Appendix 16

Economic Assessment

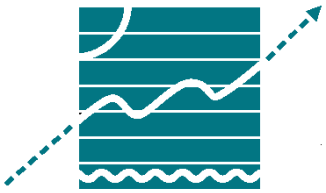
Northparkes Mines Step Change Project

Economic Assessment

Prepared for

Umwelt (Australia) Pty Limited

By



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EXECUTIVE SUMMARY

Gillespie Economics was commissioned by Umwelt (Australia) Pty Limited on behalf of Northparkes Mines (NPM) to complete an economic impact assessment for the NPM Step Change Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment being prepared to support an application under the *Environmental Planning and Assessment Act 1979*.

NPM are seeking approval for a Project which encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases, augmentation to approved Tailings Storage Facilities and an extended mine life of seven years until the end of 2032 at the approved ore processing rate of up to 8.5 million tonnes per annum (Mtpa)

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

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits of the Project using Benefit Cost Analysis); and
- The economic activity that the Project would provide to the local (Parkes LGA), regional (Parkes and Forbes LGAs) and NSW economy using input-output analysis.

A BCA of the Project indicated that it would have net production benefits to Australia of $28M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $28M, the Project 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 impacts of the Project that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions. These impacts are estimated at less than $1M to Australia, considerably less than the estimated net production benefits of the Project. There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of $32M. Overall, the Project is estimated to have net social benefits to Australia of between $28M and $60M 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 Project to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- NPM shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable ($11M present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties ($12M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- The local community in the form of any voluntary contributions to community infrastructure and services.

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

The non-market costs, including greenhouse gas costs, that accrue to NSW and are not already internalised into the production costs of the Project through mitigation measures and compensation costs are estimated at less than $1M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the Project would result in net benefits to NSW.

An economic impact analysis, using input-output analysis, estimated that the Project would make up to the following total annual contribution to the local economy for the peak years of production:

- $329M in annual direct and indirect regional output or business turnover;
- $220M in annual direct and indirect regional value added;
- $34M in annual direct and indirect household income; and
- 470 direct and indirect jobs.

The Project is estimated to make up to the following total annual contribution to the regional economy for peak years of production:

- $335M in annual direct and indirect regional output or business turnover;
- $223M in annual direct and indirect regional value added;
- $39M in annual direct and indirect household income; and
- 497 direct and indirect jobs.

The incremental economic impacts of the Project would be less than this level in the years where incremental production is ramping up and ramping down.

Cessation of the Project operation may lead to a reduction in economic activity. The significance of these Project 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 Project 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

1.1 ECONOMIC ASSESSMENT

Gillespie Economics was commissioned by Umwelt (Australia) Pty Limited on behalf of Northparkes Mines (NPM) to complete an economic impact assessment for the NPM Step Change Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared to support an application under the *Environmental Planning and Assessment Act 1979*.

NPM are seeking approval for a Project which encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases, augmentation to approved Tailings Storage Facilities and an extended mine life of seven years until the end of 2032 at the approved ore processing rate of up to 8.5 million tonnes per annum (Mtpa)

The scope of work completed by Gillespie Economics for this assessment included addressing the Director-General's Environmental Assessment Requirements (DGRs) relating to economics, issued on 11 March 2013, including:

- "A conclusion justifying the project on economic,…..grounds,……. "
- Include an assessment of the potential direct and indirect economic benefits of the project for local and regional communities and the State;
- A detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community.

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

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

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

The NSW Department of Planning and Infrastructure's (DP&I) (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* (the Draft Guideline) 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 NSW Government (2012) Draft *Guideline for the use of cost benefit analysis in mining and coal seam gas proposals* also endorses BCA as the appropriate methodology for evaluating mining proposals. This latter guideline does not provide guidance on other forms of economic assessment.

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

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

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

- A BCA of the Project (Section 2); and
- An economic impact assessment of the Project (Section 3) for three regions:
  - The local economy comprising the Parkes Local Government Area (LGA);
  - The regional economy comprising the Parkes and Forbes LGAs; and
  - The NSW economy.

1.2 PROJECT DESCRIPTION

Northparkes is a copper and gold mine located in Central West NSW 27km from Parkes. Northparkes is a joint venture between Rio Tinto (80%) and the Sumitomo Group (20%). Northparkes existing operations are approved until 2024.

NPM are seeking approval for a Project which encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases, augmentation to approved Tailings Storage Facilities and an extended mine life of seven years until the end of 2032 at the approved ore processing rate of up to 8.5 million tonnes per annum (Mtpa)

The Project area consists of existing and proposed mining operations and associated infrastructure. The major components of the Project include:

- Continuation of approved underground block cave mining in the E48 and E26 ore bodies, and associated underground infrastructure;
- Development of underground block caving in the E22 resource beneath the E22 open cut void;
- Campaign open cut mining through development of five open cut resources including;
  - Development of four small open cut pits E31, E31N, E28, E28N; and
  - Proposed E26 open cut which is located in an area of previous underground block cave subsidence (existing vertical extent of subsidence void is approximately 200 metres);
- Amendments to the configuration of tailings storage facilities (TSFs) including;
  - continuation of tailings disposal to the existing and approved TSFs (TSF 1 and 2, infill between TSF 1 and 2, and Estcourt) to an approved height of 28 metres;
  - provision for additional raises on Estcourt TSF to provide for an increased height from the approved 25 metres to up to approximately 28 metres above ground surface; and
  - development of a new TSF 3, which will extend to the south and from the southern embankment of TSF 2 to a height of approximately 28 metres above ground surface, which incorporates the approved Rosedale TSF;

- Development of new waste dumps for the management of E28/E28N and E26 open cut waste rock. Waste rock from E31 and E31N open cut mining areas will be utilised in the development of TSF 3;

- Continuation of approved ore processing infrastructure up to 8.5 Mtpa capacity, and road haulage of copper concentrate to the existing Goonumbla rail siding;

- Continued use of existing site infrastructure including administration buildings, workshop, internal access roads and service infrastructure;

- Continued use of surface mining infrastructure including ventilation shafts, hoisting shaft and ore conveyors;

- Continuation of existing approved water supply and management processes;

- Development of an amended access road to service all mine related traffic entering the site;

- Establishment of new visitor car parking facilities and access control to support the amended mine site access;

- Continuation of approved mining operations for an extended life of an additional 7 years until end of 2032; and

- Rehabilitation and closure of the mine site will be carried out after the end of the operational life of the Project in accordance with relevant approvals.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Introduction to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics. Applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW environmental assessment framework are further guided by the NSW DP&I *Draft Guidelines for Economic Effects and Evaluation in EIA* (James and Gillespie 2002) and the NSW Government (2012) *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

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

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

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

Definition of Society

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

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

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

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

BCAs of mining projects are therefore often undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia. A consideration of the distribution of costs and benefits can then be

undertaken to identify the benefits and costs that accrue to NSW and other regions. However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

Definition of the Project Scope

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a BCA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For mining projects, typically only the costs and benefits from the mining activity and delivering it to Port or domestic users, are relevant.

Silver, gold and copper are intermediate goods i.e. they are an input to other production processes. However, these other production processes themselves require approval and, in BCA, would be assessed as separate projects.

Net Production Benefits

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

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

Net production benefits can be estimated based on market data on the projected financial[1] value of a mineral resource less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

Environmental, Social and Cultural Impacts

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

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

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

- "can be readily identified, measured in physical terms and valued in monetary terms;
- can be identified and measured in physical terms but cannot easily be valued in money terms; and
- are known to exist but cannot be precisely identified, measured or value" (NSW Treasury 2007).

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

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

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

In attempting to value the impacts of a project on the well-being of people there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in BCA (NSW Government, 2012).

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

Consideration of Net Social Benefits

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

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

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

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

Any other residual environmental, cultural or social costs that remain unquantified in the analysis[2] can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

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

Steps in BCA of the Project

BCA of the Project involves the following key steps:

- Identification of the base case;
- Identification of the Project 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 Project based on financial, technical and environmental advice provided by NPM and its' specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND THE PROJECT

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

Under the base case, the current mining operation at Northparkes would cease in 2025 with associated site decommissioning. The residual value of land and capital equipment being used for that operation would be able to be realised by sale or alternative use.

In contrast, the Project (as described in Section 1.2) would extend the life of the existing mining life for approximately 7 years until the end of 2032. At the end of the Project the residual value of capital equipment and land would be able to be realised through sale or alternative use.

