Wallarah 2 Coal Project

Benefit Cost Analysis

Prepared for

Wyong Areas Coal Joint Venture

By

Gillespie Economics
Tel: (02) 9804 8562
Email: gillecon@bigpond.net.au

TABLES

ATTACHMENTS

EXECUTIVE SUMMARY

Wyong Areas Coal Joint Venture (WACJV) has been exploring the Wyong Coal Development Areas under licence of the NSW Government since 1995. WACJV is now seeking to develop the coal resource via the Wallarah 2 Coal Project (W2CP).

The W2CP involves underground longwall mining of up to 5 million tonnes per annum (Mtpa) of export quality thermal coal for a period of up to 42 years, including the development of two above ground infrastructure sites.

The proposal requires the preparation of an Environmental Assessment (EA) in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979*. An economic assessment is required as part of the EA.

From an economic perspective there are two important aspects of the W2CP that can be considered:

- The economic efficiency of the proposal (i.e. consideration of the economic costs and benefits of the proposal) which can be evaluated using benefit cost analysis (BCA); and
- The regional economic impacts of the proposal (i.e. the economic stimulus that the proposal would provide to the regional economy) which can be evaluated using regional economic impact assessment.

This study relates to the preparation of a BCA. A regional economic impact assessment of the W2CP has been prepared separately by the Central Coast Research Foundation.

The BCA identified a range of potential economic costs and benefits of the W2CP and quantified the production costs and benefits. Key environmental externalities of the W2CP were then also quantified based on market values, the replacement/repair cost method, the property valuation method and benefit transfer.

The analysis indicated that the total net quantified production benefit of the W2CP is likely to be in the order of $1,242M. The net production benefit is distributed amongst a range of stakeholders including:

- WACJV shareholders;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of Company tax; and
- the local community via the Community Enhancement Program.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions required under the EP&A Act (if applicable).

The W2CP also has a range of external economic costs and benefits. Most of these e.g. those related to subsidence, flooding and noise would be paid for by the WACJV either directly or indirectly (via the Mine Subsidence Board) and therefore have already been included in the estimation of net production benefits. External costs associated with greenhouse gas generation have been estimated at $388M. These may initially be borne by the community, however, would ultimately be internalised into the production costs of WACJV through the purchase of required carbon pollution permits (once the Commonwealth Government's proposed Carbon Pollution Reduction Scheme is implemented). Alternatively, the WACJV may reduce the carbon liability associated with the Project through methane mitigation actions and onsite electricity generation. However, this latter action would only make economic sense if the carbon permit savings and value of electricity generated are greater than the costs of taking the actions. This is the subject of ongoing investigations.

There would also be externality costs associated with the clearing of native vegetation. However, these are assumed to be counterbalanced by the offset actions proposed by WACJV. External benefits associated with employment have been estimated at $665M.

Overall the W2CP is estimated to have net benefits to the community of $1,519M and hence is desirable and justified from an economic efficiency perspective.

Table ES1
Benefit Cost Analysis Results of the W2CP (Present Values)

	Costs	**$M**	**Benefits**	**$M**
Production	Opportunity cost of land	$47	Sale value of coal	$3,727
	Opportunity cost of capital	$0		
	Capital costs[a]	$686		
	Operating costs ex royalties and carbon tax	$1,752		
	Rehabilitation and decommissioning costs	Offset by residual value of land and capital	Residual value of land and capital	Offset by rehabilitation and decommissioning costs
	Production Sub-total	***$2,484***		***$3,727***
	Net Production Benefit	**$0**		**$1,242**
Externalities[a]	Local water supply	Negligible		
	Subsidence impacts	Accounted for through Mine Subsidence Board Levy	Social and economic value of employment	$665
	Waterways, creeks and riparian areas	Some capital work costs included above		
	Groundwater	Negligible		
	Flooding	Accounted for through Mine Subsidence Board Levy		
	Air quality	Negligible		
	Noise	Costs of mitigation included in capital and operating costs		
	Ecology and biodiversity	Some loss of values but offset. Cost of offset included in opportunity cost of land and operating costs		
	Aboriginal and European heritage	Negligible		
	Traffic and transport	Negligible		
	Visual amenity	Negligible		
	Greenhouse gas	$388		
	Externality sub-total	***$388***		***$665***
	Net externality benefit			**$277**
Net Community benefits				**$1,519**

* Cost and benefits over time have been discounted at 7%.

