ATLAS-CAMPASPE
Mineral Sands Project
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX I 〉 SOCIO-ECONOMIC ASSESSMENT

CRISTAL Resource Strategies

Atlas-Campaspe Mineral Sands Project
Socio-Economic Assessment

Prepared for

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EXECUTIVE SUMMARY

Cristal Mining Australia Limited (Cristal Mining) seeks a Development Consent under Division 4.1 in Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* for the Atlas-Campaspe Mineral Sands Project (the Project). The Project includes the development of a mineral sands mining operation, together with the construction and operation of a rail loadout facility located near the township of Ivanhoe.

A Socio-Economic Assessment is required as part of the Environmental Impact Statement (EIS).

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

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

A Benefit Cost Analysis (BCA) of the Project indicated that it would have total net production benefits of $639 million (M), with $251M of these net production benefits accruing to Australia. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, may be assessed. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project to Australia, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $251M. This is equivalent to each household in the study region and in NSW valuing residual environmental impacts at $18,000 and $94, respectively.

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

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify some of the residual environmental impacts of the Project. 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 impacts. These impacts are estimated at $12M in total or $0.1M 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 $94M.

Overall, the Project is estimated to have net community benefits to Australia of between $251M and $345M, and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts of the Project as specified in the EIS have been quantified and included in the BCA, any other residual environmental, cultural or social impacts of this Project (e.g. impacts on Aboriginal heritage) or the larger Project, that remain unquantified, would need to be valued at greater than between $251M and $345M for the Project to be questionable from an Australian economic 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 is potentially distributed amongst a range of stakeholders including:

- Cristal Mining in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $362M or $203M present value at a 7 percent (%) discount rate) from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Far West Statistical Subdivision (SSD) and Murray-Darling SSD region;
- the NSW Government via royalties (estimated at $95M or $48M present value at a 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the Far West SSD and Murray-Darling SSD region; and
- the local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

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

Greenhouse gas emission costs occur at the National and global level and would be internalised into the operating costs of the Project through payment of the carbon tax. The economic costs associated with a reduction in agricultural production and road transport are initially borne by affected local landholders and road users. However, Cristal Mining would internalise these impacts through the purchase of impacted land and the estimated mitigation costs. The economic costs associated with the clearing of native vegetation would occur at the State or National level and would be counterbalanced by the biodiversity offset actions proposed by Cristal Mining. The costs of these offset actions are internalised into the production costs of the Project. Aboriginal heritage impacts will potentially occur to local Aboriginal people as well as NSW households[1]. Cristal Mining will develop a Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental externalities would largely occur at the State or local level and were found to be minor or insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the State or local level[2].

The non-market costs, quantified in the analysis, that accrue to NSW are estimated at $0.1M. These are considerably less than the net production benefits that directly accrue to NSW through royalties and potential non-market employment benefits. Consequently, as well as resulting in net benefits to Australia the Project is likely result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that both the construction and operation phases of the Project would provide economic activity to the regional and NSW economy, with the main impacts being from Project operation. The operation of the Project is estimated to make up to the following contribution to the regional economy:

- $279M in annual direct and indirect regional output or business turnover;
- $152M in annual direct and indirect regional value added;

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

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

- $20M in annual direct and indirect household income; and
- 229 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $388M in annual direct and indirect regional output or business turnover;
- $202M in annual direct and indirect regional value added;
- $54M in annual direct and indirect household income; and
- 643 direct and indirect jobs.

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

It is anticipated that during the initial development of the Project an average annual workforce of 150 people would be required, with approximately 60 of these people (peak of 120 for 2 to 3 months) migrating into the region. There would also be some indirect workforce and population increases as a result of flow-on effects. However, this is expected to have minimal impacts on community infrastructure in the region. Impacts from the cumulative construction workforce across a number of resource development projects has the potential to further increase the demand for short-term accommodation that would otherwise be available for tourism to be occupied by construction workers. However, room and bed occupancy rates in the region would suggest sufficient capacity to accommodate both sources of demand and the provision of construction camps would significantly reduce the cumulative demand for short-term accommodation.

The operation of the Project has the potential to increase the population of the region by up to 119, with corresponding increased demand for housing, schools, health and community infrastructure. Cumulative impacts with other resource development projects would increase the population of the region by up to 249 (190 excluding construction workforce). This increase in population would partially offset some the population decline that the region has been experiencing and hence impacts on community infrastructure should be negligible. Nevertheless, the Project (together with other resource development projects), would lead to increased demand for a community infrastructure and services and may have some other social impacts.

Cristal Mining would work in partnership with the Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible. In this respect, a range of general and specific social impact mitigation and management measures are proposed.

Ultimate 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

The Atlas-Campaspe Mineral Sands Project (the Project) includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility). Cristal Mining Australia Limited (Cristal Mining) is the proponent of the Project.

The proposed Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, New South Wales (NSW) and 270 km south-east of Broken Hill, NSW. The proposed Ivanhoe Rail Facility is located approximately 135 km north-east of the Atlas-Campaspe Mine.

Product (mineral concentrates) generated as a result of operations at the proposed Atlas-Campaspe Mine would be trucked to the Ivanhoe Rail Facility for transfer to train wagons, which would then be railed to the existing Broken Hill Mineral Separation Plant (the MSP).

An Environmental Impact Statement (EIS) has been prepared to accompany a Development Application made for the Project, in accordance with Division 4.1 of Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act). A Socio-Economic Assessment is required as part of the EIS.

The Director-General's Requirements for the preparation of the Project EIS require an assessment of:

- potential direct and indirect economic benefits of the Project for local and regional communities and the State;
- potential impacts on local and regional communities, including:
  - increased demand for local and regional infrastructure and services (such as housing, childcare, health, education, emergency services); and
  - impacts on social amenity;
- a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the Project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanisms; and
- a detailed assessment of the costs and benefits of the 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* (the Draft Guideline) and the Office of Social Policy's (1995) *Techniques for Effective Social Impact Assessment: A Practical Guide*.

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

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

The DP&I's Draft Guideline (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The 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 Draft Guideline (James and Gillespie, 2002) indicates that economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic activity to the local and regional economy can be estimated using input-output modelling (regional economic impact assessment).

The Draft Guideline (James and Gillespie, 2002) also identifies the need to consider the distribution of benefits and costs in terms of:

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

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

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

- a BCA of the Project (Section 2);
- a regional economic impact assessment of the Project (Section 3); and
- an Employment, Population and Community Infrastructure Assessment (EPCIA) (Section 4).

A consultation program for the EIS was undertaken by Cristal Mining and is described in Section 3 in the Main Report of the EIS.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Background to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics and applications in NSW are guided by these theoretical foundations as well as the *NSW Government Guidelines for Economic Appraisal* (NSW Treasury, 2007). BCA applications within the NSW environmental assessment framework are further guided by the DP&I's Draft Guideline (James and Gillespie, 2002).

BCA is primarily concerned with comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value (NPV) of greater than zero), the project is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

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

Definition of Society

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different definitions of society. Depending on agency jurisdiction and the geographical spread of benefits and costs, this could range from the population of a local government area through to the whole world. However, most applications of BCA are at the National level. This National focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spillovers between states. These include transfers between States associated with the tax system and the movement of resources over State boundaries.

Nevertheless, Boardman *et al*. (2001, p. 36) identify that "*where major impacts spill over national borders, then the BCA should be undertaken from the global as well as the national perspective"*. Adopting a sub-national perspective is not recommended (Boardman *et al.*, 2001) as it can result in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers. This is particularly the case for major projects which involve the use of resources drawn from across the nation as well as internationally and which generate benefits that are enjoyed by people who are resident in NSW and beyond.

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

Definition of the Project Scope

The scope of the project being assessed in a BCA is important to clearly establish. The Project being assessed in the EIS includes the development of the Atlas-Campaspe Mine together with the construction and operation of the Ivanhoe Rail Facility (Section 2.2). The Project would also result in a number of activities that would be subject to separate approvals (i.e. are not part of the Project). These associated activities include the processing of Project mineral concentrates at the MSP, the transport of MSP products by rail to port, and the disposal of MSP process waste at the Ginkgo and Snapper Mines prior to the cessation of operations at the Ginkgo and Snapper Mines (i.e. before approximately Year 12 of the Project).

From an economic perspective these associated activities form part of a larger project aimed at mining of mineral sands and deliver to port for sale. As identified by NSW Treasury (2007, p. 38) "*the scope of the project evaluated should be such that the project is a discrete whole*." While a project may consist of a series of component parts, it is the evaluation of the larger project which is critical (NSW Treasury, 2007). Consequently, for the purpose of the BCA the evaluation is undertaken of the larger project (i.e. the mining of mineral sands, processing and delivery of mineral concentrate to port for sale).

This definition of the Project for which approval is being sought under a number of applications has important implications for the identification of the costs and benefits of the 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 Project, are relevant. Put simply, only the costs and benefits from the mining of the mineral sands and delivery of mineral concentrates to port are relevant.

In this regard, it is important to recognise that while mineral concentrates are an intermediate good (i.e. they are used as an input into the production of other goods and services), it is not appropriate to include the costs and benefits associated with the downstream use of the mineral concentrates. BCA is a form of partial equilibrium analysis that attempts to isolate the marginal impacts of a particular project, holding all other things equal, including in this case the levels of downstream use of mineral concentrates. The downstream uses of the Project mineral concentrates constitute different projects[3], that have their own sets of costs and benefits and themselves can be subject to BCA.

Steps in BCA

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.

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

What follows is a BCA of the larger project (i.e. Project and associated activities) based on financial, technical and environmental advice provided by Cristal Mining and its' specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

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

Without approval of the Project, no mining of the subject mine land would occur and it would continue to be used for agricultural activities while the land in the vicinity of the Ivanhoe Rail Facility, to the south of the existing Orange-Broken Hill railway, would also continue to be used for agricultural activities.

In contrast to the "base case", the Project as defined in the EIS would involve two main development components:

1. Construction and development of infrastructure for mining operations at the Atlas and Campaspe deposits (the proposed Atlas-Campaspe Mine).
2. Construction and operation of the Ivanhoe Rail Facility.

The proposed life of the Project as defined in the EIS is approximately 20 years, commencing approximately 1 July 2013 or upon the grant of all required approvals.

The activities associated with the two main development components of the Project as defined in the EIS, are summarised below.

Atlas-Campaspe Mine

- Ongoing exploration activities.
- Sequential development and operation of two separate mineral sands ore extraction areas within the Mining Lease Application 1 area.
- Use of conventional mobile equipment to mine and place mineral sands ore into dry mining units[4] at a maximum ore production rate of up to 7.2 million tonnes per annum.
- Mineral processing infrastructure including the primary gravity concentration unit, salt washing facility and a wet high intensity magnetic separator circuit.
- Mineral concentrate stockpiles and materials handling infrastructure (e.g. towers and stackers).
- Progressive backfilling of mine voids with overburden behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path.
- Placement of sand residues and coarse rejects (and MSP process wastes[5]) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams.
- Development of a groundwater borefield at the Atlas deposit and localised dewatering systems (bores, spearfields and trenches) at both the Atlas and Campaspe deposits, including associated pump and pipeline systems.
- Reverse osmosis plant to supply the salt washing facility and potable water.
- Progressive development of water storage dams, sediment basins, pumps, pipelines and other water management equipment and structures.

[4] Mining would use conventional open pit methods and would not involve dredge mining.

[5] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

- Administration/office buildings, car parking facilities, workshop and stores.
- On-site accommodation camp.
- Sewage treatment plant.
- Diesel powered generators, electricity distribution station and associated internal electricity transmission lines.
- Site access road, internal access roads and haul roads.
- Roadworks along the proposed mineral concentrate transport route to the Ivanhoe Rail Facility.
- Transport of mineral concentrates along the mineral concentrate transport route to the Ivanhoe Rail Facility.
- Road transport of MSP process waste[6] in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, stockpiling and placement behind the advancing ore extraction areas.
- Development of soil stockpiles and laydown areas.
- Monitoring and rehabilitation.
- Other associated minor infrastructure, plant, equipment and activities.

Ivanhoe Rail Facility

- Development of a rail siding for:
  - loading of train wagons with mineral concentrate for rail transport to the MSP via the Orange-Broken Hill railway; and
  - unloading of MSP process waste in sealed storage containers (transported via the Orange-Broken Hill railway) from train wagons[6].
- Site access road and internal haul roads/pavements.
- Hardstand areas for mineral concentrate and MSP process waste[6] unloading, stockpiling/sealed container storage and loading.
- A retention basin, drains, pumps, pipelines and other water management equipment and structures.
- Site office and car parking facilities.
- Extension to the existing 11 kilovolt powerline.
- Monitoring, landscaping and rehabilitation.
- Other associated minor infrastructure, plant, equipment and activities.

As described in Section 2.1, the Project would also result in a number of activities that would be subject to separate approvals (i.e. are not part of the Project). These associated activities include the processing of Project mineral concentrates at the MSP, the transport of MSP products by rail to port, and the disposal of MSP process waste at the Ginkgo and Snapper Mines prior to the cessation of operations at the Ginkgo and Snapper Mines (i.e. before approximately Year 12 of the Project). For the purpose of the BCA it is necessary to include consideration of the benefits and costs up to and including delivery to port (Section 2.1). The BCA therefore includes these associated activities as well as the Project.

[6] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

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

BCA is primarily concerned with the evaluation of the "with" project scenario relative to the counterfactual (base case) of no proposal. Where there are a number of alternatives to a project, 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 EIS Project were considered by Cristal Mining in the development of the Project description. Section 6.9.2 in the Main Report of the EIS provides more detail on the consideration of Project alternatives.

The Project assessed in the EIS and the larger Project evaluated in the BCA is considered by Cristal Mining to be a feasible alternative that minimises environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by Cristal Mining, 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.

Table 2.1
Potential Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Net production benefits	• Opportunity cost of land. • Opportunity cost of capital equipment. • Capital costs of Atlas-Campaspe Mine development and the Ivanhoe Rail Facility including an allowance for land acquisitions for biodiversity offsets. • Operating costs (excluding royalties), including overburden removal, mining, mineral processing, administration, rehabilitation, road transport, MSP, rail and port costs.	• Value of mineral sands. • Residual value of capital equipment and land at the cessation of the Project.
Potential environmental, social and cultural impacts	• Flora and fauna impacts. • Road transport impacts. • Aboriginal heritage impacts. • Non-Aboriginal heritage impacts. • Surface water impacts. • Groundwater impacts. • Lost agricultural production. • Operational noise impacts. • Road noise impacts. • Rail noise impacts. • Air quality impacts. • Greenhouse gas generation. • Visual impacts.	• Any non-market benefits of employment.

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

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with the NSW Treasury (2007) guidelines, the analysis has been undertaken in real values with discounting at 7 percent (%) and sensitivity testing at 4% and 10%. An analysis period of 22 years[7] has been adopted for the BCA. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have been initially been left unquantified and interpreted using the threshold value method[8]. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[9].

2.4.1 Incremental Production Costs and Benefits[10]

Economic Costs

Opportunity Cost of Land and Capital Equipment

All land and equipment required for the Project would be purchased as part of the capital cost of the Project reported below.

Capital Cost of the Project

Capital costs of the Project include land purchases, Atlas-Campaspe Mine infrastructure and development, capital equipment, Ivanhoe Rail Facility development, road works and replacement capital equipment. The capital costs include an allowance for land acquisitions for the Project and properties required for biodiversity offsets. These incremental capital costs over the life of the Project are estimated at $249 million (M). These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Mine

The annual operating costs of the Project include those associated with overburden removal, mining, mineral processing (including the MSP), administration and services, rehabilitation, road transport, transport to port and port charges. Average annual incremental operating costs of the Project (excluding royalties) are estimated at $105M.

While royalties are a cost to Cristal Mining, they are part of the overall net production benefit of the mining and processing activity that is redistributed by the 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 over the life of the Project in the order of $95M, or $48M in present value terms at 7% discount rate.

Decommissioning and Rehabilitation Costs

The Project would cease in 2032 with associated decommissioning and rehabilitation costs, estimated at $67M. These costs are already included in operating costs above.

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7 A 22 year analysis period has been adopted to allow for the time until the commencement of the Project in July 2013 (i.e. one year), the Project life (i.e. 20 years) and an additional year at the end of the Project for decommissioning.

8 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.

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

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

Economic Benefits

Value of Mineral Concentrates

The main economic benefit of the Project is the market value of the mineral concentrates of zircon, rutile, leucoxene, ilmenite and titanium.

Rutile has a titanium dioxide content of around 95% and is an important feedstock mineral for the titanium dioxide pigment industry. Titanium dioxide is widely used in the manufacture of paint, paper and plastics. Rutile is also used in the manufacture of welding rods and the production of titanium metal. Titanium is light and strong and is used in the aerospace industry, bio-engineering and some sporting goods.

Ilmenite and leucoxene also contain titanium dioxide and are used as feedstock in the titanium dioxide pigment industry. However, as they contain more iron than rutile, they have a relative value that is typically 20 to 25% of the rutile selling price.

Finely ground zircon is commonly used for glazes in the ceramic industry. These products include kitchen and bathroom tiles, dinnerware and decorative ceramics. Zircon is also widely used in television screens and computer monitors.

Both demand and supply of these minerals influences current and projected prices.

