Tasman Extension Project
Environmental Impact Statement

APPENDIX M

SOCIO-ECONOMIC ASSESSMENT

Resource Strategies

DONALDSON COAL
Part of Gloucester Coal

TASMAN EXTENSION PROJECT

SOCIO-ECONOMIC ASSESSMENT

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EXECUTIVE SUMMARY

The Tasman Underground Mine is located approximately 20 kilometres west of the Port of Newcastle in New South Wales (NSW). The Tasman Underground Mine is owned and operated by Donaldson Coal Pty Limited (Donaldson Coal). Donaldson Coal is a wholly owned subsidiary of Gloucester Coal Ltd (GCL).

The Tasman Extension Project (the Project) provides for the extension and continuation of operations at the existing Tasman Underground Mine. Approval of the Project would provide the ongoing employment of the existing Tasman Underground Mine workforce, with up to 404 direct and indirect jobs in the Newcastle region and 736 direct and indirect jobs in NSW.

The Project requires the preparation of an Environmental Impact Statement (EIS) in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979*. A socio-economic assessment is required as part of the EIS.

From a socio-economic perspective there are four 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 efficiency of individual aspects of the Project, such as transporting coal on public roads;
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional 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 net production benefits of $87 million (M), with $63M 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. This threshold value is the opportunity cost to Australia of not proceeding with the Project. 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, that impact Australia[1], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $63M. This is equivalent to each household in the Newcastle Statistical Subdivision and NSW valuing residual environmental impacts at $319 and $24, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify 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 emissions, Aboriginal heritage impacts and nominal accident costs from the road transport of run-of-mine coal to Bloomfield coal handling and preparation plant. These impacts are estimated at $16M in total or $6M 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 at in the order of $37M.

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

Overall, the Project is estimated to have net benefits to Australia of between $57M and $94M and hence is desirable and justified from an economic efficiency perspective.

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

- Donaldson Coal and its Australian and overseas shareholders in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable or Minerals Resource Rent Tax payable from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties which are subsequently used to fund provision of government infrastructure and services across the State, including the region; and
- the local community in the form of voluntary contributions to community infrastructure and services.

The externalities costs 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 Donaldson Coal.

Greenhouse gas emissions costs occur at the National and global level and may potentially be internalised in the future through payment of a carbon tax once the Commonwealth Government's proposed carbon tax scheme is implemented. The economic costs associated with the clearing of native vegetation would occur at the State or National level and would be counterbalanced by the offset actions proposed by Donaldson Coal. Aboriginal archaeological impacts would accrue at the regional or State level while Aboriginal cultural heritage impacts would accrue to local Aboriginal people. Other potential environmental externalities would largely occur at the State or Local level and were found to be minor or negligible. External benefits associated with employment provided by the Project would largely accrue at the Local or State level[2].

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 Newcastle economy in the peak years of production:

- $193M in annual direct and indirect output;
- $97M in annual direct and indirect value added;
- $37M in annual direct and indirect household income; and
- 404 direct and indirect jobs.

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

- $281M in annual direct and indirect output;
- $141M in annual direct and indirect value added;
- $65M in annual direct and indirect household income; and
- 736 direct and indirect jobs.

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

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 (including upgrades of existing surface and underground infrastructure), an additional 20 people would be required in the short-term (12 to 18 months). During operation of the Project the additional direct workforce from the Project is estimated at 40. However, no change in population is expected as a result of the construction or operation of the Project as contractor labour during construction is expected to come from existing contractor firms located within the region or daily commuters from Sydney. The operational workforce is expected to come from the employment and unemployment pool in the region aided by the cleanskin, apprenticeship and graduate programs run by GCL (Donaldson Coal). Consequently, no additional impact on community infrastructure is anticipated and no specific mitigation or management measures are required. Even if it were conservatively assumed that all new labour was sourced from people migrating into the region, the demand for community infrastructure would be insignificant in the context of historical and projected population growth in the region.

GCL (Donaldson Coal) would continue to develop and run programs that help in the recruitment of local labour and would work in partnership with Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible.

Cessation of the Project operation in 2030 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.

Given these uncertainties it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the regional economic activity and skills and expertise that the Project and other mining operations bring to the region, to strengthen and broaden the region’s economic base.

1 INTRODUCTION

The Tasman Underground Mine is located within Mining Lease (ML) 1555, approximately 20 kilometres (km) west of the Port of Newcastle in New South Wales (NSW). The Tasman Underground Mine is owned and operated by Donaldson Coal Pty Limited (Donaldson Coal). Donaldson Coal is a wholly owned subsidiary of Gloucester Coal Ltd (GCL).

The Tasman Extension Project (the Project) provides for the extension and continuation of operations at the existing Tasman Underground Mine.

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 an EIS for the Project 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 and 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 mechanism;
- 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; and
- a detailed economic justification of transporting coal on public roads, including assessment of the costs and benefits of alternative transport methods.

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

From a socio-economic perspective there are four 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 efficiency of individual aspects of the Project, such as transporting coal on public roads;
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional economy); and
- the distribution of impacts between stakeholder groups (i.e. the equity or social impact considerations).

Planning NSW's (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

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

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

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

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

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

- a BCA of the Project (Section 2);
- a BCA of transporting coal on public roads (Appendix 1);
- a regional economic impact assessment of the Project (Section 3); and
- an Employment, Population and Community Infrastructure Assessment (EPCIA) (Section 4).

A consultation programme for the EIS was undertaken by Donaldson Coal and is described in Section 3 in the Main Report of the EIS.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from a community perspective, it must be more economically efficient than the base case or "without" Project scenario. Technically, a project is more economically efficient than the "without" project scenario if the aggregate benefits to society exceed the aggregate costs (James and Gillespie, 2002). For mining projects, the main economic benefit is the producer surplus (net production benefits) generated by the Project and any non-market employment benefits it provides (refer to Portney, 1994), while the main potential economic costs relate to any environmental, social and cultural costs.

While some producer surplus benefits and environmental impacts may accrue internationally, these outcomes are normally excluded from BCA which is focused on surpluses that accrue to the consumers and producers who are the constituents of public policy decision-makers. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, this is considered the correct approach both conceptually and pragmatically given the interconnected nature of the Australian economy and society and the spillovers between states, including those associated with the tax system, provision of community infrastructure and services and the movement of resources over state boundaries.

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 different timing of costs and benefits;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs.

What follows is a BCA of the Project based on financial, technical and environmental advice provided by Donaldson Coal 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, the Tasman Underground Mine would continue to operate under its existing approval until approximately 2018. On cessation of the mine it is assumed that surface infrastructure would be decommissioned and the existing pit top rehabilitated. Donaldson Coal would realise some residual value from its capital equipment and land resources.

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

- continued underground mining of the Fassifern Seam using a combination of total and partial pillar extraction methods within ML 1555;
- underground mining of the West Borehole Seam using a combination of total and partial pillar extraction methods;
- production of run-of-mine (ROM) coal up to 1.5 million tonnes per annum (Mtpa);
- development of a new pit top facility, associated ROM coal handling infrastructure and intersection with George Booth Drive;
- development of ventilation surface infrastructure;
- continued transport of Fassifern Seam ROM coal from the existing Tasman Underground Mine pit top to the Bloomfield Coal Handling and Preparation Plant (CHPP) via truck on public and private roads to approximately 2015 (inclusive);
- transport of West Borehole Seam ROM coal from the new pit top to the Bloomfield CHPP via truck on public and private roads;
- progressive development of sumps, pumps, pipelines, water storages and other water management equipment and structures;
- ongoing exploration activities;
- ongoing surface monitoring, rehabilitation and remediation of subsidence effects; and
- other associated infrastructure, plant, equipment and activities.

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

A comparison of coal production between the "with" and "without" Project scenarios is provided in Table 2.1.

BCA is primarily concerned with the evaluation of a Project relative to the counterfactual (base case) of no Project. Where there are a number of alternatives to a project then these can also be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Project were considered by Donaldson Coal in the development of the Project description. Section 6 in the Main Report of the EIS provides more detail on the consideration of Project alternatives.

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

Table 2.1
Indicative Production Schedule

Year	Financial Year Ending	"Without" the Project		"With" the Tasman Extension Project			
		Fassifern Seam ROM Coal (kt)	Total Product Coal (kt)	Fassifern Seam ROM Coal (kt)	West Borehole Seam ROM Coal (kt)	Total ROM Coal (kt)	Total Product Coal (kt)[1]
-2	2012	725	537	725		725	537
-1	2013	748	587	275		275	215
1	2014	748	589	578		578	455
2	2015	582	423	185	766	951	691
3	2016	440	345		1,155	1,155	907
4	2017	440	335		1,428	1,428	1,086
5	2018	339	242		1,428	1,428	1,021
6	2019				1,428	1,428	1,038
7	2020				1,500	1,500	966
8	2021				1,500	1,500	926
9	2022				1,500	1,500	889
10	2023				1,500	1,500	903
11	2024				1,428	1,428	906
12	2025				1,428	1,428	923
13	2026				1,428	1,428	885
14	2027				1,017	1,017	620
15	2028				464	464	283
16	2029				462	462	282
17	2030				241	241	147
Total[2]		**4,022**	**3,058**	**763**	**18,673**	**19,436**	**12,928**

1 Note that the processing of ROM coal, handling and transportation of product coal and handling and disposal of coal rejects would be in accordance with the Abel Underground Mine Project Approval (05_0136) and any relevant modifications.

2 Totals are for years 1 to year 17.

Note:

kt = kilotonne

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 2.2.

It should be noted that the potential environmental, social and cultural impacts of underground mining and surface facilities, listed in Table 2.2, 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 economic costs arise.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with NSW Treasury (2007) guidelines, the analysis has been undertaken in real values with discounting at 7% and sensitivity testing at 4% and 10%. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social values have been estimated, where relevant, using market data and benefit transfer. Where impacts have been left unquantified the threshold value method is used to interpret them.

Table 2.2
Potential Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	• Opportunity cost of land • Opportunity cost of capital equipment • Capital costs of development including ancillary works and sustaining capital • Operating costs (ex royalties), including administration, mining, coal handling and transportation to Port • Decommissioning and rehabilitation costs of existing pit top in 2015 and new pit top at cessation of the Project in 2030	• Avoided decommissioning and rehabilitation of existing pit top in 2018 • Value of coal • Residual value of capital and land at the cessation of the Project
Non-Market Production Impacts	• Greenhouse gas emission costs	• Any non-market benefits of employment
Underground Mining Impacts	• Surface water impacts • Groundwater impacts • Flora and fauna impacts • Aboriginal heritage impacts • Non-Aboriginal heritage impacts • Subsidence damage to houses and infrastructure • Blasting vibration • Visual impacts	
Surface Facilities Impacts	• Surface water impacts • Flora and fauna impacts • Construction and operational noise impacts • Air quality impacts • Road transport impacts • Road transport noise • Aboriginal heritage impacts • Non-Aboriginal heritage impacts • Visual impacts	

2.4.1 Incremental Production Costs and Benefits[1]

Economic Costs

Opportunity Cost of Land and Capital Equipment

Donaldson Coal already owns land and capital equipment as part of its current mining operation. Under the "without" Project scenario, the value of this land and capital equipment could be realised by sale or alternative use in 2018. There is an opportunity cost of using this land and capital equipment for the Project instead of its next best use. An indication of the opportunity cost of the land and capital equipment can be gained from their market value. This is estimated at $1 million (M) for land and $2-3M for capital equipment. The market value of land reflects, among other things, the net present value of any potential use of the land.

1 All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Capital Cost of the Project

Capital costs of the Project include capital equipment; mine development; development of a new pit top facility and associated ROM coal handling infrastructure; access road and roundabout on George Booth Drive; progressive development of sumps, pumps, pipelines, water storages and other water management equipment and structures; ongoing exploration; other associated minor infrastructure, plant and equipment; land acquisitions/compensation for properties required for biodiversity offsets. These incremental capital costs over the life of the Project are estimated at $139M. 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 mining, environmental management and monitoring, transportation of ROM coal to Bloomfield CHPP, ROM coal processing, administration, rail transport to port and port charges. Average annual incremental operating costs of the Project (excluding royalties and the Minerals Resource Rent Tax [MRRT]) are estimated at $49M.

While royalties and the MRRT are a cost to Donaldson Coal they are part of the overall producer surplus benefit of the mining and processing activity that is redistributed by government. Royalties and the MRRT 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 $87M, or $41M in present value terms at 7% discount rate. It is not possible at this time to identify the magnitude of the MRRT liability.

Decommissioning and Rehabilitation Costs

With the Project, mining of the Fassifern coal seam ceases earlier than under the base case i.e. 2015. It is assumed that the surface infrastructure would be decommissioned and the existing pit top rehabilitated at a cost of approximately $0.5M. At cessation of the Project, surface infrastructure at the new pit top would also be decommissioned and the site rehabilitated at a cost of approximately $0.5M.

Economic Benefits

Value of Coal

The main economic benefit of the Project is the value of the product coal exported. This can be estimated from the increased thermal coal, coking coal and high ash coal volumes that would be produced, together with assumed export prices of coal and exchange rate. For the purpose of the analysis the export coal price is assumed to average United States Dollars (USD) $123 per tonne (/t) for metallurgical coal, USD$96/t for thermal coal and USD$75/t for high ash coal, although prices are assumed to be higher in the first couple of years of the analysis and lower thereafter. A USD/Australian Dollars (AUD) exchange rate of 1.0 is initially assumed declining to 0.8.

