SOCIO-ECONOMIC ASSESSMENT

Abel Upgrade Modification Environmental Assessment

APPENDIX H

Resource Strategies

DONALDSONCOAL
Part of the Yancoal Australia Group

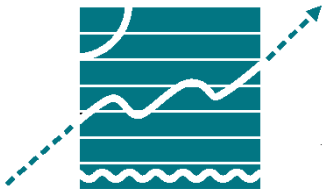
Abel Upgrade Modification

Socio-Economic Assessment

Prepared for

Donaldson Coal Pty Limited

By



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EXECUTIVE SUMMARY

Donaldson Coal Pty Limited (Donaldson Coal) is seeking a Modification under section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* to its existing approval for the Abel Underground Mine. The Modification includes a change in mine layout and mining method and an increase in annual run-of-mine coal production of up to 6.1 million tonnes per annum.

A Socio-Economic Assessment is required as part of the Environmental Assessment (EA).

From a socio-economic perspective there are three important aspects of the Modification that can be considered:

- the economic efficiency of the Modification (i.e. consideration of economic costs and benefits);
- the economic impacts of the Modification (i.e. the economic activity that the Modification would provide to the regional and State economy); and
- the distribution of impacts between stakeholder groups (i.e. the equity or social impact considerations).

A Benefit Cost Analysis (BCA) of the Modification indicated that it would have incremental (i.e. in comparison to the approved Abel Underground Mine) net production benefits of $265 million (M), with $165M of these net production benefits 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. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

For the Modification to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Modification to Australia would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $165M. This is equivalent to each household in the region valuing residual environmental impacts at $837. The equivalent figure for NSW and Australian households is $64 and $20, respectively.

The threshold value may also be interpreted as the opportunity cost to Australia of not proceeding with the Modification.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Modification. The main quantifiable environmental impacts of the Modification that have not already been incorporated into the estimate of net production benefits relate to greenhouse gas impacts. These impacts are estimated at $25M in total or $0.2M to Australia, considerably less than the estimated net production benefits of the Modification.

Overall, the Modification is estimated to have net community benefits to Australia of $165M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts of the Modification as specified in the EA have been quantified and included in the BCA, any other residual environmental, cultural or social impacts of this Modification (e.g. impacts on Aboriginal heritage) that remain unquantified, would need to be valued at greater than $165M for the Modification to be questionable from an Australian economic perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Modification 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 is potentially distributed amongst a range of stakeholders including:

- Donaldson Coal shareholders in the form of after tax (and after voluntary contributions) profits;
- the Commonwealth Government in the form of any Company tax payable ($57M present value) and Minerals Resource Rent Tax from the Modification, which are subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the regional area;
- the NSW Government via royalties ($75M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- the regional community in the form of voluntary contributions to community infrastructure and services.

The potential environmental, cultural and social impacts of the Modification may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely insignificant or internalised into the production costs of Donaldson Coal.

Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Modification biodiversity offsets. The cost of providing biodiversity offsets is included in the estimation of net production benefits. Aboriginal heritage impacts will potentially occur to Aboriginal people and NSW households[1], however, these economic costs remain unquantified in the analysis. All other potential impacts would occur at the local level or state[2] level and were found to be insignificant.

The non-market costs, quantified in the analysis, that accrue to NSW are estimated at $0.2M. These are considerably less than the net production benefits that directly accrue to NSW through royalties ($75M). Other benefits to NSW would include any voluntary contributions to the regional community and benefits to NSW shareholders[3]. Consequently, as well as resulting in net benefits to Australia the Modification is likely result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that the operation phase of the Abel Underground Mine (including the activities associated with the Modification) would make up to the following average annual contribution to the regional economy for 17 years:

- $459M in annual direct and indirect regional output or business turnover;
- $156M in annual direct and indirect regional value added;
- $96M in annual direct and indirect household income; and
- 1,052 direct and indirect jobs.

[1] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

[2] It should be noted that the studies that found public good values for employment surveyed NSW households.

[3] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and the MRRT.

The Modification is estimated to make up to the following incremental (i.e. in comparison to the existing approved Abel Underground Mine) average annual contribution to the regional economy for 17 years:

- $81M in annual direct and indirect regional output or business turnover;
- $50M in annual direct and indirect regional value added;
- $5M in annual indirect household income; and
- 64 indirect jobs.

For the NSW economy, the operation of the Abel Underground Mine (including the activities associated with the Modification) is estimated to make up to the following average annual contribution to the NSW economy for 17 years:

- $624M in annual direct and indirect regional output or business turnover;
- $244M in annual direct and indirect regional value added;
- $146M in annual direct and indirect household income; and
- 1,593 direct and indirect jobs.

The Modification is estimated to make up to the following incremental average annual contribution to the NSW economy for 17 years:

- $95M in annual direct and indirect regional output or business turnover;
- $57M in annual direct and indirect regional value added;
- $10M in annual indirect household income; and
- 112 indirect jobs.

Any changes in the workforce and populations of regions may have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities.

It is anticipated that approximately 25 construction workers would be required for modifications and upgrades to the Bloomfield Coal Handling and Preparation Plant (CHPP) and 5 construction workers would be required for the construction of the downcast ventilation shaft. However, it is envisaged that most of the required construction workforce would be contractor labour from existing contractor firms located within the region. Any construction workforce unable to be sourced locally would most likely be able to be sourced from Sydney and commute to the region daily. Consequently, little, if any, population change as a result of the construction workforce is envisaged.

The Modification relates to the continuation and expansion of an existing activity. The operational workforce associated with the Modification is estimated at up to an additional 25 employees for the underground mining operations and up to 23 additional employees at the Bloomfield CHPP, during peak periods. Donaldson Coal has established a number of programs to aid in the local recruitment of its workforce. It is therefore highly likely that all of the additional workforce required for the Modification would already reside in the Newcastle Region. Consequently, no additional impact on community infrastructure is anticipated.

However, even if it were conservatively assumed that all of the additional workforce (and associated flow-on employees and families) migrated into the region, the maximum additional population in the region would be 413, which is insignificant in the context of historical and projected population growth in the region. Nevertheless, Donaldson Coal would continue to develop and run programs that help in the recruitment of local labour and would work in partnership with Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible.

1 INTRODUCTION

1.1 ECONOMIC ASSESSMENT

Gillespie Economics was commissioned by Donaldson Coal Pty Ltd (Donaldson Coal) to complete a socio-economic assessment for the Abel Upgrade Modification (the Modification). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared to support an application in accordance with provisions of section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979.*

The scope of work completed by Gillespie Economics for this assessment included addressing the Director-General's Requirements, issued on 21 February 2012, relating to socio-economics. These indicate that a socio-economic assessment is required as part of the EA including:

- a detailed assessment of the potential direct and indirect economic benefits of the proposal for local and regional communities and the State;
- potential impacts on local and regional communities, including:
  - increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services); and
  - impacts on social amenity;
- a description of the measures that would be implemented to minimise the adverse social and economic impacts of the proposed modification, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism; and
- a detailed assessment of the costs and benefits of the proposed modification as a whole, and whether it would result in a net benefit for the NSW community.

In this respect, consideration was given to the relevant aspects of the Department of Planning and Infrastructure's (DP&I) *Draft Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002) and the Office of Social Policy's (1995) *Techniques for Effective Social Impact Assessment: A Practical Guide*.

From a socio-economic perspective there are three important aspects of the Modification that can be considered:

- The economic efficiency of the Modification (i.e. consideration of the economic costs and benefits of the Modification);
- The economic impacts of the Modification (i.e. the economic activity that the Modification will provide to the local/regional or NSW economy); and
- the distribution of impacts between stakeholder groups (i.e. the equity or social impact considerations).

The DP&I's draft *Guideline for Economic Effects and Evaluation in EIA* (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 identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The above draft guideline indicates that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the local economy can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

The draft guidelines also identify the need to consider the distribution of benefits and costs in terms of:

- intra-generational equity effects – the incidence of benefits and costs within the present generation; and
- inter-generational equity effects – the distribution of benefits and cost between present and future generations.

These social impacts are often considered in terms of the impacts on employment, population and community infrastructure and services.

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

- a BCA of the Modification (Section 2);
- an economic impact assessment of the Modification (Section 3) for two regions:
  - the regional economy comprising the Local Government Areas (LGAs) of Cessnock, Lake Macquarie, Maitland, Newcastle and Port Stephens (i.e. the Newcastle Statistical Subdivision;
  - the NSW economy; and
- an Employment, Population and Community Infrastructure Assessment (EPCIA) (Section 4).

A consultation program for the EA was undertaken by Donaldson Coal and is described in Section 1 in the Main Report of the EA.

1.2 MODIFICATION DESCRIPTION

The Abel Underground Mine is an underground coal mining operation located approximately 23 kilometres (km) north-west of the Port of Newcastle, NSW in the Newcastle Coalfield. It is located within the Cessnock, Maitland and Newcastle LGAs.

The Abel Underground Mine is owned and operated by Donaldson Coal, a wholly owned subsidiary of Yancoal Australia Limited and is approved to extract up to 4.5 million tonnes per annum (Mtpa) run-of-mine (ROM) coal, over a mine life of approximately 21 years (i.e. until 31 December 2028). The Project Approval also covers the operation of the Bloomfield Coal Handling and Preparation Plant (CHPP), which is approved to process up to 6.5 Mtpa ROM coal from the Abel Underground Mine, Tasman Underground Mine, Bloomfield Colliery and other sources.

The key components of the proposed Modification include:

- The introduction of longwall mining in a section of the Lower Donaldson Seam.
- The introduction of shortwall mining in a section of the Upper Donaldson Seam, and a section of the Lower Donaldson Seam.
- The extension of mining, using bord and pillar extraction, in a southern section of the Upper Donaldson Seam that overlies the Lower Donaldson Seam within ML 1618 (referred to as the ‘thin seam workings’).

- Development of the modified mine layout to meet the existing approved subsidence management commitments.
- An extension of the mine life of approximately two years (i.e. until 31 December 2030).
- Increased annual ROM coal production of up to 6.1 Mtpa.
- An increase in the amount of ROM coal received from the Tasman Underground Mine (per annum and in total).
- Increased internal transport of the ROM coal from the Abel Underground Mine and the Tasman Underground Mine to the Bloomfield CHPP.
- Increased throughput of coal at the Bloomfield CHPP and rail loading facility.
- Modifications and upgrades to the CHPP.
- Increased annual and total quantity of fine and coarse rejects from the Bloomfield CHPP disposed at the Bloomfield Colliery and Donaldson Open Cut void.
- Potential upgrades to the integrated water management system of the Abel Underground Mine, Donaldson Open Cut Mine and Bloomfield Colliery.
- Construction and use of a downcast ventilation shaft.
- Development and use of in seam gas drainage infrastructure.
- Other associated minor infrastructure, plant, equipment and activities.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

2.1.1 Introduction to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics. Aplications 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 DP&I's *Draft Guidelines for Economic Effects and Evaluation in EIA* (James and Gillespie 2002).

BCA is primarily concerned with 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. 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), the project is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

BCA is not primarily concerned with distributional considerations. Nevertheless, the distribution of the costs and benefits of a project can provide additional information that may be of assistance to decision-makers.

2.1.2 Definition of Society

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different definitions of society. Depending on agency jurisdiction and the geographical spread of benefits and costs, this could range from the population of a Council area through to the whole world. However, most applications of BCA are 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 spillovers between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, as identified by Boardman *et al*. (2001), "where major impacts spill over national borders, then the BCA should be undertaken from the global as well as the national perspective".

Adopting a sub-national perspective is not recommended (Boardman *et al*., 2001), as it can result in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers. This is particularly the case for major projects which involve the use of resources drawn from across the nation as well as internationally and which generate benefits that are enjoyed by people who are resident in NSW and beyond.

The BCA for this Modification is undertaken from a global and national level perspective. Initially, all the benefits and costs of the Modification, whomever they accrue to are included in the BCA. The BCA is then truncated to include only those benefits and costs of the Modification that accrue to Australia.