Demand for these minerals is derived demand, i.e. dependent on demand for the end products within which the minerals are used. This fluctuates considerably based on numerous market factors including the price of the end product, the prices of related end product, income of consumers, expected future prices, population, preferences, etc.

World supply fluctuates depending on price of the end product, prices of factors of production, prices of related goods, expected future prices, the number of suppliers, technology, and the political situation in developing countries where potential deposits are located, etc.

Prices fluctuate considerably and are expected to continue to do so. Cristal Mining has provided its projection of annual revenue that it expects would be generated from the Project and this has been included in the analysis.

Residual Value at End of the Evaluation Period

At the end of the life of the Project, capital equipment and land (excluding biodiversity offsets) may have some residual value that could be realised by sale or alternative use. The residual value of capital at the end of the Project life is assumed to be $28.5M. The rehabilitation of the Project would aim to restore self-sustaining ecosystems including native species characteristic of vegetation communities cleared by Project development that could be used either for light intensity grazing or for nature conservation purposes. Conservatively, it is assumed that land required for the Project would be rehabilitated for nature conservation purposes and would therefore have a residual value of $0M.

2.4.2 Environmental, Social and Cultural Costs and Benefits

Flora and Fauna

An assessment of the impacts of the Project on flora and fauna has been undertaken as part of the EIS (Appendices A and B of the EIS). The surface disturbance associated with the Project would involve the clearance of approximately 4,158 hectares (ha) of native vegetation and approximately 305 ha of cleared land (Appendix A of the EIS).

This native vegetation includes two Endangered Ecological Communities and a number of threatened flora species (Appendix A of the EIS). The surface disturbance areas also include known habitat for a number of threatened fauna species (Appendix B of the EIS).

A range of measures to avoid, mitigate and offset impacts on biodiversity are proposed (Appendices A and B of the EIS). Of particular note, the Project incorporates progressive rehabilitation of disturbance areas and a biodiversity offset comprising some 16,270 ha. The conservation of the proposed biodiversity offset areas would be secured in perpetuity through one of a selection of mechanisms being considered. With the implementation of the progressive rehabilitation of Project disturbance areas and mine landforms and implementation of the biodiversity offset proposal, it is considered that the potential impacts of the Project on terrestrial fauna and flora would largely be offset and hence no significant economic cost would arise that would warrant inclusion in the BCA. Land costs and operational expenditure associated with the biodiversity offset areas have been included in the BCA in the capital and operating costs the Project.

Road Transport

The potential impacts of increased road traffic that would arise due to the Project on local traffic conditions and road safety have been considered by GTA Consultants (2012) (Appendix D of the EIS). It was concluded that no significant impacts on the performance and safety of the road network would be expected to arise as a result of the Project, and no specific management or mitigation measures (apart from the proposed road works and road safety improvements) were considered to be warranted (Appendix D of the EIS). The costs of these road works and road safety improvements are included in the capital costs of the Project.

Rail Transport

The Project would involve the construction of the Ivanhoe Rail Facility approximately 4.5 km south-west of the Ivanhoe township to facilitate the transport of mineral concentrates from the Atlas-Campaspe Mine to the MSP. The design and construction of the rail siding would be undertaken in accordance with the requirements of the Australian Rail Track Corporation (ARTC). The costs of these works are included in the capital costs of the Project.

The ARTC has confirmed that there is sufficient capacity to accommodate the Project rail movements and that the proposed rail traffic would not have any material effect upon any other services that operate on the rail network (refer to Section 3.1.6 in the Main Report of the EIS).

Aboriginal Heritage

The Project has the potential to impact Aboriginal heritage sites in Project land disturbance areas. Of the 100 known Aboriginal heritage sites located within the study area, 29 would be subject to direct disturbance (Niche Environmental and Heritage, 2012) (Appendix E of the EIS). The majority of the sites that would be directly impacted are of low to moderate archaeological significance. Three sites of high significance along the proposed mineral concentrate transport route would be directly but only partially impacted (i.e. surface disturbance only with no impact to the subsurface material/context). Two of these are an extensive, continuous landscape of occupation potential for further surface and subsurface Aboriginal Objects. Portions of these sites are in the disturbance area. The third site contains artefacts, hearths, non-human bone and organic material. A portion of the site would be impacted.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the Aboriginal and Non-Aboriginal Cultural Heritage Assessment (Appendix E of the EIS).

Impacts on highly significant Aboriginal heritage sites may also potentially impact the well-being of the broader community. However, few studies have attempted to monetise these impacts and none have been in the context of the types of sites potentially impacted by Project or the type of impacts (e.g. partial impacts). Consequently, for purpose of the BCA impacts on Aboriginal heritage sites remain unquantified.

Non-Aboriginal Heritage

Two items identified in the site survey were assessed as having local heritage significance, and these items are all located outside of the project disturbance area (Appendix E of the EIS). Therefore no significant economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Groundwater

The review of available baseline hydrogeological data indicates localised temporal surface ponding due to limited drainage, and underlying saline groundwater aquifers at moderate to significant depths (GEO-ENG, 2013) (Appendix F of the EIS).

The Project is expected to have a limited and localised effect on areas where temporary surface ponding occurs (i.e. through excavation) (Appendix F of the EIS). In addition, there are not expected to be any measurable changes in the quality of temporary surface ponding areas as a consequence of the Project (Appendix F of the EIS).

A numerical groundwater model was used to simulate the potential effects of the Project (including groundwater supply borefield and localised dewatering) on groundwater systems and groundwater users. Extraction of groundwater for water supply purposes from the groundwater supply borefield and dewatering systems (where the orebody lies below the groundwater table) would form localised groundwater drawdown. The predicted drawdown due to the Project at the only registered bore local to the Atlas-Campaspe Mine is negligible (Appendix F of the EIS).

Given the existing higher salinities of the deep groundwater aquifer, no appreciable change in groundwater salinity is expected as a consequence of mining and there is expected to be negligible change in groundwater quality as a result of the Project (Appendix F of the EIS).

At the cessation of mining, a final void would remain at the north-western extent of both the Atlas and Campaspe footprints. The depths of the final voids would remain above the groundwater table (i.e. a permanent water body would not be formed in the void), however, incident rainfall and local surface water runoff following rainfall events would temporarily pond in the void prior to evaporating or infiltrating to the groundwater table. The final voids would be a potential location for increased infiltration, but would also increase the potential for evapotranspiration. Given the limited size of the final voids, the net effect is expected to be negligible (Appendix F of the EIS).

Based on the results of the numerical modelling, the predicted maximum annual groundwater volumes required to be licensed over the life of the Project would be 6,528 million litres (ML) (Appendix F of the EIS). Cristal Mining currently holds a combined total of 21,442 share components (units or ML) in the Western Murray Porous Rock Groundwater Source defined in the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011* under the NSW *Water Management Act, 2000*. The existing volumetric licence allocations held by Cristal Mining are considered to be adequate (Appendix F of the EIS).

Notwithstanding the above, there is an opportunity cost associated with the use of existing volumetric licence allocations for the Project instead of sale or alternate use. This opportunity cost is the market value of these licences. However, as the groundwater is saline, there is no significant demand for water from this source in the region (Appendix F of the EIS) and hence the market value is expected to be low. Consequently, it is assumed that the opportunity cost of using share components for the Project is close to zero.

Given the above, no economic effects have been identified in the BCA with respect to drawdown effects on groundwater users.

Surface Water

The Atlas-Campaspe Mine is located approximately mid-way between two ill-defined drainage systems (Evans & Peck, 2012) (Appendix G of the EIS):

- **Willandra Creek and Willandra Lakes system** (to the north and west of the Atlas-Campaspe Mine) - this system contains numerous dry lakes (Mulurulu, Garnpung, Leaghur, Mungo and Chibnalwood) which drain from north-east to south-west; and
- **Arumpo Creek and Prungle Lakes system** (to the east and south of the Atlas-Campaspe Mine) - this system also drains from north-east to south-west.

The regional surface drainage in the vicinity of the Atlas-Campaspe Mine occurs by overland flow from north-east towards the south-west. The Atlas-Campaspe Mine contains no defined water courses other than a few minor drainage lines that drain from the south-eastern end of the Campaspe deposit towards a relic lake depression (Appendix G of the EIS).

The absence of defined drainage lines has led landholders to construct extensive catch drain systems in the region to direct overland flow into excavated tanks to provide water for domestic stock. The Project would encroach into a small portion of a sub-catchment which has the potential to have a minor effect on runoff to an unnamed tank system (Appendix G of the EIS).

The proposed Atlas-Campaspe Mine site is located in an area of complex landform with gentle slopes and numerous closed depressions which pond with surface runoff after significant rainfall. The climate of the area is semi-arid (average annual rainfall less than 300 millimetres) and surface runoff is highly ephemeral. The complex landform and semi-arid climate combine to provide conditions in which the risk of off-site surface water impacts is minimal (Appendix G of the EIS).

Based on the above, no economic effects have been identified in the BCA with respect to surface water quality or quantity impacts.

Agricultural Production

The present value of foregone agricultural production is reflected in land prices. The value of foregone agricultural production, as a result of the Project, has therefore been incorporated in the BCA through inclusion of the full land value (opportunity cost) of affected properties. Refer to Attachment 1 for a detailed consideration of agricultural economic impacts.

Operational Noise

No exceedances of the NSW Environment Protection Authority (EPA) operational noise criteria are predicted as a result of the Project (Wilkinson Murray, 2012) (Appendix J of the EIS). The Project would not result in any significant operational noise impacts and hence no economic effects have been included in the BCA.

Road Transport Noise

The potential impact of increased Project road traffic on noise levels was assessed (Appendix J of the EIS). No exceedances of the EPA road transport noise criteria are predicted as a result of the Project (Appendix J of the EIS), and therefore no economic effects have been included in the BCA.

Rail Transport Noise

Project mineral concentrates and MSP process waste would be transported via rail between the Ivanhoe Rail Facility and the MSP.

Appendix J of the EIS concluded that the Project rail movements would marginally increase rail noise levels (i.e. the compliance distance from the track to meet the relevant rail noise criteria would at maximum increase by a negligible 5 metres). Consideration of the above indicates that no significant economic effects would arise with respect to Project rail noise that would warrant inclusion in the BCA.

Air Quality

Air quality impacts may potentially occur at nearby residences as a result of dust generation at the Project. However, no Project-only exceedances of the EPA criteria are predicted as a result of the Project (Katestone Environmental Pty Ltd, 2013) (Appendix K of the EIS). The Project would not result in any significant air quality impacts and hence no economic effects have been included in the BCA.

Mineral Concentrate and Process Waste Management

A Mineral Concentrate and Process Waste Materials Assessment has been prepared for the Project (Radiation Advice & Solutions, 2012) (Appendix L of the EIS). Radiation Advice & Solutions (2012) concluded that with the implementation of the proposed management measures the risk of harm to employees, members of the public and the environment from the handling, stockpiling and transporting mineral concentrates and process wastes would be negligible (Appendix L of the EIS).

Based on the above, no economic effects have been identified in the BCA with respect to potential impacts associated with the handling, stockpiling and transporting mineral concentrates and process wastes.

Greenhouse Gases

The Project is predicted to generate in the order of 1 million tonnes of greenhouse gas emissions associated with mining, processing and transport of mineral concentrate to port (Appendix K of the EIS). To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of CO_2-e is required that reflects its social costs. The social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the social cost of CO_2-e with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of CO_2-e is to examine the price of CO_2-e credits/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price of AUD$23 per tonne of carbon dioxide equivalent (/t CO_2-e) was used, with sensitivity testing from AUD$8/t CO_2-e to AUD$40/t CO_2-e (refer to Attachment 2).

Visual Impacts

The Project would not result in any significant visual impacts and hence no economic effects have been included in the BCA.

Non-market Value of Employment

Historically the employment benefits of projects have tended to be omitted from BCA on the implicit assumption that labour resources used in a project would otherwise be employed elsewhere. Where this is not the case, Streeting and Hamilton (1991) and Bennett (1996) outline that otherwise unemployed labour resources utilised in a project should be valued in a BCA at their opportunity cost (wages less social security payments and income tax) rather than the wage rate which has the effect of increasing the net production benefits of the Project. 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. These are non-market values.

It has also been recognised that the broader community may hold non-environmental, non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvouges, 1997) and the viability of rural communities (Bennett *et al*., 2004).

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

The Project would result in operational employment of 200 people for 19 years. Applying the more conservative Bulli Seam Operation value for employment provided a non-use employment benefit of the Project of $94M. In the context of a fully employed economy there may be some contention about the inclusion of this value, particularly as it requires benefit transfer from a study of an underground coal mining operation in another region of NSW. Consequently, sensitivity testing that excludes this value has also been undertaken.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

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

The Project is estimated to have net production benefits of $639M, with $251M of these accruing to Australia. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, may be assessed. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

Table 2.2
Benefit Cost Analysis Results of the Project (Present Values at 7% Discount Rate)

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land	$0	Revenue	$1,759
	Opportunity cost of capital equipment	$0	Residual value of capital	$6
	Capital costs	$195	Residual value of land	$0
	Operating costs	$931	-	-
	Production Sub-total	***$1,126***	***-***	***$1,765***
	Net Production Benefits			**$639 ($251)**
Non-market Impacts	Flora and fauna	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs	Non-market benefits of employment	$94
	Road transport	Negligible. The costs of road works and road safety improvements are included in the capital costs of the Project	-	-
	Rail transport	Negligible.	-	-
	Aboriginal heritage	Unquantified	-	-
	Non-Aboriginal heritage	Nil	-	-
	Groundwater	Negligible	-	-
	Surface water	Negligible	-	-
	Agricultural production	Included in capital costs (land acquisitions)	-	-
	Operational noise	Negligible	-	-
	Road transport noise	Negligible	-	-
	Rail transport noise	Negligible	-	-
	Air quality	Negligible	-	-
	Greenhouse gas emissions	$12	-	-
	Visual	Negligible	-	-
	Non-market impacts sub-total	***$12 ($0.1)***	-	***$94***
NET SOCIAL BENEFITS – including employment benefits				**$721 ($345)**
NET SOCIAL BENEFITS – excluding employment benefits				**$627 ($251)**

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.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental, cultural and social impacts from the Project, that impact Australia[11], would need to be valued by the community at greater than the estimate of the Australian net production benefits (i.e. greater than $251M). This is equivalent to each household in the Far West Statistical Subdivision (SSD) and Murray-Darling SSD valuing residual environmental impacts at $18,000. The equivalent figure for NSW households is $94.

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

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

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify some of the environmental, social and cultural impacts of the Project. From Table 2.2 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 $12M in total or $0.1M 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 $94M.

Overall, the Project is estimated to have net social benefits to Australia of between $251M and $345M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts of the Project as specified in the EIS have been quantified and included in the BCA, any other residual environmental, cultural or social impacts of this Project (e.g. impacts on Aboriginal heritage) or the larger Project that remain unquantified would need to be valued at greater than between $251M and $345M for the Project to be questionable from an Australian economic perspective.

2.5.2 Distribution of Costs and Benefits

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

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

- Cristal Mining in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $362M or $203M present value at a 7% discount rate) from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Far West SSD and Murray-Darling SSD region;
- the NSW Government via royalties (estimated at $95M or $48M present value at a 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the Far West SSD and Murray-Darling SSD region; and
- the local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

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

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

Value		Distribution			
		Local	**State**	**National**	**Global**
Net Production Benefits					
Net production benefits to Cristal Mining	$388M	-	-	-	✓
Net production benefits to Commonwealth Government – Company tax	$203M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$48M	✓	✓	-	-
Total	***$639M***				
Non-market Costs and Benefits					
Benefits					
Non-market benefit of employment	$94M	✓	✓	-	-
Total	***$94M***				
Costs					
Flora and fauna	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs	✓	✓	✓	-
Road transport	Negligible. The costs of road works and road safety improvements are included in the capital costs of the Project	✓	-	-	-
Rail transport	Negligible.	✓	✓	✓	-
Aboriginal heritage	Unquantified	✓	✓	-	-
Non-Aboriginal heritage	Nil.	✓	-	-	-
Groundwater	Negligible.	✓	-	-	-
Surface water	Negligible.	✓	-	-	-
Agricultural production	Included in capital costs (land acquisitions)	✓	-	-	-
Operational noise	Negligible.	✓	-	-	-
Road transport noise	Negligible.	✓	-	-	-
Rail transport noise	Negligible.	✓	-	-	-
Air quality	Negligible.	✓	-	-	-
Greenhouse gas emissions rest of the world[1]	$12	-	-	-	✓
Greenhouse gas emissions Australia[1]	$0.1	✓	✓	✓	
Visual	Negligible.	✓	-	-	-
Total	***$12M***				
Net Benefits	**$721M**				

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

Note: Totals may have minor discrepancies due to rounding.

Greenhouse gas emission costs occur at the National and global level and would be internalised into the operating costs of the Project through payment of the carbon tax. The economic costs associated with a reduction in agricultural production and road transport are initially borne by affected local landholders and road users. However, Cristal Mining would internalise these impacts through the purchase of impacted land and the estimated mitigation costs. The economic costs associated with the clearing of native vegetation would occur at the State or National level and would be counterbalanced by the biodiversity offset actions proposed by Cristal Mining. The costs of these offset actions are internalised into the production costs of the Project. Aboriginal heritage impacts would potentially occur to local Aboriginal people as well as NSW households[12]. Cristal Mining would develop a Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental externalities would largely occur at the State or local level and were found to be minor or insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the State or local level[13].