BCA is primarily concerned with the evaluation of a project relative to the counterfactual of no project. Where there are a number of alternatives to a project then these can also be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Project were considered by NPM in the development of the Project description. Section 2.4 of the Main Volume of the EA provides more detail on the consideration of Project alternatives.

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

2.3 IDENTIFICATION OF BENEFITS AND COSTS

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

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

Category	Costs	Benefits
Net production benefits	Opportunity costs of capital equipment Opportunity cost of land[1] Development costs including labour, capital equipment and acquisition costs for impacted properties and offsets[1] Operating costs of mine including labour and mitigation measures Rehabilitation and decommissioning costs at end of the Project life	Avoided decommissioning and rehabilitation costs in 2024/25 Value of mineral production Residual value of capital equipment and land at end of Project life
Potential environmental, social and cultural impacts	Noise impacts and blasting impacts Air quality and greenhouse gas impacts Surface water and groundwater impacts Agricultural impacts[1] Ecology impacts Road transport impacts Aboriginal heritage impacts Non-Aboriginal heritage impacts Visual impacts	Any non-market benefits of employment

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

It should be noted that the potential environmental, social and cultural costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated to the extent where community wellbeing is insignificantly affected (i.e. those bearing the costs are fully compensated), then no additional environmental, social or cultural economic costs should be included in the Project BCA, apart from costs associated with mitigation and compensation.

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 19 years. Any impacts that occur after the analysis period are included in the analysis as a present value in the final year of the analysis. Where competitive market prices are available, they have been used as an indicator of economic values. Environmental, cultural and social impacts have initially been left unquantified and interpreted using the threshold value method[3]. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[4].

2.4.1 *Production Costs and Benefits*[5]

Production Costs

Opportunity Cost of Land and Capital

Under the base case or without Project scenario, the current mining operation at Northparkes would cease in 2025 and the value of land and capital equipment used in that mining operation would be able to be realised through sale or alternative use. There is an opportunity cost associated with continuing to use this land and capital equipment for the Project instead of its next best use. An indication of the opportunity cost of this land and capital equipment can be gained from its market

[3] The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.
[4] Benefit transfer refers to borrowing economic values that have been determined for other study sites.
[5] All values reported in this section are undiscounted Australian dollars unless otherwise specified.

value, estimated at $11M and $0M[6], respectively. The market value of land reflects among other things, the present value of the expected stream of profits from the next best alternative land use (e.g. agriculture).

Development Cost of the Project

Development costs of the Project are associated with the purchase of mining equipment, development of underground block caving and open cut puts, amendments to tailings storages, development of new waste dumps, development of access roads and establishment of new car parking facilities. These costs include labour costs during the development of the Project, which reflect the value of labour resources in their next best use.

These incremental development costs over the life of the mine are estimated at $346M, including sustaining capital. These development costs include an allowance for acquisition of land for properties adversely affected by noise/dust/vibration and ecological offsets. Development costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Project

The operating costs of the Project include those associated with mine operation, plant and infrastructure operations and general costs. These costs include labour costs, which reflect the value of labour resources in their next best use. The incremental operating costs of the Project are included in the BCA in the years that they are expected to occur

While royalties are a cost to NPM, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties in the order of $32M ($12M present value).

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

Rehabilitation and Decommissioning Costs

Decommissioning and rehabilitation costs at the end of the Project life are estimated at $124M.

Production Benefits

Avoided Rehabilitation and Decommissioning Costs

At the end of the current approval life in 2024/25 the site infrastructure area would require decommissioning at an estimated cost of $120M. With the Project these costs in 2024/25 would be avoided at this time and hence represent a benefit of the Project.

Value of Mineral Resources

Total incremental silver, gold and copper production from the Project, have been valued based on the projected prices provided by NPM. There is uncertainty around future silver, gold and copper prices as well as the AUD/USD exchange rate and hence assumed values have been subjected to sensitivity testing (see Section 2.6).

[6] Existing capital equipment is assumed to have a zero value and new capital equipment will be required for the Project. The cost of this new capital equipment is included in the development costs of the Project.

Residual Value at End of the Evaluation Period

At the end of the Project, capital equipment and land (excluding offsets) may have some residual value that could be realised by sale or alternative use. The residual value of land and capital equipment is estimated at $11M and $0M[7], respectively.

2.4.2 *Environmental, Social and Cultural Costs and Benefits*

The environmental, social and cultural impacts of the Project are discussed in detail in the EA. This section summarises these findings and where possible interprets and values impacts in terms of economic efficiency.

Greenhouse Gases

The Project combined with the existing approval is predicted to generate in the order of 4.3 Mt of Scope 1, Scope 2 and Scope 3 emissions over the lifetime of the Project. The economic analysis is only concerned with the incremental greenhouse gas emissions that would arise from the Project. These have been estimated on the basis of the relative level of mineral production of the Project and included in the BCA as an environmental cost of the Project.

To place an economic value on CO_2-e emissions, a shadow price of CO_2-e is required that reflects its global social costs. The global social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the global social cost of CO_2-e with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the global damage costs of CO_2-e is to examine the price of CO_2-e credits/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price of AUD$23/t CO_2-e rising at 2.5 per cent per year in real terms for three years (based on the Governments carbon tax) and then remaining constant was used. Sensitivity testing assuming a shadow price from AUD$8/t CO_2-e to AUD$40/t CO_2-e was also undertaken (refer to Attachment 1).

This represents the global social cost of carbon i.e. the cost of carbon emissions to the population of the whole world. In the absence of any studies that have focused on the social damage cost of carbon emissions to Australians, some means of apportioning global damage costs borne by Australians is required. For the purpose of the economic assessment this has been undertaken using Australia's share of global gross domestic product (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%.

Agricultural Production

The Project will result in the disturbance of approximately 117 ha of farming land owned by NPM that is currently used for commercial farming activities. The present value of foregone agricultural production is reflected in land prices. The value of foregone agricultural production, as a result of the Project, has therefore been incorporated into the BCA through inclusion of the full land value (opportunity cost) of affected properties. A separate analysis by WHK Ivey has also been undertaken of the agricultural impacts of the Project.

Noise

During periods of worse case meteorological conditions and during construction, one private residence is likely to be subject to significant noise impacts and will likely have acquisition rights under any Project approval. NPM will undertake targeted monitoring during worse case periods during construction and implement a hierarchy of controls to mitigate potential significant impacts. The

[7] It is assumed that capital equipment required for the Project has a zero value at the end of the Project life.

impacts on this property can potentially be valued using the property value method, where the change in property value as a result of the noise impacts is estimated. Instead of incorporating the partial property value impact on this property, the full cost of acquiring the affected property has been incorporated into the development costs of the Project. This will overstate the impact on the property potentially experiencing significant noise impacts.

In addition, two private residents are predicted to experience moderate noise exceedances during the operation of the Project. The proponent would be required to undertake additional 'receiver-based noise mitigation measures for residences predicted to be moderate affected, if required by the landowner. These mitigation costs have been included in the development costs of the Project. This may understate the impact on properties experiencing moderate noise exceedances.

Blasting

A detailed blasting assessment has been completed for the Project which indicates that there will be no significant blasting impacts on surrounding private residences. NPM will continue to undertake monitoring and manage blasting activities to ensure compliance with relevant criteria. . Consequently, no economic costs have been included in the BCA for blasting impacts.

Air Quality

Predicted dust emissions from the Project are estimated to make a minimal contribution to surrounding receiver areas. No private residences are predicted to exceed relevant long term (annual average) air quality criteria. During periods of worse case background dust concentration levels the Project may result in exceedence of the relevant short term maximum air quality criteria on occasion, but this is expected to be less than two days per year at surrounding private residences. To minimise and prevent these occurrences, NPM will undertake additional real time air quality monitoring to inform the management of operations in order to minimise impacts on surrounding areas. Consequently, no economic efficiency impacts are included in the BCA.

Water Resources

The existing water management system will be extended to include all areas of additional disturbance associated with the Project. Water for operational uses will continue to be sourced from on-site collection and externally through existing licences and approvals. The Project is not predicted to have significant impacts on downstream water users in relation to surface water and groundwater resources. However, there is an opportunity cost associated with continuing to hold water licences required for the Project instead of selling them. These impacts have been included in the BCA by applying an estimated market value of water of $2,000/ML.

Ecology

Project impacts on identified ecological values have been avoided, where practicable, through Project design. However, approximately 116 hectares of treed vegetation will be impacted by the Project, including the disturbance of habitat for identified threatened species. Two Threatened Ecological Communities (TECs) will be impacted by the Project with total disturbance of approximately 38ha.