There is obviously considerable uncertainty around the economic value of coal from the Project (and the USD/AUD exchange rate). Consequently, variations in the assumed economic value of coal from the Project have been included in the sensitivity analysis in Section 2.6.

Avoided Decommissioning and Rehabilitation Costs

Under the base case or "without" Project scenario the existing Tasman Underground Mine would cease operation in approximately 2018 with associated decommissioning and rehabilitation costs estimated at approximately $0.5M. With the Project these costs in 2018 would be avoided.

Residual Value at End of the Evaluation Period

At the end of the Project, capital equipment and land (excluding offsets) may have some residual value that could be realised by sale or alternative use. For conservatism the residual value of capital equipment is assumed to be zero and the residual value of land is assumed to be $1M.

2.4.2 Non-market Costs and Benefits

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

- greenhouse gas emission costs and any non market benefits of employment provided by the Project (i.e. non-market impacts that are related to production);
- continuation of existing environmental impacts associated with the Tasman Underground Mine pit top and the extension of these impacts to the new Project pit top facilities including environmental externalities associated with increased delivery of coal on the public road network, and additional general traffic movements associated with increased delivery, visitor and workforce traffic; and
- subsidence effects and associated environmental impacts on the natural and built environment above the Project underground mining area.

These are considered in turn below.

Non-market Impacts of Production

Greenhouse Gas Emission Costs

The Project is predicted to generate a total of some 335,286 t of direct (scope 1) greenhouse gas emissions associated with mining and ROM coal haulage activities (Appendix J of the EIS). In addition, a total of some 78,408 t of indirect (scope 3) greenhouse gas emissions associated with the processing of Project ROM coal (at the Bloomfield CHPP), the transportation of product coal to the Port of Newcastle and on-site diesel and electricity usage would be generated (Appendix J of the EIS). Scope 2 greenhouse gas emissions would also be generated by electricity use at the Project (Appendix J of EIS). The economic analysis has included these scope 1, scope 2 and scope 3 emissions as a potential economic cost of the Project.

In addition, the Project would result in the loss of carbon sequestration benefits from the clearing of native vegetation (approximately 11 hectares [ha]). It is considered that the loss of carbon sequestration benefits associated with the clearance of this vegetation would be offset by the revegetation of approximately 22 ha of disturbance areas at the Project site at the completion of the Project (i.e. the old and new pit tops).

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. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of AUD$30/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 Appendix 2).

Social and Economic 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 people's 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), particularly if there is unemployment or there are significant adjustment costs in moving between jobs (friction in the labour market).

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 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).

From 2019 to 2027 the Project would provide 131 operational jobs with employment levels declining thereafter until Project cessation in 2030. Using the more conservative Bulli Seam Operation employment value gives an estimated $37M for the employment benefits of the Project. This value has been included in the BCA. 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 a mining operation in another region of NSW. Consequently, sensitivity testing that excludes this value has also been undertaken.

Underground Mining

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

The Project bord and pillar mining method allows for subsidence impacts to be varied by increasing or reducing the amount of coal extracted in particular areas. As a component of the Project, Donaldson Coal would implement performance measures for significant surface features.

These performance measures would be achieved by implementing subsidence control zones to manage subsidence effects on the surface feature and achieve the performance measure (Appendix A of the EIS). The subsidence control zones may involve partial extraction or limiting extraction to first workings (i.e. no secondary extraction) in some areas. Detailed Extraction Plans would be prepared to demonstrate the mine design is such that the performance measures would be achieved.

The performance measures are detailed in Section 2.6.3 of the Main Report of the EIS and are also, where relevant, referred to in the discussion below.

Surface Water

Performance measures would be implemented to achieve negligible connective cracking to underground workings. The implementation of the Project subsidence control zones is predicted to minimise the potential for surface cracking that might lead to a loss of baseflow in creeks (Appendix C to the EIS).

As a result of the implementation of the performance measures and associated subsidence control zones beneath creeks, any impacts of subsidence on creeks are expected to be minimal, and overall, the Project is predicted to result in no measurable change in the flow regime in Surveyors Creek or to have any material impacts on surface water quality, existing surface water users or environmental flows (Appendix C of the EIS).

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

Groundwater

There is no alluvium present within the Project area (Appendix B of the EIS).

The Project would involve mining in the Permian coal measures, which have elevated salinity and are not considered significant exploitable aquifers (Appendix B of the EIS). Excess groundwater inflows that accumulate in the underground workings would be pumped to historic workings in the same coal measures in close proximity to the workings. This is considered a preferred disposal method for this water over release to the surrounding environment.

The Project is predicted to have negligible impact on baseflow to Surveyors Creek and no impacts are predicted for any private registered groundwater bore or well (Appendix B of the EIS).

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

Flora and Fauna

Areas of native vegetation overlying the Project underground mining area would not be significantly impacted by subsidence effects. A number of threatened flora and fauna species and endangered ecological communities were identified in the Project area and surrounds as described in Appendices E, F and G of the EIS. Performance measures to be implemented would achieve negligible environmental consequences for groundwater dependent ecosystems. Assessment of the impacts of the Project indicated that with the implementation of the Project performance measures, none of the populations of these species or endangered ecological communities would be significantly impacted by the Project.

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

Aboriginal Heritage

The landscape of the mining area is characterised by areas of moderate to steep gradient with rocky outcrops and areas of lower gradient characteristic of lower elevation central lowlands. Some rock outcrops contain sandstone overhangs with potential archaeological deposit and/or grinding grooves. These features are potentially susceptible to subsidence impacts (e.g. cracking). Artefact scatters in the lower elevations are not sensitive to potential subsidence impacts.

Various subsidence control zones have been applied to the mine plan would substantially reduce the potential impacts of the Project on Aboriginal heritage (Appendix K of the EIS). Following application of the subsidence control zones, two Aboriginal heritage sites (both grinding groove sites) have been identified as being of high significance, one with a less than 5% probability of perceptible impacts and one with a 5 to 10% probability of perceptible impacts (Appendix K of the EIS). Impacts on highly significant Aboriginal heritage sites have been shown to affect the well-being of the broader community (Gillespie Economics, 2009a). Using benefit transfer from Gillespie Economics (2008, 2009a, 2009b) together with the above estimates of the probability of perceptible impacts, the expected value of economic cost is estimated at between $1M and $5M.

Significant and widespread traditional, historical and contemporary cultural values and associations with the investigation area have been identified by the registered Aboriginal parties (and are also known through ethnohistorical evidence). These do not necessarily involve Aboriginal objects or physical evidence. These associations and cultural values include (among other more specific values) the entire Mount Sugarloaf area as being a cultural landscape of high traditional, historical and contemporary cultural significance to the Aboriginal community. Of particular note, three rock features have been identified within the study area as having substantial cultural value. Following implementation of the subsidence control zones, the probability of perceptible impacts at these sites ranges from very unlikely to unlikely (Appendix K of the EIS).

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 preparation of the Aboriginal Heritage Management Plan.

Non-Aboriginal Heritage

There are no items that are considered to be of non-Aboriginal heritage significance in the Project area and surrounds (Appendix L of the EIS). Therefore no economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Subsidence Damage to Houses and Other Property Improvements

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

Conceptually, property damage costs from subsidence can be estimated by combining the probability of damage occurring with an estimate of the cost of damage, for each year of the analysis. However, the probability of damage occurring is considered to be low and the level of damage, should it occur, is also considered to be low. An alternative approach to making some allowance for subsidence damage to houses and other property is via inclusion of the Mine Subsidence Fund contributions in the economic costs of the Project.

Donaldson Coal has adopted a subsidence performance measure for principal residences that involve the maintenance of safety, the maintenance of serviceability or compensation for any loss of serviceability and the compensation or repair of any damage. The process for management and repair of subsidence damage to property is provided in Appendix A of the EIS. This involves Donaldson Coal making contributions to the Mine Subsidence Board in accordance with the requirements of the NSW *Mine Subsidence Compensation Act, 1961*. The cost of any compensation or repair of damage from mine subsidence that is required would then be met by the Mine Subsidence Board (MSB).

Subsidence Damage to Infrastructure

There is a range of infrastructure located above or in close proximity to the Project underground mining area that may potentially be adversely affected by subsidence effects. These include features such as:

- electrical infrastructure (i.e. TransGrid and Ausgrid electricity transmission lines);
- telecommunication infrastructure (i.e. fibre optic cables and copper telecommunication cables);
- Sheppeard Drive and associated drainage infrastructure; and
- fire trails and other minor tracks and roads.

Donaldson Coal has adopted subsidence performance measures for infrastructure. Potential impacts on these items of infrastructure would be managed through the Extraction Plan process. Management measures would be implemented by Donaldson Coal where required and remediation of subsidence damage would be facilitated and funded by the MSB, as required. Mine Subsidence Fund contributions and general subsidence management costs have been included in the Project BCA.

Blasting Vibration

Blasting at the Project has the potential to cause structural damage or human discomfort at properties located above the underground mining area, where blasting is used underground to assist with the breakup of igneous intrusions in the coal seam. The potential impacts of blast overpressure and vibration were assessed in Appendix I of the EIS. The assessment concluded that with the implementation of suitable blast control measures, all nearby private receivers would be below relevant building damage and human comfort criteria. Hence, no economic effects have been identified in the BCA with respect to blasting impacts.

Visual Impacts

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

Cliff lines and steep slopes occur along Sugarloaf Range within the Project area, and have aesthetic, recreational and cultural values. Visual impacts may occur as a result of isolated rock fall, cliff collapse or block fall due to mine subsidence.

Extraction beneath cliff lines and steep slopes would be restricted to achieve no additional risk to public safety and no more than minor impact to the cliff lines (e.g. limited to occasional, isolated rock fall and cracking). Such falls also occur naturally and the fresh exposed rock surfaces become weathered and less visually prominent over time.

Other subsidence related impacts, such as surface cracking within streams, along unsealed tracks and on steep slopes and potential increases in erosion may also result in localised aesthetic impacts.

Any visual impacts that could potentially arise would mainly be in relation to visitors to the Sugarloaf State Conservation Area and Heaton State Forest and Mount Sugarloaf public lookout. Any impact on visual amenity could potentially affect the consumer surplus of visitors. However, it is considered that the subsidence performance measures proposed (Section 2.6.3 of the Main Report of the EIS) are likely to result minimal visual impacts and hence minimal impact on visitors to Sugarloaf State Conservation Area, Heaton State Forest or Mount Sugarloaf public lookout.

Surface Facilities

Surface Water

Water supply for the existing and new pit top facilities is sourced from rainfall runoff collected from disturbed areas and groundwater that accumulates in the mine workings.

The primary purpose of the water storages at the existing and new pit top facilities is pollution control as no water is captured from undisturbed areas and no unregulated river access licences are required for the Project pit tops (Appendix C of the EIS).

Excess contained surface and groundwater that accumulates at the pit top storages would be pumped to historic workings in the Permian coal measures in close proximity to the Project workings. This is considered a preferred disposal method for this water over release to the surrounding environment.

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

Flora and Fauna

Development of surface extensions would result in approximately 11 ha of vegetation clearance associated with the Project new pit top construction.

A number of threatened flora and fauna species and endangered ecological ecosystems were identified in the Project area and surrounds as described in Appendices E, F and G of the EIS. Assessment of the impacts of the Project indicated that none of the populations, threatened species or endangered ecological ecosystems would be significantly impacted by the Project.

The Project incorporates rehabilitation of disturbance areas and a biodiversity offset and compensatory measures. The conservation of the proposed biodiversity offset area would be secured in perpetuity through one of a selection of mechanisms being considered.

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

Operational Noise

As described in the Noise and Vibration Impact Assessment (Appendix I of the EIS), the Project surface facilities, including the pit tops and the ventilation fans would contribute to the noise environment at nearby private rural residences.

No private residences have been identified in Appendix I of the EIS as being above applicable noise criteria and hence no operational noise impacts from Project surface facilities have been included in the BCA.

Blasting Overpressure and Vibration

Construction blasting at the Project has the potential to cause structural damage or human discomfort at properties surrounding the new pit top. The potential impacts of blast overpressure and vibration were assessed in Appendix I of the EIS. The assessment concluded that all nearby private receivers would be below relevant building damage and human comfort criteria. Hence, no economic effects have been identified in the BCA with respect to blasting impacts.

Air Quality

As described in the Air Quality and Greenhouse Gas Assessment (Appendix J of the EIS), the Project surface facilities, including the pit tops and the ventilation fans would contribute to the air quality environment at nearby private rural residences.

No private residences have been identified in Appendix J of the EIS as being above applicable air quality criteria and hence no operational air quality impacts from Project surface facilities have been included in the BCA.

Road Transport

The potential impacts of increased road traffic that would arise due to the Project on local traffic conditions and road safety, including increased haulage of coal on the public road network have been considered in the Road Transport Assessment (Appendix H of the EIS). The Project would include the provision of a new roundabout on George Booth Drive at the new pit top access road and Daracon Quarry access road. 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 (Appendix H of the EIS).

Notwithstanding, following feedback from local residents, Donaldson Coal has committed to further driveway entrance upgrade works on George Booth Drive between Richmond Vale Road and John Renshaw Drive and the costs for these works have been included in the Project capital costs.