2.1.3 Definition of the Modification Scope

This raises the important issue of Modification scope. The Modification scope is as defined in Section 1.2. It includes a change in mine layout and mining method, and increases in annual ROM coal production (up to 6.1 Mtpa), processing of ROM coal at the Bloomfield CHPP and delivery of product coal by rail to the Port of Newcastle.

This definition of the Modification for which approval is being sought has important implications for the identification of the costs and benefits of the Modification. Even when a BCA is undertaken from a global perspective and includes costs and benefits of a Modification that accrue outside the national border, only the costs and benefits associated with the defined Modification, are relevant. Put simply, only the costs and benefits from the mining of the coal from the Modification and its delivery to port are relevant.

In this regard, it is important to recognise that while coal is an intermediate good (i.e. it is used as an input into the production of other goods and services), it is not appropriate to include the costs and benefits associated with the downstream use of coal. BCA is a form of partial equilibrium analysis that attempts to isolate the marginal impacts of a particular project, holding all other things equal, including in this case the levels of downstream use of coal. The downstream use of the Modification coal constitutes a different project[1], that itself can be subject to BCA. For instance, if the coal is exported to China, its potential uses are different projects that each have their own sets of costs and benefits. If the coal is proposed to be used for coal-fired electricity generation then the costs associated with that project would include the cost of coal, labour, land and capital inputs, electricity distribution and environmental impacts, such as greenhouse gas generation. The benefits associated with an electricity generation project would include the Chinese community's willingness to pay for electricity. There may also be externality benefits of electricity for economic development, education, and medical care. All of these costs and benefits are relevant considerations at this next stage of the production process.

2.1.4 Steps in BCA

BCA of the Modification involves the following key steps:

- identification of the base case;
- identification of the Modification and its implications;
- identification and valuation of the incremental benefits and costs;
- 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 Modification based on financial, technical and environmental advice provided by Donaldson Coal and its' specialist consultants.

[1] As identified by NSW Treasury (2007), Projects or programs may contain a range of elements related to one another and the point at which a discrete project can be identified will require careful judgement. In this respect, NSW Treasury (2007) cautions against excessive aggregation in project scope i.e. inclusion of activities in the project scope that can themselves be considered to be separate projects.

2.2 IDENTIFICATION OF THE BASE CASE AND THE MODIFICATION

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

Under the base case, mining at the Abel Underground Mine would continue in accordance with the current approval. In contrast, the Modification (as described in Section 1.2) includes a change in mine layout and mining method, an increase in annual ROM coal production to up to 6.1 Mtpa, processing of coal and delivery to port.

BCA is primarily concerned with the evaluation of a project relative to the counterfactual of no project. Where there are a number of alternatives to a project then these can also be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Modification were considered by Donaldson Coal in the development of the Modification description.

The Modification assessed in the EA and evaluated in the BCA is considered by Donaldson Coal to be the most feasible alternative for minimising environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by Donaldson Coal and was subject to detailed economic analysis.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or "without" Modification scenario, the Modification 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 Modification 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
Incremental Economic Benefits and Costs of the Modification

Category	Costs	Benefits
Net Production Benefits	Opportunity costs of capital equipment. Opportunity cost of land.[1] Development costs including labour, capital equipment and acquisition costs for impacted properties and offsets. Operating costs of mine including labour and mitigation measures. Rehabilitation and decommissioning costs at end of the Modification life.	Value of coal production. Residual value of capital equipment 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. Road transport impacts. Aboriginal heritage impacts. Non-Aboriginal heritage impacts. Visual impacts.	Any non-market benefits of employment. Value of ecological offsets.

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

Note: There are also net production benefits and potential environmental costs associated with increased throughput at the CHPP from Tasman Underground Mine. The development of the CHPP facilitates additional coal mining at the Tasman Underground Mine. The costs and benefits of the Tasman Underground Mine extension have already been considered as part of the Tasman Extension Project (Gillespie, 2012) and therefore are not reassessed in this economic analysis.

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), then no environmental, social or cultural economic costs should be included in the Modification BCA.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with NSW Treasury (2007) 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 17 years (i.e. the life of the Modification). Where competitive market prices are available, they have generally 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[2]. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[3].

2.4.1 Production Costs and Benefits[4]

Production Costs

Opportunity Cost of Land and Capital

The Modification extends the life of Abel Underground Mine by two years from 2028 to 2030. There is potentially a small opportunity cost of continuing to use capital equipment and land for an additional two years rather than being able to realise its value by sale or alternative use in 2028.

However, Donaldson Coal has advised that capital equipment is likely to have little residual value at the end of the current approval and hence there would be no additional opportunity cost of capital equipment as a result of an additional two years mine life from the Modification.

There would be some residual value of land at the end of the current approval and hence an opportunity cost of continuing to use this land for an additional two years rather than being able to realise its value by sale or alternative use. However, this is assumed to be offset by the benefit of delaying the costs associated with decommissioning and rehabilitating the surface infrastructure site.

Development Cost of the Modification

Development costs of the Modification are associated with the purchase of mining equipment, upgrading the Bloomfield CHPP, upgrades to the integrated water management system, construction of a downcast ventilation shaft, and other associated minor infrastructure, plant equipment and activities. These costs include labour costs during the development of the Modification, which reflect the value of labour resources in their next best use.

These incremental development costs over the life of the mine are estimated at $442M. These development costs include an allowance for acquisition of land for ecological offsets that may be required for additional disturbance required for the Modification. Development costs are included in the economic analysis in the years that they are expected to occur.

[2] 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.

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

[4] All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Annual Operating Costs of the Modification

The operating costs of the Modification include those associated with mine operation, plant and infrastructure operations (including CHPP operation), coal delivery (rail freight and Port handling and loading) 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. The average annual operating costs (excluding depreciation and royalties) are estimated at approximately $34M over 17 years. Although it should be noted that the Modification has the effect of bringing forward in time operating costs relative to the current approval and hence there are additional operating costs in the first 11 years of the Modification and reduced average annual operating costs in subsequent years.

While royalties are a cost to Donaldson Coal, 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 Modification. Nevertheless, it should be noted that the Modification would generate total royalties in the order of $86M ($75M present value).

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

The Modification would delay site decommissioning and rehabilitation at the Abel Underground Mine by two years. This delay is a benefit of the Modification, due to discounting. However, this benefit is assumed to be offset by opportunity costs of land used in the Modification for an additional two years.

Production Benefits

Value of Coal

Total incremental ROM coal production is estimated at 19 Mt with peak production at 6.1 Mtpa ROM. Product coal is a combination of coking coal and thermal coal, for export.

Both demand for and supply of coal influences current and projected prices.

Projected prices for the Modification product thermal coal were assumed to be AUD$135/tonne for coking coal and AUD$90 for thermal coal. There is uncertainty around future coal prices (valued in USD) as well as the AUD/USD exchange rate and hence assumed coal prices have been subjected to sensitivity testing (see Section 2.5).

Residual Value at End of the Evaluation Period

At the end of the Modification, capital equipment and land (excluding offsets) may have some residual value that could be realised by sale or alternative use. For most capital equipment the residual value is assumed to be zero at the end of the Modification, apart from longwall equipment which is estimated to have a residual value of $80M at the end of longwall operations in 2023. The delay in realising the residual value of land is assumed to be offset by the delay in decommissioning and rehabilitation costs.

2.4.2 *Environmental, Social and Cultural Costs and Benefits*

The environmental, cultural and social impacts of the Modification can be considered within three main contexts:

- greenhouse gas emission costs and any non market benefits of employment provided by the Modification (i.e. non-market impacts that are related to production);
- additional environmental impacts associated with the Modification in comparison to the approved Abel Underground Mine; and
- subsidence effects and associated environmental impacts on the natural and built environment above the areas the method of underground mining would change due to the Modification.

These are considered in turn below.

Non-market Impacts of Production

Greenhouse Gas Emission Costs

The Modification is predicted to generate a total of some 1,265,052 tonnes of direct (scope 1) greenhouse gas emissions associated with mining and internal ROM coal haulage activities and 803,817 t of indirect (scope 2) greenhouse gas emissions associated the purchase of electricity (Appendix E of the EA). In addition, a total of some 189,498 t of indirect (scope 3) greenhouse gas emissions associated with the transportation of product coal to the Port of Newcastle and on-site diesel and electricity usage would be generated (Appendix E of the EA). Under the existing approval scope 1, 2 and 3 greenhouse gas emissions are estimated to average 47,356 t per annum.

In addition, the Modification would result in the loss of carbon sequestration benefits from the clearing of native vegetation (approximately 11.3 hectares [ha]) associated with the construction of the downcast ventilation shaft, a revised alignment of the approved overland conveyor and, if required, modifications to an existing tailings disposal storage location (the U Cut south void) at the Bloomfield Colliery. It is considered that the loss of carbon sequestration benefits associated with the clearance of this vegetation would be offset by the rehabilitation of these sites at the completion of the mining operations.

To place an economic value on incremental carbon dioxide equivalent (CO_2-e) emissions generated by the Modification, a shadow price of CO_2-e is required that reflects its social costs. The social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the 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 damage costs of CO_2-e is to examine the price of CO_2-e credits. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of AUD$23/t CO_2-e rising at 2.5% per year in real terms for three years and then remaining constant, was used. Sensitivity testing assuming a shadow price from AUD$8/t CO_2-e to AUD$40/t CO_2-e was also undertaken (Attachment 1).

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. For the purpose of the economic assessment this has been undertaken using Australia's share of global Gross Domestic Product (GDP) (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%.

Social and Economic Value of Employment

The Modification will result in 25 additional employees for the underground mining operations and 23 additional employees at the Bloomfield CHPP in peak years of production under the Modification. However, employee numbers may be less than under the current approval in the latter years of the Modification life. Average annual employment is estimated to be unchanged between the Modification and the current approval. Consequently, no non-market benefits of employment are included in the BCA.

Underground Mining

As described in Appendix A of the EA, underground mining results in mine subsidence effects occurring at the surface. These effects include shifting of the ground surface (generically referred to as subsidence). Subsidence effects can result in some impacts on natural features including streams and heritage sites.

The existing subsidence management commitments, designed to protect key natural and built surface features, would be maintained for the Modification.

These subsidence management commitments are detailed in Attachment 3 of the Main Report of the EA and are also, where relevant, referred to in the discussion below.

Surface Water

There would be no longwall or shortwall mining beneath Schedule 2 (i.e. 3rd order and above) streams for the Modification. Longwall and shortwall mining would occur beneath Schedule 1 (i.e. 1st and 2nd order streams), however, potential consequences of subsidence in these areas would be similar to those associated with the approved mine layout (Appendix A of the EA).

As a result of maintaining the subsidence management commitment for Schedule 2 streams, no additional consequences of subsidence on streams are expected due to the Modification (Appendix C of the EA).

No incremental economic effects have been identified in the BCA with respect to surface water impacts from underground mining.

Groundwater

The Modification would involve mining in the Permian coal measures, which have elevated salinity and are not considered significant exploitable aquifers (Appendix B of the EA).

Drawdown in the alluvium at the end of mining would be limited, and the alluvium would remain partially saturated (Appendix B of the EA). There would be no longwall or shortwall mining beneath the Blue Gum Creek alluvium.

The Modification is predicted to have very limited (i.e. less than 1 m³/day) incremental impact on baseflow to/from the streams overlying the underground mining areas, and no impacts are predicted for any private registered groundwater bore or well (Appendix B of the EA).

Consequently there are considered to be no significant environmental groundwater impacts for inclusion in the BCA.

Flora and Fauna

There would be no additional impacts to native vegetation overlying the longwall and shortwall mining areas (i.e. due to subsidence effects) in comparison to the potential impacts associated with the approved mine layout (Appendix I of the EA).

Consequently there are considered to be no significant environmental flora and fauna impacts from underground mining for inclusion in the BCA.

