Mt Arthur Coal

bhpbilliton
resourcing the future

Appendix J –
Socio-Economic Assessment

MT ARTHUR COAL OPEN CUT MODIFICATION

SOCIO-ECONOMIC ASSESSMENT

PREPARED BY
GILLESPIE ECONOMICS

October 2012
HVE-11-01
DOC. ID: 482858

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

EXECUTIVE SUMMARY

Hunter Valley Energy Coal (HVEC) seeks to modify the current Project Approval (09_0062) at the Mt Arthur Coal Mine to allow open cut coal mining for an additional four years at the currently approved rate of 32 million tonnes per annum run-of-mine coal (the Modification).

An Environmental Assessment of the Modification is required in accordance with provisions of section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979*. A socio-economic assessment is required as part of the Environmental Assessment.

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 net production benefits to Australia of AUD$1,031 Million (M). Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia are considered to be valued at less than $1,031 M, the Modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified an attempt was made to quantify them. 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 emissions, surface water and groundwater impacts. These impacts are estimated at $102 M globally or $9 M to Australia, considerably less than the estimated net production benefits of the Modification. There may also be some non-market benefits of employment provided by the Modification which remain unquantified. Overall, the Modification is estimated to have net benefits to Australia of at least $1,022 M and hence is desirable and justified from an economic efficiency 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, including:

- HVEC and its shareholders in the form of after tax (and after voluntary/mandatory contributions) profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $308 M present value) and the minerals resource rent tax payable from the Modification, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Muswellbrook, Upper Hunter Shire and Singleton Local Government Areas;
- the NSW Government via royalties (estimated at $299 M present value) which are subsequently used to fund provision of government infrastructure and services across the state, including the Muswellbrook, Upper Hunter Shire and Singleton Local Government Areas; and
- the local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

The 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 internalised into the productions costs of HVEC.

Greenhouse gas emission costs occur at the national and global level and would be internalised into the operating costs of the Modification through payment of the carbon tax. The economic costs associated with a reduction in agricultural production, air quality, noise, road traffic and visual impacts are initially borne by affected local landholders. However, HVEC would internalise these impacts through the purchase of significantly impacted landholders and/or the implementation of management and mitigation actions. The economic costs associated with the clearing of native vegetation would occur at the state or national level and would be counterbalanced by the biodiversity offset actions proposed by HVEC. The costs of these offset actions are internalised into the production costs of the Modification. Other potential environmental externalities would largely occur at the state or local level and were found to be minor or insignificant. Non-market benefits associated with employment provided by the Modification would largely accrue at the local or state level.

The non-market costs that accrue to NSW are estimated at less than $9 M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW through royalties[1]. Consequently, as well as resulting in net benefits, to Australia the Modification would result in net benefits to NSW.

An economic impact analysis, using input-output analysis, found that the operation of the Modification is estimated to make up to the following contribution to the regional economy for a period of four years:

- $2,691 M in annual direct and indirect regional output or business turnover;
- $1,654 M in annual direct and indirect regional value added;
- $326 M in annual direct and indirect household income; and
- 2,715 direct and indirect jobs.

For the NSW economy, the operation of the Modification is estimated to make up to the following contribution for a period of four years:

- $4,591 M in annual direct and indirect regional output or business turnover;
- $2,601 M in annual direct and indirect regional value added;
- $891 M in annual direct and indirect household income; and
- 9,071 direct and indirect jobs.

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

The peak construction period of the Modification would last for approximately 12 months and require a workforce of around 240 people. However, most of this workforce is expected to already reside in the region or commute from outside the region. Consequently, little, if any, population change and hence community infrastructure impacts are expected to occur as a result of the construction component of the Modification.

[1] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and mineral resource rent tax, shareholder payments as well as any direct contributions through the Voluntary Planning Agreement.

The Modification relates to the continuation of an existing activity for a period of four years at the currently approved rate of 32 million tonnes per annum of run-of-mine coal. The Modification would therefore result in continued employment of the existing workforce at the Mt Arthur Coal Mine, up to 2,600 full-time equivalent jobs for a period of four years. Consequently, no population changes are envisaged as a result of the operational workforce. Therefore no community infrastructure impacts would occur as a result of the operation phase of the Modification.

Cessation of the Modification may lead to a reduction in economic activity. The significance of these Modification cessation impacts would depend on:

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

1 INTRODUCTION

Hunter Valley Energy Coal (HVEC), a wholly-owned subsidiary of BHP Billiton, owns and operates the Mt Arthur Coal Mine located approximately 5 kilometres south-west of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW).

HVEC seeks to modify the current Project Approval (09_0062) for extension of open cut coal mining at the Mt Arthur Coal Mine for a period of four years at the currently approved rate of 32 million tonnes per annum (Mtpa) run-of-mine (ROM) coal (the Modification).

An Environmental Assessment (EA) of the Modification is required in accordance with provisions of section 75W of the *NSW Environmental Planning and Assessment Act, 1979*. A socio-economic assessment is required as part of the EA.

The Director-General's Requirements for the preparation of the Modification EA require an 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, emergency services and Council's water and wastewater supply services); and*
  - *impacts on social amenity;*
- *a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the proposal, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanisms; and*
- *a detailed assessment of the costs and benefits of the modified project 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 NSW Department of Planning and Infrastructure's (DP&I) (James and Gillespie, 2002) *Draft Guideline for Economic Effects and Evaluation in EIA* (Draft Guideline) 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 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).

The DP&I's Draft Guideline (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The DP&I's Draft Guideline (James and Gillespie, 2002) identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The DP&I's Draft Guideline (James and Gillespie, 2002) indicates that economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic activity to the local economy can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

The DP&I's Draft Guideline also identifies 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); and
- an Employment, Population and Community Infrastructure Assessment (EPCIA) (Section 4).

A consultation programme for the EA was undertaken by HVEC and is provided in Section 1.3 in the Main Report of the EA.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Introduction to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics and applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW EA framework are further guided by the DP&I's Draft Guidelines.

BCA is primarily concerned with comparison of the present value of aggregate benefits to society, as a result of a project, policy or programme, 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 (NPV) 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.

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 world as a whole. 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 Modification BCA 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.

Definition of the Modification Scope

This raises the important issue of Modification scope. The Modification scope is as defined in the EA and summarised in Section 2.2. It includes the continuation of open cut mining operations extracting up to 32 Mtpa of ROM coal for a four year period and delivery of product coal via the Antiene Rail Spur and Main Northern Railway line to the Port of Newcastle (the Port).

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 the 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 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 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.

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 HVEC and its' specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND MODIFICATION

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

Without approval of the Modification, mining at the Mt Arthur Coal Mine of up to 32 Mtpa of ROM coal would cease in 2022. On cessation of mining activities at the Mt Arthur Coal Mine it is assumed that the residual value of some capital equipment and land would be able to be realised through sale or alternate use.

[1] As identified by NSW Treasury (2007), Projects or programmes 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.

In contrast to the "base case", the main activities associated with the development of the Modification include:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved maximum rate of 32 Mtpa;
- an increase in open cut disturbances areas;
- use of conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the maximum number of train movements per day from 24 to 38;
- the relocation of the load point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage, magazine and associated facilities; and
- the construction of additional offices and a control room and a small extension to the ROM coal stockpile footprint.

At the end of the Modification it is assumed that the surface infrastructure would be decommissioned and surface areas rehabilitated, and it is assumed that the residual value of capital equipment and land would be realised through sale or alternative use.

BCA is primarily concerned with the evaluation of the "with" project scenario relative to the counterfactual (base case) of no proposal. 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 HVEC in the development of the Modification description. Section 6.2 in the Main Report of the EA provides more detail on the consideration of Modification alternatives.

The Modification assessed in the EA and evaluated in the BCA is considered by HVEC to be a feasible alternative that minimises environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by HVEC 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.

Table 2.1 - Potential Incremental Economic Benefits and Costs of the Modification

Category	Costs	Benefits
Production	• Opportunity cost of land (Year 2023). • Opportunity cost of capital equipment (Year 2023). • Development costs including an allowance for land acquisitions for noise, dust and biodiversity offsets. • Operating costs (ex royalties), including administration, mining, coal handling, transportation to the Port and loading. • Decommissioning and rehabilitation costs at cessation of the Modification in 2027.	• Avoided decommissioning and rehabilitation costs (Year 2023). • Value of product coal. • Residual value of capital equipment and land at the cessation of the Modification in 2027.
Potential environmental, social and cultural impacts	• Greenhouse gas generation. • Lost agricultural production. • Operational noise impacts. • Air quality impacts. • Surface water impacts. • Groundwater impacts. • Flora and fauna impacts. • Road transport impacts. • Aboriginal heritage impacts. • Non-Aboriginal heritage impacts. • Visual impacts.	• Any non-market benefits of employment. • Value of ecological offsets.

It should be noted that the potential environmental, social and cultural impacts of the Modification, listed in Table 2.1, are only economic costs to the extent that they affect individual and community wellbeing through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

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 20 years. 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 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] 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.

2.4.1 Incremental Production Costs and Benefits

Economic Costs

Opportunity Cost of Land and Capital Equipment

Under the base case or "without" Modification scenario the existing Mt Arthur Coal Mine would cease mining operations in approximately 2022. The residual value of capital equipment and land (excluding offsets) at the Mt Arthur Coal Mine is estimated at approximately $30 million[4] (M) and $54 M, respectively, that could be realised through alternate use or sale. There is an opportunity cost associated with continuing to use the capital equipment and land for the Modification instead of realising its residual value.

