capital and land at end of Modification life
Potential environmental, social and cultural impacts	Greenhouse gas impacts Noise impacts Blasting impacts Air quality impacts Surface water impacts Groundwater impacts Ecology impacts Forestry production Road transport impacts Aboriginal heritage impacts Non-Aboriginal heritage impacts Visual impacts	Any non-market benefits of employment

It should be noted that the potential environmental, social and cultural costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated to the extent where community wellbeing is insignificantly affected (i.e. those bearing the costs are fully compensated or impacts are immaterial from an aggregate community welfare perspective (NSW Government 2012)), then no environmental, social or cultural economic costs should be included in the BCA of the Modifications.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with NSW Treasury (2007) guidelines, NSW DP&I draft guidelines (James and Gillespie 2002) and NSW Government (2012) draft guidelines, the analysis has been undertaken in real values with discounting at 7 percent (%) and sensitivity testing at 4% and 10%. The analysis period is six years, capturing the anticipated life of the Modifications. Any costs or benefits that continue after this period are included in the final year of the analysis as present values. Where competitive market prices are available, they have been used as an indicator of economic values. Environmental, cultural and social impacts have been initially been left unquantified and interpreted using the threshold value method[6] (James and Gillespie 2002). An attempt has also been made to consider the main environmental, cultural and social impacts using market data and benefit transfer[7]. However, as identified by NSW Government (2012) in estimating benefit and costs there is the practical principle of materiality – costs and benefits that do not have a material bearing on the decision do not need to be quantified and included in a BCA. Where some impacts remain unquantified these have been interpreted using the threshold value method.

2.4.1 *Production Costs and Benefits*[8]

Production Costs

Opportunity Cost of Land and Capital

There is an opportunity cost associated with using land (including land purchased for offsets) and capital equipment that is already in Coalpac ownership, for the Modifications instead of its next best use. An indication of the opportunity cost of this land and capital equipment can be gained from its market value, estimated at $6M and $10M, respectively.

Development Cost of the Modifications

Development costs of the Modifications are associated with:

- Moving overburden in advance of mining;
- Refurbishment of the existing Invincible Coal Preparation Plant;
- Relocation of the Cullen Valley Mine crusher;
- General road & drainage repairs/upgrades; and
- Installation of water pipeline to connect the Cullen Valley and Invincible operations.

These incremental development costs are estimated at $7M. Capital costs are included in the economic analysis in the years that that they are expected to occur.

Annual Operating Costs of the Modifications

The operating costs of the Modifications include those associated with mine operations (including topsoil and overburden stripping, ROM coal mining and haulage, rehabilitation and offset management), plant and infrastructure operations (including Invincible CPP operation), coal delivery (road freight to the power station) and general costs (including overheads and administration, marketing and the research levy). These costs include labour costs, which reflect the value of labour resources in their next best use.

[6] The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.
[7] Benefit transfer refers to borrowing economic values that have been determined for other study sites.
[8] All values reported in this section are undiscounted Australian dollars unless otherwise specified. Production costs and benefits are based on commercial-in-confidence financial data provided by Coalpac.

While royalties are a cost to Coalpac, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Modifications. Nevertheless, it should be noted that the Modifications would generate total royalties in the order of $36M ($29M present value)[9].

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

Rehabilitation and Decommissioning Costs

Annual progressive rehabilitation costs are included in the operating costs for the Modifications reported above. A provision for final site infrastructure decommissioning and rehabilitation works of $0.8M has also been included in the analysis.

Production Benefits

Value of Coal

Total product coal production is estimated at up to 2.2 Mtpa ROM. This ROM coal will be delivered to Wallerawang and MPPS, unwashed and has a financial value of approximately $50/tonne. However, its economic value is higher. As identified by NSW Trade and Investment and NSW Treasury (2013), in the absence of coal from Coalpac, Wallerawang and MPPS may need to pay around $1.00/GJ more for their coal, which would increase costs from around $50/tonne to $70/tonne. This replacement value for Coalpac production reflects a shadow price of coal suitable for inclusion in the BCA.

Avoided Rehabilitation and Decommissioning Costs

The Modifications will result in the postponement of rehabilitation and decommissioning costs in 2014. These costs are estimated at $4.9M based on current approved rehabilitation cost estimates.

Residual Value at End of the Evaluation Period

At the end of the Modifications, capital equipment and land may have some residual value that could be realised by sale or alternative use. This residual value is estimated at $8M for capital equipment and $4M for land.

2.4.2 *Environmental, Social and Cultural Costs and Benefits*

This Section is based on the analysis of physical impacts provided by technical experts for the EA. These estimated physical impacts are then considered from an economic perspective.

Greenhouse Gases

The Modifications are predicted by Pacific Environment (2013) to generate a total of 0.0121 Mt of direct carbon dioxide equivalent (CO_2-e) emissions associated with mining (Scope 1 emissions), 0.0022 Mt of indirect (Scope 2) CO_2-e emissions and 0.0121 Mt of indirect (Scope 3) CO_2-e emissions associated with the transport of product coal to the MPPS and on-site diesel and electricity[10].

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.

[9] Royalties have been estimated by applying a royalty rate of 8.2% to the financial value of the coal.
[10] Scope 3 omissions associated with the burning of coal are beyond the scope of a BCA of a mining project.

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 trying to estimate the global damage costs of CO_2-e is to examine the price of CO_2-e credits/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price of AUD$23/t CO_2-e was used. However, the present value of greenhouse gas emissions from the Modifications was estimated at $0.1M which is immaterial from an aggregate economic efficiency perspective.

This represents the global social cost of carbon i.e. the cost of carbon emissions to the population of the whole world. In the absence of any studies that have focused on the social damage cost of carbon emissions to Australians, some means of apportioning global damage costs borne by Australians is required. One approach to doing this is to use Australia's share of global GDP (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%. However, this apportionment makes the impact even more immaterial from an aggregate economic efficiency perspective.

Operational Noise

Mining

Noise modelling under neutral atmospheric conditions for the day and evening periods identifies that noise levels would be significantly less than the Project Specific Noise Criteria (PSNC) at all identified receptor locations.

Noise modelling under enhanced meteorological conditions indicates that one private residential receiver and one private property are predicted to experience minor (1-2 dB) exceedances of the PSNC during the day period as a result of Modification operations at Invincible Colliery. Three private residential receivers would experience minor (1-2 dB) exceedances of the PSNC during day prevailing conditions at Cullen Valley Mine, with two of these also experiencing minor exceedances during the evening period. Five additional private properties are predicted to experience minor (1-2 dB) exceedances of the PSNC and two private properties are predicted to experience moderate (between 2 and 5 dB) noise impacts as a result of Cullen Valley Mine operations.

The impact of the Modification noise on nearby properties can potentially be valued using the property value method, where the change in property values as a result of the noise impacts, are estimated. However, given the minor potential exceedances during enhanced meteorological conditions only, the impact on private receivers is likely to be immaterial from an aggregate economic efficiency perspective. No economic cost is therefore included in the BCA.

Road Noise

Coalpac employees and contractors would primarily utilise the Castlereagh Highway to access both sites. The total contribution of traffic associated with the Modifications to the total background on the Castlereagh Highway will be a small fraction of the overall usage of the Highway. Incremental noise impacts as a result of usage levels for the duration of the Modifications are therefore predicted to be negligible. Consequently, the economic impact is likely to be immaterial from an aggregate economic efficiency perspective and therefore no economic costs have been included in the BCA.

Blasting

Blasting required for the mining operations proposed for the Modifications has the potential to cause indirect blast vibration and overpressure impacts at residential properties, Aboriginal heritage sites such as rock shelters and the nearby rock formations. Any predicted impacts on private property can potentially be estimated using the property value method, where the change in property value as a result of the blasting impacts, are estimated.

Any impacts on Aboriginal heritage sites and the nearby rock formations could potentially be estimated using non-market valuation methods such as choice modelling.

However, blasting assessments commissioned with experts in the field found that historical blasting operations at Invincible Colliery and Cullen Valley Mine have been well managed, with blasting monitoring demonstrating compliance with regulatory criteria. Given that neither the scale nor nature of operations is proposed to be modified, no impacts on private property are predicted. Coalpac has committed that blasting from the Modifications will have no significant impact (be non-damaging) on nearby sandstone rock formations. The blast impact limits and progressive monitoring and management approach to be implemented for the Modifications will achieve this outcome through a multidisciplinary program of field investigation. The process will be undertaken to establish the basis on which blasting near the nearby sandstone rock formations can occur to ensure their protection. Successful implementation of these measures will mean that the economic impacts from blasting are likely to be immaterial from an aggregate economic efficiency perspective and therefore no economic costs have been included in the BCA.

Air Quality

Air quality modelling indicates that there will be no exceedances of the annual average PM_{10}, TSP or dust deposition criteria as a result of the Modifications alone, or cumulatively, at private residences. One private industrial property located adjacent to Invincible Colliery is predicted to be impacted by the cumulative 24-hour average PM_{10} criteria with the existing activities in the area, rather than the Modifications, being the main contributors.

Predictions of 24-hour and annual average $PM_{2.5}$ concentrations of the proposed Modifications show that the levels predicted are well below the relative advisory standards for both 24-hour averaging periods. Predicted annual average $PM_{2.5}$ concentrations are all below 1 µg/m3, and in most cases the levels are below the level which could be detected by monitoring.

Consequently, the economic impacts from air quality impacts are likely to be immaterial from an aggregate economic efficiency perspective and therefore no economic costs have been included in the BCA.

Surface Water

The Modifications may require that Coalpac hold additional relevant surface water licences under the *Water Act 1912*. Some of these licences may also be required to be held for a longer periods that the Modification is sought for, pending stabilisation of the final landform. At this stage it is not anticipated that any additional water licences will be required. However, the economic value of any additional licences if required is likely to be immaterial from an aggregate economic efficiency perspective.

Groundwater

Coalpac currently holds a number of groundwater licences for water extraction/mine dewatering purposes. Coalpac has an allocation under these licences of 80 ML/annum from the Murray-Darling Porous Rock Groundwater Sources. At an assumed value of $2,000 per ML, the opportunity cost of holding these licences in perpetuity is immaterial from an aggregate economic efficiency perspective.

The localised zone of minor depressurisation due to the Modifications is not predicted to result in any reduction in the water level in any nearby privately owned bores (AGE 2013). Consequently, no economic effects are included in the BCA for impacts on privately owned bores.

Ecology

The Modifications Disturbance Boundary will result in the clearing of approximately 151 ha of native vegetation, including 89 ha at Invincible Colliery and 62 ha at Cullen Valley Mine.

A Biodiversity Offset Strategy (BOS) is proposed that includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Modifications at a ratio of 4.1:1.

Land opportunity costs and operational expenditure associated with the BOS have been included in the development and operating costs of the Modifications.

The impacted vegetation, and associated fauna, is likely to have non-use values to the community that would be lost as a result of the Modifications. These values could potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community that would be gained as a result of the Modifications. Provided that 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 BCA. In this respect, it is noted that the BOS is required to improve or at least maintain biodiversity values in the long term.

Forestry Production

The Modifications are predicted to result in the clearing of approximately 151 ha within the Ben Bullen State Forest. The opportunity cost of using this land for mining is its value in its highest alternative use. The alternative use is potentially a combination of forestry, recreation, conservation and carbon sequestration. Conservation values were considered earlier. This section focuses on forestry, recreation and carbon sequestration values of the affected section of Ben Bullen State Forest.

