



## **Appendix 19**

Economic Assessment

Deloitte Access Economics

Economic impact  
assessment of the  
United Wambo Open  
Cut Coal Mine  
Project

Umwelt (Australia) Pty  
Limited

July 2016

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# Glossary

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ABS	Australian Bureau of Statistics
AUD	Australian dollar
CHPP	Coal Handling and Preparation Plant
CBA	Cost benefit analysis
CGE	Computable general equilibrium
CO2-e	Carbon dioxide equivalent
CPI	Consumer Price Index
DA	Development Application
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EL	Exploration Lease
EPA	Environment Protection Authority
ETL	Electricity Transmission Line
FOB	Free On Board
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GRP	Gross Regional Product
GSP	Gross State Product
ha	hectares
km	kilometres
kV	kilovolt
LEA	Local Effects Analysis
LGA	Local Government Area
ML	Mining Lease
Mtpa	million tonnes per annum
NPV	Net Present Value
NSW	New South Wales
PM	Particulate Matter
ROM	Run-of-Mine
SA3	Statistical Area 3
SEARs	Secretary's Environmental Assessment Requirements
SUA	Significant Urban Area
TSP	Total Suspended Particulates

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# Executive Summary

Deloitte Access Economics has been commissioned by Umwelt (Australia) Pty Ltd to undertake an economic impact assessment of the United Wambo Open Cut Coal Mine Project ('the Project'). The report is prepared solely for the use of United Collieries Pty Ltd (United) and their contractor Umwelt (Australia) Pty Ltd pursuant to its contract. United is involved in a joint venture with Wambo Coal Pty Ltd (Wambo). The economic assessment comprises a cost benefit analysis (CBA) and a local effects analysis (LEA) in line with the *NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals*. This report has been prepared for the purpose of addressing the Secretary of Department of Planning and Environment's Environmental Assessment Requirements (SEARs) for the Project.

## About the Project

The United Wambo Open Cut Coal Mine Project (the Project) is located in the Lower Hunter Valley, New South Wales (NSW) approximately 16 kilometres west of Singleton.

Under a 50:50 joint venture between United Collieries Pty Ltd (United) and Wambo Coal Pty Ltd (Wambo), the Project proposes to extend the approved life of the existing Wambo Open Cut mine (under a modified mine plan) and establish a new open cut mine at United (the United Open Cut). The joint operation will make use of Wambo mine's existing coal handling and preparation plant (CHPP) and rail loading facilities.

The Project will require changes to existing mining, public and private infrastructure, including relocation of a 2 kilometre section of the Golden highway, relocation of existing transmission lines and construction of additional water management controls and other mining infrastructure.

## Net benefits to NSW

The cost benefit analysis (CBA) estimates the direct and indirect impacts of the Project on the NSW community. The CBA compares the Project case to a baseline case, which involves open cut operations at Wambo to 2020 (as proposed in DA 305-7-2003 Modification 12) and proceeds with the decommissioning of the currently suspended underground operations at United. The net economic value of the incremental costs and benefits of the Project are estimated relative to the baseline case. These costs and benefits are estimated using information provided by United and Wambo and the findings of the Environmental Impact Statement (EIS).

The items considered in the CBA are listed in Table i. These items have been drawn from the NSW Treasury (2007) *Government Guidelines for Economic Appraisal* and the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* which attributes costs and benefits of a project to members of a specified community. From these components, the share of the net benefits that accrue to the NSW community are then aggregated.

**Table i : Benefit and cost components for CBA**

<b>Item</b>	<b>Benefit components</b>	<b>Cost components</b>
Net producer surplus	Gross mining revenue Residual value of land Residual value of capital	Operating costs Capital costs Decommissioning costs Environmental mitigation costs Transport management costs Rehabilitation expenses Purchase costs for land Local contributions Taxes (Australian, state and local) Royalties
Royalties	Royalties payable to NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	Payments to existing landholders	Opportunity cost of land
Economic benefit to workers	Wages paid to workers	Reservation wage for workers in the mining sector
Economic benefit to suppliers	Revenue paid to suppliers	Opportunity cost of supplier goods and services
Net environmental, social and transport-related costs		Greenhouse gas emissions Air quality Traffic and transport Ambient noise Biodiversity* Water* Aboriginal heritage* Non-Aboriginal heritage* Visual amenity*
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure, net of payments made by the Joint Venture*

\* Item has been considered qualitatively

Assessment of these costs and benefits indicates that the Project is expected to generate net benefits of \$414 million to NSW over its life, assuming a 7% discount rate. This net benefit is comprised of:

- Net producer surplus attributable to NSW of \$2.1m
- Royalties payable to the NSW Government of \$368.6m
- Company income tax attributable to NSW of \$66.6m
- Environmental, social and transport costs to NSW valued at \$23.8m

The Project was found to have no reportable impacts to existing landholders or suppliers in NSW. As the Project Area already consists primarily of mining areas (including previous

United mining infrastructure, existing Wambo open cut mine and rehabilitated land previously used for mining), the Project does not include any additional land purchases and is not expected to affect the productivity of land in the vicinity of the project. It is expected that 7 residential properties will be eligible for voluntary acquisition for air quality and/or noise impacts associated with the Project. However, assuming that any acquisitions are made at market value, there is no additional surplus for these landholders.

Similarly, it is assumed that local suppliers will earn similar margins relative to what they receive under the base case such that there are no additional benefits to suppliers in NSW. This is a conservative estimate given that suppliers might otherwise be affected by a decline in mining activity in the region.

It is also assumed that there are no additional public infrastructure costs under the Project case as any public infrastructure costs induced by Project will be paid for by the proponent under a Voluntary Planning Agreement with Singleton Council.

The net benefits to NSW excludes some costs and benefits that could not be valued. As recommended under the NSW guidelines, qualitative analysis was undertaken for these items, including impacts on biodiversity, visual amenity, Aboriginal and non-Aboriginal heritage and water.

These impacts that are considered qualitatively would need to generate costs of \$39 million per year (in real terms) for NSW over the life of the Project in order to fully offset its net benefits. This is equivalent to undiscounted costs of \$902 million over the period and is considered to be unlikely given the evidence regarding these impacts.

The CBA results rely on a number of assumptions and valuations. Consequently, the sensitivity of the results to a number of parameters were analysed, including variation in the discount rate, export coal price forecasts, royalty and tax payments, workers benefits and carbon prices. In all scenarios the incremental net benefits of the Project to NSW exceed the costs. For example, in considering the potential for significantly lower coal prices over the operating period (that is, prices in the 9<sup>th</sup> percentile of historical prices) the net economic benefits of the Project to NSW are estimated at \$264 million.

**Table ii: Net benefits to NSW community**

Summary item	Value (\$m, NPV)
Incremental benefits to NSW	437.3
Incremental costs to NSW	23.8
Overall net benefit of Project for NSW community	413.5

Source: Deloitte Access Economics calculations

## Effects on local community

The local effects analysis (LEA) estimates the social and economic impacts of the Project to the communities located near the Project Area. The locality is defined as the Lower Hunter Statistical Area 3 (SA3) and includes the populations of Singleton, Cessnock and Dungog.

The results of the LEA are complementary to the CBA and translate effects to NSW to those relevant to communities located near the Project Area.

### **Local employment and income effects**

The Project is estimated to directly employ an average of 132 people from the locality during the establishment phase and 230 people from the locality during ongoing operations, measured in full time equivalents (FTE), incremental to the base case. This is approximately 50% of the total direct employment anticipated from the Project.

The net local employment effect is estimated as the additional employment income from the Project in excess of average wages in the locality. This is calculated to be between \$5 million to \$9 million per year over the life of the Project.

### **Other local industry effects**

Beyond labour effects, the Project will generate additional expenditure on other non-labour inputs such as fuel, utilities and professional services, a share of which will directly contribute to the local economy.

The mines' local share of expenditure on non-labour inputs is estimated at 29%, based on a town resource cluster analysis completed by Umwelt (2016). Assuming this share is maintained during the Project, the locality is expected to benefit from \$66 million a year during the establishment phase and \$89 million a year during ongoing operations.

The Project Area is already used almost entirely for mining such that the Project is likely to have a limited impact of existing land uses, tourism and business travel.

Considering that the Project involves continued use of existing mining areas, and that employment effects are small relative to the labour force in the locality, there are not anticipated to be any short run adjustments in the cost of living for local residents.

### **Environmental and social changes in local community**

With the exception of greenhouse gas emissions, most of the environmental and social impacts evaluated in the CBA will accrue to the locality. These include impacts on air quality, water and visual amenity. The most notable local costs are in terms of traffic and transport impacts in the locality which is valued at \$460,000 per year during the establishment phase and \$610,000 per year during ongoing operations.

### **Second round effects**

Labour and non-labour expenditure is expected to have flow-on impacts for the local economy. These effects are estimated using computable general equilibrium (CGE) modelling. A CGE model represents the dynamic relationship between economic agents and illustrates how changes in one part of the economy (such as the production of more coal) have flow-on impacts for other parts (such as effects on employment, income and exports). These impacts were estimated using Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM).

The Project is estimated to increase gross regional product (GRP) in the locality and in New South Wales by \$2.1 billion and \$3.0 billion respectively.

Incremental employment, including direct Project employment and flow-on employment effects (including any crowding out that might occur in other economic sectors) is estimated to increase for the life of the Project, peaking at 130 FTE and 99 FTE in the locality and in the rest of NSW. That is, after accounting for persons that would be employed elsewhere in the economy if the Project did not go ahead, the net employment effect is positive in the locality and in NSW over the life of the Project.

**Deloitte Access Economics**

# 1 Introduction

Deloitte Access Economics has been commissioned to undertake an economic impact assessment of the proposed United Wambo Open Cut Coal Mine Project ('the Project').

The Project is a 50:50 joint venture between United Collieries Pty Ltd (United) and Wambo Coal Pty Ltd (Wambo) to combine existing open cut operations at the Wambo mine under a modified mine plan with a proposed new open cut coal mine at United. United is 95% owned by Abelsore Pty Limited, a wholly-owned subsidiary of Glencore Coal Pty Ltd (Glencore), and 5% by the Construction, Forestry, Mining and Energy Union (CFMEU) and is managed by Glencore. Wambo is owned by Peabody Energy Australia Limited (Peabody) (75%), a wholly-owned subsidiary of Peabody Energy Corporation and Sumiseki Materials Co. Ltd (25%).

The United and Wambo mining operations are co-located within the Hunter Valley of New South Wales, approximately 16 kilometres west of Singleton. The village of Warkworth is 1km south east of the Project Area.

The Project will involve new open cut operations at United (the United Open Cut) and extended operations at the Wambo Open Cut under a modified mine plan to produce up to 10 million tonnes per annum (Mtpa) of ROM coal over approximately 23 years. Wambo Open Cut has existing approval to produce 8 Mtpa of run of mine (ROM) coal up to and including 2017, with a modification currently being sought to extend this to 2020. The Project will seek a mine extension to the approved Wambo Open Cut surface mining area and to mine deeper resources below the approved Wambo Open Cut area. There will also be a number of changes to the existing mining, public and private infrastructure in the Project Area.

The Project is State Significant Development as defined under State Environmental Planning Policy (State and Regional Development) 2011 and will require development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Project will also require a modification to the existing Wambo mine development consents under section 75W of the EP&A Act to harmonise these consents with the Project.

This economic assessment has been prepared as part of the Environmental Impact Statement (EIS) required to accompany these development applications. The required components of the EIS, including the economic assessment requirements, are outlined in the Secretary of Department of Planning and Environment's Environmental Assessment Requirements (SEARs) for the Project.

In accordance with the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals, this report undertakes an assessment of the net economic benefits of the Project to the NSW community, within a cost benefit analysis (CBA) framework. It considers the economic costs and benefits of the Project, relative to a baseline or 'business-as-usual' scenario. The baseline involves open cut operations at Wambo to 2020 (as proposed in DA 305-7-2003 Modification 12) and no production at the currently suspended underground operations at United.

The CBA is accompanied by a Local Effects Analysis (LEA) to assess likely effects of the project on the locality (that is, Lower Hunter Statistical Area 3), including Computable General Equilibrium (CGE) modelling to analyse the secondary impacts of the Project on the regional and NSW community, as measured by changes in economic activity and employment. The CGE analysis can be used as an extension to the LEA. However, the CGE results may not be directly comparable to the CBA results or other projections outlined in the Environmental Impact Statement. This is because it encompasses a broader range of impacts than the initial economic analysis.

## 1.1 Report structure

The chapters of this report are structured in accordance with the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals.

The structure of this report is as follows:

- Chapter 2 outlines the methodology employed in this report including how the approach used aligns to the NSW CBA guidelines.
- Chapter 3 details the Project and defines the base case and the expected scenario under the Project case.
- Chapter 4 presents the results of the cost benefit analysis, identifying the net benefits of the Project for the NSW community.
- Chapter 5 presents the results of a local effects analysis, including use of Computable General Equilibrium (CGE) modelling for second round and flow on effects.
- Appendix A provides a checklist illustrating how this report has met the requirements of various guidelines.
- Appendix B presents an overview of the CGE model.

## 2 Methodology

Deloitte Access Economics has established a methodology for undertaking this CBA and economic impact analysis for the Project that addresses the SEARs and aligns to relevant guidelines. This chapter reviews the SEARs and relevant guidelines before discussing how these have been applied to develop the methodology.

### 2.1 Secretary's Environmental Assessment Requirements

The SEARs for the Project were issued in December 2015 and include the need for an assessment of the significance of the resource and the economic costs and benefits of the Project. In addition, consideration of potential impacts on demand for the provision of local infrastructure and services is also required to be addressed and is examined in the Social Impact and Opportunities Analysis (SIOA) for the Project (refer to Appendix 4 of the EIS). The SEARs require that relevant guidelines must be considered during the assessment of potential impacts of the Project (see Section 2.2).

The remainder of the SEARs cover topics beyond the scope of an economic impact assessment; however, there are particular areas that are potentially relevant to the methodology adopted in this report. These include impacts on land resources, water resources, biodiversity, heritage, air quality, greenhouse gases, noise, transport and visual impacts. These impacts have been considered, where relevant, as part of this economic assessment.

### 2.2 Relevant guidelines

The following guidelines have been used in preparing this report:

- NSW Treasury (2007) "NSW Government Guidelines for Economic Appraisal"; and
- NSW Government (2015) "Guidelines for the economic assessment of mining and coal seam gas proposals".

The Treasury guidelines provide a high level framework for cost benefit analysis (CBA) while the NSW Government guidelines provide a framework specific for application of CBA and Local Effects Analysis (LEA) for mining developments.

The 2015 Guidelines replace the "Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals" (NSW Government, 2012). These guidelines state the type of information and analysis needed by the NSW Government to inform its assessment process.

A full account of the requirements of these guidelines is given in Appendix A and the relevant requirements are cross-referenced against sections of the report.

## 2.3 Implications of these guidelines

Together, these guidelines set the key requirements for this economic assessment. While Appendix A contains an item by item reconciliation of how these guidelines have been addressed or considered, it is first worth considering their implications qualitatively. Overall, they require that the economic assessment be carried out using a set of standard approaches and with consideration of certain topics.

The guidelines specify two components for the economic assessment as part of a development application: a cost benefit analysis (CBA) to assess the public interest by estimating the net present value of the Project to the NSW community, and a local effects analysis (LEA) to assess the likely impacts of the Project in the locality.

Following the guidelines for CBA, our analysis involves:

- establishing a base case against which to assess the economic and other impacts of changes due to the Project;
- defining the scope of the Project including the inputs required to achieve the Project's objectives;
- quantifying changes resulting from the Project relative to the base case with respect to both benefits and costs, including:
  - economic benefits such as revenues from additional coal output;
  - economic resource costs such as capital expenditure and operating costs;
  - externalities including environmental and social impacts; and
- estimation of the monetary value of these changes using market prices, where available, otherwise using imputed prices or a qualitative assessment;
- consolidation of values by applying an appropriate discount rate to estimate the net present value of the Project's future net benefits;
- undertaking a sensitivity analysis on the key variables in considering uncertainties related to specific benefits and costs;
- assessing the distribution of benefits and costs across different groups and geographic levels; and
- reporting of results, including unquantified impacts, so as to include all material that may be relevant to the decision maker.

The base case and the Project case are described in Section 3. Section 4 then covers the identification, quantification, consolidation and reporting of the costs and benefits relating to the Project. In particular, the CBA has been prepared with respect to the net benefits attributable to NSW, which is the community of interest specified in the NSW Government Guidelines (2015). This means that the benefits and costs estimated in the CBA are those that accrue to the NSW community only.

As suggested in the guidelines, the results from the CBA contain much of the information required for the LEA analysis. The LEA translates the effects estimated at the state-wide level into the impacts on the communities located near the Project.

The assessment of the consequences of the Project for the local area is required by section 79C of the EP&A Act, including an assessment of local employment effects. These local effects are presented in Section 5.