The non-market costs, quantified in the analysis, that accrue to NSW are estimated at $0.1M. These are considerably less than the net production benefits that directly accrue to NSW through royalties and the potential non-market employment benefits. Consequently, as well as resulting in net benefits to Australia the Project is likely result in net benefits to NSW.

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 net community benefit to Australia (excluding employment benefits) was tested for changes to the following variables:

- opportunity cost of capital equipment;
- capital costs;
- operating costs;
- value of mineral concentrate;
- residual value of capital equipment; and
- greenhouse gas emission costs.

This analysis indicated (refer to Attachment 3) that the results of the BCA are not sensitive to changes made in assumptions regarding any of these variables. In particular, significant increases in the values used for external impacts such as greenhouse gas did not change the positive sign of the NPV of the Project BCA. Hence the Project's desirability from an economic efficiency perspective is not changed. The results were most sensitive to any potential decreases in the sale value of mineral concentrate.

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

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

3 REGIONAL ECONOMIC IMPACTS

3.1 INTRODUCTION

The BCA discussed in Section 2 is concerned with whether the incremental benefits of the Project exceed the incremental costs, and therefore whether the community would 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.

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.,* 1985; Jensen and West, 1986). A number of impacting agents would result from the Project including construction activity and mining operations. These impacts are considered in terms of a number of indicators[14]:

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

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

For this assessment, the impacts of the Project have been estimated for the two regions:

- the Far West SSD and Murray-Darling SSD referred to as the regional economy; and
- the State of NSW.

The Far West SSD incorporates the Broken Hill City Council and Central Darling Shire Council local government areas and the Unincorporated area. The Murray-Darling SSD incorporates the Wentworth Shire Council and Balranald Shire Council local government areas.

A range of methods can be used to examine the regional economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.,* 1985). Input-output analysis is used in this study.

Input-output analysis essentially involves two steps:

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

[14] These indicators should not be confused with costs and benefits that are considered in the BCA.

The input-output method is based on a number of assumptions that are outlined in Attachment 4, and result in estimated impacts being an upper bound impact estimate.

3.2 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

For this assessment, two input-output tables were used:

- a 2006 input-output table[15] of the NSW economy developed by Monash University and indexed to 2012; and
- a 2006 input-output table of the regional economy, developed by Gillespie Economics using the Generation of Regional Input-output Tables procedure[16] (Bayne and West, 1988) (and the Monash NSW table as the parent table) and indexed to 2012.

The 109 sector input-output tables were aggregated to 30 sectors and 6 sectors for the purpose of describing the economies.

A highly aggregated 2005-06 input-output table for the regional economy is provided in Table 3.1. The rows of the table indicate how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD) (which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA) (which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

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

	Ag, Forestry, Fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	TOTAL
Ag, Forestry, Fishing	17,105	58	11,313	4	45	1,445	29,970	3,953	17,010	164,971	215,903
Mining	11	24,022	1,023	972	132	84	26,244	72	7,624	299,763	333,703
Manuf.	8,113	7,352	17,637	848	5,480	22,429	61,859	18,913	14,444	196,895	292,111
Utilities	2,344	5,078	2,758	105,670	578	10,333	126,761	12,646	3,889	92,554	235,850
Building	541	1,393	355	1,829	14,160	4,625	22,902	0	70,975	17,527	111,404
Services	16,515	10,973	37,646	5,374	8,015	133,513	212,036	381,667	216,702	219,006	1,029,411
TOTAL	44,629	48,877	70,730	114,697	28,408	172,428	479,770	417,250	330,644	990,716	2,218,382
Household Income	47,766	44,779	38,182	17,184	27,608	397,387	572,906	0	0	0	572,906
OVA	50,831	168,572	59,049	46,991	10,407	143,795	479,645	48,803	11,691	1,781	541,919
Imports	72,677	71,474	124,150	56,978	44,980	315,800	686,060	418,439	62,813	70,235	1,237,548
TOTAL	215,903	333,703	292,111	235,850	111,404	1,029,411	2,218,382	884,492	405,149	1,062,733	4,570,755
Employment	1,487	735	623	266	419	7,407	10,936				

Note: Totals may have minor discrepancies due to rounding. Ag = agriculture; Manuf. = manufacturing.

[15] A key driver in the preparation of regional input-output tables is employment by industry information from the Australian Bureau of Statistics (ABS) Census. The relevant data from the 2011 ABS Census was not available at the time of preparation of this report and hence 2006 data was relied on.

[16] Refer to Attachment 5.

Gross regional product (value-added) for the regional economy is estimated at $1,115M, comprising $573M to households as wages and salaries (including payments to self employed persons and employers) and $542M in OVA.

The employment total working in the region was 10,936 people.

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

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

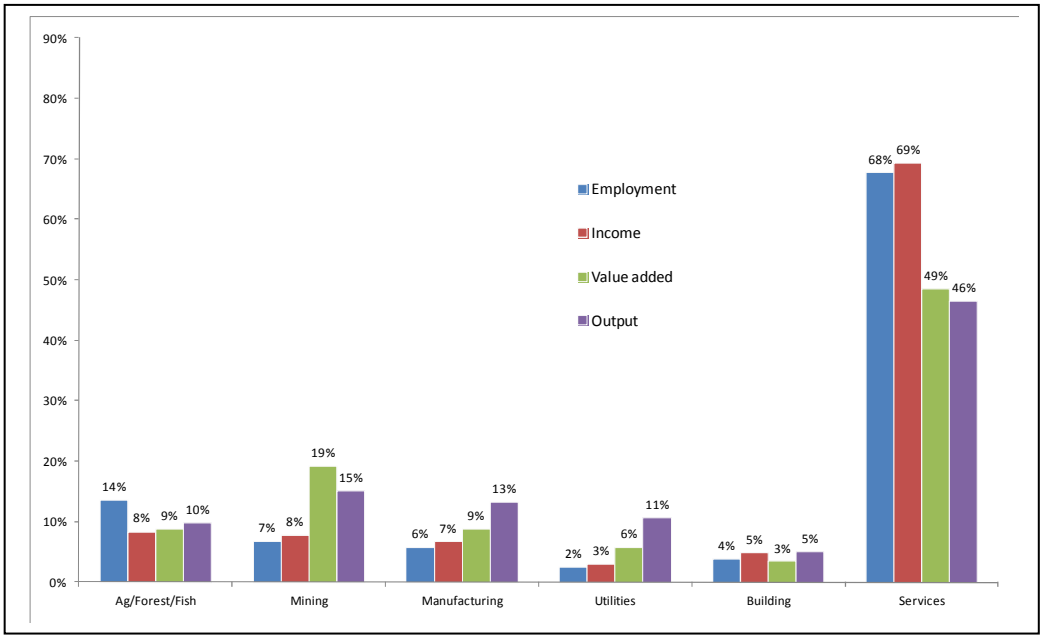
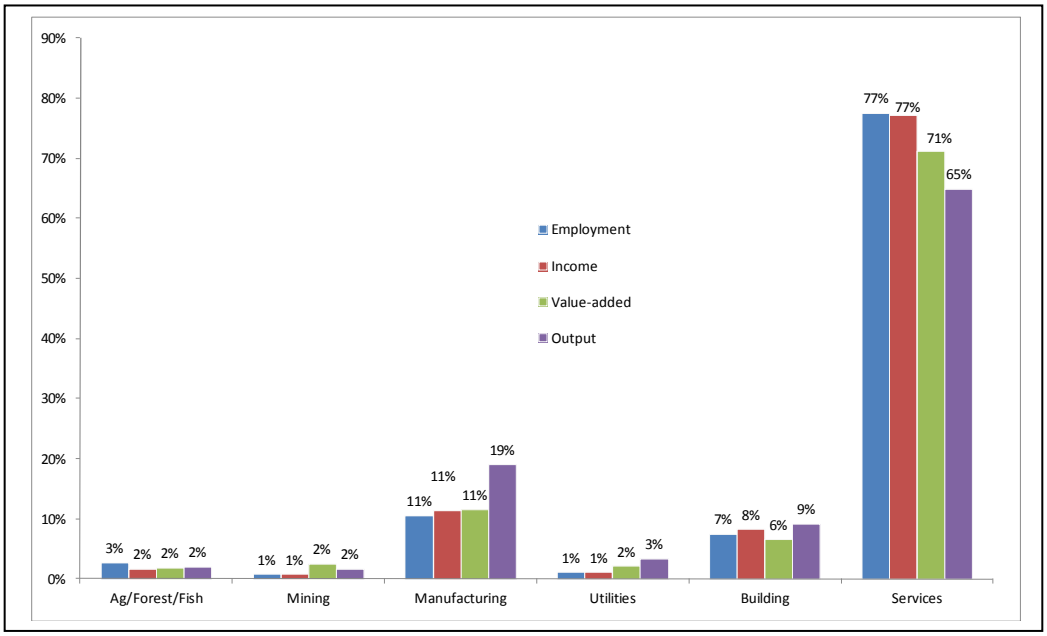


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2006)



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

What is clear from these figures is that in terms of gross regional output and value-added, the *metal ores (non-ferrous) mining sectors* are the most significant sectors of the regional economy (Figure 3.3). For income and employment, *retail trade sectors*, *health sectors*, *education sectors* and *personal/other services sectors* are the most significant sectors (Figure 3.4). The *metal ores (non-ferrous) mining sectors*, *food manufacturing sectors*, *utilities sectors* and *retail trade sectors* are the most important sectors in the region for imports and exports (Figure 3.5).

3.3 ECONOMIC IMPACT OF THE PROJECT

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

3.3.1 *Construction Phase*

Introduction

Economic activity associated with the Project construction phase in Year 1 of the Project is estimated to potentially mainly occur within five sectors of the economy:

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

Impact on Regional Economy

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

Construction activities would be facilitated by a short-term peak workforce of up to 300 people for approximately 2 to 3 months in Year 1 of the Project, but average approximately 150 people during that year. Based on the input-output coefficients of the *other construction sector* and the *trade services sector* in the transactions table (indexed to 2012) for the region, in the order of $40.5M of the capital costs in Year 1 of the Project would need to be spent on the *other construction sector* and the *construction trade services sector* within the region to result in an average annual workforce of 150 people working in the region. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

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

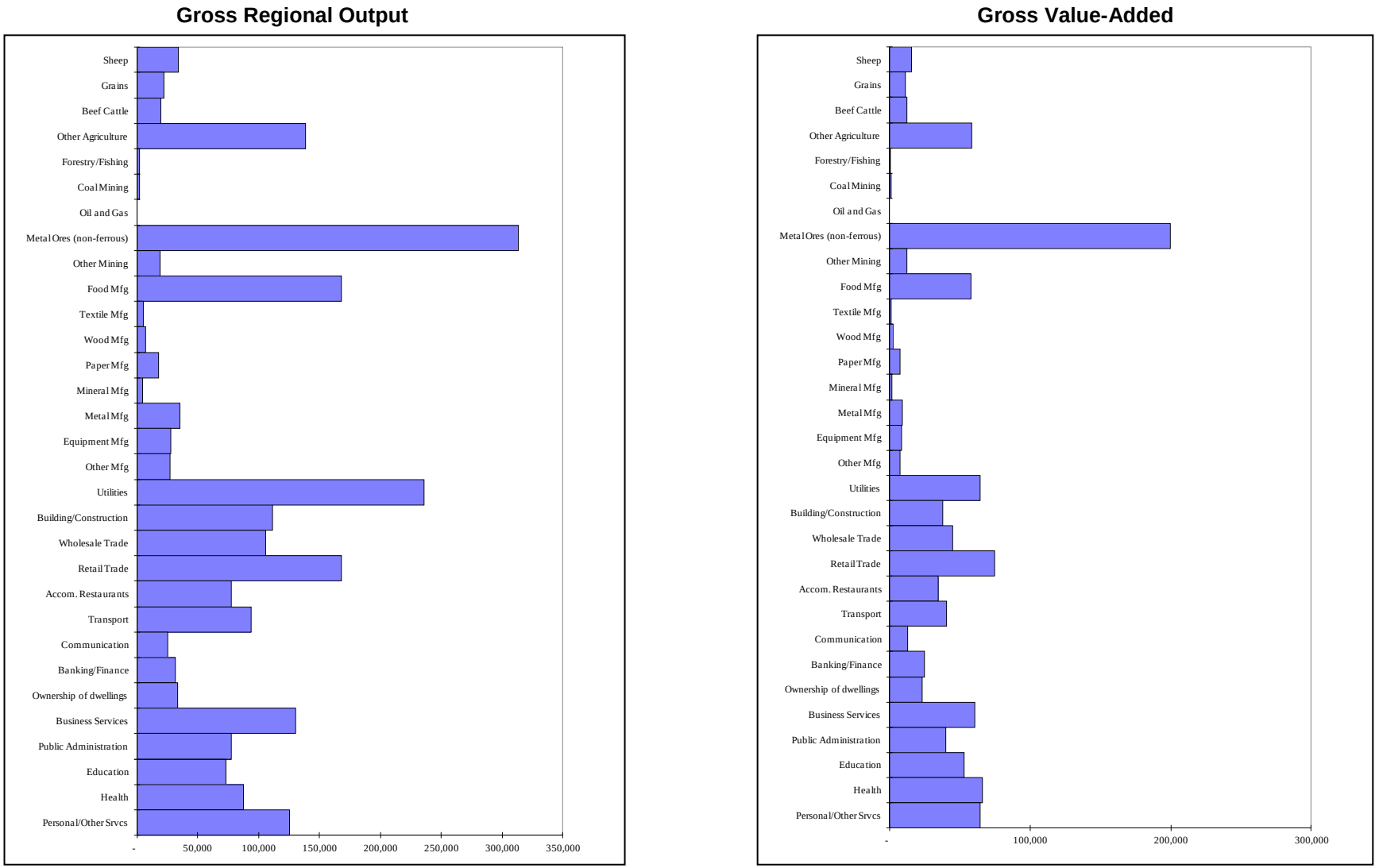


Figure 3.4
Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

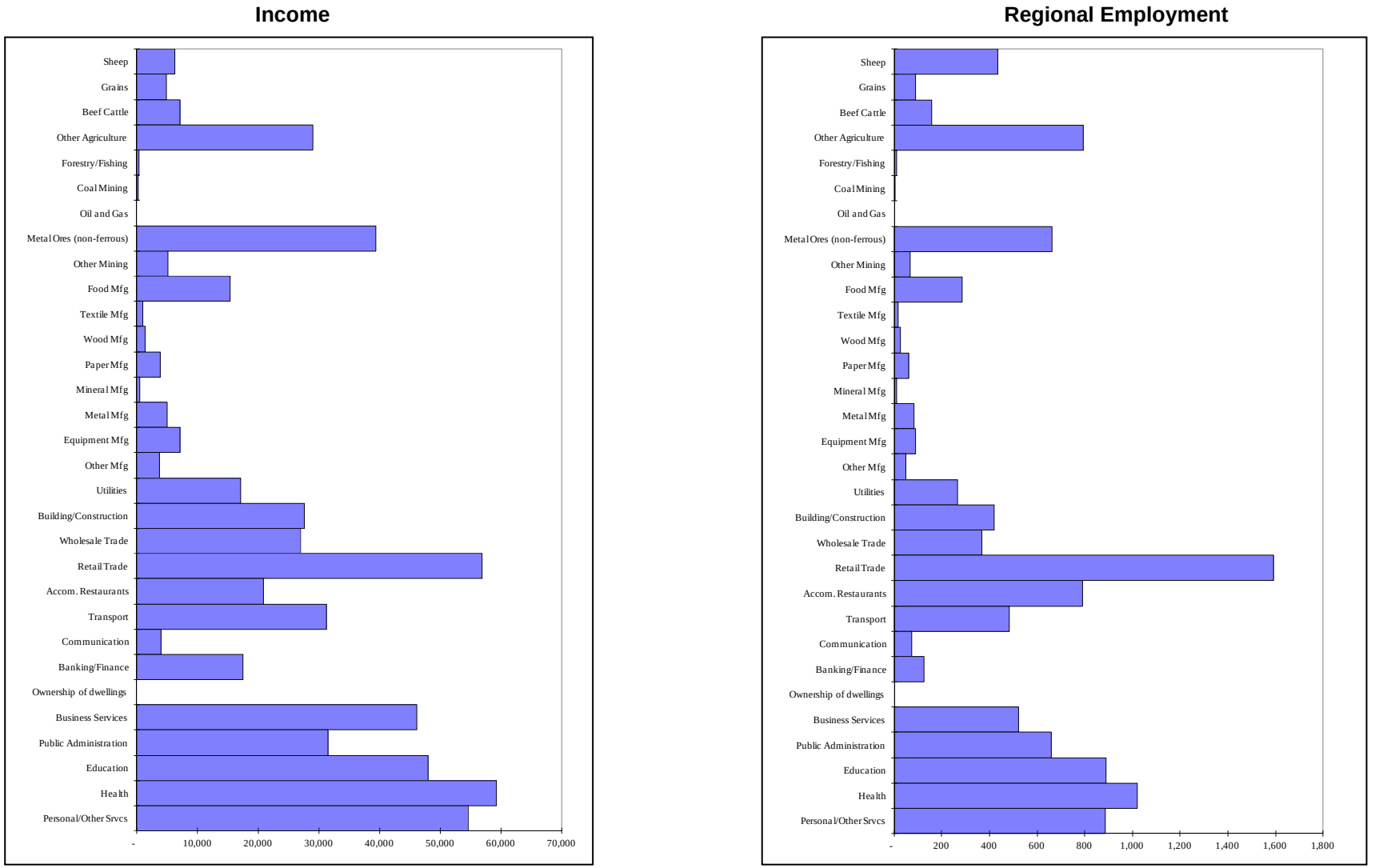


Figure 3.5
Sectoral Distribution of Regional Imports and Exports ($'000)