GHD (2011) assessed the disturbance of a much larger area (803 ha) of the Ben Bullen State Forest and identified the value of forestry harvest under a sustainable yield scenario at $0.2M. The value associated with the 151 ha would be immaterial from an aggregate economic efficiency perspective.

Recreation values would also appear to be minimal with Ben Bullen State Forest having no formal recreation infrastructure i.e. walking tracks, 4WD tracks, camping areas etc. (NSW DPI 2011). While hunting is permitted in this State Forest (NSW Game Council 2011), no information was available on the level of activity in Ben Bullen State Forest or in particular the area impacted by the Modifications. Nevertheless, the economic impact on hunting is likely to be immaterial from an aggregate economic efficiency perspective. For instance, if it is assumed that the Modifications would prevent two people per weekend from hunting for 20 years, then using the upper level consumer surplus per person per hunting trip reported by Whitten and Bennett (2001) i.e. $62.03, and adjusting the value for the consumer price index gives a present value of less than $0.1M. Similarly, if the Modification would prevent two people per day from using the site for the other recreation activities for 20 years, then using a consumer surplus value per visit for Gibraltar Range National Park (Bennett 1995) i.e. $19 per visit, and adjusting the value for the consumer price index gives a present value of less than $0.3M.
Ben Bullen State Forest also provides some carbon sequestration benefits. No information was available on the specific carbon sequestration benefits of the Ben Bullen State Forest. However, some indication of the potential level of sequestration benefits can be obtained from other sources. The Australian Greenhouse Office (2006) identifies indicative carbon sequestration levels over time for mixed species environmental plantings in different geographical areas. It identifies that sequestration rates peak when trees are about 10 to 20 years old then gradually decline. North-west of Sydney, environmental plantings peak at around 10 tCO_2-e /ha/yr 15 years after planting and then decline to 2 tCO_2-e /ha/yr 60 years after planting.

Conservatively applying the peak 10 tCO_2-e /ha/yr to the affected area of Ben Bullen State Forest for a 20 year analysis[11] gives a global sequestration benefit of $0.4M and Australian sequestration benefits of $0.004M.

Road Transport

The Modification will involve traffic movements associated with the operations of the Cullen Valley Mine and Invincible Colliery, including staff vehicle movements and coal transport to domestic destinations.

DC Traffic Engineering (2013) identifies that road usage associated with the Modifications would be minimal in the context of current intersection performance and the average annual growth rate of traffic on the Castlereagh Highway. DC Traffic Engineering (2013) concludes that the traffic impacts associated with the Modifications would be negligible and that no intersection upgrades would be required as a consequence of the Modifications. Consequently, no economic costs associated with road transport externalities are included in the BCA.

Aboriginal Heritage

Aboriginal archaeology assessment identified five sites that will be directly impacted by the Invincible Colliery Modification. These sites have previously been identified by AECOM (2011) as being of low scientific significance and artefacts associated with each are proposed to be collected prior to any disturbance. No known Aboriginal sites will be directly impacted by the Cullen Valley Mine Modification.

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 have been left to consideration as part of the preparation of the Aboriginal Heritage Assessment. In this respect, it is noted that Coalpac has negotiated an agreement with two local Aboriginal groups which includes compensation payments and the provision of employment opportunities. To the extent that these arrangements completely compensate them for impacted Aboriginal heritage there are no additional impacts for inclusion in the BCA.

Impacts on highly significant Aboriginal heritage sites have also been shown to affect the well-being of the non-Aboriginal (Gillespie Economic 2009a, 2009b, 2010). However, no highly scientific significant Aboriginal heritage sites are predicted to be directly impacted by the Modifications. Consequently, the economic impacts on Aboriginal heritage for the non-Aboriginal community are likely to be immaterial from an aggregate economic efficiency perspective and therefore no economic costs have been included in the BCA.

Non-Aboriginal Heritage

No known Non-Aboriginal Heritage sites will be directly impacted by mining activities proposed for the Modifications. The existing Blast Management Plans for Invincible Colliery and Cullen Valley Mine will be updated for any operations associated with the Modifications to ensure that the potential for indirect impacts on any Non-Aboriginal heritage buildings or structures are minimised.

Consequently, the economic impacts on Non-Aboriginal Heritage sites are likely to be immaterial from an aggregate economic efficiency perspective and therefore no economic costs have been included in the BCA.

[11] Assuming no sequestration benefits for the life of the Modifications and until revegetation reaches 16 years of age.

Visual Impacts

The visual assessment predicted that the impact of the Modifications would vary from low to high due to a range of factors including topography, existing vegetation screening, viewing distance and the sensitivity of the receptor location.

At Invincible Colliery, views toward infrastructure and proposed active mining areas from residential receptor locations are generally screened from views by existing topography, established rehabilitation and existing vegetation. However road users of the Castlereagh Highway would continue to experience high visual impacts. These will be minimised as far as possible through retained vegetation and additional plantings along the Castlereagh Highway.

The visual impacts of the Cullen Valley Modification will be restricted to those receptors to the north of the site with views of proposed open cut mining area. In order to minimise these potential impacts, a bund will be constructed at the northern extent of the area as one of the first activities to provide screening of subsequent mining activities. There will be high visual effects to those northern receptors for a period of approximately two years from commencement of the Modification, after which the rehabilitation of the bund in this area will reduce the high / moderate visual effects to low.

The costs of mitigation measures have been included in the capital costs of the Modifications. While some residual visual impacts will arise from the Modifications these are unlikely to be material from an aggregate economic efficiency perspective.

Non-market Value of Employment

Historically employment benefits of projects that are enjoyed by people other than those who are employed, have tended to be omitted from BCA on the implicit assumption that labour resources used in a proposal would otherwise be employed elsewhere and that there are no costs associated with transferring from one job to another. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Boardman et al (2001) identifies that these labour resources should be valued in a BCA at their opportunity cost (e.g. wages less social security payments and income tax) rather than the wage rate. Adopting this approach would have the effect of increasing the net production benefits of the proposal.

In addition, there may be social costs of unemployment that require the estimation of employees' willingness to pay to avoid the trauma created by unemployment (Streeting and Hamilton, 1991). These values have not been included in the BCA of the Modifications and so the net social benefits of the Modification may be underestimated.

Although employees' willingness to pay to avoid the trauma created by unemployment are omitted from the Modification BCA, it has also been recognised that the broader community may hold non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvouges, 1997).

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).

The Modifications will directly employ up to 81 people for the duration of the Modification. Using benefit transfer from the more conservative Bulli Seam Operation study and applying the employment value to the estimated incremental direct employment of the Modifications[12] gives an estimated $8M for the non-market employment benefits of the Modifications. This value has been included in the BCA. In the context of a fully employed economy and a different project context to the source study[13] there may be some contention about the inclusion of this value. Consequently, the results are reported with and without these values.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.2. The main decision criterion for assessing the economic desirability of a project to society is its Net Present Value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the project, because the community as a whole would obtain net benefits from the project.

The Modifications are estimated to have total net production benefits of $219M, with all of these accruing 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 Modification, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Modification. The threshold value indicates the price that the community must value any residual environmental impacts of the Modification (be willing to pay) to justify in economic efficiency terms the no development option.

For the Modification to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Modification, that impact Australia, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $219M. This is equivalent to each household in the Bathurst and Lithgow Local Government Areas (LGAs) valuing residual environmental impacts at $9,000. The equivalent figure for NSW and Australian households is $82 and $27, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to qualitatively consider and where possible quantify the main environmental, cultural and social impacts. However, from Section 2.4 it is evident that most of the potential impacts of the Modification are largely immaterial from an aggregate economic efficiency perspective. The main potential impact from an economic efficiency perspective is the clearing of native vegetation in Ben Bullen State Forest. However, a BOS is proposed that aims to offset lost conservation values. Provided the BOS offsets lost values it serves to internalise the ecological costs into the operating costs of Coalpac. There may also be non-market benefits from the employment provided by the Modification.

Overall, the Modifications are estimated to have net social benefits to Australia of between $219M and $227M, and hence the Modifications are desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been qualitatively considered and where possible quantified in the Modification BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $219M and $227M for the Modifications to be questionable from an Australian economic efficiency perspective.

[12] This is consistent with the non-market valuation studies which focused on direct employment.
[13] The source study was concerned with a continuation of an existing underground mine rather than a new open cut mine.

Table 2.2
Benefit Cost Analysis Results of the Modifications (Present Values at 7% discount rate)

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
	Opportunity cost of capital	$10	Avoided decommissioning and rehabilitation costs in 2014	$5
Production	Opportunity cost of land	$5	Value of coal	$504
	Development costs	$7	Residual value of capital	$5
	Operating costs	$275	Residual value of land	$2
	Decommissioning and rehabilitation costs	*Included in operating costs*		
	Sub-total	***$297***	***Sub-total***	***$516***
	Net Production Benefits			**$219**
Environmental, cultural and social impacts	Greenhouse gas impacts	Insignificant*	Non-market values of employment	$8
	Noise impacts	Insignificant*		
	Blasting	Insignificant*		
	Air quality impacts	Insignificant*		
	Surface water	Insignificant*		
	Groundwater	Insignificant*		
	Ecology	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs		
	Forestry	Insignificant*		
	Road transport impacts	Insignificant*		
	Aboriginal heritage	Insignificant*		
	Non-Aboriginal heritage impacts	Insignificant*		
	Visual impacts	Insignificant*		
	Non-market impacts sub-total	***Insignificant****		***$8***
NET SOCIAL BENEFITS – including employment benefits				**$219**
NET SOCIAL BENEFITS – excluding employment benefits				**$227**

*from an aggregate economic efficiency perspective
Note: totals may have minor discrepancies due to rounding.

2.5.2 Distribution of Costs and Benefits

Introduction

As identified in Section 2.1, BCA is only concerned with the single objective of economic efficiency. BCA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, BCA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed (Table 2.3).

Intra Generational

The net production benefit of the Modification is distributed amongst a range of stakeholders including:

- The Commonwealth Government in the form of any Company tax payable ($11M present value[14]) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties ($29M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area;
- Coalpac and its shareholders in the form of after tax (and after voluntary contributions) profits ($25M present value); and
- The operator of the MPPS in the form of lower cost coal (and ultimately electricity consumers in NSW in the form of lower electricity prices)($155M);
- The local community in the form of any voluntary contributions to community infrastructure and services.

The residual environmental, cultural and social impacts of the Modification, after mitigation and offsetting, while considered immaterial from an aggregate economic efficiency perspective, may potentially accrue to a number of different stakeholder groups at the local, State, National and global level.

Any residual noise costs will occur at a local level. Surface water and groundwater use will impact at the local level but will have been paid for through the acquisition of any water entitlements required. Greenhouse gas costs will occur at the local, state, national and global level. The clearing of native vegetation will potentially impact households at the local, State and National level who hold values for the impacted flora and fauna. However, compensation will be made in the form of a BOS. Blasting impacts on adjacent rock formations could potentially accrue to anyone who values these formations, however, measures are proposed to ensure no damage to these formations occurs. Other potential environmental impacts would largely occur at the local level and were found to be insignificant from an aggregate economic efficiency perspective. Any non-market benefits associated with employment provided by the Modifications would largely accrue at the local or State level[15].

[14] Using a 30% company tax rate.

[15] It should be noted that the study from which the employment values were transferred, surveyed NSW households only.