Development Cost of the Modification

Development costs of the Modification include relocating the Macquarie Generation conveyor load points and the explosive magazine, as well as duplication of the existing rail loop, all in 2015. There is also ongoing capital costs associated with four years additional open cut mining, including an allowance for land acquisitions of properties impacted by noise and dust or required for biodiversity offsets. These incremental development costs over the life of the Modification are estimated at $1,049 M. These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Mine

The annual operating costs of the Modification include those associated with mining, environmental management and monitoring, ROM coal processing, administration, rail transport to the Port and the Port charges. Average annual incremental operating costs of the Modification (excluding royalties) are estimated at $1,370 M.

While royalties are a cost to HVEC they are part of the overall producer surplus benefit of the mining and processing 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 over the life of the Modification in the order of $744 M, or $299 M in present value terms at 7% discount rate (i.e. discounted because they would accrue between 2022 and 2026).

Decommissioning and Rehabilitation Costs

With the Modification, mining activities and Coal Handling and Preparation Plant operations would cease in 2026 with associated decommissioning and rehabilitation costs, estimated at $98 M over a four year period.

Economic Benefits

Value of Product Coal

The main economic benefit of the Modification is the value of the product coal mined. This can be estimated from the increased thermal coal volumes that would be produced, together with assumed export prices of coal and exchange rate. For the purpose of the analysis the export coal price is assumed to average $97 per tonne (/t) for thermal coal.

[4] All values reported in this section are undiscounted Australian Dollars (AUD$) unless otherwise specified.

There is obviously considerable future uncertainty around the economic value of coal. Consequently, variations in the assumed economic value of coal from the Modification have been included in the sensitivity analysis in Section 2.6.

Avoided Decommissioning and Rehabilitation Costs

Under the base case or "without" Modification scenario the existing Mt Arthur Coal Mine would cease mining operations in approximately 2022 with associated decommissioning and rehabilitation costs, estimated at $98 M over a four year period. With the Modification these costs would be avoided.

Residual Value at End of the Evaluation Period

At the end of the Modification, capital equipment and land (excluding biodiversity offsets) may have some residual value that could be realised by sale or alternative use. The residual value of capital and land at the end of the Modification life is assumed to be $35 M and $54 M, respectively.

2.4.2 Environmental, Social and Cultural Costs and Benefits

Greenhouse Gases

The Modification is predicted to generate in the order of 9.44 million tonnes of greenhouse gas emissions associated with mining and transport of product coal by rail to the Port. To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, 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/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price of $23/t CO_2-e rising at 2.5% per year in real terms for three years and then remaining constant, was used (refer to Attachment 1). Sensitivity testing assuming a shadow price from $8/t CO_2-e to $40/t CO_2-e was also undertaken.

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 (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%.

Agricultural Production

The present value of foregone agricultural production is reflected in land prices. The value of foregone agricultural production, as a result of the Modification, has therefore been incorporated in the BCA through inclusion of the full land value (opportunity cost) of affected properties including offsets.

Operational Noise

As described in the Noise and Blasting Assessment (provided in Appendix G of the EA), the Mt Arthur Coal Mine contributes to the existing noise environment at nearby private rural residences. A comparison of the noise exceedances as a result of the Modification compared to the existing approved operations is provided below.

Two existing noise management zone exceedances have moved into the affectation zone noise criteria as a result of the Modification. These two affectation zone exceedances are existing noise management zone exceedances under Project Approval 09_0062, and are in the zone of affectation for air quality criteria for the existing Mt Arthur Coal Mine. The incremental impact of Modification noise on nearby properties can potentially be valued using the property value method, where the change in property value as a result of the incremental noise impacts, are estimated. However, given the existing affectation of these properties the incremental impacts are likely to be negligible and hence no additional costs are included in the BCA.

Five additional management zone exceedances are predicted due to the Modification. One existing affectation exceedance is predicted to move to a management exceedances as a result of the Modification. Four properties will be in the minor noise management zone (note: three of these were predicted in the Consolidation Project, however, were not included in the noise management zone of PA 09_0062). Contemporary Development Consent conditions for residences in the moderate noise management zone typically require proponents to provide at receiver noise mitigation on request. An allowance has been included in the BCA for noise mitigation measures for properties in the moderate and minor noise management zone. It is recognised that to the extent that any residual noise impacts occur, after mitigation, noise costs of the Modification included in the BCA will be understated.

Air Quality

Potential air quality impacts may occur at nearby residences as a result of dust generation at the Modification from activities such as coal and overburden handling, emissions from stockpiles and haul roads, and blasting. The air quality assessment identifies that no additional exceedances of EPA criteria are predicted due to the Modification.

Surface Water

The Modification would result in changes to flows in local creeks due to the progressive extension of the open cut mining operations and associated subsequent capture and re-use of drainage from operational catchment areas. The reduction in catchment reporting to the Hunter River is predicted to be less than 0.02%. Average flow rates in the Hunter River would be expected to reduce in proportion.

In addition, there is an opportunity cost associated with using 7,938 megalitres per annum (ML/annum) [5] of existing water access licences for the Modification instead of their next best use.

The opportunity cost of the reduced creek flows and Water Access Licences have been included in the BCA using an estimated market value of water of $2,000/ML. These opportunity costs only occur for the four years of the Modification.

Groundwater

The numerical modelling shows that three bores would experience an additional drawdown greater than 2 m due to the Modification, however, these bores are located on HVEC-owned land. Therefore, no privately-owned bores would experience an incremental drawdown greater than 2 m due to the Modification. The Modification is therefore likely to have no discernible incremental impact on privately-owned bores and hence no economic cost is included in the BCA.

The Modification is predicted to result in some additional reduction in groundwater flows to the nearby streams and rivers estimated at up to 0.72 ML per day in the Hunter River alluvium. The opportunity cost of this quantity of water has been included in the BCA using an estimated market value of water of $2,000/ML. This opportunity cost is assumed to be in perpetuity.

[5] 7,938 ML/annum comprises 5,741 ML/annum general security entitlement licences and 2,197 ML/annum high security entitlement licences.

Flora and Fauna

The Modification would require the removal of 228.9 hectares (ha) of native vegetation. This comprises mostly derived grasslands (173 ha) and woodland (44.6 ha). The total land clearance area is slightly larger (259.9 ha) as it includes some introduced species or cleared map units. This would remove habitat for a range of threatened fauna species.

As part of the Modification approximately 1,500 ha of Biodiversity and Heritage Offset Area will be established. This area would be reserved for conservation of woodland and forest communities as well as Derived Understory. The land and operating cost of this offset has been included in the analysis. Provided the offset does sufficiently compensate for lost ecological values, then the economic values would also likely be offset and hence no significant economic cost would arise that would warrant inclusion in the BCA.

Traffic and Transport

Impacts of the Modification would be limited to the change to traffic regime associated with the proposed site entrance off Edderton Road. The cost is included in the development costs of the Modification. This is not expected to affect the performance of local roads and intersections. Hence, no economic effects have been identified in the BCA with respect to the predicted road transport movements associated with the Modification.

Aboriginal Heritage

The Modification has the potential to impact Aboriginal heritage sites in the Modification land disturbance area. Fifty-five Aboriginal sites will be impacted by the Modification, however, none are considered to be of high regional significance. One potential archaeological deposit is considered to be of high local significance.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic. Impacts on highly significant Aboriginal heritage sites have also been shown using choice modelling to affect the well-being of the broader community (Gillespie Economics 2008, 2009a, 2009b). However, as no sites of high significance would be affected by the Modification no economic costs are included in the BCA.

Non-Aboriginal Heritage

The Modification would not impact any items of non-Aboriginal heritage and hence no economic effects have been included in the BCA.

Visual Impacts

The Modification would not result in any additional properties being visually impacted. However, those properties already impacted would be affected by an additional four years of views of mine operations (2023 to 2026) relative to the existing approval. Visual intrusion to surrounding landholders can potentially impact their property value[6]. Impacted properties are already eligible under the existing Project Approval 09_0062 to receive impact mitigation measures such as tree screening. Consequently, additional visual impacts of the Modification are likely to be minor, short-term and a considerable distance into the future. Discounting undertaken for the economic analysis would further decrease the present values of any such impacts. However, it is recognised that to the extent that any significant residual visual impacts occur, after mitigation, visual impact costs of the Modification included in the BCA would be understated.

[6] And potentially consumer surplus.

Non-market Value of Employment

Historically employment benefits of projects that are enjoyed by people other than those who are employed, have tended to be omitted from BCA on the implicit assumption that labour resources used in a proposal would otherwise be employed elsewhere and that there are no costs associated with transferring from one job to another. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Boardman *et al.* (2001) identifies that these labour resources should be valued in a BCA at their opportunity cost (e.g. wages less social security payments and income tax) rather than the wage rate. Adopting this approach would have the effect of increasing the net production benefits of the proposal. In addition, there may be social costs of unemployment that require the estimation of employees' willingness to pay to avoid the trauma created by unemployment (Streeting and Hamilton, 1991). These values have not been included in the Modification BCA.

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

In a study of the Metropolitan Colliery in the NSW Southern Coalfields, Gillespie Economics (2008) estimated the value the community would hold for the 320 jobs provided over 23 years at $756 M (present value). In a similar study of the Bulli Seam Operations, Gillespie Economics (2009a) estimated the value the community would hold for the 1,170 jobs provided over 30 years at $870 M (present value). In a study of for the Warkworth Mine extension, Gillespie Economics (2009b) estimated the value the community would hold for 951 jobs from 2022 to 2031 at $286 M (present value).