Aboriginal Heritage

Additional Aboriginal heritage surveys were conducted for the Modification. A total of 15 Aboriginal heritage sites and one Potential Archaeological Deposit (PAD) were identified within, or in close proximity to, the longwall and shortwall areas (Appendix F of the EA).

Six artefact sites (two possible scarred trees, rock shelter with a PAD and three grinding groove sites) were assessed as having low scientific significance within a local context. Four grinding groove sites were assessed as having a low to moderate scientific significance within a local context (Appendix F of the EA).

The likelihood of potential impacts to three grinding groove sites (two with a low to moderate significance, and one with low significance) was assessed as unlikely (less than 5% chance). Maximum predicted strains at the other four grinding groove sites (two with a low to moderate significance, and two with low significance) were assessed as having a possible (10 to 50%) chance that cracking could occur at these sites (Appendix F of the EA).

These potential impacts were described in the draft Aboriginal Cultural Heritage Assessment which was reviewed by the relevant Aboriginal Stakeholders.

Significant and widespread traditional, historical and contemporary cultural values and associations with the investigation area have been identified by the registered Aboriginal parties (and are also known through ethnohistorical evidence). These do not necessarily involve Aboriginal objects or physical evidence. These associations and cultural values include (among other more specific values) the entire the Black Hill locality (including the Modification area) as a cultural landscape; the Black Hill Spur Aboriginal pathway; and ‘The Doghole’, a historically documented initiation/ceremonial site (Appendix F of the EA).

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

Impacts on highly significant Aboriginal heritage sites have been shown to affect the well-being of the broader community (Gillespie Economics, 2009a). However, community values for impacts on sites of low-moderate significance remain untested.

Consequently, in this analysis impacts on Aboriginal sites remain unquantified.

Non-Aboriginal Heritage

No items that are considered to be of non-Aboriginal heritage significance would be impacted by the Modification. Therefore no economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Subsidence Damage to Houses and Other Property Improvements

In the Modification underground mining area and surrounds, there are a number of private houses, buildings, sheds, dams, fences and other improvements that would potentially be affected by mine subsidence.

The existing subsidence management commitment for principal residences would be maintained for the Modification. As such, there would be no longwall or shortwall mining beneath principal residences without agreement from the relevant owner.

No additional consequences of subsidence to other property improvements are predicted due to the Modification compared to those predicted for the approved mine layout (Appendix A of the EA).

Donaldson Coal currently makes contributions to the Mine Subsidence Board (MSB) in accordance with the requirements of the NSW *Mine Subsidence Compensation Act, 1961*. The cost of any compensation or repair of damage from mine subsidence that is required would then be met by the MSB.

Donaldson Coal would continue to make contributions to the MSB for the Modification.

Subsidence Damage to Infrastructure

There is a range of infrastructure located above or in close proximity to the underground mining area that may potentially be adversely affected by subsidence effects. Infrastructure with more than 20 mm predicted subsidence associated with the proposed longwall and shortwall mining includes the:

- Blackhill, Taylors and Meredith Roads, and other unsealed public roads;
- Ausgrid 132 kV power line, and the network of 66 kV and low voltage powerlines servicing residential properties;
- Testra direct buried optical fibre cable and copper telecommunications cables;
- Black Hill Quarry; and
- Stockrington Quarry.

No additional consequences of subsidence are predicted due to the Modification at the locations of these infrastructure in comparison to those predicted for the approved mine plan (Appendix A of the EA).

Potential impacts on these items of infrastructure would be managed through the Extraction Plan/Subsidence Management Plan process. Management measures would be implemented by Donaldson Coal where required and remediation of subsidence damage would be facilitated and funded by the MSB, as required.

Mine Subsidence Fund contributions and general subsidence management costs for the Modification would be similar to those for the approved mine layout.

Blasting Vibration

Underground blasting to assist with the breakup of igneous intrusions in the coal seam has the potential to cause structural damage or human discomfort at properties located above areas where blasting is used underground. The potential impacts of blast overpressure and vibration were assessed in Appendix D of the EA. The assessment concluded that with the implementation of suitable blast control measures, all nearby private receivers would be below relevant building damage and human comfort criteria.

Hence, no economic effects have been identified in the BCA with respect to blasting impacts.

Visual Impacts

The Modification would have limited potential for visual impacts as mining would be underground. Visual aspects of the key surface features of the mining operations are described below.

The Modification may increase the potential surface cracking and erosion on steep slopes. However, the areas where this would potentially occur would not be visible from major roads. The Modification is expected to result in minimal additional visual impacts.

Surface Facilities

Surface Water

Water supply for the Abel Underground Mine (including Bloomfield CHPP) is sourced from rainfall runoff collected from disturbed areas and groundwater that accumulates in the mine workings.

No unregulated river access licences are required for the Abel Underground Mine (Appendix B of the EA).

The water management system would be revised for the Modification, and has been designed (Appendix C of the EA) such that discharge from the site would only be in accordance with Donaldson Coal's Environment Protection Licence (EPL) No. 11080.

No economic effects have been identified in the BCA with respect to surface water impacts from the Modification.

Flora and Fauna

Minor clearance (approximately 11.3 ha) may be required for the Modification (i.e. for the downcast ventilation shaft, revised alignment of an approved overland conveyor and, if required, modifications to an existing tailings disposal storage location at the Bloomfield Colliery).

No threatened ecological communities have been identified in the proposed disturbance areas.

Land opportunity costs associated with an offset area and offset management costs have been included in the BCA. Provided that the offset compensates for the values of the lost ecology there would be no loss in biodiversity values.

Operational Noise

No private residences have been identified in Appendix D of the EA as being above applicable noise criteria and hence no operational noise impacts from the Modification have been included in the BCA.

Air Quality

No private residences have been identified in Appendix E of the EA as being above applicable air quality criteria and hence no air quality impacts from the Modification have been included in the BCA.

Road Transport

Additional road traffic generated by the operation of the Modification would be limited to an increase in employees (i.e. 25 additional employees for underground mining operations and 23 additional employees at the Bloomfield CHPP).

Additional traffic generation associated with the Modification is expected to be well within the daily variations experienced on the major roads surrounding the Abel Underground Mine (i.e. John Renshaw Drive and the New England Highway) (Appendix G of the EA).

Any minor increases in traffic generation associated with the Modification could be satisfactorily accommodated on the public road network, with a negligible perceivable impact on operating conditions (Appendix G of the EA).

Aboriginal Heritage

The downcast ventilation shaft and overland conveyor would be located to avoid impacts to Aboriginal heritage.

If the modifications to the U Cut south area required, surveys would be conducted with relevant Aboriginal stakeholders prior to any additional surface disturbance in this area in accordance with the protocols described in the Aboriginal Heritage Management Plan.

The Aboriginal Heritage Management Plan would be updated in consultation with relevant Aboriginal stakeholders to include the proposed clearance area. Additional disturbance for the modifications to the U Cut south would not occur without approval of the Aboriginal Heritage Management Plan by the Department of Planning and Infrastructure.

Visual Impacts

The proposed downcast ventilation shaft for the Modification would be located within a vegetated area of land owned by Coal & Allied. The height of surrounding vegetation would obscure views of the downcast ventilation shaft (and the associated minimal lighting required for security and safety reasons) from public areas.

The modifications and upgrades to the Bloomfield CHPP would be within the approved disturbance area and immediately adjacent to existing infrastructure, and as such, would not significantly alter the visual impacts of the area.

There are considered to be no visual impacts that are sufficiently significant that they would warrant inclusion in the BCA.

2.4.3 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 Modification, because the community as a whole would obtain net benefits from the Modification.

The Modification is estimated to have incremental (i.e. in comparison to the approved Abel Underground Mine) net production benefits of $265M, with $165M of these net production benefits accruing to Australia[5]. 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[6], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $165M. This is equivalent to each household in the region valuing residual environmental impacts at $837. The equivalent figure for NSW and Australian households is $64 and $20, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Modification. From Table 2.2 these impacts to Australia are estimated at $0.2M, considerably less than the estimated net production benefits of the Modification to Australia.

Overall, the Modification is estimated to have net social benefits to Australia of $165M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Modification BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than $165M for the Modification to be questionable from an Australian economic perspective.

[5] This is the net production benefits of the Modification minus net profit accruing to overseas shareholders.

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

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

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land	$0	Value of coal	$1,077
	Opportunity cost of capital	$0	Residual value of land and capital	$38
	Development costs	$329		
	Operating costs	$522		
	Decommissioning and rehabilitation costs	$0		
	Sub-total	**$851**	***Sub-total***	**$1,115**
	Net Production Benefits			**$265 ($165)**
Non-market production impacts	Greenhouse gas emission	$25 ($0.2)	Non-market values of employment	$0
Underground mining impacts	Surface water	Negligible		
	Groundwater	Negligible		
	Flora and fauna	Negligible		
	Aboriginal heritage	Unquantified		
	Non-Aboriginal heritage	Negligible		
	Subsidence damage to infrastructure	Negligible		
	Blasting vibration	Negligible		
	Visual impacts	Negligible		
Surface facilities impacts	Surface water	Negligible		
	Flora and fauna	Some loss of values but offset. Cost of offset included in capital and operating costs		
	Operational noise	Negligible		
	Blasting overpressure and vibration	Negligible		
	Air quality	Negligible		
	Road transport	Negligible		
	Aboriginal heritage	Negligible		
	Non-Aboriginal heritage	Negligible		
	Visual impacts	Negligible		
	Non-market impacts sub-total	**$25 ($0)**		**$0**
NET SOCIAL BENEFITS				**$240 ($165)**

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

2.4.4 Distribution of Costs and Benefits

While BCA is primarily concerned with the aggregate benefits and costs of the Modification to Australia, the distribution of costs and benefits may also be of interest to decision-makers.

The net production benefit shown in Table 2.3 is potentially distributed amongst a range of stakeholders including:

- Donaldson Coal shareholders in the form of after tax (and after voluntary contributions) profits;
- the Commonwealth Government in the form of any Company tax payable ($57M present value) and Minerals Resource Rent Tax from the Modification, which are subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the regional area;
- the NSW Government via royalties ($75M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- the regional community in the form of voluntary contributions to community infrastructure and services.

The potential environmental, cultural and social impacts of the Modification may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely insignificant or internalised into the production costs of Donaldson Coal.

Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Modification biodiversity offsets. The cost of providing biodiversity offsets is included in the estimation of net production benefits. Aboriginal heritage impacts will potentially occur to Aboriginal people and NSW households[7], however, these economic costs remain unquantified in the analysis (Section 2.4.2). All other potential impacts would occur at the local level or state[8] level and were found to be insignificant.

The non-market costs that accrue to NSW are estimated at less than $0.2M. These are considerably less than the net production benefits that directly accrue to NSW through royalties ($75M). Other benefits to NSW would include any voluntary contributions to the regional community and benefits to NSW shareholders[9]. Consequently, the Modification would result in net benefits to NSW.

[7] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

[8] It should be noted that the studies found public good values for employment surveyed NSW households.

[9] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and the MRRT.

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 Donaldson Coal	$133	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	$57	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$75	✓	✓	-	-
Net production benefits to local and regional community in the form of voluntary contributions	Unquantified	✓	-	-	-
Total	***$265***				
Non-market Production Impacts					
Non-market benefit of employment	$0	✓	✓	-	-
Greenhouse gas emissions rest of the world	$25	-	-	-	✓
Greenhouse gas emissions Australia[1]	$0.2	✓	✓	✓	
Underground Mining Impacts					
Surface water	Negligible	✓	-	-	-
Groundwater	Negligible	✓	-	-	-
Flora and fauna	Negligible	✓	✓	-	-
Aboriginal heritage	Unquantified	✓	✓	-	-
Non-Aboriginal heritage	Negligible	✓	-	-	-
Subsidence damage to infrastructure	Negligible	✓	-	-	-
Blasting vibration	Negligible	✓	-	-	-
Visual impacts	Negligible	✓	-	-	-
Surface Facilities Impacts					
Surface water	Negligible	✓	-	-	-
Flora and fauna	Some loss of values but offset. Cost of offset included in capital and operating costs	✓	✓	-	-
Operational noise	Negligible	✓	-	-	-
Blasting overpressure and vibration	Negligible	✓	-	-	-
Air quality	Negligible	✓	-	-	-
Road transport	Negligible	✓	-	-	-
Aboriginal heritage	Negligible	✓	✓	-	-
Non-Aboriginal heritage	Negligible	✓	-	-	-
Visual impacts	Negligible	✓	-	-	-
Total	***$25***				
Net Social Benefits	**$240**				

[1] Assuming the global social damage cost of carbon is distributed in accordance with relative share of global gross domestic product.