The Project also has the potential to impact on two threatened species, Pine Donkey Orchid and Sloane's Froglet, if it is confirmed that these species occur in the proposed disturbance area.

NPM has committed to the development of a comprehensive Biodiversity Offset Strategy. The capital and operating costs of implementing the Biodiversity Offset Strategy has been included in the capital and operating costs of the Project.

The impacted vegetation, and associated fauna, is likely to have non-use values to the community that would be lost as a result of the Project. These values could potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community that would be gained as a result of the Project. Provided the values held by the community for the offsets are equal or greater than values that would be lost then no additional economic costs warrant inclusion in the BCA. The Government's offsets policy and the DGRs for the Project requires that offsets improve or at least maintain biodiversity values.

Road Transport

Assessment of potential road transport impacts indicated that the existing transport infrastructure will continue to operate satisfactorily during peak traffic generation periods of the Project. Road works proposed as part of the Project to mitigate any potential impacts have been designed to accommodate future traffic movements in accordance with relevant guidelines. These road works will be completed in consultation with Parkes Shire Council and local landholders. The costs of these road works have been included in the capital costs of the Project. No significant residual impacts have been identified that warrant inclusion in the BCA.

Aboriginal Heritage

The Project will result in direct impacts to four archaeological sites of low scientific significance that will be salvaged in consultation with the Aboriginal community. NPM has committed to the continued implementation of an updated Aboriginal Heritage Management Plan (AHMP) to mitigate and manage identified impacts within the Project area. The costs of preparing and implementing this plan and mitigation measures have been included in the capital and operating costs of the Project.

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

In addition to the value that impacted sites may have to the Aboriginal community, sites may also have non-use economic values to the broader community which can potentially be estimated using non-market valuation methods such as choice modelling. However, existing studies have shown mixed results. Gillespie Economics (2008, 2009a, 2009b) has shown significant positive community values for the conservation of highly significant Aboriginal heritage sites such as rock overhangs containing highly significant Aboriginal sites such as grinding groove, engraving, rock art and artefacts, and open areas containing grinding grooves, scar trees and bora grounds. However, these studies may overstate the economic values high significance heritage since they relate to uncompensated impacts and projects like the Project include mitigation and compensation measures. They are also not relevant to Aboriginal sites of low significance. Other studies e.g. Rolfe and Windle (2003) have shown negative WTP of the community for the conservation of Aboriginal heritage sites.

Consequently for this BCA the economic impacts on Aboriginal heritage sites, after mitigation and compensation, remain unquantified but are considered to be insignificant in economic terms.

European Heritage

The Project will not impact on any items of National, State or local Heritage significance. Consequently no economic costs are included in the BCA.

Visual Impacts

The Project has a substantial buffer of mine owned land. Potential views to the Project are consistent with existing and approved operations and hence visual impacts are considered to be insignificant. Consequently, no economic costs are included in the BCA.

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 Project BCA and so the net social benefits of the Project may be underestimated.

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

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

The Project will provide direct employment for up to 350 people for an additional seven years. Using benefit transfer from the more conservative Bulli Seam Operation study and applying the employment value to the estimated incremental direct employment of the Project[8] gives an estimated $32M for the non-market employment benefits of the Project.

It is recognised that there has been some controversy about the inclusions of this value in the BCA and the therefore BCA results are reported with and without the inclusion of this value.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

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

[8] This is consistent with the non-market valuation studies which focused on direct employment.

The Project is estimated to have total net production benefits of $49M, with $28M of these net production benefits accruing to Australia[9]. 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 Project, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Project. The threshold value indicates the price that the community must value any residual environmental impacts of the Project (be willing to pay) to justify in economic efficiency terms the no development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia[10], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $28M.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. From Section 2.4 it is evident that the main potential impacts of the Project are internalised into the production costs of the Project through mitigation measures and compensation costs. Other costs not already included in the production costs of the Project include those associated with greenhouse gas costs, although from Table 2.2 it is evident that the greenhouse gas impacts to Australian are small. There may also be non-market benefits from the employment provided by the Project.

Overall, the Project is estimated to have net social benefits to Australia of between $28M and $60M, and hence is desirable and justified from an economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the Project BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $28M and $60M for the Project to be questionable from an Australian economic efficiency perspective.

[9] This is the net production benefits of the Project minus net profit accruing to overseas shareholders, assuming 18% Australian ownership.
[10] Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis. This is mainly relevant to the consideration of greenhouse gas impacts.

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

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land	$0	Avoided decommissioning and rehabilitation costs in 2024	$47
	Opportunity cost of capital equipment	$6	Value of minerals	$459
	Development costs	$175	Residual value of land	$0
	Operating costs	$241	Residual value of capital equipment	$0
	Decommissioning and rehabilitation costs	$37		
	Sub-total	***$460***	***Sub-total***	***$509***
	Net Production Benefits			**$49 ($28)**
Environmental, cultural and social impacts	Greenhouse gas impacts	$13 ($0.1)	Non-market values of employment	$32
	Agricultural impacts	Insignificant. Included in opportunity cost of land and development costs (land acquisitions)		
	Noise impacts	Cost of acquisition and noise mitigation measures are included in development costs.		
	Blasting	Insignificant		
	Air quality impacts	Insignificant. Cost of mitigation measures included in development costs		
	Water resources	Opportunity cost included in development costs.		
	Ecology	Some loss of values but offset. Cost of biodiversity offset included in development and operating costs		
	Road transport impacts	Insignificant. Cost of road works included in development costs.		
	Aboriginal heritage	Insignificant. Costs of mitigation measures included in development and operating costs.		
	Non-Aboriginal heritage impacts	Insignificant		
	European Heritage	Nil		
	Visual impacts	Insignificant		
	Non-market impacts sub-total	***$13 ($0.1)***		***$32***
NET SOCIAL BENEFITS – including employment benefits				**$68 ($60)**
NET SOCIAL BENEFITS – excluding employment benefits				**$36 ($28)**

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

2.5.2 Distribution of Costs and Benefits

Introduction

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

Intra Generational

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

- NPM shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable ($11M present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties ($12M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- The local community in the form of any voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, State, National and global level.

Noise costs will occur at a local level. These have been at least partially incorporated into the estimation of net production benefits via acquisition and mitigation costs for affected properties. As such, the potential bearers of these costs are compensated. Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The potential bearers of these costs are therefore compensated via the payment to the Commonwealth Government. The clearing of native vegetation will potentially impact households at the local, State and National level who hold values for the impacted flora and fauna. However, compensation will be made in the form of a biodiversity offsets package. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Any non-market benefits associated with employment provided by the Project would largely accrue at the local or State level[11].

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

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

Value ($M)		Distribution			
		Local	State	National	Global
Net Production Benefits					
Net production benefits to NPM	$26	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	$11	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$12	✓	✓	-	-
Net production benefits to local and regional community in the form of voluntary contributions	Unquantified	✓	-	-	-
Total	***$49***				
Non-market Costs and Benefits					
Benefits					
Non-market benefit of employment	$32	✓	✓	-	-
Total	***$32***				
Costs					
Greenhouse gas emissions rest of the world[1]	$13	-	-	-	✓
Greenhouse gas emissions Australia[2]	$0.1	✓	✓	✓	
Agricultural impacts	Insignificant. Included in opportunity cost of land and development costs (land acquisitions)	✓	-	-	-
Noise impacts	Cost of acquisition and noise mitigation measures are included in development costs.	✓	-	-	-
Blasting	Insignificant	✓	-	-	-
Air quality impacts	Insignificant. Cost of mitigation measures included in development costs	✓	-	-	-
Water resources	Opportunity cost included in development costs.	✓	-	-	-
Ecology	Some loss of values but offset. Cost of biodiversity offset included in development and operating costs	✓	✓	✓	-
Road transport impacts	Insignificant. Cost of road works included in development costs.	✓	-	-	-
Aboriginal heritage	Insignificant. Costs of mitigation measures included in development and operating costs.	✓	-	-	-
Non-Aboriginal heritage impacts	Insignificant	✓	-	-	-
European Heritage	Nil	✓	-	-	-
Visual impacts	Insignificant	✓	-	-	-
Total	***$13***				
Net Social Benefits	**$68**				

Note: Totals may have minor discrepancies due to rounding.