The Modification would result in continued employment of the existing workforce at the Mt Arthur Coal Mine, up to 2,600 full-time equivalent jobs for a period of four years. While this is likely to have significant non-market economic benefits it is not considered appropriate to extrapolate the results of the above studies outside the employment level range which they addressed. Consequently, in this analysis this benefit remains unquantified.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

The present value of incremental 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 Modification to society is its 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 net production benefits of $1,328 M, with $1,031 M of these accruing to Australia. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Modification, after mitigation, may be assessed. 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, that impact Australia[7], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $1,031 M. This is equivalent to each household in the Muswellbrook, Upper Hunter Shire and Singleton Local Government Areas (LGAs) valuing residual environmental impacts at $51,000. The equivalent figure for NSW and Australian households is $387 and $125, 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, social and cultural impacts of the Modification. From Table 2.2 the main quantifiable impacts of the Modification that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions and impacts on surface water and groundwater resources. These impacts are estimated at $102 M in total or $9 M to Australia, considerably less than the estimated net production benefits of the Modification. There may also be some non-market benefits of employment provided by the Modification which remain unquantified.

Overall, the Modification is estimated to have net community benefits to Australia of at least $1,022 M and hence is desirable and justified from an economic efficiency perspective.

The present value of the incremental costs and benefits of the Modification, using a 7% discount rate are provided in Table 2.2.

2.5.2 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 total net production benefit is distributed amongst a range of stakeholders including:

- HVEC and its shareholders in the form of after tax (and after voluntary/mandatory contributions) profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $308 M present value) and the minerals resource rent tax (MRRT) payable from the Modification, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Muswellbrook, Upper Hunter Shire and Singleton LGAs;
- the NSW Government via royalties (estimated at $299 M present value) which are subsequently used to fund provision of government infrastructure and services across the state, including the Muswellbrook, Upper Hunter Shire and Singleton LGAs; and
- the local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

[7] Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis (Section 2.1). This is mainly relevant to the consideration of greenhouse gas impacts.

Table 2.2 - Benefit Cost Analysis Results of the Modification ($M Present Values at 7% Discount Rate)

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity costs of capital equipment	$13	Avoided mine decommissioning and rehabilitation costs	$40
	Opportunity cost of land	$24	Value of coal	$3,963
	Development costs including ancillary works, land acquisition and sustaining capital	$444	Residual value of land	$19
	Operating costs, including administration, mining, coal handling, transportation	$2,195	Residual value of capital equipment	$13
	Mine decommissioning and rehabilitation costs	$31	-	-
	Production Sub-total	***$2,707***	**-**	***$4,035***
	Net Production Benefits			**$1,328 ($1,031)**
Non-market Impacts	Greenhouse gas emissions	$94 ($1)	Non-market benefits of employment	Unquantified
	Agricultural production	Reflected in land values and included in development costs and opportunity cost of land.	-	-
	Operational noise	Cost of noise mitigation measures is included in operating costs.	-	-
	Air quality	Cost of mitigation measures is included in operating costs.	-	-
	Surface water	$4	-	-
	Groundwater	$4	-	-
	Flora and fauna	Some loss of values however these are offset. Cost of biodiversity offset included in development and operating costs.	-	-
	Traffic and transport	Minimal. Cost of Edderton Road site entrance included in development costs.	-	-
	Aboriginal heritage	Minimal	-	-
	Non-Aboriginal heritage	Nil	-	-
	Visual	Minimal	-	-
	Non-market impacts sub-total	***$102 ($9)***	-	***Unquantified***
NET BENEFITS – excluding employment benefits				**$1,226 ($1,022)**

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

The environmental, social and cultural costs may potentially accrue to a number of different stakeholder groups at the local, state, National and global level (Table 2.3), however, are largely internalised into the production costs of HVEC.

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

Value		Distribution			
		Local	State	National	Global
Net Production Benefits					
Net production benefits to HVEC	$720M	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	$308M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$299M	✓	✓	-	-
Total	***$1,327M***				
Non-market Costs and Benefits					
Benefits					
Non-market benefit of employment	Unquantified	✓	✓	-	-
Total	***Unquantified***				
Costs					
Greenhouse gas emissions rest of the world[1]	$93M	-	-	-	✓
Greenhouse gas emissions Australia[1]	$1M	✓	✓	✓	
Agricultural production	Reflected in land values and included in development costs and opportunity cost of land.	✓	-	-	-
Operational noise	Cost of noise mitigation measures is included in operating costs.	✓	-	-	-
Air quality	Cost of mitigation measures is included in operating costs.	✓	-	-	-
Surface water	$4	✓	-	-	-
Groundwater	$4	✓	-	-	-
Flora and fauna	Some loss of values but offset. Cost of biodiversity offset included in development and operating costs.	✓	✓	-	-
Road transport	Minimal. Cost of Edderton Road site entrance re-alignment included in development costs.	✓	-	-	-
Aboriginal heritage	Minimal	✓	-	-	-
Non-Aboriginal heritage	Nil	✓	-	-	-
Visual	Minimal	✓	-	-	-
Total	***$102M***				
Net Benefits	**$1,226M**				

Note: Totals may have minor discrepancies due to rounding.

[1] Assuming the global social damage cost of carbon is distributed in accordance with relative share of global Gross Domestic Product.

Greenhouse gas emission costs occur at the national and global level and would be internalised into the operating costs of the Modification through payment of the carbon tax. The economic costs associated with a reduction in agricultural production, air quality, noise, road traffic and visual impacts are initially borne by affected local landholders. However, HVEC would internalise these impacts through the purchase of significantly impacted landholders and/or the implementation of management and mitigation actions. The economic costs associated with the clearing of native vegetation would occur at the state or national level and would be counterbalanced by the biodiversity offset actions proposed by HVEC. The costs of these offset actions are internalised into the production costs of the Modification. Other potential environmental externalities would largely occur at the state or local level and were found to be minor or insignificant. Non-market benefits associated with employment provided by the Modification would largely accrue at the local or state level[8].

Overall, the net production benefits that directly accrue to NSW are greater than the residual environment, cultural and social impacts and hence as well as resulting in net benefits to Australia the Modification would also result in net benefits to NSW.

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.3 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 net community benefit to Australia (excluding employment benefits) was tested for changes to the following variables:

- opportunity cost of land and capital equipment;
- capital costs;
- operating costs;
- mine decommissioning and rehabilitation costs;
- value of coal;
- residual value of land and capital equipment;
- foreign ownership levels;
- greenhouse gas emission costs;
- surface water impacts; and
- groundwater impacts.

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, surface water and groundwater impacts did not change the positive sign of the NPV 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 35%) would be required to make the Modification welfare reducing.

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

3 REGIONAL ECONOMIC IMPACTS

3.1 INTRODUCTION

The BCA reported 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 regional economic impact assessment is the effect of an impacting agent on an economy in terms of a number of specific indicators of economic activity.

- ***Output*** – is the gross value of business turnover.
- ***Value-added*** – is the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.
- ***Income*** – is the wages paid to employees including imputed wages for self employed and business owners.
- ***Employment*** – is 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). A number of impacting agents would result from the Modification including relocating the Macquarie Generation conveyor load points and the explosive magazine, as well as duplication of the existing rail loop in 2015 and continuation of mining operations from 2023 to 2026.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985) depending on the likely distribution of economic effects from the Modification in question. In selecting the appropriate economy, regard needs to be had to capturing the local expenditure associated with the proposal but not making the economy so large that the impact of the project becomes trivial (Powell and Chalmers, 1995).

For this assessment, the impacts of the Modification have been estimated for the two regions where the economic effects would mostly occur:

- the Muswellbrook, Upper Hunter Shire and Singleton LGAs referred to as the regional economy; and
- NSW.

A range of methods can be used to examine the regional 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). Input-output analysis is used in this study.

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 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, and 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 of the regional economy was developed using the Generation of Input-Output Tables 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 economies.

A highly aggregated 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, which includes stock changes, capital expenditure and government expenditure. The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA), which includes gross operating surplus and depreciation and net indirect taxes and subsidies and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

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	22,617	82	49,848	6	152	2,895	**75,600**	6,577	72,535	189,590	**344,301**
Mining	39	106,136	4,149	57,239	995	821	**169,379**	319	-91,080	2,789,060	**2,867,678**
Manuf.	4,043	50,938	118,889	3,498	24,771	54,895	**257,035**	40,670	136,100	631,731	**1,065,536**
Utilities	2,594	18,850	12,695	445,448	2,372	16,664	**498,623**	15,949	11,510	409,114	**935,196**
Building	1,966	18,390	1,434	10,206	69,203	26,313	**127,512**	0	263,601	18,373	**409,485**
Services	26,080	105,969	117,869	18,672	37,342	306,685	**612,618**	400,447	479,356	665,726	**2,158,147**
TOTAL	**57,339**	**300,365**	**304,885**	**535,069**	**134,835**	**408,274**	**1,740,767**	**463,961**	**872,022**	**4,703,593**	**7,780,342**
Household Income	99,848	391,132	192,406	68,063	110,962	831,996	**1,694,408**	0	0	0	**1,694,408**
OVA	69,422	1,767,288	123,983	162,029	37,217	255,815	**2,415,754**	79,626	30,833	8,454	**2,534,668**
Imports	117,691	408,892	444,263	170,035	126,471	662,061	**1,929,414**	899,544	165,661	333,455	**3,328,073**
TOTAL	**344,301**	**2,867,678**	**1,065,536**	**935,196**	**409,485**	**2,158,147**	**7,780,342**	**1,443,131**	**1,068,515**	**5,045,502**	**15,337,491**
Employment	2,317	5,435	2,286	861	1,383	12,648	**24,930**	0	0	0	0

Note: Totals may have minor discrepancies due to rounding.