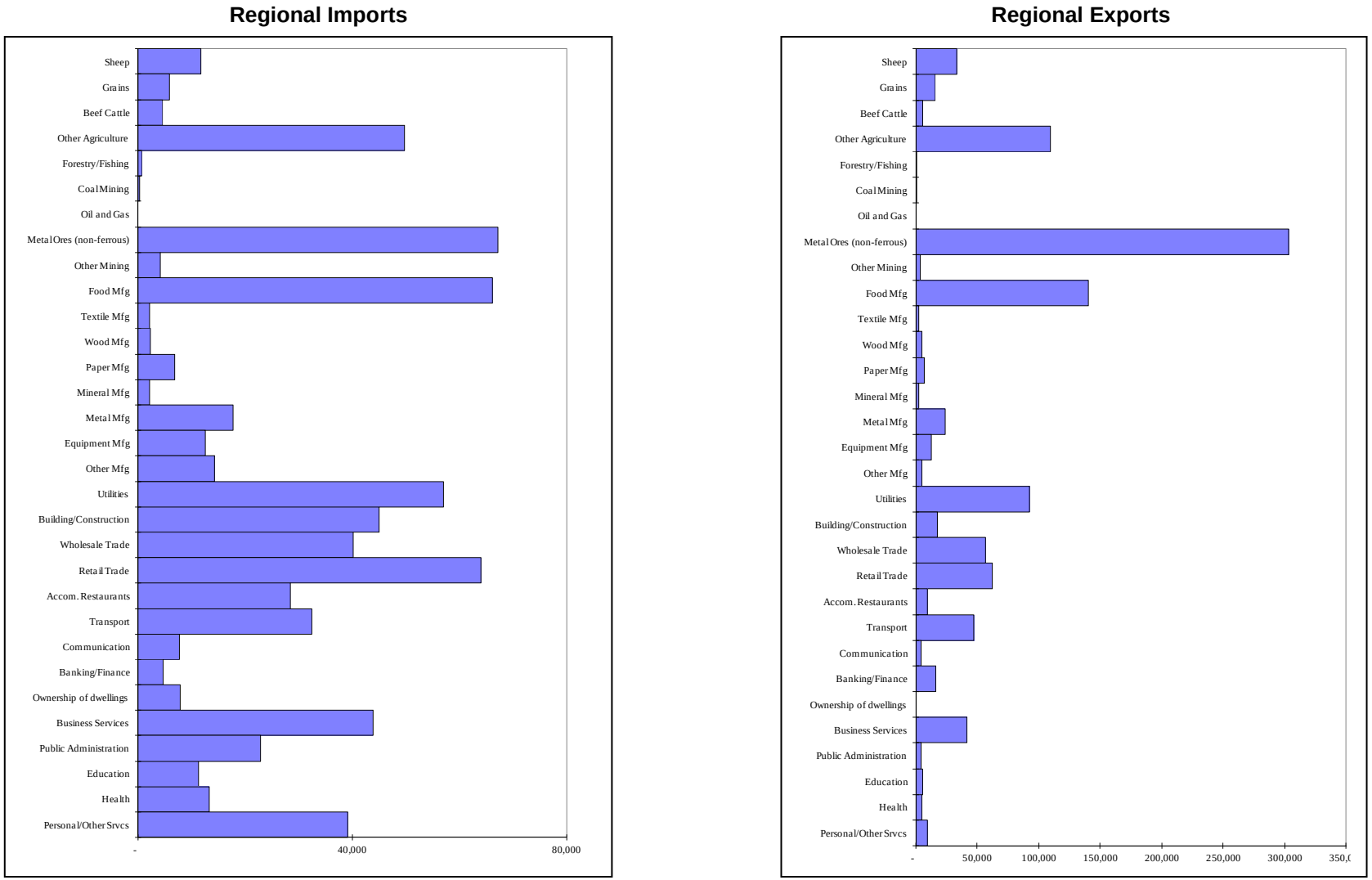


Table 3.2
Economic Impacts of Construction of the Project on the Regional Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	40,465	12,087	10,848	22,935	63,400
Type 11A Ratio	*1.00*	*0.30*	*0.27*	*0.57*	*1.57*
VALUE ADDED ($'000)	16,304	5,131	5,769	10,901	27,204
Type 11A Ratio	*1.00*	*0.32*	*0.35*	*0.67*	*1.67*
INCOME ($'000)	11,920	4,002	3,260	7,262	19,182
Type 11A Ratio	*1.00*	*0.34*	*0.27*	*0.61*	*1.61*
EMPLOYMENT (No.)	150[1]	56	55	111	261
Type 11A Ratio	*1.00*	*0.37*	*0.37*	*0.74*	*1.74*

[1] Direct employment of 150 represents average annual construction employment. It is assumed that these people reside in the region. Where they do not, a proportion of the consumption induced flow-on impacts will leak from the region.

Impacts

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

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

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

- $63M in annual direct and indirect output;
- $27M in annual direct and indirect regional value added;
- $19M in annual direct and indirect household income; and
- 261 direct and indirect jobs.

These particular impacts on the regional economy are likely to be felt for a period in the order of 12 months in Year 1 of the Project. In Year 5 of Project, construction activities requiring an average annual workforce of approximately 100 people, would occur. The regional impacts of this would be up to two thirds of those reported in Table 3.2 for Year 1 of the Project.

Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from input-output analysis (refer to Attachment 4). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect (e.g. total income effect from an initial income effect and total employment effect from an initial employment effect etc.).

The Type 11A ratio multipliers for the construction phase of the Project range from 1.57 for output up to 1.74 for employment.

Main Sectors Affected

Flow-on impacts from the construction phase of the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the *construction trade-services, wholesale and retail trade, other business services, health services, accommodation, cafes and restaurants, education services and personal services*.

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

Table 3.3
Distribution of Regional Employment Impacts of Project Construction

Sector	Average Direct Effects	Production Induced	Consumption Induced	TOTAL EFFECT
Primary	0	0	1	1
Mining	0	0	0	0
Manufacturing	0	5	1	7
Utilities	0	1	1	1
Wholesale/Retail	0	7	13	20
Accommodation, cafes, restaurants	0	1	11	11
Building/Construction	150	32	0	182
Transport	0	2	2	4
Services	0	8	27	35
Total	**150**	**56**	**55**	**261**

Note: Totals may have minor discrepancies due to rounding.

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

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

Impact on the NSW Economy

When the impact of $40.5M of expenditure in the *other construction sector* and the *construction trade services sector* is assessed for the NSW economy, the impacts are greater because of the larger intersectoral linkages and hence multipliers for the larger economy.

Impacts

The direct and indirect on the NSW economy are reported in Table 3.4.

Table 3.4
Economic Impacts of Construction of the Project on the NSW Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	40,465	36,668	46,579	83,247	123,712
Type 11A Ratio	*1.00*	*0.91*	*1.15*	*2.06*	*3.06*
VALUE ADDED ($'000)	16,304	15,790	23,725	39,515	55,819
Type 11A Ratio	*1.00*	*0.97*	*1.46*	*2.42*	*3.42*
INCOME ($'000)	13,462	13,122	13,577	26,699	40,161
Type 11A Ratio	*1.00*	*0.98*	*1.01*	*1.98*	*2.98*
EMPLOYMENT (No.)	151	153	181	334	485
Type 11A Ratio	*1.00*	*1.01*	*1.20*	*2.21*	*3.21*

Based on the above approach, the Project may result in impacts on the NSW economy of up to:

- $124M in annual direct and indirect output;
- $56M in annual direct and indirect regional value added;
- $40M in annual direct and indirect household income; and
- 485 direct and indirect jobs.

These particular impacts on the NSW economy are only likely to be felt for a period of in the order of 12 months in Year 1 of the Project with approximately two thirds of these impacts experienced in Year 5 of the Project.

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

3.3.2 Operation Phase

Introduction

For the analysis of the Project, a new Project sector was inserted into the regional input-output table reflecting a typical year's production levels.

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

- the estimated gross annual revenue was allocated to the *output* row;
- the estimated wage bill of those residing in the region was allocated to the *household wages* row with any remainder allocated to *imports*;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;

- allocation was then made between *intermediate sectors* in the local economy and *imports* based on advice from Cristal Mining 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 resides in the region was allocated to the *employment* row.

Impacts on the Regional Economy

Economic Activity

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

Table 3.5
Annual Economic Impacts of the Operation of the Project on the Regional Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	232,000	36,045	11,166	47,210	279,210
Type 11A Ratio	*1.00*	*0.16*	*0.05*	*0.20*	*1.20*
VALUE ADDED ($'000)	123,178	22,820	5,939	28,759	151,937
Type 11A Ratio	*1.00*	*0.19*	*0.05*	*0.23*	*1.23*
INCOME ($'000)	5,753	10,636	3,355	13,991	19,744
Type 11A Ratio	*1.00*	*1.85*	*0.58*	*2.43*	*3.43*
EMPLOYMENT (No.)	48	124	57	181	229
Type 11A Ratio	*1.00*	*2.59*	*1.19*	*3.77*	*4.77*

Notes: The average annual workforce of the Project is estimated at 200 comprising 80 employees and 120 contractors. Sixty percent of these are estimated to reside in the region. Forty-eight direct employment represents the proportion of direct employees residing in the region. The proportion of contractors residing in the region is located in the production induced flow-ons.

Totals may have minor discrepancies due to rounding.

The Project is estimated to make up to the following total annual contribution to the regional economy for 20 years:

- $279M in annual direct and indirect regional output or business turnover;
- $152M in annual direct and indirect regional value added;
- $20M in annual direct and indirect household income; and
- 229 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Project range from 1.20 for output up to 4.77 for employment.

Capital intensive industries tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. This is exacerbated in this analysis by low level of direct employees with most of the workforce being contractors who are included in the production induced flow-on 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 regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- services to mining sector;
- road transport sector;
- ownership of dwellings sector;
- accommodation, cafes and restaurants sector;
- retail trade sector;
- wholesale trade sector;
- health services sector;
- personal services sector; and
- education sector.

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities would be generated by the Project (Table 3.6).

Table 3.6
Distribution of Regional Employment Impacts of Project Operation

Sector	Average Direct Effects	Production Induced	Consumption Induced	TOTAL
Primary	0	0	1	1
Mining	48	73	0	121
Manufacturing	0	2	2	3
Utilities	0	0	1	1
Wholesale/Retail	0	7	13	20
Accommodation, cafes, restaurants	0	2	11	13
Building/Construction	0	1	0	1
Transport	0	30	2	32
Services	0	10	28	38
Total	**48**	**125**	**57**	**229**

Note: Totals may have minor discrepancies due to rounding.

Table 3.6 indicates that direct, production induced and consumption induced employment impacts of the Project on the regional economy are likely to have different distributions across sectors. Production induced flow-on employment would occur mainly in mining, transport and services sectors while consumption induced flow-on employment would be mainly in the services, wholesale/retail 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 an increased economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

Impact on the NSW Economy

Introduction

The NSW economic impacts of the Project were assessed by inserting a new Project sector into a 2012 NSW input-output table in the same manner described in Section 3.2. The primary difference from the sector identified for the regional economy was that 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 2012 dollars) are shown in Table 3.7.

Table 3.7
Annual Economic Impacts of the Operation of the Project on the NSW Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	232,000	92,865	62,782	155,648	387,648
Type 11A Ratio	*1.00*	*0.40*	*0.27*	*0.67*	*1.67*
VALUE ADDED ($'000)	122,136	47,959	31,979	79,937	202,073
Type 11A Ratio	*1.00*	*0.39*	*0.26*	*0.65*	*1.65*
INCOME ($'000)	5,753	30,079	18,300	48,379	54,132
Type 11A Ratio	*1.00*	*5.23*	*3.18*	*8.41*	*9.41*
EMPLOYMENT (No.)	48	351	244	595	643
Type 11A Ratio	*1.00*	*7.31*	*5.09*	*12.40*	*13.40*

Note: Totals may have minor discrepancies due to rounding.

The Project is estimated to make up to the following total contribution to the NSW economy for 20 years:

- $388M in annual direct and indirect regional output or business turnover;
- $202M in annual direct and indirect regional value added;
- $54M in annual direct and indirect household income; and
- 643 direct and indirect jobs.

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

3.4 IMPACT OF CESSATION OF THE PROJECT ON THE REGIONAL ECONOMY

The Project would provide economic activity to the regional and NSW economy for a period of 20 years. Ultimate cessation of the mining operations would result in a contraction in regional economic activity.

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

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

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

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

The Murray-Darling Basin is a large sedimentary basin covering 300,000 square kilometres that contains mineral sand deposits. New mining resource developments in the region would help broaden the region’s economic base and buffer against impacts of the cessation of individual projects.

Ultimately, the significance of the economic impacts of cessation of the 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 more 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 be less significant.

4 EMPLOYMENT, POPULATION AND COMMUNITY INFRASTRUCTURE ASSESSMENT

4.1 INTRODUCTION

This section addresses social impacts that may potentially arise from social change processes, specifically changes in employment levels and populations. Changes in the workforce and populations of a region may well have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities. This may include the number and type of services that are available to be used and the accessibility of these services.

The objective of this EPCIA is to examine the potential impacts of the Project on the existing community infrastructure as a result of employment and population change associated with the Project, while having regard to other projects that are also occurring within the region.

The basic methodology for carrying out the EPCIA was to:

- analyse the existing socio-economic environment of the region potentially impacted by the Project;
- analyse the likely incremental magnitude of the additional Project workforce and associated population growth including estimated flow-on employment effects;
- consider the potential impacts of estimated employment and population change on community infrastructure based on ABS data and available reports about current social issues in the region; and
- recommend impact mitigation or management measures for any substantive impacts that are identified.

The geographic scope of the EPCIA was determined by the location of Project and the region that would potentially service the Project and its employees. The Project is located in the Murray-Darling Basin, approximately 80 km north of Balranald and 270 km south-east of Broken Hill in NSW. Both the construction and operation workforce are proposed to be accommodated within an accommodation camp located at the Atlas-Campaspe Mine. However, in between rosters the main residential location of the workforce is expected to be Mildura, Broken Hill, Balranald and Ivanhoe. For the purpose of this analysis the focus was on the NSW region containing Broken Hill, Balranald and Ivanhoe i.e. the Far West SSD and Murray-Darling SSD. The assessment does not consider potential impacts on Mildura as it is located outside of NSW.

The assessment draws on a range of publications and reports as well as data provided by Cristal Mining, the ABS[17], and information from Section 3 on the potential regional economic impacts of the Project. While the Project would also be expected to have population and workforce effects at a NSW State level and in other nearby centres, these effects would not be of sufficient magnitude to warrant consideration of potential adverse effects.

[17] At the time of preparation of this report only limited 2011 ABS Census data was available. For the data that was available, the ABS had changed the definition of geographic boundaries. New boundaries were inconsistent with the region defined for the input-output analysis. Consequently, earlier ABS data was relied on.

4.2 REGIONAL PROFILE

Population

In 2006, the region had a population of 32,046, representing approximately 0.5% of the NSW population (Table 4.1).

Table 4.1
Region and NSW Population and Growth Rates - 1996 to 2006

Region	Total Population			Population Change	
	1996	2001	2006	People	%
Murray-Darling SSD	**10,209**	**9,754**	**9,649**	**- 562**	**-5.5%**
Balranald SLA	*2,964*	*2,770*	*2,570*	*- 394*	*-13.3%*
Wentworth SLA	*7,245*	*6,984*	*7,079*	*- 166*	*-2.3%*
Far West SSD	**25,085**	**24,097**	**22,399**	**- 2,686**	**-10.7%**
Broken Hill SLA	*21,356*	*20,363*	*19,356*	*- 2,000*	*-9.4%*
Central Darling SLA	*2,651*	*2,687*	*2,158*	*- 493*	*-18.6%*
Unincorporated Far West SLA	*1,078*	*1,047*	*885*	*-193*	*-17.9%*
Region Total	**35,294**	**33,851**	**32,046**	**- 3,248**	**-9.2%**
NSW	**6,038,696**	**6,371,745**	**6,585,736**	**547,040**	**9.1%**

Source: ABS (2006a).

Note: Totals may have minor discrepancies due to rounding.

SLA = statistical local area.

The populations of the region (and sub-regions) declined between 1996 and 2006 (Table 4.1), illustrating the trend of depopulation of many inland rural areas in NSW.