The residual non-market costs that have been quantified and accrue to NSW are estimated at less than $1M. This is considerably less than the net production benefits that directly accrue to NSW through royalties ($12M). NSW will obtain additional benefits through voluntary contributions to the local and regional community and infrastructure and services provided with a share of Commonwealth Government Company tax. There are also additional benefits to NSW from the potential non-market

employment benefits ($32M). Consequently, as well as resulting in net social benefits to Australia the Project would result in net social benefits to NSW.

Intergenerational

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

However, it should be noted that the costs and benefits in BCA are defined and valued based on the microeconomic underpinnings of BCA. They are based on the values held by individuals in the society i.e. current generations. There is no way to measure the value that future generations hold for impacts of current day projects as they are not here to express it.

Nevertheless, as identified by Boardman et al (2001) this is not considered a serious problem for BCA because:

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

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

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.2 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

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

- Opportunity costs of land;
- Development costs;
- Operating costs;
- Decommissioning and rehabilitation costs;
- Residual value of land;
- Value of minerals;
- Level of Australian ownership;

- Greenhouse costs; and
- Non-market employment impacts.

What this analysis indicates (refer to Attachment 2) is that the results of the BCA are most sensitive to assumptions regarding the value of minerals. However, it was also sensitive to the level of development and operating costs.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA reported in Section 2 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community will in aggregate be better off 'with' the Project 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. These indicators can be defined as follows:

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

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.,* 1985; Jensen and West, 1986). The regional economic impact assessment of the Project is concerned with the incremental economic activity that the continued operation of the Northparkes mine would provide. The impacts are estimated for the peak years of the Project.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the project, but not making the economy so large that the impact of the project becomes trivial (Powell and Chalmers, 1995). For this study, the economic impacts of the project have been estimated for the following Australian Bureau of Statistics (ABS) geographical areas:

- The local economy of Parkes LGA;
- The regional economy of Parkes and Forbes LGAs; and
- NSW.

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.,* 1985). Economic base theory and Keynesian multipliers are relatively simple approaches that provide impact measurement only in aggregate terms. Mathematical programming models are especially useful in micro-level studies of firms and industries but become complex for whole economies. Mathematical programming models are therefore sometimes used to estimate direct effects on an industry or sector with input-output analysis used to assess economy-wide effects. Econometric models, particularly those of the general equilibrium type, have the potential to measure economic impacts in a similar way to that of input-output models with relaxation of some of the limitations of input-output analysis (Powell *et al.,* 1985). However, development of these models at the regional scale is complex and there are difficulties associated with estimating a large number of coefficients and parameters when there is virtually no local data available. 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). However, 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.), then the input-output model provides a reasonable and cost effective approach to estimating disaggregated impacts by sector at the regional level (Powell *et al.,* 1985; West, undated). This study uses input-output analysis.

3.2 INPUT OUTPUT METHODOLOGY

Input-output analysis essentially involves two steps:

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

Input-output analysis reports multipliers which are summary measures used for identifying the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from input-output analysis (refer to Attachment 3). Type 11A ratio multipliers (the kind reported in this assessment) summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

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. Key terminology used in the input-output assessment is also explained in Attachment 3.

3.3 INPUT OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

3.3.1 Introduction

A 2013 input-output table of the local (Parkes LGA) and regional (Parkes and Forbes LGAs) economies was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 4) with an 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 six sectors for the purpose of describing the economies.

Highly aggregated 2013 input-output tables for the local and regional economy are provided in Tables 3.1 and 3.2. The rows of these tables indicate how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD - which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Table 3.1 - Aggregated Transactions Table: Local Economy 2013 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	8,863	20	621	0	22	414	9,940	281	24,029	93,996	128,246
Mining	4	14,785	1,145	9	108	47	16,098	27	4,619	183,324	204,070
Manuf.	3,051	5,011	13,686	320	5,355	12,870	40,294	7,611	20,813	86,325	155,043
Utilities	741	2,940	1,972	34,426	496	5,788	46,363	3,674	832	28,338	79,207
Building	479	1,458	283	910	12,960	5,496	21,586	0	54,429	11,154	87,168
Services	9,804	7,135	17,448	2,186	7,211	86,734	130,518	98,670	172,410	254,075	655,674
TOTAL	22,943	31,349	35,155	37,851	26,152	111,348	264,798	110,263	277,132	657,213	1,309,407
Household Income	28,200	25,372	24,696	5,247	19,951	222,854	326,321	0	0	0	326,321
OVA	38,064	104,845	19,158	16,616	12,018	119,921	310,622	18,748	9,799	1,181	340,350
Imports	39,038	42,503	76,034	19,493	29,047	201,551	407,666	210,771	52,648	46,592	717,676
TOTAL	128,246	204,070	155,043	79,207	87,168	655,674	1,309,407	339,782	339,578	704,987	2,693,754
Employment	631	377	313	71	255	3,734	5,380				

Table 3.2- Aggregated Transactions Table: Region Economy 2013 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	23,488	45	3,788	1	71	1,343	28,736	2,283	48,392	180,230	259,642
Mining	9	14,877	1,126	12	165	81	16,270	43	4,521	184,969	205,804
Manuf.	9,060	5,462	26,496	491	9,782	25,273	76,564	16,828	38,546	141,665	273,604
Utilities	1,571	2,951	3,232	44,418	705	8,961	61,839	5,813	882	32,705	101,239
Building	1,035	1,483	412	1,127	21,060	7,586	32,703	0	85,753	18,542	136,998
Services	22,074	7,914	37,361	2,992	12,166	151,684	234,191	166,731	271,252	368,203	1,040,377
TOTAL	57,237	32,732	72,415	49,042	43,949	194,929	450,304	191,699	449,346	926,315	2,017,664
Household Income	53,885	24,632	42,072	6,420	30,196	353,084	510,289	0	0	0	510,289
OVA	77,107	106,508	33,896	21,323	18,854	192,357	450,044	29,666	15,888	1,665	497,263
Imports	71,413	41,933	125,220	24,454	44,000	300,008	607,027	316,294	85,364	65,670	1,074,355
TOTAL	259,642	205,804	273,604	101,239	136,998	1,040,377	2,017,664	537,660	550,598	993,650	4,099,571
Employment	1,305	382	544	91	415	6,090	8,826				

Value-added for the local economy is estimated at $667M, comprising $326M to households as wages and salaries (including payments to self-employed persons and employers) and $340M in OVA.

Value-added for the regional economy is estimated at $1,008M, comprising $510M to households as wages and salaries (including payments to self-employed persons and employers) and $497M in OVA.

The employment total working in the local and regional economy was 5,380 and 8,826, respectively.

The economic structure of the local and regional economy can be compared with that for NSW through a comparison of results from the respective input-output models (Figures 3.1, 3.2 and 3.3). This reveals that the agriculture and mining sectors in the local and regional economy are of greater relative importance than they are to the NSW economy, while the manufacturing sectors, building sectors and service sectors are of less relative importance than they are to the NSW economy. The utilities sectors are of similar relative importance in the local, regional and NSW economy.