Following the guidelines for LEA, our analysis includes:

- defining the spatial area and population groups to be included and analysed;
- quantitatively and qualitatively analysing the local effects relating to:
  - local employment, such as workers employed by the Project who are ordinarily resident in the locality, as well as the expenditure of additional labour earnings by both local and non-local workers in the local economy;
  - non-labour Project expenditure, such as purchases made in the locality relating to the construction and operations activity attributable to the Project;
  - other local industries, such as the impact of the Project on agriculture or tourism in the local area, and potential temporary impacts on food and housing markets for local residents; and
  - the positive and negative externalities that the Project could create in the locality, including environmental and social impacts;
- an analysis of flow-on effects, including indirect impacts resulting from the Project due to adjustments in the economy such as price movements or changes in labour demand and supply.

The LEA draws on material presented in the CBA—for example, the CBA already requires that externalities relating to the Project are identified and quantified. The LEA includes the portion of these externality benefits or costs that are incurred within the locality. Qualitative impacts in the CBA are also discussed qualitatively in the LEA where they are incurred in the local area. Computable general equilibrium (CGE modelling) is used to inform the analysis of flow-on effects.

The following section sets out our approach for ensuring that all the relevant requirements of the SEARs and relevant guidelines are covered within the CBA and LEA presented in this report.

## 2.4 Our methodology

Taking the aforementioned guidelines together creates a set of requirements which requires a specialised methodology to ensure each issue is addressed in a meaningful manner. A traditional CBA focusing on the Project itself will not satisfy the range of issues identified above.

To address this, Deloitte Access Economics has applied a methodology consistent with the NSW Government Guidelines (2015) which analyses relevant benefit and cost items within a CBA framework. The share of these costs and benefits attributable to NSW are analysed and aggregated to estimate net benefits to the NSW community (Chapter 4) and the local community (Chapter 5). Flow-on effects are then estimated as an additional component of the LEA using CGE modelling. This three step process has been designed to analyse the issues identified in the guidelines and requirements in a transparent and meaningful manner.

The CGE modelling provides an addition and extension of the CBA. The CBA focuses on the direct effects of the Project including effects that take place in a market (such as the sale of coal) and effects which do not take place in a market (such as the creation of dust). The results from the CBA are used as inputs to the CGE model which is used to trace these immediate effects through the economy more broadly. For example, increased capital expenditure may lead to increased demand for steel and fuel as inputs. This, in turn, can increase demand for labour in iron mines and oil refineries. This chain of events will create complex interactions between supply and demand in each market which will ultimately be resolved by changes in prices and outputs across the economy. The CGE model provides a way to trace this chain of events through to its final result.

It should be noted that the CGE model is fundamentally built on the national accounting system and focuses on outputs that are traded in markets and contribute to gross domestic product (GDP) – it does not capture environmental and other externality costs that are captured as part of the CBA.

The NSW Government guidelines (2015) suggest that flow-on effects may be estimated using CGE modelling, Input Output (IO) multiplier analysis or qualitatively. Compared to other approaches, CGE modelling uses a more complex set of techniques and involves different assumptions about the state of the economy. For example, IO modelling generally assumes that there is an unlimited source of resources available in the economy to meet increases in demand. In contrast, CGE modelling generally assumes that the economy and sectors within the economy are competing for the use of resources. This means that increases in demand from the Project may result in effects such as increased prices in other markets and crowding out effects (rather than just increased output). In this sense, CGE modelling is likely to provide more conservative estimates of economic impacts than those provided by IO modelling.

## 3 The Project

The CBA methodology described above provides a structured approach to assessing whether the Project is likely to result in overall benefits to the communities of interest. To carry out this assessment, the costs and benefits associated with the Project are compared to those under a base case that represents 'business as usual'. This comparison allows for an incremental analysis, to reach a clear conclusion on the net benefits of the Project.

This chapter defines both the base case and the Project case in turn.

### 3.1 Base case

The United and Wambo coal mining operations are located approximately 16 kilometres west of Singleton in the Hunter Valley of NSW. United is owned 95% by Abelsore Pty Limited (a wholly-owned subsidiary of Glencore Coal Pty Ltd) and 5% by the Construction, Forestry, Mining and Energy Union (CFMEU) and is managed by Glencore. Wambo is owned by Peabody Energy Australia Limited (Peabody) (75%), a wholly-owned subsidiary of Peabody Energy Corporation and Sumiseki Materials Co. Ltd (25%).

Underground operations at United have been suspended since March 2010, when the mine entered a period of care and maintenance. United's development consent to carry out underground mining at the site has since expired. Under the base case, it is assumed that the United site would be closed permanently and the land will be rehabilitated.

Wambo has current approval for a run of mine (ROM) production rate of 8 million tonnes per annum (Mtpa) from open cut operations up to and including 2017. Product coal is transported from Wambo via the train loading facility, with an approved rail capacity of 15 Mtpa of product coal until 2025.

Under the base case, it is assumed that Wambo open cut mining operations would continue as per the DA 305-7-2003 Modification 12 proposal (Mod 12). That is, Wambo will continue mining until 2020 to produce a total of 7.7Mt of product coal between 2017 and 2020 at an average rate of 1.9 Mtpa and employ approximately 290 full-time equivalent (FTE) employees. After 2020, it is assumed that open cut production would cease and the open cut mining areas would be rehabilitated.

### **Treatment of the Wambo DA 305-7-2003 Modification 12 proposal**

The inclusion of the Wambo Mod 12 as part of the base case has led to a conservative assessment of the economic benefits. That is, if Mod 12 is not approved, the estimated net benefits of the Project to NSW would be higher than those reported in this assessment.

It should be noted that the environmental impact assessments completed as part of the broader Environmental Impact Statement assume that Wambo mine operations end in 2017 and that the DA 305-7-2003 Mod 12 proposal is not approved. The findings of these assessments have been used to quantify the environmental impacts of the Project as part of this Cost Benefit Analysis. Again, this suggests that the incremental environmental costs of the Project are conservatively estimated in this assessment. That is, if Mod 12 were approved, the environmental costs of the Project to NSW would be lower than those reported in this assessment.

## **3.2 Project case**

The Project will include the following activities:

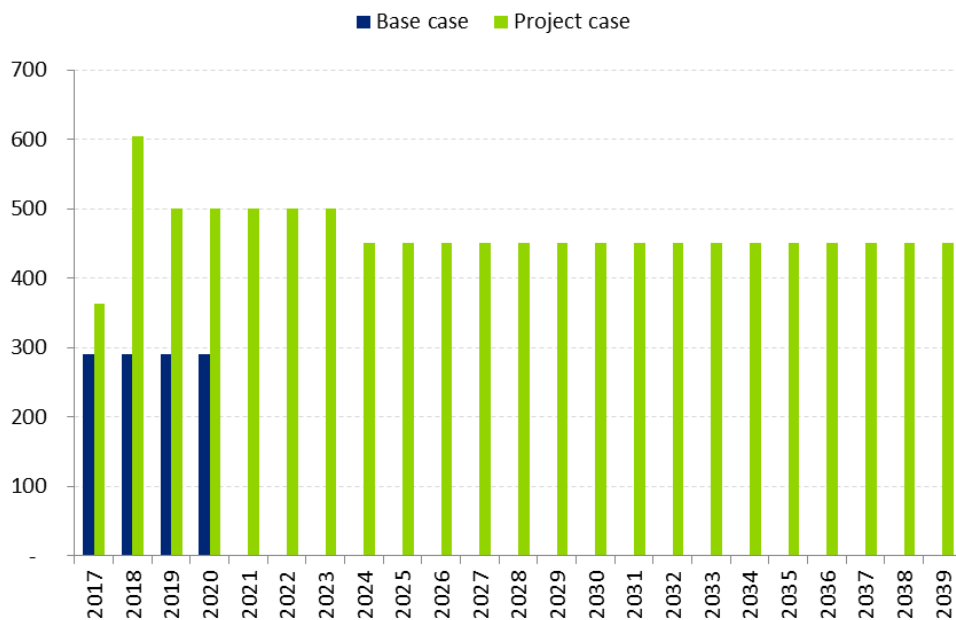
- The operation of a multi-seam open cut mining operation integrating the existing and approved Wambo Open Cut under a modified mine plan and the proposed United Open Cut
- Modification to the Wambo Open Cut boundary, resulting in approximately 3.8 hectares of additional disturbance.
- Production of up to 10 Mtpa of ROM coal and a total of 176Mt of ROM coal over 23 years, of which 165Mt is total economically recoverable reserve incremental to the base case.
- Construction of temporary facilities in the United mining infrastructure area, and an expansion and upgrade of the Wambo mining infrastructure area;
- Use of the existing Wambo Coal Handling and Preparation Plant (CHPP) and train loading facility;
  - Note that while the Project seeks approval to extend the life of these approved facilities to match the duration of the Project, the proposed activity will use these facilities within their currently approved annual capacity of 14.7 Mtpa ROM coal feed and 15Mtpa product coal respectively.
- transportation of processed coal off-site via train using Wambo's existing train loading facility with transport rates increased from six to eight trains per day, but no increase in the total approved capacity of 15Mtpa and therefore no change to annual train movements;
- realignment of a 2 kilometre section of the Golden Highway to accommodate the proposed United Open Cut Mine;
- relocation of an existing 330 kV electricity transmission line which traverses United lease CCL775, with other 66 kV and 11 kV power lines requiring relocation outside of the proposed mining areas;

- Decommissioning and capping of existing tailings storage facilities located in areas proposed for overburden emplacement and ongoing use of existing tailings storage facilities and storages established in other mine voids as required.
- Transport of coarse rejects from coal preparation by truck to the open cut overburden areas for emplacement and subsequent covering by overburden material.
- construction of additional mine water management controls, including dams;
- a workforce of up to 500 total operational employees; and
- decommissioning of site infrastructure and rehabilitation of the United and Wambo sites following completion of mining operations.

The proposed Project Area is depicted below in Figure 3.1.

It is expected that the Project will employ a combined operational and construction workforce of 363 FTE employees in 2017 before peaking at 605 FTE employees in 2018, during the primary establishment phase. Over the following years, the operational workforce is expected to number 500 FTE employees out to 2023, subsequently declining to 450 FTE employees for the remaining life of the Project to the year 2039. These expected employment levels are presented below in Chart 3.1.

**Chart 3.1: Base case and Project case employment (FTEs)**



Source: United and Wambo

Figure 3.1: Project case – proposed Wambo and United Open Cut Mine

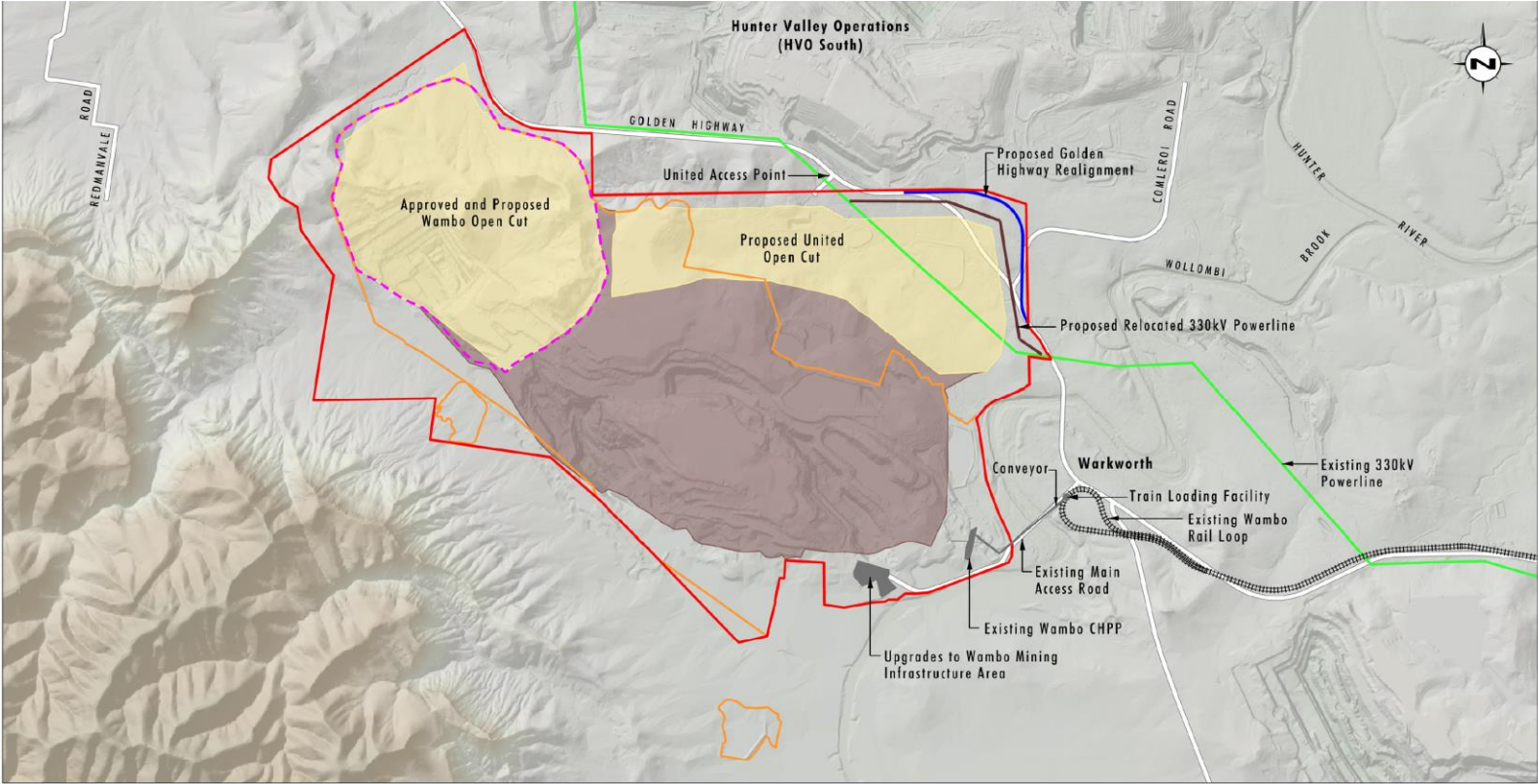


Image Source: United LiDAR (2015)  
 Data Source: Glencore (2015)

- Legend**
- ▭ Project Area
  - ▭ Proposed Conceptual Extraction Area
  - ▭ Active Mining Area
  - ▭ Approved Wambo Surface Development Area
  - ▭ Approved Wambo Open Cut
  - Proposed Golden Highway Realignment
  - Existing 330kV Powerline
  - Proposed Relocated 330kV Powerline

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FIGURE 1.5  
 Overview of The Project

### 3.2.1 Interaction with other projects

As discussed previously, Wambo currently operates both open cut and underground operations at the Wambo mine site. This Project only relates to the development of the open cut mining operations. The existing Wambo underground mining operations do not form part of the Project, and will continue to be owned and managed separately by Wambo.

The Project will use available approved capacity in Wambo's existing CHPP and train loading facilities. Wambo will continue to own and operate these facilities in accordance with the currently approved throughput levels (albeit with extended life), with the Project delivering ROM coal to these facilities for coal washing, handling and loading onto trains for transportation. United, as the manager of the Project, does not have operational control over these facilities and it is anticipated that they will continue to be managed and operated by Wambo (subject to changes in the commercial arrangements that exist between United and Wambo).

The Project Area is predominantly surrounded by existing mining activities. In addition to Wambo's existing open cut and underground mining operations already discussed, this includes Coal and Allied's HVO including Carrington, North Pit, Cheshunt, Riverview and South Lemington Pits and their associated buffer lands. A number of mines are located further south including Mt Thorley Warkworth and Bulga Coal.

It is not expected that the Project will impact upon these other mining activities.

## 3.3 Project options

Although not included in the NSW Government Guidelines (2015), CBA typically requires the assessment to report on all feasible Project options. This assessment only evaluates the Project put forward by the proponent. Deloitte Access Economics was not engaged to consider alternative Project options.

It is noted however, that the proponent did consider a number of alternatives for the Project in order to maximise resource recovery and operational efficiencies, while also aiming to minimise environmental and social impacts. This included consideration of alternative mining options, layouts, overburden emplacements and infrastructure arrangements to optimise the Project's final design.

A summary of these alternative options considered by the proponent and the reasons for their exclusion are described below.

- **Alternative mine plans:** Several standalone mine plans have been considered by both United and Wambo in order to realise resource recovery across the two operations. This has included consideration of both open cut and underground mining methods separately operated by both parties.

Developing the proposed United Open Cut Mine as a standalone mine was constrained due to the proximity of neighbouring mining operations, natural features (e.g. Wollombi Brook) and public infrastructure. A standalone mine would have required new infrastructure facilities which would have resulted in significantly

increased environmental impacts through increased land disturbance and cumulative amenity impacts, and lowered coal recovery.

Underground mining options were also excluded due to project specific issues associated with mining below an open cut operation which would have impacted on safety and stability matters along with other issues concerning geology, geotechnics and gas which made underground mining uneconomic.

In addition, options were excluded where they resulted in an additional final void, or poor final landform outcomes. In particular, options that resulted in higher emplacement areas restricted the ability to provide a natural landform outcome.

- **Coal processing and transport options:** Alternative coal processing and transport options included construction of new onsite CHPP, rail loop and associated facilities at United. This was less desirable due to available capacity at the Wambo CHPP and existing Wambo train loading facilities and additional impacts in terms of cost, noise, site disturbance and resource sterilisation.
- **Infrastructure locations:** An option to not relocate the Golden Highway and the 330 kV transmission line were considered, but resulted in constrained mining conditions, resource sterilisation and poorer final landforms. Alternative options for the relocation of the 330 kV transmission line were also excluded because they would impede take-off and landing access for the Glider Club. Alternative site access locations were excluded due to inadequate sight distances, impacts on mine design, the sterilisation of coal resources and the ability to maximise resource efficiency by using the existing infrastructure.