Table 2.3 - Distribution of Benefits and Costs (Present Values at 7% Discount Rate)

Value ($M)		Distribution			
		Local	State	National	Global
Net Production Benefits					
Net production benefits to proponent	$25	✓	✓	✓	-
Net production benefits to Commonwealth Government – Company tax	$11	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$29	✓	✓	-	-
Net production benefits to MPPS	$155	✓	✓	-	-
Net production benefits to local and regional community in the form of voluntary contributions	Unquantified	✓	-	-	-
Total	***$219***				
Non-market Costs and Benefits					
Benefits					
Non-market benefit of employment	$8	✓	✓	-	-
Total	***$8***				
Costs					
Greenhouse gas impacts	Insignificant*	✓	✓	✓	✓
Noise impacts	Insignificant*	✓	-	-	-
Blasting	Insignificant*	✓	✓	-	-
Air quality impacts	Insignificant*	✓	-	-	-
Surface water	Insignificant*	✓	-	-	-
Groundwater	Insignificant*	✓	-	-	-
Ecology	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs	✓	✓	-	-
Forestry	Insignificant*	✓	-	-	-
Road transport impacts	Insignificant*	✓	-	-	-
Aboriginal heritage	Insignificant*	✓	-	-	-
Non-Aboriginal heritage impacts	Insignificant*	✓	-	-	-
Visual impacts	Insignificant*	✓	-	-	-
Total	***Insignificant****				
Net Social Benefits	**$226**				

*From an aggregate economic efficiency perspective

Note: Totals may have minor discrepancies due to rounding.

From a NSW perspective, the Modifications would provide direct net production benefits in the form of royalties ($29M) and lower cost coal for MPPS ($155M). In addition NSW will obtain infrastructure and services provided with a share of Commonwealth Government Company Tax. Part of the profit to Coalpac from the Modifications may also accrue to NSW depending on the residential location of Coalpac shareholders. There are also additional benefits to NSW from the Modifications in the form of potential non-market employment benefits ($8M). Consequently, as well as resulting in net social benefits to Australia the Modifications would result in net social benefits to NSW.

Intergenerational

Some of the environmental, social and cultural impacts of the Modifications may be felt by future generations. This is particularly the case for non-market environmental impacts. However, as identified above, BCA is not concerned with distributional issues. The consideration of intergenerational equity issues is therefore outside the scope of BCA.

However, it should be noted that the costs and benefits in BCA are defined and valued based on the microeconomic underpinnings of BCA. They are based on the values held by individuals in the society i.e. current generations. 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.

Nevertheless, as identified by Boardman et al (2001) this is not considered a serious problem for BCA 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 BCA also reduces the influence of costs and benefits that occur a long way into the future.

Furthermore, increased wealth (e.g. royalties, profits and taxes) generated by projects that have a net benefit to the community 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.

2.6 SENSITIVITY ANALYSIS

This NPV presented in Table 2.2 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA 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.

In this analysis, the BCA result was tested for 20% (+ and -) changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land;
- Opportunity costs of capital;
- Capital costs;
- Operating costs;
- Shadow price of coal;
- Residual value of capital and land; and
- Non-market employment impacts.

In addition sensitivity analysis was undertaken using the financial value of the coal instead of its shadow price.

What the sensitivity analysis indicates (refer to Attachment 2) is that the results of the BCA using a shadow price of coal as indicated by NSW Department of Trade and Investment and NSW Treasury (2013) are not sensitive to the changes made in assumptions regarding any of these variables. Under all assumptions the Modifications would have net social benefits to Australia and NSW. The results were most sensitive to any potential decreases in the shadow price of coal and increases in operating costs.

Using the financial value of the coal rather than the shadow price of the coal substantially reduces the net social benefits of the Modifications, indicating that the majority of the net social benefit of the Modifications is the provision of low cost coal to the MPPS.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA in Section 2 is concerned with whether the incremental benefits of the Modifications exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Modifications compared to 'without' them. In contrast, the focus of the regional economic impact assessment is the effect (impact) of the Modifications on the economy in terms of a number of specific indicators of economic activity, such as gross regional output, value-added, income and employment.

These indicators can be defined as follows:

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

An impacting agent may be an existing activity within an economy or may be a change to an economy (Powell *et al.,* 1985; Jensen and West, 1986). This assessment is concerned with the economic impact of annual production of the Modifications at 2.2 Mtpa.

3.2 REGIONAL ECONOMY

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the production scenarios, but not making the economy so large that the impact of the proposal becomes trivial (Powell and Chalmers, 1995). For this study, the economic impacts have been estimated for the regional economy comprising the Local Government Areas (LGAs) of Lithgow and Bathurst.

3.3 METHOD OF ASSESSMENT

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and Input-Output (IO) models (Powell *et al.,* 1985).

Economic base theory and Keynesian multipliers are relatively simple approaches that provide impact measurement only in aggregate terms. Mathematical programming models are especially useful in micro-level studies of firms and industries but become complex for whole economies. Mathematical programming models are therefore sometimes used to estimate direct effects on an industry or sector with IO analysis used to assess economy-wide effects. Econometric models, particularly those of the general equilibrium type, have the potential to measure economic impacts in a similar way to that of IO models with relaxation of some of the limitations of IO analysis (Powell *et al.,* 1985).

Consistent with the DP&I's draft guideline, this study uses IO analysis. The IO method is based on a number of assumptions that are outlined in Attachment 3 and result in the estimated impacts being an upper bound impact estimate. Key terminology used in the IO assessment is also explained in Attachment 3.

One of the key simplifying assumptions of IO analysis is that there is unlimited labour and capital available to the region at fixed prices and therefore regional economic activity does not face capacity constraints that would result in increases in prices and crowding-out of other economic activity.

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. In this situation a mining project requiring labour and other resources would compete for them with existing activities. However, the Bathurst and Lithgow Region is not at full employment and is not a closed economy. It has potential access to employed and unemployed labour and capital resources from the region and across the country and overseas, including labour resources that were recently made redundant via the closure of the Invincible Colliery and Cullen Valley Mine as well as the reduction and/or suspension of other mining operations in the LGA.

Even where a mining project utilises already employed labour resources from inside the region, there is a filter effect where these jobs are filled by other employed or unemployed labour resources[16], which creates vacancies that are then filled by other employed or unemployed labour resources[16] etc., with these employed and unemployed labour resources[16] coming from both inside or outside the region. The potential labour force to meet demand in the region is considerably greater than just the labour force in the region and hence from a regional perspective is virtually unlimited. Consequently, for small open economies, crowding out of other economic activity is likely to be negligible.

While more complex models such as Computable General Equilibrium (CGE) modelling can conceptually deal with the positive economic activity impacts of a project and any partially offsetting negative economic activity impacts, for small regional economies, it is unlikely that these more complex models will surpass the simpler input-output model.

Firstly, the small open economy condition minimises the need to address offsetting impacts. Secondly, given the considerable difficulties associated with estimating a large number of coefficients and parameters required for CGE models when there is virtually no local data available, many exogenous assumptions are required to be made by the modeller and so the increased 'fuzziness' is likely to more than offset the increase in model sophistication. Consequently, CGE models are mostly used at the State and National level for large scale policy issues.

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 a project (construction and/or operation) in a form that is compatible with the input-output equations so that the IO multipliers and flow-on effects can then be estimated (West, 1993).

IO analysis reports multipliers which are summary measures used for identifying the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from IO analysis (refer to Attachment 3). Type 11A ratio multipliers (the kind reported in this assessment) 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.

[16] Including the continual addition to the labour force from school leavers, TAFE and University graduates and potentially those not currently seeking employment.

3.4 INPUT-OUTPUT TABLES AND ECONOMIC STRUCTURE OF THE REGION

A 2011 IO table of the local and regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 4) using a 2011 IO table of the NSW economy (developed by the Centre for Agricultural and Regional Economics) as the parent table. The 111 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economy.

Highly aggregated 2011 IO tables for the regional economy is provided in Table 3.1. The rows of the table indicate 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 depreciation 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.

Value-added for the regional economy is estimated at $3,383M, comprising $1,386M to households as wages and salaries (including payments to self-employed persons and employees) and $1,997M in OVA.

The employment total working in the regional economy in 2011 was 22,707.

The economic structure of the regional economy can be compared with that for NSW through a comparison of results from the respective input-output models (Figures 3.1 and 3.2). This reveals that the mining, manufacturing, utilities and public and personal services sectors in the regional economy are of greater relative importance than they are to the NSW economy, while the building, trade and accommodation, and business services sectors are of less relative importance than they are to the NSW economy.

Table 3.1 - Aggregated Transactions Table: Regional Economy 2011 ($'000)

	Agricult. Forestry Fishing	Mining	Manufact.	Utilities	Building	Trade Accomm.	Business Services	Public Personal Services	TOTAL	Household Exp.	O.F.D	Exports	Total
Ag/Forest/Fish	20,910	577	63,092	29	165	3,633	528	878	89,813	5,725	24,101	34,041	153,679
Mining	26	25,975	5,426	77,662	436	151	437	194	110,308	153	17,757	745,872	874,089
Manufacturing	6,057	21,946	101,174	7,648	32,995	35,331	23,724	22,605	251,479	82,570	68,923	549,568	952,540
Utilities	1,390	6,538	11,035	190,616	3,921	9,563	10,609	8,273	241,945	34,293	156,867	348,155	781,260
Building	1,988	19,551	4,603	10,709	71,812	6,024	21,906	13,772	150,365	1,198	203,970	16,184	371,716
Trade/Accomm	4,594	10,049	39,169	6,197	6,649	19,524	28,293	26,282	140,756	364,627	28,586	117,262	651,231
Business Srvs	8,119	48,429	92,781	24,400	36,428	79,710	183,287	101,002	574,156	405,621	69,270	330,200	1,379,247
Public/Personal Srvs	2,462	9,506	8,738	3,486	4,045	10,838	36,441	37,028	112,543	246,634	602,669	118,991	1,080,836
TOTAL	**45,546**	**142,570**	**326,017**	**320,747**	**156,451**	**164,774**	**305,224**	**210,035**	**1,671,364**	**1,140,820**	**1,172,142**	**2,260,272**	**6,244,597**
H-hold Income	26,128	143,797	139,240	75,690	69,450	178,214	266,070	487,720	1,386,307	-	-	-	1,386,307
O.V.A.	51,764	456,154	128,310	251,612	40,960	137,082	497,790	188,458	1,752,129	150,586	36,543	57,898	1,997,156
Imports	30,240	131,568	358,973	133,212	104,855	171,161	310,163	194,624	1,434,797	568,384	180,951	-	2,184,132
TOTAL	**153,679**	**874,089**	**952,540**	**781,260**	**371,716**	**651,231**	**1,379,247**	**1,080,836**	**6,244,597**	**1,859,790**	**1,389,635**	**2,318,170**	**11,812,192**
Employment	749	1,173	2,180	709	1,111	4,893	3,363	8,529	**22,707**				

