Appendix 18

Benefit Cost Analysis

South East Open Cut Project

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Modification to the

Existing ACP Consent

South East Open Cut Project and Ashton Coal Project Modification

Benefit Cost Analysis

Prepared for

Ashton Coal Operations Pty Limited

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TABLES

ATTACHMENTS

EXECUTIVE SUMMARY

Ashton Coal Operations Pty Limited (ACOL) operates the Ashton Coal Project (ACP) which is located 14 kilometres north-west of Singleton in the Hunter Valley. The ACP currently comprises the North East Open Cut (NEOC), the Ashton Underground Mine and the Ashton coal handling and preparation plant (CHPP). The NEOC will exhaust available coal by the end of 2010.

The proposal is to establish the South East Open Cut (SEOC) to facilitate continuity of coal supply and employment, and for modifications to the ACP relating to the maximum coal extraction allowed from the Ashton Underground Mine.

The proposed SEOC 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 SEOC Project that can be considered:

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

This study relates to the preparation of a BCA of the SEOC Project. A REIA of the Project was prepared separately by the Hunter Valley Research Foundation.

The BCA identified a range of potential economic costs and benefits of the SEOC Project and initially quantified the production costs and benefits. Environmental, cultural and social externalities of the Project were then also quantified based on market data, the replacement/repair cost method, the property valuation method and benefit transfer.

The analysis indicated that the net production benefit of the SEOC Project is likely to be in the order of $298M. The net production benefit is distributed amongst a range of stakeholders including:

- ACOL;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of company tax.

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 SEOC Project also has a range of external economic costs and benefits. External costs associated with the proposal have been valued at $38M. These costs relate to greenhouse gas generation and impacts on highly significant Aboriginal heritage sites. 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 ACOL. External benefits associated with employment have been estimated at $116M.

Overall the SEOC Project is estimated to have quantified net benefits to the community of $368M and hence is desirable and justified from an economic efficiency perspective.

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

	COSTS	$ Million	BENEFITS	$ Million
Production	Opportunity cost of land	$11	Sale value of coal	$992
	Opportunity cost of capital	$9	Residual value of land at the cessation of the Project	$8
	Capital costs including infrastructure, sustaining capital, land acquisitions, costs of biodiversity offsets	$91	Residual value of capital at the cessation of the Project	$0
	Operating costs, including administration, mining, processing and transportation, and rehabilitation (ex royalties)	$591	-	
	Production Sub-total	**$702**	**-**	**$1,000**
	Net Production Benefits		**-**	**$298**
Externalities	Greenhouse	$32	Economic and social benefits of employment	$108
	Noise and vibration	Included above in opportunity cost of land and capital costs	Economic value of offsets	Capital cost included above, values gained are offset by a loss
	Air quality	Included above in opportunity cost of land and capital costs	-	
	European heritage	Negligible impact	-	
	Aboriginal heritage	$5	-	
	Ecology	Values lost are offset	-	
	Groundwater	Negligible	-	
	Surface water	Negligible	-	
	Visual amenity	Negligible	-	
	Traffic and transportation	Negligible, cost of intersection included in capital costs	-	
	Externality Sub-total	**$38**	**-**	**$108**
	Net Externality Cost		**-**	$70
NET COMMUNITY BENEFITS				**$368**

* Cost and benefits over time have been discounted at 7%. Lump sum values from the benefit transfer of CM values have been placed in year 1 of the analysis and discounted.

1 INTRODUCTION

Ashton Coal Operations Pty Limited (ACOL) operates the Ashton Coal Project (ACP) which is located 14 kilometres north-west of Singleton in the Hunter Valley. The ACP currently comprises the North East Open Cut (NEOC), the Ashton Underground Mine and the Ashton coal handling and preparation plant (CHPP). The NEOC will exhaust available coal by the end of 2010.

The proposal is to establish the South East Open Cut (SEOC) to facilitate continuity of coal supply and employment, and for modifications to the ACP relating to the maximum coal extraction allowed from the Ashton Underground Mine.

An Environmental Assessment (EA) for the Project 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) Director-General's Requirements for the Project refer to the need for a:

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

"a detailed assessment of the costs and benefits of the project as a whole and whether it would result in a net benefit for the NSW community" .

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

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

Planning NSW (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* identified 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* identify 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 SEOC. A regional economic impact assessment of the Project was prepared separately by the Hunter Valley Research Foundation.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the SEOC Project to be desirable from an economic perspective it must be economically efficient. Technically, a Project 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 costs.

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

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

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

2.2 IDENTIFICATION OF THE BASE CASE AND THE SEOC

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

Under the base case:

- the NEOC will cease at the end of 2010;
- 160 full time employees at the NEOC would lose their jobs;
- land acquired in the Camberwell Village as a buffer to the NEOC operation would be able to be sold;
- the residual value of the capital equipment from the NEOC would be realised through sale;
- the Ashton Underground Mine and CHPP will continue operating.