[a] Property acquisition costs are accounted for in capital and operating costs. Acquisition is an option that may be undertaken for mitigating certain impacts.

1 INTRODUCTION

Wyong Areas Coal Joint Venture (WACJV) has been exploring the Wyong Coal Development Areas under licence of the NSW Government since 1995. WACJV is now seeking to develop the coal resource via the Wallarah 2 Coal Project (W2CP).

An Environmental Assessment (EA) for the W2CP is being prepared in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979* (EP& A Act). The Department of Planning (DoP) Environmental Assessment Requirements for the proposal refer to the need for a:

" conclusion justifying the project, taking into consideration: the economic..... impacts of the project..."

"comprehensive assessment of the potential economic and social impacts and benefits of the project that demonstrate that the project as a whole has would result in a net benefit to the community.....including consideration of the economic implications of the Commonwealth's proposed Carbon Pollution Reduction Scheme".

From an economic perspective there are two important aspects of the W2CP that can be considered:

- The economic efficiency of the proposal (i.e. consideration of the economic costs and benefits); and
- The economic impacts of the proposal (i.e. the economic stimulus that the proposal will provide to the regional or State economy).

Planning NSW (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. Planning NSW's (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

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

This study relates to the preparation of a BCA of the W2CP. A regional economic impact assessment of the proposal has been prepared separately by the Central Coast Research Foundation.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the W2CP to be economically desirable it must be economically efficient. Technically, a proposal is economically efficient and desirable on economic grounds if the benefits to society exceed the costs (James and Gillespie, 2002). For mining projects, the main economic benefit is the producer surplus generated by the mine and the employment benefits it provides, while the main economic costs relate to environmental and cultural impacts.

BCA is used to weigh up these benefits and costs and involves the following steps:

- identification of the base case;
- identification of the proposal and its implications;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- sensitivity testing;
- application of decision criteria; and
- consideration of non-quantified benefits and costs.

What follows is a BCA of the W2CP based on financial, technical and environmental advice provided by WACJV and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND THE W2CP

The benefits and costs of the W2CP can be identified and estimated through a comparison of the Project to the 'base case' or 'do nothing' scenario. This is the situation "without" the W2CP.

In this study, the base case involves cessation of existing investigations and realisation of the value of land and capital assets accumulated in anticipation of the W2CP.

In contrast, the W2CP involves:

- Underground longwall mining of up to 5 million tonnes per annum (Mtpa) of export quality thermal coal for a period of up to 42 years. Approval is being sought for an initial duration of 28 years;
- Development of a coal handling plant providing crushing and screening and storage facilities at the Tooheys Road site;
- Construction of a rail loop and loading infrastructure at the Tooheys Road site;
- Development of surface infrastructure for employees as the Buttonderry site on Hue Hue Road;
- Development of an underground drift entry ;
- Construction of ventilation shafts and gas and water management facilities;
- Transport of coal by rail to either Newcastle for export or to a local power station.

At the end of the W2CP it is assumed that capital equipment would be sold and the land used for surface infrastructure would be rehabilitated and allocated to its next best use.

WACJV has considered numerous variations on the mine plan for the W2CP throughout the planning process. These have occurred primarily to reduce environmental impacts of the proposal. The W2CP is considered by WACJV to be the preferred proposal for optimising economic reserve recovery, taking into account environmental and subsidence constraints. The BCA therefore focuses on WACJV's preferred proposal.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the identified base case, the W2CP may have the potential incremental economic benefits and costs shown in Table 2.1.

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

Table 2.1
Economic Benefits and Costs of the W2CP

Category	Costs	Benefits
Production	• Opportunity cost of land (including land for biodiversity offsets) • Opportunity cost of capital • Capital costs including surface infrastructure, sustaining capital, land acquisitions • Operating costs, including administration, mining, processing and transportation (ex royalties) • Decommissioning and rehabilitation costs of surface facilities	• Sale value of coal • Residual value of capital and land at the cessation of the proposal
Externalities	• Local water supply impacts • Subsidence impacts • Waterways, creeks and riparian area impacts • Groundwater impacts • Flooding impacts • Air quality impacts • Noise impacts • Ecology and biodiversity impacts • Aboriginal and European heritage impacts • Traffic and transport impacts • Visual amenity impacts • Greenhouse gas impacts	• Economic and social benefits of employment

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

In accordance with the NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2007), where competitive market prices are available, they have generally been used as an indicator of economic values. Non-market values have been estimated using the replacement/repair cost method, property valuation method and benefit transfer.