OFD = other final demands.

Gross regional product (value-added) for the regional economy is estimated at $4,229 M, comprising $1,694 M to households as wages and salaries (including payments to self employed persons and employers) and $2,535 M in OVA.

The employment total working in the region was 24,930 people.

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

Figure 3.1 - Summary of Aggregated Sectors: Regional Economy (2005-06)

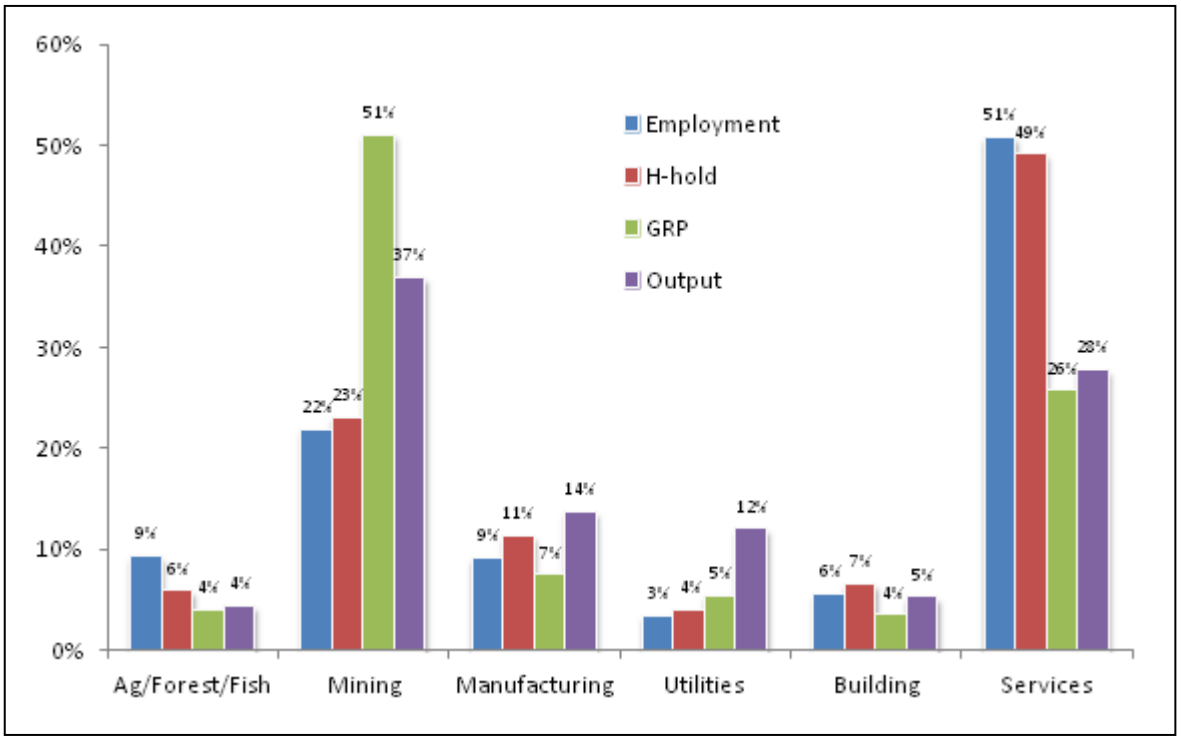
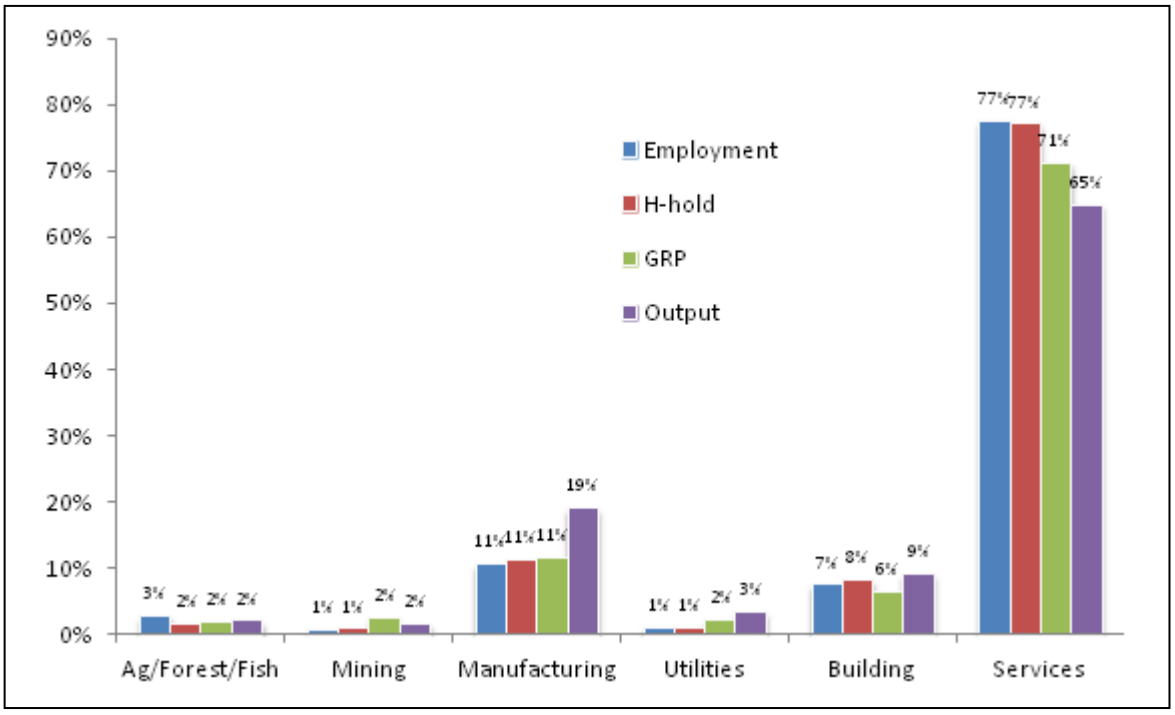


Figure 3.2 - Summary of Aggregated Sectors: NSW Economy (2005-06)



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 economy.

What is clear from these figures is that in terms of gross regional output, value-added, income, employment, imports and exports, coal mining is the most significant sector of the regional economy. The next most significant sectors for output and value-added are the utilities sector and business services sector. For income and employment the next most significant sectors are business services and retail trade. The food manufacturing sectors and utilities sectors are the next most important sectors in the region for imports and exports.

For comparison, the horse breeding and grape growing sectors are located in the other agriculture sector in Figures 3.3 to 3.5, while wine manufacturing is located in the food manufacturing sector.

3.3 ECONOMIC IMPACT OF THE MODIFICATION

The revenue, expenditure and employment associated with the construction and operation of the Modification would provide economic activity to the regional economy, as well as to the broader NSW economy. The regional impacts of both the construction and operation of the Modification are estimated for the indicators of output, value-added, income and employment.

3.3.1 *Construction Phase*

Introduction

Economic activity associated with the Modification construction phase in 2015 is estimated to potentially mainly occur within five sectors of the economy:

- the *other construction sector* which includes businesses involved in the construction of non-residential buildings and sites, including port terminals;
- the *construction trade services sector* which includes businesses involved in plumbing, electrical, and other trades;
- the *other property services sector* which includes businesses involved in the leasing of industrial machinery, plant or equipment;
- the *agriculture, mining and construction machinery, lifting and material handling equipment manufacturing sector*; and
- *other machinery and equipment manufacturing sector*.

Impact on Regional Economy

Given the largely specialist nature of capital equipment and the relatively small size of the regional economy, for the purpose of this analysis a conservative assumption is made that all such purchases and the leasing of machinery are made outside the regional economy. Thus regional economic activity from the Modification construction phase primarily relates to the *other construction sector* and *construction trade services sector*.