Figure 3.1 - Summary of Aggregated Sectors: Regional Economy

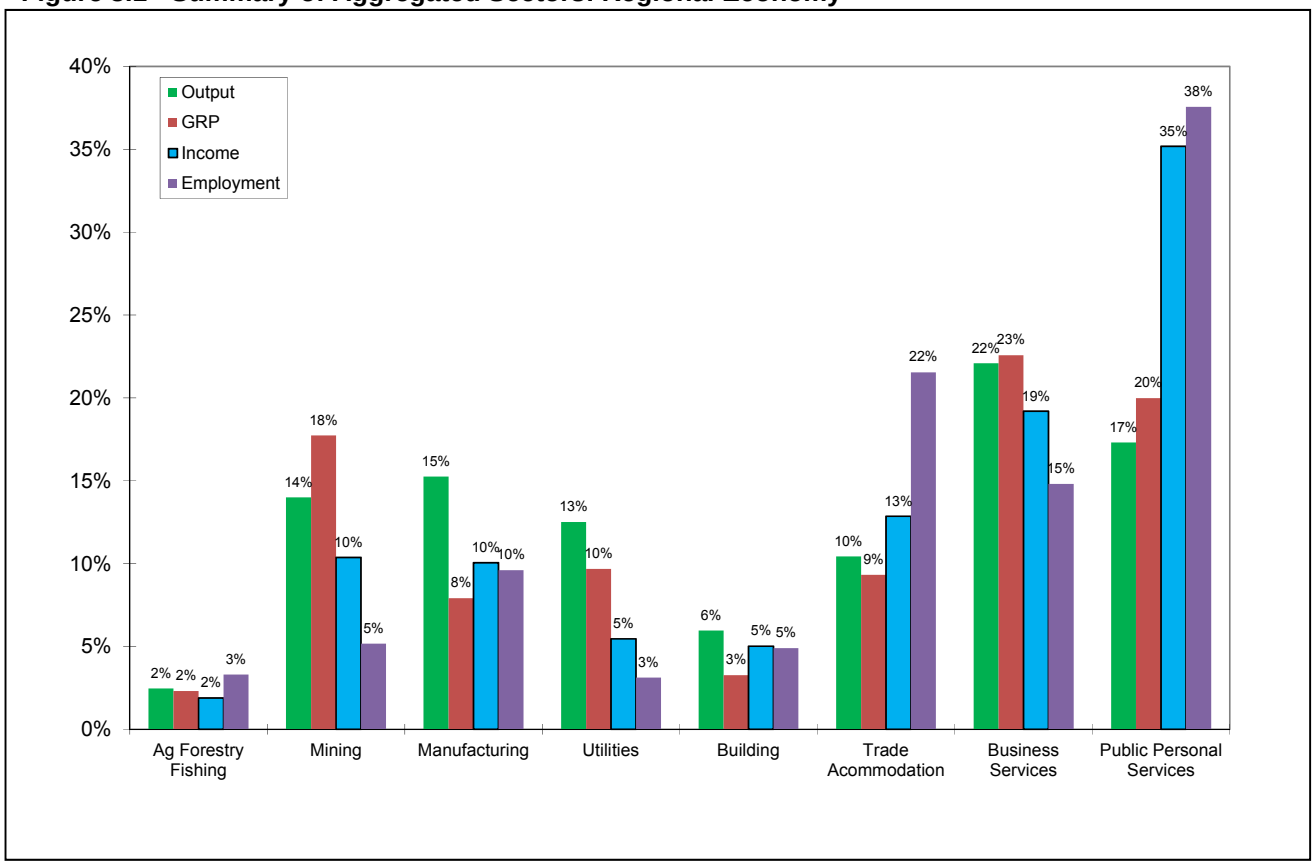
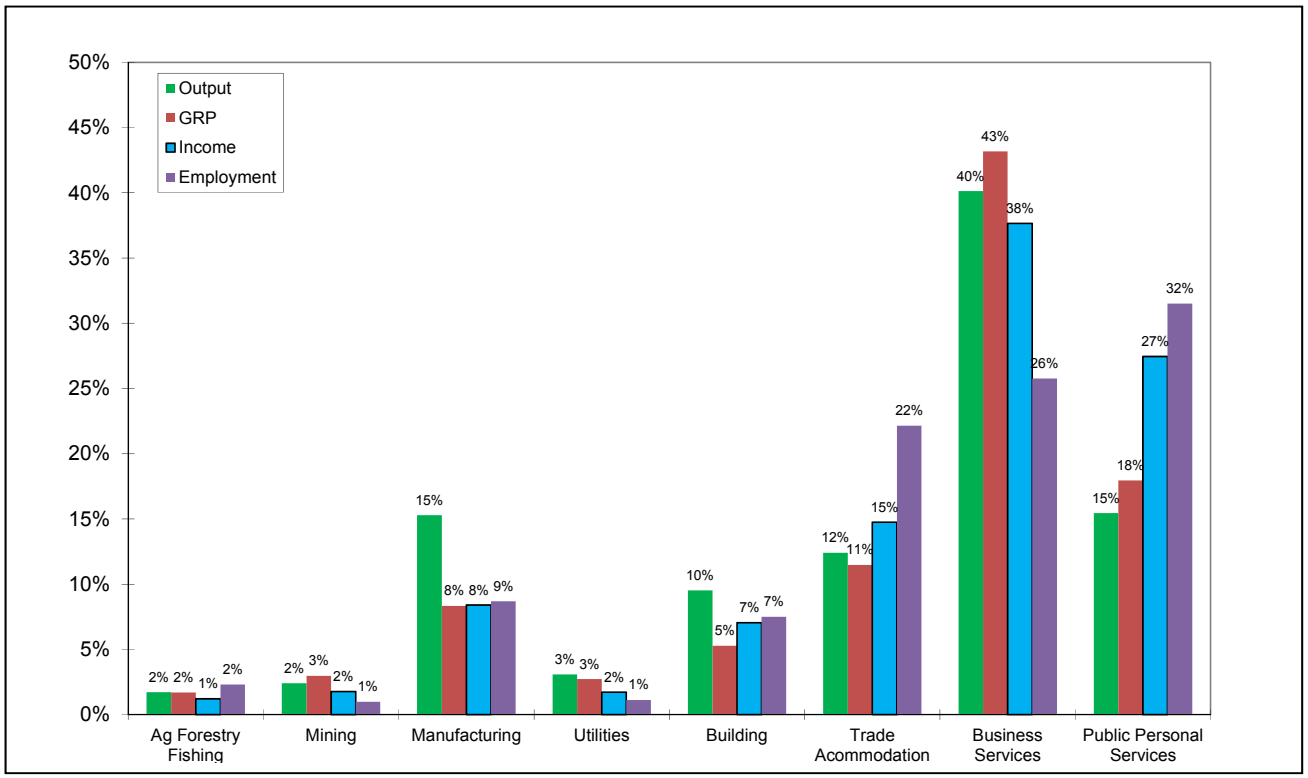


Figure 3.2 - Summary of Aggregated Sectors: NSW Economy



Figures 3.3 to 3.5 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.

The coal mining sector and utilities sectors[17] are the most significant sectors in the regional economy for output and value-added. The coal mining sector and the education sectors are the most significant sectors for regional income while the retail trade sector and education sectors are the most significant sectors for regional employment. The coal mining sector, food manufacturing sectors and utilities sectors are the most significant sectors for imports and exports.

[17] Over 90% of which is the electricity generation and electricity transmission sectors.

Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

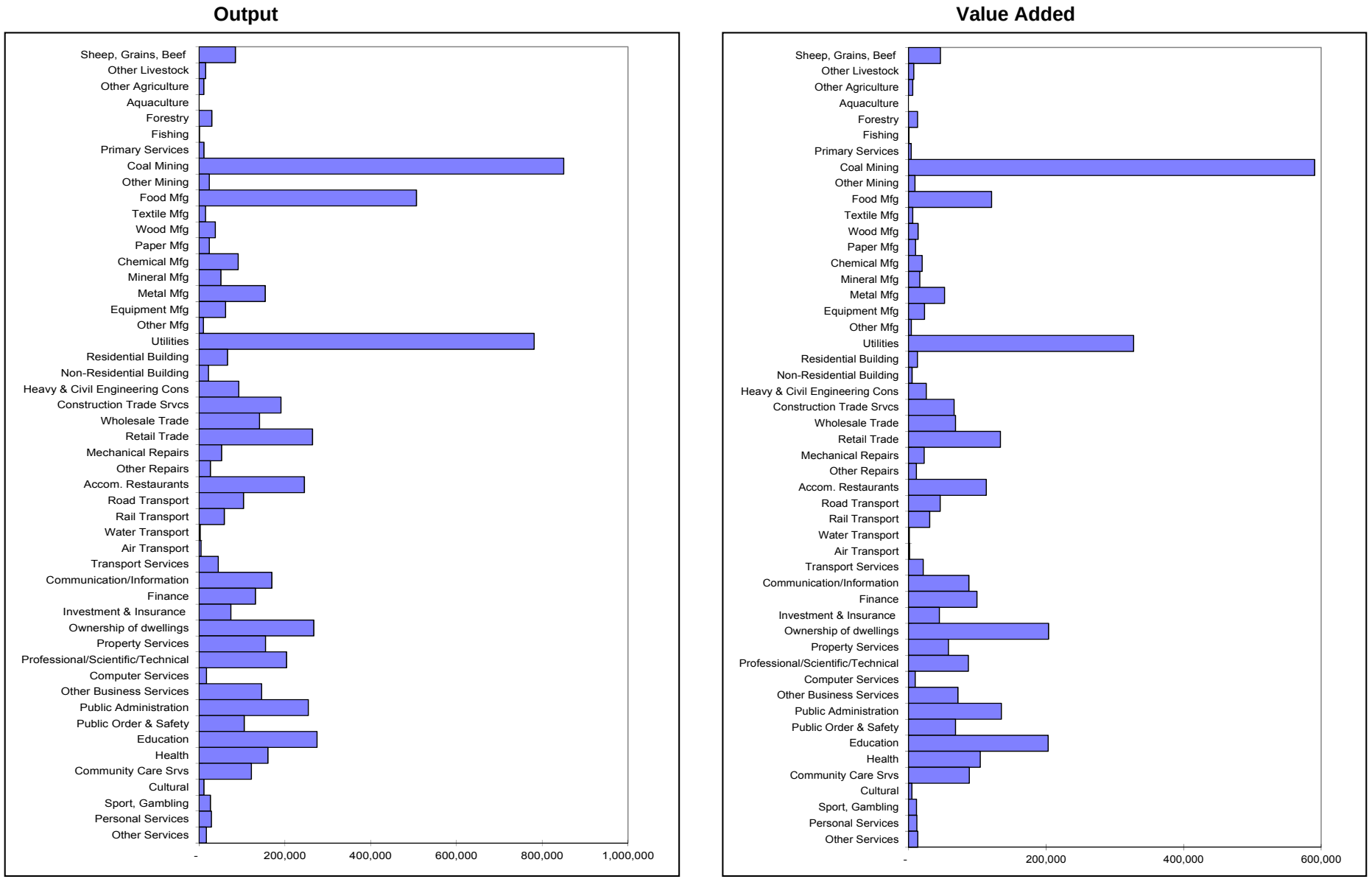
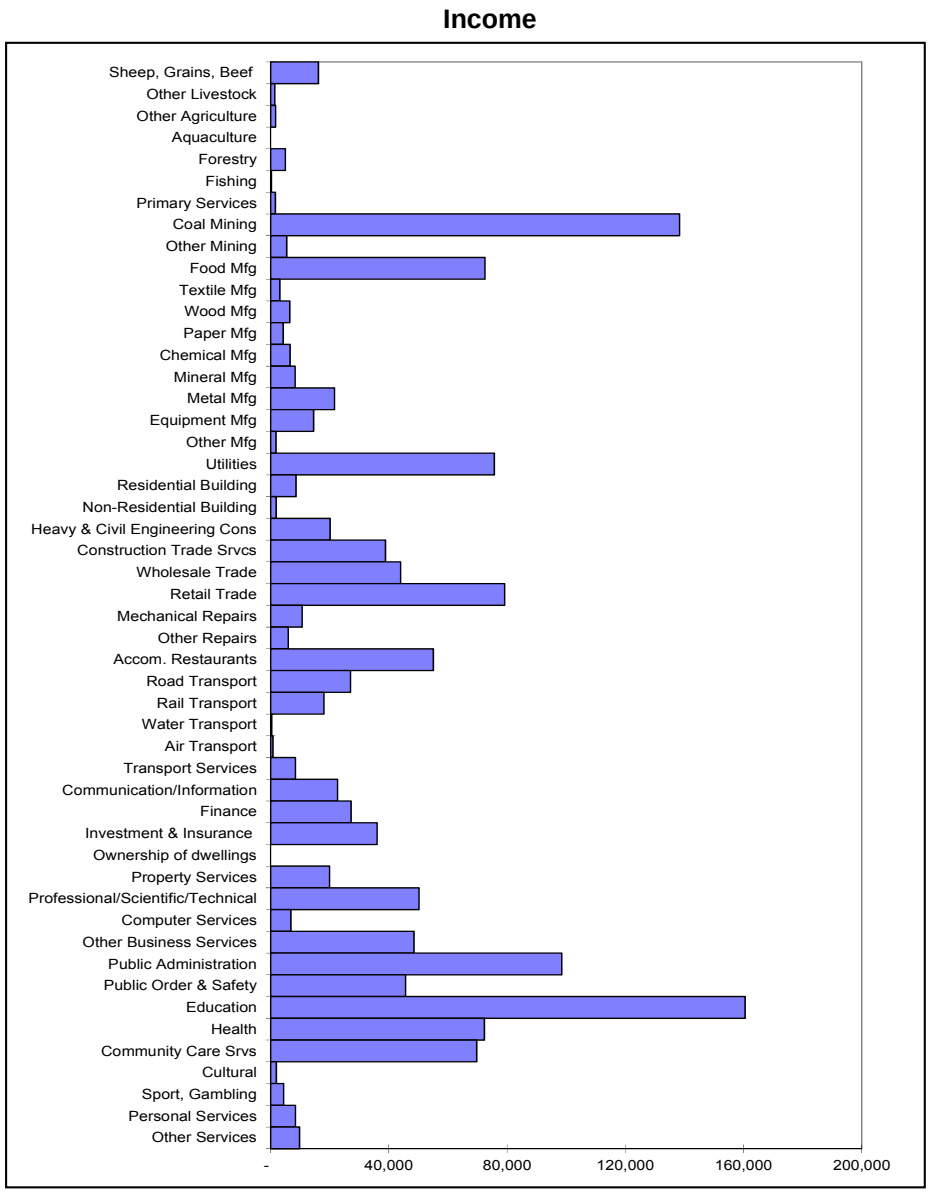