Note: Totals may have minor discrepancies due to rounding.

2.5 SENSITIVITY ANALYSIS

The 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:

- Development costs;
- Operating costs;
- Value of coal;
- Greenhouse costs; and
- Residual value of capital.

What this analysis indicates (Attachment 2) is that the results of the BCA are not sensitive to the changes made in assumptions regarding any of these variables. In particular, significant increases in the values used for external impacts such as greenhouse gas costs did not change the positive sign of the net present value of the Modification. Hence the Modification's desirability from an economic efficiency perspective is not changed.

The results were most sensitive to any potential decreases in the sale value of coal. A sustained reduction in coal price (over 33%) would be required to make the Modification undesirable from an economic efficiency perspective.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA in Section 2 is concerned with whether the incremental benefits of the Modification exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Modification compared to 'without' it. In contrast, the focus of the regional economic impact assessment is the effect (impact) of the Modification 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 a local economy (Powell *et al.,* 1985; Jensen and West, 1986). This assessment is concerned with the economic impact of average annual production of the Modification (i.e. 3.6 Mtpa ROM coal production) compared to the average annual production under the current approval (i.e. 2.6 Mtpa ROM coal production.

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 two regions:

- The regional economy comprising the LGAs of Cessnock, Port Stephens, Newcastle, Maitland and Port Macquarie (i.e. Newcastle Statistical Sub-division); and
- The NSW economy.

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 models (Powell *et al.,* 1985). This study uses input-output analysis.

Input-output analysis essentially involves two steps:

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

The input-output method is based on a number of assumptions that are outlined in Attachment 3. These result in estimated impacts being an upper bound impact estimate.

3.2 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

A 2006 input-output table[10] of the regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 4) using a 2006 input-output table of the NSW economy (developed by Monash University) as the parent table. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economy.

The resulting 6 sector 2006 input-output table 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). For example, the mining sector in the regional economy sells $16,000 worth of output to the agriculture, forestry and fishing sector of the regional economy, $42,584,000 worth of output to the mining sector of the regional economy etc, sells $1,394,000 of output directly to households and exports $916,730,000 worth of output from the region.

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 of Table 3.1. For the mining sector to produce $1,152,868,000 worth of output, it purchases $104,000 of inputs from the agriculture, forestry and fishing sector of the regional economy, $42,584,000 of inputs from the mining sector of the regional economy etc, imports $130,559,000 of inputs from outside the region, generates $709,177,000 in other value added, employs 2,273 people and pays $150,384,000 in wages and salaries.

Table 3.1
Aggregated Transactions Table: Regional Economy 2006 $'000

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	5,210	104	53,983	17	640	20,108	80,062	36,107	88,978	146,046	351,193
Mining	16	42,584	83,271	125,586	6,359	4,153	261,969	1,394	-27,225	916,730	1,152,868
Manufacturing	32,231	37,215	1,797,045	28,654	381,091	997,263	3,273,500	705,662	731,871	5,765,119	10,476,153
Utilities	3,584	7,473	163,699	979,533	16,256	193,578	1,364,123	144,583	20,054	618,646	2,147,406
Building	2,463	8,617	24,290	28,291	672,890	271,283	1,007,834	0	2,038,505	164,397	3,210,736
Services	41,939	66,754	1,167,476	68,708	361,460	4,469,637	6,175,975	4,392,512	5,466,987	8,009,805	24,045,279
TOTAL	85,443	162,747	3,289,764	1,230,788	1,438,697	5,956,023	12,163,463	5,280,258	8,319,170	15,620,743	41,383,635
Household Income	69,912	150,384	1,581,260	155,696	817,163	8,675,384	11,449,801	0	0	0	11,449,801
OVA	62,747	709,177	1,345,491	411,354	308,138	4,021,630	6,858,537	672,889	294,152	28,076	7,853,654
Imports	133,091	130,559	4,259,637	349,568	646,738	5,392,241	10,911,834	6,242,146	1,580,417	1,107,411	19,841,809
TOTAL	351,193	1,152,868	10,476,153	2,147,406	3,210,736	24,045,279	41,383,635	12,195,294	10,193,739	16,756,230	80,528,898
Employment*	1,805	2,273	22,802	2,281	11,708	140,819	181,688				

* Number of people employed in each industry.

Note: Totals may have minor discrepancies due to rounding.

[10] A key driver in the development of regional input-output tables is detailed employment by industry data from the Census. At the time of the preparation of this report this data from the 2011 Census was not available.

Gross regional product (GRP or value-added) for the regional economy in 2006 was estimated at $19,303M, comprising $11,450M to households as wages and salaries (including payments to self employed persons and employers) and $7,854M in OVA (Table 3.1).

The employment total working in the region was estimated to be 181,688 people (Table 3.1).

The economic structure of the regional economy can be contrasted 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 economies are not dissimilar, with the main difference being the greater relative importance of the manufacturing sectors to the regional economy as well as the greater relative importance of gross regional product (value-added) and output in the mining and utilities sectors to the regional economy. The agriculture/forestry/fishing sectors, building sectors and services sectors are of slightly lower relative importance to the regional economy than they are to the NSW economy.

Figure 3.1
Summary of Aggregated Sectors: Regional Economy (2006)

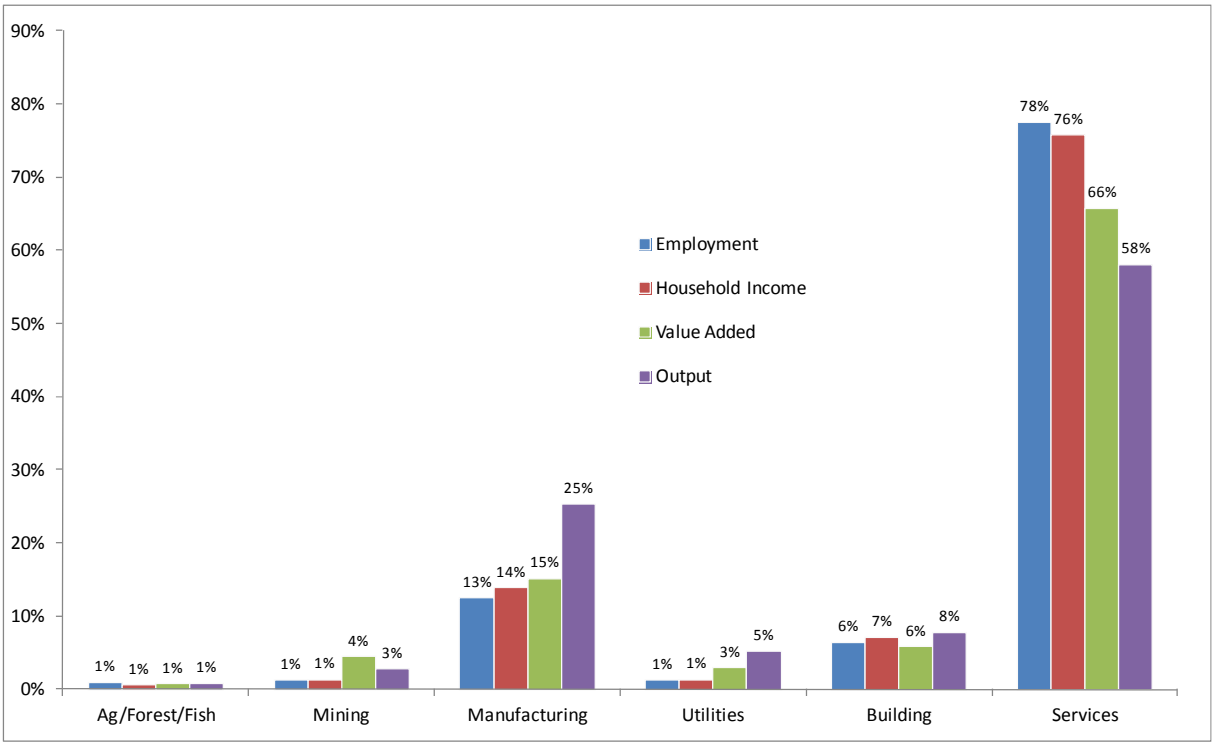
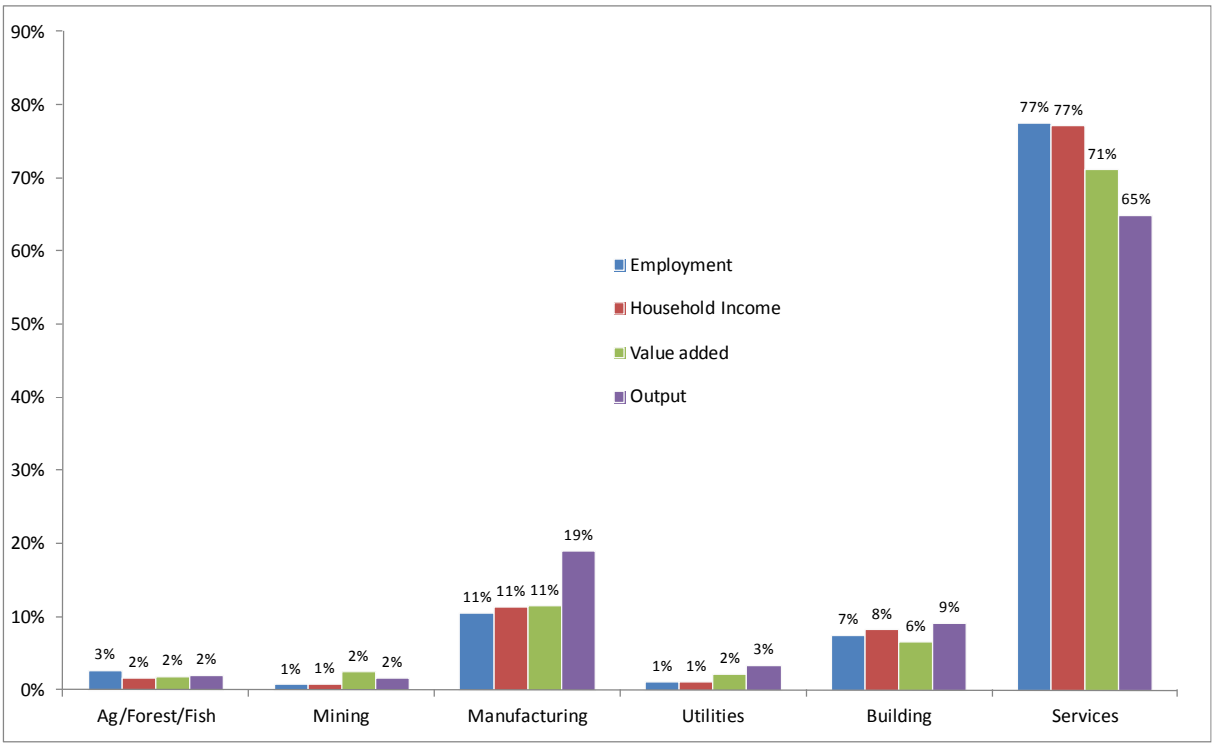


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2006)