In contrast, the SEOC Project involves:

- development of the SEOC with extraction of up to 3.6 million tonnes per annum (Mtpa) of run-of-mine (ROM) production for up to 7 years;
- continued employment of 160 fulltime employees;
- utilisation of existing buffer land and capital from the NEOC;
- purchase of additional mining lease land and buffer land;
- development of ancillary infrastructure;
- provision of an ecological offset for the vegetated land that will be cleared;
- rehabilitation of the SEOC at cessation of mining and sale of land, including buffer land;
- sale of residual capital at the cessation of the SEOC. See Section 4 of the EA for a full description of the Project.

The modification to the existing ACP development consent will increase the limit on annual ROM Production from the Ashton Underground Mine to enable compliance in years when there is only one longwall move and hence higher volumes of ROM production will be achieved. However, this modification will not lead to any overall increase in the average annual production, and so has little impact on the BCA.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the identified base case, the SEOC 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 SEOC Project

Category	Costs	Benefits
Production	• Opportunity cost of land • Opportunity cost of capital • Capital costs including infrastructure, sustaining capital, land acquisitions, costs of biodiversity offsets • Operating costs, including administration, mining, processing and transportation, and rehabilitation	• Sale value of coal • Residual value of capital and land at the cessation of the Project
Externalities	• Greenhouse gas generation • Noise and vibration • Air quality • European heritage • Aboriginal heritage • Ecology • Groundwater • Surface water • Visual amenity • Traffic and transportation	• Economic and social benefits of employment • Economic value of offsets

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.

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 ACOL, for the SEOC instead of its next best use. This includes the mining lease land as well as properties in the Camberwell Village. This opportunity cost of this land is its market value, which is conservatively estimated at $11.4M.

Opportunity Cost of Plant

Where the SEOC would utilise plant and machinery from the NEOC, there is an opportunity cost associated with utilising this plant rather than realising its value through sale. This opportunity cost is estimated at $10M.

Capital Cost of the SEOC

Capital costs of the SEOC Project are associated with the provision of ancillary infrastructure, demolition of existing structures in the SEOC footprint, bunding, purchase of new equipment, sustaining capital, land acquisitions for impacted properties and biodiversity offsets. These capital costs over the life of the Project are estimated at approximately $100M and have been 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 SEOC include those associated with overburden removal, mining, conveying coal, washing, rehabilitation, technical services, safety and training, site facilities, site administration, environmental management, rail freight, port charges, demurrage and management and marketing fees. Average annual operating costs of the SEOC Project (excluding royalties) are estimated at $135M.

While royalties are a cost to ACOL they are part of the overall producer surplus benefit of the Project that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the SEOC. Nevertheless, it should be noted that the Project would generate total royalties of $104M.

Economic Benefits

Sale Value of Coal

The SEOC Project will involve the mining of up to 3.6 Mtpa of ROM to produce both semi-soft coking coal and thermal coal.

Based on Macquarie Research forecasts an average value of US$90/tonne for semi-soft coking coal and US$73/tonne for thermal coal, and a US$/AUD$ exchange rate of 0.75, has been assumed. However, given the uncertainty associated with future coal prices and the exchange rate, sensitivity testing has been undertaken in Section 2.6.

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

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

At cessation of the SEOC, rehabilitated land and buffer land is estimated to have a residual value of $13.4M. The residual value of capital is estimated at $2M.

2.4.2 External Costs and Benefits

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

Greenhouse Gas Generation - the SEOC would generate in the order of 1.4 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 AUS$30/t CO_2-e was used, with sensitivity testing from AUS$8/t CO_2-e to AUS$40/t CO_2-e. Refer to Attachment A.

Noise and Blasting – acoustic modelling predicted that all private residences within 1km to 2km of the northern boundary of the site, including all dwellings within Camberwell Village, are likely to be impacted by noise levels above the adopted amenity criteria. These impacts can potentially be valued by examining changes in property value (i.e. the property valuation method). However, ACOL has already purchased all but 17 properties within the Camberwell Village, and the full cost of these acquisitions has already been included in the opportunity cost of land estimates above. Furthermore, it is expected that the private owners of those properties impacted above Department of Environment and Climate Change (DECC) guidelines will be granted options to sell their properties to ACOL. The full costs of such land acquisition (rather than the partial property value change) have been incorporated into the capital costs of the analysis.

Air quality – air quality monitoring indicated that several properties will be impacted by dust levels above the relevant DECC criteria. Impacts that reduce the enjoyment associated with a property can potentially be valued by examining changes in property value (i.e. the property valuation method). However, the properties impacted by air quality are the same properties that are likely to be impacted by noise effects and hence the full cost of acquisition has already been taken into account above.