Figure 3.4 Sectoral Distribution of Income ($'000) and Employment (No.)



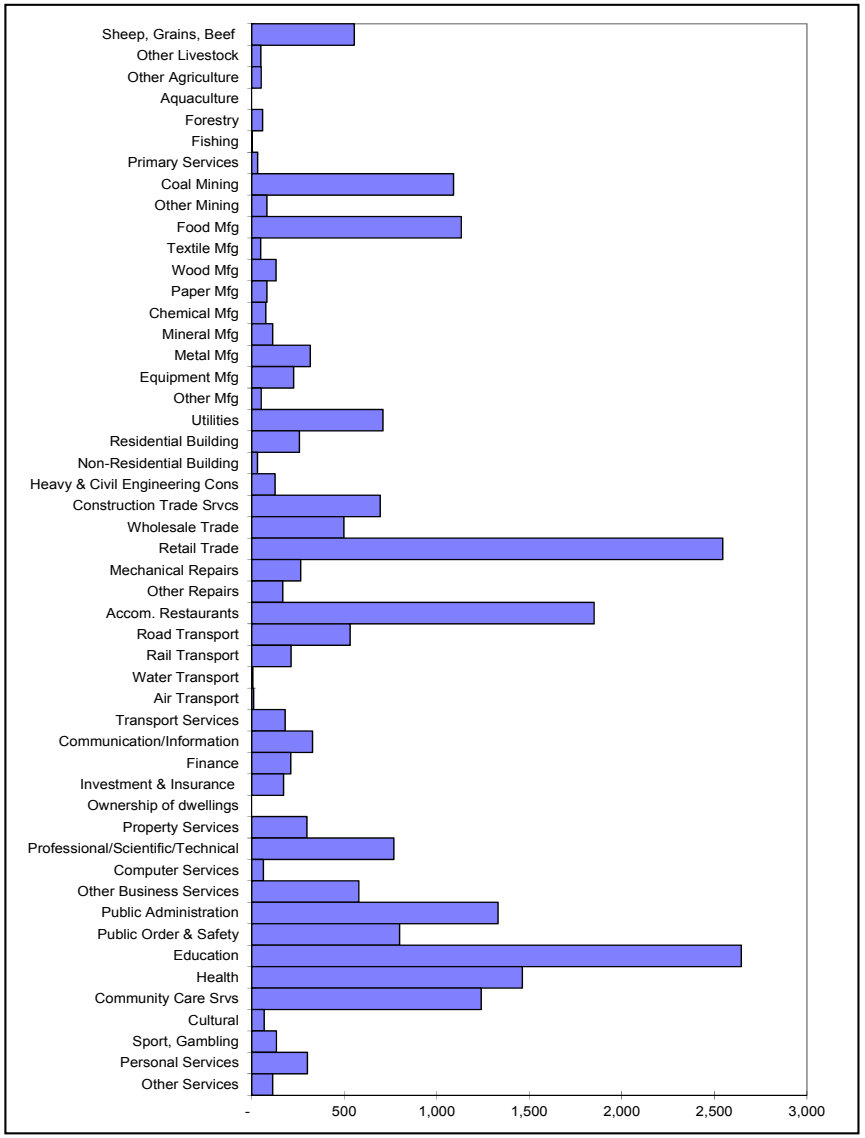
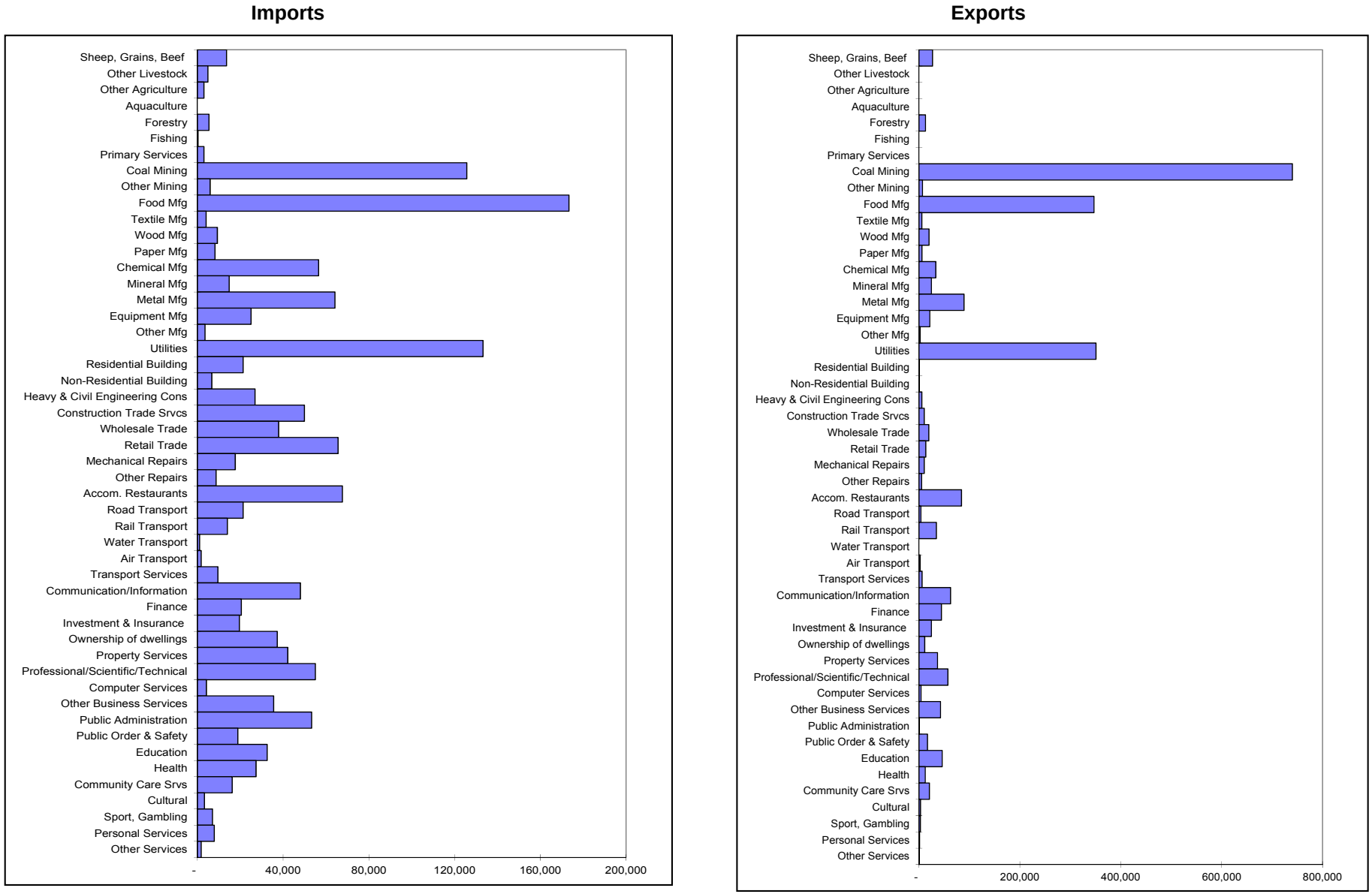


Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)



3.5 ECONOMIC IMPACT OF THE MODIFICATIONS

3.5.1 Introduction

The revenue, expenditure and employment associated with the operation of the Modifications would provide additional years of economic activity to the regional and NSW economy. This section models the positive economic activity associated with the Modification using input-output analysis.

3.5.2 Impacts on the Regional Economy

Introduction

For the analysis of the economic activity associated with the Modification, a new Modification sector was inserted into the regional input-output table reflecting annual production levels of 2.2 Mtpa ROM. The revenue and expenditure data for the new sector was obtained from financial information provided by Coalpac. For this new sector:

- The estimated gross annual revenue was allocated to the Output row;
- The estimated wage bill of those residing in the region was allocated to the household wages row with the remainder allocated to a separate household wages row that is not included in the calculation of flow-on effect;
- Non-wage expenditure was allocated between intermediate sectors in the regional economy and imports based on advice from Coalpac and 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 National Input-Output Tables;
- The difference between average total revenue and average total costs was allocated to the other value-added row; and
- Direct employment working in the region provided by the Modifications that was allocated to the employment row.

Economic Activity

The total and disaggregated annual impacts of the Modifications on the regional economy (in 2013 dollars) is shown in Table 3.2.

Table 3.2 - Economic Impacts of the Modifications on the Regional Economy ($2013)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	106,189	28,140	14,701	42,841	149,030
Type 11A Ratio	*1.00*	*0.27*	*0.14*	*0.40*	*1.40*
VALUE ADDED ($'000)	26,217	11,468	8,058	19,527	45,744
Type 11A Ratio	*1.00*	*0.44*	*0.31*	*0.75*	*1.75*
INCOME ($'000)	8,485	7,017	3,058	10,075	18,560
Type 11A Ratio	*1.00*	*0.83*	*0.36*	*1.19*	*2.19*
EMPL. (No.)	81	96	67	164	245
Type 11A Ratio	*1.00*	*1.19*	*0.83*	*2.02*	*3.02*

*Contractors are located in production-induced flow-ons.

