Economic Impact Assessment of the Hume Coal project

Prepared for Hume Coal Pty Ltd

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Abbreviations

2015 Guidelines	Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2015)
2017 EIA	BAEconomics, Economic Impact Assessment of the Hume Coal project (20 February 2017)
2018 Updated EIA	BAEconomics, Updated Economic Impact Assessment of the Hume Coal project (7 November 2018)
2018 Technical Notes	Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2018)
ABS	Australian Bureau of Statistics
AIP	Aquifer Interference Policy
ASNA	Australian System of National Accounts
BISO	BIS Oxford Economics
BRP	Berrima Rail Project
CAV	Construction accommodation village
CBA	Cost benefit analysis
CEGEM	Cadence Economics General Equilibrium Model
CPP	Coal preparation plant
DIIS	Department of Industry, Innovation and Science
DSE	Dry sheep equivalent
EEC	Endangered ecological communities
EIS	Environmental impact statement
EVAO	Estimated value of agricultural operations
FTE	Full-time equivalent
GDE	Groundwater dependent ecosystem
GDP	Gross domestic product
GE	General equilibrium
GHG	Greenhouse gas
GL	Gigalitre
GRI	Gross regional income
GRP	Gross regional product
GSI	Gross state income
GSP	Gross state product
GVA	Gross value of agricultural production
ha	Hectare
HCC	Hard coking coal
IEA	International Energy Agency
LEA	Local effects analysis

LGA	Local government area
LQ	Location quotient
MIA	Mine Infrastructure Area
Mt	Million tonnes
Mtpa	Million tonnes per annum
NSW Treasury Guide	NSW Government Guide to Cost-Benefit Analysis (2017)
PCI	Pulverised coal injection
ROM	Run of mine
SEARs	Secretary's Environmental Assessment Requirements
SIA	Social Impact Assessment
WAL	Water Access Licence

Summary

BAEconomics was commissioned by Hume Coal Pty Ltd (Hume Coal) to prepare an economic impact assessment of the proposed Hume Coal project (the project). The project involves developing, operating and rehabilitating an underground coal mine and associated infrastructure over an estimated 23-year timeframe, including the construction of a rail spur that is the subject of a separate environmental impact statement (EIS), the Berrima Rail Project (BRP).

The approach to preparing the assessment is consistent with various guidelines published by the NSW Government, including the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' published in 2015 (the 2015 Guidelines). The 2015 Guidelines require a public interest test in the form of a cost-benefit analysis (CBA) to be undertaken to assess the net benefit of the project to the NSW community. The 2015 Guidelines also require a 'local effects analysis' (LEA) to be undertaken to assess the likely impacts of the project on the local region.

While the BRP component of the project is subject to a separate EIS process, from an economic perspective, the benefits that would accrue to NSW and to the local community as a result of the project and the BRP arise jointly. That is, the project would not be developed in the absence of the BRP; conversely, the BRP would not be commissioned in the absence of the project. The CBA and LEA presented in this report therefore incorporate the combined costs of the project and the BRP component of the project, including the costs of any external effects. The net benefits to NSW and the local community identified in this report therefore arise as a result of the project, including the BRP component of the project.

Net benefits of the project for New South Wales

Table S-1-1 summarises the net benefits of the project for New South Wales.

The 2015 Guidelines prescribe a narrowly defined list of items that may be deemed a 'benefit for New South Wales'. If that narrow focus is applied, the net present value (NPV) of the net benefits accruing to New South Wales is estimated to be $192 million in NPV terms, consisting of royalties of $148 million in NPV terms and the NSW share of company income tax of $45 million in NPV terms.

If a broader interpretation of the 2015 Guidelines is adopted, the NPV of the net benefits accruing to New South Wales is estimated at $290 million, consisting additionally of:

- disposable income benefits that would accrue to NSW workers of $63 million in NPV terms;

- land, payroll and local government taxes accruing directly to New South Wales of $21 million in NPV terms; and
- the NSW share of personal income taxes and Medicare payments of $14 million in NPV terms.