Economic Benefits

Sale Value of Coal

The W2CP will involve the extraction of up to 5 million tonnes per annum of export quality thermal coal, without the need for a coal washing plant.

W2CP coal will be sold to both export and domestic markets. However, in the first 10 years of mining it is anticipated that the majority of coal will be sold on the export market.

An average value of AUD$98/tonne has been assumed for the analysis. However, given the uncertainty associated with future thermal coal prices, sensitivity testing has been undertaken in Section 2.6.

Residual Value of Land and Capital at End of the Evaluation Period

Advice from WACJV is that the residual value of land and capital at the end of the Project life would more than offset closure costs. Conservatively, in this analysis it is assumed that they would exactly offset closure costs.

2.4.1 Production Costs and Benefits[1]

Economic Costs

Opportunity Cost of Land

There is an opportunity cost associated with using land already owned by WACJV, for the W2CP instead of its next best use. This opportunity cost is the market value of the land, estimated at $50M.

Opportunity Cost of Plant

Where the mining and coal handling activity would utilise plant and machinery already owned by WACJV, there is an opportunity cost associated with utilising this plant for the Project rather than selling it or using it elsewhere. However, there is no existing mine operation and hence the opportunity cost of capital is zero.

Capital Cost of the Proposal

Capital costs of the W2CP are associated with development of a coal handling plant, construction of a rail loop and loading infrastructure, development of surface infrastructure for employees, development of underground longwalls, sustaining capital and land acquisitions for impacted properties. These capital costs over the life of the proposal are estimated at approximately $1.4B. 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 W2CP include those associated with underground mining, coal handling, rail transport, port costs, demurrage, marketing and commissions, corporate costs and environmental management. Average annual operating costs of the W2CP (excluding royalties) are estimated at $161M.

While royalties are a cost to WACJV they are part of the overall producer surplus benefit of mining that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the W2CP. Nevertheless, it should be noted that the Project would generate total royalties of $638M.

Decommissioning and Rehabilitation Costs of Surface Facilities

The surface facilities would be decommissioned and rehabilitated at cessation of mining. No separate decommissioning and rehabilitation cost has been included in the analysis as WACJV advise that sale of land and residual capital would more than offset closure costs.

[1] All values reported in this section are undiscounted unless specified.

2.4.2 External Costs and Benefits

The W2CP may have a number of external environmental, cultural and social impacts. These are discussed below and as far as possible are valued using either market data, the replacement/repair cost method, the property valuation method or benefit transfer.

Local Water Supply Scheme – the W2CP has been designed to safeguard surface and underground water regimes. Groundwater modelling has shown that effects on alluvial groundwater system will be minor and transient. The extraction area of W2CP covers only 5% of the entire combined Gosford Wyong Water Supply Scheme catchment area, the majority of which lies within the Wyong State Forest. There will be some minor alterations to flows of drainage lines in these areas as a result of subsidence. However, the overall impact to the water supply will be negligible.

Nevertheless, in recognition of the importance of this issue to the community, WACJV is proposing as part of the Project an enhancement scheme designed to assist in improving overall water quality in the catchment that is affected by rural residential and agricultural activity.

The overall impact of the Project on the water supply scheme is therefore likely to be positive. While no attempt has been made to value these positive impacts, the capital and operating cost of this enhancement scheme have been included in the analysis.

Subsidence impacts – the Project will occur completely within two mine subsidence districts and has been designed to minimise subsidence and to meet subsidence criteria for these areas. Houses built in accordance with the Hue Hue Mine Subsidence District criteria should have appropriate levels of structural protection to mitigate the impacts of subsidence. Any damage to houses or surface infrastructure is an economic cost that will be remedied by the Mine Subsidence Board should any impacts arise. The costs of these repairs are accounted for in the analysis via inclusion in the operating costs, above, of the payments made to the Mine Subsidence Board. Furthermore, an allowance has been made in the capital cost for some voluntary or conditioned land acquisitions, should these be required.

Waterways, creeks and riparian areas –the mining plan has been modified over time to ensure the stability of the confluence of Jilliby Creek and Little Jilliby Creek during all flows. Where required for these or other streams affected by subsidence, riparian protection works will be undertaken. There is sufficient allowance in the capital cost estimated to accommodate such works.