### 3.4 Significance of the resource

The SEARs include the need for an assessment of the significance of the resource in relation to the Project.

The repealed Clause 12AA in Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries 2007)* provides an indication of items that could be considered in relation to assessing the 'significance of the resource'. This includes considering the economic benefits (both to the State and the region) of developing the resource, including benefits in terms of employment generation, expenditure and the payment of royalties. These items are considered in detail in this report.

The net economic benefits to NSW are considered in the cost benefit analysis presented in Section 4 (with royalties specifically addressed in Section 4.3.2), while the regional benefits associated with the proposed development are analysed in the local effects analysis in Section 5.

While the remainder of clause 12AA is directed at the State Government itself, we note that the Project will develop additional recoverable resources from existing mine sites and will make use of existing infrastructure and land that is already used for mining purposes. Further, the Project will enable additional exports from NSW to international customers.

## 4 Net benefits to NSW

This section presents the results of the cost benefit analysis (CBA), which assesses the net present value of the Project to the NSW community. This involves identifying incremental costs and benefits of the Project relative to the base case, quantifying those items wherever possible, and deriving the share of each item that is attributable to NSW.

The Project is estimated to contribute a total net economic benefit for the NSW community of approximately \$414 million (in present value terms).

The steps in this analysis and the detailed results are described in this section.

### 4.1 Scope of the cost benefit analysis

The scope of any CBA for a project is defined by:

- **Base case** – identifying the ‘business as usual’ or ‘do nothing’ scenario against which to assess the potential economic, social and environmental changes due to the project.
- **Project case** – full specification of the project scenario to be assessed, relative to the base case.
- **Community of interest** – defining the community for which the benefits and costs of the project should be assessed.

The definitions of the base case and Project case for this CBA are described in Sections 3.1 and 3.2 respectively. The community of interest for the CBA is the NSW community, as prescribed by the NSW Government guidelines (See Section 2.2).

### 4.2 Identifying costs and benefits

The costs and benefits considered in this analysis are set out in Table 4.1.

In recognition of the broad range of impacts of the Project, costs and benefits have been separated into eight categories according to the part of the community that they accrue to. For instance, the Project owners will receive the net producer surplus, while royalties and company income tax will be paid to the NSW and Australian Governments respectively. Other third parties that may be impacted by the Project include landholders, workers, suppliers, residents in the local community and Singleton Council. This categorisation assists in apportioning the share of the net benefits of the Project to the NSW community.

Section 4.3 describes the techniques used to value each of these items and provides the justification behind the classification of each as a net cost or net benefit.

**Table 4.1: Benefit and cost items considered in the CBA**

<b>Item</b>	<b>Benefit components</b>	<b>Cost components</b>
Net producer surplus	Gross mining revenue Residual value of land Residual value of capital	Operating costs Capital costs Decommissioning costs Environmental mitigation costs Transport management costs Rehabilitation expenses Purchase costs for land Local contributions Taxes (Australian, state and local) Royalties
Royalties	Royalties payable to NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	Payments to existing landholders	Opportunity cost of land
Economic benefit to workers	Wages paid to workers	Reservation wage for workers in the mining sector
Economic benefit to suppliers	Revenue paid to suppliers	Opportunity cost of supplier goods and services
Net environmental, social and transport-related costs		Greenhouse gas emissions Air quality Traffic and transport Ambient noise Biodiversity* Water* Aboriginal heritage* Non-Aboriginal heritage* Visual amenity*
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure, net of payments made by the Joint Venture*

\* Item has been considered qualitatively

As recommended in the guidelines, where it is difficult to place a value on a particular cost or benefit of the Project, a qualitative analysis has been undertaken. These items are considered qualitatively in Section 4.3. In some cases these items have been considered qualitatively because there is expected to be no significant difference in outcomes under the baseline and Project case (such as water resources) or because there is no reliable method available to value them in these particular circumstances (such as visual amenity and heritage impacts).

## 4.3 Costs and benefits to NSW

This section details the methods used to value the costs and benefits under each item identified in Table 4.1, and to apportion a share of each value to the NSW community. The quantification of costs and benefits has relied on a range of approaches and data sources, including financial information provided by the proponent, government data publications and non-market values published in the literature.

All present values reported in this section are calculated using a 7% discount rate, are reported in 2016 price terms, and are discounted back to the start of 2016. Undiscounted estimates of each cost and benefit are reported in the text in brackets.

### 4.3.1 Net producer surplus attributable to NSW

The total net producer surplus of the Project is estimated at \$268 million (\$880 million) in present value (and undiscounted) terms. This represents the additional value of the Project to the Project owners, calculated as total revenue net of all direct costs, taxes and royalty payments, relative to the base case (see Table 4.2).

Following the NSW Government (2015) guidelines, it is necessary to determine the share of the net producer surplus attributable to the NSW community, based on the ownership structure of the Wambo mine in the base case, and of the Joint Venture in the Project case.

As noted in Section 1, the Wambo mine is owned by Peabody Energy Australia Limited, which is a subsidiary of Peabody Energy Corporation and Sumiseki Materials Co. Ltd. Both of these owners are based overseas. Accordingly, 100% of the net producer surplus under the base case will accrue to international investors.

Under the Project case, mining operations will take place at both the United mine and Wambo mine, with the net producer surplus shared 50:50 between the owners of each mine according to the terms of the joint venture. The United mine is owned by United Collieries Pty Limited, which is in turn 95% owned by Abelshore Pty Limited (a wholly-owned subsidiary of Glencore Coal Pty Ltd – a foreign entity). The remaining 5% share in United Collieries Pty Limited is held by the Construction, Forestry, Mining and Energy Union. This results in 2.5% of the net producer surplus under the Project case being attributable to Australia. Applying the NSW share of the Australian population (32%) suggests that around 0.8% of the net producer surplus is attributable to the NSW community (see Table 4.3).

Overall, the net producer surplus of the Project attributable to the NSW community is estimated at \$2.1 million (\$7.0 million), in present value (and undiscounted) terms.

The assumptions underlying each component of the total net producer surplus estimate are documented on the following pages.

For the base case, the net producer surplus attributable to NSW would be zero as the Wambo Mine is 100% foreign-owned.

**Table 4.2: Calculation of total net producer surplus**

Item	Project case (\$m, NPV)
<b>Revenue</b>	<b>5,178</b>
Gross mining revenue	5,178
Residual value of land	-
Residual value of capital	-
<b>Costs</b>	<b>4,260</b>
Operating costs	3,902
Capital costs	322
Rehabilitation and decommissioning costs*	17
Environmental mitigation costs*	10
Transport management costs*	-
Purchase costs for land	9
Local contributions	-
<b>Taxes</b>	<b>242</b>
Corporate income tax <sup>a</sup>	208
Payroll tax	27
Local government rates	6
<b>Royalties</b>	<b>408</b>
Ad valorem coal royalties	408
<b>Net producer surplus</b>	<b>268</b>

Source: Deloitte Access Economics calculations

<sup>a</sup> Nil in the base case due to net loss position

\* The majority of rehabilitation and decommissioning costs, environmental mitigation costs and transport management costs in the Project case are included in ongoing operating cost estimates, and have not been separately itemised.

**Table 4.3: Calculating the share of the net producer surplus attributable to NSW**

	Project Case
Net producer surplus (\$m, NPV)	268
Australian share of Project's ownership (%)	2.5%
NSW share of Australia (%)	32%
NSW share of Project's ownership (%)	0.800%
<b>Value of net producer surplus attributable to NSW (\$m)</b>	<b>2.1</b>

Source: Deloitte Access Economics calculations

#### 4.3.1.2 Revenue

**Gross mining revenue** is estimated at \$5,178 million (\$10,971 million) in the Project case, in present value (and undiscounted) terms.

Production estimates were provided by the proponents. Under the base case, it is anticipated that 7.7 Mt of product coal (low ash thermal) will be produced between 2017 and 2020 from Wambo open cut operations. Under the Project case, open cut mining operations will be undertaken at both United and Wambo for 23 years, between 2017 and 2039. Project case production over the life of the mine is estimated to total around 120 Mt of product coal, comprising 45% low ash thermal coal, 33% mid ash thermal coal, 17% semi-soft coking coal and around 4% high ash thermal coal.

The underlying prices for projecting revenue were developed from contract price consensus forecasts published by Consensus Economics in March 2016. These benchmark prices were converted to Australian dollars using the annual average foreign exchange consensus forecasts published by Consensus Economics in January 2016. Nominal consensus price forecasts from 2017 to 2021 were also converted to real 2016 price terms using inflation rate assumptions published by the Department of Industry, Innovation and Science (2016).

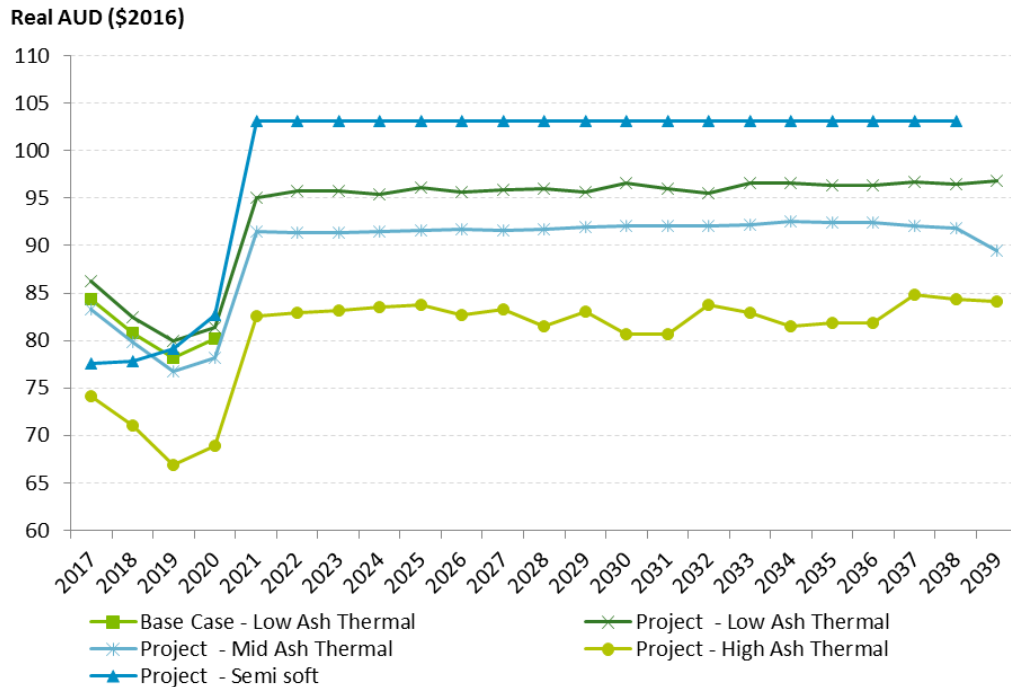
The benchmark prices were then adjusted based on coal quality information provided by the proponent to account for variations in product types (based on their predicted energy content) under each year of production. In addition, the price for semi-soft coking coal was calculated at 67% of the reported price forecast for metallurgical coal, based on a high-level comparison of historical prices presented in Resource and Energy Quarterly (Department of Industry, Innovation and Science 2016). The weighted average prices for each coal product type used in the analysis are presented in Chart 4.1.

The **residual value of land and capital** at the conclusion of mining operations was also considered.

The proponent has advised that the land within the Project Area would be progressively rehabilitated into a combination of grazing land and areas used for biodiversity purposes under both cases. As the timing and extent of any land sales are uncertain and the market value likely to be negligible, the residual value of land under each case is assumed to be zero for the purpose of calculating net producer surplus.

Similarly, the proponent has advised that it is reasonable to assume that all capital assets will be fully depreciated over the life of the mine under the base case and Project case. Accordingly, no residual asset values have been incorporated in the net producer surplus estimates.

**Chart 4.1: Coal price forecasts**



Source: Deloitte Access Economics, adjusted from Consensus Economics (2016) and Department of Industry and Science (2016)

### 4.3.1.3 Costs

**Operating costs** associated with mining operations from 2017 are estimated at \$3,902 million (\$8,233 million) in the Project case, in present value (and undiscounted) terms.

This encompasses the expenditure incurred as a direct result of extracting ROM coal, processing it into saleable product and delivering it to a port before loading (known as free on board [FOB] costs) as well as ongoing expenditure on land rehabilitation, environmental monitoring and mitigation, operational resources and the maintenance of mining equipment and machinery necessary for production and other indirect operating costs that relate specifically to the Project case.

The FOB cost estimates have been calculated based on econometric modelling undertaken by Shafiee, Nehring and Topal for open cut coal mines in Australia (2009). The authors define per tonne operating costs as a function of deposit average thickness, the stripping ratio, capital cost and the daily production rate.

The proponent has provided estimates for these parameters in the base case and Project case, including any variations over the course of mining activity. An average deposit thickness of 2.75 metres for the base case and 2.58 metres for the Project were assumed, with reference to the reported thickness of seams associated with open cut operations at United and Wambo (NSW Department of Primary Industries, 2009).

The estimates produced by the model based on these inputs have then been increased by:

- an additional \$6.25 per tonne of product coal to account for CHPP costs;
- an additional \$4 and \$5 per tonne of product coal to account for other overheads in the base case and Project case respectively; and
- an additional \$10 per tonne of exported product coal, to account for distribution and selling expenses.

These cost add-ons have been assumed based on experience with other projects, with guidance from the proponent.

Overall, total operating costs under the base case are estimated at \$646 million (\$522 million in present value terms). Under the Project case, operating costs are estimated at \$8,233 million, equivalent to \$3,902 million in present value terms.

Under the Project case, there are additional operating costs that will be incurred during the establishment phase of the project. In present value (and undiscounted) terms, an additional \$53 million (\$67 million) in operating costs has been included.

**Capital costs** of the Project have been estimated at \$322 million (\$381 million) in present value (and undiscounted) terms, based on data provided by the proponent.

This is inclusive of expenditure on equipment purchases, upgrades to the mine infrastructure area, mine surface development and onsite and offsite infrastructure.

Should the Project receive approval, this expenditure will be incurred during the establishment phase of the project from 2017 to 2021, with a peak annual capital investment of \$282 million in 2017.

One-off **rehabilitation and decommissioning costs** have been separately itemised for the CBA in addition to the ongoing costs of progressive rehabilitation which are included within operating cost estimates. These additional costs are estimated at \$17 million (\$76 million) in the Project case, in present value (and undiscounted) terms.

Should the Project not receive approval, it is assumed that the United site would remain closed and the land will be rehabilitated. It is also assumed that open cut mining areas at Wambo would be rehabilitated after the conclusion of open cut mining production in 2020 (as per the DA 305-7-2003 Modification 12 proposal). Other areas within the Wambo mine, such as the CHPP and rail facilities will be decommissioned at later stages to coincide with the progression of the existing approved underground mining operations.

Under the Project case, the Project Area will be progressively rehabilitated, with these costs included in the estimates of ongoing operating costs. However, additional one-off decommissioning costs have been included as separate cost items for the Project, to account for activity undertaken after the conclusion of open cut mining operations.

The reduced present value estimate in the Project case is due to delays in certain rehabilitation and decommissioning expenditure items caused by the extension of open cut mining activity.

It should be noted that while the Project is not responsible for the rehabilitation and decommissioning of the CHPP and rail facilities, as this falls within a separate approval, these costs have been included in this analysis to recognise that the Project will postpone this expenditure from 2032 to 2040.

A number of costs related to **environmental mitigation** have been included in the ongoing operating cost estimates for each case. This includes the costs associated with ongoing environmental monitoring of noise, air, water, meteorological conditions, biodiversity, rehabilitation, and health impacts. This also includes mitigation practices such as installation of noise controls on equipment, installation of haul road bunds, haul road dust suppression and temporary rehabilitation to minimise dust and reduce visual impacts. Remaining environmental mitigation costs have been separately quantified.

In the Project case, an additional one-off expense of \$11.5 million has been included in 2017. This is valued at \$10 million in present value terms. This cost includes \$9.5 million to offset loss of ecological values and \$2 million to account for the up-front costs of providing management zone mitigation to residential properties in the area.

The additional costs to offset loss of ecological values as a result of the project have been estimated from data provided by Umwelt (Australia) Ltd on the ecosystem and species credit requirements generated by the Project (and excluding credits gains by site rehabilitation) (Table 4.4).

**Table 4.4: Ecological offset costs**

<b>Credit type</b>	<b>Credit requirements</b>	<b>Cost per credit (\$)</b>	<b>Total offset cost (\$m)</b>
Ecosystem	13,361	\$673	\$9
Species	562	\$901	\$0.5
<b>TOTAL</b>			<b>\$9.5</b>

Source: Umwelt (Australia) Ltd

These costs assume that all ecological offset costs will be paid into the Upper Hunter Biodiversity Offset Scheme Fund. As such, these costs are likely to be overestimated given the Biodiversity Offset Strategy proposed by the Joint Venture includes a number of offsetting measures, including the establishment of proponent-managed sites that would reduce the need to buy credits. Ongoing consultation will occur with the NSW Government regarding the implementation of the offset strategy for the Project.