The great majority of potential external effects that have been identified would be internalised, that is, mitigated or otherwise paid for by Hume Coal. Given that this is the case, the only two external effects that would represent a 'cost' to New South Wales would be the NSW share of GHG emissions and potential agricultural impacts, amounting to around $1 million in NPV terms in total.

Table S-1-1. Net benefits of the project for New South Wales

Direct and indirect costs	(NPV, AU$ 2018 millions)	Direct and indirect benefits	(NPV, AU$ 2018 millions)
Items prescribed in the 2015 Guidelines:			
External effects (GHG)	$0.1	Royalties	$148
Loss of agricultural value added	$0.9	NSW share of company income tax	$45
		Economic benefit to NSW landholders	N/a
		Economic benefit to NSW suppliers	N/a
		Net producer surplus	$0
Total direct and indirect costs	$1	Total direct and indirect benefits	$193
Net benefits to New South Wales			$192
Items reflecting a broader interpretation of the Guidelines:			
		Economic benefit to NSW workers	$63
		Land taxes	$1
		Local government rates	$1
		Payroll taxes	$18
		NSW share of personal income taxes	$14
		NSW share of Medicare payments	$1
		Total direct and indirect benefits	$98
Net benefits to New South Wales			**$290**

Notes: Totals may not sum precisely due to rounding.
Source: BAEconomics analysis.

Net benefits of the project for the local economy

For the purpose of undertaking the LEA, the 2015 Guidelines require proponents to adopt a study area that should match a 'SA3' geographical definition. In the case of the project, the relevant SA3 area is the Southern Highlands SA3 Region.

Table S-1-2 summarises the net benefits of the project for the local region.

Employment-related benefits refer to the additional employment and the additional disposable income that the project would bring to the local region:

- The project would have an average operational workforce of 266 full-time equivalent (FTE) workers. Between 128 and 175 FTEs of the operational workforce are expected to live in the 'workforce catchment area', as defined by a 45-minute commute. Of this share of the operational workforce, between 68 and 93 FTEs are expected to live in the Southern Highlands SA3 Region. If broader employment flow-on effects are taken into account, the total employment effects benefiting the local region are estimated at between 105 and 144 FTEs.
- The disposable income accruing to the operational workforce (excluding the construction workforce) is estimated to be $272 million in NPV terms. The disposable income accruing to the 128 to 175 FTEs of the operational workforce expected to live in the 'workforce catchment area' is estimated to be $58 to $79 million in NPV terms. The disposable income accruing to the 68 to 93 FTEs expected to live in the Southern Highlands SA3 Region is estimated to be $31 to $42 million in NPV terms. If broader disposable income flow-on effects applicable to the Southern Highlands SA3 Region workforce are taken into account, the total local income effects are estimated to be $59 to $80 million in NPV terms.

Total operating expenditures for the project are estimated to amount to $747 million in NPV terms. Of these expenditures, up to $349 million in NPV terms could be sourced from suppliers located in the Southern Highlands SA3 Region. Local government rates are expected to amount to $160,000 per annum, or $2 million in NPV terms over the life of the project. The potential loss of agricultural income has been estimated to be around $124,000 in NPV terms.

Table S-1-2. LEA Summary ($2018)

	(A)	(B) Project direct: Total	(C) Project direct: Local	(D) Net effect: Local	(E) Total Local Effects: Low	(F) Total Local Effects: High
(1)	Employment related:					
(2)	FTEs	266	128-175	68 - 93	105	144
(3)	Disposable income (NPV, AU$ m)	$272	$58 - $79	$31 - $42	$59	$80
(4)	Other, non-labour expenditure (NPV, AU$ m)	$747	$349	$349	$0	$349
(5)	Local government rates (NPV, AU$ m)	$2	$2	$2	$2	$2
(6)	Externality benefit/cost – Loss of agricultural income (NPV, AU$ m)	(-) $0.1	(-) $0.1	(-) $0.1	(-) $0.1	(-) $0.1

Source: BAEconomics analysis.