Furthermore, from an economic perspective any increase in use of the public road network can result in an increased probability of accidents as well as an increase in road pavement damage. Road pavement damage costs are already included in the economic analysis through the road haulage contractor costs. These contractor costs would include amortisation of operating costs including payments to labour, fuel, vehicle operating costs and heavy vehicle registration fees, which includes heavy vehicle charges which aim to reflect road pavement damage costs and future road infrastructure requirements (National Transport Commissions, 2012).

Nominal accident costs are a function of the vehicle kilometres travelled each year, the likely accident rates and the costs per accident. Based on data from Austroads (2008) the present value of incremental nominal accident costs associated with the Project are estimated at $0.5M[2].

[2] This number is based on a comparison between the Project and the without project case which is mining of the Fassifern seam until 2018.

Road Transport Noise

The potential impact of increased Project road traffic on noise levels was also assessed. It was concluded that the Project would have minimal impact on cumulative traffic noise on public roads in the vicinity of the Project, as the opening of the Hunter Expressway in 2013 is expected to significantly reduce the total traffic movements on George Booth Drive (Appendix I of the EA), and therefore traffic noise levels are expected to fall on George Booth Drive, even with the increased Project traffic movements. Traffic noise effects on this basis do not warrant inclusion in the BCA.

Aboriginal Heritage

The proposed new pit top has been subject to detailed survey. No known Aboriginal heritage sites are located within the proposed disturbance footprint.

Surface disturbance works associated with supporting infrastructure for the Project are described in Section 2 in the Main Report of the EIS. As part of the Project detailed design phase, the final location of some of the ancillary infrastructure and surface works (e.g. exploration works, access tracks, subsidence monitoring, subsidence restoration works and surface rehabilitation works) would be determined and would be located to avoid disturbance to known Aboriginal heritage sites.

Consequently there are considered to be no significant Aboriginal heritage impacts associated with surface facilities for inclusion in the BCA.

Non-Aboriginal Heritage

There are no items that are considered to be of non-Aboriginal heritage significance in the Project area and surrounds (Appendix L of the EIS). Therefore no economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Visual Impacts

No major upgrades to the existing pit top facility are proposed as part of the Project. The pit top would be decommissioned or placed in care and maintenance following completion of mining in the Fassifern Seam.

Therefore, there would be no visual modification as a result of the Project during the operation of the existing pit top facility and a potential minor improvement in visual impacts during the decommissioning of the existing pit top facility.

Views of the new pit top facility and ventilation shaft may be available along George Booth Drive. However views would be restricted by mature remnant vegetation along the road reserve and the construction of a vegetated visual bund.

Views from the Sugarloaf State Conservation Area of the new pit top and ventilation shaft are expected to be very limited due to intervening topography and vegetation.

The visual impact on views from areas beyond the sub-regional setting are considered to be very low given the reduction in clarity of viewing that occurs with distance, the level of visual modification compared to the overall view, and the location of the existing pit top facility adjacent to an existing industrial development (i.e. the Orica facilities).

Night lighting would be used at the new pit top facility and ventilation shaft, however impacts of night lighting are expected to be minimal given the distance to private residences, intervening topography and vegetation and the use of directional lighting.

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

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

The Project is estimated to have total net production benefits of $87M. Allowing for foreign ownership levels the net production benefits that would accrue to Australia is estimated at $63M. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, may be assessed. This threshold value is the opportunity cost to Australia of not proceeding with the Project. 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, that impact Australia[3], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $63M. This is equivalent to each household in the Newcastle Statistical Subdivision (SSD) and NSW valuing residual environmental impacts at $319 and $24, respectively.

It should be noted that the Project incorporates the implementation of material subsidence control measures that would have the net effect of reducing both coal extraction and potential environmental impacts within subsidence control zones (Section 2.4.2). Hence the above values are in the context of a mitigated Project with respect to mine subsidence. Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the remaining residual environmental impacts of the Project. From Table 2.2 the main quantifiable environmental impacts of the project, that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions, Aboriginal heritage impacts and nominal accident costs from road transport of coal to Bloomfield CHPP. These impacts are estimated at $16M in total or $6M 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 at in the order of $37M.

Overall, the Project is estimated to have net benefits to Australia of between $57M and $94M and hence is desirable and justified from an economic efficiency perspective.

The present value of the incremental costs and benefits of the Project, using a 7% discount rate are provided in Table 2.3.

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

Table 2.3
Benefit Cost Analysis Results of the Project ($M Present Values at 7% Discount Rate)

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land	$0.6	Value of coal	$593.7
	Opportunity cost of capital equipment	$1.9	Residual value of capital equipment at the cessation of the Project	$0.4
	Capital costs of establishment and construction including ancillary works, land acquisition and sustaining capital	$93.6	Residual value of land at the cessation of the Project	$0.0
	Operating costs, including administration, mining, coal handling, transportation,	$410.7	Avoided decommissioning and rehabilitation costs	$0.4
	Decommissioning and rehabilitation costs	$0.6		
	Production Sub-total	***$507.3***		***$594.0***
	Net Production Benefits			**$86.7 ($63.0)**
Non-market production impacts	Greenhouse gas emissions	$10.7 ($0.1)	Non-market benefits of employment	$36.7 ($36.7)
Underground mining impacts	Surface water	Negligible		
	Groundwater	Negligible		
	Flora and fauna	Negligible		
	Aboriginal heritage	$5.0 ($5.0)		
	Non-Aboriginal heritage	Negligible		
	Subsidence damage to houses and other property improvements	Cost of Mine Subsidence Fund contributions included in operating costs		
	Subsidence damage to infrastructure	Cost of Mine Subsidence Fund contributions included in operating costs		
	Blasting vibration	Negligible		
	Visual impacts	Negligible		
Surface facilities impacts	Surface water	Negligible		
	Flora and fauna	Some loss of values but offset. Cost of offset included in capital costs		
	Operational noise	Negligible		
	Blasting overpressure and vibration	Negligible		
	Air quality	Negligible		
	Road transport	$0.5 ($0.5)		
	Road transport noise	Negligible		
	Aboriginal heritage	Negligible		
	Non-Aboriginal heritage	Negligible		
	Visual impacts	Negligible		
	Externalities sub-total	***$16.2 ($5.6)***		***$36.7 ($36.7)***
NET BENEFITS (including employment benefits)				**$107.2 ($94.1)**
NET BENEFITS (excluding employment benefits)				**$70.5 ($57.4)**

Note: Totals may have minor discrepancies due to rounding.
Numbers in brackets relate to impacts accruing to Australia

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 potentially distributed amongst a range of stakeholders including:

- Donaldson Coal and its Australian and overseas shareholders in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable or MRRT payable from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties which are subsequently used to fund provision of government infrastructure and services across the State, including the region; and
- the local community in the form of voluntary contributions to community infrastructure and services.

The externalities costs may potentially accrue to a number of different stakeholder groups at the local, State, National and global level (Table 2.4), however, are largely internalised into the productions costs of Donaldson Coal.

Greenhouse gas emission costs occur at the National and global level and may potentially be internalised in the future through payment of a carbon tax once the Commonwealth Government's proposed carbon tax scheme is implemented. 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 Donaldson Coal. Aboriginal archaeological impacts would accrue at the regional or State level while Aboriginal cultural heritage impacts would accrue to local Aboriginal people. Other potential environmental externalities would largely occur at the State or Local level and were found to be minor or negligible. External benefits associated with employment provided by the Project would largely accrue at the Local or State level[4].

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

Table 2.4
Distribution of Benefits and Costs (Present Values at 7% Discount Rate)

Value		Distribution			
		Local	**State**	**National**	**Global**
Net Production Benefits					
Net production benefits to Donaldson Coal	$31.7M	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	$13.6M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$41.4M	✓	✓	-	-
Total	***$86.7M***				
Non-market Costs and Benefits					
Non-market benefit of employment	$36.7M	✓	✓	-	-
Total	***$36.7M***				
Costs					
Greenhouse gas emissions rest of the world[1]	$10.6M	-	-	-	✓
Greenhouse gas emissions Australia[1]	$0.1M	✓	✓	✓	
Underground Mining Impacts					
Surface water	Negligible	✓	-	-	-
Groundwater	Negligible	✓	-	-	-
Flora and fauna	Negligible	✓	✓	-	
Aboriginal heritage	$5.0M	✓	✓	-	-
Non-Aboriginal heritage	Negligible	✓	✓	-	-
Subsidence damage to houses and other property improvements	Cost of Mine Subsidence Fund contributions included in operating costs	✓	-	-	-
Subsidence damage to infrastructure	Cost of Mine Subsidence Fund contributions included in operating costs	✓	-	-	-
Blasting vibration	Negligible	✓	-	-	-
Visual impacts	Negligible	✓	-	-	-
Surface Facility Impacts					
Surface water	Negligible	✓	-	-	-
Flora and fauna	Some loss of values but offset. Cost of offset included in capital costs	✓	✓	-	-
Operational noise	Negligible	✓	-	-	-
Blasting overpressure and vibration	Negligible	✓	-	-	-
Air quality	Negligible	✓	-	-	-
Road transport	$0.5M	✓	-	-	-
Road transport noise	Negligible	✓	-	-	-
Aboriginal heritage	Negligible	✓	✓	-	-
Non-Aboriginal heritage	Negligible	✓	✓	-	-
Visual impacts	Negligible	✓	-	-	-
Total	***$16.2M***				
Net Benefits	**$107.2M**				

Note: Totals may have minor discrepancies due to rounding.

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

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.3 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for changes to the following variables:

- opportunity cost of land;
- capital costs;
- operating costs;
- value coal;
- decommissioning and rehabilitation costs;
- residual value of land and capital equipment;
- nominal road accident costs;
- greenhouse gas emission costs; and
- social value of employment.

This analysis indicated (Appendix 2) that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables, apart from value of coal and operating costs. A 20% increase in operating costs or a 20% reduction in value of coal results in negative total net benefits of the Project but a small positive net benefit from an Australian perspective (as royalty which makes up the net benefit to Australia under these scenario is based on revenue not profit).

2.7 DOWNSTREAM COSTS AND BENEFITS

A persistent issue that has arisen in community consultation concerns potential greenhouse gas emissions from the use of the coal that is exported through the Port of Newcastle. However, these impacts are not considered relevant to a BCA of the Project.

Traditional and continuing practice in BCA is to undertake the analysis from a national perspective. This is based on pragmatic grounds as well as the view that projects should be assessed from the view point of the nation which undertakes the projects, incurs the costs and is responsible for decision-making. In the BCA above, production benefits (value of export coal) and costs are valued within the national boundary e.g. coal is valued at the Port of Newcastle (free-on-board), and costs up to and including loading the coal at the Port of Newcastle for export are included. The net production benefit accruing to Australia is then estimated.

After coal leaves Australia it becomes an input into a different production process. In the case of thermal coal this production process is concerned with the burning of coal to generate electricity. This production process has its own set of costs and benefits. Costs of coal fired power generation include the costs of coal, labour, land and capital inputs, electricity distribution costs and environmental costs, such as greenhouse gas emission costs. Benefits include the financial value of electricity as well as the willingness to pay of the community for electricity above and beyond what they have to pay (i.e. consumer surplus).

There may also be externality benefits of electricity for economic development, education, and medical care. All of these costs and benefits are relevant to a consideration of this next stage of the production process, not just the greenhouse gas emission costs. Metallurgical coal (i.e. for steel making) is also an input to a different production process, with its own set of costs and benefits.

Where these different production processes occur in NSW or Australia they are subject to separate approval and decision-making requirements. Where they occur overseas they are not subject to the NSW development approval process. Decisions by the NSW Government about whether to supply additional coal for export are likely to have little impact on decisions other countries take with regard to coal fired electricity generation or steel production. While NSW is well placed to supply some of the projected additional world demand for coal (10% of the increased world coal production to 2035 is expected to come from Australia/New Zealand), 75% of growth in coal production is expected to come from China (US Energy Information Administration, 2010), and with NSW containing less than 1% of total recoverable coal reserves in the world there are significant coal supply source substitution possibilities (International Energy Outlook, 2010).

3 REGIONAL ECONOMIC IMPACTS

3.1 INTRODUCTION

The BCA reported in Section 2 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community 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 operation. These impacts are considered in terms of a number of indicators[5]:

- ***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 project 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 where the economic effects would mostly occur:

- the Newcastle SSD referred to as the regional economy; and
- NSW.

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

[5] 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 Appendix 3, 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 of the NSW economy developed by Monash University and indexed to 2011; and
- a 2006 input-output table of the regional economy, developed by Gillespie Economics using the Generation of Regional Input-output Tables (GRIT) procedure[6] (Bayne and West, 1988) (and the Monash NSW table as the parent table) and indexed to 2011.

The input-output table of the NSW and regional economies were aggregated to 30 sectors and 6 sectors, for the purpose of describing them.

The resulting 6 sector 2006 input-output table for the regional economy is provided in Table 3.1. The rows of the table indicate how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD) (which includes stock changes, capital expenditure and government expenditure). For example, the mining sector in the regional economy sells $16,000 worth of output to the agriculture, forestry and fishing sector of the regional economy, $42,584,000 worth of output to the mining sector of the regional economy etc, sells $1,394,000 of output directly to households and exports $916,730,000 worth of output from the region.