There are no **transport management costs** anticipated in the base case. While some transport management will be required during the construction phase of the Project, during the relocation of the Golden Highway, these expenses have been included in the capital cost estimates associated with this infrastructure works.

The proponents may be required to **purchase land** should private landowners seek to exercise their voluntary acquisition rights in either the base case or Project case. Specifically, it is expected that 7 additional residential properties will fall within the acquisition zones for air quality and/or noise impacts associated with the Project. While the extent and timing of acquisitions are uncertain, the proponent has advised that a total acquisition cost of \$10 million could be assumed as an expense in 2017 for the purpose of

the CBA. This is valued at \$8.7 million in present value terms. As detailed in Section 4.3.4, it is conservatively assumed that any acquisitions will be made at market value, such that there is no additional surplus for the landholders affected.

The proponent has also advised that it expects to make a **local contribution** to Singleton Council should the Project proceed, under a Voluntary Planning Agreement for the purpose of compensating the council for costs induced as a result of the mining activity. This cost has been included in capital cost estimates, and is not itemised separately.

#### 4.3.1.4 Taxes

**Total taxes** accrued as a result of open cut mining operations are estimated at \$242 million (\$513 million) in the Project case, in present value (and undiscounted) terms. These estimates are inclusive of projections for corporate income tax to the Australian Government, payroll tax payable to the NSW Government and local government rates payable to Singleton Council.

**Corporate income tax** payable is estimated at \$208 million (\$441 million) in the Project case in present value (and undiscounted) terms. The method used to develop these estimates is outlined in Section 4.3.3.

**Payroll tax** has been estimated as a function of expected employee wage costs, estimated with reference to ABS Census data and data on FTEs provided by the proponent.

Specifically, the average annual income for a full-time worker in the mining industry in the Lower Hunter SA3 has been estimated at \$102,259 per annum, based on ABS Census data scaled up to 2016 prices using the mining industry Wage Price Index (ABS 2016). Annual payroll tax payable on these labour expenditures has been estimated by applying the current 5.45% payroll tax rate to annual labour expenditure in excess of the \$750,000 annual threshold reported by the NSW Office of State Revenue (2016).

Overall, payroll tax is estimated at \$27 million (\$59 million) in the Project case, in present value (and undiscounted) terms.

With regards to **local government rates**, the proponent has advised that around \$480,000 is currently payable to Singleton Council each year for Wambo mine landholdings. In addition, the annual rates payable to Singleton Council for United mine landholdings is estimated at around \$111,500.

This analysis has assumed that the rating classification of the landholdings will remain the same in each case, with no disposal of landholdings by the proponent, and that there will be no real increase in rates payable over time. On this basis, it is assumed that the current real rates will be an ongoing expense in both cases, over the period to 2039. Overall, total rates payable are estimated to be in the order of \$6 million (\$14 million) in the both the base case and Project case, in present value (and undiscounted) terms.

**Royalties** for the extraction and sale of product coal have been estimated by applying the open cut ad valorem royalty rate of 8.2% to anticipated coal revenue in each case, after accounting for the allowable deductions related to beneficiation costs. In present value terms, royalties are estimated at \$408 million (\$866 million) in the Project case. Section 4.3.2 provides further detail on the methodology used to develop these estimates.

### 4.3.2 Royalties

The Project is estimated to generate around \$369 million (in present value terms) in additional royalties for the NSW Government, relative to the base case. In undiscounted terms, this is equivalent to an additional \$817 million in government revenue over the life of the Project.

This estimate incorporates allowable deductions of \$3.50 per tonne of product coal that is subjected to a full cycle of washing. However, excludes potential for further deductions related to payment of levies, insurance and other items such as bad debts and bank commissions, due to the variability in such payments and the difficulty to forecast them accurately over time. These deductions are unlikely to have a large effect on the estimated royalties as they are removed from gross revenue before calculating royalties payable, not removed from royalties payable.

The components used to estimate royalties are presented in Table 4.5. These include:

- Revenue from the sale of coal product over the life of mining operations in the base case and Project case (from 2016) using the price and quantity assumptions detailed in Section 4.3.1.
- Allowable deductions for beneficiation in each case, on the basis that all product coal will be subject to a full cycle of washing. These deductions were calculated at the rate of \$3.50 per tonne of product coal, as prescribed in Schedule B of the Determination under Section 283(5) of the Mining Act 1992 (Minister for Mineral Resources, 2008).
- Net disposal value, calculated as the difference between annual gross mining revenue and the total value of allowable deductions.
- Annual royalty payments, calculated using the ad valorem 'Open Cut Royalty rate' of 8.2% of the net disposal value for each year, as specified in the Mining Regulation.
- The undiscounted value of royalty payments was obtained by taking the total sum of annual royalty payments. The NPV estimate was produced by taking the present value of the annual royalty payments back to the start of 2016, using a 7% discount rate.

Comparing estimates for the base case and Project case indicates the net increase in royalties payable to the NSW Government.

**Table 4.5: Estimation of additional royalties (\$m, 2016 prices)**

Estimate	Base case (\$m, NPV)	Project case (\$m, NPV)	Incremental benefits (\$m, NPV)
Coal Production (Mt)	7.7	118.2	110.5
Gross mining revenue (\$m) (R)	\$506	\$5,178	\$4,672
Total allowable deductions for beneficiation (\$m) (D) (@ \$3.50 per tonne)	\$22	\$199	\$177
Net disposal value (\$m) (R – D)	\$484	\$4,979	\$4,495
Total royalties (\$m) (R – D) * 8.2%	\$40	\$408	\$369

Note: NPVs have been calculated using a 7% discount rate

### 4.3.3 Company income tax payable

Total company income tax payable is estimated at \$208 million (\$441 million) in the Project case in present value (and undiscounted) terms. No company income tax is expected under the base case.

These estimates were produced using the financial information described in Section 4.3.1, applying a 30% corporate tax rate to an estimate of taxable income in each year. For the purpose of this analysis, taxable income was estimated as gross mining revenue, less total costs (inclusive of FOB costs, rehabilitation and decommissioning costs, environmental mitigation costs and property acquisition costs), royalties and depreciation. Calculations of annual income tax payable also took into account tax losses accrued by the project. The exclusion of interest deductions indicates that these estimates are likely to be somewhat overestimated.

Nevertheless, the approach taken suggests an effective tax rate of 26% on profits, which is similar to other estimates. For instance, average effective tax rates of 23% and around 26% have been estimated by Clark et al. (2011) and Davidson (2015) respectively.

On the basis that NSW accounts for 32% of the Australian population, the share of company income tax attributable to NSW is estimated to be \$67 million (\$141 million) in the Project case, in present value (and undiscounted) terms. In other words, the Project generates additional tax revenue for the NSW community through corporate income tax payments.

### 4.3.4 Benefits to existing landholders

Net benefits of the Project to existing landholders in the surrounding area depend on any changes to the productivity of land or purchases of landholdings.

The Project Area consists of existing mining areas, including the previous United underground mining infrastructure, the existing Wambo open cut mine, and areas of rehabilitated land and native vegetation. The land to the north east of the Project Area is occupied by Coal and Allied's Hunter Valley Operations (HVO South), and further to the north by agricultural land. The area south of the Project Area is occupied by Wambo owned grazing land. Land to the east of the Project Area includes a small area privately owned by the Hunter Valley Gliding Club, which is surrounded by Coal and Allied owned mining buffer land. To the immediate west of the Project Area is National Park and an area of Wambo owned buffer land which is utilised for grazing.

The proponent has indicated that the Project is not expected to have any impacts that would affect the ongoing productive use of land used for grazing and agricultural purposes in the vicinity of the Project Area.

In terms of residential landholding, the Project Area is located approximately 1 km from the village of Warkworth. All but one of the residences in this village are currently owned by mining companies. Other villages in the vicinity of the mine include Jerrys Plains and Bulga, which are located 6 km and 7 km from the Project Area respectively. It is expected that 7 additional residential properties will fall within the acquisition zones for air quality and/or noise impacts associated with the Project.

Accordingly, payments may be made to those landowners, should they wish to exercise their voluntary acquisition rights. A conservative estimate of those costs has been included in the calculation of net producer surplus, as detailed in Section 4.3.1.

As the proponents are almost wholly internationally owned, property acquisition payments could be interpreted as a benefit to the NSW residents who receive them. However, as the acquisitions are legislated as a response to the costs imposed on those landholders from externalities, it is more appropriate to consider that the payments will offset those impacts.

To present a conservative assessment of the Project, this CBA assumes that any acquisitions will be made at market value, such that there is no additional surplus for those landholders.

#### 4.3.5 Benefits to workers

A Town Resource Cluster Analysis for the Project indicates that all Project employees are anticipated to be drawn from NSW (Umwelt (Australia), 2016).

Net benefits to workers include any wage premiums paid to workers in the Project above the minimum (reservation) wage that workers would accept elsewhere in the mining sector.

It is conservatively assumed that workers employed by the Project are not expected to receive a wage premium. This assumes that workers will receive a net wage consistent with market rates. To provide an indicative estimate, this net wage is estimated to be around \$75,000, that being the average annual income for a full-time worker in the mining industry in the Lower Hunter SA3, based on ABS Census data scaled up to 2016 prices using the mining industry Wage Price Index (ABS, 2016), and discounted for predicted income tax payable using ATO (2016).

This approach assumes that there is no wage increase for workers already working in the mining sector and any wage increase accrued from gaining employment in the Project from outside the mining sector or from other areas of NSW is compensation for changes in working conditions, rather than a premium.

#### 4.3.6 Benefits to suppliers

The Project is not anticipated to generate any significant additional producer surplus for suppliers in NSW to the open cut mining operations.

A Town Resource Cluster Analysis for the Project indicates that there are currently 360 suppliers to the existing United and Wambo mining operations (Umwelt (Australia), 2016). A survey of a sample of these suppliers indicated that, on average, 74% of their business is dependent on the mining industry and that 57% felt that their business was stable, 27% felt their business was declining and 16% felt their business was growing.

To estimate the net benefits to suppliers it is necessary to examine the extent to which the Project will deliver additional producer surplus relative to what they would otherwise receive in the base case.

Due to weakening global coal prices, a number of mines in NSW are currently operating at sub-economic levels, despite productivity and efficiency gains across the sector. To the extent that those mines cease operations, there is likely to be some flow on impacts for suppliers. Accordingly, it is conceivable that the Project could deliver an additional benefit to suppliers relative to the base case.

However, as the outcomes for suppliers under the base case are not readily observable, this benefit is difficult to measure. Accordingly, it is conservatively assumed that suppliers to the Project will earn similar margins relative to what they could have received from other sources under the base case.

#### 4.3.7 Net environmental, social and transport costs

It is estimated that the Project will generate net environmental, social and transport costs of \$47 million (\$112 million), in present value terms (see Table 4.6). Around \$24 million (\$59 million) of these costs are attributable to the NSW community (see Table 4.7). These estimates incorporate the quantified costs associated with particulate matter and greenhouse gas emissions, noise impacts and impacts on traffic. There are also likely to be other external impacts of the Project, including those associated with Aboriginal and non-Aboriginal heritage and visual amenity.

The remainder of this section discusses the approach used to quantify external impacts, and discusses the significance of other external impacts in qualitative terms.

**Table 4.6: Calculation of net environmental, social and transport costs**

Item	Base case (\$m, NPV)	Project case (\$m, NPV)	Incremental (\$m, NPV)
Aboriginal heritage*	-	-	-
Air quality	-	-	5.08
Ambient noise	-	0.25	0.25
Biodiversity*	-	-	-
GHG	3.16	37.64	34.48
Water*	-	-	-
Non-aboriginal heritage*	-	-	-
Traffic and transport	-	7.40	7.40
Visual amenity*	-	-	-
<b>Net environmental, social and transport costs</b>			<b>47.22</b>

Source: Deloitte Access Economics calculations

\* Considered qualitatively

# Incremental air quality costs have been independently measured by Pacific Environment (2016). As such, base case and project case costs have not been separately itemised.

**Table 4.7: Attribution of environmental, social and transport costs to NSW**

Item	Total net cost (\$m, NPV)	NSW community share (%)	Net cost to NSW (\$m, NPV)
Aboriginal heritage*	-	-	-
Air quality	5.08	100%	5.08
Ambient noise	0.25	100%	0.25
Biodiversity*	-	-	-
GHG	34.48	32%	11.09
Water*	-	-	-
Non-aboriginal heritage*	-	-	-
Traffic and transport	7.40	100%	7.40
Visual amenity*	-	-	-
<b>Net environmental, social and transport costs</b>	<b>47.22</b>	-	<b>23.83</b>

Source: Deloitte Access Economics calculations

\* Considered qualitatively

#### 4.3.7.2 Air quality

Air quality impacts have been measured in terms of the health costs associated with emissions of fine particulate matter of less than 2.5 micrometres (PM<sub>2.5</sub>).

Pacific Environment (PEL) (2016) has produced a detailed assessment of the likely costs relating to particulate matter emissions from the Project. This estimate uses an 'impact pathway approach' to provide specific estimates for the Project given its geographical

location, its proximity to population centres and the potential effect of particulate matter emissions. Pacific Environment (2016) concludes that this approach is preferable to other approaches, such as the use of unit damage cost estimates developed by PAEHolmes (2013).

Drawing on the estimates found by the Pacific Environment report indicates that the incremental cost of increases in PM<sub>2.5</sub> concentration under the Project case is estimated at \$5.1 million (\$11.1 million) in present value (and undiscounted) terms. It should be noted that these costs may differ from those reported in the Pacific Environment report as they are discounted to 2016 values in this report.

The Air Quality Impact Assessment undertaken for the Project (refer to Appendix 7 of the EIS) also considered other air pollutants associated with blasting, diesel-powered equipment and vehicles. These include oxides of nitrogen and carbon monoxide.

The Assessment found that emissions from blasting activities could be managed under fuel minimisation measures within Wambo's existing Blast Fume Management Strategy. United and Wambo will also implement a Blast Management Plan which will have controls consistent with the Wambo Strategy and with existing Glencore blasting procedures implemented elsewhere in the Hunter Valley. With these measures in place, post-blast fumes are predicted to comply with the criteria at all sensitive receivers.

Nitrogen dioxide emissions from diesel exhausts were considered to be low and in compliance with NSW Environmental Protection Authority (EPA) criteria.

Geological investigation undertaken by United and Wambo also considered the potential for spontaneous combustion to occur. The investigation found the propensity for spontaneous combustion in the strata to be mined is low, and therefore with appropriate management measures in place the risk of adverse air quality impacts associated with spontaneous combustion is low.

Overall, while this analysis does not quantify the costs associated with additional oxides of nitrogen and carbon monoxide emissions from the Project, these are not expected to be significant in relation to the Project's net benefits to NSW.

#### **4.3.7.3 Greenhouse gas emissions**

The social costs of additional greenhouse gas emissions under the Project case are estimated at \$35 million (\$78 million) in present value (and undiscounted) terms. On the basis of the NSW population share of Australia (32%), around \$11 million (\$25 million) is attributed as a cost to the NSW community.

These costs have been estimated using projections of the Scope 1 and Scope 2 carbon emissions for each year of open cut mining activity in each case, as well as an estimate of the average cost per tonne of CO<sub>2</sub> emissions.

Annual estimates of t CO<sub>2</sub>-e were obtained for the Project case from the Greenhouse Gas Impact Assessment (refer to Appendix 8 of the EIS). Using the ROM coal profile for the Project, provided by the proponent, estimates of average emissions per tonne of ROM coal were produced for each year, which were then used to develop similar profiles of Scope 1 and Scope 2 t CO<sub>2</sub>-e between 2017 and 2020 for the base case. On average, factors of 0.031

t CO<sub>2</sub>-e of Scope 1 emissions and 0.005 t CO<sub>2</sub>-e of Scope 2 emissions per tonne of ROM coal were assumed.

These emissions were valued using the forecasted European Union Emissions Allowance Units price, based on futures derivatives published by the European Energy Exchange. This price series was used in the review of the NSW Energy Savings Scheme (NSW Government, 2015). The series assumes that the cost of carbon is included in wholesale electricity prices from 2021 onwards. When scaled up to 2016 price terms using the Consumer Price Index (ABS, 2016), the estimates increase gradually from \$8.96 / t CO<sub>2</sub>-e in 2017 to \$18.92 / t CO<sub>2</sub>-e in 2039. Recognising that this is conservative estimate of the cost of carbon, alternative price assumptions have also been considered in the sensitivity analysis presented in Section 4.5.

#### 4.3.7.4 Traffic

The impact of the Project on traffic and transport has also been quantified. Valuations of the cost of additional travel time for background traffic along the Golden Highway due to the realignment of the Highway and road closures due to blasting have produced an incremental cost estimate of around \$7.4 million (\$23 million) for the Project, in present value (and undiscounted) terms. This is wholly attributed to the NSW community.

This valuation has considered three key potential Project impacts on traffic, being:

- additional travel time for vehicles due to the 800m extension of the Golden Highway;
- temporary delays for vehicles due to closure of the Golden Highway during blasting events;
- additional delays for through traffic at the intersection between the Golden Highway and Wambo Mine Access Road.