Figure 3.1 - Summary of Aggregated Sectors: Local Economy

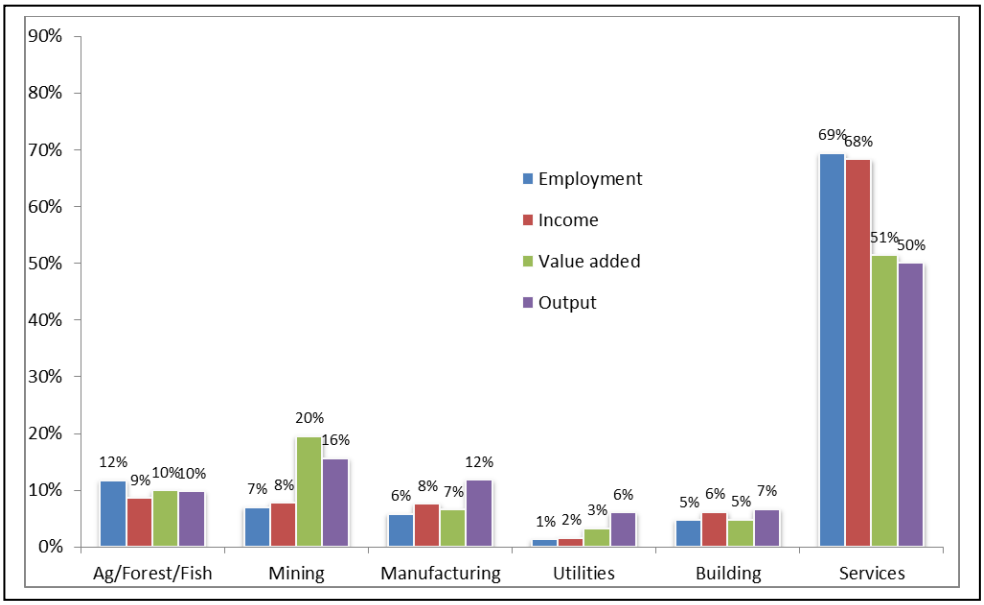


Figure 3.2 - Summary of Aggregated Sectors: Regional Economy

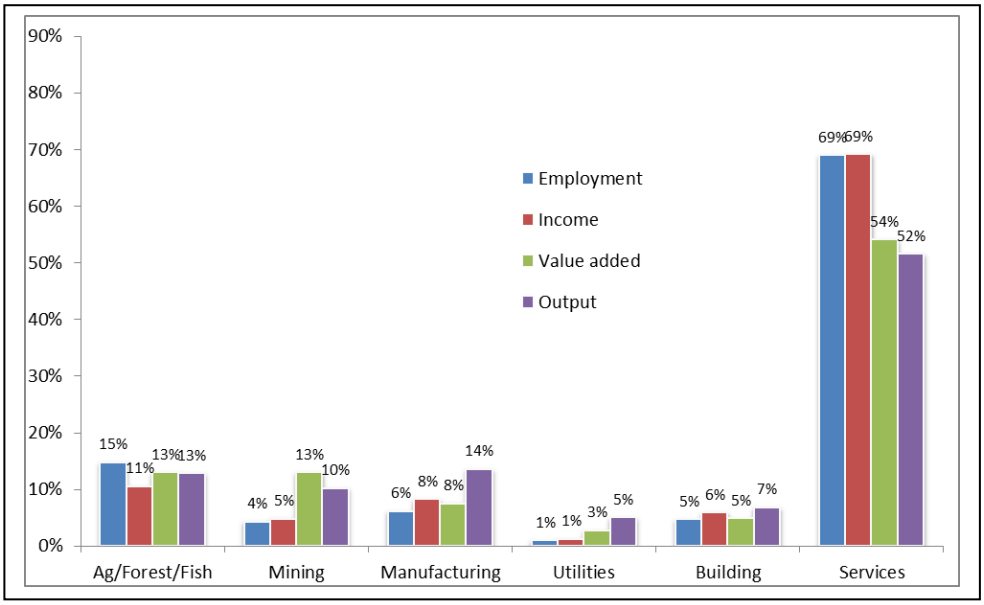
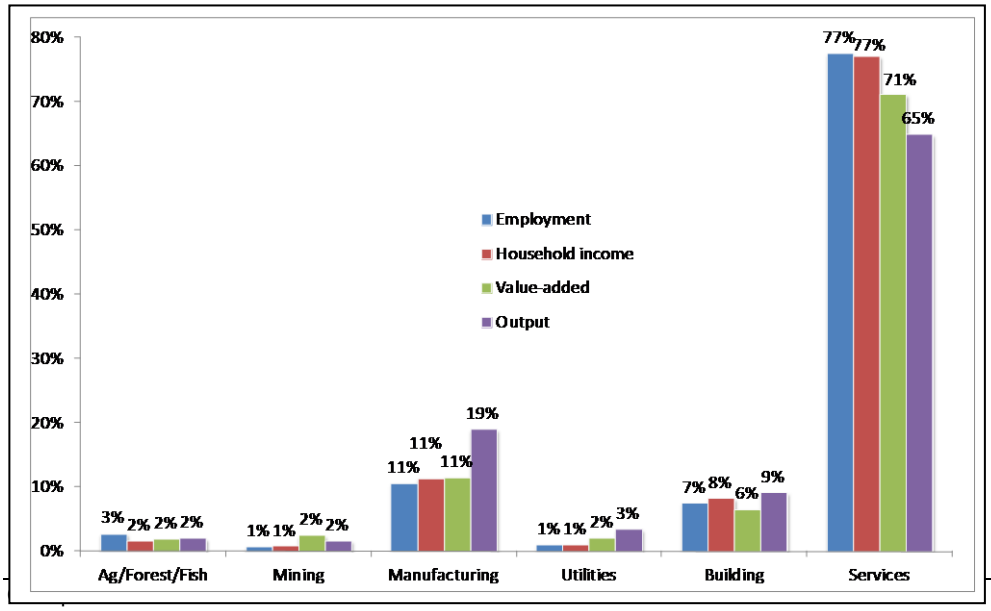


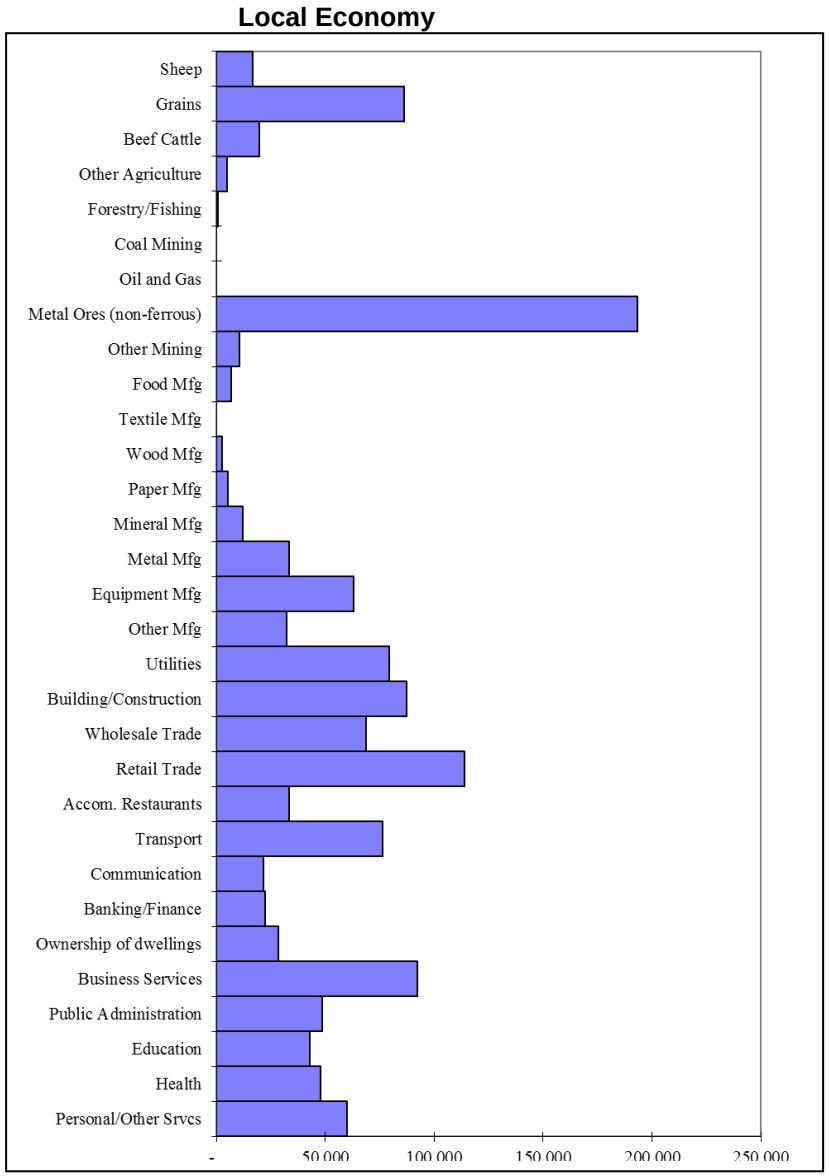
Figure 3.3 - Summary of Aggregated Sectors: NSW Economy



Figures 3.4 to 3.7 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 local and regional economy.

In terms of output and value-added, metal ores (non-ferrous) mining sectors, retail trade, business services sectors and grains sectors are the most significant to both the local and regional economy. The retail trade sectors, education sectors and health sectors are the most significant sectors to the local and regional economy for household income and employment.