The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA) (which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row of Table 3.1. For the mining sector to produce $1,152,868,000 worth of output, it purchases $104,000 of inputs from the agriculture, forestry and fishing sector of the regional economy, $42,584,000 of inputs from the mining sector of the regional economy etc, imports $130,559,000 of inputs from outside the region, generates $709,177,000 in other value added, employs 2,273 people and pays $150,384,000 in wages and salaries.

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

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

The economic structure of the regional economy can be contrasted with that for NSW through a comparison of results from the respective input-output models (Figures 3.1 and 3.2). This reveals that the economies are not dissimilar, with the main difference being the greater relative importance of the manufacturing sectors to the regional economy as well as the greater relative importance of gross regional product (value-added) and output in the mining and utilities sectors to the regional economy. The agriculture/forestry/fishing sectors, building sectors and services sectors are of slightly lower relative importance to the regional economy than they are to the NSW economy.

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[6] Refer to Appendix 4.

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

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

* Number of people employed in each industry.

Note: Totals may have minor discrepancies due to rounding.

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

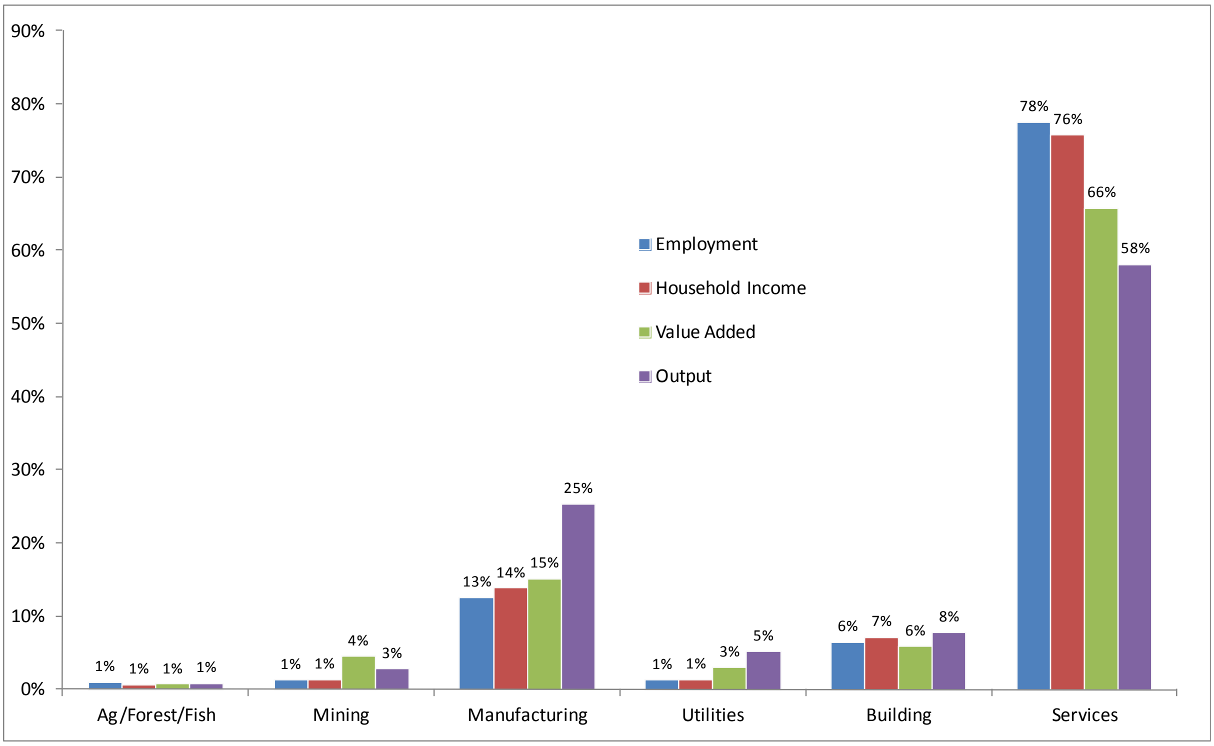
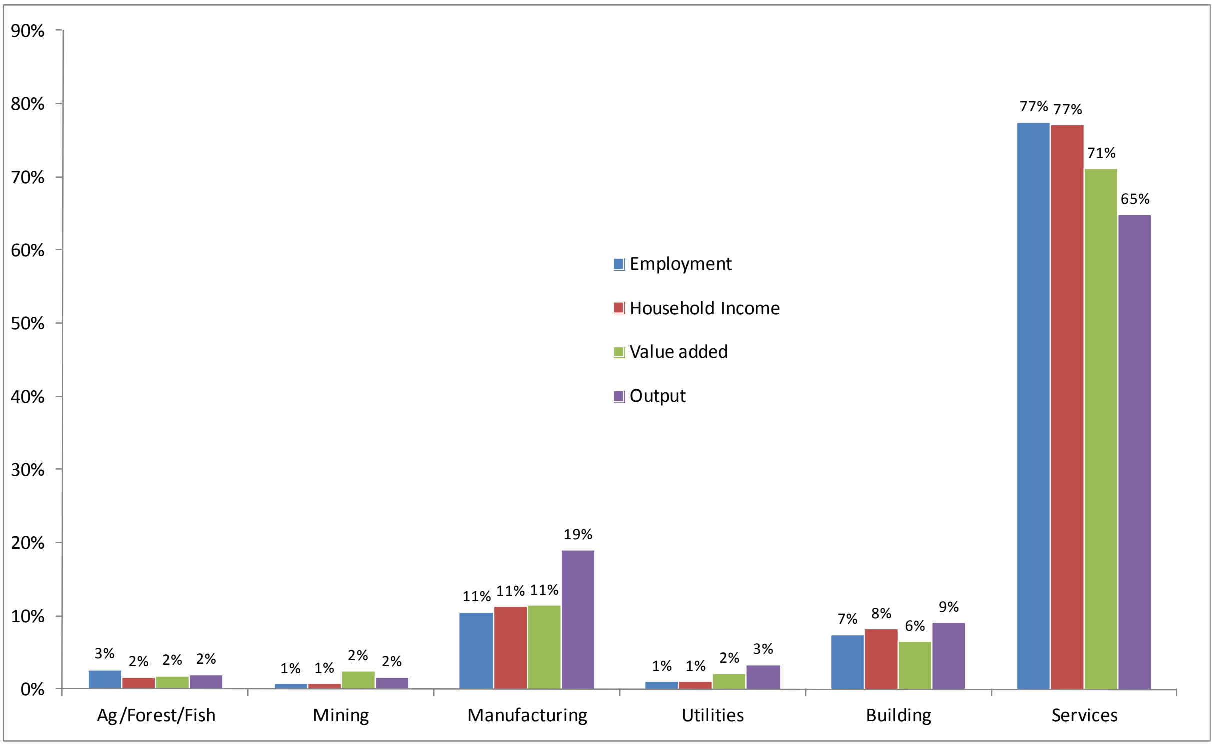


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2006)



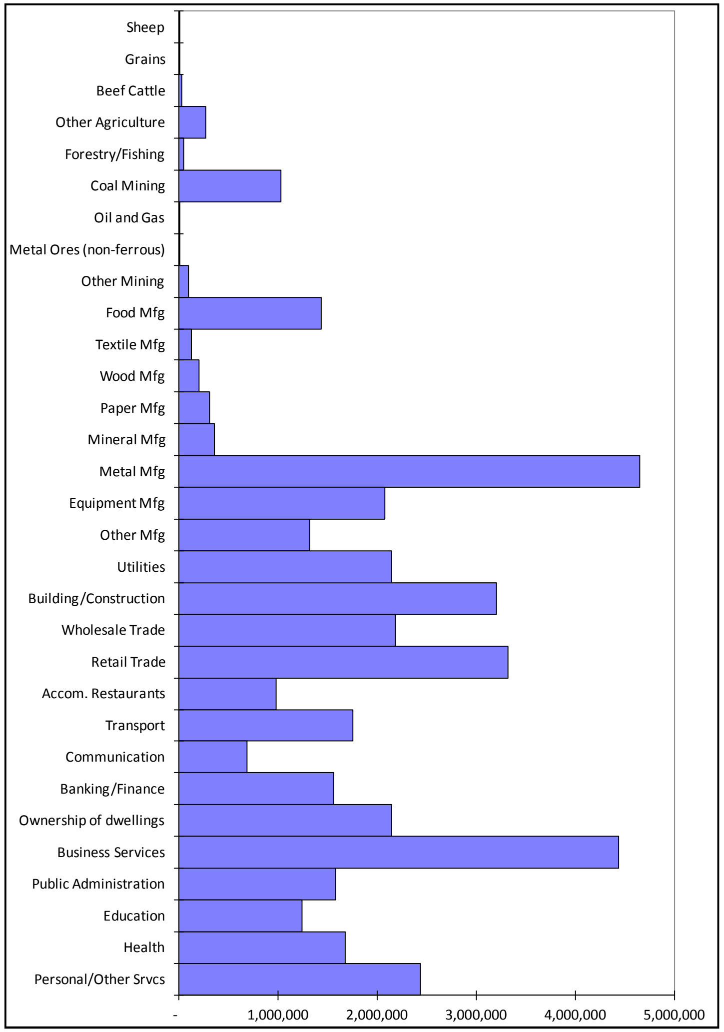
Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the regional economy

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

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

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

Gross Regional Output



Gross Value-Added

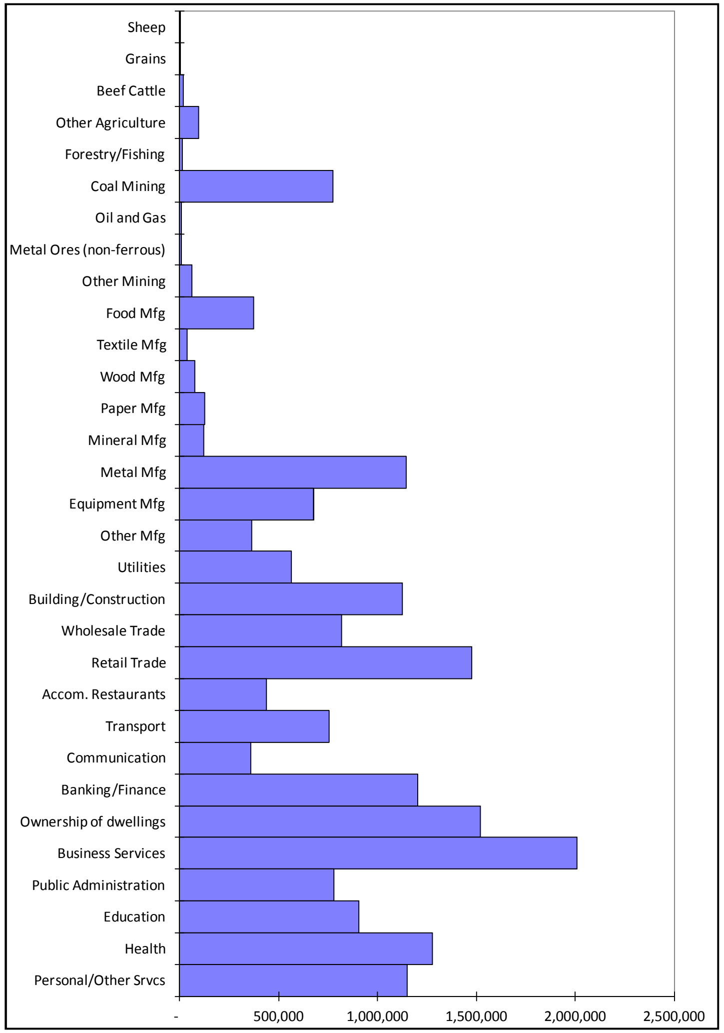
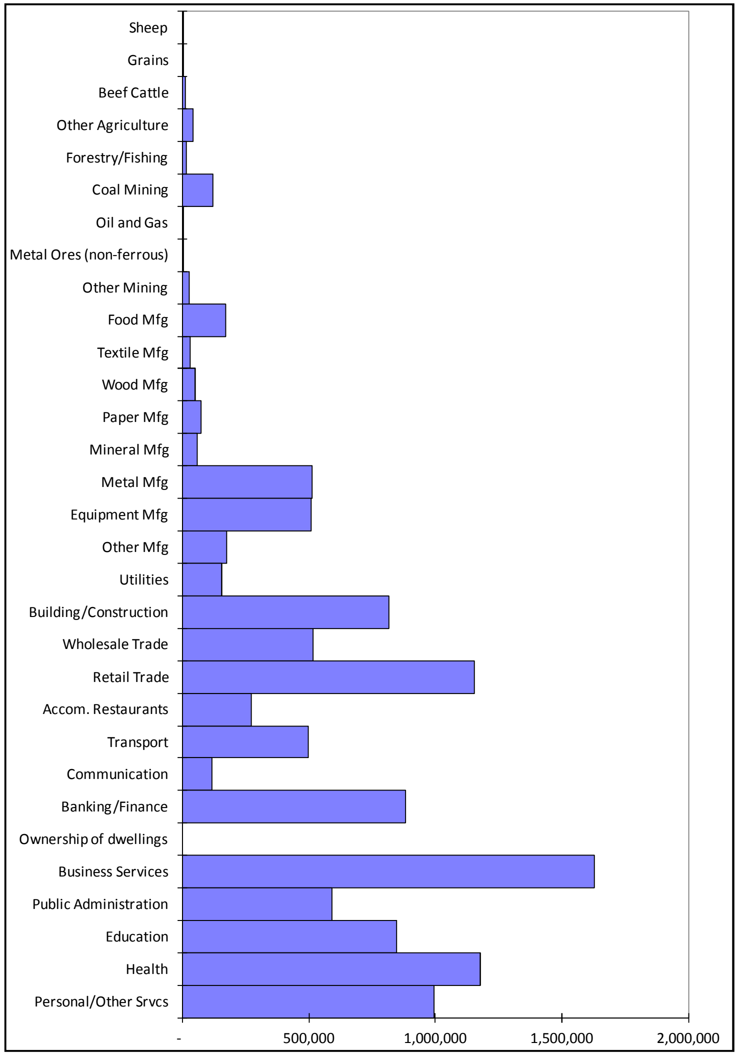