The Modifications are conservatively estimated to make up to the following direct and indirect average annual contribution to the regional economy for 3 years when operating at full production, with lessor impacts when production associated with the Modifications is ramping up and ramping down:

- $149M in annual direct and indirect regional output or business turnover;
- $46M in annual direct and indirect regional value added;
- $19M in annual direct and indirect household income; and
- 245 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Modifications' impact on the regional economy range from 1.40 for output up to 3.02 for employment.

Capital intensive industries such as coal mining tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. A lower ratio multiplier for income (compared to employment) also generally occurs as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the Modifications. Capital intensive mining projects also typically have a relatively low ratio multiplier for output and value-added reflecting the relatively high direct output and value-added compared to that in flow-on sectors.

Main Sectors Affected

Flow-on impacts from the Modifications are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output and value-added flow-ons are likely to be the:

- Exploration and Mining Support Services;
- Road Transport;
- Professional, Scientific and Technical Services;
- Ownership of Dwellings;
- Retail Trade;
- Food and Beverage Services;
- Electricity Transmission, Distribution, On Selling and Electricity Market Operation;
- Wholesale Trade; and
- Education and Training.

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 Modifications (Table 3.3).

Table 3.3 - Sectoral Distribution of Employment Impacts on the Regional Economy

Sector	Average Direct Effects	Production - induced	Consumption - induced	Total
Primary	0	0	1	2
Mining	81	40	0	121
Manufacturing	0	2	3	6
Utilities	0	1	1	2
Wholesale/Retail	0	3	21	24
Accommodation, cafes, restaurants	0	2	10	12
Building/Construction	0	2	1	3
Transport	0	23	3	26
Services	0	23	28	50
Total	**81**	**96**	**67**	**245**

Note: Totals may have minor discrepancies due to rounding.

Table 3.3 indicates that direct, production-induced and consumption-induced employment impacts of the Modifications on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in the mining, transport and services 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 Modifications and/or the products and services required by employees would directly benefit from the Modification by way of increased economic activity. However, because of the inter-linkages between sectors, many indirect businesses also obtain economic activity.

3.6 MINE CESSATION

The Modifications will provide additional economic activity to the regional and NSW economy, for the life of the Modifications. Conversely, the cessation of the mining operations in the future would result in a contraction in regional and NSW economic activity.

The magnitude of the regional economic impacts of cessation of the Modifications 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 the cessation of the Modifications would depend on whether the workers and their families affected would leave the regional area. If it is assumed that some or all of the workers remain in the regional area, then the impacts of cessation of the Modifications would not be as severe compared to a greater level leaving the regional area. 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 the cessation of the Modification would approximate the direct and production-induced effects in Table 3.2. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.2.

The decision by workers, on cessation of the Modifications, 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).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with mining closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is its capacity to expand its factors of production by attracting investment and labour from outside the region (BIE, 1994). This in turn can depend on a region's natural endowments. In this respect, the regional area is highly prospective with considerable coal resources (NSW DPI, 2010).

It is therefore likely that, over time, new mining developments, including the potential to extend the life of the Cullen Valley Mine and Invincible Colliery would occur, offering potential to strengthen and broaden the economic base of the regional area and hence buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of the Modifications would depend on the economic structure and trends in the regional economy at the time. For example, if cessation of the Modifications takes place in a declining economy, the impacts would be more significant. Alternatively, if cessation of the Modifications takes place in a growing diversified economy where there are other development opportunities, the impacts of cessation would be less significant.

4 CONCLUSION

A BCA of the Modifications indicated that they would have net production benefits to Australia of $219M. Provided the residual environmental, social and cultural impacts of the Modifications that accrue to Australia are considered to be valued at less than $219M, the Modifications can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified an attempt was made to qualitatively consider and where possible quantify the main environmental, cultural and social impacts. However, it is evident that the most of the potential impacts of the Modifications are largely immaterial from an aggregate economic efficiency perspective. The main potential impact from an economic efficiency perspective is the clearing of native vegetation in Ben Bullen State Forest. However, a BOS is proposed that aims to offset lost conservation values. Provided the BOS offsets lost values it serves to internalises the ecological costs into the operating costs of Coalpac. There may also be non-market benefits from the employment provided by the Modifications. Overall, the Modifications are estimated to have net social benefits to Australia of between $219M and $227M, and hence are desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been qualitatively considered and where possible quantified in the Modifications BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $219M and $227M for the Modifications to be questionable from an Australian economic efficiency perspective.

An economic impact analysis, using input-output analysis estimated that the Modifications would make up to the following direct and indirect average annual contribution to the regional economy for at least 3 years, with lessor impacts when the incremental production associated with the Modifications is ramping up and ramping down:

- $149M in annual direct and indirect regional output or business turnover;
- $46M in annual direct and indirect regional value added;
- $19M in annual direct and indirect household income; and
- 245 direct and indirect jobs.

Cessation of mining under the Modifications will ultimately lead to a reduction in economic activity in the region and NSW. The significance of these cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if Modifications cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

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ATTACHMENT 1 – VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO_2-e) emissions a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions.

A prerequisite to valuing this environmental damage is scientific dose-response functions identifying how incremental emissions of CO_2-e would impact climate change and subsequently impact human activities, health and the environment on a spatial basis. Only once these physical linkages are identified is it possible to begin to place economic values on the physical changes using a range of market and non-market valuation methods. Neither the identification of the physical impacts of additional greenhouse gas nor valuation of these impacts is an easy task, although various attempts have been made using different climate and economic modelling tools. The result is a great range in the estimated damage costs of greenhouse gas.

The *Stern Review: Economics of Climate Change* (Stern, 2006) acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted an estimate of United States (US) $85 per tonne (/t) of carbon dioxide (CO_2) for the "business as usual" case (i.e. an environment in which there is an annually increasing concentration of greenhouse gas in the atmosphere).

Tol (2006) highlights some significant concerns with Stern's damage cost estimates including:

- that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's estimate of the social cost of carbon is based on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development; and
- Stern uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

All these have the effect of magnifying the social cost of the carbon estimate, providing what Tol (2006) considers to be an outlier in the marginal damage cost literature.

Tol (2005) in a review of 103 estimates of the social cost of carbon from 28 published studies found that the range of estimates was right-skewed: the mode was US$0.55/t CO_2 (in 1995 US$), the median was US$3.82/t CO_2, the mean US$25.34/t CO_2 and the 95th percentile US$95.37/t CO_2. He also found that studies that used a lower discount rate and those that used equity weighting across regions with different average incomes per head, generated higher estimates and larger uncertainties. The studies did not use a standard reference scenario, but in general considered 'business as usual' trajectories.

Tol (2005) concluded that "it is unlikely that the marginal damage costs of CO_2 emissions exceed US$14/t CO_2 and are likely to be substantially smaller than that". Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US$30 per tonne of carbon (US$8/t CO_2).

Tol (2011) surveyed the literature on the economic impact of climate change. Tol (2011) identifies the mean estimated from published studies is a marginal cost of carbon of $177/t C ($48/ tCO2-e) and a modal estimate of $49/t C ($13 tCo2-e) reflecting the fact that the mean estimate is driven by some very large estimates. For peer reviewed studies only, the mean estimate of the social cost of carbon is $80/tC ($22/tCo2-e).

An alternative method to trying to estimate the damage costs of CO_2 is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2 resulting in climate change damage costs or may purchase credits that offset their CO_2 impacts, internalising the cost of the externality at the price of the carbon credit. The price of carbon credits therefore provides an alternative estimate of the economic cost of greenhouse gas. However, the price is ultimately a function of the characteristics of the scheme and the scarcity of permits, etc. and hence may or may not reflect the actual social cost of carbon.

In the first half of 2008 the carbon price under the European Union Emissions Trading Scheme was over €20/t CO_2. The average price was €22/t CO_2 in the second half of 2008, and €13/t CO_2 in the first half of 2009. In March 2012, the permit price reduced to under €10 /t CO_2.

In 2008, spot prices in the Chicago Climate Exchange were in the order of US$3.95/t CO_2. However, the Chicago Climate Exchange cap and trade system ended on December 31, 2010.

In 2011, the greenhouse penalty for benchmark participants in the New South Wales Government Greenhouse Gas Reduction Scheme that fail to reduce emissions rose to $15.50 t CO_2.

Under the Australian Commonwealth Government's Climate Change Plan (Department of Climate Change and Energy Efficiency 2011) around 500 of the biggest polluters in Australia will need to buy and surrender to the Government a permit for every tonne of carbon pollution they produce. For the first three years, the carbon price will be fixed like a tax, before moving to an emissions trading scheme in 2015. In the fixed price stage, starting on 1 July 2012, the carbon price will start at $23 a tonne, rising at 2.5 per cent a year in real terms. From 1 July 2015, the carbon price will be set by the market.

Given the above information and the great uncertainty around damage cost estimates, the BCA uses the carbon price proposed by Australian Government's Climate Change Plan i.e. $23 a tonne, as reflective of the global social damage cost of carbon.

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ATTACHMENT 2 – BCA SENSITIVITY TESTING

Table 2-1
Benefit Cost Analysis Sensitivity Testing, Project Australian Net Social Benefit (Present Value)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS WITH SHADOW PRICE OF COAL	$253,386,016	$227,423,240	$204,957,000
CENTRAL VALUE WITH FINANCIAL VALUE OF COAL	$73,609,642	$64,045,299	$55,877,629
INCREASE 20%			
Opportunity cost of land	$252,317,747	$226,384,922	$203,947,000
Opportunity cost of capital	$252,618,907	$226,518,809	$203,946,670
Capital costs	$252,039,863	$226,114,829	$203,684,272
Operating costs	$192,851,165	$172,378,689	$154,708,141
Coal value	$364,624,335	$328,209,877	$296,637,988
Avoided rehabilitation and decommissioning costs	$254,322,747	$228,333,707	$205,842,636
Residual value of capital and land	$255,184,772	$228,939,835	$206,241,742
Employment benefits	$255,038,690	$229,029,394	$206,519,527

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	$254,454,286	$228,461,558	$205,967,000
Opportunity cost of capital	$254,153,126	$228,327,671	$205,967,329
Capital costs	$254,732,170	$228,731,651	$206,229,727
Operating costs	$313,920,868	$282,467,791	$255,205,858
Avoided rehabilitation and decommissioning costs	$252,449,286	$226,512,773	$204,071,363
Coal value	$142,147,698	$126,636,603	$113,276,011
Residual value of capital and land	$251,587,261	$225,906,645	$203,672,257
Employment benefits	$251,733,343	$225,817,086	$203,394,472

ATTACHMENT 3 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS AND COMPARISON TO COMPUTABLE GENERAL EQUILIBRIUM MODELLING

UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. "The *basic assumptions* in input-output analysis include the following:

- there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between input-output 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 input-output 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 input-output 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 therefore do not take account of economies of scale, unused capacity or technological change since they describe average effects rather than marginal effects (ABS, 1995).

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 = Initial + Production Induced + Consumption Induced Effects / Initial Effects

Type 11B Ratio Multiplier = Flow-on Effects / Initial Effects

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

IO ANALYSIS COMPARED TO CGE MODELLING

IO analysis and CGE modelling are two alternative modelling methods for estimating the economic activity associated with a project. IO analysis has historically been applied at the regional level while CGE modelling has historically been applied at the State and National level for major policies and developments. CGE modelling has recently been adapted for use at the regional level.

IO analysis identifies the 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 and employment. The impacts from IO analysis are based on a number of simplifying assumptions, most notably 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. Consequently, there are no partially offsetting reductions in economic activity ("crowding out") in other sectors in the region. The results of IO modelling can be seen as representing an upper bound for the net economic activity associated with a project. IO analysis is a static analysis that looks at impacts in a particular year, chosen by the analyst.