European heritage – a number of European heritage sites will be directly and indirectly impacted by the SEOC Project. Impacts on heritage sites can potentially affect the use and non-use values of the community, with these impacts estimated using non-market valuation methods, such as choice modelling. However, the sites impacted by the Project are of local significance only and hence the impacts on community non-use values are likely to be negligible. Nevertheless, prior to impact, the sites will be researched, surveyed and documented to enhance the historical knowledge of the area.

Aboriginal heritage – archaeological surveys identified 85 Aboriginal heritage sites that may be impacted by the SEOC Project. Two sites are of high significance. In addition to the value of these sites to the Aboriginal community, these sites may have non-use economic values to society which can potentially be estimated using non-market valuation methods such as choice modelling. Gillespie Economics (2008) undertook a CM study for the Metropolitan Coal Project and estimated the values the community hold for rock overhangs containing highly significant Aboriginal sites such as grinding

[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.

groove, engraving, rock art and artefacts. These were valued at $2.9M per Aboriginal site. A simple extrapolation of this result to the two highly significant Aboriginal sites impacted by the SEOC, suggests an impact of $5.8M .

Ecology – the SEOC Project will result in the clearing of 24.7ha of regenerating Central Hunter Ironbark, which was given preliminary determination by the NSW Scientific Committee as an endangered ecological community (EEC). Two bird species (Grey-crowned Babbler and Speckled Warbler) listed in the Threatened Species Conservation Act were identified within the site. No other threatened mammals, frogs or reptiles were identified. To offset the impact on flora and fauna, ACOL is proposing an offset package that includes:

- the offset of at least 27 hectares of 'like' vegetation in the local area;
- revegetation of the open cut operations with suitable species for a mix of grasslands and woodlands;
- provision of 3 nest boxes for each hollow removed; and
- enhancement and management of the Glennies Creek riparian corridor, consisting of approximately 35 ha.

The impacted vegetation, and associated fauna, is likely to have non-use values to the community that can be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community. The capital cost of providing offsets has been included above. The community value of offsets is assumed to approximate the community value of clearing i.e. result in no net loss in community values.

Groundwater – the Project is predicted to result in a maximum drawdown of less than 1.5m in a small area near the pit shell, with drawdown nearer the creek generally less than 0.5m. The impact on Glennies Creek is a loss of 47m3/d, representing around 0.03% of the average daily flow. The reversal of hydraulic gradient in the alluvium, is expected to result in an overall reduction in salt load to the creek and to the Hunter River and overall groundwater quality impacts during the post closure phase are expected to minimal. No economic consequences of these groundwater impacts have been identified.

Surface water impacts – the SEOC will result in the removal of sections of four tributaries that drain in a westerly direction to Glennies Creek. However, the impact on flow in Glennies Creek is likely to be negligible.

A dam will be established on the largest tributary to the east of the SEOC area to capture water for use onsite, with a water transfer facility to convey excess clean water from the dam to a controlled release point on Glennies Creek. Any periods of water deficit for the SEOC will be addressed through reducing the throughput of the CHPP, which accounts for approximately 70% of water usage, or the purchase of additional water extraction licences.

Visual impacts – the major visual elements of the SEOC Project are the environmental bund and out of pit emplacement and the conveyor between the SEOC and existing ACP that includes a crossing of the New England Highway. To the extent that visual impacts affect the amenity of surrounding properties this may be reflected in changes in property values and be estimated using the property valuation method. However, any visual effect on property values has already been included in the analysis through the opportunity cost of land and capital cost of further acquisitions. Amenity impacts on people travelling along the New England highway are likely to be negligible and temporary, until vegetation is established on the environmental bund and emplacement area.

Traffic and transport – as the SEOC will replace the existing NEOC, no additional traffic will be generated once the SEOC is operational. A small increase in traffic is likely during the construction phase. The primary access to the site will be from a new intersection east of McInerney Road. The cost of this intersection has been included in the capital costs above.

As the SEOC replaces the NEOC, at peak production rail transport is expected to increase in the order of only 1 to 2 trains per day above existing levels, sufficient capacity is available on the rail line to facilitate the small peak increase.

Social and Economic Value of Employment - the ROM production associated with the SOEC will result 160 people being employed for 7 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 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) and the viability of rural communities (Bennett *et al*., 2004).

Gillespie Economics (2008) estimated the values the community hold for each year that the Metropolitan Colliery provides 320 jobs. This was valued at $33M (present value) per year of mine life. A simple extrapolation of this result to the SEOC, which will provide an additional 160 jobs for 7 years, suggests a resulting community value of the Project in the order of $116M.