Figure 3.4 Sectoral Distribution of Gross Regional Output ($'000)



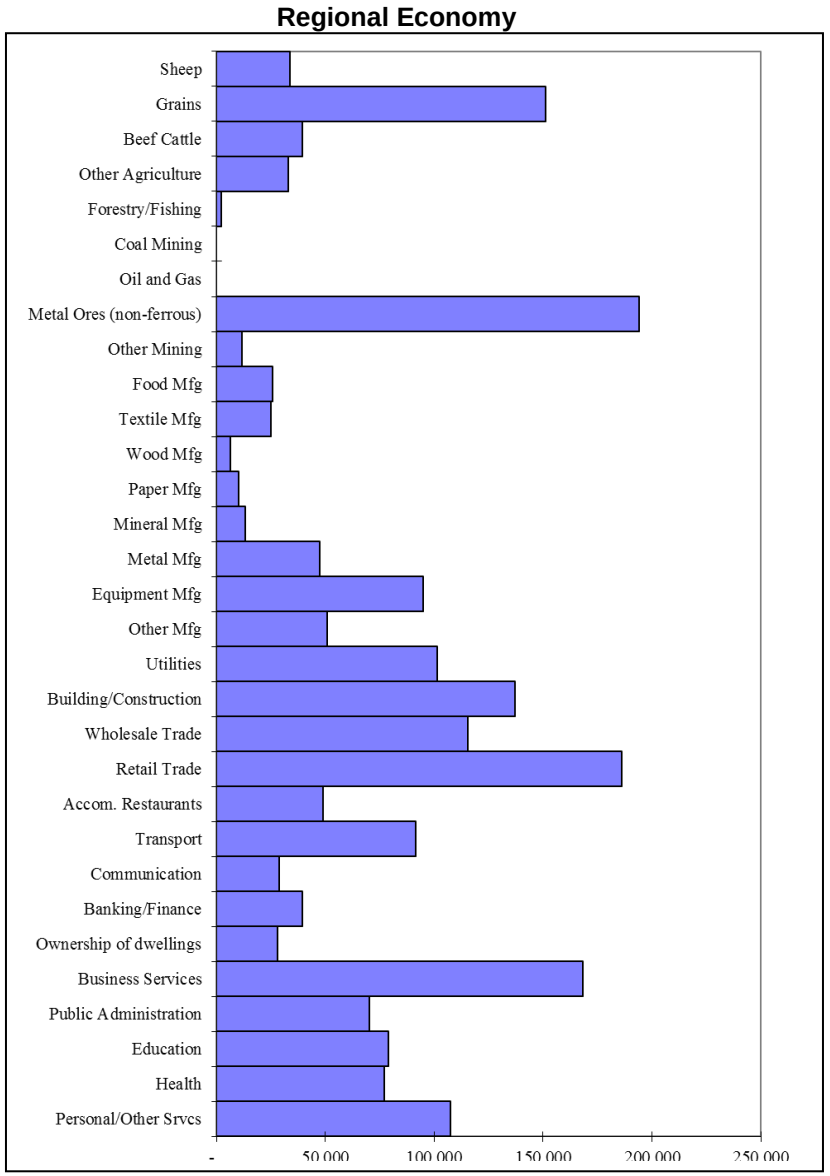


Figure 3.5 Sectoral Distribution of Value Added ($'000)

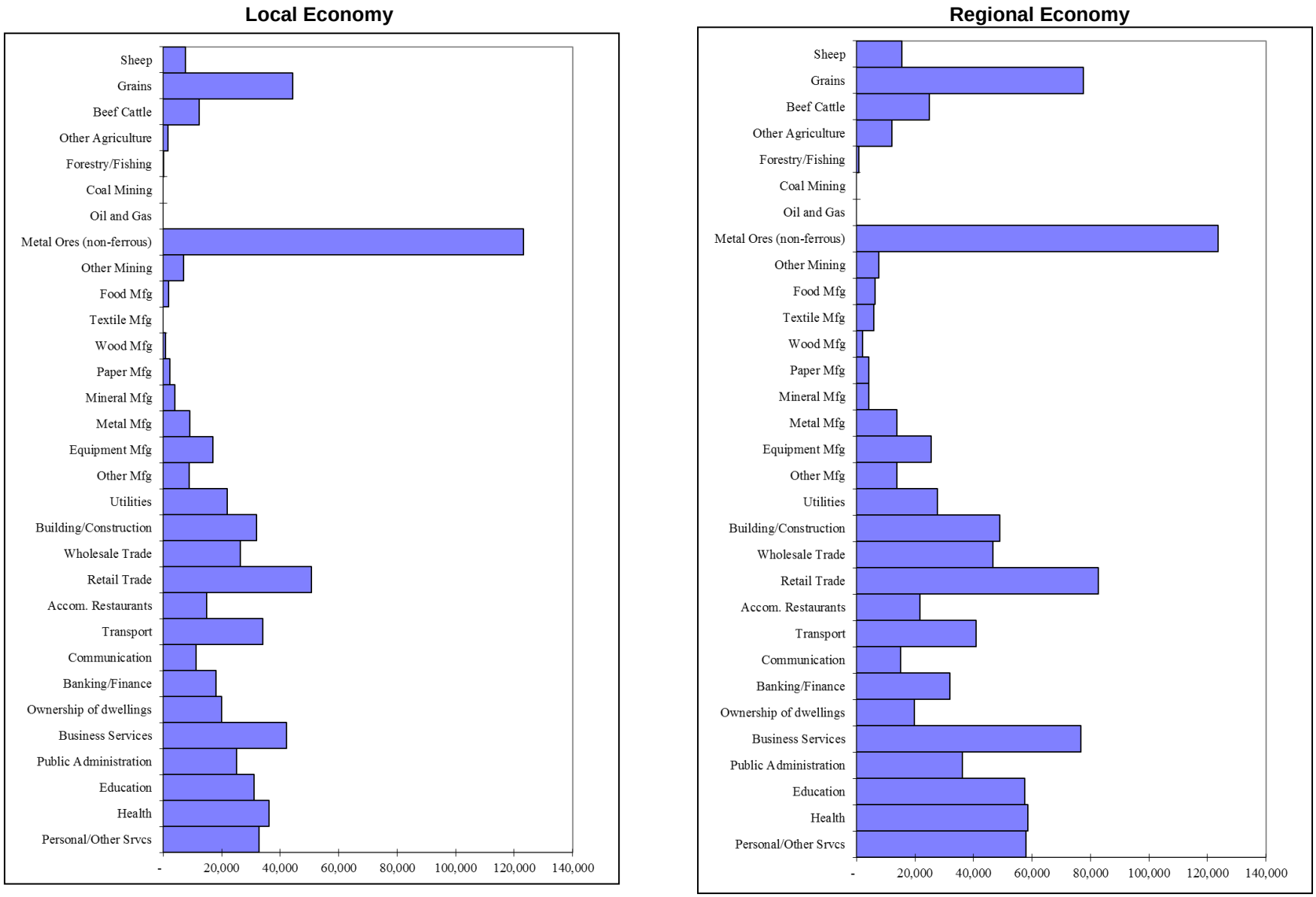


Figure 3.6 Sectoral Distribution of Household Income ($'000)