1 Introduction

BAEconomics was commissioned by Hume Coal Pty Ltd (Hume Coal) to prepare an economic impact assessment (EIA) of the proposed Hume Coal project (the project). The economic assessment described in this report forms part of an Environmental Impact Statement (EIS), which has been prepared to accompany a Development Application made for the project in accordance with Division 4.1 of Part 4 of the NSW *Environmental Planning and Assessment Act*, 1979 (EP&A Act).

1.1 Purpose and scope of the economic assessment

This economic assessment has been prepared to address the economic components of the Secretary's Environmental Assessment Requirements (SEARs), with reference to various guidelines published by the NSW Government, in particular the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (2015, 'the 2015 Guidelines'). The 2015 Guidelines require a 'cost-benefit analysis' (CBA) to be undertaken to assess the net benefit of the project to the NSW community. The 2015 Guidelines also require a 'local effects analysis' (LEA) to be undertaken to assess the likely impacts of the project on the local economy.

The project involves developing, operating and rehabilitating an underground coal mine and associated infrastructure over an estimated 23-year timeframe, including the construction of a rail spur that is the subject of a separate EIS, the Berrima Rail Project (BRP). While the BRP component of the project is subject to a separate EIS process, from an economic perspective, the benefits that would accrue to NSW and to the local community as a result of the project and the BRP arise jointly. That is, the project would not be developed in the absence of the BRP; conversely, the BRP would not be commissioned in the absence of the project.

Given that their benefits and costs are inextricably linked, the CBA and LEA presented in this report incorporate the combined costs of the project and the BRP component of the project, including the costs of any external effects. The net benefits to the State of New South Wales and the local community identified in this report therefore arise as a result of the project, including the BRP component of the project. This approach is consistent with the approach specified in the 'NSW Government Guidelines for Economic Appraisal' (NSW Treasury 2007, p.33), which state that:

> *Project interdependencies may arise in which the costs or benefits of one project are dependent on whether or not a second project of group of projects, goes ahead. The appropriate response is to evaluate projects as a single project…*

The approach that has been applied is also fully consistent with that recommended by the European Commission (1997, pp.16-17), which similarly requires an integrated analysis for projects that are mutually dependent.

1.2 Context for this EIA

This EIA replaces an earlier EIA prepared by BAEconomics dated 20 February 2017 ('the 2017 EIA'), which was subsequently updated ('the 2018 Updated EIA') in October 2018. The 2017 EIA and the 2018 Updated EIA were reviewed by the Independent Planning Commission (IPC) of NSW (IPC 2019). The IPC requested BIS Oxford Economics (BISO) to prepare an initial and a supplemental peer review of the 2017 EIA and the Updated EIA. In its report ('the IPC Report'), the IPC subsequently identified a number of issues in the EIA that required clarification, including concerns identified by BISO. These issues have been addressed in this EIA.

Table 1-1 summarises the recommendations or comments made by the IPC and BISO in relation to the EIA and where they have been addressed in this document.

Table 1-1. Independent Planning Commission and BISO recommendations

Recommendation	Issue	Recommendation	Where addressed
IPC 2019 recommendations			
R20	Peer review by BIS Oxford Economics	BISO's concerns in relation to transparency, project costs, revenues and externalities should be addressed	See 'BISO 2017 recommendations' below
R21	Employment assumptions	The assumptions in the EIS in regard to employment numbers and percentage of unskilled workers and whether these come from outside the local area should be consistent with the assumptions used in the Social Impact Assessment.	Section 5.1.2
R22	Uncertainty	Residual economic uncertainties should be addressed.	Section 4.4
R23	Market for coking coal	The market for coking coal, including the most recent forecasts by the Australian Government should be reviewed.	Section 3.2.1, Appendix B
BISO 2017 recommendations			
BISO 2017 P.5	2017 Treasury Guidelines	Some of the approach and principles noted by the Treasury Guidelines should be noted or adhered to in the analysis.	Sections 3.6.1.4, 3.6.2.1, 3.6.2.3, 3.6.3.2
IPC Report Para. 361, 374 BISO 2017 P.1,2	Employment benefits (CBA, LEA)	Employment benefits (and associated tax benefits) should either be removed from the CBA or a better justification should be made for the existence (and claimed size) of such benefits.	Section 3.6
IPC Report Para. 361, 374	"	The existence of a shadow price of unemployed labour should be	Section 3.6.2.3