2.5 CONSOLIDATION OF VALUE ESTIMATES

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.2.

Table 2.2
Benefit Cost Analysis Results of the SEOC Project (Present Values)

	COSTS	$ Million	BENEFITS	$ Million
Production	Opportunity cost of land	$11	Sale value of coal	$992
	Opportunity cost of capital	$9	Residual value of land at the cessation of the Project	$8
	Capital costs including infrastructure, sustaining capital, land acquisitions, costs of biodiversity offsets	$91	Residual value of capital at the cessation of the Project	$0
	Operating costs, including administration, mining, processing and transportation, and rehabilitation (ex royalties)	$591	-	
	Production Sub-total	**$702**	**-**	**$1,000**
	Net Production Benefits		**-**	**$298**
Externalities	Greenhouse	$32	Economic and social benefits of employment	$108
	Noise and vibration	Included above in opportunity cost of land and capital costs	Economic value of offsets	Capital cost included above, values gained are offset by a loss
	Air quality	Included above in opportunity cost of land and capital costs	-	
	European heritage	Negligible impact	-	
	Aboriginal heritage	$5	-	
	Ecology	Values lost are offset	-	
	Groundwater	Negligible	-	
	Surface water	Negligible	-	
	Visual amenity	Negligible	-	
	Traffic and transportation	Negligible, cost of intersection included in capital costs	-	
	Externality Sub-total	**$38**	**-**	**$108**
	Net Externality Cost		**-**	$70
NET COMMUNITY BENEFITS				**$368**

Cost and benefits over time have been discounted at 7%. Lump sum values from the benefit transfer of CM values have been placed in year 1 of the analysis and discounted.

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 SEOC Project, because the community as a whole would obtain net benefits from the extension.

Table 2.3 indicates that the SEOC Project would have net production benefits of $298M. The net production benefit is distributed amongst a range of stakeholders including:

- ACOL;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of Company tax.

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 SEOC Project also has a range of external economic costs and benefits. External costs associated with the extension have been estimated at $38M and relate to greenhouse gas generation and impact on two highly significant Aboriginal sites. 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 ACOL. External benefits associated with employment have been estimated at $116M.

Overall the SEOC Project is estimated to have quantified net benefits to the community of $368M and hence is desirable and justified from an economic efficiency perspective.

Greenhouse and ecology impacts of the SEOC Project would initially be borne by the general community, however, would then be internalises into the production costs of ACOL through the purchase of required carbon pollution permits (once the Commonwealth Government's proposed Carbon Pollution Reduction Scheme is implemented) and provision of ecological offsets.

Impacts on Aboriginal sites would be partly internalised into the production costs of ACOL through the development and implementation of an Aboriginal Heritage Management Plan.

Employment benefits of the Project would accrue to the broad community.

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;
- opportunity cost of capital;
- capital costs;
- operating costs;
- revenue from sale of coal;
- residual value of land;
- residual value of capital;
- greenhouse gas impacts;
- Aboriginal heritage 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 or Aboriginal site impacts had little impact on the overall economic desirability of the SEOC Project.

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 37% 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 environmental, cultural and social impact. Varying these 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 SEOC and initially quantified the production costs and benefits. Environmental, cultural and social externalities of the Project were then also quantified based on market data, the replacement/repair cost method, the property valuation method and benefit transfer.

The analysis indicated that the net production benefit of the SEOC Project is likely to be in the order of $298M. The net production benefit is distributed amongst a range of stakeholders including:

- ACOL;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of company tax.

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 SEOC Project also has a range of external economic costs and benefits. External costs associated with the Project have been valued at $38M. These costs relate to greenhouse gas generation and impacts on highly significant Aboriginal heritage. 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 ACOL. External benefits associated with employment have been estimated at $116M.

Overall the SEOC Project is estimated to have quantified net benefits to the community of $368M and hence is desirable and justified from an economic efficiency perspective.

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ATTACHMENT 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 (2008), 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 were in the order of US$3.95/t CO_2.

More recent information on the cost of carbon credits can be obtained from the carbon reduction schemes in Australia. 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	416	367	325
Opportunity cost of capital	415	366	325
Capital costs	398	350	309
Operating costs	283	250	222
Revenue	641	567	503
Residual value of capital	419	370	328
Residual value of land	417	368	327
Aboriginal site impacts	416	367	326
Value of employment	439	390	348
Greenhouse costs @ $40/tonne (t)	405	357	317

DECREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
Opportunity cost of land	418	370	328
Opportunity cost of capital	419	370	329
Capital costs	436	386	344
Operating costs	551	486	432
Revenue	193	170	150
Residual value of capital	415	367	325
Residual value of land	417	368	327
Aboriginal site impacts	416	367	326
Value of employment	395	347	306
Greenhouse costs @ $8/t	443	392	348