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

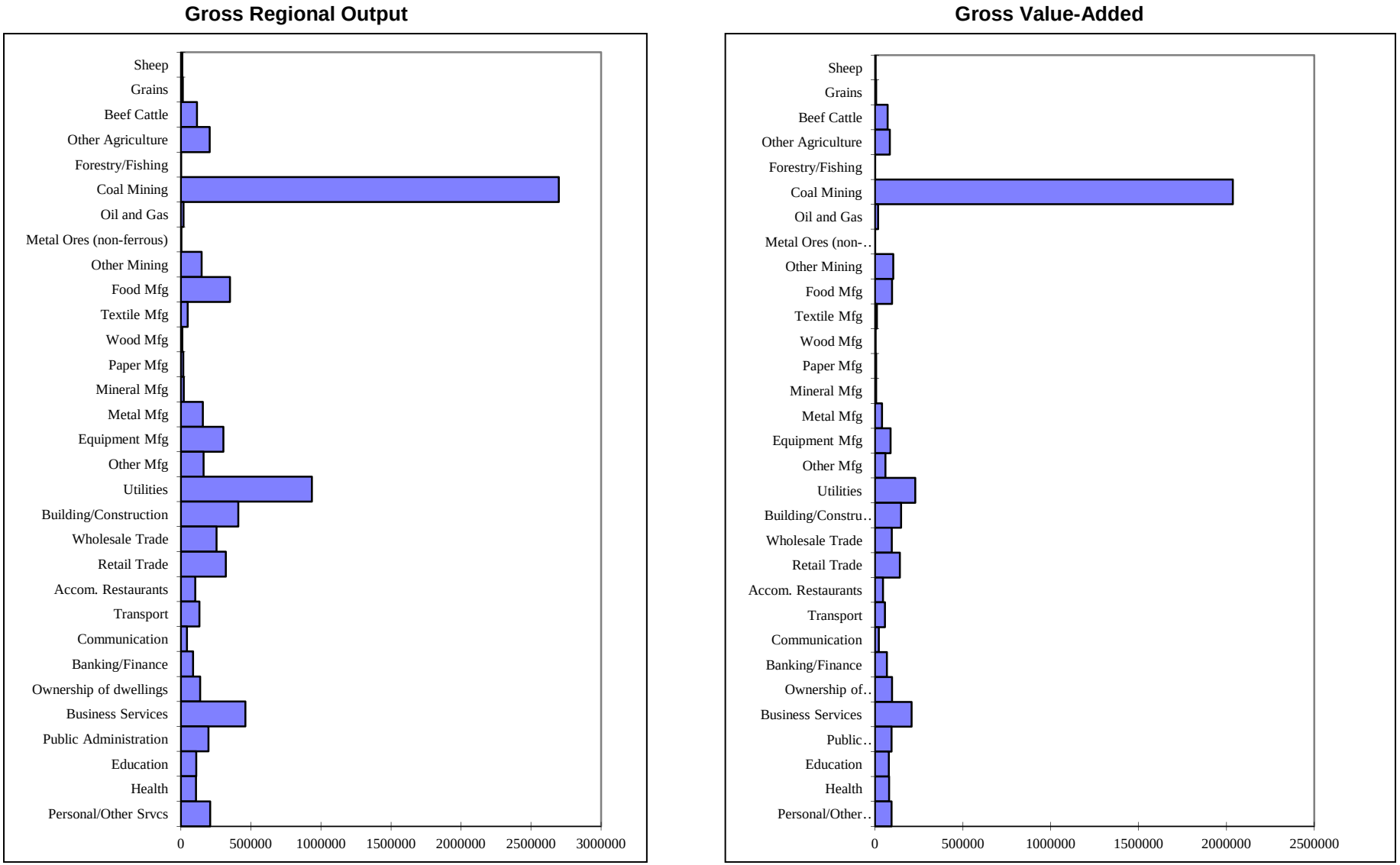


Figure 3.4 - Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

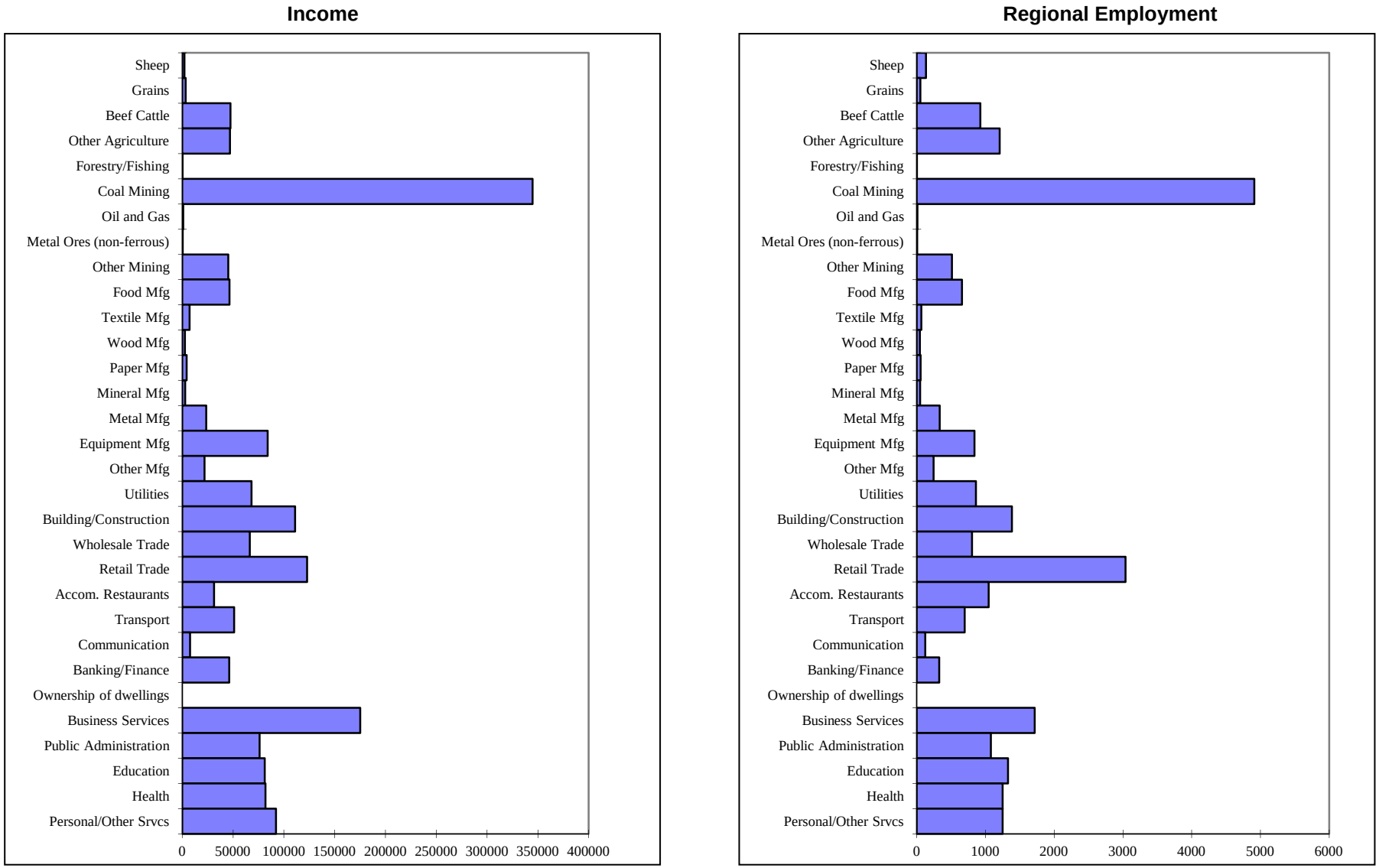
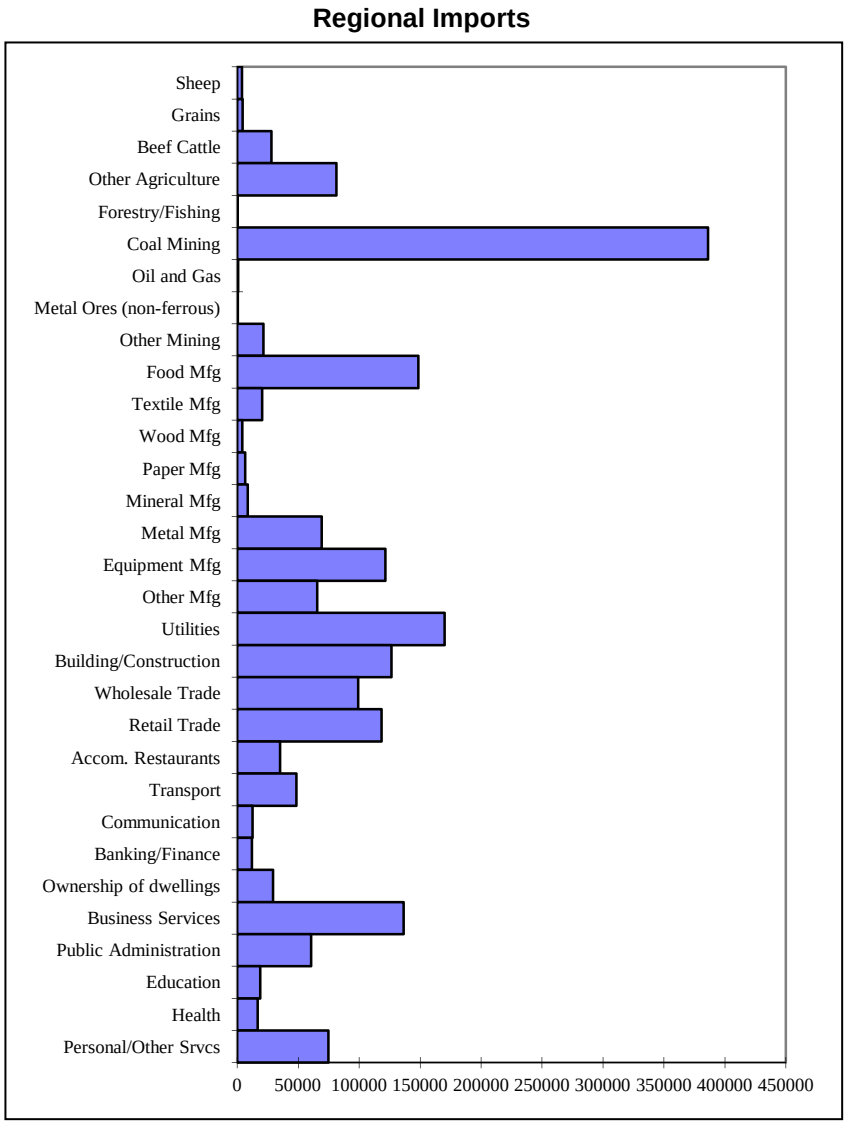
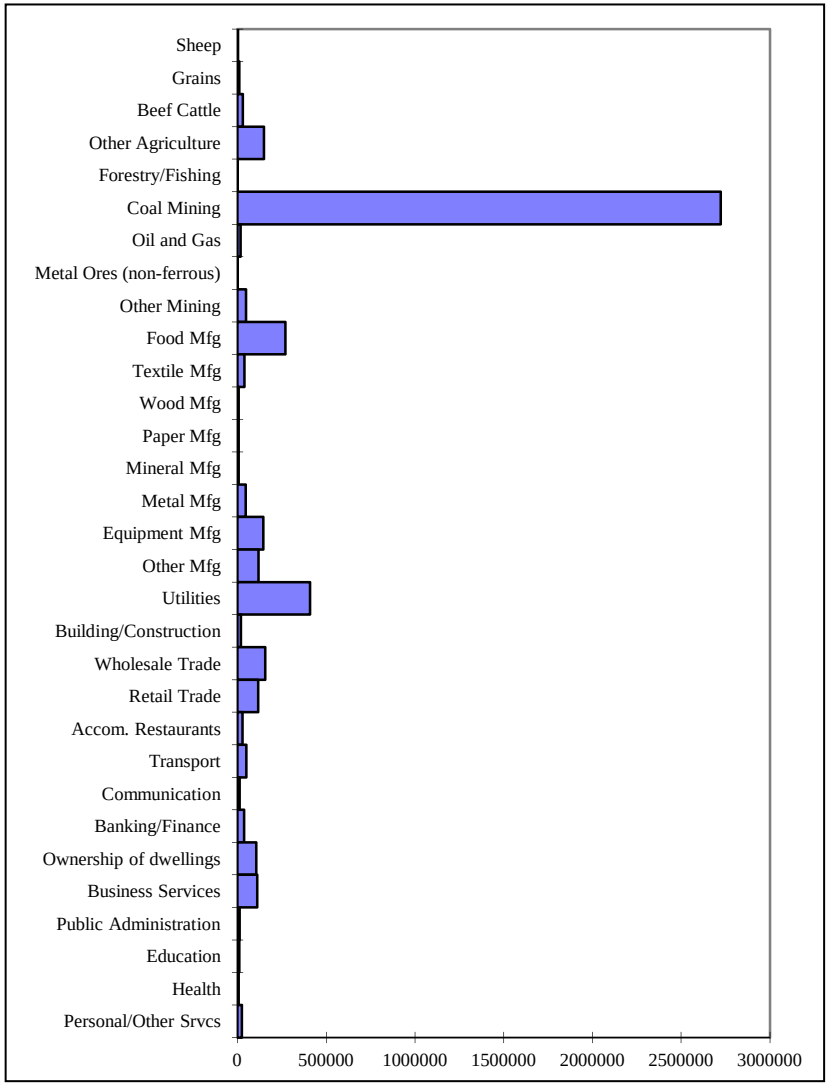