The realignment of the Golden Highway is expected to cause an 800m extension of the Highway route. Assuming an average speed of 100km/h, this will add around 29 seconds to journeys for vehicles travelling on the Highway. The cost of this additional travel time has been quantified in monetary terms using unit costs of \$34.89 and \$52.63 per vehicle hour for light and heavy vehicles respectively. These estimates are drawn from average travel time values for vehicles on rural roads reported by Transport for NSW (2013), updated to 2016 prices using Consumer Price Index data (ABS, 2016).

Traffic volume and vehicle classification data for the Golden Highway, west of Wambo Mine Access Road from the Traffic and Transport Impact Assessment for the Project (refer to Appendix 17 of the EIS) was used to obtain a total average cost. The valuation excludes the impact of the extension of mine-associated vehicles, assuming a background average daily traffic volume on the Highway of 3,058 vehicles in 2017.<sup>a</sup> This estimate was then increased by 2.6% p.a. over the life of the project, consistent with the assumptions used in the Assessment. It is assumed that traffic volumes will remain constant from 2039 onwards, for

<sup>a</sup> This estimate is derived from data in the Traffic and Transport Assessment, subtracting the total 7 day average traffic volume for Wambo Mine Access Road (934) from the total 7 day average traffic volume for the Golden Highway East of Wambo Mine Access Road (3,992). The resulting estimate of 3,058 vehicles is very similar to the total 7 day average traffic volume for Golden Highway West of Wambo Mine Access Road, and hence is assumed as a reasonable estimate of non-mine related traffic that will experience additional journey times due to the Highway extension.

the purpose of including additional travel time costs in perpetuity. The valuation assumes no change in the proportion of background heavy and light vehicles over time – assuming constant shares of 17.6% and 82.4% respectively.

Overall, it is estimated that the extension of the Golden Highway will generate additional travel time costs for background traffic of around \$6 million in present value terms, or \$11 million in undiscounted terms from 2017 to 2039.

The valuation of traffic impacts also includes the cost of delays to non-mine related road users due to temporary road closures during blasting events in the Project case. The proponent has provided annual data on the number of blasting events to occur in each year, and has indicated that road closures due to these events range from 10 to 15 minutes.

Total annual vehicle delay costs of around \$1 million (\$3 million) in present value (and undiscounted) terms have been calculated on this basis, using the same background traffic projections and travel time cost estimates described above, but also accounting for additional vehicle operating costs in idling state of \$9.53 per hour, as reported by Transport for NSW (2013), updated to 2016 prices using Consumer Price Index data (ABS, 2016). The valuation is likely to be an overestimate of the impacts of the Project in this regard, as it conservatively assumes that there would be no road closures due to blasting events in the base case, and does not take into account that blasting events will, in practice, be planned to minimise road closure impacts.

Finally, this analysis has also considered the impact of the Project on average delays experienced by through traffic at the Golden Highway and Wambo Mine Access Road intersection. The Traffic and Transport Impact Assessment for the Project provides vehicle demand flow and average delay projections for this intersection, for AM and PM peak hour periods in 2018 in the base case and Project case, and in 2028 only under the Project. This data indicates that through traffic will continue to experience no delays at this intersection in both cases. Accordingly, no additional travel time delays have been included in the CBA.

#### **4.3.7.5 Ambient noise**

The costs associated with the ambient noise impacts of the Project have been valued at \$0.3 million (\$0.5 million) in present value (and undiscounted) terms. This cost is wholly attributed to the NSW community in the CBA.

This valuation uses data on modelled noise levels for 169 residential properties for four representative years under the Project case, obtained from the Noise Impact Assessment (refer to Appendix 9 of the EIS). To obtain a conservative estimate of the average noise levels likely to be experienced at each property, in excess of typical background levels, for each year of production under the Project case, the following calculations were made:

- The day, evening and night 'Rated Background Noise Levels' were subtracted from the annual average Project noise level predictions for each property, for day, evening and night periods respectively.
- The maximum noise exposure across the day, evening, and night periods (in excess of the background level) was identified for each property, in each of the modelled years.

- These identified noise exposure levels were then converted into a Project case time series, using the timing assumptions specified in Table 4.8.

**Table 4.8: Application of noise modelling results to Project timelines**

Noise modelling year	Project years applied
Year 2	2017 to 2021
Year 6	2022 to 2026
Year 11	2027 to 2031
Year 16	2032 to 2039

To present a conservative estimate of the impact of the Project, no noise costs have been calculated for the base case.

These additional noise impacts have been valued at a constant unit cost of \$63.89 per dB per household per year. This cost estimate is based on the upper limit of the range recommended to the European Commission DG Environment by Navrud (2002) (32 euros per dB per household per year) converted to 2016 Australian dollars using exchange rate and Consumer Price Index data.

Overall, the total noise impacts of the Project on residential properties are estimated to be around \$0.3 million (\$0.5 million) in present value (and undiscounted) terms. This should be interpreted as an indication of the scale of noise related externality costs and not a precise valuation, particularly as the unit cost estimates applied relate to traffic noise rather than the noise impacts of mining. It should also be noted that should the Project be approved, the proponent intends to undertake mitigation activities for residential properties that fall within the noise management zone. An estimate of this up-front cost has been included in the net producer surplus estimates for the Project case.

#### 4.3.7.6 Biodiversity

The Biodiversity Impact Assessment undertaken for the Project (refer to Appendix 13 of the EIS) has focused on assessing the impacts on biodiversity within the additional disturbance area for the project, given that the Wambo Surface Development Area has previously been assessed and approved for disturbance.

The Assessment identifies that the Project will disturb approximately 714 hectares. The direct impacts of this disturbance will include loss of native vegetation and fauna habitats as a result of direct clearance works and works associated with the construction and operation of the Project. In particular, it is noted that:

- The predicted decline in groundwater levels will have a negligible impact on identified groundwater dependent ecosystems.
- The Project will generate low risks for the subterranean ecosystem, based on the potential groundwater drawdown impacts on the alluvium of Wollombi Brook.
- The Project is likely to have a significant impact on the Central Hunter Valley Eucalypt Forest and Woodland CEEC due to the loss of 223.5 hectares of the community.

- The Project is unlikely to have a significant impact on three identified species of national environmental significance (regent honeyeater, swift parrot and spotted-tailed quoll).

In addition, the Project is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the Project. Some impacts on habitat connectivity, fugitive light emissions, dust, noise, surface water flow changes, groundwater changes, weeds and feral animals may occur during the construction and operational phases. The Joint Venture has advised that it is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

Overall, while the Project disturbance will impact biodiversity values in the short-term, the biodiversity offset strategy will be designed to restore those values in perpetuity. Accordingly, the impacts of the Project on biodiversity have been assessed qualitatively in the CBA. An estimate of the costs associated with the implementation of the offset strategy has been included under the environmental mitigation costs item in Section 4.3.1.

#### 4.3.7.7 Visual amenity

A detailed assessment of the likely visual impacts of the Project on surrounding private landowners and key public vantage points has been prepared by Umwelt as part of the EIS. In the absence of appropriate monetary values to quantify the visual impacts of the Project, these are acknowledged qualitatively in the CBA.

The Assessment indicates that there are currently significant differences in visual amenity within and surrounding the Project Area due to variation in landscape elements. While the Project Area exists within a mining landscape (including numerous mining operations, mined land and existing infrastructure), the local area is dominated by agricultural land uses, predominantly grazing, with more intensive cropping land located on the alluvial flats associated with the Hunter River and Wollombi Brook. The forested foothills of the Wollemi National Park lie approximately 0.5 kilometres to the west of the Project Area. Many of the residences surrounding the Project Area and other surrounding public viewing locations currently have extensive views of open cut mining and associated activities.

It has been identified that the key aspects of the Project which have the potential to result in visual impacts include:

- Clearing and overburden removal, which may be associated with views of mobile plant and equipment, exposed surfaces, dust, blasting operations and night lighting.
- Active mining operations, which may be associated with views of mobile plant and equipment, exposed surfaces, dust, blasting operations and night lighting.
- Emplacement of overburden, which may be associated with views of mobile plant and equipment exposed surfaces, dust and night lighting.
- Rehabilitation, which may be associated with views of mobile plant and equipment and regenerating vegetation.

Emplacement areas will generally continue to be the most visible element of the Project for viewing locations to the south, east and north-east. Meanwhile, the active mining face within the approved Wambo Open Cut will be the most visible element for viewing

locations to the northwest as mining progresses through the main ridgeline. This mining is currently approved. It is expected that the progressive rehabilitation of overburden emplacement areas from the early stages of the Project and shaping of the final landform to incorporate natural landform features will reduce the visual impact of emplacement areas.

In addition, it is expected that the Project will not substantially alter the nature of existing views from the Golden Highway. Road users on the Golden Highway will have intermittent views of mining activities within both the United Open Cut and Wambo Open Cut. Additional roadside tree planting and progressive rehabilitation of the emplacement areas will reduce the visual impact of these activities over time. The cost of these measures has been included in ongoing operating cost estimates.

The use of mobile lighting during night time operations will be required to be managed so that mobile lighting does not impact on road users or local amenity. Where possible, mobile lighting plant will also be screened from residences and public viewing locations by overburden emplacement areas, vegetation or natural topography.

#### **4.3.7.8 Aboriginal Heritage**

The Aboriginal Heritage Impact Assessment undertaken for the Project (refer to Appendix 15 of the EIS) reports the findings of an assessment of scientific significance for 128 stone artefact sites identified within a 5.6km<sup>2</sup> Survey Area within the Project Area. The survey program included all areas within the Project Area that are not previously modified by approved mining activities, or areas approved for disturbance on the Wambo mine lease. It is expected that 127 of these sites will be impacted by the Project, with the remaining one site partially impacted.

The majority of sites (122) have been assessed as having low scientific significance. In most cases this is because the sites are low density artefact scatters or isolated finds located in landforms with thin A horizon soils where further subsurface archaeological deposits are unlikely. In some cases the artefacts may be more numerous but erosion has affected a large percentage of the site and the visible artefacts are displaced and of limited archaeological value. The remaining six sites have been assessed to have a low-moderate scientific significance. Due to the existing level of disturbance within the Survey Area, no sites have been assessed as having a high or moderate scientific significance.

Given the difficulty in placing a quantitative value on Aboriginal Heritage, the impact of the Project on Aboriginal Heritage is analysed qualitatively in this analysis. Management options have been proposed to manage the impacts of the Project, with all sites to be salvaged by a surface collection and all visible surface artefacts recorded.

#### **4.3.7.9 Non-Aboriginal Heritage**

The Historic Heritage Impact Assessment for the Project (refer to Appendix 16 of the EIS) has identified non-Aboriginal historical heritage sites contained within and in the vicinity of the Project Area and assessed the significance of any potential impacts on those sites due to the Project.

In general, the Assessment concludes that all but two of the identified and potential historical heritage components to be impacted by the Project have been assessed as having

no significance with no research potential. The two components assessed as being significant are the Dog-leg fence and the former house site, which have been assessed as State and local significance respectively. The Wambo Homestead Complex which is a site of State significance to the south of the Project Area is not predicted to be impacted. The Assessment sets out recommendations for management of those sites to minimise the impacts.

Due to the challenges in quantifying impacts on historical heritage (see, for instance, Productivity Commission 2006:145), these impacts are acknowledged qualitatively in this analysis.

#### **4.3.7.10 Surface water and Groundwater**

The impacts of the Project on surface water and groundwater resources have been considered in the Surface Water Impact Assessment (refer to Appendix 11 of the EIS) and Groundwater Impact Assessment (refer to Appendix 12 of the EIS).

Overall, the Surface Water Impact Assessment found that the Project is expected to have minor to negligible impacts on flows, water quality and water users relative to the existing approved impacts on Wollombi Brook, Waterfall Creek and on the Hunter River with the proposed Water Management Systems in place.

The Project will result in changes to the catchment areas for Wollombi Brook, North Wambo Creek, Redbank Creek and Waterfall Creek compared to the catchment areas of the currently approved final landform at United and Wambo operations. The reductions in catchment areas for North Wambo Creek and Redbank Creek from the approved final landform are considered to be small within the context of ephemeral streams and in consideration of the existing licensed extraction rights. The change in total catchment contributing to the downstream watercourses of Wollombi Brook, when the Project is compared to the approved final landform is negligible, with the reduction in total catchment less than 0.4 per cent. The Project is therefore predicted to make a negligible contribution to cumulative impacts to flows in Wollombi Brook.

The Project is not considered to adversely impact water quality in downstream watercourses, and hence it is considered that any impacts of the Project on downstream water users will be negligible.

In addition, all water take for the Project will be managed under the *Water Management Act 2000* either under harvestable rights provisions or water access licences, ensuring that all water take is within the sustainable yield volume for the catchments and watercourses determined by the NSW Government.

With regards to groundwater, the Assessment found that, due to the extent of existing mining within and surrounding the Project Area, the Project is expected to make a relatively minor contribution to the extent of cumulative groundwater drawdown.

It is expected that the Project will contribute to drawdown at one private bore, resulting in a cumulative drawdown that will exceed 2m during and post mining. This bore is not currently serviceable, but it is understood to have been installed within the shallow weathered coal measures. It is predicted that the bore, if repaired, will not go completely dry, but rather remain useable with a reduced peak pumping capacity due to the predicted

decline in water level. This bore is located on a property within the predicted noise affectation zone for the Project and which is likely to be subject to acquisition clauses should the Project be approved. Whilst the property remains in private ownership the proponent will consult with the property owner to determine appropriate alternate water supply arrangements if there is any material impact on serviceable water supply.

It is also noted that groundwater takes associated with the Project are within the entitlements currently held by United and Wambo.

#### 4.3.8 Net public infrastructure costs

It is also relevant to consider the extent to which the Project will require additional expenditure on public infrastructure by government, after accounting for any portion of those costs which are to be paid for by the proponent.

In the context of the Project, it is noted that the cost of all proposed infrastructure relocations will be paid for by the proponent. These costs have been included in the capital cost estimates. In addition, it is anticipated that any further public infrastructure costs will be covered by a Voluntary Planning Agreement with Singleton Council. This topic has been covered in Section 4.3.1.

## 4.4 Overall cost benefit analysis results

Given the values assigned to each item in Section 4.3, it is estimated that the Project will deliver a net economic benefit to the NSW community of approximately \$414 million (in present value terms).

Table 4.9 presents the overall results of the CBA for the NSW community, while Table 4.10 provides a detailed summary of the results by item. Each estimate is measured in NPV terms, calculated using a 7% discount rate, in 2016 price terms, discounted back to the start of 2016.

The additional royalties to the NSW Government is the main incremental benefit to NSW of the Project in relation to the base case. The key incremental costs of the Project (within the NSW community) are the additional external costs, such as the cost of greenhouse gas emissions.

As recommended in guidelines, where it is difficult to place a value on a particular cost or benefit of the Project, a qualitative analysis has been undertaken. The results indicate that these non-quantified externalities would need to generate costs of around \$39 million per year (in real terms) for NSW from 2017 to 2039 to fully offset the estimated net benefits of the Project. This is equivalent to undiscounted costs of \$902 million over the period. This outcome is considered to be unlikely given the evidence contained in the EIS regarding the nature and scale of these impacts.

**Table 4.9: Overall CBA results for NSW community**

Summary item	Value (\$m, NPV)
Incremental benefits to NSW	437.3
Incremental costs to NSW	23.8
Overall net benefit of Project for NSW community	413.5

Source: Deloitte Access Economics calculations

**Table 4.10 Breakdown of CBA results by item**

Item	Incremental (\$m, NPV)	NSW community share (%)	Net benefit to NSW (\$m, NPV)	Net cost to NSW (\$m, NPV)
Net producer surplus	387.1	See Table 4.3	2.1	-
Royalties	368.6	100%	368.6	-
Company income tax	208.1	32%	66.6	-
Benefits to existing landholders	-	-	-	-
Benefits to workers	-	-	-	-
Benefits to suppliers	-	-	-	-
Net environmental, social and transport costs	-47.2	See Table 4.7	-	23.8
Net public infrastructure costs	-	-	-	-
<b>Total</b>	916.6	-	437.3	23.8

## 4.5 Sensitivity analysis

The CBA results presented above are subject to the assumptions and valuations applied to each cost and benefit, as outlined in Section 4.3. Accordingly, it is necessary to test the sensitivity of the estimate of net economic benefit by also considering upper and lower bound discount rates, and varying the size of a number of parameters of interest. This provides an insight into the range of possible outcomes that could be expected from the Project, given a number of different scenarios.

Based on the recommendations in the Guidelines (see Section 2.2), sensitivity analysis has been undertaken using a lower bound discount rate of 4% and an upper bound discount rate of 10%. It is noted that this lower bound rate of 4% is recognised in the literature as a reasonable discount rate to use when there is an interest in incorporating intergenerational concerns (Arrow et al, 2012).

Table 4.11 illustrates the variation in the net benefits to NSW under alternative discount rates.

**Table 4.11: Central CBA results – alternative discount rates**

Discount rate	Overall net benefit of Project for NSW community (\$m, NPV)
4%	566.6
7%	413.5
10%	310.1

Source: Deloitte Access Economics calculations

In all three scenarios, the Project is estimated to deliver a net benefit for the NSW community, that is, the benefits for NSW are estimated to exceed the costs of the Project borne by NSW, including the quantifiable externality costs.