Consistent with the trend for NSW, the proportion of the region population under the age of 44 has been declining over time, while the proportion of the population over the age of 44 has been increasing (Table 4.2). However, the region has a lower proportion of population in the 15 to 44 year age bracket compared to NSW and a higher proportion of the population in the 45 to 64 years age bracket (Table 4.2).

The median age in 2006 for the population of Far West SSD and Murray-Darling SSD is 42 and 40, respectively compared to 37 for NSW (ABS, 2011).

Table 4.2
Distribution of the Region and NSW Population by Age Group

Proportion of Total Population	Murray-Darling SSD		Far West SSD		NSW	
	1996	2006	1996	2006	1996	2006
Aged 14 years and younger	24%	20%	21%	19%	21%	20%
Aged 15 years to 44 years	41%	36%	41%	35%	45%	42%
Aged 45 years to 64 years	23%	29%	23%	28%	21%	25%
Aged 65 years and over	12%	15%	15%	18%	13%	14%

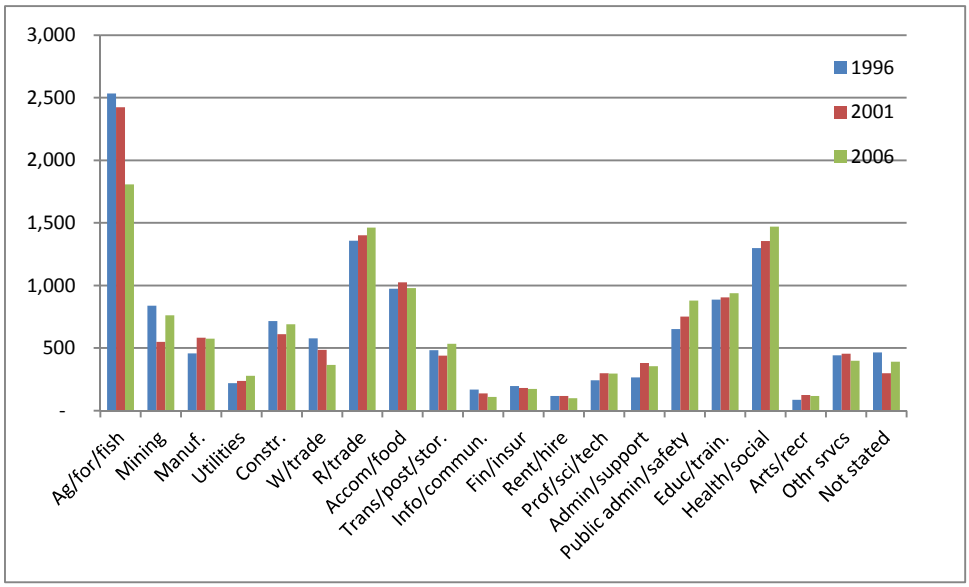
Source: ABS (2006a).

Note: Total percentages may not add to 100% due to rounding.

Employment

Employment by industry data for the region is presented on Figure 4.1. This indicates that the main employment sectors are agriculture, forestry and fishing, retail trade, health care and social assistance. Employment in these latter two sectors has been growing over time while the employment in the agriculture, forestry and fishing sector has been declining. Other sectors whose employment levels have been declining include mining, construction, wholesale trade, information media and telecommunications, financial and insurance services, rental, hiring and real estate services. Employment in the manufacturing sector, retail trade sector and services sectors of professional, scientific and technical services, administrative and support services, public administration and safety, and education and training have been growing.

Figure 4.1
Employment by Industry in the Region

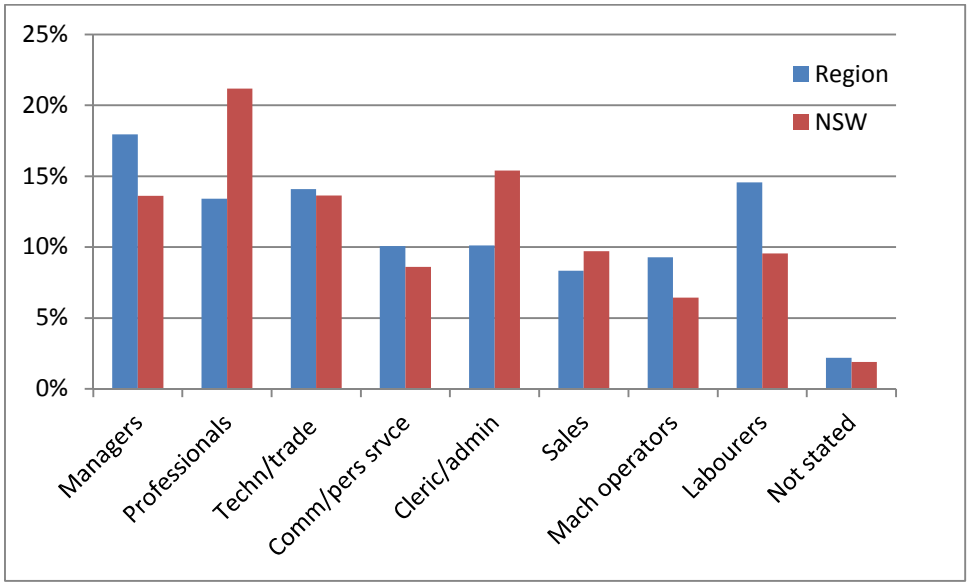


Source: ABS (2006a).

Relative to the NSW economy, the sectors in the region that employs a significantly greater proportion of workers is the agriculture/forestry/fishing sectors and mining sectors. Sectors that employ a significantly lesser proportion of workers include the manufacturing, finance/insurance and professional/technical services sectors (ABS, 2006a).

Relative to the NSW economy, the region has a higher relative proportion of managers (reflecting farm managers), machine operators and labourers and a significantly lower proportion of professionals and clerical and administrative workers (Figure 4.2).

Figure 4.2
Occupations in the Region and NSW



Source: ABS (2006a).

The median individual income and median family income of Far West SSD residents is 60% and 55% of that for NSW, respectively. The median individual income and median family income of Murray-Darling SSD residents is 69% and 66% of that for NSW, respectively (ABS, 2011). Average individual taxable income in 2009 in the Far West SSD and Murray-Darling SSD was $50,488 and $44,880, respectively, compared to $59,782 for NSW (ABS, 2011).

The total labour force and level of employed persons in the Far West SSD and Murray-Darling SSD has declined since 1996. The unemployment rate in the Far West SSD and Murray-Darling SSD declined between Censuses (Table 4.3). However, the unemployment rate for the Far West has been consistently higher than that for NSW while the unemployment rate for the Murray-Darling SSD has tended to be lower than that for NSW (Table 4.3). The level of unemployment in the March 2012 quarter is reported as 74 people (5.1%) for Balranald SLA, 367 people (9.5%) for Wentworth SLA, 765 people (8.3%) for Broken Hill SLA and 142 (13.8%) for Central Darling SLA (Commonwealth Department of Education, Employment and Workplace Relations, 2012).

Table 4.3
Labour Force in the Region

Labour Force	Far West SSD			Murray-Darling SSD		
	1996	2001	2006	1996	2001	2006
Employed	8,689	8,403	8,314	4,317	4,366	4,376
Unemployed	1,354	1,153	793	386	218	228
Total labour force	10,043	9,556	9,107	4,708	4,584	4,604
Not in the labour force	9,062	8,550	7,683	2,858	2,575	2,511
Labour force status not stated	604	1,053	1,240	225	431	534
Unemployment rate	13%	12%	9%	8%	5%	5%
NSW Unemployment Rate	**9%**	**7%**	**6%**	-	-	-

Source: ABS (2006a).

Note: Totals may have minor discrepancies due to rounding.

Housing

In 2006 there were approximately 9,300 private occupied dwellings in the Far West SSD and 3,617 in the Murray-Darling SSD, about 0.38% and 0.14% of the NSW total, respectively (Table 4.4). The Far West and Murray-Darling SSDs had a higher proportion of separate houses than NSW (approximately 90% and 89% respectively, compared with approximately 70% for NSW) and a lower proportion of townhouses/units/flats/apartments (approximately 4% and 4% respectively, compared with 29% in NSW) (Table 4.4).

Table 4.4
Housing Stock in the Region and NSW (Occupied Dwellings Only)

Housing Stock	Far West SSD			Murray-Darling SSD			NSW
	1996	2001	2006	1996	2001	2006	2006
Total Private Dwellings	9,799	9,741	9,300	3,579	3,634	3,617	2,470,452
% Separate Houses	91%	92%	90%	85%	84%	89%	70%
% Townhouse, Flat, Unit, Apartment	3%	3%	4%	4%	4%	4%	29%
% Other	3%	3%	3%	8%	8%	6%	1%
% Not Stated	2%	1%	0%	2%	2%	0%	0%

Source: ABS (2006a).
Note: Percentages may not add to 100% due to rounding.

At the 2006 Census, there were 1,857 unoccupied dwellings in the Far West SSD and 577 unoccupied dwellings in the Murray-Darling SSD (Table 4.5).

Table 4.5
Housing Stock in the Region (All Dwellings)

Housing Stock	Far West SSD (2006)			Murray-Darling SSD (2006)		
	Occupied Dwelling	Unoccupied dwelling	Total Dwelling	Occupied Dwelling	Unoccupied dwelling	Total Dwelling
Separate house	8,376	1,690	10,066	3,197	502	3,699
Semi-detached, row or terrace house, townhouse	262	55	317	54	3	57
Flat, unit or apartment	349	91	440	149	46	195
Other dwelling	308	21	329	213	22	235
Dwelling structure not stated	7	0	7	0	4	4
Total	**9,302**	**1,857**	**11,159**	**3,613**	**577**	**4,190**

Source: ABS (2006a).

Short Stay Accommodation

There are 56 short-term accommodation establishments in the region (Table 4.6), including hotels, motels, serviced apartments, caravan parks and visitor hostels.

Data on establishments with 15 or more rooms shows that there are 14 establishments providing 362 rooms and 1,023 beds in Murray-Darling SSD (Table 4.6). In the Far West SSD, there are 14 establishments (Table 4.6). Room and bed occupancy rates in the March quarter 2012 in the Murray-Darling SSD were relatively low at approximately 40% and 22%, respectively (Table 4.6).

Table 4.6
Short Stay Accommodation in the Region

Short Stay Tourism Accommodation	Far West SSD	Murray-Darling SSD
Caravan Parks	4	5
Holiday Flats and Units	0	0
Visitor Hostels	1	0
Establishments 5 to 14 rooms	11	7
Establishments 15 or more rooms	14	14
Rooms	-	362
Beds	-	1,023
Guest Nights	-	20,097
Room Occupancy Rates (%)	-	40.1
Bed Occupancy Rate (%)	-	22.0
Accommodation Gross Takings ($)	-	945,980

Source: ABS (2011); ABS (2012).

Community Infrastructure

Education

The NSW Department of Education and Training is the main provider of primary and secondary education to residents of the Far West SSD and Murray-Darling SSD, accounting for 92% and 82% of primary school enrolments and 98% and 82% of secondary school enrolments in 2006, respectively (Table 4.7).

Table 4.7
Education in the Region

	Far West SSD			Murray-Darling SSD		
	1996	**2001**	**2006**	**1996**	**2001**	**2006**
Preschool	377	396	381	184	165	156
Infants/Primary	2,486	2,043	1,795	1,077	970	826
Public	*91%*	*90%*	*92%*	*82%*	*79%*	*82%*
Private	*9%*	*10%*	*8%*	*18%*	*21%*	*18%*
Secondary	1,424	1,498	1,270	739	662	638
Public	*97%*	*94%*	*98%*	*89%*	*87%*	*82%*
Private	*3%*	*6%*	*2%*	*11%*	*13%*	*18%*
TAFE	588	858	508	128	199	163
University	264	285	250	62	75	84
Other	80	154	100	17	46	26
Not Stated	1,639	1,563	2,195	524	563	845
Total	**6,858**	**6,797**	**6,499**	**2,731**	**2,680**	**2,738**

Source: ABS (2006a).

In both SSDs there has been declining demand for total enrolments at infant/primary schools and secondary schools (Table 4.7), with the proportion attending public schools remaining relatively static apart from in the Murray-Darling SSD where the proportion attending public secondary schools has declined. There is therefore likely to be some spare infrastructure capacity in both private and public schools servicing the Far West SSD and Murray-Darling SSD population.

In the Far West SSD there has been a declining demand for TAFE and University enrolments while in the Murray-Darling SSD there has been an increase in demand for these places (Table 4.7).

Health, Arts and Recreation

The region is serviced by Broken Hill Base Hospital, Ivanhoe District Hospital, Balranald District Hospital, Menindee Public Hospital and Wentworth District Hospital.

According to the 2006 population Census there were 1,108 people employed in the health care and social assistance industries in the Far West SSD and 207 employed in these industries in the Murray-Darling SSD (Table 4.8). The proportion of employment in the health care and social assistance sectors in the Far West SSD was greater than for NSW while the proportion of employment in the health care and social assistance sectors in the Murray-Darling SSD was less than for NSW (Table 4.8).

Table 4.8
Employment in Health, Arts and Recreation Services

	Far West SSD		Murray-Darling SSD		NSW	
Health Care and Social Assistance						
Health Care and Social Assistance	39	0.5%	6	0.2%	9,400	0.3%
Hospitals	387	5.2%	87	2.4%	94,187	3.4%
Medical and Other Health Care Services	248	3.4%	26	0.7%	85,108	3.1%
Residential Care Services	229	3.1%	21	0.6%	44,648	1.6%
Social Assistance Services	205	2.8%	67	1.9%	59,618	2.2%
Total	***1,108***	***15.0%***	***207***	***5.8%***	***292,961***	***10.7%***
Arts and recreation services	-					
Arts and Recreation Services	0	0.0%	0	0.0%	1,740	0.1%
Heritage Activities	39	0.5%	19	0.5%	4,424	0.2%
Creative and Performing Arts Activities	12	0.2%	0	0.0%	8,122	0.3%
Sports and Recreation Activities	17	0.2%	19	0.5%	18,873	0.7%
Gambling Activities	8	0.1%	4	0.1%	4,799	0.2%
Total	***76***	***1.0%***	***42***	***1.2%***	***37,958***	***1.4%***
TOTAL	**1,184**	**16.0%**	**249**	**7.0%**	**330,919**	**12.0%**
TOTAL EMPLOYMENT	**7,384**		**3,564**		**2,748,394**	

Source: ABS (2006b).

Note: Totals may have minor discrepancies due to rounding.

The proportion of employment in the arts and recreation services for the Far West and Murray-Darling SSDs was lower than for NSW, across all subsectors apart from heritage activities (Table 4.8).

4.3 Project Workforce and Population Change

4.3.1 Introduction

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

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

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

Whether local labour is sourced from the unemployment pool or from other industries, it can reduce unemployment levels - directly in the case of employing unemployed people and indirectly via the filter effect[18], where labour is sourced from other industries.

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

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

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

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

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

4.3.2 Construction

Direct Workforce and Population Change

It is estimated by Cristal Mining that the average annual construction workforce for Year 1 of the Project would be approximately 150 (peak of approximately 300 for 2 to 3 months). A construction/development phase would also occur in Year 5 of the Project with an average annual workforce of approximately 100 (Section 4.3.4).

Construction generally requires a labour force with highly specialised skills including specialised welders, fitters, electrical contractors, machinery mechanics and construction engineers (Centre for International Economics, 2001). These types of professions are located in the construction sector, wholesale trade sector (mechanics) and the professional/technical service sector. The region has a lower proportion of workers in these sectors than NSW. Consequently, it is likely that many of the construction workers (assumed to be 80%) would temporarily migrate into the broader region (Far West SSD, Murray-Darling SSD and Victoria [Mildura]) for the period that they are required. It is anticipated that the majority of these non-local workers would be single or not bring their families into the region. This reflects the fact that the construction workforce in the mining industry and large infrastructure projects is generally very mobile and tends not to have accompanying spouses and children.

Assuming that the construction workforce is spread between the main population centres as in Table 4.9, the maximum direct average annual employment and population change to the region from the construction phase of the Project would be approximately 60 (peak of approximately 120 for 2 to 3 months).

Table 4.9
Direct and Indirect Construction Workforce and Population by Location

Residential Location of Construction Workforce		Total Construction Workforce	Direct Construction Workforce[1]	Direct Population[1]	Indirect Construction Workforce[2]	Indirect Population[2]
Inside Region						
Broken Hill	25%	38	30	30	6	14
Ivanhoe	5%	8	6	6	1	3
Balranald	20%	30	24	24	4	12
Sub-total	**50%**	**75**	**60**	**60**	**11**	**29**
Outside Region						
Mildura	50%	75	60	60	11	29
Sub-total	**50%**	**75**	**60**	**60**	**11**	**29**
Total	**100%**	**150**	**120**	**120**	**22**	**58**

[1] Assumes 80% of workforce in-migrates to the region.

[2] Assumes 20% of workforce in-migrates to the region.

Note: Totals may have minor discrepancies due to rounding.

Indirect Workforce and Population Change

From Section 3.3.1 (Table 3.2), it is evident that for every direct job generated in the region by the Project there would be 0.74 indirect jobs generated in the region as a result of production induced and consumption induced flow-ons.