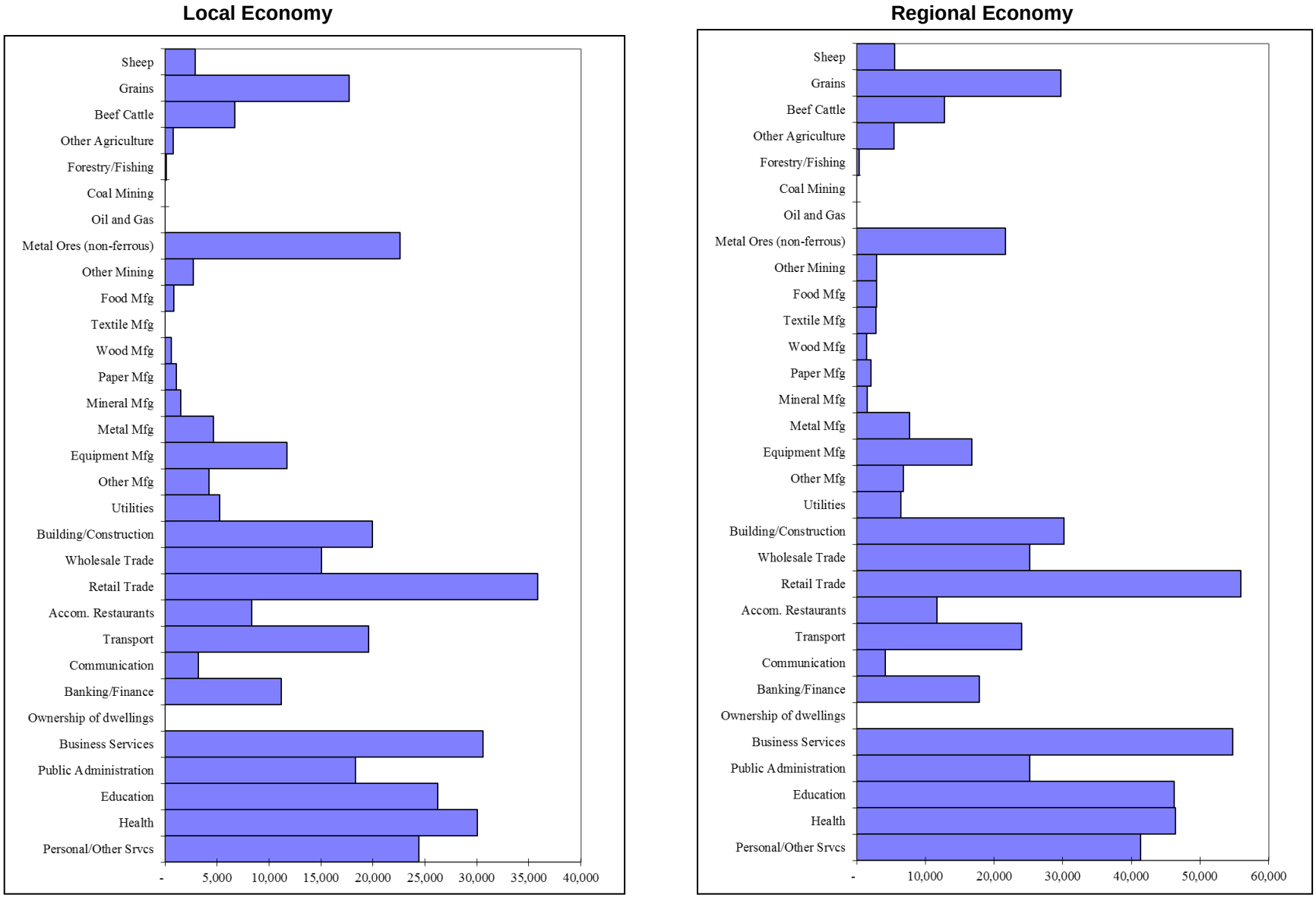
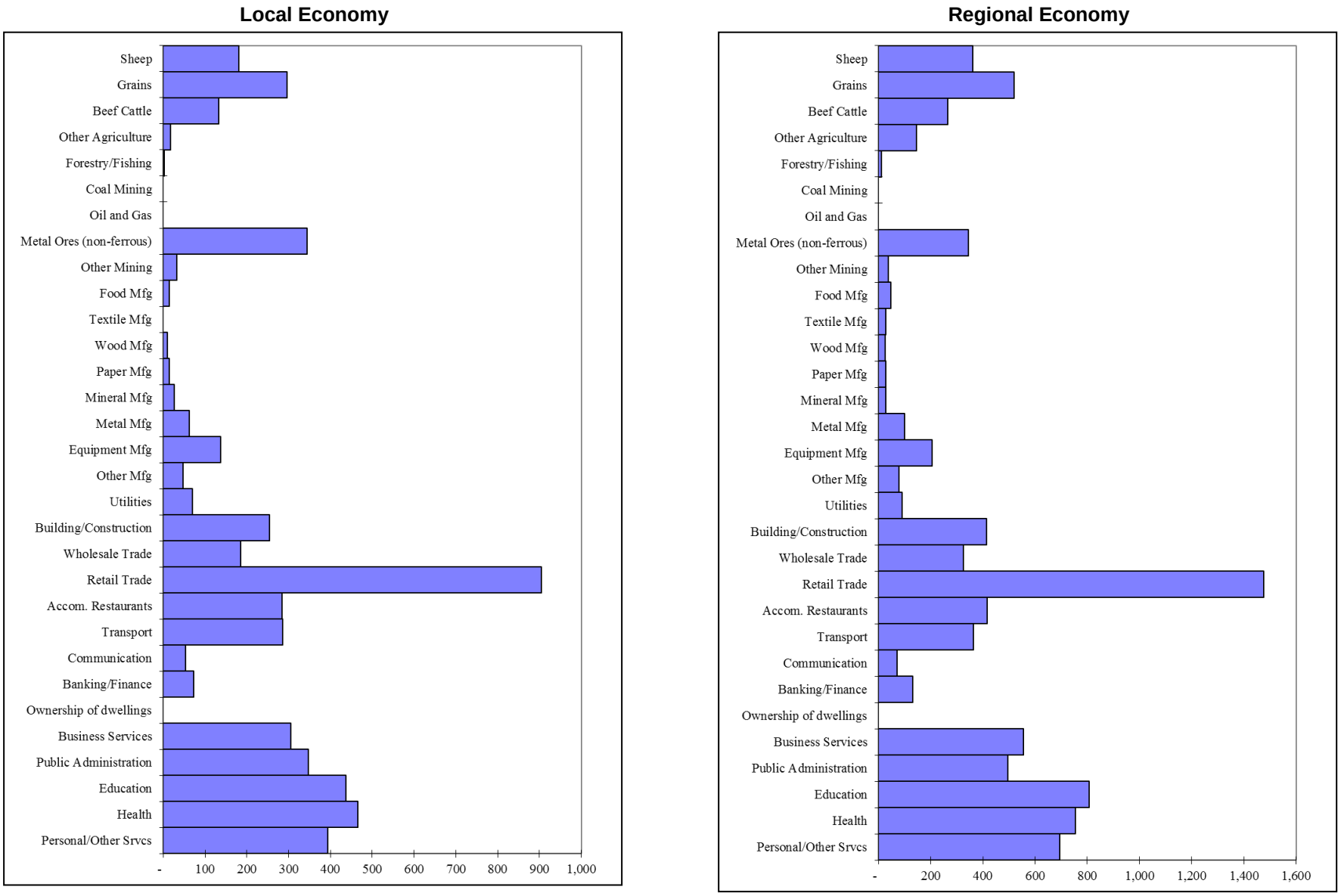


Figure 3.7 Sectoral Distribution of Employment (No.)



3.4 ECONOMIC IMPACT OF THE PROJECT

3.4.1 Introduction

Northparkes Mines currently provides economic activity to the local and regional economy, as well as the broader NSW economy. The Project would enable this level of economic activity to continue for up to seven additional years. The regional impacts of the continued operation of Northparkes Mines are estimated for the indicators of output, value-added, income and employment.

A new Project sector was inserted into the local and regional input-output table reflecting average annual production levels for the peak years of additional mining activity. This information was obtained from NPM. For the new Project sector:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of those residing in the regions was allocated to the *household wages* row with any remainder allocated to as secondary household wages row that is not included in the estimation of multipliers;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;
- allocation was then made between *intermediate sectors* in the regions and *imports* based on advice from NPM 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 *other value-added* row*;* and
- direct employment by Project that works in the region was allocated to the *employment* row.

The main difference between the sector for the local economy and the sector for the regional economy was that a greater number of employees reside in the regional economy and the regional economy was also able to capture a greater level of direct expenditure.

3.4.2 Impacts on the Local and Regional Economy

Economic Activity

The total and disaggregated annual impacts of the Project on the local and regional economy (in 2013 dollars) are shown in Tables 3.3 and 3.4.

Table 3.3 - Economic Impacts of the Project on the Local Economy ($2013)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	293,858	21,309	13,602	34,911	328,769
Type 11A Ratio	*1.00*	*0.07*	*0.05*	*0.12*	*1.12*
VALUE ADDED ($'000)	204,079	9,177	6,811	15,988	220,067
Type 11A Ratio	*1.00*	*0.05*	*0.03*	*0.08*	*1.08*
INCOME ($'000)	25,577	4,512	4,241	8,752	34,329
Type 11A Ratio	*1.00*	*0.18*	*0.17*	*0.34*	*1.34*
EMPL. (No.)	320	67	84	150	470
Type 11A Ratio	*1.00*	*0.21*	*0.26*	*0.47*	*1.47*

Table 3.4 - Economic Impacts of the Project on the Regional Economy ($2013)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	293,858	23,549	17,536	41,085	334,943
Type 11A Ratio	*1.00*	*0.08*	*0.06*	*0.14*	*1.14*
VALUE ADDED ($'000)	204,086	10,090	8,634	18,725	222,811
Type 11A Ratio	*1.00*	*0.05*	*0.04*	*0.09*	*1.09*
INCOME ($'000)	28,586	5,264	5,350	10,614	39,200
Type 11A Ratio	*1.00*	*0.18*	*0.19*	*0.37*	*1.37*
EMPL. (No.)	320	74	103	177	497
Type 11A Ratio	*1.00*	*0.23*	*0.32*	*0.56*	*1.56*

The Project is estimated to make up to the following total annual contribution to the local economy for the peak years of production:

- $329M in annual direct and indirect regional output or business turnover;
- $220M in annual direct and indirect regional value added;
- $34M in annual direct and indirect household income; and
- 470 direct and indirect jobs.