Figure 3.4
Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

Income



Regional Employment

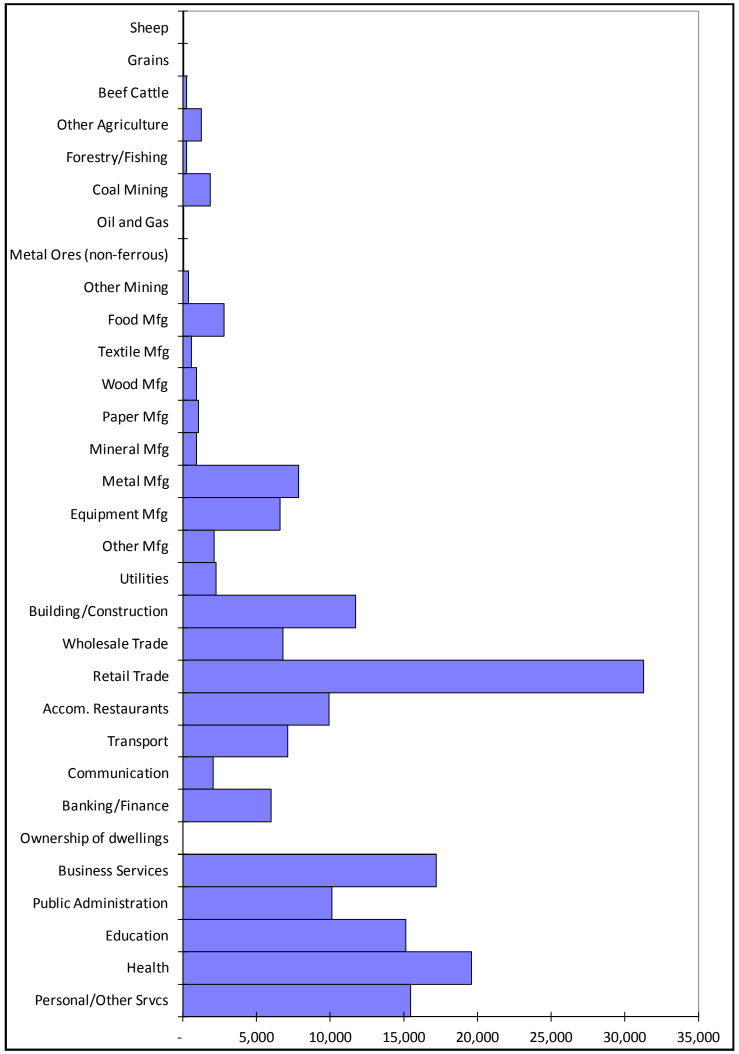
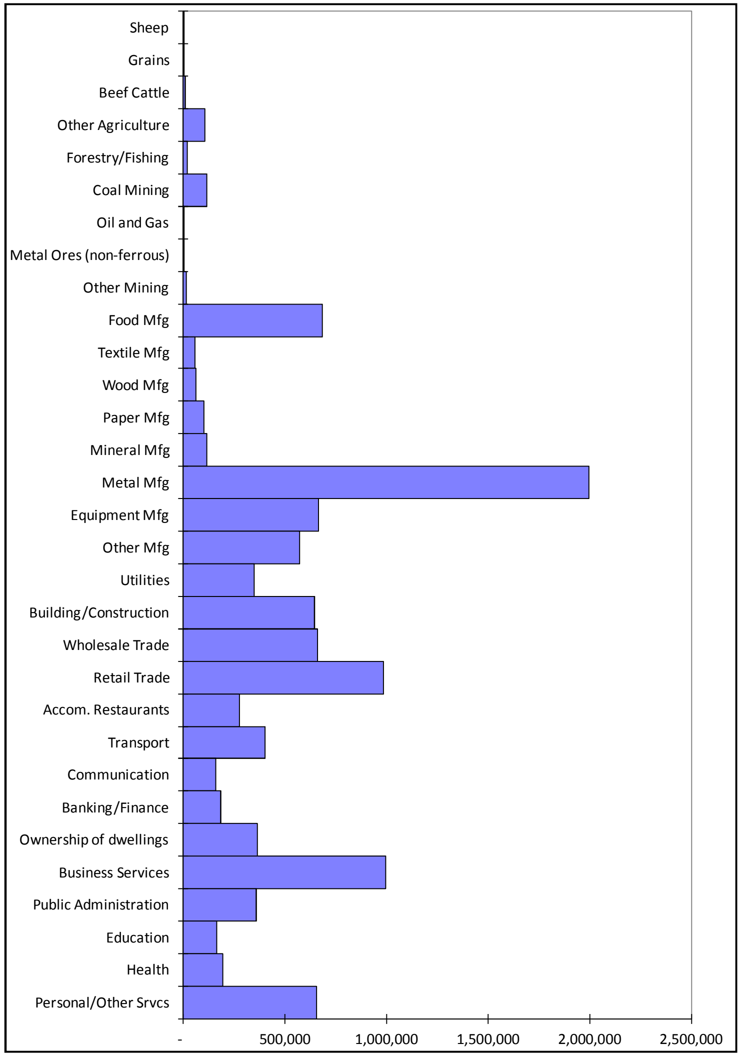
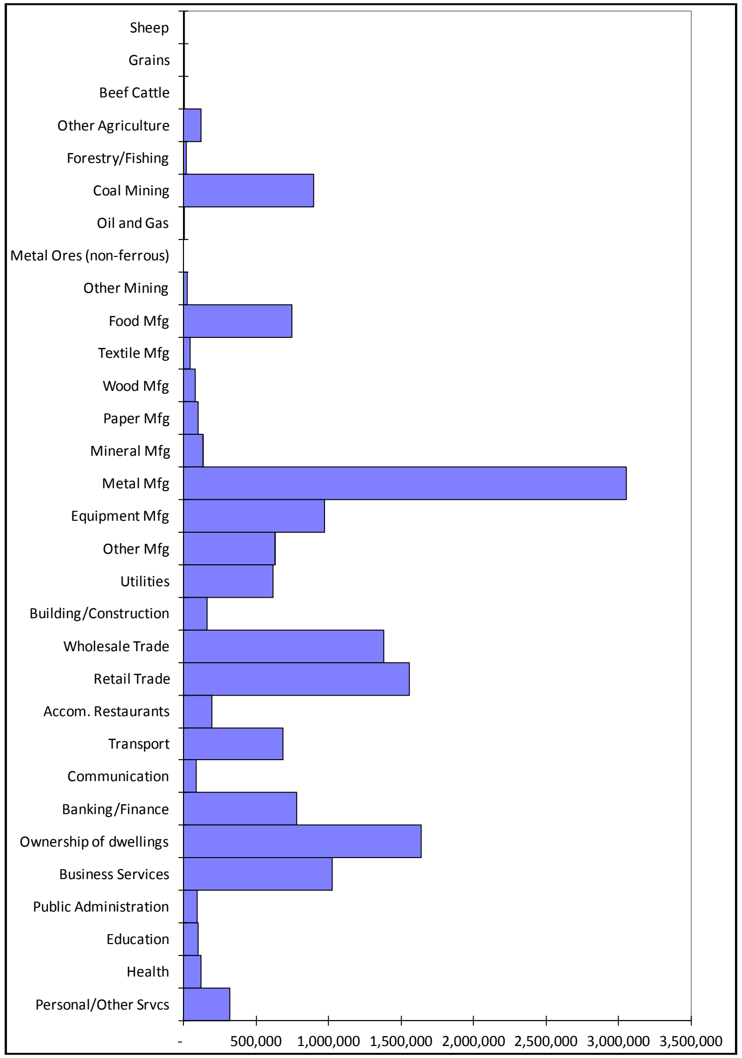


Figure 3.5
Sectoral Distribution of Imports and Exports ($'000)

Regional Imports



Regional Exports



3.3 ECONOMIC IMPACT OF THE PROJECT

The revenue, expenditure and employment associated with the construction and operation of the Project would contribute economic activity to the regional economy, as well as to the broader NSW economy.

3.3.1 Construction Phase

Economic activity increases associated with Project construction are estimated to occur mainly within five sectors of the economy:

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

Impact on the Regional Economy

For the purpose of this analysis a very conservative assumption is made that all such purchases and the leasing of machinery are made outside the regional economy. Thus regional economic activity impacts from the Project construction phase primarily relate to the *other construction sector* and *construction trade services sector*.

It is estimated that the construction workforce for the Project would be employed over a 12 to 18 month period in 2013 to 2014 with the average workforce being approximately 20 people. Based on the input-output coefficients of the combined *other construction sector* and *construction trade services sector* in the regional region transactions table (indexed to 2011) in the order of $5.8M of the capital costs would need to be spent in the combined *other construction sector* and *construction trade services sector* within the region to result in a workforce of 20 people. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Table 3.2
Economic Impacts of Construction on the Regional Economy

	Direct	Production induced	Consumption induced	Total Flow on	Total
OUTPUT ($'000)	5,811	3,768	2,013	5,781	11,592
Type 11A Ratio	*1.00*	*0.65*	*0.35*	*1.00*	*2.00*
VALUE ADDED ($'000)	2,314	1,512	948	2,460	4,773
Type 11A Ratio	*1.00*	*0.65*	*0.41*	*1.06*	*2.06*
INCOME ($'000)	1,674	1,040	695	1,736	3,410
Type 11A Ratio	*1.00*	*0.62*	*0.42*	*1.04*	*2.04*
EMPL. (No.)	20	13	11	23	43
Type 11A Ratio	*1.00*	*0.63*	*0.54*	*1.16*	*2.16*

Impacts of Construction

In estimating the total regional impacts associated with Project construction, 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 currently located in the region or migrate into the region. Where workers commute from outside the region then some of the consumption-induced flow-on effects will leak from the region.

From Table 3.2 it is estimated that construction of the Project would result in impacts on the regional economy of up to:

- $12M in annual direct and indirect output;
- $5M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 43 direct and indirect jobs.

Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (Australian Bureau of Statistics [ABS], 1995). There are many types of multipliers that can be generated from input-output analysis (refer to Appendix 5). 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 regional Type 11A ratio multipliers for the construction phase of the Project are estimated to range from 2.00 for output up to 2.16 for employment.

Main Sectors Affected

The input-output analysis indicates that 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 *other construction and construction trade services, wholesale and retail trade, scientific research, technical and computer services, other property services, legal, accounting marketing and business management services, other business services, education and health.*

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

Table 3.3
Distribution of Average Direct and Flow-on Employment by Industry Sector in the Regional Economy from Construction of the Project

Aggregated Sectors	Average Direct Effects	Production induced	Consumption-induced	Total
Primary	0	0	0	0
Mining	0	0	0	0
Manufacturing	0	2	1	3
Utilities	0	0	0	0
Wholesale/Retail	0	1	2	4
Accommodation, cafes, restaurants	0	0	2	2
Building/Construction	20	5	0	25
Transport	0	0	0	1
Services	0	3	5	9
Total	**20**	**12**	**11**	**43**

Note: Totals may have minor discrepancies due to rounding.

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

- *Building/construction sectors,* specifically t*he other construction sector* and *construction trade services sector*;
- *Services sectors,* predominantly *other property services, legal, accounting and business management sector, scientific research, technical and computer services and other business services*;
- *manufacturing sectors*, predominantly *cement lime and concrete slurry manufacturing, iron and steel manufacturing, structural metal products manufacturing and fabricated metal products manufacturing*;
- *wholesale and retail trade sectors*; and
- *transport sectors,* predominantly *road transport*.

Consumption-induced employment flow-ons would mainly generate additional jobs in the:

- *services sectors,* predominantly *education, health, community services, sport, gambling and recreation services and personal service;*
- *wholesale and retail trade sectors;* and the
- *accommodation, cafes and restaurants sector.*

Impact on the NSW Economy

The impact of construction on the NSW economy would be greater than at the regional level as the larger NSW economy is able to capture more of the expenditure associated with construction and the level of intersectoral linkages (as reflected by the multipliers) are larger.

3.3.2 Operation Phase

For the analysis of the Project operation, a new Tasman Underground Mine sector was inserted into the regional input-output table[9] reflecting peak production levels of 1.5 Mtpa of ROM coal for the Project. The revenue, expenditure and employment data for this new sector was obtained from financial information provided by Donaldson Coal. For this new sector:

- the estimated gross annual revenue of the Project was allocated to the o*utput* row;
- the estimated wage bill of employees residing in the region was allocated to the *household wages* row with any remainder allocated to *imports*;
- non-wage local expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added* based on advice from Donaldson Coal;
- allocation was then further made between *intermediate sectors* in the local economy and *imports* based on 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 in the Project that resides in the region was allocated to the *employment* row.