Recommendation	Issue	Recommendation	Where addressed
BISO 2017 P.1,2		acknowledged even if such costs cannot be quantified.	
BISO 2017 P.2	Non-labour project expenditures (LEA)	Non-labour expenditures are not quantified.	Section 5.2
BISO 2017 P.16	Conflation of GSP and economic welfare	The statement that Gross State Product (GSP) is not an appropriate measure as a basis for a CBA.	Section 3.1.1
IPC Report Para. 361, 375 BISO 2017 P.1	Project costs and revenues	Project costs and revenues and the composition of the Net Producer Surplus should be more transparently indicated, as suggested in the Guidelines.	Sections 3.2, 3.3, 3.4, 3.8
BISO 2017, P.15		Presentation of a worksheet detailing the discounted cashflow (DCF) analysis	Appendix C
IPC Report Para. 361 BISO 2017 P.1	Flow-on effects	The flow-on effects at the State-wide levels should be removed from the EIA summary, to be consistent with the stipulations of the CBA guidelines issued by NSW Treasury (2017).	State-wide flow-on effects have been removed from EIA
IPC Report Para. 361, 375 BISO 2017 P.2	Externalities	The magnitude of externalities should be more transparently indicated.	Section 3.8
BISO 2017 P.2	Groundwater prices	Recommendation to revisit how groundwater prices may change with the impact of the project.	Section 3.8

1.3 Structure of this report

This report is structured as follows:

- Section 2 describes the Hume Coal project, the local region, and the SEARs;
- Section 3 sets out the cost-benefit methodology, the approach to valuing external effects, and how key net benefits accruing to New South Wales have been calculated;
- Section 4 contains the results of the CBA and of the sensitivities, and comments on distributional impacts, as well as potential major risks and unquantified impacts; and
- Section 5 contains the LEA, including effects relating to local employment, non-labour project expenditures, effects on other local industries, as well as the flow-on effects of the project for the local region.

Supporting documentation is presented in the following appendices:

- Appendix A lists the assumptions underpinning the CBA and LEA;
- Appendix B contains a review of the coking coal market;
- Appendix C discusses the appropriate treatment of economic benefits for workers;
- Appendix D sets out the approach for deriving flow-on effects for the LEA; and
- Appendix E presents a discounted net NPV of costs and benefits calculation.

2 Project and regional context

This section provides an overview of the project and its regional context:

- Section 2.1 sets out the range of activities comprising the project;
- Section 2.2 describes the local region where the project would be located; and
- Section 2.3 sets out where the issues raised in the SEARs are addressed in this report.

2.1 Project description

This EIA considers all aspects of the combined Hume Coal and Berrima Rail projects. The former is outlined below while the latter is described in Appendix D to the Hume Coal EIS.

The Hume Coal Project involves developing and operating an underground coal mine and associated infrastructure over a total estimated project life of 23 years. Indicative mine and surface infrastructure plans are provided in Figure 2-1 and Figure 2-2. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report. In summary, the project involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other low impact fieldwork to facilitate detailed design.
- Establishment of a temporary construction accommodation village.
- Development and operation of an underground coal mine, comprising of approximately two years of construction and 19 years of mining, followed by a closure and rehabilitation phase of up to two years, leading to a total project life of 23 years. Some coal extraction will commence during the second year of construction during installation of the drifts, and hence there will be some overlap between the construction and operational phases.
- Extraction of approximately 50 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam, at a rate of up to 3.5 million tonnes per annum (Mtpa). Low impact mining methods will be used, which will have negligible subsidence impacts.
- Following processing of ROM coal in the Coal Preparation Plant (CPP), production of up to 3 Mtpa of metallurgical and thermal coal for sale to international and domestic markets.
- Construction and operation of associated mine infrastructure, mostly on cleared land, including:
    - one personnel and materials drift access and one conveyor drift access from

the surface to the coal seam;

- ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;
- a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;
- surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;
- overland conveyors;
- rail load-out facilities;
- an explosives magazine;
- ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and
- environmental management and monitoring equipment.