Figure 3.5 - Sectoral Distribution of Imports and Exports ($'000)





Construction activities will be facilitated by a workforce of up to 240. Based on the input-output coefficients of the *other construction sector* and *trade services sector* in the regional transactions table (indexed to 2012) in the order of $80M of the capital costs in 2015 would need to be spent on the *other construction sector and construction trade services sector* within the region to result in a workforce of 240 people. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Impacts

Table 3.2 – Annual Economic Impacts of Construction of the Modification on the Regional Economy

	Direct Effect	Production-induced	Consumption-induced	Total Flow-on	Total Effect
OUTPUT ($'000)	79,525	35,209	17,527	52,737	132,262
Type 11A Ratio	1.00	0.44	0.22	0.66	1.66
VALUE ADDED ($'000)	31,117	14,796	8,152	22,948	54,065
Type 11A Ratio	1.00	0.48	0.26	0.74	1.74
INCOME ($'000)	23,042	13,180	6,755	19,935	42,978
Type 11A Ratio	1.00	0.57	0.29	0.87	1.87
EMPL. (No.)	240	159	99	258	498
Type 11A Ratio	1.00	0.66	0.41	1.07	2.07

Note: Totals may have minor discrepancies due to rounding.

* Direct employment of 240 represents average annual construction employment. It is assumed that these people reside in the region. Where they do not, a proportion of the consumption-induced flow-on impacts will leak from the region.

In estimating the total regional impacts, it is important to separate the flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these two effects operate in different ways and have different spatial impacts.

Production-induced effects occur in a near-proportional way within a region, whereas the consumption-induced flow-on effects only occur in a proportional way if workers and their families are located in the region or migrate into the region. Where workers commute from outside the region some of the consumption-induced flow-on effects leak from the region. Where workers are already located in the region i.e. unemployed or employed, some of the consumption-induced flow-ons in the region may already be occurring through expenditure of their current wage or unemployment benefits.

In total, the construction phase of the Modification would contribute in the order of up to:

- $132 M in annual direct and indirect output;
- $54 M in annual direct and indirect regional value added;
- $43 M in annual direct and indirect household income; and
- 498 direct and indirect jobs.

These particular impacts on the regional economy are likely to be felt for a period of in the order of 12 months in 2015.

Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (Australian Bureau of Statistics [ABS], 1995). There are many types of multipliers that can be generated from input-output analysis (Attachment 3). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect.

The Type 11A ratio multipliers for the construction phase of the Modification range from 1.66 for output up to 2.07 for employment.

Main Sectors Affected

Flow-on impacts from the construction phase of 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 *construction trade-services, wholesale and retail trade, scientific research, technical and computer services, other property services, other business services, health services, accommodation, cafes and restaurants and personal services*.

Examination of the estimated direct and flow-on employment impacts (Table 3.3) gives an indication of which sectors employment opportunities would be generated in.

Table 3.3 - Distribution of Regional Employment Impacts of Modification Construction

Sector	Average Direct Effects	Production-induced	Consumption-induced	Total
Primary	0	0	2	3
Mining	0	1	0	1
Manufacturing	0	16	4	20
Utilities	0	1	1	2
Wholesale/Retail	0	14	28	42
Accommodation, cafes, restaurants	0	1	15	16
Building/Construction	240	93	1	333
Transport	0	4	3	7
Services	0	28	45	73
Total	**240**	**159**	**99**	**498**

Note: Totals may have minor discrepancies due to rounding.

Direct employment impacts would generate demand for employment in the *other construction sector* and *construction trade services sector*. Production-induced employment impacts would mainly generate demand for employment in the building and construction sectors, services sectors, manufacturing sectors and wholesale/retail trade sectors.

Consumption-induced employment flow-ons would mainly generate demand in the services sectors, wholesale/retail trade sectors and accommodation, cafes and restaurants sector.

Impact on the NSW Economy

When the impact of $80M of expenditure in the *other construction sector* and *construction trade services sector* is assessed for the NSW economy, the impacts are greater because of the larger inter-sectoral linkages and hence multipliers for the larger economy. These impacts are presented in Table 3.4.

Table 3.4 - Annual Economic Impacts of Construction of the Modification on the NSW Economy

	Direct Effect	Production-Induced	Consumption-Induced	Total Flow-on	Total Effect
OUTPUT ($'000)	79,525	72,777	85,761	158,538	238,063
Type 11A Ratio	1.00	0.92	1.08	1.99	2.99
VALUE ADDED ($'000)	31,117	31,387	43,683	75,070	106,186
Type 11A Ratio	1.00	1.01	1.40	2.41	3.41
INCOME ($'000)	23,042	25,904	24,998	50,903	73,945
Type 11A Ratio	1.00	1.12	1.09	2.21	3.21
EMPL. (No.)	240	300	334	633	873
Type 11A Ratio	1.00	1.25	1.39	2.64	3.64

Note: Totals may have minor discrepancies due to rounding.

Based on the above approach, the Modification may result in construction-related impacts on the NSW economy of up to:

- $238 M in annual direct and indirect output;
- $106 M in annual direct and indirect regional value added;
- $74 M in annual direct and indirect household income; and
- 873 direct and indirect jobs.

These particular impacts on the NSW economy are only likely to be felt for a period of in the order of 12 months.

The above estimated impacts on the NSW economy are likely to be conservative because expenditures in NSW may not be limited to expenditures in the *other construction sector* and *construction trade services sector.* This is because the larger NSW economy is likely to be able to also supply some machinery and equipment manufacturing and machinery leasing that could not be supplied by the smaller regional economy.

3.3.2 Operation Phase

Introduction

For the analysis of the Modification, a new Mt Arthur Modification sector was inserted into the regional input-output table reflecting average annual production levels of 32 Mtpa ROM coal between 2023 and 2026.

The revenue and expenditure data for this new sector was obtained from financial information provided by HVEC for the Modification. For this new sector:

- the estimated gross annual revenue was allocated to the *output* row;
- the estimated wage bill of those residing in the region was allocated to the *household wages* row with any remainder allocated to *imports*;
- non-wage expenditure was initially allocated across the relevant intermediate sectors in the economy, imports and *OVA*;
- allocation was then made between *intermediate sectors* in the local economy and *imports* based on advice from HVEC and regional location quotients;
- purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the national input-output tables;
- the difference between total revenue and total costs was allocated to the *OVA* row*;* and
- direct employment by Modification that resides in the region was allocated to the *employment* row.

Impacts on the Regional Economy

Economic Activity

The total and disaggregated annual impacts of the Modification on the regional economy (in 2012 dollars) are shown in Table 3.5.