CGE modelling estimates the additional **net (positive and negative) regional economic activity** associated with a project in terms of a number of economic indicators including value-added and employment, but also real income, gross domestic product, house rentals etc. CGE modelling is underpinned by an IO database as well as a system of interdependent behaviour and accounting equations (several thousand equations) which are based on economic theory (but mostly without econometric backing at the regional level). These equations **ensure** that any change in demand in a region, no matter how small, translates into some change in prices and hence there is some 'crowding out' of other economic activity in the region. Results can be sensitive to changes in these behavioural assumptions[18]. The CGE modelling can be dynamic or comparative static.

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 not the industry as a whole. This is an empirical issue and would depend on the migration of labour into the region and timely management of land releases by Councils. Few studies exist that examine this issue. However, Deloitte Access Economics (2012) in a study for Singleton Council "*found insufficient evidence to conclude that house prices, rent or grocery prices were, on the whole more expensive than other regional communities".* This was in relation to all mining in the region rather than a single project and casts doubt on the price changes assumed by CGE modelling.

[18] For example, Abelson. P. (2011) highlights an example where using the Monash Multi-Region Forecasting CGE model, the Productivity Commission and the main creator and user of the model, Peter Dixon, estimated substantially different level of impacts.

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ATTACHMENT 4 – 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 coal 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 4-1 (Powell and Chalmers, 1995).

Table 4-1
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).

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

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APPENDIX G

Traffic and Transport Impact Review

Ref: HB-PROJ-0009-02 Letter response on Coalpac Modification Rev B

16 December 2013

Dorian Walsh
Environmental Scientist
Hansen Bailey
PO Box 473
Singleton NSW 2330

Dear Dorian

Invincible Colliery and Cullen Valley Mine Modifications – Traffic and Transport Issues

DC Traffic Engineering understands that Coalpac Pty Ltd (Coalpac) is seeking to modify Project Approval PA 07_0197 and Development Consent DA 200-5-2003 for its Invincible Colliery and Cullen Valley Mine.

The Invincible Colliery Modification (INV MOD4) will seek approval for the following activities that are not approved under its current Project Approval (PA 07_0127):

- Extension to PA 07_0127 for four years from December 2016 to December 2020;
- Extension of 88 ha to the area approved for open cut mining;
- Extension of 86 ha to area approved for highwall mining. These highwall mining operations will not result in additional surface disturbance;
- Installation of a water pipeline which will result in the ability to transfer water between Invincible Colliery and Cullen Valley Mine. The pipeline alignment will largely remain on or adjacent to existing access tracks within the Ben Bullen State Forest; and
- Backfilling of the residual final voids resulting from existing mining operations and the rehabilitation of areas affected by subsidence from historic underground mining operations in the area to create a free-draining final landform.

All other aspects of operations on site, including coal production and processing, coal transport, operational hours and employment would generally remain consistent with that approved under PA 07_0127.

The Cullen Valley Mine Modification (CV MOD2) is seeking approval for the following activities that are not approved under its current Development Consent (DA 200-5-2003):

- Extension of 62 ha to areas approved for open cut mining;
- Extension of 80 ha to areas approved for highwall mining. These highwall mining operations will not result in additional surface disturbance;
- The ability to benefit from the transfer of water to and from Invincible Colliery; and
- Backfilling and rehabilitation of the residual final void resulting from existing mining operations to create a free-draining final landform.

All other aspects of operations, including coal production and processing, coal transport, operational hours and employment would generally remain consistent with that approved under DA 200-5-2003.

In June 2010, a Traffic Impact Assessment was prepared by Hyder Consulting (Hyder Assessment) which assessed the traffic impacts associated with an increase from 0.9 to 1.2 Million tonnes per annum (Mtpa) run of mine (ROM) coal at Invincible Colliery. The Traffic Impact Assessment found increased yield would primarily generate additional truck movements between the Colliery and the Mt. Piper Power Station located 3km south, as well as smaller volumes to other domestic customers. The traffic impacts as assessed in the Hyder Assessment are considered to be reflective of the current traffic conditions accounting for the background (non-Invincible Colliery related) traffic as well as the existing and forecast traffic volumes generated by the proposed Invincible Colliery Modification.

The Hyder Assessment used three study intersections as indicators of overall road network performance due to the increase in yield from 0.9 to 1.2 Mtpa ROM at Invincible Colliery. These were (i) the Castlereagh Highway/ Invincible Colliery Access, (ii) the Castlereagh Highway/ Boulder Road and (iii) the Boulder Road/ Mt. Piper Power Station Access intersections. The study concluded that:

> *"A comparison between the SIDRA outputs for the 2016 [do nothing] case and the* [2010] *Modification case showed very little difference in the likely performance of the three study intersections. Furthermore, it showed that there would be relatively little traffic impact due to the additional truck traffic required to transport the additional volume of product coal proposed."* (Hyder, 2010[1]).

The Hyder Assessment also concluded that *"no mitigation measures are proposed in addition to those already in place for Invincible Colliery"*.

Modification INV MOD4, which is the subject of the current Project Application, will result in a continuation of coal production at Invincible Colliery for a further four years up to the end of year 2020. However, the rate of coal production and transportation arrangements will be consistent to the existing operations since there will be no change to the maximum volume of raw coal extracted, clean coal produced and hence transported. As such, the only foreseeable traffic volume change as a result of INV MOD4 proposal will be the growth in background (non-Invincible Colliery related) traffic during the additional four year approval period.

The Hyder Assessment indicated that there has been an average annual growth rate of 2% in the background traffic on the surrounding road network. As the three test intersections showed good performance (average delays less than 6 seconds/ vehicle and less than 1 vehicle queued), there is ample spare capacity in the network to absorb the background traffic growth of 2% per annum during the additional four years of product coal transportation from Invincible Colliery as proposed.

There are no changes to the rate of coal production, transportation arrangements or approval period for Cullen Valley Mine proposed under CV MOD2. As such, there is no foreseeable increase in Cullen Valley Mine traffic volumes as a result of the Modification.

It is concluded that the proposed Modifications INV MOD4 and CV MOD2 are not expected to have significant traffic impacts, and further assessment in these respects is not considered necessary.

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[1] Hyder Consulting (2010) *Invincible Colliery Modification – Traffic Impact Assessment*.

If there are any queries regarding this letter, please contact me at the details below.

Kind regards

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APPENDIX H

Final Void Rehabilitation Strategy

Coalpac

Proprietors of Invincible Colliery
and Cullen Valley Mine

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CULLEN VALLEY MINE AND INVINCIBLE COLLIERY

Mining Void and Final Landform Modification Assessment

February 2014

1. INTRODUCTION

There are currently three open cut mining voids at Invincible Colliery and a further three open cut mining voids at Cullen Valley Mine. These voids were left open to facilitate the continuation of future mining activities and will assist the recommencement of mining under the proposed Modifications.

This assessment describes the current status of mining voids at Cullen Valley Mine and Invincible Colliery and discusses the likely final landform and rehabilitation outcomes based on available materials. In addition this assessment seeks to quantify the fill material that could be made available from the proposed Modifications and its capacity to improve the rehabilitation of existing voids within the proposed Modification Boundary to achieve a higher quality final landform and superior rehabilitation outcomes within the mining areas.

This letter report includes a summary of the methodology used, a description of each of the mining voids at Cullen Valley Mine and Invincible Colliery, a discussion of the potential impacts and a conclusion summarising the key findings.

2. METHODOLOGY

A review of the current status and extent of mining voids at Cullen Valley Mine and Invincible Colliery was undertaken in December 2013 and January 2014. This review included visual inspections, compilation of photographic montages, aerial photos, mine planning surveys and material balance assessments.

For the purpose of this assessment, a mining void is defined as an area that has been previously excavated during approved operations and remains only partially backfilled.

3. MINING VOID ASSESSMENT

This section includes a description of the existing mining voids at Invincible Colliery and Cullen Valley Mine. The locations of the mining voids assessed in this report are shown on **Figure 1**.

3.1 Void 104

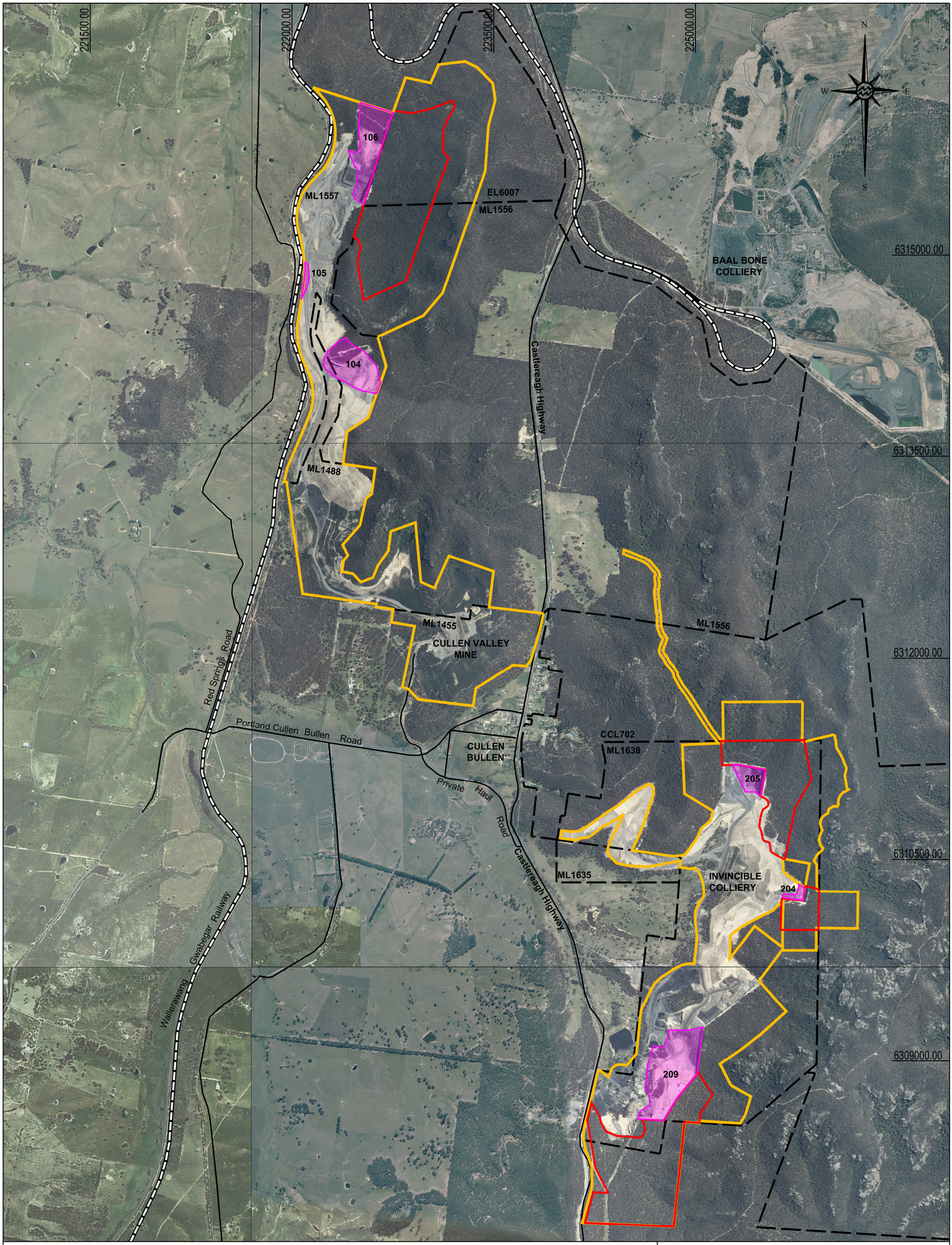
Mining void 104 at Cullen Valley Mine is approximately 120 m long by 60 m wide and covers an area of 1.9 ha. Mining void 104 has an exposed highwall on its northern side and is partially filled with overburden material from previous mining activities. The void contains no water, and is bounded by established rehabilitated land to the north and south (planted in 2009), Ben Bullen State Forest to the east and a mine haul road to the west. To achieve the preferred final landform outcome mining void 104 needs an estimated 304,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 1**).