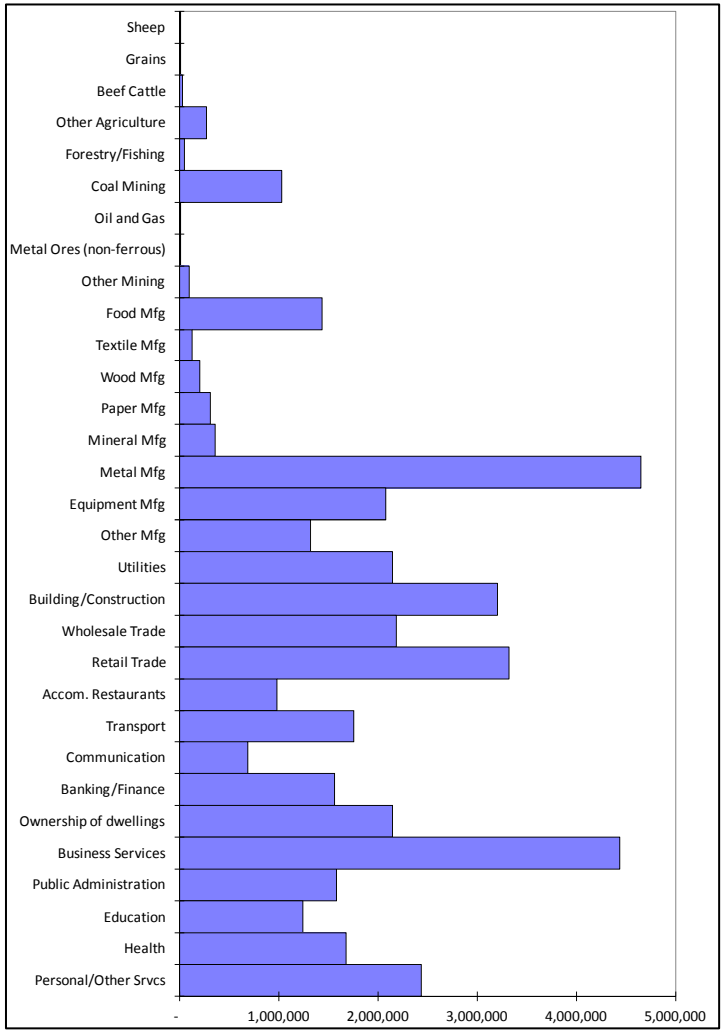
Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the regional economy

What is clear from these figures is the importance of the tertiary sectors and manufacturing sectors to the regional economy, with coal mining being the dominant primary sector activity. In terms of gross output in the regional economy, the business services sectors and metal manufacturing sectors are the most significant, with the business services sectors also being the most significant in terms of value-added and income. The retail sector is the most significant sector to the regional economy in terms of employment, while the metal manufacturing sectors are the most significant sectors in the regional economy in terms of exports and imports.

At an individual sector level, the retail trade sector and basic non-ferrous metal manufacturing sector are the most significant sectors for output, while the retail trade sector and health sector are the most significant sectors in terms of value-added, employment and income. The retail trade sector and basic non-ferrous metal manufacturing sector are the most significant sectors for imports and exports.

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

Gross Regional Output



Gross Value-Added

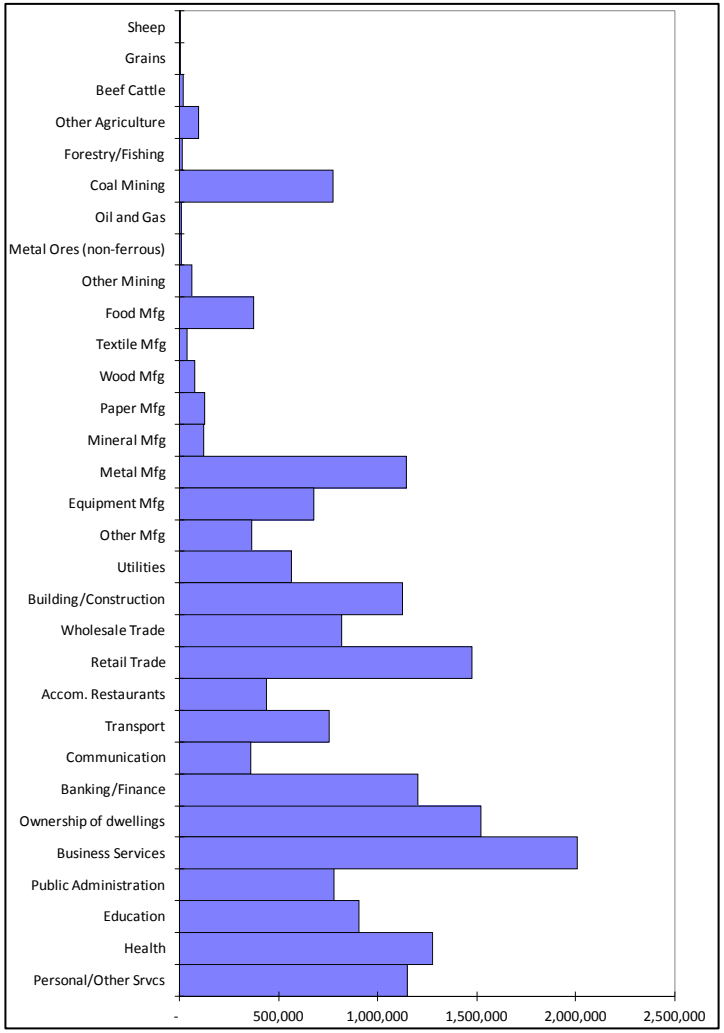
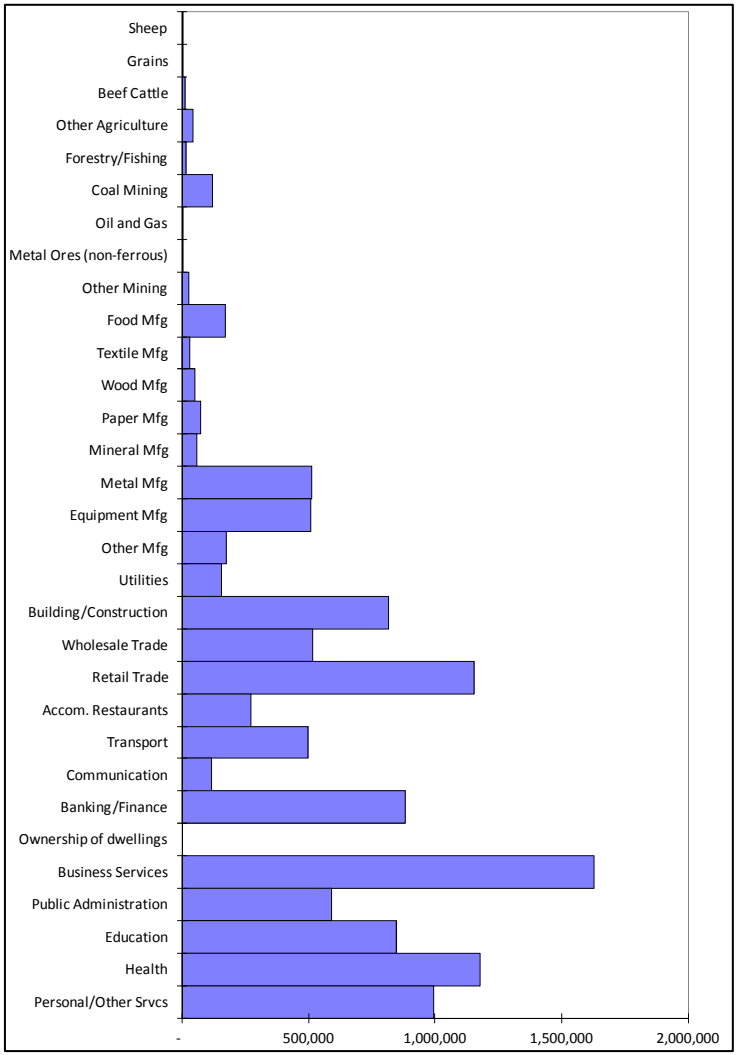


Figure 3.4
Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

Income



Regional Employment

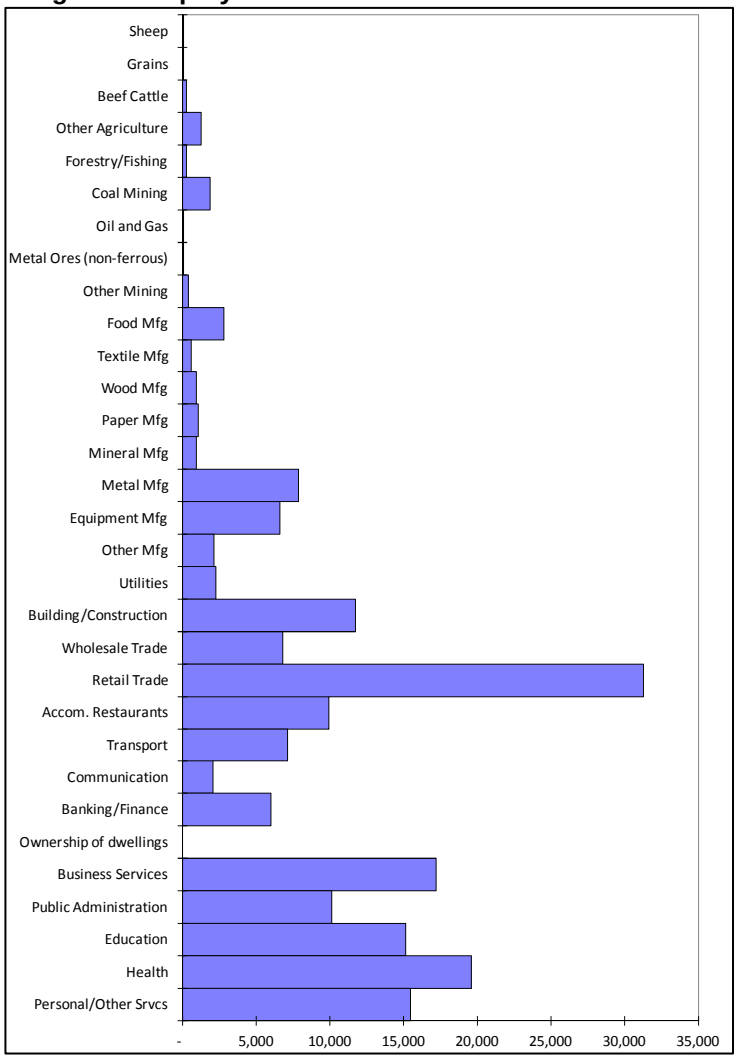
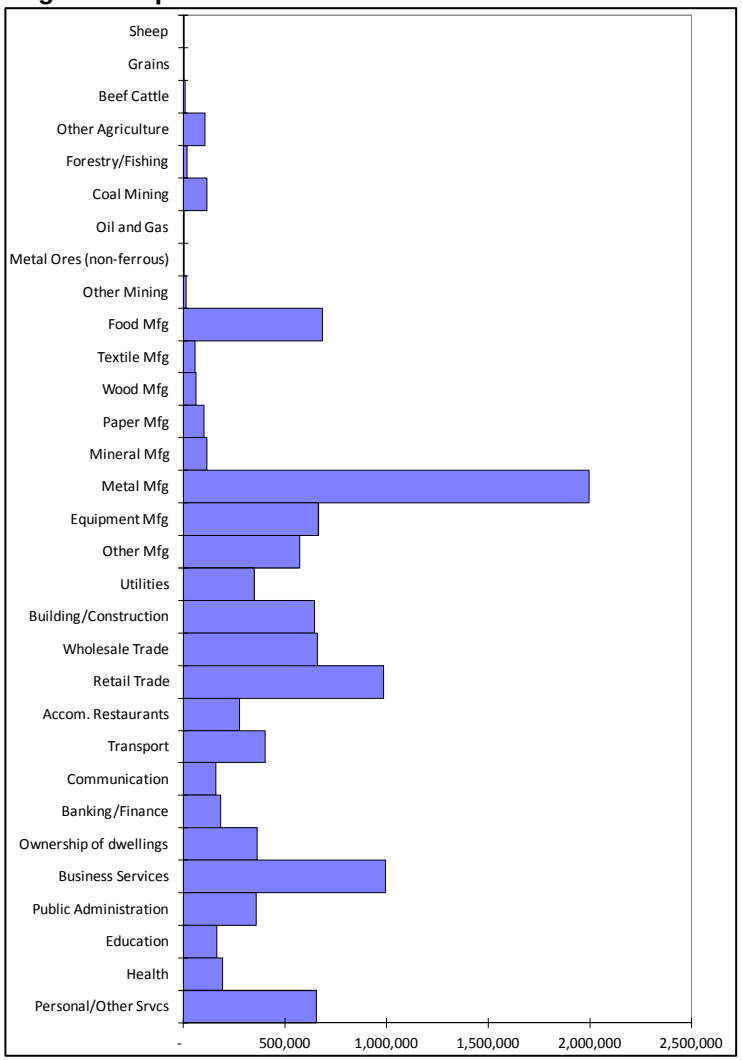
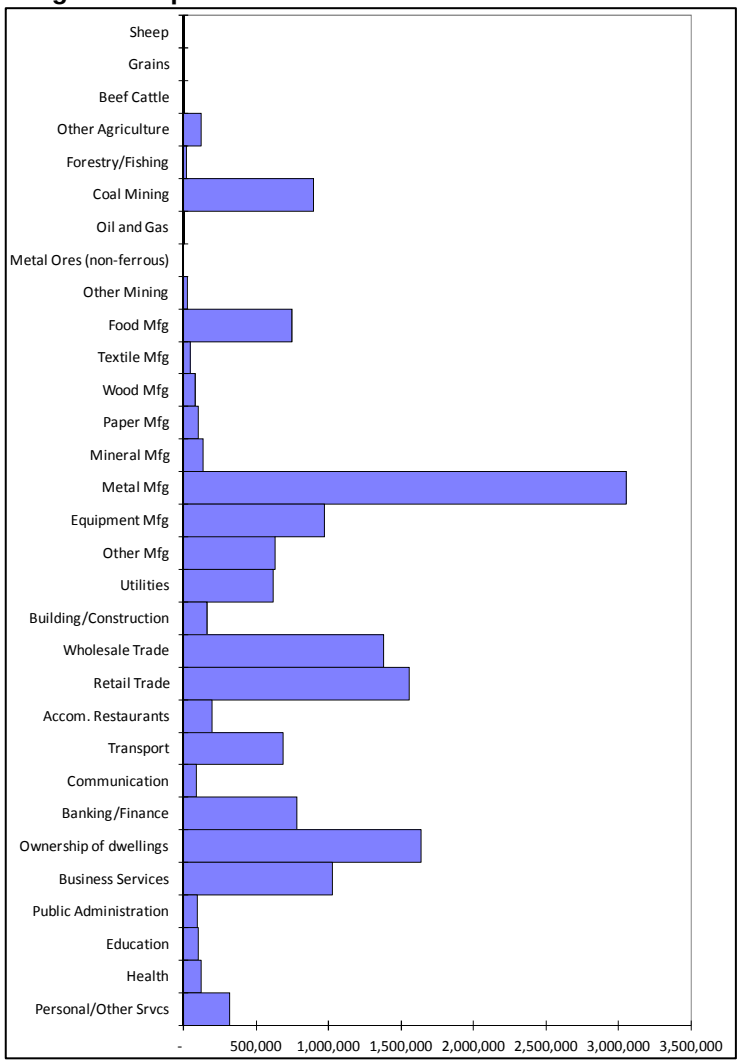