The major difference between the sectors generated for the regional input-output table and the NSW input-output table was the greater intermediate expenditure that could be captured at the NSW level compared to the regional economy. The former had a greater reliance on imports.

On this basis, the estimated impacts of the operation of the Project were determined for the regional economy and for the NSW economy (Tables 3.4 and 3.5).

Table 3.4
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 ($'000)	117,000	54,363	21,963	76,326	193,326
Type 11A Ratio	*1.00*	*0.47*	*0.19*	*0.65*	*1.65*
VALUE ADDED ($'000)	57,876	28,238	10,344	38,583	96,458
Type 11A Ratio	1.00	0.49	0.18	0.67	1.67
INCOME ($'000)	14,408	15,196	7,606	22,803	37,211
Type 11A Ratio	1.00	1.06	0.53	1.58	2.58
EMPL. (No.)	122	165	117	282	404
Type 11A Ratio	1.00	1.35	0.96	2.31	3.31

* It is noted that the total employment for the Project is 151 comprising 131 employees and 20 contractors. Contractors are located in production-induced effects. 93% of employees are estimated to reside in the region.

[9] Inflated to 2011

Table 3.5
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 ($'000)	117,000	88,654	75,625	164,279	281,279
Type 11A Ratio	*1.00*	*0.76*	*0.65*	*1.40*	*2.40*
VALUE ADDED ($'000)	59,047	43,508	38,520	82,028	141,075
Type 11A Ratio	1.00	0.74	0.65	1.39	2.39
INCOME ($'000)	15,492	27,670	22,044	49,714	65,205
Type 11A Ratio	1.00	1.79	1.42	3.21	4.21
EMPL. (No.)	131	301	304	605	736
Type 11A Ratio	1.00	2.30	2.32	4.62	5.62

* It is noted that the total employment for the Project is 151 comprising 131 employees and 20 contractors. Contractors are located in production-induced effects. 100% of employees are estimated to reside in NSW.

In total, the operation of the Project is estimated to make up to the following contribution to the regional economy in the peak years of production:

- $193M in annual direct and indirect output;
- $97M in annual direct and indirect value added;
- $37M in annual direct and indirect household income; and
- 404 direct and indirect jobs.

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

- $281M in annual direct and indirect output;
- $141M in annual direct and indirect value added;
- $65M in annual direct and indirect household income; and
- 736 direct and indirect jobs.

To the extent that Donaldson Coal can maximise local procurement, the regional intersectoral linkages reported in this assessment could be increased, with corresponding increases in local economic activity and employment.

Multipliers

The multipliers for any particular sector of a regional economy reflect primarily:

- the magnitude of and relationship between the direct effects, e.g. labour, income and gross profit, to output levels;
- the level of direct intermediate sector expenditures that would be captured within the region; and
- the ability of other sectors in the region to supply production and consumption induced goods and services that are demanded.

The type 11A ratio multipliers for the operation of the Project are provided in Tables 3.4 and 3.5. For the regional economy, the Type 11A ratio multipliers ranged from 1.65 for output up to 3.31 for employment. For the larger NSW region Type 11A ratio multipliers ranged from 2.39 for value added up to 5.62 for output.

Main Sectors Affected

The input-output analysis indicates that flow-on impacts from the operation 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:

- *services to mining* which includes businesses based in part of a mining operation such as washing;
- *services to transport* which included businesses engaged in stevedoring and port operation;
- *scientific research, technical and computer services* which includes businesses engaged in scientific research, surveying and consulting engineering services.
- *coal mining* which includes businesses engaged in contract mining*;*
- *other business services* which includes businesses engaged in providing security and cleaning services; and
- *retail trade sector* which consists of business engaged in retail trade.

For NSW similar sectors are likely to be the most impacted, however, other sectors also become more significant such as the wholesale trade, ownership of dwellings, road transport and legal, accounting, marketing and business management services sectors.

Tables 3.6 and 3.7 indicate that direct, production-induced and consumption-induced incremental employment impacts of the Project on the regional economy are likely to have different distributions across sectors.

Table 3.6
Distribution of Flow-on Employment by Industry Sector for the Regional Economy

Sector	Average Direct Effects	Production Induced	Adjusted Consumption-Induced	Total
Primary	0	0	1	1
Mining	122	52	0	174
Manufacturing	0	17	7	25
Utilities	0	2	1	4
Wholesale/Retail	0	16	26	42
Accommodation, cafes, restaurants	0	2	18	20
Building/Construction	0	3	1	4
Transport	0	24	4	27
Services	0	48	60	108
Total	**122**	**165**	**117**	**404**

Note: Totals may have minor discrepancies due to rounding.

Table 3.7
Distribution of Flow-on Employment by Industry Sector for the NSW Economy

Sector	Average Direct Effects	Production Induced	Adjusted Consumption-Induced	Total
Primary	0	1	6	6
Mining	131	55	0	187
Manufacturing	0	35	28	63
Utilities	0	7	4	11
Wholesale/Retail	0	34	66	100
Accommodation, cafes, restaurants	0	5	40	45
Building/Construction	0	8	5	13
Transport	0	69	10	79
Services	0	88	144	232
Total	**131**	**301**	**304**	**736**

Note: Totals may have minor discrepancies due to rounding.

Production-induced employment impacts would generate demand for employment across a range of sectors including *mining*, *manufacturing, wholesale/retail trade, transport and services*. Consumption-induced employment flow-ons would mainly generate demand in the *services sectors*, *wholesale/retail trade sectors, accommodation, cafes and restaurants sectors and services sectors.*

3.4 IMPACT OF CESSATION OF THE PROJECT ON THE REGIONAL ECONOMY

The establishment and operation of the Project would stimulate demand in the regional and NSW economy leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, 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
- 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 3.6. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.6.

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

Ultimately, the significance of the economic impacts of cessation of the 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.

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

4 EMPLOYMENT, POPULATION AND COMMUNITY INFRASTRUCTURE ASSESSMENT

4.1 INTRODUCTION

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

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

The basic methodology for carrying out the EPCIA was to:

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

The geographic scope of the EPCIA was determined by the location of Project and the region that would potentially service the Project and its employees. The Project is located approximately 20 km west of Newcastle. Approximately 93% of mine employment is estimated to live in the Newcastle SSD.

The assessment draws on a range of publications and reports as well as data provided by Donaldson Coal, the ABS Census (ABS, 2007), and information from Section 3 on the potential regional economic impacts of the Project. While the Project may also have population and workforce effects at a NSW state level and in other nearby regions such as Gosford, Wyong and Sydney, these effects would not be of sufficient magnitude to warrant consideration of potential adverse effects.

4.2 PROJECT WORKFORCE AND POPULATION CHANGE

The main drivers for impacts on community infrastructure are changes in employment and population and the spatial location of these changes in employment and population. Employment that is directly generated by the 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 services where changes in employment status or income result in changes in demand for some particular services (e.g. health services).

Whether local labour is sourced from the unemployment pool or from other industries, it can reduce unemployment levels - directly in the case of employing unemployed people and indirectly via the filter effect[10] where labour is sourced from other industries.

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

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

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

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

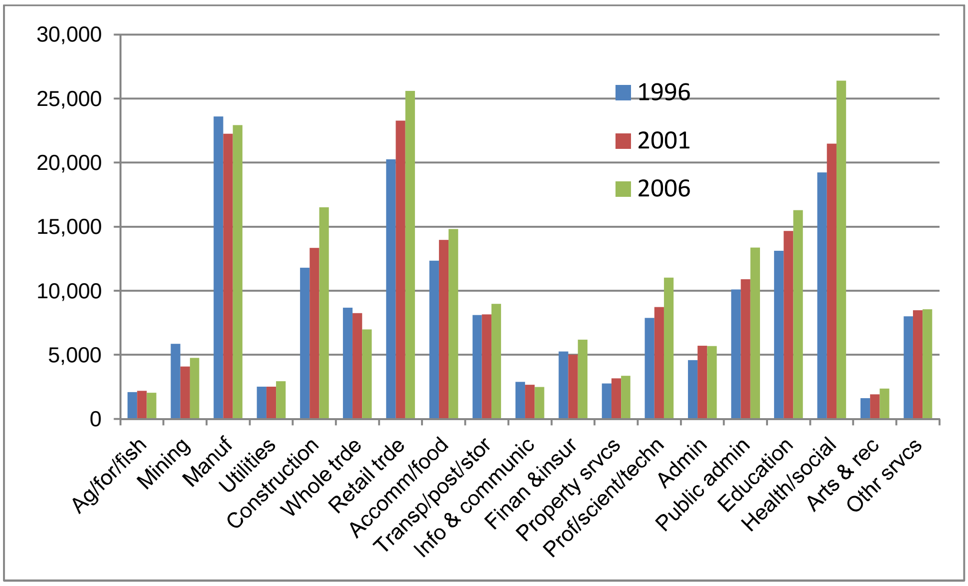
4.2.1 Construction Workforce and Population Change

It is anticipated that during the initial development of the Project (including upgrades of existing surface and underground infrastructure), an additional 20 people would be required in the short-term (12 to 18 months).

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

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

Figure 4.1
Newcastle SSD Employment by Industry



4.2.2 Operation Workforce and Population Change

The Project relates to the continuation and expansion of an existing activity. Currently, the total direct workforce at the Tasman Underground Mine is approximately 110 people. The operational workforce associated with the Project is estimated at 151 (comprising 131 direct employees and 20 contractors), hence the additional direct workforce from the Project is estimated at 40.

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

Table 4.1
Unemployment in the Newcastle SSD (June Quarter)

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

Source: ABS (2011)

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

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

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

However, if it were conservatively assumed that all of this workforce migrated into the region, that the multiplier reported in Table 3.4 applies and the additional migrating direct and indirect workforce had the same household occupancy as NSW households, the maximum additional population in the region would be 353 (Table 4.2).

Table 4.2
Maximum Employment and Population Change in the Region

Additional Direct Worforce	Flow-on	Total	Assumed Household Size	New Population to the Region
41	95	136	2.6	353

Note: Totals may have minor discrepancies due to rounding.

4.3 COMMUNITY INFRASTRUCTURE IMPACT ASSESSMENT

Between 2006 and 2010 the Newcastle SSD experienced a growth in population of 29,277 or 7,319 people per annum (Table 4.3). A maximum potential population influx to the Newcastle SSD of up to 353 (Table 4.2) represents less than 1 month's average population growth between 2006 and 2010 for the Newcastle SSD.

Table 4.3
Newcastle SSD Population Growth

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

Source: ABS (2011a)

The demand this maximum potential population influx would create for housing represents 0.2% of total occupied housing stock in 2006 or 1.9% of unoccupied residential properties in 2006 (Table 4.4).

Table 4.4
Predicted Maximum Project-Related Demand for Additional Accommodation

Demand for Housing	Housing Stock	
	Occupied Dwellings 2006	Unoccupied Dwellings 2006
353	191,011	18,906

Source: ABS (2006)

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

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

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

	1996	2001	2006	Demand
Preschool	7,222	7,789	8,944	31
Infants/Primary				
Government	35,270	34,669	31,706	
Catholic	6,722	7,188	6,889	
Other Non Government	2,292	3,012	3,899	
Total	**44,284**	**44,869**	**42,494**	**38**
Secondary				
Government	23,475	23,516	22,460	
Catholic	4,767	5,449	5,408	
Other Non Government	2,119	3,056	3,888	
Total	**30,361**	**32,021**	**31,756**	**33**

Source: ABS (2011b)

These demands can be compared to the total enrolments in 2006 and growth/decline in school enrolments between 1996 and 2006 in Table 4.5. In this context, it is evident that the maximum potential increased demand for schooling associated with incremental Project employment effects could be considered to be insignificant. In relation to government schools, the maximum additional demand for schooling is a very small percentage of the decline in enrolments that has been occurring.

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

Table 4.6
Employment in Health, Arts and Recreation Services

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

Source: ABS (2011c).

* Totals may have minor discrepancies due to rounding.

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.

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

4.4 SOCIAL AMENITY

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

The Road Transport Assessment provides a detailed assessment of the potential impacts of the Project on road traffic. It indicates that traffic flows in the vicinity of the Project would increase as a result of the Project and that traffic generation would include additional coal haulage on the public road network. However, the opening of the Hunter Expressway and forecast growth in background traffic would have significantly more impact on the operation of the road system than the Project. Halcrow (2012) concluded that the Project's contribution to overall traffic conditions on George Booth Drive and John Renshaw Drive would be such that no significant impacts on the performance, capacity, efficiency and safety of the road network are expected to arise as a direct result of the Project (Appendix H of the EIS).

The Project EIS document includes assessment of the likely impacts on the noise environment. It indicates that noise and vibration effects during construction and operation of the Project would be below the relevant assessment criteria at nearby private receivers and hence any noise impacts are considered acceptable. Similarly the Project EIS document concludes that air quality goals would not be exceeded at sensitive receptors.