Plate 1
Void 104 - Cullen Valley Mine, looking west

3.2 Void 105

Mining void 105 is a relatively small area compared to other voids at Cullen Valley Mine and is located adjacent to the haul road in close proximity to rehabilitated land to the east and the Wallerawang – Gwabegar Railway to the west. Void 105 has an exposed area on the low-wall side of the currently approved mining area which has an average height of 4 m above the level of the main haul road. There is no water stored or collected in the area of void 105. To achieve the preferred final landform outcome, void 105 needs an estimated 11,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 2**).

Plate 2
Void 105 - Cullen Valley Mine, looking north



LEGEND

- Coalpac Mining Leases
- Modification Boundaries
- Modification Disturbance Boundaries
- Current Mining Voids
- Road
- Rail

Current Mining Voids

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

Figure: 1

Drawn By:	Date:	Drawing No.:	Revision:	
D.E	30/01/14	23.4.6.1CV	A	MGA Zone 56

3.3 Void 106

Mining void 106 at Cullen Valley Mine is approximately 640 m long by 170 m wide and covers an area of 10.4 ha. Void 106 has an exposed highwall to its north while the natural slope and topography reduces the height of the highwall to the east with the Ben Bullen State Forest. The void has been designed to capture surface water runoff from disturbed areas and minimise potential impacts to water quality on downstream users and, as such, contains a sedimentation pond at its lowest point. Void 106 is bounded by the Ben Bullen State Forest to the north and east and the Wallerawang – Gwabegar Railway to the west. The Cullen Valley Mine Modification Disturbance Boundary is located immediately to the east of void 106. To achieve the preferred final landform outcome, void 106 needs an estimated 90,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 3**).

Plate 3
Void 106 - Cullen Valley Mine, looking east

3.4 Void 204

Mining void 204 at Invincible Colliery is approximately 330 m long by 230 m wide and covers an area of 6.7 ha. Void 204 has an exposed highwall on its eastern side and overburden material on the low wall side immediately to the west. Void 204 contains a small volume of water and is bounded by the Ben Bullen State Forest to the north and east and established rehabilitation to the south and west. The Invincible Colliery Modification Disturbance Boundary is located to the immediate east and adjoins void 204. To achieve the preferred final landform outcome mining void 204 needs an estimated 220,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 4**).

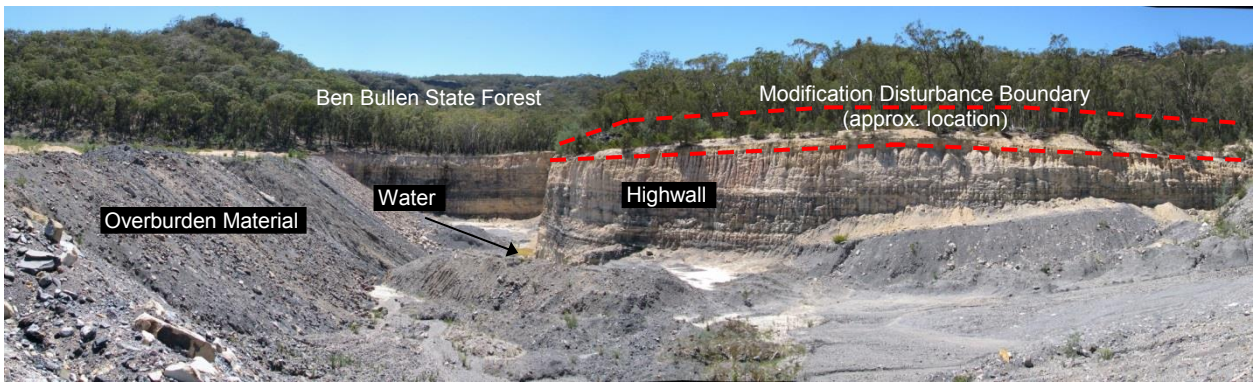


Plate 4
Void 204 – Invincible Colliery, looking east

3.5 Void 205

Mining void 205 at Invincible Colliery is approximately 190 m long by 100 m wide and covers an area of 1.8 ha. Void 205 has exposed highwalls on its northern and eastern sides and overburden material on the low wall side immediately to the south and west. Void 205 contains an estimated 7.6 ML of water resulting from seepage of water held in the abandoned underground mine workings of the Lithgow seam as well as surface water runoff.

Void 205 currently acts as a sedimentation pond for the management of dirty water at the Invincible Colliery and is used as a water source for dust suppression as required. Void 205 is bounded by the Ben Bullen State Forest to the north, east and west and rehabilitated land to the south. The Modification Disturbance Boundary is located to the immediate north and east and adjoins void 205. To achieve the preferred final landform outcome void 205 needs an estimated 215,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 5**).

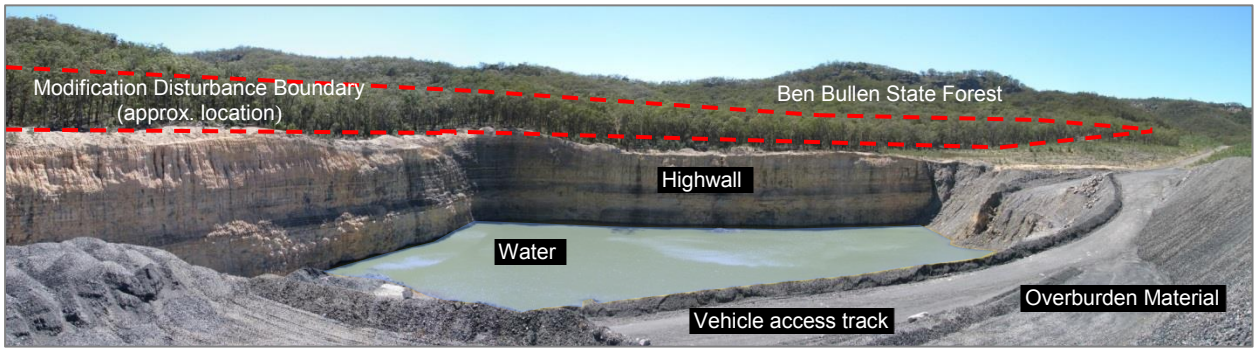


Plate 5
Void 205 – Invincible Colliery, looking east

3.6 Void 209

Mining void 209 at Invincible Colliery is approximately 1,280 m long by 300 m wide and covers an area of 51 ha. Void 209 has an exposed highwall to the east and low-wall to the west, overburden material is located immediately to the north and south of the void area. Void 205 does not hold any water and is bounded by Ben Bullen State Forest to the east and south and a shaped overburden stockpile to the north. The Modification Disturbance Boundary is located to the south and east and immediately adjacent to void 205. To achieve the preferred final landform outcome Void 209 needs an estimated 1,200,000 m^3 of additional fill material which would be available from the proposed Modification (see **Plate 6**).

Plate 6
Void 209 – Invincible Colliery, looking south

3.7 Rehabilitation of Existing Mining Voids

The existing mining voids at Cullen Valley Mine and invincible Colliery could be rehabilitated in their current form consistent with the approved Care and Maintenance Mining Operations Plan and Rehabilitation Cost estimate. However, it should be noted that higher quality final landform and superior rehabilitation outcomes would be achieved if additional material was made available.

As demonstrated Cullen Valley Mine contains three existing mining voids located generally in the northern portion of the currently approved mining area (Voids 104, 105 and 106). These voids cover approximately 16 ha and would benefit from an estimated 405,000 m^3 of additional fill material to achieve the optimal final landform outcome and meet the preferred rehabilitation objectives.

Invincible Colliery contains three mining voids located in the Northern and Eastern mining areas (Voids 204, 205 and 209). These voids cover approximately 60 ha and would benefit from an estimated 1,635,000 m^3 of additional fill material to achieve the preferred final landform outcome and meet the rehabilitation objectives.

A description of each mining void at Cullen Valley Mine and Invincible Colliery is summarised in **Table 1**.

Table 1
Capacity of Mining Voids at Cullen Valley Mine and Invincible Colliery

Void	Surface area (ha)	Average Length (m)	Average Width (m)	Average depth (m)	Optimal fill material required (m^3)
104 (CVM)	1.9	120	60	18	304,000
105 (CVM)	4.0	272	15	4	11,000
106 (CVM)	10.4	640	170	8	90,000
204 (INV)	6.7	330	230	18	220,000
205 (INV)	1.8	190	100	18	215,000
209 (INV)	51.0	1,280	303	7	1,200,000
Total					**2,040,000**

4. IMPACT ASSESSMENT

The existing mining voids at Invincible Colliery and Cullen Valley Mine were strategically left open to facilitate the continuation of future mining activities and the efficient extraction of the coal resource. The existing mining voids at both sites contain highwalls that expose the coal seams and would allow direct access to the remaining coal reserves. Due to delays in the determination of future mining approvals at Invincible Colliery and Cullen Valley Mine, which have been outside of Coalpac's control, both sites have been placed on Care and Maintenance until the determination of these Modifications. As such, the existing final voids have not yet been rehabilitated.

Material from the current mining voids has been used in the rehabilitation of adjacent mining areas as per the mining schedule at the time. As such, there is now a limited volume of suitable material available (including topsoil and bulk overburden) to infill these voids and achieve the desired long-term outcomes of a stable and free-draining landform that is consistent with the surrounding landscape.

If these remaining voids were to be in-filled under existing approvals, additional disturbance of forested areas adjacent to the voids and also existing rehabilitation areas would be required to treat existing open cut highwalls. Some additional fill material could be sourced from adjacent overburden dumps and existing rehabilitated areas, however, this would fall short of the volume required to achieve the preferred free draining final landform and meet rehabilitation objectives.

Excess overburden material from the existing mining voids has been deliberately incorporated into the previously mined and rehabilitated areas at each site. This demonstrates the ability for mine plan designs to include some flexibility in shaping the final landform to accommodate any surplus or deficit in overburden material.

5. CONCLUSION

The closure of Invincible Colliery and Cullen Valley Mine in their current form, while possible, would create a less than optimal rehabilitation and final landform outcome.

The assessment of overburden waste volumes derived from the Modifications, as provided in this assessment, has identified that the Modifications will provide sufficient quantities of material to achieve a higher quality final landform and superior rehabilitation outcomes in the proposed Modification areas and existing approved mining areas at Cullen Valley Mine and Invincible Colliery. Through careful mine planning, the Modifications will ensure no voids remain in the final landscape at either site.

Coalpac is committed to developing a free-draining final landform to ensure that the landscape is representative of pre-mining conditions and is compatible with the surrounding landscapes of the Ben Bullen State Forest. The mining activities proposed for the Modifications will promote a better rehabilitation and final landform outcome in the long term by providing access to the required quality and quantity of overburden and topsoil materials to allow the infilling of existing mining voids at Invincible Colliery and Cullen Valley Mine.