Figure 3.5
Sectoral Distribution of Imports and Exports ($'000)

Regional Imports



Regional Exports



3.3 ECONOMIC IMPACT OF THE MODIFICATION

The main economic impact of the Modification is associated with the additional revenue, expenditure and employment from the operation of the Modification relative to the mining under the current approval. Expansion of production would stimulate economic activity for the regional economy, as well as for the broader NSW economy. The regional impacts of current operation of the Abel Mine and operation under the Modification are estimated for the indicators of output, value-added, income and employment.

3.3.1 *Operation Phase*

Introduction

For the analysis of the operational phase of the Modification, two new sectors were separately inserted in the regional input-output table. The first sector reflected the average annual production under the current approval i.e. 2.6 Mtpa ROM. The second reflected the average annual production under the Modification i.e. 3.6 Mtpa ROM. The average annual revenue, operating costs and employment levels under each of these scenarios was obtained from financial information provided by Donaldson Coal.

For these sectors:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of employees was allocated to the *household wages* row. All employees were assumed to reside in the region;
- non-wage expenditure was initially allocated between *imports* and *intermediate sectors* in the economy based on the proportions in the coal sector of the regional input-output table;
- the difference between total revenue and total costs was allocated to the *other value-added* row*;* and
- the direct employment number was allocated to the *employment* row.

Impacts on the Regional Economy

Economic Activity

The total and disaggregated average annual impacts of the current approval and Modification on the regional economy (in 2012 dollars) are shown in Tables 3.2 and 3.3. The incremental average annual impacts of the Modification are shown in Table 3.4.

Table 3.2
Economic Impacts of the Current Approval on the Regional Economy ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	188,965	134,988	53,389	188,378	377,343
Type 11A Ratio	*1.00*	*0.71*	*0.28*	*1.00*	*2.00*
VALUE ADDED ($'000)	17,743	63,535	25,145	88,680	106,423
Type 11A Ratio	*1.00*	*3.58*	*1.42*	*5.00*	*6.00*
INCOME ($'000)	38,142	33,822	18,490	52,312	90,454
Type 11A Ratio	*1.00*	*0.89*	*0.49*	*1.37*	*2.37*
EMPL. (No.)	318	389	280	669	987
Type 11A Ratio	*1.00*	*1.22*	*0.88*	*2.10*	*3.10*

* Direct employment of 318 represents average annual employees residing in the regional economy. Contractors are located in production-induced flow-ons.

Table 3.3
Economic Impacts of the Modification on the Regional Economy ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	250,578	151,699	56,494	208,193	458,771
Type 11A Ratio	*1.00*	*0.61*	*0.23*	*0.83*	*1.83*
VALUE ADDED ($'000)	58,164	71,401	26,608	98,009	156,173
Type 11A Ratio	*1.00*	*1.23*	*0.46*	*1.69*	*2.69*
INCOME ($'000)	38,141	38,009	19,565	57,574	95,715
Type 11A Ratio	*1.00*	*1.00*	*0.51*	*1.51*	*2.51*
EMPL. (No.)	318	437	296	734	1,052
Type 11A Ratio	*1.00*	*1.38*	*0.93*	*2.31*	*3.31*

* Direct employment of 318[14] represents average annual employees residing in the regional economy. Contractors are located in production-induced flow-ons.

Table 3.4
Incremental Economic Impacts of the Modification on the Regional Economy ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	61,613	16,710	3,105	19,816	81,429
VALUE ADDED ($'000)	40,421	7,866	1,462	9,328	49,750
INCOME ($'000)	0	4,187	1,075	5,262	5,261
EMPL. (No.)	0	48	16	64	64

[14] While it is recognised that the Modification will result in approximately 25 additional operational employees for the Abel Underground Mine operations at peak production and approximately 23 additional employees at the Bloomfield CHPP at peak production the regional economic impact assessment is based on average annual employment levels over life of the Abel Underground Mine.

The Abel Underground Mine (including the activities associated with the Modification) is estimated to make up to the following average annual contribution to the regional economy for 17 years (Table 3.3):

- $459M in annual direct and indirect regional output or business turnover;
- $156M in annual direct and indirect regional value added;
- $96M in annual direct and indirect household income; and
- 1,052 direct and indirect jobs.

The Modification is estimated to make up to the following incremental (i.e. in comparison to the approved Abel underground Mine) average annual contribution to the regional economy for 17 years (Table 3.4):

- $81M in annual direct and indirect regional output or business turnover;
- $50M in annual direct and indirect regional value added;
- $5M in annual indirect household income; and
- 64 indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Modification's impact on the regional economy range from 1.83 for output up to 3.31 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 occur 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 Modification. 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 Modification are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- Services to mining sector;
- Electricity supply sector;
- Other property services sector;
- Retail trade sector;
- Wholesale trade sector;
- Construction trade services sector; and the
- Rail transport sector.

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 Modification (Table 3.5).

Table 3.5
Sectoral Distribution of Employment Impacts on the Regional Economy

Sector	Regional Economy			
	Average Direct Effects	Product.-induced	Consump.-induced	Total
Primary	0	1	2	3
Mining	318	83	0	402
Manufacturing	0	66	18	84
Utilities	0	10	3	14
Wholesale/Retail	0	52	65	117
Accommodation, cafes, restaurants	0	10	44	55
Building/Construction	0	47	2	50
Transport	0	53	10	63
Services	0	115	151	266
Total	**318**	**437**	**296**	**1,052**

Note: Totals may have minor discrepancies due to rounding.

Table 3.5 indicates that direct, production-induced and consumption-induced employment impacts of the Modification on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in the services sectors, mining sectors, manufacturing sectors, wholesale/retail trade sectors, transport sectors and building construction sectors while consumption induced flow-on employment would be mainly in services sectors, wholesale/retail trade sectors and accommodation/cafes/restaurants sectors.

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

Impact on the NSW Economy

Introduction

The NSW economic impacts of the Modification were assessed by separately inserting two new sectors in the NSW input-output table in the same manner described in Section 3.3.1. The primary difference from the sectors identified for the regional economy was that a greater level of expenditure was captured by NSW economy compared to the regional economy.

Economic Activity

The total and disaggregated average annual impacts of the current approval and Modification on the regional economy (in 2012 dollars) are shown in Tables 3.6 and 3.7. The incremental average annual impacts of the Modification are shown in Table 3.8.

Table 3.6
NSW Economic Impacts of the Current Approval ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	188,965	181,615	158,349	339,964	528,929
Type 11A Ratio	*1.00*	*0.96*	*0.84*	*1.80*	*2.80*
VALUE ADDED ($'000)	17,742	88,068	80,656	168,723	186,465
Type 11A Ratio	*1.00*	*4.96*	*4.55*	*9.51*	*10.51*
INCOME ($'000)	38,141	52,233	46,157	98,390	136,531
Type 11A Ratio	*1.00*	*1.37*	*1.21*	*2.58*	*3.58*
EMPL. (No.)	318	547	616	1,164	1,482
Type 11A Ratio	*1.00*	*1.72*	*1.94*	*3.66*	*4.66*

Table 3.7
NSW Economic Impacts of the Modification ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	250,578	204,095	169,674	373,769	624,347
Type 11A Ratio	*1.00*	*0.81*	*0.68*	*1.49*	*2.49*
VALUE ADDED ($'000)	58,164	98,966	86,424	185,391	243,555
Type 11A Ratio	*1.00*	*1.70*	*1.49*	*3.19*	*4.19*
INCOME ($'000)	38,141	58,697	49,458	108,155	146,296
Type 11A Ratio	*1.00*	*1.54*	*1.30*	*2.84*	*3.84*
EMPL. (No.)	318	615	660	1,275	1,593
Type 11A Ratio	*1.00*	*1.93*	*2.08*	*4.01*	*5.01*

Table 3.8
NSW Incremental Economic Impacts of the Modification ($2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	61,613	22,480	11,325	33,805	95,418
VALUE ADDED ($'000)	40,422	10,899	5,769	16,668	57,089
INCOME ($'000)	0	6,464	3,301	9,765	9,765
EMPL. (No.)	0	68	44	112	112

The Abel Underground Mine (including the activities associated with the Modification) is estimated to make up to the following average annual contribution to the NSW economy for 17 years (Table 3.7):

- $624M in annual direct and indirect regional output or business turnover;
- $244M in annual direct and indirect regional value added;
- $146M in annual direct and indirect household income; and
- 1,593 direct and indirect jobs.