The Project is estimated to make up to the following total annual contribution to the regional economy for the peak years of production:

- $335M in annual direct and indirect regional output or business turnover;
- $223M in annual direct and indirect regional value added;
- $39M in annual direct and indirect household income; and
- 497 direct and indirect jobs.

The incremental economic impacts of the Project would be less than this level in the years where incremental production is ramping up and ramping down.

Multipliers

The Type 11A ratio multipliers for the Project impact on the local economy range from 1.08 for value-added up to 1.47 for employment. For the regional economy, the Project impact Type 11A ratio multiplier range from 1.08 for value-added up to 1.56 for employment.

Capital intensive industries such as mining tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. A lower ratio multiplier for income (compared to employment) also generally

occur as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the Project. 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 Project are likely to affect a number of different sectors of the local and regional economy. The sectors most impacted by output and value-added flow-ons are likely to be the:

- Agricultural and mining machinery manufacturing sector;
- Services to mining sector;
- Wholesale mechanical repairs sector;
- Retail trade sector;
- Wholesale trade sector;
- Accommodation, cafes and restaurants sector; and
- Water supply sector;
- Government administration sector;
- Health 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 Project (Table 3.5).

Table 3.5 - Sectoral Distribution of Employment Impacts on the Local and Regional Economy

	Local Economy				**Regional Economy**			
Sector	**Average Direct Effects**	**Product.-induced**	**Consump.-induced**	**Total**	**Average Direct Effects**	**Product.-induced**	**Consump.-induced**	**Total**
Primary	0	0	0	0	0	0	1	1
Mining	320	8	0	328	320	9	0	329
Manufacturing	0	13	2	16	0	15	4	19
Utilities	0	5	1	6	0	5	1	6
Wholesale/Retail	0	14	22	36	0	15	26	41
Accommodation, cafes, restaurants	0	1	13	14	0	1	15	16
Building/Construction	0	1	0	1	0	1	1	2
Transport	0	2	3	5	0	2	4	6
Services	0	22	42	64	0	25	52	78
Total	**320**	**67**	**84**	**470**	**320**	**74**	**103**	**497**

Note: Totals may have minor discrepancies due to rounding.

Table 3.8 indicates that direct, production-induced and consumption-induced employment impacts of the Project on the local and regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in services sectors, wholesale/retail trade sectors, manufacturing sectors and mining sectors while consumption induced flow-on employment would be mainly in services sectors, wholesale/retail trade sectors and accommodation/cafes/restaurants sectors.

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

3.4.3 Impact on the NSW Economy

Introduction

The NSW economic impacts of the Project were assessed by inserting a new Project sector into a 2013 NSW input-output table in the same manner described in Section 3.4.1. The primary difference from the sector identified for the local and 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 Project on the NSW economy (in 2013 dollars) are shown in Table 3.6.

Table 3.6 - NSW Economic Impacts of the Project

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	293,858	118,456	103,569	222,025	515,883
Type 11A Ratio	*1.00*	*0.40*	*0.35*	*0.76*	*1.76*
VALUE ADDED ($'000)	203,462	45,641	52,753	98,394	301,857
Type 11A Ratio	*1.00*	*0.22*	*0.26*	*0.48*	*1.48*
INCOME ($'000)	30,090	29,019	30,189	59,209	89,299
Type 11A Ratio	*1.00*	*0.96*	*1.00*	*1.97*	*2.97*
EMPL. (No.)	320	299	403	702	1,022
Type 11A Ratio	*1.00*	*0.94*	*1.26*	*2.20*	*3.20*

The Project is estimated to make up to the following total annual contribution to the NSW economy for the two peak years of production:

- $516M in annual direct and indirect regional output or business turnover;
- $302M in annual direct and indirect regional value added;
- $89M in annual direct and indirect household income; and
- 1,022 direct and indirect jobs.

The impacts on the NSW economy are substantially greater than for the local and 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. At the NSW level, there is greater scope for labour and resources required for the Project to be diverted from other sectors of the economy, particularly in times of near full employment of the economy, and hence for there to be some partially offsetting reduction in economic activity.

3.5 MINE CESSATION

As outlined in Sections 3.2 and 3.3, the Project will provide continued economic activity to the local, regional and NSW economy, for approximately seven years relative to existing approved operations. Conversely, the cessation of the mining operations in the future would result in a contraction in local,

regional and NSW economic activity. The Project delays the contraction of economic activity in the economy

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

- The movements of workers and their families;
- Alternative development opportunities; and
- Economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of Project cessation would depend on whether the workers and their families affected would leave the regional area. If it is assumed that some or all of the workers remain in the local and regional area, then the impacts of mining cessation would not be as severe compared to a greater level leaving the local and regional area. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption, the local and regional economic impacts of Project cessation would approximate the direct and production-induced effects in Table 3.3 and Table 3.4. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.3 and Table 3.4.

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

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

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

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

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

4 CONCLUSION

A BCA of the Project indicated that it would have net production benefits to Australia of $28M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $28M, the Project 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 Project that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions. These impacts are estimated at less than $1M to Australia, considerably less than the estimated net production benefits of the Project. There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of $32M. Overall, the Project is estimated to have net social benefits to Australia of between $28M and $60M 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 Project to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- NPM shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable ($11M present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties ($12M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- The local community in the form of any voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project 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 NPM.

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

An economic impact analysis, using input-output analysis, estimated that the Project will make up to the following total annual contribution to the local economy for the peak years of production:

- $329M in annual direct and indirect regional output or business turnover;
- $220M in annual direct and indirect regional value added;
- $34M in annual direct and indirect household income; and
- 470 direct and indirect jobs.

The Project is estimated to make up to the following total annual contribution to the regional economy for the peak years of production:

- $335M in annual direct and indirect regional output or business turnover;

- $223M in annual direct and indirect regional value added;
- $39M in annual direct and indirect household income; and
- 497 direct and indirect jobs.

The incremental economic impacts of the Project would be less than this level in the years where incremental production is ramping up and ramping down.

Cessation of the Project operation may lead to a reduction in economic activity. The significance of these Project 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 Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

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ATTACHMENT 1 – VALUING GREENHOUSE GAS EMISSIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Given the above information and the great uncertainty around damage cost estimates, the BCA uses the carbon price proposed by Australian Government's Climate Change Plan i.e. $23 a tonne, rising at 2.5 per cent a year in real terms for three years, as reflective of the global social damage cost of carbon. From 2015 it is assumed that the carbon price remains constant. A range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of this report.

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ATTACHMENT 2 – BCA SENSITIVITY TESTING

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

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$83	$60	$45
INCREASE 20%			
Opportunity cost of land	$82	$59	$45
Development costs	$63	$45	$34
Operating costs	$52	$39	$31
Decommissioning and rehabilitation costs	$84	$60	$46
Mineral value	$142	$99	$71
Level of Australian ownership	$85	$61	$45
Residual value of land	$83	$60	$45
Non-market employment benefits	$90	$66	$51
GREENHOUSE COSTS @ $40/TONNE (T)	$83	$59	$45

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	$84	$60	$45
Development costs	$103	$75	$56
Operating costs	$115	$80	$59
Decommissioning and rehabilitation costs	$82	$59	$44
Mineral value	$24	$20	$18
Level of Australian ownership	$81	$59	$45
Residual value of land	$83	$59	$45
Non-market employment benefits	$76	$53	$39
GREENHOUSE COSTS @ $8/T	$83	$60	$45

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

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

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

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

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

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

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

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

Multipliers therefore do not take account of economies of scale, unused capacity or technological change since they describe average effects rather than marginal effects (ABS, 1995).

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

Components of the conventional output multiplier are as follows:

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

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

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

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

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

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

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

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

A description of the different ratio multipliers is given below.

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

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

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

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

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

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ATTACHMENT 4 – THE GENERATION OF REGIONAL 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 Northparks mining sector. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A4-1 (Powell and Chalmers, 1995).

Table A4-1
The GRIT Method

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

Source: Bayne and West (1988).

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