Groundwater – as identified above, the W2CP has been designed to safeguard surface and underground water regimes. Groundwater modelling has shown that effects on alluvial groundwater system will be minor and transient and hence there will be negligible effects on stream flows. In addition there is little usage of groundwater in the region, especially of any deep groundwater in the mining area, and hence there will be negligible ongoing effects on groundwater users. No economic implications associated with groundwater have therefore been identified.

Flooding – the Project will result in some subsidence–induced topographic changes near water courses and floodplains. There are 70 dwellings in the Yarramalong/Dooralong study area located within the 1 in 100 year AFI floodplain. Of these, 26 will be adversely affected as a result of subsidence-induced topographic changes, eight will be negligibly affected, 38 will be beneficially affected and seven will remain unchanged. Three dwellings near Hue Hue Creak will be adversely impacted and one will be beneficially impacted.

The Mine Subsidence Board will be responsible for developing mitigation measures to rectify, reduce or otherwise compensate landholders for increased risk of flood inundation for properties affected by mine subsidence.

The costs of these actions are accounted for in the analysis via inclusion in the operating costs, above, of the payments made to the Mine Subsidence Board and in certain cases of potential land acquisition.

Air quality – atmospheric modelling of both construction and operational dust and odour was undertaken for the Project. Concentration of dust and deposition rates of dust from the construction phase are predicted to be well within Department of Environment, Climate Change and Water's (DECCW) air quality criteria.

During the operation phase of the Project, air quality impacts for particulate matter will be in compliance with long term goals as well as short term 24-hour PM10 goals. The emissions of fine particles (PM2.5) and silica were also found to comply with relevant criteria in all offsite receptor areas.

No economic implications associated with air quality have therefore been identified.

Noise – Noise modelling indicates that with appropriate controls, the Buttonderry site will meet all noise assessment goals specified under the NSW Industrial Noise Policy.

Some marginal noise exceedences may occur in certain meteorological conditions at two properties to the south of the Tooheys Road site. Consequently, a Noise Management Plan will be implemented which provides for further noise monitoring, restricting site activities when prevailing north east winds occur and specific noise mitigations measures or compensation. Outright purchase of these properties would be offered by WACJV if negotiation of suitable compensation or other mitigation strategies fail to achieve acceptable outcomes to the owners during operations.

The noise environmental of properties to the northwest of the Tooheys Road site is dominated by the F3 Freeway and while technically the Project will result in no noise exceedances at these properties, in the absence of the F3 Freeway background noise it would. WACJV therefore proposes to offer the same mitigation and management strategy for affected properties as it will for properties to the south of the Tooheys Road site.

An allowance for these actions is included in capital and operating cost estimates above. In this way any noise externalities of the Project are internalised into the costs of the W2CP.

Ecology and biodiversity – the surface facilities have been designed and located to minimise vegetation disturbance including both clearance and habitat fragmentation, and the Project will implement a range of biodiversity management measures to ameliorate potential biodiversity impacts. Nevertheless, the Project will result in the direct removal of 22.37 ha of native vegetation. A further 10 ha of native vegetation will be cleared within land adjoining the TransGrid easement for the purpose of the proposed rail loop. This clearing will potentially impact rare species including *Angophora inopina*, *Tetratheca juncea* and potentially the Squirrel Glider and Wallum Froglet.

WACJV owns approximately 115 ha of higher value conservation value forested land that will not require disturbance as part of the development. There are also significant areas of forested land within the development properties that would not be disturbed. An ecological offset strategy is proposed that includes conserving an appropriate area of existing native vegetation on lands currently owned by WACJV, actively managing other remaining vegetated areas within the project facilities sites for conservation purposes (including riparian vegetation of Wallarah Creek) and a riparian zone enhancement program along Jilliby Jilliby Creek.

The impacted vegetation, and associated fauna, is likely to have non-use values to the community that can potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community. The cost of providing offsets is included in the opportunity cost of land estimate above as existing project-owned land would be involved The community value of offsets is assumed to approximate the community value of clearing i.e. result in no net loss in community values.

Aboriginal and European heritage – there are no significant Aboriginal or European heritage features directly impacted by the Project surface infrastructure. European heritage features above the underground workings will be considered in subsidence management planning with appropriate adaptive management plans prepared. No economic implications associated with heritage have therefore been identified.

Transport and traffic – the Project surface facilities will be well serviced by road, with coal to be transported offsite by a dedicated rail loop. Implications of the Project for transport and traffic are therefore likely to be negligible. No economic implications associated with transport and traffic have been identified.