Any flow-on employment that is generated by Project construction is more likely to exhibit normal family structures[19]. The temporary nature of the flow-on effects during construction and the lower skill level required for many of these flow-on jobs, also means that it is unlikely that jobs would be filled by migration but rather by the local population. Consequently for the purpose of this analysis it is assumed that the residential location of the indirect workforce is as assumed for the direct construction workforce above (i.e. 50% located in the region) but that only 20% migrate into the region from elsewhere. On the basis of these assumptions the indirect population change is estimated at approximately 29 (peak of approximately 58 for 2 to 3 months).

4.3.3 Operation

Direct Workforce and Population Change

The Project operation would last for approximately 19 years and require a workforce of some 200 people.

The operational labour force for the Project includes a mix of professionals, managers, administration, trades, plant/equipment operators, labourers and road transport operators. Based on historical employment data from Cristal Mining's existing Ginkgo and Snapper Mines, it is estimated that the geographical location of this workforce would be as indicated in Table 4.10. It is further assumed that 20% of the workforce would migrate into the region, with 80% already residing in this region. On the basis of these assumptions the Project operation employment and population change to the region would be as per Table 4.10.

Table 4.10
Direct and Indirect Operation Workforce and Population by Location

Residential Location of Operation Workforce		Total Operation Workforce	Direct Operation Workforce[1]	Direct Population[1]	Indirect Operation Workforce[1,2]	Indirect Population[1,2]
Inside Region						
Broken Hill	20%	40	8	21	7	19
Ivanhoe	10%	20	4	10	4	9
Balranald	30%	60	12	31	11	28
Sub-total	***60%***	***120***	***24***	***62***	***22***	***57***
Outside Region						
Mildura	40%	80	16	42	15	38
Sub-total	***40%***	***80***	***16***	***42***	***15***	***38***
Total	**100%**	**200**	**40**	**104**	**36**	**94**

[1] Assumes 20% of workforce in-migrates to the region.

[2] The flow-on workforce is based on multipliers in Table 3.2 adjusting all contractor workforce from the production induced column to direct workforce.

Note: Totals may have minor discrepancies due to rounding.

Unlike temporary construction workers, a normal family size has been assumed for the migrating workers (i.e. 2.6 is the average for NSW [ABS, 2006a]). On this basis the population of the region associated with the Project direct workforce would increase by approximately 62 people.

[19] Average household size in NSW is 2.6.

Indirect Workforce and Population Change

For every direct job (employee) generated where the person resides in the region there would be 3.77 flow-on jobs to the region (Table 3.5). Adjusting the direct workforce to include contractors (that are otherwise included in production induced flow-ons in Table 3.4) for every direct job (employees and contractors) generated by the Project there would be an estimated 0.91 flow-on jobs in the region. Assuming the same residential location as for the direct operation workforce above (i.e. 60% located in the region) and that 20% of these people migrate into the region from elsewhere, the indirect population change associated with flow-ons is approximately 57 (Table 4.10).

4.3.4 Cumulative Workforce and Population Change

Iluka Resources has recently submitted the *Balranald Mineral Sands Project - Project Scoping Report* (the BMSP Project Scoping Report) (EMGA Mitchell McLennan, 2012) to the DP&I for the Balranald Mineral Sands Project (BMSP), which would include construction, mining and rehabilitation of two linear mineral sand deposits known as West Balranald and Nepean, located approximately 10 km and 45 km respectively north-west of the town of Balranald.

The construction workforce is expected to be between 150 and 250 contractor personnel with construction to commence in 2014. The operational workforce would be approximately 100 to 120 personnel for approximately 10 years, with haulage and other services generating additional employees (EMGA Mitchell McLennan, 2012). The BMSP Scoping Report (EMGA Mitchell McLennan, 2012) provides only general details regarding the likely population implications of the BMSP and so for the purpose of the cumulative impact assessment the same assumptions used for the estimate of employment and population impacts of the Project have been assumed.

Assuming the construction workforce levels for the BMSP are 150 personnel then the population impacts would be as reported in Table 4.9 for the Project. With an operational workforce of 120, the population impacts of the BMSP would be as identified in Table 4.11.

Table 4.11
Balranald Mineral Sands Project Direct and Indirect Operation Workforce and Population by Location

Residential Location of Operation Workforce		Total Operation Workforce	Direct Operation Workforce[1]	Direct Population[1]	Indirect Operation Workforce[1,2]	Indirect Population[1,2]
Inside Region						
Broken Hill	20%	24	5	12	4	11
Ivanhoe	10%	12	2	6	2	6
Balranald	30%	36	7	19	7	17
Sub-total	***60%***	***72***	***14***	***37***	***13***	***34***
Outside Region						
Mildura	40%	48	10	25	9	23
Sub-total	***40%***	***48***	***10***	***25***	***9***	***23***
Total	**100%**	**120**	**24**	**62**	**22**	**57**

[1] Assumes 20% of workforce in-migrates to the region.

[2] The flow-on workforce is based on multipliers in Table 3.2 adjusting all contractor workforce from the production induced column to direct workforce.

Table 4.12 summarises the cumulative employment and population impacts for the Project and the BMSP for two periods, namely, Year 1 where construction phases of the two projects may overlap, and Year 5 where operation phases overlap and there is an additional construction phase for the Project.

Table 4.12
Cumulative Population Impacts of the Project and the BMSP

Scenario	Construction Workforce	Operation Workforce	Direct Population Change	Indirect Population Change	Total Population Change
Year 1					
Project	150 (300)	0	60 (120)	29 (58)	89 (178)
BMSP	150 (250)	0	60 (100)	29 (48)	89 (148)
Total	**300 (550)**	**0**	**120 (220)**	**58 (106)**	**178 (326)**
Year 5					
Project (Construction)	100		40	19	59
Project (Operation)		200	62	57	119
BMSP	0	120	37	34	71
Total	**100**	**320**	**139**	**110**	**249**

Note: Only includes assumed non-local workforce that is assumed to relocate into the region.

The cumulative direct and indirect population impacts identified in Table 4.11 should be considered an upper level estimate as they are underpinned by the inherent assumptions of multipliers (refer to Attachment 4).

4.4 COMMUNITY INFRASTRUCTURE IMPACT ASSESSMENT

4.4.1 Context of Population Change

To understand the likely impact of the Project on community infrastructure and services it is necessary to consider the predicted maximum population change within the context of the recent intercensal population change of the region.

From Table 4.12 it is evident that the additional direct and indirect population during construction and operation of the Project would help to partially offset historic population decline in the region. The peak population change associated with construction activities would offset 5% of the 1996 to 2006 population decline in the region. The population change associated with Project operation would offset 4% of the 1996 to 2006 population decline in the region (Table 4.13).

Table 4.13
Project and Cumulative Population Changes in Context of Annual Population Growth

Location	Regional Intercensal Population Decline 1996- 2006	Total Population (Direct and Indirect) Change			
		Construction Year 1	% of Intercensal Decline 1996-2006	Operation Year 5[1]	% of Intercensal Decline 2001-2006
Project	-3,248	89 (178)	3% (5%)	119	4%
Cumulative	-3,248	178 (326)	5% (10%)	249	8%

[1] This includes population change as a result of operations only, as population changes as a result of construction is temporary in nature.

Notes: Totals may have minor discrepancies due to rounding.
Numbers in brackets for the construction phase represent short-term peak (i.e. 2-3 months).

The total population change associated with cumulative projects is estimated at up to 326 during Year 1 of the Project and 249 in Year 5, representing 10% and 8%, respectively, of the 1996 to 2006 population decline in the region (Table 4.13).

4.4.2 Impacts of Construction – Year 1

Direct construction employment temporarily migrating into the region is likely to have lower demands on community infrastructure to operational employment. This is largely because they tend to be single or do not bring families to the region.

The key direct impact associated with direct construction employment temporarily migrating into the region is increased demand for accommodation. Cristal Mining would provide a construction camp to accommodate workers during their shifts. However, in between shifts it is anticipated that the construction workforce would utilise a mix of accommodation including rental houses, apartments, motels, pub hotels and cabins in caravan parks that are located within a reasonable proximity to the Project. Consequently, they are unlikely to have any significant or long-term effect on the owner/occupied residential land market through purchase of properties. The estimated demand for approximately 60 short-term accommodation units/beds in the region (120 in peak periods) (Table 4.9) is considered to be able to be adequately met by available short-term accommodation.

Other than food outlets (hotel, licensed club, etc.) the availability of facilities and services is generally not a major consideration for itinerant workers and hence the implications for other community infrastructure is likely to be minimal apart from perhaps health care services.

The influx of single males during the construction phase, who may only partially integrate into the community, can potentially be associated with increased crime levels (Carrington *et al*., 2010). However, random drug and alcohol testing for on-site workers can minimise this effect. There is also potential for the Project to indirectly result in a decrease in crime rates through providing increased employment opportunities to those who are currently unemployed. Given that unemployment is a contributing factor in criminal activity, a decrease in the unemployment rate has the potential to reduce crime rates (Chapman *et al*., 2002).

The potential cumulative direct construction workforce associated with the Project and the BMSP would result in the demand for up to 120 short-term accommodation units/beds (220 in peak periods). While this increased demand has the potential to utilise short-term accommodation that would otherwise be available for tourism, room and bed occupancy rates in the region (Table 4.6) would suggest sufficient capacity to accommodate both sources of demand and the provision of construction camps would significantly reduce the cumulative demand for short-term accommodation. There is also likely to be considerable opportunity for short-term rentals, given the size of the potential pool of unoccupied properties in the region (Table 4.5).

4.4.3 Impacts of Operation – Year 5

Housing Impacts

During operation of the Project, additional direct and indirect demand is likely to be generated for up to 46 residences in region (Table 4.14). While initially, short-term accommodation may house these new families, the demand would be for longer-term rental accommodation or housing purchases.

The increased Project-only demand for housing is largely insignificant in the context of the total housing stock, rental stock and unoccupied dwellings (potential rental stock) as well as the average annual additions to the residential housing stock (i.e. building approvals) (Table 4.14).

Table 4.14
Demand for Long-Term Accommodation

Project Direct and Indirect Demand for Accommodation	Cumulative Direct and Indirect Demand for Accommodation	Average Annual Building Approvals - Total Dwellings (2006-2010)[1]	Total Housing Stock (2006)[2]	Unoccupied Residential Properties (2006)[2]
46	73	56	15,349	2,434

[1] ABS Regional Statistics (ABS, 2011).

[2] ABS Basic Community Profile (ABS, 2006a).

The Project and the BMSP would result in the direct and indirect demand for up to 73 long-term accommodation units (e.g. houses, units, etc.) in Year 5 (when the greatest cumulative operation impact would occur) (Table 4.14). This combined demand is also considered to be insignificant in the context of the housing market in the region.

Nevertheless, because of higher relative wages in the mining sector, the demand for rental accommodation and to purchase is likely to be at the higher end of the market, where supply is likely to be more limited. If population centres within the region are to capture the increased workforce associated with the Project and the BMSP they would need a supply of sufficient quality accommodation.

Where housing supply is insufficient to meet demand, even temporarily, this may manifest itself in increased property prices and higher rent prices in the region or people choosing to locate outside the region in major centres such as Mildura. While increased property prices and higher rent prices may be seen as beneficial for property owners, it can adversely affect existing tenants, particularly those on lower incomes who can be priced out of the market.

Education and Training

Workers

The Project workforce employed from within the region and outside the region would have varying skills and experience on which to draw in undertaking their job. Many are likely to have experience in the mining sector, while some may not. Nevertheless, most required training is likely to be undertaken in-house and on the job. The workforce is therefore not expected to place any significant demands on tertiary education institutions in the region.

Workers Children

During operation of the Project, incoming workers (both direct and indirect) are expected to exhibit average family structures and hence would be associated with some children creating some increased demand for education facilities within the region. Assuming that the incoming population exhibits the same characteristics as the NSW population, Table 4.15 summarises the likely demand for pre-school, infants/primary and high school places.

Table 4.15
Demand for Schooling in the Region

School Type	Project			Cumulative			Decline in Enrolments 1996 to 2006
	Direct	Indirect	Total	Direct	Indirect	Total	
Pre-school	6	5	11	9	8	17	-24
Infants/Primary	7	6	13	11	10	21	-942
Secondary school	6	5	11	9	9	18	-255
Total	**19**	**16**	**35**	**29**	**27**	**56**	**-1,221**

These demands can be compared to the enrolments at the last Census and decline in enrolments between 2001 and 2006 across the region (Table 4.7). In this context, the direct and indirect increase in demand for educational facilities as a result of the Project operation is considerably less than the decline in demand between 2001 and 2006. Cumulative increases in demand for education is also considerably less than the decline in demand between 2001 and 2006.

Increases in demand for education can potentially have positive benefits for a region such as more teachers, reduced class sizes and a broader curriculum (Gillespie Economics, 2009c).

Health

There is potential for the Project to increase the demand for public health facilities in the region such as for hospitals, General Practitioner medical services, Dental, Physiotherapy, Chiropractors, Optometrists, etc., via the anticipated increase in population during both construction and operation phase of the Project.

While the anticipated population increase during construction and operation of the Project is very small compared to the total population of the region, any increase is likely to place some additional demand on existing medical services. Cumulative changes in population levels (Table 4.11) would further increase demand for health services and facilities.

Provision of health services is primarily the responsibility of the public sector, although some aspects of these services are also provided by the non-government sector. The driving force for the provision of both private and public health services is demand which is primarily a response to population changes. While it is recognised that there may be a lag between population change and the provision of matching health services resulting in temporary health care access issues, ultimately increased populations result in the provision of more health facilities for the community (Gillespie Economics, 2009c).

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

Community Services and Recreation Facilities

Increase in population as a result of the Project would increase demand for community and recreation facilities. However, as indicated in Table 4.10 the maximum direct and indirect increase in population from the Project is very small, and would contribute to arresting a general population decline. In this context, rather than imposing additional demand on community services and facilities that may require additional investment by governments, the population increase would simply replace some of the declining demand arising from the population decline. No additional investment in community services and recreation facilities infrastructure would therefore be anticipated and the population increases may help avoid threshold levels for provision of services falling below critical levels. Cumulative impacts would further offset already declining demand.

General Community Impacts

The demand for mining labour can result in skilled labour being bid away from other professions (e.g. domestic trade services), which can result in shortages of these services in the region. However, far from being a local phenomena, Australia is experiencing a National skills shortage, with builders, engineers and tradespeople in high demand. The causes of skill shortages are complex but include skilled baby boomers reaching retirement age, negative perceptions of careers in the traditional trades, difficulties in attracting people, particularly young people, to work in some industries, large infrastructure spending by governments and the mining boom.

However, the solution does not lie in constraining economic growth that utilises trade, building and engineering skills, but rather in adjustments to traditional training and education approaches. In this respect the Federal Government's National Skills Shortages Strategy identified the need for greater flexibility in traditional trade training, including shorter apprenticeships and specialist apprenticeship pathways.

The level of employment provided by the Project, and other projects, is a small proportion of regional workforce and is likely to have minimal impacts on skills shortages in the region.

Cumulative influxes in populations associated with prospective projects can also potentially contribute to a changing sense of place for existing residents, as towns move away from their historical focus on servicing agricultural to an increased focus on servicing mining activities[20]. The high wages in the mining sector relative to other sectors can also potentially result in social divisions between those involved in the mining sector and those who are not. Both these effects can be heightened during construction phases of projects when there are high numbers of unattached construction workforces, who may only partially integrate into the community.

4.5 SOCIAL AMENITY

The proposed Atlas-Campaspe Mine is located a significant distance from potential sensitive receivers, with the closest receivers to the Project mine site located approximately 7 km away. However, there is some potential for the proposed development to negatively impact on local and regional amenity through increases in road traffic, noise, reduction in air quality and the visual prominence of the Atlas-Campaspe Mine and Ivanhoe Rail Facility.

The potential impacts of the Project on local traffic conditions and road safety have been considered by GTA (2012) (Appendix D of the EIS) and it was concluded that no significant impacts on the performance, capacity, efficiency and safety of the road network are expected to arise as a result of the Project.

[20] This phenomenon is not so relevant to Broken Hill which has a long history of mining.

The Noise and Blasting Impact Assessment (Wilkinson Murray, 2012) (Appendix J of the EIS) concluded that the proposed Project would comply with the project-specific noise, road traffic noise and sleep disturbance criteria at all modelled private residences during construction and operation. A marginal increase in rail noise levels would occur as a result of the Project rail movements between the Ivanhoe Rail Facility and the MSP.

The Air Quality and Greenhouse Gas Assessment for the Project (Appendix K of the EIS) predicted no exceedance of any air quality assessment criteria due to the Project in isolation at any sensitive receiver.

Section 4.14 of the Main Report of the EIS identified that potential visual impacts of the Atlas-Campaspe Mine development are limited. No views of the Ivanhoe Rail Facility are expected from residences in the township of Ivanhoe. Some residences surrounding the Project may experience an increased glow in the night sky, particularly during overcast weather conditions.