The estimate of net economic benefits for NSW range from around \$310 million to \$567 million, a respective 25% decrease and 37% increase on the central estimate produced using the standard discount rate of 7%. The fact that net benefits are higher under the 4% discount rate indicates that a large share of the costs of the Project occur early in the period of analysis with benefits being generated throughout the period.

The second necessary component of a sensitivity analysis is to also vary the estimates for different inputs. The importance of testing scenarios is also recognised in the relevant CBA guidelines.

The variations undertaken as part of this analysis include:

- increasing export coal price forecasts by 30%;
- decreasing export coal price forecasts by 20%;
- increasing incremental royalties by 25%;
- decreasing incremental royalties by 25%;
- increasing Project case company tax by 50%;
- decreasing Project case company tax by 50%;

- pricing the cost of carbon according to alternative prices used in the Australian Treasury Clean Energy Future Policy Scenario (288% higher than the prices used in the central case scenario, on average); and
- pricing the cost of carbon according to alternative US EPA Social Cost of Carbon estimates (5% discount rate scenario) (87% higher than the prices used in the central case scenario, on average).

The sensitivity ranges for the export coal prices were arrived at through an analysis of data over the period from January 1995 to January 2016. Specifically, the range used covers 67% of the range of historical monthly coal prices over this period. The minimum price in the lower sensitivity scenario, forecast for 2016, is placed at the 9<sup>th</sup> percentile of historical coal prices. Meanwhile, the maximum price in the upper sensitivity scenario, forecast for 2020, is placed around the 77<sup>th</sup> percentile.

The alternative prices for the cost of carbon have been identified in the Review of the NSW Energy Savings Scheme (NSW Government, 2015). As the cost of carbon series used in both the central case of the CBA and this sensitivity analysis rely on assumptions that are not completely transferable to the Australian context, the sensitivity analysis series have been used to provide a range of the potential costs associated with greenhouse gas emissions.

A comparison of the total net benefits obtained in each of these scenarios, using a 4%, 7% and 10% discount rate is presented in Table 4.12.

**Table 4.12 – Sensitivity analysis – comparison of net benefits for NSW**

Parameter	Variation in Parameter	Net Benefits (\$m)		
		4%	7%	10%
Central CBA	N/A	566.6	413.5	310.1
Export coal price forecasts	+ 30%	910.9	664.7	498.9
	- 20%	362.8	264.3	198.1
Incremental royalties	+ 25%	679.4	495.6	371.7
	- 25%	453.7	331.4	248.5
Project case company income tax	+ 50%	610.7	446.0	334.4
	- 50%	522.4	381.0	285.8
Social cost per tonne of carbon emissions	Australian Treasury Clean Energy Future Policy Scenario prices (+ 288%)	519.8	380.7	286.3
	US EPA Social Cost of Carbon prices 5% discount rate scenario (+ 87%)	554.0	404.4	303.2

Source: Deloitte Access Economics calculations

## 5 Local effects analysis

This section sets out the local effects analysis for the Project. The local effects analysis (LEA) is a new component of the economic analysis that is required to be undertaken pursuant to the Guidelines and is primarily designed to address the requirement of section 79C of the EP&A Act, which specifically requires an assessment of employment effects of the Project with reference to the “locality”.

The LEA is intended to be complementary to the CBA for NSW and is largely based on information already presented in the CBA. LEA essentially translates the effects estimated at the State level to the impacts on the communities located near the mine site.

There are a number of important points when considering the results of the LEA. First, the results of the LEA are not additive to those in the state level CBA. Rather, the results presented below are largely already covered in the CBA. Second, it is not intended that the components of an LEA can be added together to provide a single summary measure – each item reported below presents a different local effect. Finally, the LEA does not measure economic welfare outcomes.

This section starts with a description of the locality, defined as the Lower Hunter Statistical Area 3 (SA3) and population. This is followed by an analysis of the four areas covered by the LEA: local employment effects, local non-labour expenditure effects, effects on other local industries and environmental and social externalities. The chapter concludes with the results of computable general equilibrium modelling of the flow on effects of the Project.

### 5.1 Background on the locality and population

The Project is situated approximately 16 kilometres west of Singleton, and is contained entirely within the Lower Hunter Statistical Area 3 (SA3). This SA3 also includes the localities of Cessnock and Dungog. The population of the entire SA3 has been used to model the impact of the Project as labour and other expenditure is likely to be concentrated throughout this area.

The population for the SA3 was approximately 82,000 at the time of the 2011 Census. As of 2014 the population was estimated at over 88,000, indicating a population growth of approximately 2.4% per annum. This is above the growth of population for the State as a whole which is estimated at 1.4% a year from 2011 to 2014.

Several other key regional statistics are included in Table 5.1.

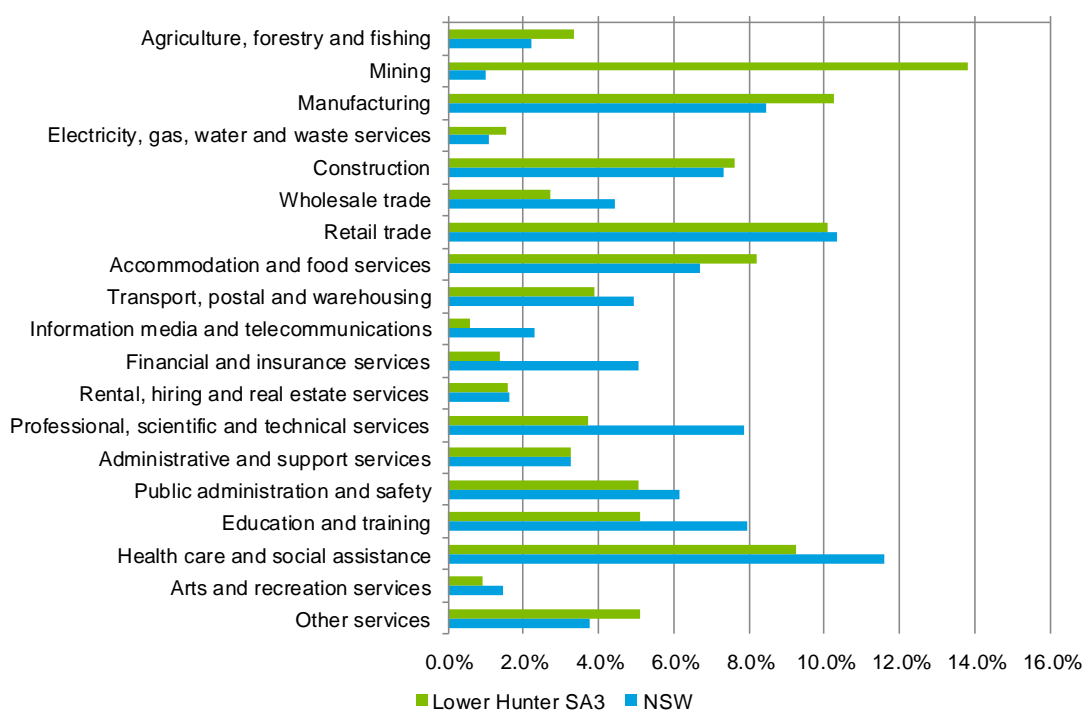
**Table 5.1: Population characteristics of the Lower Hunter SA3**

	2001	2006	2011	2001-2011 change
Population	73,738	76,432	82,221	11.50%
Mean household size	2.7	2.7	2.6	-3.70%
Median age	35	36	37	5.71%
Total occupied private dwellings	26,576	28,039	30,463	14.63%
Median monthly housing loan repayment	800	1,272	1,700	112.50%
Median rent	120	161	235	95.83%
Median household income (\$/week) – Lower Hunter SA3	701	941	1,183	68.76%
Median household income (\$/week) - NSW	826	1039	1233	49.27%

Source: ABS, 2011 Census of Population and Housing, Time Series Profile, Cat. 2003.0

Mining is the major industry of employment in the locality, employing 13.5% of the employed population. This is much higher than in NSW as a whole, where just 1.0% of the employed population work in the mining sector. The manufacturing and retail trade industries are the next highest employers in the locality, at 10.3% and 10.1% respectively.

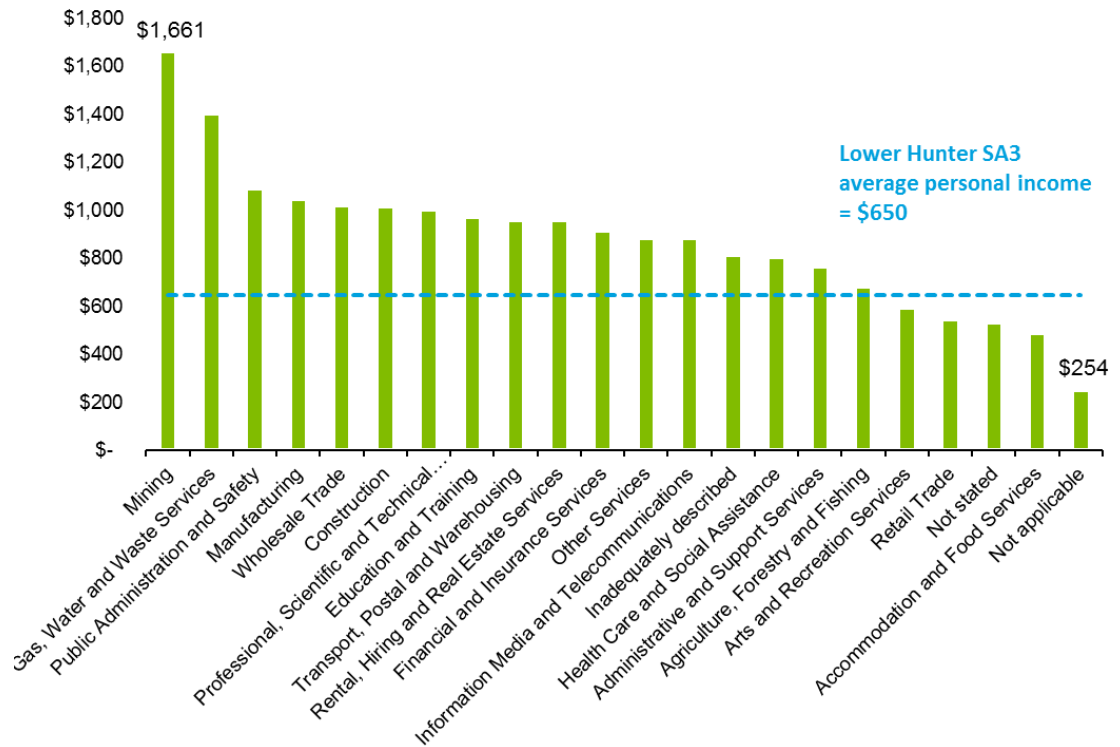
**Chart 5.1: Industry of employment in Lower Hunter SA3 and New South Wales**



Source: ABS 2011 Census

A breakdown of the average weekly wage by industry is provided in Chart 5.2. As illustrated, ‘Mining’ and ‘Electricity, Gas, Water and Waste Services’ are the two highest paying industries in the locality. ‘Mining’ employs 5031 people in the locality while ‘Public Administration and Safety’ employs 560 people.

**Chart 5.2: Lower Hunter SA3 average weekly personal income by industry – 2011 (\$2011)**



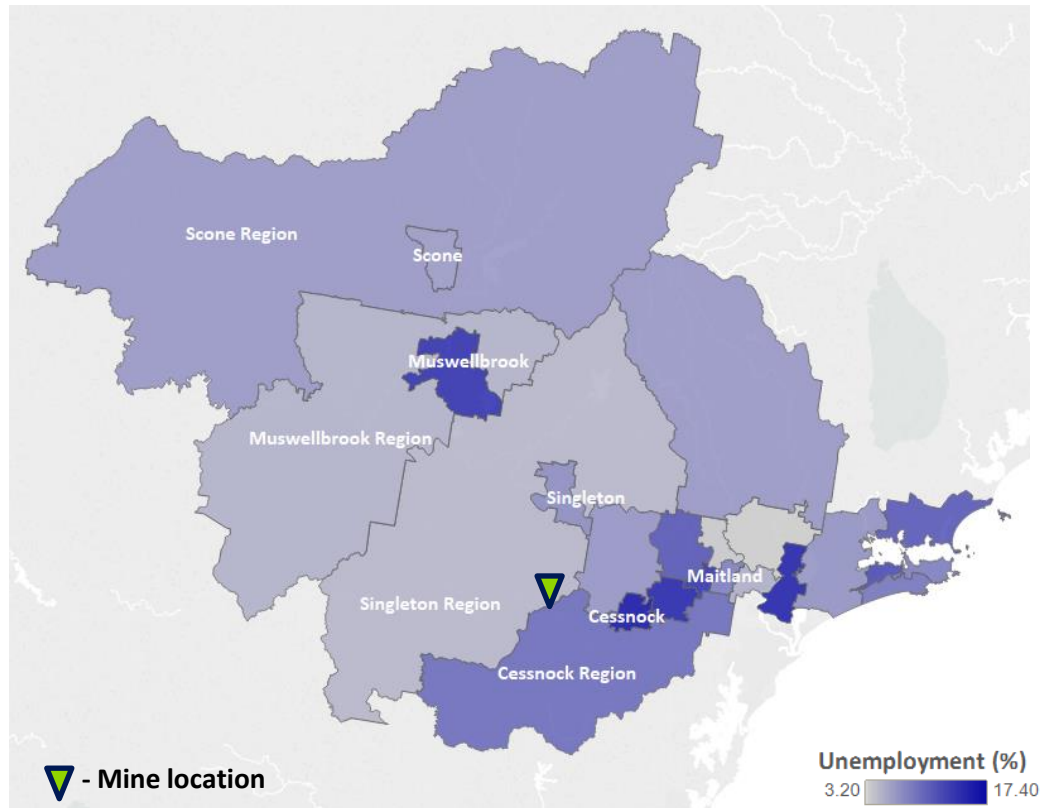
Source: ABS 2011 Census

According to the Commonwealth Department of Employment small area labour markets data, the unemployment rate for the quarter preceding December 2015 in the locality was 11.3%. This compares to a state-wide average of 5.9%, and the average for the Hunter region as a whole of 10.1% (Australian Government 2015).

As shown in Figure 5.1, while the overall level of unemployment in the locality is high, there is a significant amount of variation across the locality. Some of the Statistical Area 2's (SA2s) that make up the Lower Hunter SA3, particularly those surrounding the mine, have much lower levels of unemployment, with the areas surrounding Singleton and Muswellbrook having an unemployment rate of 4.8% and 5.1% respectively.

However, there are areas within the locality with much higher levels of unemployment. In particular, Cessnock, Raymond Terrace and Kurri Kurri-Abermain are all areas with unemployment above 16%, putting them in the top ten SA2s in NSW in terms of unemployment. It is noted that the town resource cluster analysis undertaken for the Project (Umwelt, 2016) identifies Cessnock as one of the top three towns of residence for existing Wambo employees, accounting for around 14% of all employees.

**Figure 5.1: Unemployment (%) by SA2 in the Lower Hunter locality**



Source: Australian Government 2015

Unemployment in the locality has followed a similar trend across each SA2, with the unemployment rate increasing significantly from around the March quarter of 2014. Unemployment for the Lower Hunter locality as a whole increased from 5.2% in March 2014 to 10.1% in the December quarter of 2015.

## 5.2 Local employment effects

One of the primary effects of a mining project on the locality is generating employment. The Project will both employ people directly and generate flow on employment. Of the people employed directly by the mine, a portion of them will be normally resident in the locality. Flow on employment is generated as the expenditure of direct employees in the local area generates additional employment. For example, workers at the site may spend some of their additional income at shops in towns within the locality, helping to support additional employment in these shops.

This section deals with **direct employment effects**. The guidelines indicate that CGE modelling could then be used to estimate flow on effects throughout the locality. These results are presented in Section 5.7.

However, the Guidelines require consideration of the likely **net employment effects** on the community. This is because it is likely that many of the potential employees of the Project would find employment elsewhere if the Project was not to go ahead.

These employees may work at a different mine in a similar role or may have to find employment in another industry. In either case, the net benefit of employment is the additional income that the individual would earn in being employed at the Project rather than being employed elsewhere in the local economy.

The approach to measuring net effects is set out in the guidelines and essentially involves:

- Identifying direct employment of local residents by the Project.
- Comparing average incomes for Project employees to average incomes in the locality to estimate a net increase in income from employment at the Project.

Applying this approach to the Project results in the local employment effects reported below. This analysis compares average income for Project employees with both the average income in the locality overall, and average income for mining employees in the locality.

The results below provide an average for the Project during the establishment phase and the ongoing operations phase. For the purposes of this calculation the establishment phase was defined as being from 2017-2021 (encompassing construction alongside initial years of Project operations) while the ongoing operations phase was defined as being from 2022-2039. Data on direct employment and the share of this employment by those ordinarily resident in the locality was provided by the proponent.

On advice from the proponent, it is assumed that Project employees earn the average income in the mining industry in the locality. This data, and average income in the locality across all industry sectors, was sourced from the ABS (2011) adjusted to 2016 prices using the Wage Price Index (ABS, 2016).