Table 3.5 – Annual Economic Impacts of the Operation of the Modification on the Regional Economy

	Direct Effect	Production-Induced	Consumption-Induced	Total Flow-on	Total Effect
OUTPUT ($'000)	2,461,096	97,300	133,095	230,395	2,691,491
Type 11A Ratio	*1.00*	*0.04*	*0.05*	*0.09*	*1.09*
VALUE ADDED ($'000)	1,554,293	38,139	61,903	100,042	1,654,335
Type 11A Ratio	*1.00*	*0.03*	*0.04*	*0.06*	*1.06*
INCOME ($'000)	249,408	25,654	51,294	76,948	326,356
Type 11A Ratio	*1.00*	*0.10*	*0.21*	*0.31*	*1.31*
EMPL. (No.)	1,683	282	750	1,032	2,715
Type 11A Ratio	*1.00*	*0.17*	*0.45*	*0.61*	*1.61*

* Direct employment of 1,683 represents average annual employment residing in the region.

The Modification is estimated to make up to the following total annual contribution to the regional economy for four years:

- $2,691 M in annual direct and indirect regional output or business turnover;
- $1,654 M in annual direct and indirect regional value added;
- $326 M in annual direct and indirect household income; and
- 2,715 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Modification range from 1.06 for value-added up to 1.61 for employment.

Capital intensive industries 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:

- electricity supply sector;
- services to mining sector;
- wholesale mechanical repairs sector;
- accommodation, cafes and restaurants sector;
- services to mining sector;
- agricultural and mining machinery manufacturing sector;
- retail trade sector;
- wholesale trade sector;
- personal services sector; and
- education 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 3.6).

Table 3.6 - Distribution of Regional Employment Impacts of Modification Operation

Sector	Average Direct Effects	Production-induced	Consumption-induced	Total
Primary	0	0	17	18
Mining	1,683	41	1	1,725
Manufacturing	0	37	27	64
Utilities	0	16	9	25
Wholesale/Retail	0	58	209	267
Accommodation, cafes, restaurants	0	3	116	119
Building/Construction	0	6	4	10
Transport	0	11	24	34
Services	0	111	343	454
Total	**1,683**	**283**	**750**	**2,715**

Note: Totals may have minor discrepancies due to rounding.

Table 3.6 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 services sectors, mining, manufacturing, wholesale/retail and services sectors while consumption-induced flow-on employment would be mainly in wholesale/retail, accommodation/cafes/restaurants and services 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 an increased 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 inserting a new Modification sector into a 2012 NSW input-output table in the same manner described in Section 3.2. The primary difference from the sector identified for the regional economy was that all direct employment was assumed to reside in NSW and a greater level of expenditure was captured by NSW economy compared to the regional economy.

Economic Activity

The total and disaggregated annual impacts of the Modification on the NSW economy (in 2012 dollars) are shown in Table 3.7.

Table 3.7 - Annual Economic Impacts of the Operation of the Modification on the NSW Economy

	Direct Effect	Production-Induced	Consumption-Induced	Total Flow-on	Total Effect
OUTPUT ($'000)	2,461,096	1,096,538	1,033,284	2,129,822	4,590,918
Type 11A Ratio	*1.00*	*0.45*	*0.42*	*0.87*	*1.87*
VALUE ADDED ($'000)	1,649,885	425,145	526,309	951,454	2,601,339
Type 11A Ratio	*1.00*	*0.26*	*0.32*	*0.58*	*1.58*
INCOME ($'000)	311,760	277,966	301,190	579,155	890,915
Type 11A Ratio	*1.00*	*0.89*	*0.97*	*1.86*	*2.86*
EMPL. (No.)	2,104	2,946	4,021	6,967	9,071
Type 11A Ratio	*1.00*	*1.40*	*1.91*	*3.31*	*4.31*

The Modification is estimated to make up to the following total contribution to the NSW economy for four years:

- $4,591 M in annual direct and indirect regional output or business turnover;
- $2,601 M in annual direct and indirect regional value added;
- $891 M in annual direct and indirect household income; and
- 9,071 direct and 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 IMPACT OF CESSATION OF THE MODIFICATION ON THE REGIONAL ECONOMY

The Modification approval would extend the life of the Mt Arthur Coal Mine by four years and extend the period of time that the Mt Arthur Coal Mine provides economic activity in the regional and NSW economy. Ultimate cessation of the mining operations would result in a contraction in regional economic activity.

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 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 region, then the impacts of Modification cessation would not be as severe compared to a greater proportion of employees leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption the regional economic impacts of Modification cessation would approximate the direct and production-induced effects in Table 3.5. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.5.

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 region compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local region (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with Modification 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 a region’s capacity to expand its factors of production by attracting investment and labour from outside the region (Bureau of Industry Economics, 1994). This in turn can depend on a region’s natural endowments.

The region is a prospective location with a range of coal resources. New mining resource developments in the region would help broaden the region’s economic base and buffer against impacts of the cessation of individual projects.

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 more 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 be less significant.

Nevertheless, it is not possible to foresee the likely circumstances within which Modification cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and the skills and expertise that the Modification and other mining operations would maintain in the region.

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 i.e. Muswellbrook, Singleton and the Upper Hunter Shire LGAs.

The assessment draws on a range of publications and reports as well as data provided by HVEC, the ABS Census (ABS, 2006), and information from Section 3 on the potential regional economic impacts of the Modification.

4.2 COMMUNITY INFRASTRUCTURE IMPACT ASSESSMENT

4.2.1 Introduction

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 existing Mt Arthur Coal Mine workforce;
  - 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[10] 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.

4.2.2 Construction Workforce and Population Change

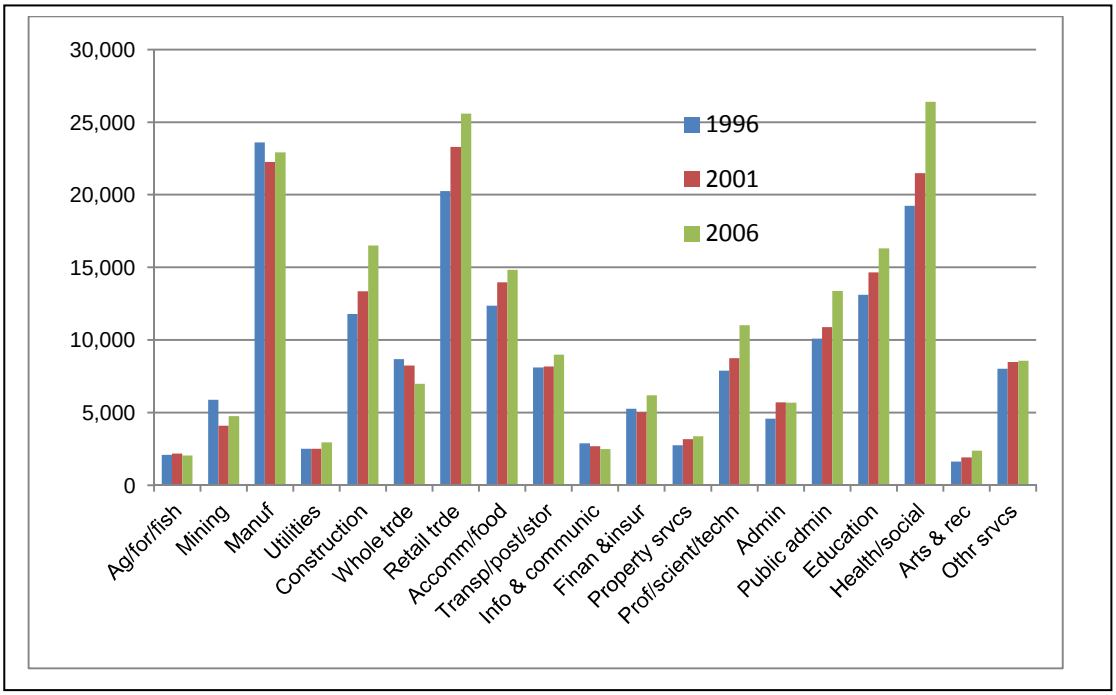
The main construction phase of the Modification would occur in 2015 with the relocation of the Macquarie Generation conveyor load points and the explosive magazine as well as the duplication of the existing rail loop. It is anticipated that during this development phase of the Modification, a workforce of up to 240 people would be required in the short-term (12 months).

Examination of the employment by industry data in Figure 4.1 indicates that the regional economy has a large and strongly growing construction sector. It is envisaged that most of the required short-term 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 Newcastle and commute to the region daily. Consequently, little, if any, population change as a result of the construction workforce is envisaged.

Therefore no community infrastructure impacts would occur as a result of the construction component of the Modification.

[10] 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.

Figure 4.1 – Employment by Industry in the Regional Economy



Source: ABS (2006)

4.2.3 Operation Workforce and Population Change

The Modification relates to the continuation of an existing activity for a period of four years at the currently approved rate of 32 Mtpa ROM coal. The Modification would therefore result in continued employment of the existing workforce at the Mt Arthur Coal Mine, up to 2,600 full-time equivalent jobs for a period of four years. Consequently, no population changes are envisaged as a result of the operation workforce. Therefore no community infrastructure impacts would occur as a result of the operation phase of the Modification.

4.3 SOCIAL AMENITY

There is potential for the proposed Modification to negatively impact on local and regional amenity through increases in road traffic, noise, a reduction in air quality and visual impacts.

The potential impacts of the Modification on local traffic conditions and road safety would be limited to the change to traffic regime associated with the proposed site entrance off Edderton Road. This intersection would be upgraded by HVEC as part of the approved Edderton Road realignment. Consequently, the Modification is not expected to affect the performance of local roads and intersections.