▪ Establishment of site access from Mereworth Road, and minor internal road modifications and relocation of some existing utilities.

▪ Coal reject emplacement underground, in the mined-out voids.

▪ The workforce consisting of Hume employees would peak at 276 FTE employees during operations, with consultants and contractors reaching a peak of 76 FTEs. The construction and rehabilitation workforce would peak at 420 FTEs.

▪ Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support land uses similar to current land uses.

2.1.1 Project and surface area

The project area, shown in Figure 2-1, is approximately 5,051 hectares (ha). Surface disturbance will mainly be restricted to the surface infrastructure areas shown indicatively in Figure 2-2, although this will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

Figure 2-1. Project area

Source: EMM / Hume Coal.

Figure 2-2. Surface infrastructure areas

Source: EMM / Hume Coal.

There will be a construction buffer zone around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

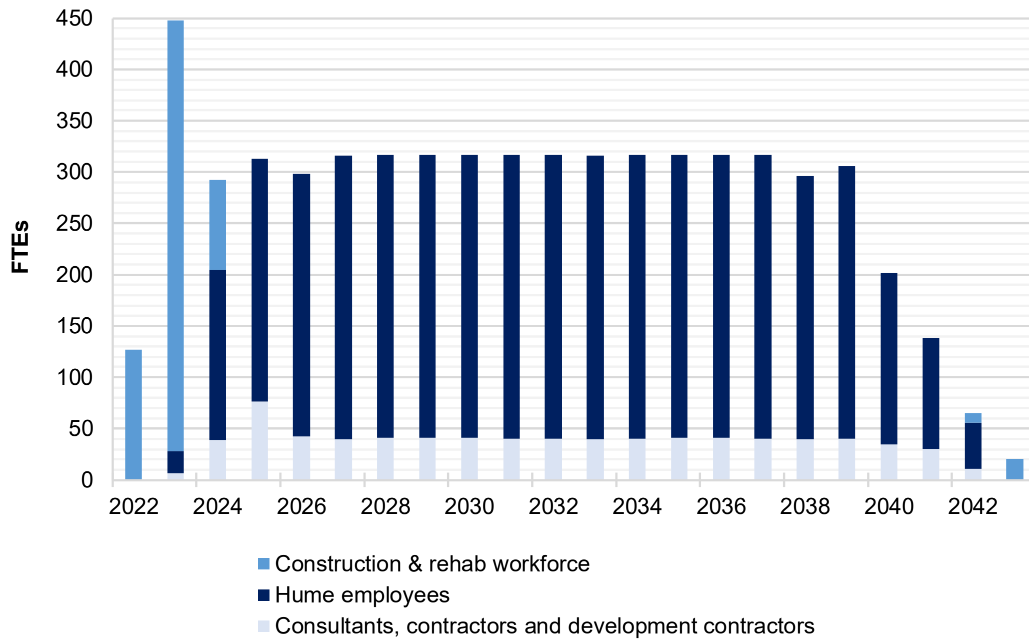
Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. As noted, the rail works and use are the subject of a separate EIS and State significant development application for the BRP.

2.1.2 Employment

Figure 2-3 shows projected employment for the project from the beginning of construction activities until mine closure and rehabilitation. Over the life of the project:

- Construction would begin in FY 2022 and would be completed by FY 2024, with rehabilitation activities commencing in FY 2042. At its peak in FY 2021, the annualised average construction workforce would amount to 420 FTEs.
- The operational workforce would begin ramping up in FY 2023 The annualised average operational workforce consisting of Hume employees and consultants/ contractors would average 266 FTEs, consisting of an average of 228 Hume employees and 38 consultants/contractors.

Figure 2-3. Hume project – Projected employment schedule



Source: Hume Coal.

2.2 Local region

The project would be located in the Southern Highlands region of New South Wales and in the Sydney Basin Biogeographic Region. The project area is located approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee local government area (LGA, Figure 2-1). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre.

2.2.1 Local setting

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, some industrial activities, some extractive industry and major transport infrastructure such as the Hume Highway.