Visual amenity – the surface facilities will be located on industrially zoned lands adjoining other industrial and light industrial land uses. Any visual impact from the F3 will be ameliorated by mounding and landscaping. No economic implications associated with visual amenity have therefore been identified.

Greenhouse gas generation – over the life of the project and assuming no methane mitigation measures are undertaken, the W2CP will generate in the order of 51 million tonnes (Mt) of greenhouse gas emissions from mining and transport of product coal by rail to the port[2]. To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions. There is great uncertainty around the social cost of carbon with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. Again, however, there is a wide range of permit prices. For this analysis a shadow price of carbon 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 Attachment A.

Social and economic value of employment - the W2CP will provide an estimated 300 direct jobs for a period of up to 42 years.

Historically employment benefits of projects has tended to be omitted from BCA on the implicit assumption that labour resources used in a proposal would otherwise be employed elsewhere. Where this is not the case and labour resources would otherwise be unemployed for some period of time, 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 proposal. 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) and the viability of rural communities (Bennett *et al*., 2004).

Gillespie Economics (2008) estimated the value the community hold for each of the 23 years that the Metropolitan Colliery provides 320 jobs, at $33M (present value). A simple extrapolation of this result to 23 years of the W2CP life provides a value of $712M. It is not considered appropriate to extrapolate the Metropolitan Colliery result to more than 23 years because diminishing marginal utility for additional years of the mine providing jobs may result in a lower average value.

[2] It should be noted that greenhouse gas generation associated with sea transport and usage of the product coal is considered to be outside of the scope of the BCA of the Project.

2.5 CONSOLIDATION OF VALUE ESTIMATES

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.3.

Table 2.3
Benefit Cost Analysis Results of the W2CP (Present Values)

	Costs	**$M**	**Benefits**	**$M**
Production	Opportunity cost of land	$47	Sale value of coal	$3,727
	Opportunity cost of capital	$0		
	Capital costs	$686		
	Operating costs ex royalties and carbon tax	$1,752		
	Rehabilitation and decommissioning costs	Offset by residual value of land and capital	Residual value of land and capital	Offset by rehabilitation and decommissioning costs
	Production Sub-total	***$2,484***		***$3,727***
	Net Production Benefit	**$0**		**$1,242**
Externalities	Local water supply	Negligible		
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	Waterways, creeks and riparian areas	Some capital work costs included above		
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	Aboriginal and European heritage	Negligible		
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	Visual amenity	Negligible		
	Greenhouse gas	$388		
	Externality sub-total	***$388***		***$665***
	Net externality benefit			**$277**
Net Community benefits				**$1,519**

* Cost and benefits over time have been discounted at 7%. Lump sum values from the benefit transfer from other studies have been inserted into the first year of the analysis and discounted.

The main decision criterion for assessing the economic desirability of a proposal 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 W2CP, because the community as a whole would obtain net benefits.

Table 2.3 indicates that the W2CP would have net production benefits of $1,519M. The net production benefit is distributed amongst a range of stakeholders including:

- WACJV shareholders;

- the NSW Government via royalties;
- the Commonwealth Government in the form of Company tax; and
- the local community via the proposed Community Enhancement Program.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions required under the EP&A Act (if applicable).

The W2CP also has a range of external economic costs and benefits. Most of these e.g. those related to subsidence, flooding and noise would be paid for by the WACJV either directly or indirectly (via the Mine Subsidence Board) and therefore have already been included in the estimation of net production benefits. External costs associated with greenhouse gas generation have been estimated at $388M. These may initially be borne by the community, however, would ultimately be internalised into the production costs of WACJV through the purchase of required carbon pollution permits (once the Commonwealth Government's proposed Carbon Pollution Reduction Scheme is implemented). Alternatively, WACJV may reduce the carbon liability associated with the Project through methane mitigation actions and potentially onsite electricity generation. However, this latter action would only make economic sense if the carbon permit savings and value of electricity generated are greater than the costs of taking the actions. This is the subject of ongoing investigations.

There would also be externality costs associated with the clearing of native vegetation. However, these are assumed to be counterbalanced by the offset actions proposed by WACJV. External benefits associated with employment have been estimated at $665M.

Overall the W2CP is estimated to have net benefits to the community of $1,519M and hence is desirable and justified from an economic efficiency perspective.