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

4.6 MITIGATION AND MANAGEMENT STRATEGIES

From Section 4.4 it is evident that the community infrastructure impacts of the Project (and cumulatively with other Projects), are likely to be negligible, given the recent population decline in the region. Nevertheless, the Project (together with other proposed projects), may conservatively lead to some minor observable positive and negative impacts such as:

- increased demand for short-term accommodation with the potential to lead to competition with tourism for accommodation;
- increased demand for housing with the potential to result in some increases in house prices and rental prices, leading to some displacement of those on low incomes;
- increased demand for health services with the potential for lags in provision of additional health care services but ultimately the provision of more health facilities for the community;
- increased demand for schools places which can offset to some extent historic declines in enrolment and result in positive benefits for a region such as more teachers, reduced class sizes and a broader curriculum;
- increased demand for child care facilities but less than historic declines in enrolments;
- increased demand for recreation facilities and other community infrastructure offsetting to some extent historic decline in demand;
- some social division between those on higher mining wages and those not employed in the mining sector;
- changing sense of place as some towns move away from their historical focus on servicing agricultural to an increased focus on servicing mining activities;
- some labour skills shortages and difficulty retaining workers in non-mine sectors as the mine attracts local labour; and
- increased crime during construction phases associated with an influx of single males.

Cristal Mining would work in partnership with the relevant Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible. In this respect, a range of general and specific social impact mitigation and management measures are proposed and would include:

- Early provision of information to relevant Councils and relevant State Government agencies regarding employment and population level changes, to facilitate early community infrastructure provision responses, to address potential demands for accommodation and housing, health services, education and childcare and other recreation and community infrastructure.
- Continuation of the current donations policy which supports education, health and community causes, to address potential demands for these services.
- Employ local residents preferentially where they have the required skills and experience and demonstrate a cultural fit with the organisation, to address potential social division in the community and a changing sense of place.
- Purchase local non-labour inputs to production preferentially where local producers can be cost and quality competitive, to address potential social division in the community and a changing sense of place.
- Include a code of conduct for construction workers with regard to behaviour in the Contractor Induction Program, to address any potential increase in crime associated with the construction workforce.
- Development of a construction camp to accommodate construction workers during their shifts, which reduces demand for short-term accommodation.

Labour skills shortages are a national issue that is being addressed through a Federal Government National Skill Shortages Strategy. The Project is expected to directly and indirectly bring additional skilled workers into the region and retain skilled workers who otherwise may have left the region.

It is expected that as with other recent mining projects in NSW, a planning agreement in accordance with Division 6 or Part 4 of the EP&A Act would be required by the Development Consent for the Project. The planning agreement would be negotiated between Cristal Mining, the DP&I and relevant Councils.

5 CONCLUSIONS

A BCA of the Project indicated that it would have total net production benefits of $639M, with $251M of these net production benefits accruing to Australia. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $251M, the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify some of the residual environmental impacts of the Project. 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 impacts. These impacts are estimated at $12M in total or $0.1M 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 $94M. Overall, the Project is estimated to have net community benefits to Australia of between $251M and $345M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts of the Project as specified in the EIS have been quantified and included in the BCA, any other residual environmental, cultural or social impacts of this Project (e.g. impacts on Aboriginal heritage) or the larger Project, that remain unquantified, would need to be valued at greater than between $251M and $345M for the Project to be questionable from an Australian economic 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:

- Cristal Mining in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $362M or $203M present value at a 7% discount rate) from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Far West SSD and Murray-Darling SSD region;
- the NSW Government via royalties (estimated at $95M or $48M present value at a 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the Far West SSD and Murray-Darling SSD region; and
- the local community in the form of voluntary and/or mandatory contributions to community infrastructure and services.

The environmental, cultural and social impacts of the 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 Cristal Mining.

The non-market costs, quantified in the analysis, that accrue to NSW are estimated at $0.1M. These are considerably less than the net production benefits that directly accrue to NSW through royalties and potential non-market employment benefits. Consequently, as well as resulting in net benefits to Australia the Project is likely result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that the operation of the Project is estimated to make up to the following contribution to the regional economy:

- $279M in annual direct and indirect regional output or business turnover;
- $152M in annual direct and indirect regional value added;
- $20M in annual direct and indirect household income; and
- 229 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $388M in annual direct and indirect regional output or business turnover;
- $202M in annual direct and indirect regional value added;
- $54M in annual direct and indirect household income; and
- 643 direct and indirect jobs.

The operation of the Project has the potential to increase the population of the region by up to 119, with corresponding increased demand for housing, schools, health and community infrastructure. Cumulative impacts with other resource development projects would increase the population of the region by up to 249 (190 excluding construction workforce). This increase in population would partially offset some the population decline that the region has been experiencing and hence impacts on community infrastructure should be negligible. Nevertheless, the Project (together with the proposed BMSP), would lead to increased demand for a community infrastructure and services and may have some other social impacts.

Cristal Mining would work in partnership with the relevant Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible. In this respect, a range of general and specific social impact mitigation and management measures are proposed.

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

AGRICULTURAL ECONOMIC ANALYSIS

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1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility). Cristal Mining Australia Limited is the proponent of the Project.

This report assesses the potential economic implications of the impacts of the Project on agricultural (including land and water) resources.

2 AGRICULTURAL AND MINING INDUSTRIES IN NEW SOUTH WALES

2.1 LAND USE

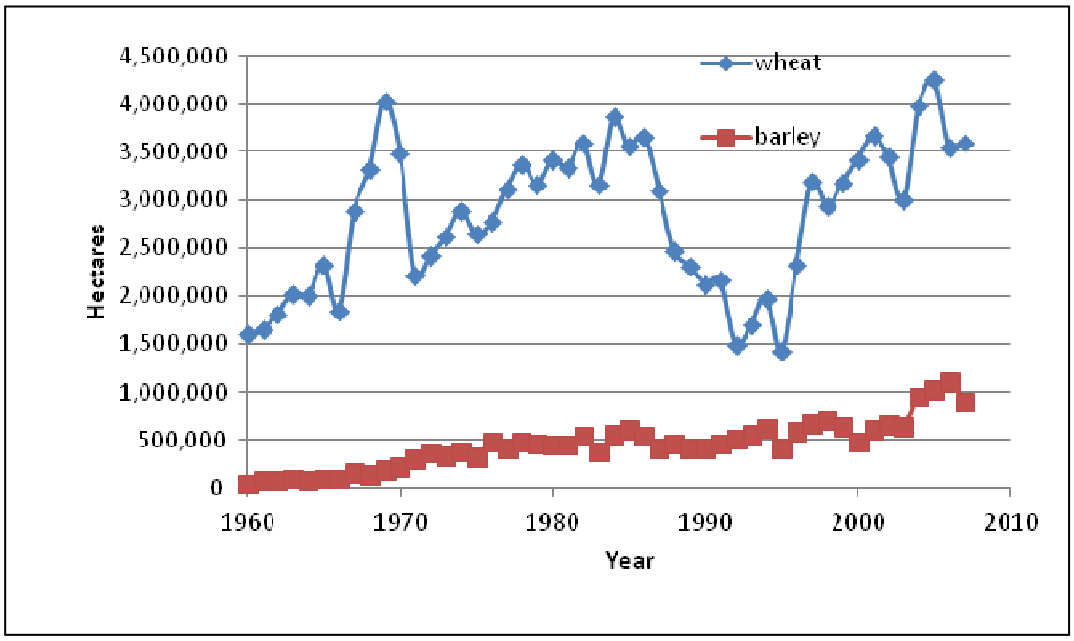
Agricultural lands are important to New South Wales (NSW) and cover approximately 81 percent (%) of NSW (i.e. 65 million [M] hectares [ha]) (Australian Natural Resources Atlas [ANRA], 2009a). While the total agricultural land area in NSW has declined marginally since 1960 (Table 2.1), the area of land under major food crop production (i.e. wheat and barley[1]) has actually increased (Figure 2.1).

Table 2.1
NSW Agricultural Land Area

Area of Agricultural Land (M ha)		
1960	**1980**	**1997**
69.95	65.01	60.90

Source: ANRA (2009b).

Figure 2.1
NSW Land Area Allocated to Wheat and Barley



Source: Australian Bureau of Statistics (2009).

[1] Wheat and barley are the two largest food crops produced in Australia.

Dryland and irrigated cropping land covers an area of approximately 84,878 square kilometres (km^2) in NSW. Mining (and waste disposal) covers an area of approximately 630 km^2, 0.74% of the area of cropping lands (Table 2.2).

Table 2.2
NSW Land Uses

Land Use	Area (km^2)	Percentage of NSW
Nature conservation	61,058	7.6%
Other protected areas	2,478	0.3%
Minimal use	59,178	7.4%
Grazing native vegetation	309,428	38.6%
Production forestry	25,242	3.2%
Plantation forestry	4,200	0.5%
Grazing modified pastures	222,164	27.7%
Dryland cropping	74,692	9.3%
Dryland horticulture	390	0.0%
Irrigated pastures	3,160	0.4%
Irrigated cropping	10,186	1.3%
Irrigated horticulture	1,073	0.1%
Land in transition	951	0.1%
Intensive animal and plant production	243	0.0%
Intensive uses (mainly urban)	10,218	1.3%
Rural residential	4,387	0.5%
Mining and waste	630	0.1%
Water	11,352	1.4%
Total	**801,030**	**100.0%**

Source: Bureau of Regional Science (2009).

The NSW agricultural industry directly provides employment for 76,261 people or 2.7% of total employment in NSW (ABS, 2006)[2]. Payment to agriculture, forestry and fishing employees in 2010-11 was $1,539M and value-added was $7,062M. Gross operating surplus and gross mixed income from agriculture, forestry and fishing was $6,908M (ABS, 2011a).

Mining land use is a small fraction of the area of NSW (i.e. less than 0.1% of the total NSW land area) (Bureau of Regional Science, 2009) and directly employs 19,026 or 0.7% of total employment in NSW (ABS, 2006). Payment to mining employees in 2010-11 was $2,466M and value-added was $10,633M. Gross operating surplus and gross mixed income from mining was $10,035M (ABS, 2011a).

In this comparison, mining is a more significant sector than agriculture in terms of payments to employees, value-added and gross operating surplus and gross mixed income. However, agriculture does employ more people, albeit while using a much larger area of NSW to achieve this employment.

Nevertheless, no policy implication should be drawn from the relative magnitudes of existing sectors. What is relevant in a policy context is whether moving from one land use to another is more economically efficient or not. That is, do the benefits to the community from changing land uses exceed the costs to the community. This is discussed in more detail in Section 4.

[2] This is based on the ABS sector of agriculture, forestry and fishing.

2.2 ECONOMIC GROWTH IN REGIONAL AREAS

Agricultural lands have historically supported the economies of regional areas. However, regional economies are facing a number of trends including:

- loss of significant industries such as abattoirs and timber mills from many rural areas;
- increased mechanisation of agriculture and aggregation of properties, resulting in loss of employment opportunities in this industry;
- preference of Australians for coastal living, particularly for retirement; and
- preference of many of today's fastest growing industries for locating in large cities (Collits, 2001).

The result is that there has been declining population growth in 47 out of 96 rural statistical local areas that are located in non-coastal statistical subdivisions (SSD) in NSW (excluding Hunter Statistical Division) (ABS, 2011b). There has also been a decline in the population of smaller towns even in regions that have been growing.

Trends in agriculture are leading to improved productivity, but reduced economic stimulus in regional areas, as demand for inputs such as labour decline. In general, the prosperity of rural areas that are reliant on agriculture has also been in decline.

It is increased or new spending in regions that contributes to economic stimulus and growth. One potential source of new spending is mining projects that utilise the resource endowments of a region. Studies (Gillespie Economics, 2003, 2007) have shown that mining projects provide significant new economic activity to regional and rural economies through direct expenditures on inputs to production as well as the expenditure of employees. This latter stimulus is enhanced by the high wages paid in the mining sector.

Mining projects can also broaden the economic base of regions, thereby insulating the economy from external shocks such as droughts and downturns in agricultural commodity prices (Collits, 2001).

3 AGRICULTURAL AND MINING INDUSTRIES IN THE REGION

3.1 AGRICULTURE

The region (i.e. the Far West and Murray-Darling SSDs) have a combined land area of approximately 19.5M ha, of which 90% is agricultural land (Table 3.1). Of this agricultural land, less than 1% is irrigated with annual irrigation volumes of over 110,889 million litres (ML) (Table 3.1). The total value of agricultural production in this region in 2006 is estimated at approximately $289M (Table 3.1).

Table 3.1
Existing Agricultural Land Use and Value of Production in the Region 2006

	Units	Far West SSD	Murray-Darling SSD	Total Region
Area				
Land Area	ha '000	14,696	4,797	19,493
Area of Agricultural Land	ha '000	13,332	4,310	17,642
Irrigation				
Area Irrigated	ha '000	4	19	23
Irrigation Volume Applied	ML	np	110,889	110,889
Other Agricultural Uses	ML	np	3,138	3,138
Total Water Use	**ML**	**31,662**	**114,027**	**145,689**
Area Irrigated as Proportion of Agricultural Land	%	0.0	0.4	0.1
Value				
Gross Value of Crops	$M	16.3	181.3	198
Gross Value of Livestock Slaughterings	$M	22.5	21.8	44
Gross Value of Livestock Products	$M	31.1	16	47
Total Gross Value of Agricultural Production	**$M**	**69.8**	**219.1**	**288.9**
Employment in Agriculture	**No.**	**481**	**993**	**1,474**

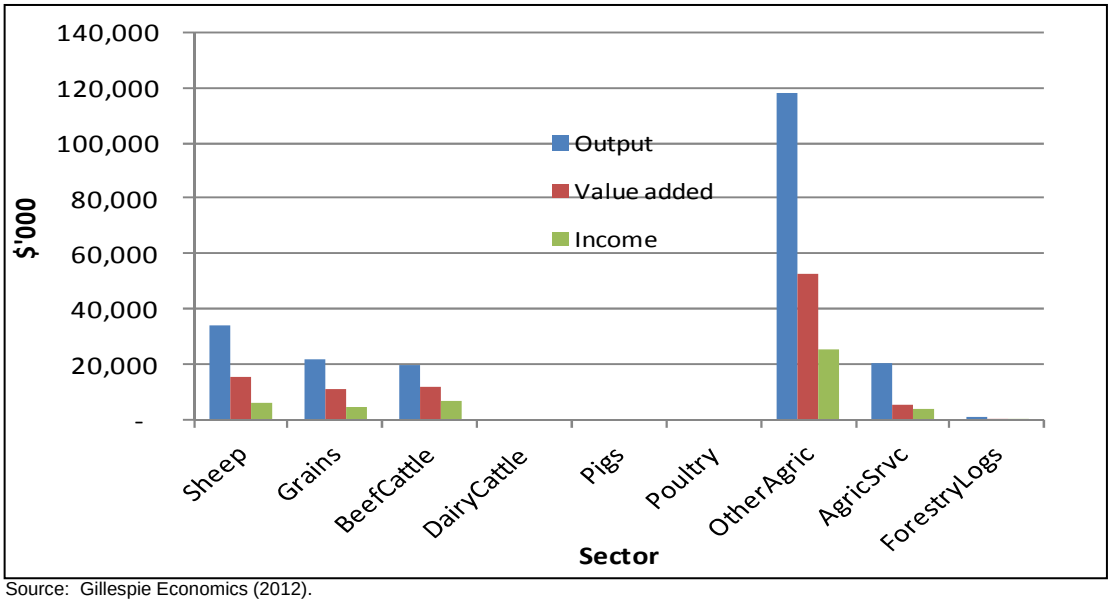
Source: ABS (2011c).

Note: Totals may have minor discrepancies due to rounding.

The input-output table developed for the region (Gillespie Economics, 2012) provides an indication of the direct relative significance of the different agricultural sectors, affirming the other agriculture sectors (which include grape and fruit growing) as the main agricultural sectors (Figure 3.1).

Total employment in the agricultural industry in the region in 2006 was 1,471 (ABS, 2006) (Table 3.2). Table 3.2 provides a more detailed employment by industry breakdown which indicates that the main agricultural employment is in grape growing, sheep farming and citrus fruit growing.

Figure 3.1
Agricultural Sectors in the Region



Source: Gillespie Economics (2012).

Table 3.2
Employment by Agricultural Sectors in the Region

Sector	No.
0100 Agriculture, nfd	23
0112 Nursery Production (Outdoors)	28
0120 Mushroom and Vegetable Growing, nfd	4
0123 Vegetable Growing (Outdoors)	24
0130 Fruit and Tree Nut Growing, nfd	29
0131 Grape Growing	388
0134 Apple and Pear Growing	3
0135 Stone Fruit Growing	3
0136 Citrus Fruit Growing	180
0137 Olive Growing	3
0139 Other Fruit and Tree Nut Growing	16
0140 Sheep, Beef Cattle and Grain Farming, nfd	4
0141 Sheep Farming (Specialised)	329
0142 Beef Cattle Farming (Specialised)	57
0144 Sheep-Beef Cattle Farming	158
0145 Grain-Sheep or Grain-Beef Cattle Farming	61
0149 Other Grain Growing	57
0152 Cotton Growing	8
0159 Other Crop Growing, nec	3
0193 Beekeeping	3
0199 Other Livestock Farming, nec	8
0301 Forestry	3
0302 Logging	3
0400 Fishing, Hunting and Trapping, nfd	3
0420 Hunting and Trapping	5

Table 3.2 (Continued)
Employment by Agricultural Sectors in the Region

Sector	No.
0522 Shearing Services	41
0529 Other Agriculture and Fishing Support Services	27
Total	**1,471**

Source: ABS (2012).