Hume Coal proposes to develop surface infrastructure on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing and small-scale farm businesses. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

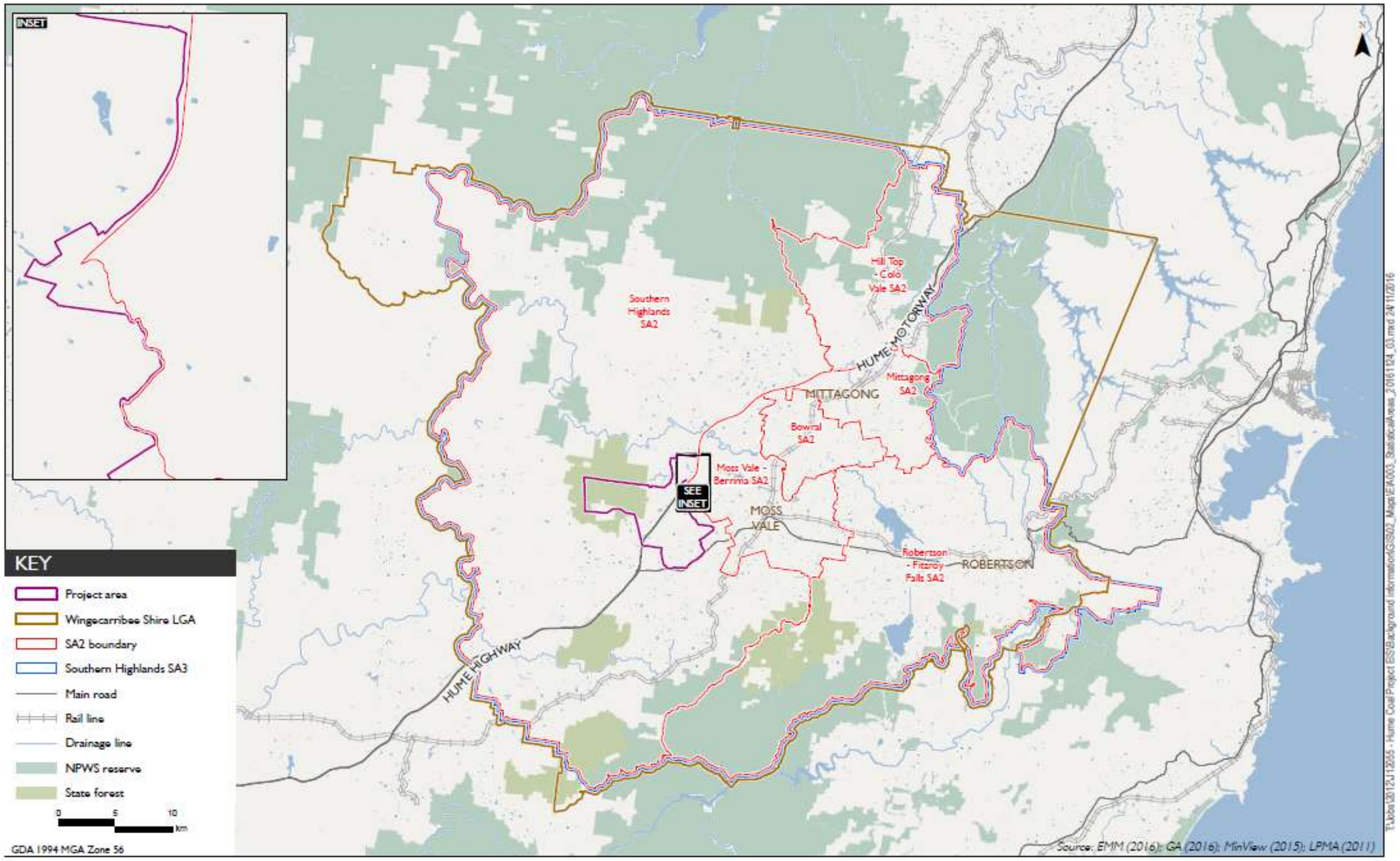
The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, at least 5 km downstream of the project area (Figure 2-1). The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area. Most of the central and eastern parts of the project area are characterised by very low rolling hills with occasional elevated ridge lines. There are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and the Golden Vale Road. The Illawarra Highway borders the south-east section of the project area. Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima Colliery is currently not operating, with production having ceased in 2013 after almost 100 years of operation.