The Modification is estimated to make up to the following incremental average annual contribution to the NSW economy for 17 years (Table 3.8):

- $95M in annual direct and indirect regional output or business turnover;
- $57M in annual direct and indirect regional value added;
- $10M in annual indirect household income; and
- 112 indirect jobs.

The impacts on the NSW economy are substantially greater than for the regional economy, as the NSW economy is able to capture more mine and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

3.4 MINE CESSATION

As outlined in Sections 3.2 and 3.3, the Modification will stimulate demand in the regional and NSW economy, for up to 17 years, leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, the cessation of the mining operations in the future would result in a contraction in regional and NSW economic activity. This would occur approximately two years after cessation of mining activity under the current approval.

The magnitude of the regional economic impacts of cessation of the Modification 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 Modification cessation on the regional economy would depend on whether the workers and their families affected would leave the region. If it is assumed that some or all of the workers remain in the regional, then the impacts of Modification cessation would not be as severe compared to a greater level leaving the regional. 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 Modification cessation would approximate the direct and production-induced effects in Table 3.3. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.3.

The decision by workers, on cessation of the Modification, to move or stay would be affected by a number of factors including the prospects of gaining employment in the local and regional economy compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local and regional areas (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 (Bureau of Industry and Economics, 1994). This in turn can depend on a region's natural endowments. In this respect, the regional is highly prospective with considerable coal resources (NSW Department of Trade and Investment, 2010).

It is therefore likely that, over time, new mining developments would occur, offering potential to strengthen and broaden the economic base of the local and regional area and hence buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of the Modification would depend on the economic structure and trends in the regional economy at the time. For example, if Modification cessation takes place in a declining economy, the impacts might be significant. Alternatively, if Modification cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Modification may not be a cause for concern.

Nevertheless, given the uncertainty about the future complementary mining activity in the regional economy it is not possible to foresee the likely circumstances within which Modification cessation would occur.

4 EMPLOYMENT, POPULATION AND COMMUNITY INFRASTRUCTURE ASSESSMENT

4.1 INTRODUCTION

Changes in the workforce and populations of a region may well have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities. This may include the number of services that are available to be used and the accessibility of these services.

The objective of this EPCIA is to examine the potential impacts of the Modification on the existing community infrastructure as a result of employment and population change associated with the Modification. Potential impacts on social amenity are also considered.

The basic methodology for carrying out the EPCIA was to:

- analyse the likely incremental magnitude of the additional Modification workforce and associated population growth including estimated flow-on employment and population effects;
- consider the impacts of estimated employment and population change on community infrastructure based on consideration of the existing socio-economic environment of the region; and
- recommend impact mitigation or management measures for any substantive impacts that are identified.

The geographic scope of the EPCIA was determined by the location of Modification and the region that would potentially service the Modification and its employees. The Modification is located approximately 20 km west of Newcastle. All of mine employment is estimated to live in the Newcastle Statistical Subdivision (SSD).

The assessment draws on a range of publications and reports as well as data provided by Donaldson Coal, the ABS Census, and information from Section 3 on the potential regional economic impacts of the Modification. While the Modification may also have population and workforce effects at a NSW state level and in other nearby regions such as Gosford, Wyong and Sydney, these effects would not be of sufficient magnitude to warrant consideration of potential adverse effects.

4.2 MODIFICATION WORKFORCE AND POPULATION CHANGE

The main drivers for impacts on community infrastructure are changes in employment and population and the spatial location of these changes in employment and population. Employment that is directly generated by the Modification may be sourced from:

- the local region either from:
  - the unemployment pool; and/or
  - workers from other industries;
- in-migration; or
- commuters.

Sourcing labour from the local region has minimal direct impact on local community infrastructure and services since it results in no changes to the regional population and hence demand for services. It may, however, have an indirect impact on some local community infrastructure and services where changes in employment status or income result in changes in demand for some particular services (e.g. health services).

Whether local labour is sourced from the unemployment pool or from other industries, it can reduce unemployment levels - directly in the case of employing unemployed people and indirectly via the filter effect[15] where labour is sourced from other industries.

The impact of commuter workers would depend on the extent to which they integrate into the regional communities, however, for the purpose of this analysis it is assumed that the impact of commuter workers is likely to be very minor.

In-migration resulting in population change is likely to have the greatest potential impact on demand for community services and infrastructure with this impact dependent on the new residential location of the migrating workforce and their families.

As well as direct employment and population changes, mining projects may also generate indirect labour demand through expenditure by employees in the local region and mine operation expenditure in the local region on other inputs to production. This induced demand for labour may also have consequences for population change and demand for community infrastructure and services.

To facilitate consideration of potential community infrastructure impacts, this section explores the likely direct and indirect employment and population effects of the Modification.

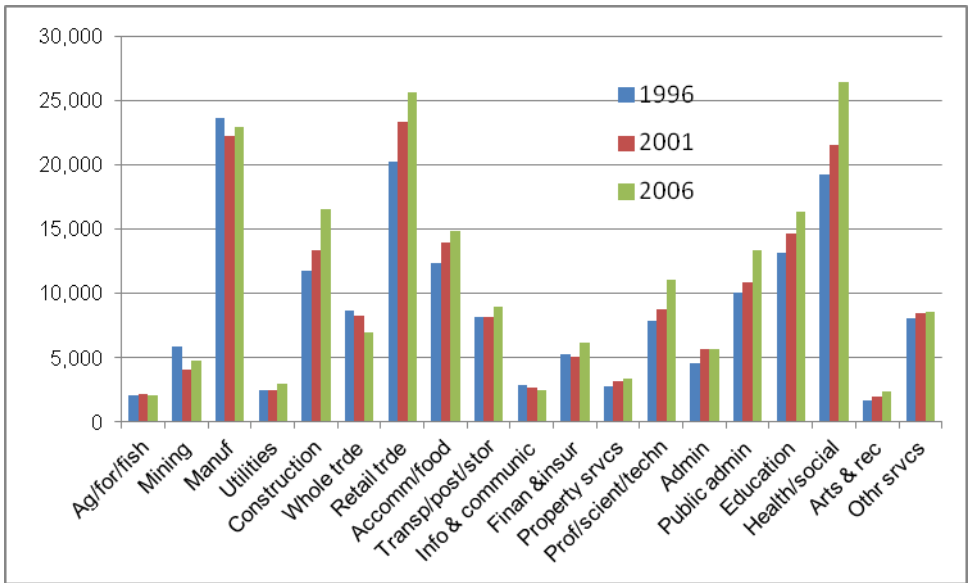
4.2.1 Construction Workforce and Population Change

It is anticipated that during the initial development of the Modification, 25 construction workers would be required over a three month period and 5 workers over a 12 week period for the construction of the downcast vent shaft.

Examination of the employment by industry data in Figure 4.1 indicates that the Newcastle Region has a strongly growing construction sector. It is envisaged that most of the required construction workforce would be contractor labour from existing contractor firms located within the region. Any construction workforce unable to be sourced locally would most likely be able to be sourced from Sydney and commute to the region daily. Consequently, little, if any, population change as a result of the construction workforce is envisaged.

[15] The filter effect refers to the situation where labour is sourced from other industries in the region making jobs available in those industries which are subsequently filled by people either from the unemployment pool or other industries with the latter making jobs available in that industry, etc.

Figure 4.1
Newcastle SSD Employment by Industry



Source: ABS, 2006

4.2.2 Operation Workforce and Population Change

The Modification relates to the continuation and expansion of an existing activity. The operational workforce associated with the Modification is estimated at up to an additional 25 employees for the underground mining operations and up to 23 additional employees at the Bloomfield CHPP, during peak periods.

Employment in the region in mining, construction, transport, professional/scientific/technical services has been growing considerably over time (Figure 4.1) and unemployment levels have been increasing since 2008. In 2010 there were 13,848 unemployed persons in the Newcastle SSD (Table 4.1).

Table 4.1
Unemployment in the Newcastle SSD (June Quarter)

		2006	2007	2008	2009	2010
Unemployed persons	No.	14,961	13,123	13,007	13,066	13,848
Unemployment rate	%	5.9	5.4	5.0	5.1	5.2

Source: ABS (2012)

Donaldson Coal has established a number of programs to aid in the local recruitment of its workforce including:

- offering apprenticeship opportunities (in conjunction with Hunter Vtec) within electrical and mechanical trades;
- the cleanskin program to introduce people who haven't worked in the mining industry before to the mining industry; and
- a graduate development program.

It is therefore highly likely that all of the additional workforce required for the Modification would already reside in the Newcastle Region. Consequently, no additional impact on community infrastructure is anticipated.

However, if it were conservatively assumed that all of this workforce migrated into the region, that the multiplier reported in Table 3.3 applies and the additional migrating direct and indirect workforce had the same household occupancy as NSW households, the maximum additional population in the region would be 413 (Table 4.2).

Table 4.2
Maximum Employment and Population Change in the Region

Additional Direct Workforce	Flow-on Workforce	Total Workforce/Family Number	Assumed Household Size	New Population to the Region
48	111	159	2.6	413

Note: Totals may have minor discrepancies due to rounding.

4.3 COMMUNITY INFRASTRUCTURE IMPACT ASSESSMENT

Between 2006 and 2010 the Newcastle SSD experienced a growth in population of 29,277 or 7,319 people per annum (Table 4.3). A maximum potential population influx to the Newcastle SSD of up to 413 (Table 4.2) represents less than 1 month's average population growth between 2006 and 2010 for the Newcastle SSD.

Table 4.3
Newcastle SSD Population Growth

	2006	2007	2008	2009	2010
Resident Population	517,511	524,968	533,526	540,796	546,788
Population Growth	-	7,457	8,558	7,270	5,992

Source: ABS (2012)

The demand this maximum potential population influx would create for housing represents 0.1% of total occupied housing stock in 2011 or 0.8% of unoccupied residential properties in 2011 (Table 4.4).

Table 4.4
Predicted Maximum Modification-Related Demand for Additional Accommodation

Demand for Housing	Housing Stock	
	Occupied Dwellings 2011	Unoccupied Dwellings 2011
159	195,306	20,086

Source: ABS (2011)

Furthermore, this maximum potential population influx is inconsequential in the context of the *Lower Hunter Regional Strategy* (NSW Department of Planning [DoP], 2006) which plans for an additional 160,000 residents and 115,000 new dwellings between 2006 and 2031.

During the operation of the Modification, any incoming workers would be expected to exhibit average family structures and hence would be associated with some children, creating some increased demand for education facilities within the region. Assuming that the maximum potential incoming population exhibits the same characteristics as the NSW working age population, Table 4.5 summarises the likely demand for pre-school, infants/primary and high school places.

Table 4.5
Predicted Modification-Related Maximum Demand for Children's Schooling

	2001	2006	2011	Demand
Preschool	**7,789**	**8,950**	**9,875**	**38**
Infants/Primary				
Government	34,669	31,705	30,408	
Catholic	7,188	6,884	7,036	
Other Non Government	3,012	3,903	4,337	
Total	**44,869**	**42,492**	**41,781**	**37**
Secondary				
Government	23,516	22,462	22,344	
Catholic	5,449	5,404	5,771	
Other Non Government	3,056	3,890	4,592	
Total	**32,021**	**31,756**	**32,707**	**45**

Source: ABS (2012)

These demands can be compared to the total enrolments in 2011 and growth/decline in school enrolments between 2001 and 2011 in Table 4.5. In this context, it is evident that the maximum potential increased demand for schooling associated with incremental Modification employment effects could be considered to be insignificant. In relation to government schools, the maximum additional demand for schooling is a percentage of the decline in enrolments that has been occurring.

There is potential for the Modification to increase the demand for public health facilities in the region such as for Hospitals, General Practitioners Medical Services, Dental, Physiotherapy, Chiropractors, Optometrists, etc. via the potential increase in population as a result of increased direct and indirect flow-on employment associated with the Modification. However, the maximum potential population increase from the Modification is very small compared to the total population of the region and Newcastle seems to be reasonably well served by health care services, having a higher concentration of employment in health care and social assistance than NSW (Table 4.6).