3.2 MINING

Mining the region directly employs 727 people, predominantly in the Silver-Lead-Zinc Ore mining sector, followed by Mineral Sand mining.

Table 3.3
Employment by Mining Sectors in the Region

Sector	No.
0600 Coal Mining	3
0800 Metal Ore Mining, nfd	11
0805 Mineral Sand Mining	72
0807 Silver-Lead-Zinc Ore Mining	505
0809 Other Metal Ore Mining	8
0911 Gravel and Sand Quarrying	3
0919 Other Construction Material Mining	3
0990 Other Non-Metallic Mineral Mining and Quarrying	11
1010 Exploration, nfd	3
1012 Mineral Exploration	30
1090 Other Mining Support Services	11
B000 Mining, nfd	67
Total	**727**

Source: ABS (2012).

4 ECONOMIC FRAMEWORKS FOR THE ASSESSMENT OF PROPOSALS THAT IMPACT AGRICULTURAL LAND AND WATER

4.1 ECONOMIC EFFICIENCY

From an economic perspective, it is desirable to use scarce resources, such as capital, labour, land and water, to maximise economic welfare or community fulfilment. This is referred to as economic efficiency and refers to a situation where production costs are as low as possible (technical or productive efficiency), and consumers want the combination of goods and services that is being produced (allocative efficiency).

Economic efficiency can be achieved for market goods, where there are no externalities, through competitive markets. In this situation, the price mechanism (interaction of supply and demand) functions to allocate resources in a manner that maximises the net benefits to society as a whole.

Agricultural land and water (where property rights have been established) are market goods. The market will allocate these resources to their most productive use for society. The exception is where a change in land use or water use may result in market failure through the occurence of externalities. In these circumstances, markets will not allocate resources to maximise economic welfare. Government intervention may therefore be required to determine how resources should be allocated.

In these situations, any Government intervention should be guided by a consideration of the costs and benefits of the intervention. The method that economists use to do this is benefit cost analysis (BCA). The essence of BCA is:

- the estimation of the extent to which a community is made better off by a resource reallocation;
- the estimation of the extent to which the community is made worse off by a resource reallocation; and
- a comparison of these two figures.

If the benefits of the intervention are greater than the costs of the intervention, then it provides net benefits to the community and results in an improvement in economically efficiency.

In a simple BCA framework, the potential costs and benefits of a mining project that impacts agricultural land and water are identified in Table 4.1.

Table 4.1
Potential Costs and Benefits of a Mining Proposal that Impacts Agricultural Land

	Costs	Benefits
Net Production Benefits	**Production**	
	Opportunity costs of land and capital	Value of mineral resource
	Capital and operating costs (including impact mitigation and rehabilitation)	Residual value of land and capital
Net Externalities	**Externalities**	
	Residual environmental impacts of mining after impact mitigitation	Any avoided environmental impacts of agriculture
		Any non use employment benefits of mining[1]

[1] Indications of the potential quantum of these benefits have been estimated using choice modelling in Gillespie Economics (2008, 2009a, 2009b).

Where the proposal uses agricultural land and water there is an opportunity cost to society of using these resources for mining instead of agriculture. The magnitude of this opportunity cost is reflected in the market value of land and water.

The market value of the land reflects, among other things, the discounted future net income that can be earned from the property, and income reflects how much the community values the outputs from the land. Where agriculture production becomes increasingly scarce, this will be reflected in the value of agricultural products and the value of agricultural land. However, the long-term trend for agricultural commodity prices has been a decline in real value rather than an increase in value, reflecting that with growth in productivity, supply has strengthened more rapidly than demand (Australian Bureau of Statistics and Resource Economics and Sciences [ABARES], 2011). Between 1961 and 2008, world population grew by 117% while food production grew by 179% (ABARES, 2011). While commodity price increases have risen over the last few years this is partly a response to government subsidies and mandates regarding the production of biofuels (ABARES, 2011). In the future, growth in global food consumption is expected to slow. Strong productivity growth and the utilisation of hitherto unused cropping should ensure the continuing adequacy of food supplies (ABARES, 2011). Consequently, substantial real increases in food prices are not anticipated.

Similiarly, the market value of agricultural water entitlements reflects, among other things, its value as an input to production (i.e. its marginal value product). Where water becomes increasingly scarce or the value of output that is produced from water becomes increasingly valuable, the value of water as an input to production increases.

The ultimate outcome of any BCA of a project is an empirical issue. But estimating the value of the opportunity cost of agricultural land and water is an integral component of the analysis.

4.2 REGIONAL ECONOMIC IMPACT ASSESSMENT

Regional economic impact assessment (using input-output analysis) may provide additional information as an adjunct to economic efficiency analysis. Input-output analysis can be used to estimate the change in economic activity in a region from land and water resources being used for mining instead of agriculture. These changes in economic activity are defined in terms of a number of specific indicators of economic activity, such as:

- 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; and
- Employment – the number of people employed (including full-time and part-time).

It is important not to confuse the results of regional economic impact assessment, which focuses on indicators of economic activity in a specific region, with the results of BCA which is concerned with the net benefits to Australia from a project.

5 PROJECT IMPACTS ON AGRICULTURAL RESOURCES

5.1 OPPORTUNITY COST OF AGRICULTURE AND WATER RESOURCES

Land Resources

The Project (including the biodiversity offset areas) would result in the temporary disturbance and the long-term loss of some agricultural lands. A summary of the agricultural lands at the Project (including the Atlas-Campapse Mine and Ivanhoe Rail Facility) and proposed biodividersity offest is provided below.

Atlas-Campaspe Mine

The agricultural land at the Atlas-Campaspe Mine is considered to be Rural Land Capability Class VI, Agricultural Suitability Class 4 and Land and Soil Capability Class 6 (i.e. suitable for grazing but not for cultivation) (Ogyris Ecological Research, 2012). It is estimated that approximately 4,418 ha of agricultural land would be progressively disturbed at the Atlas-Campaspe Mine. For the purpose of the analysis, it is conservatively assumed that the rehabiliated Atlas-Campaspe Mine would be used for conservation post-mining (i.e. not used for agriculture).

The agricultural land at the Atlas-Campaspe Mine is typically used for sheep production and the average revenue per hectare per year (ha/year) is estimated at $9.17 (Ogyris Ecological Research, 2012). The ratio of value added to output from the sheep sector in the input-output table for the region was used to estimate the gross margin for sheep production at $4.22 ha/year.

Conservatively assuming that agricultural production from the entire disturbance footprint ceases at the commencement of the Project (i.e. 2013) for perpetuity the gross value of production foregone is estimated at $41,000 per annum ($534,000 present value at 7% discount rate) and the net value of agricultural production foregone is $19,000 per annum ($246,000 present value at 7% discount rate).

Ivanhoe Rail Facility

The agricultural land at the Ivanhoe Rail Facility is considered to be Rural Land Capability Class VI, Agricultural Suitability Class 4 and Land and Soil Capability Class 6 (i.e. suitable for grazing but not for cultivation) (Ogyris Ecological Research, 2012). It is estimated that approximately 60 ha of agricultural land would be disturbed or incorporated into a vegetation management area at the Ivanhoe Rail Facility. For the purpose of the analysis, it is conservatively assumed that the rehabiliated Ivanhoe Rail Facility would be used for conservation post-mining (i.e. not used for agriculture).

The agricultural land at the Ivanhoe Rail Facility is currently used for harvesting feral goats. If the agricultural land was used for sheep production, the average revenue is estimated at $23.20 ha/year (Ogyris Ecological Research, 2012). The ratio of value added to output from the sheep sector in the input-output table for the region was used to estimate the gross margin for sheep production at $10.67 ha/year.

Conservatively assuming that agricultural production from the entire disturbance footprint ceases at the commencement of the Project (i.e. 2013) for perpetuity the gross value of production foregone is estimated at $1,400 per annum ($18,000 present value at 7% discount rate) and the net value of agricultural production foregone is $640 per annum ($8,000 present value at 7% discount rate).

Biodiversity Offset Areas

Biodiversity offsets areas proposed for the Project would result in agriculture being removed from an additional 16,540 ha outside of the mining lease. For this analysis, it is assumed that biodiversity offset is used for sheep production and has the same agriculture productivty as the Atlas-Campaspe Mine (i.e. average revenue of $9.17 per ha per year).

Assuming that agricultural production from the biodiversity offset areas ceases at the commencement of the Project (i.e. 2013) for perpetuity the gross value of production foregone is estimated at $152,000 per annum ($2M present value at 7% discount rate) and the net value of agricultural production foregone is $70,000 per annum ($0.9M present value at 7% discount rate).

Total Land Resources

In total, foregone gross and net value of agricultural production from agricultural land resources required for the Project is estimated at $2.6M and $1.2M present value (using a 7% discount rate), respectively.

Water Resources

The Project would have negligible impact on water resources that could otherwise be utilised for agricultural purposes. The groundwater extracted for the Project is saline and therefore there is no significant demand for water from this source in the region (GEO-ENG, 2013).

The Project would encroach onto a small portion of a catchment which has the potential to have a minor effect on runoff to an unnamed tank system (Evans & Peck, 2012).

5.2 REGIONAL IMPACTS

The regional impacts of the level of annual agricultural production forgone as a result of the Project (Section 5.1) were estimated from the sectors in the regional input-output table (Gillespie Economics, 2012) within which production is located i.e. the *sheep sector.* Table 5.1, Table 5.2 and Table 5.3 summarise the estimated direct and indirect regional impacts of the Project (with the conservative assumptions in Section 5.1) on annual agricultural production.

Table 5.1
Regional Economic Impacts of Agricultural Land Required for the Project Disturbance Footprint

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	41	10	7	17	57
Type 11A Ratio	1.00	0.25	0.17	0.42	1.42
VALUE ADDED ($'000)	19	4	4	8	26
Type 11A Ratio	1.00	0.22	0.19	0.41	1.41
INCOME ($'000)	8	2	2	5	12
Type 11A Ratio	1.00	0.33	0.27	0.61	1.61
EMPLOYMENT (No.)	0	0	0	0	1
Type 11A Ratio	1.00	0.10	0.07	0.17	1.17

Note: Totals may have minor discrepancies due to rounding.

Table 5.2
Regional Economic Impacts of Agricultural Land Required for the Biodiversity Offsets

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	152	37	26	63	215
Type 11A Ratio	1.00	0.25	0.17	0.42	1.42
VALUE ADDED ($'000)	70	15	14	29	98
Type 11A Ratio	1.00	0.22	0.20	0.41	1.41
INCOME ($'000)	28	9	8	17	45
Type 11A Ratio	1.00	0.33	0.27	0.61	1.61
EMPLOYMENT (No.)	2	0	0	0	2
Type 11A Ratio	1.00	0.09	0.08	0.17	1.17

Note: Totals may have minor discrepancies due to rounding.

Table 5.3
Regional Economic Impacts of Agricultural Land Required for the Ivanhoe Rail Facility

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1.4	0.3	0.2	0.6	2.0
Type 11A Ratio	1.00	0.25	0.17	0.42	1.42
VALUE ADDED ($'000)	0.6	0.1	0.1	0.3	0.9
Type 11A Ratio	1.00	0.22	0.19	0.41	1.41
INCOME ($'000)	0.3	0.1	0.1	0.2	0.4
Type 11A Ratio	1.00	0.33	0.27	0.61	1.61
EMPLOYMENT (No.)	0.0	0.0	0.0	0.0	0.0
Type 11A Ratio	1.00	0.10	0.07	0.17	1.17

Note: Totals may have minor discrepancies due to rounding.

Table 5.4 provides a summary of the annual regional production and economic impacts associated with the Project (with the conservative assumptions in Section 5.1) on annual agricultural production that would be forgone as a result of the Project (Section 5.1).

Table 5.4
Annual Regional Production/Economic Impacts of the Foregone Agriculture

	Agricultural Land			
	Atlas-Campaspe Mine	**Biodiversity Offsets**	**Ivanhoe Rail Facility**	**Total**
Area (ha)	4,418	16,540	60	21,018[1]
Production Type	Sheep	Sheep	Sheep	Sheep
Direct Output Value ($'000)	41	152	1.4	194
Direct Value Added ($'000)	19	70	0.6	89
Direct Income ($'000)	8	28	0.3	36
Direct Employment (No.)	0	2	0.0	2
Direct and Indirect Output Value ($'000)	57	215	2.0	274
Direct and Indirect Value Added ($'000)	26	98	0.9	126
Direct and Indirect Income ($'000)	12	45	0.4	58
Direct and Indirect Employment (No.)	1	2	0.0	2

[1] This is the area of agricultural land (mine disturbance area, biodiversity offsets and the Ivanhoe Rail Facility) that would be impacted in perpetuity by the Project.

Note: Totals may have minor discrepancies due to rounding.

Conservatively, the annual agricultural direct output from the agricultural resources that would potentially be impacted by the Project is estimated to be $0.2M (Table 5.4).

Table 5.5
Net Production Benefits of Agricultural Resources Potentially Affected by the Project

	Agricultural Production (sheep production)
Annual Net Production Benefits	$0.1 M
Net Production Benefits[1]	$1.2 M

Source: Gillespie Economics (2012).

[1] Discounting is at 7%.

The Project is estimated to provide considerable stimulus to the regional economy that is far in excess of the regional economic impacts associated with the maximum level of annual agricultural production that would be forgone as a result of the Project (refer to main Socio-Economic Assessment [Gillespie Economics, 2012]).

5.3 ECONOMIC EFFICIENCY OF REALLOCATION OF AGRICULTURAL RESOURCES TO THE PROJECT

The BCA completed for the Project included estimation of the present value of production costs and benefits of the Project. The present value of the net production benefit of the Project has been estimated and is detailed in the main Socio-Economic Assessment (Gillespie Economics, 2012).

This value can be compared to the present value of net production benefits from future use of agricultural lands that would be utilised by the Project which is estimated at $1.2 M (Table 5.5).

The Project is estimated to provide a considerable net production benefit that is far in excess of the net production benefit of continued use of land and water resources for agriculture.

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ATTACHMENT 2

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

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

- that in estimating the damage of climate change Stern (2006) has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's (2006) estimate of the social cost of carbon is based on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development; and
- Stern (2006) uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

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

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

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

Tol (2011) surveyed the literature on the economic impact of climate change. Tol (2011) identifies the mean estimated from published studies is a marginal cost of carbon of US$177/t C (US$48/t $CO_{2\text{-}e}$) and a modal estimate of US$49/t C (US$13/t $CO_{2\text{-}e}$) reflecting the fact that the mean estimate is driven by some very large estimates. For peer reviewed studies only, the mean estimate of the social cost of carbon is US$80/t C (US$22/t $CO_{2\text{-}e}$).

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 Euro (€) 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 31 December 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 3 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 Australian (AUD) $23 per tonne, rising at 2.5 percent 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, 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, with a central value of AUD$23/t CO_2-e.

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ATTACHMENT 3

BENEFIT COST ANALYSIS SENSITIVITY TESTING

Table A3.1
Sensitivity Testing of Net Social Benefits to Australia
(including Employment Benefits)

	4%	7%	10%
CORE ANALYSIS	$415	$345	$294
INCREASE 20%			
Capital costs	$407	$338	$289
Operating costs	$364	$304	$261
Value of mineral concentrate	$479	$395	$334
Residual value of capital equipment	$415	$345	$294
Greenhouse gas costs @$40 t CO_2-e	$415	$345	$294
DECREASE 20%			
Capital costs	$424	$351	$298
Operating costs	$466	$385	$327
Value of mineral concentrate	$351	$295	$253
Residual value of capital equipment	$415	$345	$294
Greenhouse gas costs @$8 t CO_2-e	$415	$345	$294

% = percent

t CO_2-e = tonnes per carbon dioxide equivalent

Table A3.2
Sensitivity Testing of Net Social Benefits to Australia
(excluding Employment Benefits)

	4%	7%	10%
CORE ANALYSIS	$318	$251	$202
INCREASE 20%			
Capital costs	$310	$244	$197
Operating costs	$267	$210	$169
Value of mineral concentrate	$382	$301	$242
Residual value of capital equipment	$318	$251	$202
Greenhouse gas costs @$40 t CO_2-e	$318	$250	$202
DECREASE 20%			
Capital costs	$327	$257	$207
Operating costs	$369	$291	$235
Value of mineral concentrate	$255	$200	$162
Residual value of capital equipment	$318	$251	$202
Greenhouse gas costs @$8 t CO_2-e	$318	$251	$202

ATTACHMENT 4

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

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

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (Australian Bureau of Statistics, 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 (Centre for Farm Planning and Land Management, 1989).

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

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

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

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

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ATTACHMENT 5

THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

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

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

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the non-ferrous metals and building and construction sectors. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). That means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A5.1" (Powell and Chalmers, 1995).

Table A5.1
The GRIT Method

Phase	Step	Action
I	ADJUSTMENTS TO NATIONAL TABLE	
	1	Selection of national input-output table (109 sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
II	ADJUSTMENTS FOR REGIONAL IMPORTS	
	(*Steps 4-14 apply to each region for which input-output tables are required*)	
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
III	DEFINITION OF REGIONAL SECTORS	
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
IV	DERIVATION OF PROTOTYPE TRANSACTIONS TABLES	
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
V	DERIVATION OF FINAL TRANSACTIONS TABLES	
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Table 2 in Bayne and West (1988)

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