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;
- revenue from sale of coal;
- greenhouse gas impacts;
- social and economic value of employment.

This analysis indicated (Attachment B) 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 values used for external impacts such as greenhouse gas costs had little impact on the overall economic desirability of the W2CP.

The results were most sensitive to decreases in the sale value of coal, although substantial and sustained reductions in assumed coal prices (i.e. a 40% reduction) would be required to make the Project undesirable from an economic efficiency perspective.

Consideration was also given to the uncertainty regarding the assumed value for the benefits of employment. Varying this values by plus or minus 20% had only has a moderate impact on the NPV of the Project, with the net benefits of the Project remaining strongly positive (Attachment B).

3 CONCLUSION

The BCA identified a range of potential economic costs and benefits of the W2CP and quantified the production costs and benefits. Key environmental externalities of the W2CP were then also quantified based on a range of market values, the replacement/repair cost method, the property valuation method and benefit transfer.

The analysis indicated that the total net quantified production benefit of the W2CP is likely to be in the order of $1,242M. The net production benefit is distributed amongst a range of stakeholders including:

- WACJV shareholders;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of Company tax; and
- the local community via the proposed Community Enhancement Program.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions required under the EP&A Act (if applicable).

The W2CP also has a range of external economic costs and benefits. Most of these e.g. those related to subsidence, flooding and noise would be paid for by the WACJV either directly or indirectly (via the Mine Subsidence Board) and therefore have already been included in the estimation of net production benefits. External costs associated with greenhouse gas generation have been estimated at $388M. These may initially be borne by the community, however, would ultimately be internalised into the production costs of WACJV through the purchase of required carbon pollution permits (once the Commonwealth Government's proposed Carbon Pollution Reduction Scheme is implemented). Alternatively, WACJV may reduce the carbon liability associated with the Project through methane mitigation actions and potentially onsite electricity generation. However, this latter action would only make economic sense if the carbon credit savings and value of electricity generated are greater than the costs of taking the actions.

There would also be externality costs associated with the clearing of native vegetation. However, these are assumed to be counterbalanced by the offset actions proposed by WACJV. External benefits associated with employment have been estimated at $665M.

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ATACHMENT A – VALUING GREENHOUSE GAS EMISSIONS

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

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

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

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

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

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

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

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

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

In 2008 the price of carbon credits under the European Union Emissions Trading Scheme were around Pounds (€) 24/t CO_2, the equivalent of about US$38/t CO_2 while spot prices in the Chicago Climate Exchange are in the order of US$3.95/t CO_2.

As of July 2008 the spot price under the NSW Government Greenhouse Gas Reduction Scheme was Australian Dollars (AUD) $7.25/t CO_2. Prices under the Commonwealth Governments Greenhouse Friendly Voluntary Scheme were AUD$8.30/t CO_2 and Australian Emissions Trading Unit (in advance of the Australian Governments Emissions Trading Scheme) was priced at AUD$21/t CO_2-e (Next Generation Energy Solutions, pers. comms., 24 July 2008).

A National Emissions Trading Scheme is foreshadowed in Australia by 2010. While the ultimate design and hence liabilities under the scheme are still a work in progress, the National Emissions Trading Taskforce cited a carbon permit price of around AUD$35/t CO_2.

The *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future White Paper* (Australian Government, 2008) cited a carbon permit price of AUD$23/t CO_2-e in 2010 and AUD$35/t CO_2-e in 2020 (in 2005) dollars for a 5% reduction in carbon pollution below 2000 levels by 2020.

Given the above information and the great uncertainty around damage cost estimates, a range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of the Socio-Economic Assesssment, with a conservatively high central value of AUD$30/t CO_2-e.

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ATTACHMENT B – BCA SENSITIVITY TESTING

Benefit Cost Analysis Sensitivity Testing ($Millions)

INCREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
Opportunity cost of land	2,538	1,510	991
Capital costs	2,372	1,382	887
Operating costs	1,980	1,169	768
Revenue	3,806	2,264	1,475
Value of employment	2,685	1,652	1,130
Greenhouse costs @ $40/tonne (t)	2,328	1,390	918

DECREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
Opportunity cost of land	2,558	1,528	1,009
Capital costs	2,724	1,656	1,114
Operating costs	3,116	1,869	1,232
Revenue	1,290	774	526
Value of employment	2,411	1,386	871
Greenhouse costs @ $8/t	3,031	1,804	1,181