Table 4.6
Employment in Health, Arts and Recreation Services

	Newcastle*		NSW*	
Health Care and Social Assistance				
Health care and social assistance, nfd	717	0.4%	9,400	0.3%
Hospitals	8,236	4.5%	94,187	3.4%
Medical and other health care services	6,887	3.8%	85,108	3.1%
Residential care services	3,930	2.2%	44,648	1.6%
Social assistance services	4,985	2.7%	59,618	2.2%
Total	***24,755***	***13.6%***	***292,961***	***10.7%***
Arts and recreation services, nfd	91	0.1%	1,740	0.1%
Heritage activities	105	0.1%	4,424	0.2%
Creative and performing arts activities	265	0.1%	8,122	0.3%
Sports and recreation activities	1,423	0.8%	18,873	0.7%
Gambling activities	114	0.1%	4,799	0.2%
Total	***1,998***	***1.1%***	***37,958***	***1.4%***
TOTAL IN HEALTH, ARTS AND RECREATION	**26,753**	**14.7%**	**330,919**	**12.0%**
TOTAL EMPLOYMENT	**181,971**	**100.0%**	**2,748,394**	**100.0%**

Source: ABS (2006b).

* Totals may have minor discrepancies due to rounding.

The Modification also has the potential to indirectly positively impact on public health through the provision of additional employment opportunities and the reduction in unemployment. Prolonged unemployment can generate a range of personal and social problems including increased drug and alcohol dependency and increased demand for health services (University of NSW, 2006). Providing opportunities to reduce unemployment can therefore be beneficial.

Demand for additional investment in community services such as child care, aged care and community care services, by Local, State and Commonwealth Governments can arise from increases in the population. However, as identified above the maximum potential increase in population would be very small in the context of the existing and projected population for the region (DoP, 2006). No requirement for additional investment in community services and facilities infrastructure is therefore anticipated to result from the conservative maximum assumed increase in regional employment from the Modification.

4.4 SOCIAL AMENITY

There is potential for the proposed development to negatively impact on regional amenity through increases in road traffic, noise, a reduction in air quality and visual prominence of the site. However, given the majority of the Modification's operations are underground, potential amenity impacts are therefore largely restricted to the pit top areas and associated road transport.

The Road Transport Assessment (Appendix G of the EA) found that the additional road traffic generation associated with the Modification would be well within the daily variations experienced on the major roads surrounding the Abel Underground Mine and hence there would be negligible perceivable impact on operating conditions.

No private residences have been identified as being above application air quality criteria and noise criteria (Appendix E and D of the EA) and therefore noise and air quality amenity impacts are likely to be negligible.

Visual impacts may potentially be associated with the proposed downcast ventilation shaft and upgrade to the Bloomfield CHPP. However, the height of surrounding vegetation at the location of the downcast ventilation shaft would obscure views of the ventilation shaft (and the associated minimal lighting required for security and safety reasons) from public areas. The modifications and upgrades to the Bloomfield CHPP would be within the approved disturbance area and immediately adjacent to existing infrastructure, and as such, would not significantly alter the visual impacts of the area.

Section 4 of the Main Report of the EA provides a description of various amenity related mitigation and management measures.

4.5 MITIGATION AND MANAGEMENT MEASURES

As identified above, no material change in population is expected as a result of the construction or operation of the Modification. Contractor labour during construction is likely to be sourced from existing contractor firms located within the region or daily commuters from Sydney. The operational workforce is expected to come from the employment and unemployment pool in the region aided by the cleanskin, apprenticeship and graduate programs run by Donaldson Coal. Consequently, no additional impact on community infrastructure is anticipated and no specific mitigation or management measures are required.

Notwithstanding, Donaldson Coal would continue to develop and run programs that help in the recruitment of local labour and would work in partnership with Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible. In this respect, a range of impact mitigation and management measures are proposed including:

- Continuation of the Community Support Program to help benefit a wider range of community needs such as education, environment, health, infrastructure projects, arts, leisure and research.
- Employment of local residents preferentially where they have the required skills and experience and demonstrate a cultural fit with the organisation.
- Purchase of local non-labour inputs to production preferentially where local producers can be cost and quality competitive.

5 CONCLUSION

A BCA of the Modification indicated that it would have incremental (i.e. in comparison to the approved Abel Underground Mine) net production benefits of $265 M, with $165M of these net production benefits 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. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

For the Modification to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Modification to Australia, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $165M. This is equivalent to each household in the region valuing residual environmental impacts at $837. The equivalent figure for NSW and Australian households is $64 and $20, respectively.

The threshold value may also be interpreted as the opportunity cost to Australia of not proceeding with the Modification.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify some of the residual environmental impacts of the Modification. The main quantifiable environmental impacts of the Modification that have not already been incorporated into the estimate of net production benefits relate to greenhouse gas impacts. These impacts are estimated at $25M in total or $0.2M to Australia, considerably less than the estimated net production benefits of the Modification.

Overall, the Modification is estimated to have net community benefits to Australia of $165M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts of the Modification as specified in the EA have been quantified and included in the BCA, any other residual environmental, cultural or social impacts of this Modification (e.g. impacts on Aboriginal heritage) that remain unquantified, would need to be valued at greater than $165M for the Modification to be questionable from an Australian economic perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Modification 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 is potentially distributed amongst a range of stakeholders including:

- Donaldson Coal shareholders in the form of after tax (and after voluntary contributions) profits;
- the Commonwealth Government in the form of any Company tax payable ($57M present value) and Minerals Resource Rent Tax from the Modification, which are subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the regional area;
- the NSW Government via royalties ($75M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- the regional community in the form of voluntary contributions to community infrastructure and services.

The potential environmental, cultural and social impacts of the Modification may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely insignificant or internalised into the production costs of Donaldson Coal.

Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Modification biodiversity offsets. The cost of providing biodiversity offsets is included in the estimation of net production benefits. Aboriginal heritage impacts will potentially occur to Aboriginal people and NSW households[16], however, these economic costs remain unquantified in the analysis. All other potential impacts would occur at the local level or state[17] level and were found to be insignificant.

The non-market costs, quantified in the analysis, that accrue to NSW are estimated at than $0.2M. These are considerably less than the net production benefits that directly accrue to NSW through royalties ($75M). Other benefits to NSW would include any voluntary contributions to the regional community and benefits to NSW shareholders[18]. Consequently, as well as resulting in net benefits to Australia the Modification is likely result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that the operation phase of the Abel Underground Mine (including the activities associated with the Modification) would make up to the following average annual contribution to the regional economy for 17 years:

- $459M in annual direct and indirect regional output or business turnover;
- $156M in annual direct and indirect regional value added;
- $96M in annual direct and indirect household income; and
- 1,052 direct and indirect jobs.

The Modification is estimated to make up to the following incremental (i.e. in comparison to the approved Abel Underground Mine) average annual contribution to the regional economy for 17 years:

- $81M in annual direct and indirect regional output or business turnover;
- $50M in annual direct and indirect regional value added;
- $5M in annual indirect household income; and
- 64 indirect jobs.

For the NSW economy, the operation of the Abel Underground Mine (including the activities associated with the Modification) is estimated to make up to the following average annual contribution to the NSW economy for 17 years:

- $624M in annual direct and indirect regional output or business turnover;
- $244M in annual direct and indirect regional value added;
- $146M in annual direct and indirect household income; and
- 1,593 direct and indirect jobs.

[16] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

[17] It should be noted that the studies that found public good values for employment surveyed NSW households.

[18] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and the MRRT.

The Modification is estimated to make up to the following incremental average annual contribution to the NSW economy for 17 years:

- $95M in annual direct and indirect regional output or business turnover;
- $57M in annual direct and indirect regional value added;
- $10M in annual indirect household income; and
- 112 indirect jobs.

Any changes in the workforce and populations of regions may have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities.

It is anticipated that during the initial development of the Modification 25 construction workers would be requires over a three month period and 5 workers over a 12 week period for the construction of the downcast vent shaft. However, is envisaged that most of the required construction workforce would be contractor labour from existing contractor firms located within the region. Any construction workforce unable to be sourced locally would most likely be able to be sourced from Sydney and commute to the region daily. Consequently, little, if any, population change as a result of the construction workforce is envisaged.

The Modification relates to the continuation and expansion of an existing activity. The operational workforce associated with the Modification is estimated at up to an additional 25 employees for the underground mining operations and up to 23 additional employees at the Bloomfield CHPP, during peak periods. Donaldson Coal has established a number of programs to aid in the local recruitment of its workforce. It is therefore highly likely that all of the additional workforce required for the Modification would already reside in the Newcastle Region. Consequently, no additional impact on community infrastructure is anticipated.

However, even if it were conservatively assumed that all of the additional workforce migrated into the region, the maximum additional population in the region would be 413, which is insignificant in the context of historical and project population growth in the region. Nevertheless, Donaldson Coal would continue to develop and run programs that help in the recruitment of local labour and would work in partnership with Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible.

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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/t C (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/ tCO_2-e) and a modal estimate of $49/t C ($13 tCO_2-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/tCO_2-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% 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, rising at 2.5% a year in real terms for three years, as reflective of the global social damage cost of carbon. From 2015 it is assumed that the carbon price remains constant. A range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.5 of this report.

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ATTACHMENT 2 – BCA SENSITIVITY TESTING

Table A2-1
Benefit Cost Analysis Sensitivity Testing, Modification Australian Net Present Value ($Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$179	$165	$150
INCREASE 20%			
Development costs	$143	$134	$122
Operating costs	$126	$115	$104
Coal value	$288	$267	$244
GREENHOUSE COSTS @ $40/TONNE (T)	$178	$165	$150

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Development costs	$214	$196	$178
Operating costs	$231	$214	$196
Coal value	$69	$63	$56
GREENHOUSE COSTS @ $8/T	$179	$165	$150

ATTACHMENT 3 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

Input-output analysis refers to the study of the effects that different businesses or sectors have on the economy as a whole, for a particular nation or region. This type of economic analysis was originally developed by Wassily Leontief (1905 – 1999), who later won the Nobel Memorial Prize in Economic Sciences for his work on this model.

"Input-output analysis is like general-equilibrium theory in that it encompasses all products and industries, rather than singling out one or a few for study and relegating the others to the pound of ceteris paribus. Thus, the impact of a change in any corner of the economy can conceivably find its way via indirect effects through the input-output chart to every other industry. However, input-output analysis is unlike general equilibrium theory in that it is not in itself an equilibrium system, any more than is any other production function" (West, undated, p.23). The focus of input-output analysis is the economic activity in a region that is associated with an impacting agent, ceteris paribus.

"Input-output analysis assumes full employment with no capacity constraints, and thus prices have no role to play in the input-output model (unlike general equilibrium modelling). The application of input-output analysis needs to be viewed in the light of these restrictions. If the area under study is a small open economy relative to the rest of the nation, where factors of production can easily move into and out of the region and local prices gravitate to external prices (subject to transport margins, etc.)[19], then the input-output model would be a reasonable choice.

Conversely, if the economy is closed and there is likely to be 'crowding-out' of factors, then a more complex model is required (such as general equilibrium modelling). However, for small regional economies, it is unlikely that these more complex models will surpass the simpler input-output model. Notwithstanding the small country assumption, given the considerable difficulties associated with estimating a large number of coefficients and parameters when there is virtually no local data available, the increased 'fuzziness' may more than offset the increase in model sophistication. In such cases, the old maxim of 'simple models for simple economies' may be worth keeping in mind" (West, undated, p24).

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.

[19] This is referred to as the 'small country assumption'. It also implies that there is a question of aggregation involved. If there is some product differentiation between local and imported commodities, this assumption becomes less viable.

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" (Australian Bureau of Statistics [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.

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

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

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

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

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

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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 A4-1 (Powell and Chalmers, 1995).

Table A4-1
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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