The Project EIS document indicates that views of the new pit top facility and ventilation shaft may be available along George Booth Drive, however, these views would be restricted by mature remnant vegetation along the road reserve and the construction of a vegetated visual bund. Views from the Sugarloaf State Conservation Area of the new pit top and ventilation shaft are expected to be very limited due to intervening topography and vegetation. Night lighting impacts are expected to be minimal given the distance to private residences, intervening topography and vegetation and the use of directional lighting at the surface facilities.

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

4.5 MITIGATION AND MANAGEMENT MEASURES

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

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

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

5 CONCLUSIONS

A BCA of the Project indicated that it would have net production benefits of $87M, with $63M 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. This threshold value is the opportunity cost to Australia of not proceeding with the Project. 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, 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 $63M. This is equivalent to each household in the Newcastle SSD and NSW valuing residual environmental impacts at $319 and $24, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify 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 emissions, Aboriginal heritage impacts and nominal accident costs from road transport of ROM coal to Bloomfield CHPP. These impacts are estimated at $16M in total or $6M 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 at in the order of $37M.

Overall, the Project is estimated to have net benefits to Australia of between $57M and $94M and hence is desirable and justified from an economic efficiency perspective.

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

- Donaldson Coal and its Australian and overseas shareholders in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable or MRRT payable from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties which are subsequently used to fund provision of government infrastructure and services across the State, including the region; and
- the local community in the form of voluntary contributions to community infrastructure and services, where applicable.

The externalities costs 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 Donaldson Coal.

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

Greenhouse gas emission costs occur at the National and global level and may potentially be internalised in the future through payment of a carbon tax once the Commonwealth Government's proposed carbon tax scheme is implemented. The economic costs associated with the clearing of native vegetation would occur at the State or National level and would be counterbalanced by the offset actions proposed by Donaldson Coal. Aboriginal archaeological impacts would accrue at the regional or State level while Aboriginal cultural heritage impacts would accrue to local Aboriginal people. Other potential environmental externalities would largely occur at the State or Local level and were found to be minor or negligible. External benefits associated with employment provided by the Project would largely accrue at the Local or State level[12].

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 Newcastle economy in the peak years of production:

- $193M in annual direct and indirect output;
- $97M in annual direct and indirect value added;
- $37M in annual direct and indirect household income; and
- 404 direct and indirect jobs.

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

- $281M in annual direct and indirect output;
- $141M in annual direct and indirect value added;
- $65M in annual direct and indirect household income; and
- 736 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 (including upgrades of existing surface and underground infrastructure), an additional 20 people would be required in the short-term (12 to 18 months). During operation of the Project the additional direct workforce from the Project is estimated at approximately 40. However, no change in population is expected as a result of the construction or operation of the Project as contractor labour during construction is expected to come from existing contractor firms located within the region or daily commuters from Sydney. The operational workforce is expected to come from the employment and unemployment pool in the region aided by the cleanskin, apprenticeship and graduate programs run by GCL (Donaldson Coal). Consequently, no additional impact on community infrastructure is anticipated and no specific mitigation or management measures are required. Even if it were conservatively assumed that all new labour was sourced from people migrating into the region the demand for community infrastructure would be insignificant in the context of historical and projected population growth in the region.

GCL (Donaldson Coal) would continue to develop and run programs that help in the recruitment of local labour and would work in partnership with Councils and the local community so that the benefits of the projected economic growth in the region are maximised and impacts minimised, as far as possible.

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

Cessation of the Project operation in 2030 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.

Given these uncertainties it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the regional economic activity and skills and expertise that the Project and other mining operations bring to the region, to strengthen and broaden the region's economic base.

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APPENDIX 1

ECONOMIC ANALYSIS OF TRANSPORTING COAL ON PUBLIC ROADS

TABLE OF CONTENTS

TABLES

1 INTRODUCTION

Donaldson Coal Pty Ltd (Donaldson Coal) proposes to extend its existing Tasman Underground Mine. The Tasman Extension Project (the Project) will require approval from the Minister for Planning and Infrastructure under the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act). Among other things, the Project involves continued and increased transportation of run-of-mine (ROM) coal from the mine to the Bloomfield Coal Handling and Preparation Plant (CHPP) along private and public roads.

The Director General's environmental assessment requirements (DGRs) for the preparation of an Environmental Impact Statement (EIS) for the Project issued on 14/12/11 require:

> *a detailed economic justification of transporting coal on public roads, including assessment of the costs and benefits of alternative transport methods".*

Consideration of the economic implications of the continued and increased movement of coal on the public road network is provided below, including consideration of the relative costs and benefits of three coal transport alternatives to that proposed for the Project.

2 ECONOMICS

From an economic perspective the costs and the benefits of road transport of coal and alternative transportation methods can be assessed using benefit cost analysis (BCA). This is consistent with NSW Department of Planning and Infrastructure's *Draft Guideline for economic effects and evaluation in EIA* (James and Gillespie, 2002), which identifies economic efficiency as the key consideration of economic analysis and BCA as the method used to consider the economic efficiency of proposals.

3 BENEFIT COST ANALYSIS

3.1 INTRODUCTION

BCA involves the following key steps:

- identification of the base case or "without" alternatives case;
- identification of the "with" alternatives scenario;
- physical quantification and valuation of the projects incremental benefits and costs;
- consolidation of values using discounting to account for the different timing of costs and benefits;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs, where applicable.

What follows is a BCA of alternative methods of transporting coal from the Tasman Underground Mine to the Bloomfield CHPP based on financial, technical and environmental advice provided by Donaldson Coal and its environmental consultants.

3.2 IDENTIFICATION OF THE PROJECT CASE AND ALTERNATIVES

3.2.1 Project Case

Identification of the "base case" or the scenario "without" alternative coal transportation methods is required to enable identification and measurement of the incremental economic benefits and costs of alternative transportation methods.

For this analysis, the base case involves the Project as proposed in the EIS with coal transported by road from the mine pit tops to the Bloomfield CHPP. The potential economic costs associated with this road transport include:

- contractor costs of road transport; and
- nominal accident costs.

Contractor costs are a function of volume of ROM coal transported and the dollar per tonne contractor cost. Under the Project case, ROM coal transported is predicted to increase from a current approved maximum of 975 kilotonnes (kt) per annum (pa) to a maximum of 1,500 kt pa. Road transport of coal would, once ramped up, remain near this maximum level until approximately 2026, when it would begin to decline. The unit contractor cost is estimated at $4.25/t.

It should be noted that this contractor cost would include amortisation of operating costs including payments to labour, fuel, vehicle operating costs and heavy vehicle registration fees. Heavy vehicle registration includes heavy vehicle charges aimed at recovering, among other things, the marginal or attributable costs of road wear and tear for each heavy vehicle type, a share of common road costs which benefit all road users, such as street lighting, rest bays and signage and a share of future road infrastructure requirements (National Transport Commissions, 2012). Based on these assumptions contractor costs over the Project life are estimated at $43 million (M) (present value at 7% discount rate).

An accepted method that is used to estimate the economic implications of public road traffic generation is to evaluate the nominal incidence of vehicle accidents as a function of the distance travelled, the type of road being used, and the likely accident rates on these road types. Societal accident costs can therefore be estimated based on the vehicle kilometres travelled each year, the likely accident rates and the costs per accident.

This method assumes a constant rate of accidents based on published data for the general population, and does not account for the fact that professional drivers would be expected to have lower accident rates per vehicle kilometre of travel on such a short haulage route, than the general population. Hence the nominal accident rates may be conservative in the context of professional drivers conducting short haul movements. Nevertheless, it is possible that the economics costs per accident may be greater than for the general population, given the nature and size of the vehicles involved. For instance, the University of Newcastle (2009) found that when a rigid or articulated truck is the key vehicle in an accident there is a higher risk of the accident being fatal. Given these uncertainties, sensitivity testing of accident rates and costs is undertaken in Section 3.5.

It should also be noted that the accident analysis undertaken for the Project Road Transport Assessment (Halcrow, 2012) and records held by Donaldson Coal did not identify any significant accidents (i.e. fatality or tow away) associated with the Tasman Underground Mine coal haulage on the public road network prior to 2012, and the haulage contractor operates within a Drivers Code of Conduct and the haulage activities are regularly audited. One incident involving a Tasman Underground ROM coal haulage truck was reported on 11 May 2012. This incident involved a motorcyclist reportedly losing control and colliding with a ROM coal haulage truck on George Booth Drive.

Under the Project case, coal haulage vehicle kilometres travelled each year will ramp up from 929,314 kilometres (km) at 975 kt to 1,171,714 km at 1,500 kt (Table A1-1). In 2013, it is anticipated that less coal would be hauled than the existing maximum rate, but haulage of waste rock is expected to be undertaken in that year which would compensate for the reduced coal haulage rate (i.e. total haulage would remain within the 975 kt current maximum rate of coal haulage on the public road network).

Table A1-1
Haulage Truck Annual Travel Characteristics

	Existing Maximum	Project Maximum	Proportion of Existing
Coal per Year (tonnes)	975,000	1,500,000	154%
Haulage Truck Trips per Year	55,714	85,714	154%
Vehicles Kilometres Travelled per Year	929,314	1,171,714	126%
Vehicle Hours of Travel per Year	13,340	16,179	121%

Source: Halcrow (2012).

The lower rate of vehicle kilometres travelled per tonne of coal produced as shown in Table A1-1 is a factor of reduced haulage distance from the new pit top in comparison to the existing pit top that is located further to the south (Halcrow, 2012). This reduces the potential impacts of the additional Project coal haulage on nominal accident rates.

Austroads (2008) identifies the following nominal accident exposure rates for non-urban project evaluation in Australia[1] (Table A1-2).

Table A1-2
Non-urban Accident Rates
(expected accidents per 100 million kilometres of travel)

Road description (model road state)	Accident category			
Undivided roads (sealed)	**Fatal**	**Injury**	**Property**	**Total**
MRS 5 Sealed <= 4.5m	1.50	28.50	74.00	104.00
MRS 6 Sealed 4.51 – 5.2m	1.95	37.06	58.00	97.00
MRS 7 Sealed 5.21 – 5.8m	2.00	38.00	54.00	94.00
MRS 8 Sealed 5.81 – 6.4m	1.63	30.58	54.50	87.00
MRS 9 Sealed 6.41 – 7.0m	1.25	23.75	45.00	70.00
MRS 10 Sealed 7.01 – 7.6m	1.13	21.38	35.50	58.00
MRS 11 Sealed 7.61 – 8.2m	1.06	20.19	30.75	52.00
MRS 12 Sealed 8.21 – 8.8m	1.00	19.00	29.00	49.00
MRS 13 Sealed 8.81 – 9.4m	1.06	20.19	24.75	45.00
MRS 14 Sealed 9.41 – 10.0m	1.03	19.59	34.35	55.00
MRS 15 Sealed 10.01 – 11.6m	1.00	19.00	35.00	55.00
MRS 16 Sealed 11.61 – 13.7m	0.97	18.41	35.63	55.00
MRS 17 Sealed >= 13.7	1.06	20.19	33.75	55.00

Source: Austroads (2008).

Notes:

MRS = model road state.

m = metres.

[1] These exposure rates are in relation to all vehicles using the roads. No separate data is available for heavy vehicles (Austroads 2012, pers. comms; National Transport Commission 2012, pers. comms.).

The public roads used for haulage of coal from the Tasman Underground Mine pit top to the Bloomfield CHPP are largely two lane undivided, with typical widths of about 7 metres (making no allowance for passing lanes etc that are available on the haulage route). Consequently, for the assessment of accident rates MRS9 has been assumed i.e. total accident rate of 70 per 100 million kilometres of travel. To allow for consideration of a range of potential accident rates, sensitivity testing was conducted to examine whether altering the assumed accident rate materially altered the economic costs that could be potentially attributed to the Project coal haulage (Section 3.5).

Austroads (2008) identify the following unit costs per accident[2] (Table A1-3).

Table A1-3
Estimated Average Crash Costs by Severity Category for NSW Non-urban Projects

Fatal	Average Casualty	Property
$2,260,000	$191,000	$7,500

Source: Austroads (2008).

Based on the above assumption, nominal accident costs based on general non-urban accident rates published by Austroads that could be attributed to the Project coal haulage (indexed to 2011 values) have been calculated. This is based on the total vehicle kilometres travelled per annum, and proportionally applying the accident rates in Table A1-2 which are per 100,000,000 km of travel and the accident costs in Table A1-3. Based on these calculations, over the life of the Project case, impacts are estimated at $0.7M (present value at 7% discount rate).

3.2.2 Alternatives

Donaldson Coal has previously evaluated a number of alternative road haulage transport routes. The existing approved public road haulage route was selected on the basis of a number of factors including consideration of capital costs and transport efficiency (including the required haulage distance on the public road network) and other relevant environmental factors (e.g. avoiding coal haulage through built up residential areas).

The approved road haulage route has also been the subject of a range of public road upgrade works by Donaldson Coal in support of the Tasman Underground Mine, in accordance with the existing Development Consent, including the provision of intersection and road upgrade works (Halcrow, 2012).

The following therefore considers alternatives that do not involve any transport of coal on the public road network, or constrain public road haulage on the current approved route to the current maximum haulage rate. In contrast to the Project case, alternative coal transport options for the Project include:

- transportation from the Tasman Underground Mine pit top to Bloomfield CHPP by surface conveyor;
- transportation from Tasman Underground Mine to Bloomfield CHPP by underground conveyor; and
- constraining the Project to currently approved maximum ROM coal production levels (975 kt per annum) so as not to increase the current annual level of road transportation of coal. This would extend the duration of the Project (i.e. as a result of a cap on annual production levels).