Those properties already experiencing visual impacts would be affected by an additional four years of views of mine operations (years 2023 to 2026) relative to the existing approval. Impacted properties are already eligible under the existing Project Approval 09_0062 to receive impact mitigation measures such as tree screening. Consequently, additional visual impacts of the Modification are likely to be minor and short-term.

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

4.4 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. Contracted labour during construction in 2015 is likely to be sourced from existing contractor firms located within the region or daily commuters from Newcastle. The Modification would result in continued employment of the existing workforce at the Mt Arthur Coal Mine, up to 2,600 full-time equivalent jobs for a period of four years. No additional operational workforce is envisaged. Consequently, no additional impact on community infrastructure is anticipated and no specific mitigation or management measures are required.

Notwithstanding, HVEC would continue to develop and run programmes 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 economic activity 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 Programme 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 CONCLUSIONS

A BCA of the Modification indicated that it would have net production benefits to Australia of $1,031 M. Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia are considered to be valued at less than $1,031 M, the Modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified, an attempt was made to quantify them. 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 emissions, surface water and groundwater impacts. These impacts are estimated at $102 M globally or $9 M to Australia, considerably less than the estimated net production benefits of the Modification. There may also be some non-market benefits of employment provided by the Modification which remain unquantified. Overall, the Modification is estimated to have net benefits to Australia of at least $1,022 M and hence is desirable and justified from an economic efficiency 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, including:

- HVEC and its shareholders in the form of after tax (and after voluntary/mandatory contributions) profits.
- The Commonwealth Government in the form of any Company tax payable (estimated at $308 M present value) and the MRRT payable from the Modification, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Muswellbrook, Upper Hunter Shire and Singleton LGAs.
- The NSW Government via royalties (estimated at $299 M present value) which are subsequently used to fund provision of government infrastructure and services across the state, including the Muswellbrook, Upper Hunter Shire and Singleton LGAs.
- The local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

The 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 internalised into the productions costs of HVEC.

The non-market costs that accrue to NSW are estimated at less than $9 M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW through royalties[11]. Consequently, as well as resulting in net benefits to Australia the Modification would result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that the operation of the Modification is estimated to make up to the following contribution to the regional economy for a period of four years:

- $2,691 M in annual direct and indirect regional output or business turnover;
- $1,654 M in annual direct and indirect regional value added;

[11] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and MRRT, shareholder payments as well as any direct contributions through the Voluntary Planning Agreement.

- $326 M in annual direct and indirect household income; and
- 2,715 direct and indirect jobs.

For the NSW economy, the operation of the Modification is estimated to make up to the following contribution for a period of four years:

- $4,591 M in annual direct and indirect regional output or business turnover;
- $2,601 M in annual direct and indirect regional value added;
- $891 M in annual direct and indirect household income; and
- 9,071 direct and indirect jobs.

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

The peak construction period of the Modification would last for approximately 12 months and require a workforce of around 240 people. However, most of this workforce is expected to already reside in the region or commute from outside the region. Consequently, little, if any, population change and hence community infrastructure impacts are expected to occur as a result of the construction component of the Modification.

The Modification relates to the continuation of an existing activity for a period of four years at the currently approved rate of 32 Mtpa ROM coal. The Modification would therefore result in continued employment of the existing workforce at the Mt Arthur Coal Mine, up to 2,600 full-time equivalent jobs for a period of four years. Consequently, no population changes are envisaged as a result of the operation workforce. Therefore no community infrastructure impacts would occur as a result of the operation phase of the Modification.

Cessation of the Modification may lead to a reduction in economic activity. The significance of these Modification cessation impacts would depend on:

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

6 REFERENCES

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

Australian Bureau of Statistics (2006) *Census of Population and Housing*.

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

Bureau of Industry and Economics (1994) *Regional Development: Patterns and Policy Implications*. Research Report No. 56, AGPS, Canberra.

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

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

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

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

Hunter Valley Energy Coal (2009) *Mt Arthur Coal Mine Consolidation Project Environmental Assessment*.

James, D. and Gillespie, R. (2002) *Draft Guideline for Economic Effects and Evaluation in EIA*. Prepared for Department of Planning and Infrastructure.

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

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

NSW Treasury (2007) *Treasury Guidelines for Economic Appraisal*.
Website: www.treasury.nsw.gov.au.
Date Accessed: 20 March 2012.

Office of Social Policy (1995) *Techniques for Effective Social Impact Assessment: A Practical Guide*.

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

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

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

Streeting, M. and Hamilton, C. (1991) *Economic Analysis of the Forests of South-eastern Australia*. Prepared for the Resource Assessment Commission.

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

ATTACHMENT 1

VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO_2-e) emissions a shadow price of carbon (C) 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 (t) 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: The 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 (2006) damage cost estimates including:

- that in estimating the damage of climate change Stern (2006) has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's (2006) 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 (2006) uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

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

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

Tol (2005) concluded that:

> *it is unlikely that the marginal damage costs of CO_2 emissions exceed US$14/t CO_2 and are likely to be substantially smaller than that.*

Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US$30 per tonne of carbon (/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 US$177/t C (US$48/t CO_2-e) and a modal estimate of US$49/t C (US$13/t CO_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 US$80/t C ($22/t CO_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 Euros (€)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.

As stated in *Securing a Clean Energy Future: The Australian Government's Climate Change Plan* (Commonwealth Department of Climate Change and Energy Efficiency, 2011) around 500 of the biggest polluters in Australia will need to buy and surrender to the Commonwealth 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/t, 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/t, 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 $8/t Australian Dollars (AUD) CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of this report.

REFERENCES

Department of Climate Change and Energy Efficiency (2011) *Securing a Clean Energy Future: The Australian Government's Climate Change Plan,* Commonwealth of Australia, Canberra.

Nordhaus, W. (2008) *A Question of Balance: Weighing the Options on Global Warming Policies*. Yales University Press, New Haven and London.

Stern, N. (2006) *Stern Review: The Economics of Climate Change.* Cabinet Office – HM Treasury. Website: www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf

Tol, R. (2005) *The Marginal Damage Costs of Carbon Dioxide Emissions: an Assessment of the Uncertainties*. Energy Policy 33 (2005), pp. 2064-2074.

Tol, R. (2006) *The Stern Review of the Economics of Climate Change: A Comment.* Economic and Social Research Institute, Hamburg, Vrije and Carnegie Mellon Universities.

Tol, R. (2011) The Social Cost of Carbon, *Annual Review of Resource Economics*, 3, 419-443.

ATTACHMENT 2

BENEFIT COST ANALYSIS SENSITIVITY TESTING

Table A2.1 - Sensitivity Testing of Net Benefits to Australia ($'000) (Excluding Employment Benefits)

	4%	7%	10%
CORE ANALYSIS	**$1,503**	**$1,022**	**$698**
INCREASE 20%			
Opportunity cost of land and capital equipment	$1,496	$1,016	$694
Capital costs	$1,413	$958	$653
Operating costs	$1,045	$709	$483
Decommissioning and rehabilitation costs	$1,514	$1,030	$704
Value of coal	$2,328	$1,585	$1,087
Residual value of land and capital equipment	$1,510	$1,026	$701
Foreign ownership	$1,379	$937	$641
Greenhouse gas costs @$40 t CO_2-e	$1,502	$1,021	$698
Surface water impacts	$1,502	$1,021	$697
Groundwater impacts	$1,501	$1,021	$698
DECREASE 20%			
Opportunity cost of land and capital equipment	$1,511	$1,027	$702
Capital costs	$1,593	$1,085	$743
Operating costs	$1,961	$1,334	$913
Decommissioning and rehabilitation costs	$1,495	$1,016	$694
Value of coal	$678	$458	$309
Residual value of land and capital equipment	$1,496	$1,017	$695
Foreign ownership	$1,628	$1,106	$756
Greenhouse gas costs @$8 t CO_2-e	$1,504	$1,022	$699
Surface water impacts	$1,504	$1,022	$699
Groundwater impacts	$1,505	$1,022	$699

% = percent.

t CO_2-e = tonne carbon dioxide equivalent.

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" (Guy and West, undated). 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.)[1], 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" (Guy and West, undated).

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

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

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

[1] 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.

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 2 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 devices" (Australian Bureau of Statistics [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 an Australian Dollar (AUD) $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 AUD$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 AUD$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 AUD$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. 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 (Centre for Farm Planning and Land Management, 1989).

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

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

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

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

REFERENCES

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

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

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

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

Guy R. West, G. (undated) *Notes On Some Common Misconceptions In Input-Output Impact Methodology*, Department of Economics, The University of Queensland. Website: http://espace.library.uq.edu.au/eserv.php?pid=UQ:11078&dsID=DP262Oct99.pdf

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 non-ferrous metals and building and construction sectors. 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. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

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). That 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 method is shown in Table A4.1 (Powell and Chalmers, 1995).

Table A4.1 - The GRIT Method

Phase	Step	Action
I		**ADJUSTMENTS TO NATIONAL TABLE**
	1	Selection of national input-output table (109-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
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.
III		**DEFINITION OF REGIONAL SECTORS**
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
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.
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: Table 2 in Bayne and West (1988)

REFERENCES

Bayne, B.A. and West, G.R. (1988) *GRIT – Generation of Regional Input-Output Tables: User's Reference Manual*. Australian Regional Developments No. 15, Office of Local Government, Department of Immigration, Local Government and Ethnic Affairs, Australian Government Publishing Service, Canberra.

Jensen, R. (1980) The Concept of Accuracy in Input-Output Models, *International Regional Science Review* 5(2), 139-54.

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