Average income data were adjusted to FTE terms, based on the reported breakdown of full-time to part-time employees for the mining industry and all industries in the locality (ABS, 2011). It was assumed that part-time employees would earn, on average, 50% of the income of full-time employees in all cases. Estimates of net (post-tax) income were then developed based on income tax estimates produced using the ATO Simple Tax Calculator (2016).

The results in Table 5.2 demonstrate that the Project is estimated to directly employ 261 people during the establishment phase and 456 people during ongoing operations, measured in average FTE terms, incremental to the base case. The local share of employment is around 50% during both the establishment and ongoing operations phases, based on the location of current employees as reported by Umwelt (2016).

This local employment is estimated to boost net income in the locality. The additional income is in the range of \$5 million (during establishment) to \$9 million (during ongoing operations) per annum, assuming that these individuals would earn the average wage in the locality (across all industries) if they weren't employed at the Project.

The summary results of the LEA conservatively apply the employment effects presented in Table 5.2.

**Table 5.2: Estimated local employment effects relative to mining industry employment in the locality – incremental to base case**

	Establishment phase		Ongoing operations phase	
	Ordinarily resident in locality	Not ordinarily resident in locality	Ordinarily resident in locality	No ordinarily resident in locality
Direct employment (FTE)	132	129	230	226
Average net income for Project employees (FTE) (\$/year)	76,476	76,476	76,476	76,476
Average net income in mining industry (FTE) (\$/year)	76,476	76,476	76,476	76,476
Average increase in net income per employee (FTE) (\$/year)	-	-	-	-
Increase in net income per year due to direct employment (\$m)	-	-	-	-
FTE equivalent	-	-	-	-

Source: Deloitte Access Economics calculations

**Table 5.3: Estimated local employment effects relative to average employment in the locality – incremental to base case**

	Establishment phase		Ongoing operations phase	
	Ordinarily resident in locality	Not ordinarily resident in locality	Ordinarily resident in locality	No ordinarily resident in locality
Direct employment (FTE)	132	129	230	226
Average net income for Project employees (FTE) (\$/year)	76,476	76,476	76,476	76,476
Average net income in locality (FTE) (\$/year)	38,897	38,897	38,897	38,897
Average increase in net income per employee (FTE) (\$/year)	37,579	37,579	37,579	37,579
Increase in net income per year due to direct employment (\$m)	5	5	9	8
FTE equivalent	128	125	222	218

Source: Deloitte Access Economics calculations

### 5.3 Non-labour expenditure effects

In addition to employment, the other major economic effect of the proposal on the locality is through expenditure on other, non-labour, inputs. For example, the Project requires a range of non-labour inputs including fuel, tyres, water and professional services. Expenditure on these inputs that is made within the locality generates local economic activity.

The Guidelines indicate that the estimated effects related to other, non-labour expenditure in an LEA is restricted to the direct expenditure made by the Project in the local area. These expenditures are reported in the table below.

The Guidelines do not require a net effect of local non-labour expenditure to be made.

The results below provide an average for the Project during the establishment phase and the ongoing operations phase. For the purposes of this calculation the establishment phase was defined as being from 2017-2021 while the ongoing operations phase was defined as being from 2022-2039. Data on direct operating expenditure was estimated as a function of deposit average thickness, the stripping ratio, capital cost and the daily production rate, with adjustments for further CHPP costs, overheads and distribution and selling expenses on advice from the proponent (methodology described in Section 4.3.1). The share of expenditure in the locality was calculated with reference to supplier expenditure location data in Umwelt (2016).

**Table 5.4: Estimated local operating expenditure effects – incremental to base case**

	Establishment phase		Ongoing operations phase	
	In locality	Outside locality	In locality	Outside locality
Total direct expenditure (average annual \$m)	66	162	89	217

Source: Deloitte Access Economics calculations

As can be seen above, the Project is estimated to directly spend \$228 million a year on average during the establishment phase and \$306 million a year on average during ongoing operations on non-labour operating expenditure. The local share of expenditure is around 29% in both phases. This is likely to underestimate the local share of operating expenditure, given that the proportions are based on the location of non-labour supplier expenditure that is directly reliant on the Project. Data on the location of supplier employees indicate that the share of supplier expenditure concentrated in the locality could be higher than assumed here.

There would also be some additional local expenditure effects associated with the capital expenditure to be incurred by the proponent. In the absence of data on the geographical distribution of capital expenditure, these effects are acknowledged qualitatively in this analysis.

## 5.4 Effects on other local industries

The development or extension of a mining project can have effects on other local industries, even where there are no direct monetary links between the Project and the local economy. This can be through purchase of goods and services or through generation of additional labour earnings.

The Guidelines provide some examples where a mining project can have effects on local industries:

- Displacement of a specific land use;
- Affecting on tourism and business travel; or
- Creating short run market adjustments in the cost of living for local residents, particularly in food and housing markets.

The guidelines require a qualitative discussion of these issues.

Displacement of specific land use discussed in Section 4.3.4 accrue to the locality. The Project will result in a reduction in land available for other land uses. However, because Project involves extending the operation of areas currently or previously used from mining, it does not represent a significant change from current land use practices. Current grazing activities on a small area of Wambo-owned land (30 hectares) in the northwest corner of the Project Area will be discontinued. In the base case, grazing will also be discontinued until 2020 under planned modifications to the Wambo Open Cut mine. Following the cessation of mining, most of the area will be rehabilitated for biodiversity purposes with some areas of agricultural land retained in areas of higher land capability.

The Project is not expected to have any material effects on tourism and business travel. The Project involves the continued use of existing mining areas and does not affect any local accommodation providers. Overall the Project is not expected to result in a change in either the supply or demand of tourism or business travel services in the locality.

Finally, the Project involves the continued use of existing mining areas and employment effects that are small relative to the current available labour force in the locality. It is not anticipated that this will result in significant changes in supply or demand in capacity constrained local markets and so it is not expected that there will be any short run market adjustments in the cost of living for local residents. For example, the Project is expected to employ around 132 FTE within the locality during the establishment phase. This can be compared to the forecast from the Department of Planning that around 550 additional dwellings will be constructed in the Singleton LGA alone between 2016 and 2021.

## 5.5 Environmental and social effects

Externalities (both positive and negative) are a major way in which the locality is affected by the Project. For example, much of the noise and dust generated by the Project affect those normally residing in the locality. Similarly, any infrastructure investment made by the Project also benefits those normally resident in the locality. In fact, many of the externalities identified in Section 4.3.7 are concentrated in the locality.

The guidelines indicate that an LEA should start with the externalities investigated in the CBA and identify those that create material, un-mitigated effects within the locality. The portion of the cost measured in the CBA that are incurred within the locality should then be reported in an LEA.

Of the external and social effects discussed in Section 4.3.7, those that create local effects are:

- Aboriginal heritage;
- Air quality;
- Ambient noise;
- Biodiversity;
- Greenhouse gas emissions;
- Water;
- Non-Aboriginal heritage;
- Traffic and transport; and
- Visual amenity.

Effects which can be quantified and attributed to the local area are provided in the table below. The process to attribute these costs to the local area has generally been to identify what percentage of the consequences would be felt within the local area and then apply this percentage to the total cost estimated in Section 4.3.7. In particular air quality, noise, traffic and transport costs were entirely allocated to the local area. Greenhouse gas costs were apportioned to the locality based on its share of the Australian population.

The results below provide an average for the Project during the establishment phase and the ongoing operations phase. For the purposes of this calculation the establishment phase was defined as being from 2017-2021 while the ongoing operations phase was defined as being from 2022-2039.

**Table 5.5: Estimated local externality effects – incremental to base case**

	Establishment phase		Ongoing operations phase	
	In locality (\$m)	Outside locality (\$m)	In locality (\$m)	Outside locality (\$m)
Aboriginal heritage*	-	-	-	-
Air quality	0.377	-	0.512	-
Ambient noise	0.042	-	0.014	-
Biodiversity*	-	-	-	-
Greenhouse gas emissions	0.009	2.325	0.014	3.681
Water*	-	-	-	-
Non-Aboriginal heritage*	-	-	-	-
Traffic and transport	0.460	-	0.610	-
Visual amenity*	-	-	-	-
<b>Total</b>	<b>0.9</b>		<b>1.2</b>	

Source: Deloitte Access Economics calculations

\* Considered qualitatively

Of the externalities that are readily quantifiable, the results above indicate that traffic and transport impacts are expected to account for the majority of local effects with the total value of external effects estimated to be around \$460,000 per year during the establishment phase and \$610,000 a year during ongoing operations.

The externalities which are dealt with qualitatively are:

- **Aboriginal heritage:** Attribution of this effect to the local area is challenging. The affected sites are all within the locality and, in this sense, the costs are borne by the locality. However, these costs may be more broadly spread among individuals who feel a cultural or historical connection to the affected sites.
- **Biodiversity:** The analysis provided in Section 4.3 indicates that the risks of the Project to biodiversity are short-term, and will be appropriately counterbalanced given the proposal to implement an appropriate biodiversity offset strategy. These impacts would be shared across the NSW community, with the locality potentially bearing a greater-than-proportional share to the extent that affected ecosystems and species are unique to the locality.
- **Water:** The analysis provided in Section 4.3.7 indicates that while Project will have some effects on water resources, these will not be significant in a downstream context in regards to surface water, and not likely to have a significant impact on water users or the environment in terms of groundwater (with the exception of one private bore). In this sense, it is unlikely that there will be significant costs borne by the locality.
- **Non-Aboriginal heritage:** Similar to Aboriginal heritage, attribution of this effect to the local area is challenging. The sites affected are all within the locality and, in this sense, the costs are borne by the locality. However, these costs may be more broadly spread among individuals who feel a cultural or historical connection to the affected sites.

- Visual amenity: Although non-quantifiable, the visual amenity effects discussed in Section 4.3.7 are entirely borne by those living with the locality.

## 5.6 LEA results

Combining the results from the sections above provides a view of the effects of the Project on the locality. Again, it is important to note that the results of the LEA are not additive to those in the state level CBA. Rather, the results presented below are largely already covered in the CBA. Second, it is not intended that the components of an LEA can be added together to provide a single summary measure – each item reported below presents a different local effect. Finally, the LEA does not measure economic welfare outcomes.

The results below provide an average for the Project during the establishment phase and the ongoing operations phase. For the purposes of this calculation the establishment phase was defined as being from 2017-2021 while the ongoing operations phase was defined as being from 2022-2039.

Overall, the Project is expected to directly employ around 132 FTE per year from the locality during the establishment phase and 230 FTE per year from the locality during ongoing operations, incremental to the base case. This direct employment is expected to result in a net increase in income in the locality of \$5 million a year during the establishment phase and \$9 million a year during ongoing operations, equivalent in 128 and 222 additional FTE respectively (assuming that these individuals would earn the average wage in the locality if they weren't employed at the Project).

In addition to employment the Project is expected to directly spend \$66 million a year in the locality on non-labour inputs during the establishment phase and \$89 million a year in the locality during ongoing operations.

The Project also creates external costs to the locality. The largest external cost is expected to be from traffic and transport impacts. The total value of quantifiable external effects estimated to be around \$900,000 per year during the establishment phase and \$1.2 million a year during ongoing operations.

**Table 5.6: Estimated local effects – Establishment phase**

	<b>Project direct: Total</b>	<b>Project direct: Local</b>	<b>Net local effects</b>
Employment			
Average FTE	261	132	128
Income (\$m)			5
Other non-labour expenditure (\$m)	228	66	
Externalities			
Aboriginal heritage	-	-	
Air quality	0.377	0.377	
Ambient noise	0.042	0.042	
Biodiversity	-	-	
GHG	2.333	0.009	
Water	-	-	
Non-Aboriginal heritage	-	-	
Traffic and transport	0.460	0.460	
Visual amenity	-	-	

Source: Deloitte Access Economics calculations

**Table 5.7: Estimated local effects – Ongoing operations phase**

	<b>Project direct: Total</b>	<b>Project direct: Local</b>	<b>Net local effects</b>
Employment			
Average FTE	456	230	222
Income (\$m)			9
Other non-labour expenditure (\$m)	306	89	
Externalities			
Aboriginal heritage	-	-	
Air quality	0.512	0.512	
Ambient noise	0.014	0.014	
Biodiversity	-	-	
GHG	3.695	0.014	
Water	-	-	
Non-Aboriginal heritage	-	-	
Traffic and transport	0.610	0.610	
Visual amenity	-	-	

Source: Deloitte Access Economics calculations

## 5.7 Second round and flow on effects

This section estimates the flow-on effects of the Project for the local and NSW economies. The section adopts a bottom up framework to determine the likely size, timing and location of the additional activity generated by the establishment and ongoing operations phases of the Project to the locality and the rest of NSW. For this, we have relied on comprehensive data on the capital expenditure and the operational activity associated with the Project, described in Section 4.3.1. This commercial information includes forward development and operational expenditures, production volumes and workforce requirements over the design and construction, and operational phases of the Project.

### 5.7.1 CGE methodology

Two main techniques are used to measure the second round economic impacts of a major project are Input Output (IO) multiplier analysis or Computable General Equilibrium (CGE) modelling.

IO modelling is based on a system of accounts that shows the flow of economic resources between different industries and groups in the economy. IO modelling and the multipliers derived from it generally assume that there is an unlimited source of resources available in the economy to meet increases in demand.

CGE modelling is an extension of IO modelling, in that it is based on a database that incorporates input output tables and the transactional detail between economic agents. CGE models build on this by incorporating a system of equations and modelling parameters, based on a widely accepted body of economic theory, that model competition for resources (particularly in labour and capital markets) between economic agents. This allows for economy-wide modelling of economic impacts that incorporates any “crowding-out” effects of the development.

In contrast to IO modelling, CGE modelling generally assumes that the economy and sectors within the economy are competing for the use of resources. This means that increases in demand from the Project may result in effects such as increased prices in other markets and crowding out effects (rather than just increased output). In this sense, CGE modelling is likely to provide more conservative estimates of economic impacts than those provided by IO modelling.

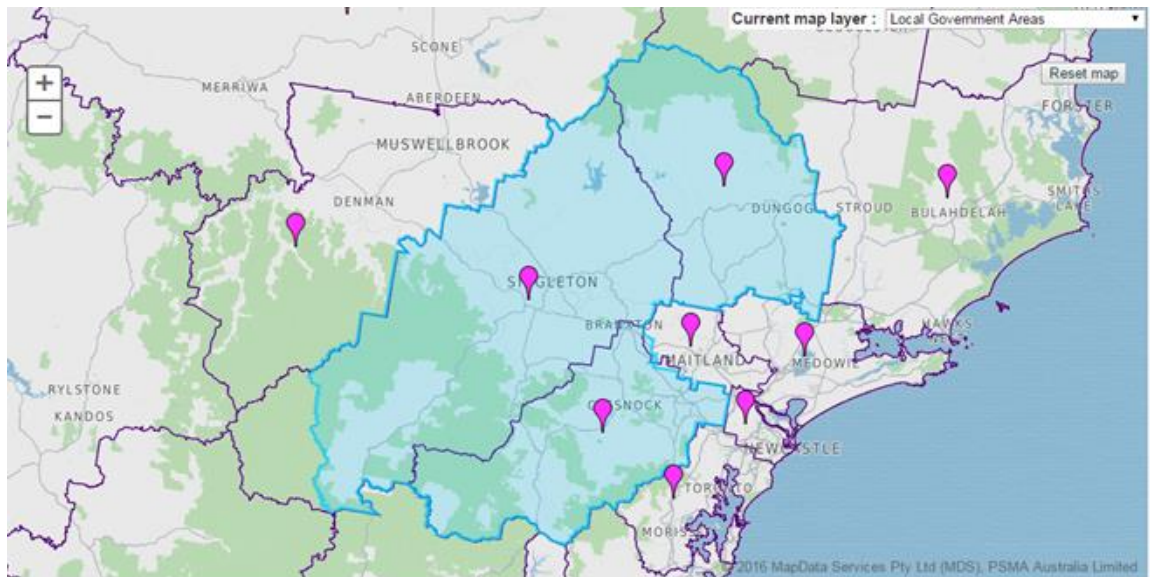
The economy-wide impacts of the Project have been projected using the Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM). The model projects macroeconomic aggregates such as GDP, employment and wages for the Project scenario against a reference case for each of the modelling years from 2016 to 2039. More technical detail regarding CGE modelling can be found in Appendix B.

The model has been disaggregated and customised to match the attributes of the broader regional economy. To disaggregate the broader region from the rest of NSW in the model, information was used from the most recent 2011 Census on the workforce population.

Modelling has been undertaken for the period to 2039 for the following economic regions:

- **The locality** — we have modelled a locality as close to the Lower Hunter SA3 as is possible. The CGE model can be disaggregated at the level of Local Government Areas and so we have represented the locality using the LGAs of Cessnock, Singleton and Dungog.
- **New South Wales** — includes the rest of the State of New South Wales.

**Figure 5.2: The locality modelled in the CGE model compared to the Lower Hunter SA3**



The results from the economic impact analysis are presented as percentages and absolute deviations in output, employment and wages from a baseline scenario in which the Project does not exist. The results are provided for the broader region, rest of NSW and total NSW.

Based on the capital and operational expenditures, the modelling gauges the wider economic impacts of the development and operation of the Project at two levels:

- **Direct impacts** — the economic gains associated with ‘core’ commercial operations, namely the coal extraction and processing, and revenues generated by the sale of coal exports from the mine.
- **Indirect, induced and crowding out impacts** — the economic gains in related upstream or downstream industries where the benefits associated with increased resource activity are typically the highest. As outlined above, the CGE modelling also captures any crowding out of activity in other sectors of the economy as a result of the Project.