2 No separate data is available in relation to heavy vehicles.

3.3 IDENTIFICATION AND VALUATION OF THE INCREMENTAL COSTS AND BENEFITS OF ALTERNATIVES

3.3.1 Conveyor Options

Donaldson has identified that both the underground and overland conveyor alternatives would require a significant capital investment, estimated at $102M and $54M, respectively. These costs are associated with components such as equipment design and procurement, construction/installation, underground development, road and stream crossings and land acquisition.

Once constructed, conveyor operating costs are assumed to be the same for the aboveground and underground conveyor options i.e. $2.50/t of ROM coal transported.

These alternatives would both avoid the road haulage contractor costs associated with ROM coal transport on the public road network and the nominal accident costs associated with road haulage of coal under the Project case.

The development work that would be required for the underground conveyor option (i.e. establishment of drifts between the Tasman and Abel underground mining operations) would also yield a quantity of saleable coal estimated at 100 kt from the Upper Donaldson Seam (60% coking coal and 40% thermal coal) and 145 kt from the Sandgate Seam (100% thermal coal). For the purpose of this analysis, coking coal and thermal coal prices of $168 and $123 free-on-board (FOB) were assumed with adjustment for the costs of trucking to the CHPP, washing, rail to Port and loading (to obtain a net value).

The infrastructure required for both alternatives may also have some residual value at the cessation of the Project, although for the purpose of the analysis this is assumed to be zero.

The overland conveyor option would also be expected to have a range of potential environmental impacts that would vary, depending on the final conveyor alignment and the pre-existing environmental values in the conveyor corridor. Given the nature of the topography, vegetation and land uses between the Project and the Bloomfield CHPP such impacts may include effects on native vegetation (potentially including threatened species and/or endangered ecological communities) and heritage sites as well as requirements to construct conveyor structures across streams and public roads. Noise related impacts may also occur during construction and operation of the overland conveyor.

The environmental impacts of the underground conveyor option would be limited to any material surface works that may be required and any effects of dewatering associated with the underground drifts.

3.3.2 Constraining the Tasman Extension Project Production Rate

Constraining the Project to currently approved levels of ROM coal production and hence extending the mine life would reduce annual road haulage contractor costs and associated nominal road accident costs in most years of the analysis relative to the Project case. However, relative to the Project case road transport levels would increase in the final three years of the Project life and then continue (with associated road transport costs and nominal accident costs) for an additional 4 years.

Restricting the Project to currently approved maximum levels of ROM coal production and extending the mine life would result in a corresponding reduction in the net production benefits of the Project (i.e. due to discounting of revenues and costs that occur further into the future). While no detailed financial model was available for this option, the financial information available for the Project was used to approximate the net production effects of reducing annual production relative to the Project and extending the mine life (i.e. assuming the same total capital and operating costs and revenue would be spread over a longer duration). This analysis is likely to be conservative, as Project coal production at the higher rate would generally be expected to be more cost efficient, as fixed costs would be incurred over a longer period of time with the extended duration option.

3.3.3 Summary of Costs and Benefits

The incremental costs and benefits categories of the three alternative coal transportation options are summarised in Table A1-4.

Table A1-4
Incremental Costs and Benefits of Relevant Alternatives

Coal Transport Alternatives					
Underground Conveyor		**Overland Conveyor**		**Capping Road Transport at Current Maximum Levels – Extended Project Duration**	
Costs	**Benefits**	**Costs**	**Benefits**	**Costs**	**Benefits**
Capital costs	Avoided road haulage contractor costs	Capital costs	Avoided road haulage contractor costs	Reduced producer surplus from mining	Reduced road haulage contractor costs
Operating costs	Avoided nominal road accident costs	Operating costs	Avoided nominal road accident costs	-	Reduced nominal annual road accident costs
Negligible environmental impact costs	Residual value of infrastructure	Environmental impact costs (e.g. flora, heritage, noise) associated with surface development and operation	Residual value of infrastructure	-	Reduced annual trucking rates on the public road network, offset by longer duration of trucking – no change to total trucking
-	Value of underground development coal that is produced	-	-	-	-

3.4 CONSOLIDATION OF VALUE ESTIMATES

For the proposal to be justified on economic grounds, it must be economically efficient. Technically, a proposal is economically efficient if the present value of the benefits to society exceed the present value of the costs (James and Gillespie, 2002).

The present value of the costs and benefits the coal transport alternatives, relative to the Project case of continued road transport, are reported in Table A1-5.

Table A1-5
Net Present Value of Alternatives at 7% Discount Rate ($M)

Costs	Alternatives		
	Underground Conveyor	**Overland Conveyor**	**Capping road transport at current maximum levels – extended Project duration**
Capital costs	$89	$47	$0
Operating costs	$26	$26	$0
Reduced producer surplus of mining	$0	$0	$23
Sub-total	**$115**	**$73**	**$23**
Benefits			
Avoided private costs of road transport	$44	$44	-
Avoided nominal accident costs	$1	$1	-
Delayed private costs of road transport	-	-	$5
Delayed nominal accident costs	-	-	$0[1]
Residual value of capital equipment	$0	$0	$0
Net value of coal recovered during development	$23	-	-
Sub-total	**$68**	**$44**	**$5**
Net Quantified Benefit/Disbenefit	**-$47**	**-$29**	**-$18**
Unquantified environmental, cultural and social impacts	**Negligible**	**Yes**	**Negligible**

Note: $ values rounded to nearest whole number.
[1] $0.02M
Totals may have minor discrepancies due to rounding.

Relative to the proposed transport of Project ROM coal on public roads from the pit top to the Bloomfield CHPP, the alternative transport options analysed all result in a net cost.

When environmental, cultural and social impacts that have not been costed are also considered, these would be expected to increase the net costs, particularly for the overland conveyor option.

It should be noted that most of the costs and benefits of road transport accrue to Donaldson Coal. The exception is the nominal accident costs associated with road transport on the public road network (estimated as $0.7M, present value).

The cost to Donaldson Coal of reducing these nominal accident costs is substantial. The underground conveyor and overland conveyor alternatives would both avoid $0.7M (present value) in nominal accident costs but to achieve this benefit would require Donaldson Coal to bear a net cost of $48M and $30M, respectively. The capping of road transport at current maximum levels would result in a benefit of $0.02M in delayed nominal accident costs, but to achieve this benefit would require Donaldson Coal to bear a net cost of $18M (i.e. approximately 29% of the net production benefit of the Project accruing to Australia of $63M).

From an economic efficiency perspective, none of the coal transport alternatives analysed can therefore be justified.

3.5 SENSITIVITY TESTING

The net present values (NPVs) presented in Table A1-5 are based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for changes to the following variables:

- nominal accident rates;
- accident costs;
- capital costs;
- conveyor operating costs;
- road haulage costs;
- value of coal; and
- washing and transport costs of coal recovered from underground development.

This analysis indicated (Table A1-6) that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the nominal accident rates or accident costs had little impact on the NPV of the alternatives. The results were most sensitive to changes in the capital costs of a underground or overland conveyor. However, even substantial reductions in the estimated capital cost of a conveyor were not sufficient to result in these options having a positive NPV.

Table A1-6
Sensitivity Testing ($M)

	Underground Conveyor			Overland Conveyor			Capping road transport at current maximum levels – extended Project duration		
	4%	7%	10%	4%	7%	10%	4%	7%	10%
Core Analysis	-$45	-$47	-$48	-$26	-$29	-$30	-$31	-$18	-$9
20% Increases									
Nominal accident rates	-$45	-$47	-$47	-$26	-$29	-$30	-$31	-$18	-$10
Accident costs	-$45	-$47	-$47	-$26	-$29	-$30	-$31	-$18	-$10
Capital costs	-$64	-$65	-$64	-$36	-$38	-$39	-$31	-$18	-$9
Conveyor operating costs	-$52	-$52	-$52	-$33	-$34	-$34	-$31	-$18	-$9
Road haulage costs	-$34	-$38	-$41	-$14	-$20	-$23	-$30	-$17	-$9
Value of coal	-$39	-$41	-$42	-$26	-$29	-$30	-$31	-$18	-$9
Washing and transport costs of coal	-$46	-$48	-$49	-$26	-$29	-$30	-$31	-$18	-$9
20% Decreases									
Nominal accident rates	-$45	-$47	-$48	-$26	-$29	-$30	-$31	-$18	-$9
Accident costs	-$45	-$47	-$48	-$26	-$29	-$30	-$31	-$18	-$9
Capital costs	-$26	-$29	-$31	-$16	-$19	-$21	-$31	-$18	-$9
Conveyor operating costs	-$39	-$42	-$44	-$19	-$24	-$26	-$31	-$18	-$9
Road haulage costs	-$57	-$56	-$54	-$37	-$37	-$37	-$32	-$19	-$10
Value of coal	-$51	-$53	-$53	-$26	-$29	-$30	-$31	-$18	-$9
Washing and transport costs of coal	-$44	-$46	-$47	-$26	-$29	-$30	-$31	-$18	-$9

4 CONCLUSION

Road transportation of ROM coal from the Project to the Bloomfield CHPP, as proposed, is associated with a range of costs including private contractor costs and nominal accident costs.

Alternative coal transport options for the Project (underground conveyor, aboveground conveyor or continued road transport capped at currently approved levels) would avoid or reduce these costs and therefore provide an incremental community benefit.

However, these alternative coal transport options have additional capital, operating, production and environmental/cultural/social costs associated with them. On balance the potential costs of these alternatives are estimated to significantly outweigh the potential benefits, and therefore cannot be justified from an economic efficiency perspective.

Road safety related mitigation measures are described in Section 4 of the Main Report of the Environmental Impact Statement.

5 REFERENCES

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APPENDIX 2

BENEFIT COST ANALYSIS SENSITIVITY TESTING

Table A2.1 Total Net Benefits Sensitivity Testing
(Present Value $M)

	4%	7%	10%
CORE ANALYSIS	111.5	70.5	41.4
INCREASE 20%			
Opportunity cost of land and capital equipment	110.9	70.0	41.0
Capital costs	89.7	51.8	25.0
Operating costs	-1.0	-11.7	-19.5
Decommissioning and rehabilitation costs	111.4	70.5	41.4
Revenue	272.6	189.2	130.3
Residual value of land and capital equipment	111.6	70.6	41.5
Nominal road accident costs	111.4	70.4	41.3
Aboriginal heritage costs	110.5	69.5	40.4
Greenhouse gas emission costs @ $40/t CO2-e	106.9	66.9	38.6
DECREASE 20%			
Opportunity cost of land and capital equipment	112.1	71.0	41.8
Capital costs	133.3	89.2	57.8
Operating costs	223.9	152.6	102.4
Decommissioning and rehabilitation costs	111.5	70.5	41.4
Revenue	-49.6	-48.2	-47.4
Residual value of land and capital equipment	111.4	70.4	41.4
Nominal road accident costs	111.6	70.6	41.5
Aboriginal heritage costs	112.5	71.5	42.4
Greenhouse gas emission costs @ $8/t CO2-e	122.0	78.7	47.9

Table A2.2 Minimum Australian Net Benefits Sensitivity Testing
(Present Value $M)

	4%	7%	10%
CORE ANALYSIS	85.8	57.3	37.2
INCREASE 20%			
Opportunity cost of land and capital equipment	85.5	57.1	37.0
Capital costs	75.4	48.4	29.3
Operating costs	32.2	18.2	8.1
Decommissioning and rehabilitation costs	85.8	57.3	37.2
Revenue	162.6	114.0	79.5
Residual value of land and capital equipment	85.9	57.4	37.2
Nominal road accident costs	85.7	57.2	37.1
Aboriginal heritage costs	84.8	56.3	36.2
Greenhouse gas emission costs @ $40/t CO2-e	85.8	57.3	37.1
DECREASE 20%			
Opportunity cost of land and capital equipment	86.1	57.6	37.4
Capital costs	96.2	66.3	45.0
Operating costs	139.4	96.5	66.2
Decommissioning and rehabilitation costs	85.9	57.4	37.2
Revenue	9.0	0.7	-5.2
Residual value of land and capital equipment	85.8	57.3	37.1
Nominal road accident costs	86.0	57.4	37.2
Aboriginal heritage costs	86.9	58.3	38.1
Greenhouse gas emission costs @ $8/t CO2-e	85.9	57.4	37.2

APPENDIX 3

UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS (REPRODUCED FROM ABS 1995, P.24)

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 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.

APPENDIX 4

THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

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

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

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

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

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Table A4.1
The GRIT Method

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

Source: Table 2 in Bayne and West (1988)

APPENDIX 5

BACKGROUND TO MULTIPLIERS

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 [ABS], 1995). Conventional output, employment, value added and income multipliers show the output, employment, value added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

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

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

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

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

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

The *simple multiplier* is the initial effect plus the production induced effects.

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

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

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

A description of the different ratio multipliers is given below.

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

Type 1B Ratio Multiplier = Initial + Production Induced Effects / Initial Effects

Type 11A Ratio Multiplier = Initial + Production Induced + Consumption Induced Effects / Initial Effects

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

(Centre for Farm Planning and Land Management, 1989)

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