Because of these two distinct elements, the results presented in this section may not necessarily be comparable to the output value and employment projections outlined in other areas of this CBA and local effects analysis, which take a narrower financial view.

## 5.7.2 Estimated flow on effects

The following discussion provides the economic impacts of the Project over the modelling period to 2039. This section outlines the projected impacts to the locality and the NSW state-wide impacts.

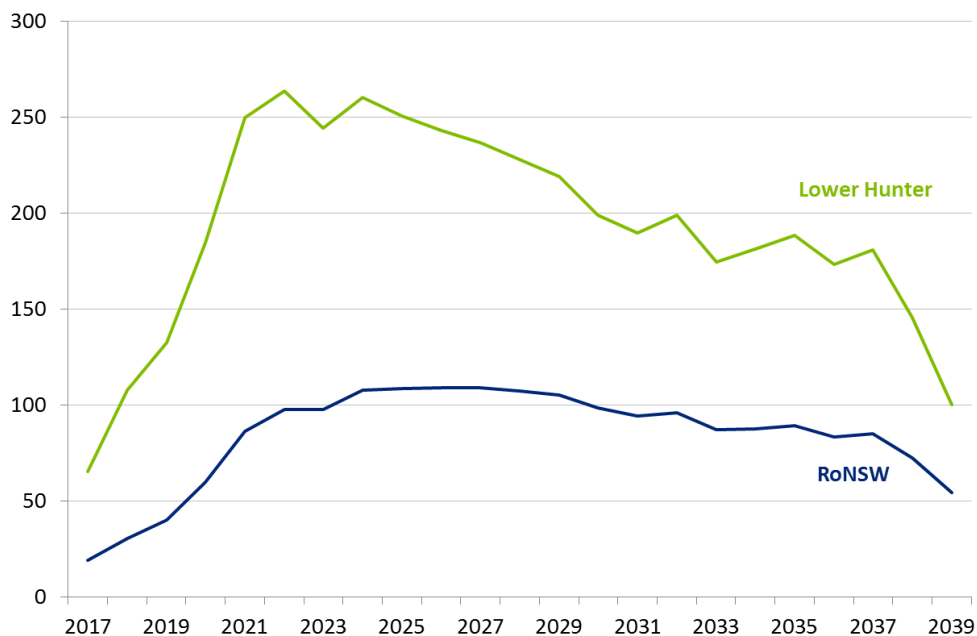
### 5.7.2.1 Economic impacts – Gross Production

Chart 5.3 shows the full temporal profile of production impacts on economy output levels in real 2016 terms as a result of the Project.

GRP is projected to increase by \$108 million in 2018 as a result of the peak in construction activity for the Project. The GRP impacts increase further in subsequent years as the positive impact of incremental coal production flows through, peaking at over \$263 million in 2022 in the locality (see the chart below). The total annual state-wide gross state product (GSP) impacts across the rest of the State peak at around \$109 million in 2026.

In NPV terms, over the modelling period, total locality GRP is projected to increase by \$2.1 billion. There is also an impact on the rest of the NSW economy with an increase of \$884 million in NPV terms over the period to 2039. Therefore, GSP State-wide is projected to be \$3.0 billion greater over the modelling period under the Project scenario.

**Chart 5.3: Gross production impacts for Lower Hunter and Rest of NSW, (\$ million)**



Note: All values are in real 2016 terms  
Source: Deloitte Access Economics

**Table 5.8: Economic impacts (2016 \$m)**

	NPV	2017	2019	2024	2029	2034	2039
<b>GRP/ GSP (\$m 2016)</b>							
Locality	2.52	4.91	6.75	4.83	4.33	1.63	2.52
Rest of NSW	0.02	0.03	0.04	0.03	0.03	0.02	0.02
<b>Total NSW</b>	<b>2.52</b>	<b>4.91</b>	<b>6.75</b>	<b>4.83</b>	<b>4.33</b>	<b>1.63</b>	<b>2.52</b>
<b>Deviation from the reference case (%)</b>							
Locality		2.52	4.91	6.75	4.83	4.33	1.63
Rest of NSW		0.02	0.03	0.04	0.03	0.03	0.02

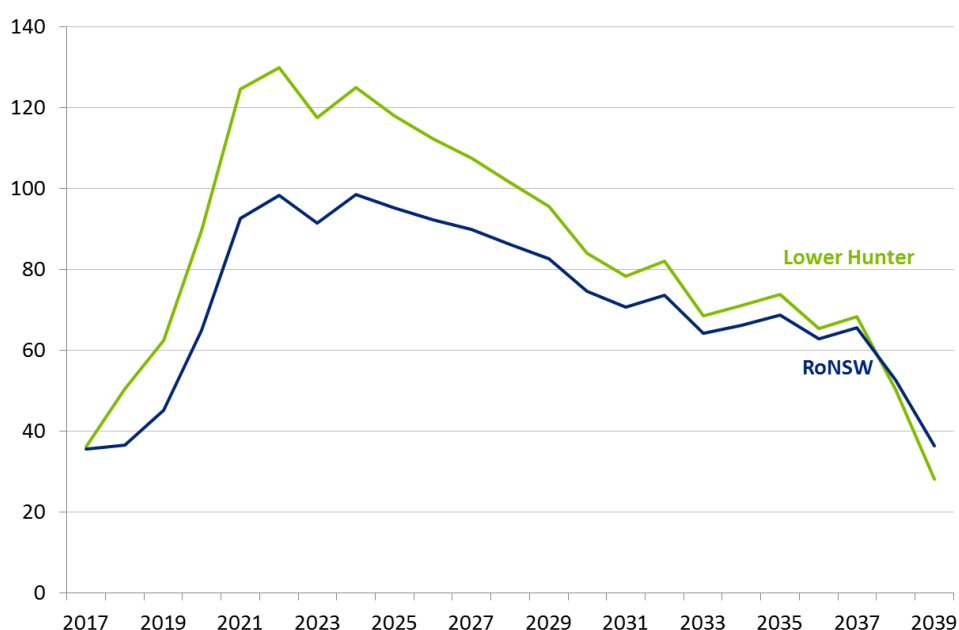
Note: All values are in real 2016 terms. The NPV discount rate is 7%.

Source: Deloitte Access Economics

### 5.7.2.2 Employment and Wages impacts

The complete temporal profile of projected incremental employment impacts in the locality and the rest of NSW are shown in Chart 5.4.

**Chart 5.4: Incremental employment impacts by region, FTEs**



Source: Deloitte Access Economics

The locality employment includes the incremental effects of direct employment at the Project, flow on effects throughout the economy and any crowding out that might occur in other sectors of the economy. This means that the results reported below take into account the fact that many of those directly employed by the Project would find employment elsewhere in the economy if the Project did not go ahead. This is why the incremental employment figures below are lower than the direct figures reported in Section 5.2.

Total projected incremental employment in the locality peaks in 2022, at 130 FTEs and remains positive throughout the modelling period. The incremental employment impact in NSW is expected to also peak at 228 FTEs in 2022 and is projected to be higher in all years of the modelling period under the Project scenario.

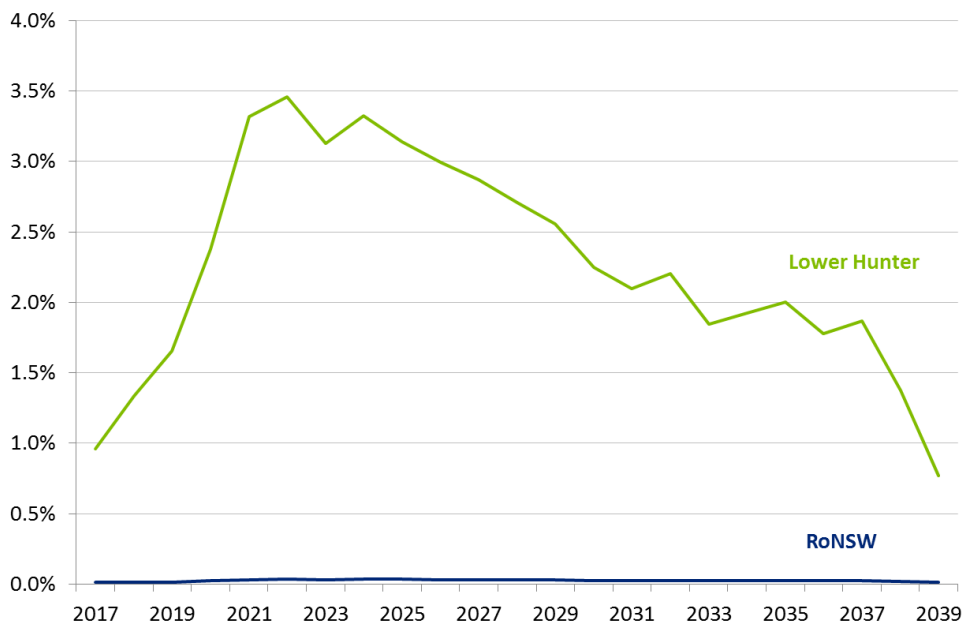
**Table 5.9: Incremental employment impacts, 2016 – 2039**

	2017	2019	2024	2029	2034	2039
<b>Employment (FTE)</b>						
Locality	36	63	125	96	71	28
Rest of NSW	3	45	99	84	68	38
Total NSW	7	106	222	178	138	65
<b>Deviations from the baseline</b>						
Locality	0.13	0.23	0.30	0.21	0.18	0.07
Rest of NSW	0.00	0.00	0.00	0.00	0.00	0.00

Source: Deloitte Access Economics

Growth in employment associated with the Project is also accompanied by an increase in real wages (see Chart 5.5). This occurs because there is increased competition for labour resources brought about by the Project which puts upward pressure on wages in the locality. The Project is predicted to have a negligible impact on wages in the rest of NSW.

**Chart 5.5: Broader regional real wages impact**



Source: Deloitte Access Economics

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# Appendix A: Checklist

## NSW Treasury (2007) NSW Government Guidelines for Economic Appraisal

Table A.1: Key issues mentioned in NSW Treasury (2007)

Draft Guidelines	Addressed	Reference
Identify Options		3
“Do nothing” option	Yes	3.1
Option development	Yes	3.2, 3.3
Identify Benefits		
Avoided Costs	Yes	4
Savings	Yes	4
Revenues	Yes	4.3.1.2
Benefits to consumers not reflected in revenue flows	Yes	4.3
Benefits to the broader community	Yes	4.3
Identify Costs		
Identify all relevant cost items	Yes	4.2
Stream of costs should cover full project period	Yes	4.3
Identify Qualitative Factors		
Identify costs and benefits that cannot be quantified	Yes	4.3.7
Other impacts include environmental considerations, industrial relations, social or regional impact, safety, public relations, resource availability	Yes	4.3.7
Assess Net Benefits		
Assessment of benefits in real terms	Yes	4.4
Discount at 7% rate, with 4% and 10% for sensitivity testing	Yes	4.5
Net Present Value	Yes	4.4
Net Present Value per \$ of capital outlay	NA	
Benefit-Cost Ratio (BCR)	NA	
Internal Rate of Return (IRR)	NA	
Sensitivity Testing		
Projected outcomes under alternative scenarios	Yes	4.5
Emphasis given on pessimistic alternatives	Yes	4.5
Ecologically Sustainable Development		
Inter-generational equity principle	Yes	4.5
Identification of Environmental Impacts	Yes	4.3.7
Valuation of Environmental impacts	Yes	4.3.7
Sensitivity and Threshold Analyses	Yes	4.5
Use of ENVALUE	NA	

Note: NAs in this table reflect summary measures that were not assessed as being necessary to reach conclusions.

## NSW Government (2015), “Guidelines for the economic assessment of mining and coal seam gas proposals”

**Table A.2: Key issues mentioned in the Guideline**

Draft Guidelines	Addressed	Reference
Establish the base case	Yes	3.1
Existing land use on the Project Area	Yes	3.1
Assess interactions with projects in the surrounding area	Yes	3.2.1
Define project	Yes	3
Cost benefit analysis	<b>Yes</b>	4
Estimate royalties payable	Yes	4.3.2
Estimate company income tax	Yes	4.3.3
Net producer surplus (and attribution to NSW)	Yes	4.3.1
Indirect benefits (and attribution to NSW)	Yes	4.3.4, 4.3.5, 4.3.6
Indirect costs to NSW	Yes	4.3.7
Aboriginal cultural heritage	Yes	4.3.7
Air quality	Yes	4.3.7
Ambient noise	Yes	4.3.7
Biodiversity	Yes	4.3.7
Greenhouse gas	Yes	4.3.7
Groundwater	Yes	4.3.7
Non-Aboriginal heritage	Yes	4.3.7
Surface water	Yes	4.3.7
Traffic	Yes	4.3.7
Visual amenity	Yes	4.3.7
Net present value	Yes	4.4
Sensitivity analysis	Yes	4.5
Local Effects analysis	Yes	5
Effects on local employment	Yes	5.2
Effects on non-labour project expenditure	Yes	5.3
Effects on other local industries	Yes	5.4
Environmental and social impacts on the local community	Yes	5.5
Flow-on effects	Yes	5.7

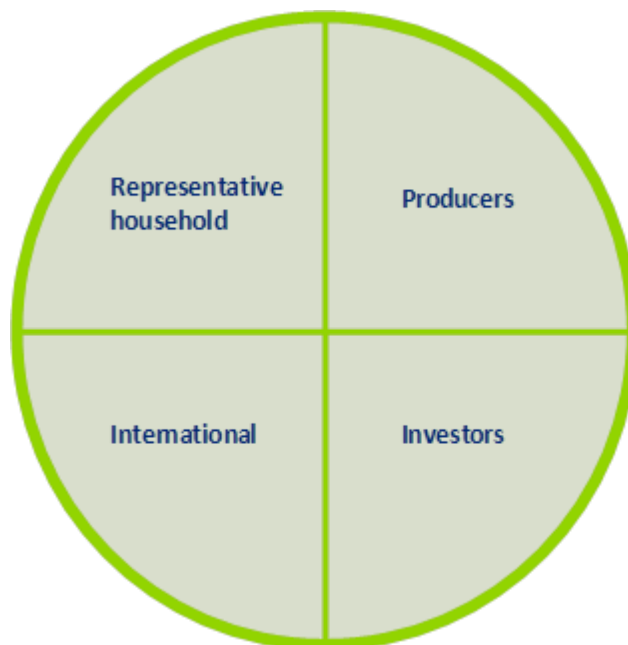
## Appendix B: Computable general equilibrium modelling

The Deloitte Access Economics – Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as gross domestic product, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works.

Figure B.1 shows the key components of the model for an individual region. The components include a representative household, producers, investors and international (or linkages with the other regions in the model, including other Australian States and foreign regions). Below is a description of each component of the model and key linkages between components. Additional technical detail is also provided.

**Figure B.1: Key components of DAE-RGEM**



DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a ‘regional consumer’ that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).
- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a constant elasticity of substitution production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The model contains a more detailed treatment of the electricity sector that is based on the ‘technology bundle’ approach for general equilibrium modelling developed by ABARE (1996).
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).

- For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically-produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.
- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

### The representative household

Each region in the model has a so-called representative household that receives and spends all income. The representative household allocates income across three different expenditure areas: private household consumption; government consumption; and savings.

Going clockwise around Figure B.1, the representative household interacts with producers in two ways. First, by allocating expenditure across household and government consumption, this sustains demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) as well as net taxes. Factors of production are used by producers as inputs into production along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The representative household's relationship with investors is through the supply of investable funds – savings. The relationship between the representative household and the international sector is twofold. Firstly, importers compete with domestic producers in consumption markets. Secondly, other regions in the model can lend (borrow) money from each other.

Some detail:

- The representative household allocates income across three different expenditure areas – private household consumption; government consumption; and savings – to maximise a C-D utility function.
- Private household consumption on composite goods is determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. Private household consumption on composite goods from different sources is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption on composite goods, and composite goods from different sources, is determined by maximising a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of generating capital.

## Producers

Apart from selling goods and services to households and government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another's production. For example, coal producers supply inputs to the electricity sector or the steel manufacturing sector.

Capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region's capital stock, is undertaken by producers. In other words, investment demand adds to household and government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. Firstly, they compete with producers in overseas regions for export markets, as well as in their own region. Secondly, they use inputs from overseas in their production.

Some detail:

- Sectoral output equals the amount demanded by consumers (households and government) and intermediate users (firms and investors) as well as exports.
- Intermediate inputs are assumed to be combined in fixed proportions at the composite level. As mentioned above, the exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the 'technology bundle' approach developed by ABARE (1996).
- To minimise costs, producers substitute between domestic and imported intermediate inputs is governed by the Armington assumption as well as between primary factors of production (through a CES aggregator). Substitution between skilled and unskilled labour is also allowed (again via a CES function).
- The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply (is assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as DAE-RGEM. There are other labour market 'settings' that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand changes being absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

## Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destinations based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

Some detail:

- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

### **International**

Each of the components outlined above operate simultaneously in each region of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions must be met such as global exports and global imports are the same and that global debt repayments equals global debt receipts each year.

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