2.2.2 Study area

For the purpose of undertaking the LEA, the 2015 Guidelines require proponents to adopt a study area that should match a SA3 geographical definition. In the case of the project, the relevant SA3 area is the Southern Highlands SA3 Region (Figure 2-4). Figure 2-4 shows the Southern Highlands SA3 Region, which comprises the five Statistical Area Level 2 (SA2) areas of Southern Highlands, Hill Top, Mittagong, Bowral, Moss Vale, and Robertson Fitzroy Falls. Figure 2-4 also shows that the Southern Highlands SA3 Region largely aligns with the Wingecarribee Shire LGA.

Figure 2-4. Project area within the context of statistical area boundaries



Source: Hume Coal / EMM.

2.3 Secretary's Environmental Assessment requirements

The SEARs state that the EIS for the project must address the following socio-economic components (P.3):

- *an assessment of the likely social impacts of the development; and*
- *an assessment of the likely economic impacts of the development, paying particular attention to:*
  - *the significance of the resource;*
  - *economic benefits of the project for the State and region; and*
  - *the demand for the provision of local infrastructure and services, having regard to Wingecarribee Shire Council's requirements..*

This report addresses the economic components of the SEARs. The social impact components of the SEARs are addressed separately in Chapter 20 and Appendix R of the EIS.

2.3.1 Significance of the resource

The repealed clause 12AA of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP) indicates the matters that may be relevant in assessing the 'significance of the resource'. Clause 12AA of the Mining SEPP required the significance of the resource to be assessed, having regard to the economic benefits, both to the State and the region, of developing the resource. The matters taken to be relevant were:

- employment generation;
- expenditure, including capital investment; and
- the payment of royalties to the State.

The broader economic benefits of the project for the State of New South Wales and the Southern Highlands region are considered in the CBA and the LEA, the results of which are presented in Sections 4 and 5:

- The net economic benefits of the project for New South Wales are estimated to be $192 million in NPV terms or $290 million in NPV terms if economic benefits accruing to workers are also considered.
- For the local region, the economic benefits of the project are estimated to be 68 to 93 additional FTEs, or 105 to 144 additional FTEs if broader employment flow-on effects are taken into account. The additional disposable income in the local region is estimated to be $31 to $41 million in NPV terms, or $59 to $80 million in NPV terms if broader income flow-on effects are considered.

Estimates of project employment are provided in Section 2.1. The project would generate:

- between FY 2023 and FY 2042, 266 FTE operational jobs on average, consisting of an average of 228 FTE Hume employees and 38 FTE consultants and contractors; and
- between FY 2022 and FY 2225, an average of 212 FTE construction jobs, and between FY 2042 and FY 2043, an average of 15 FTE rehabilitation jobs.

In terms of project expenditure, the project is expected to require around $922 million in total capital expenditures ($640 million in NPV terms), including for sustaining capital expenditures and rehabilitation, and around $1,647 million in operating expenditures ($747 in NPV terms).

Future royalties are expected to amount to $339 million, or $148 million in NPV terms.

2.3.2 Local government requirements

We understand that Wingecarribee Shire Council has not communicated any requirements with respect to the SEARs and does not intend to do so.

3 Cost-benefit methodology

The 2015 Guidelines require a cost-benefit analysis (CBA) and a local effects analysis (LEA) to be prepared to evaluate the economic impacts of a coal mining proposal. The CBA is intended to identify the economic impacts relating to the State of NSW, while the LEA focuses on the local region that would be impacted by a proposal. While these two analyses differ in their geographical focus, they rely on the same data set and on common assumptions.

In this section we describe the methodology, data and assumptions that have been applied to prepare the CBA, most of which carry over to the LEA:

- Section 3.1 discusses the requirements in relation to the CBA set out in the 2015 Guidelines, and how the Guidelines have been interpreted; while
- Sections 3.2 through 3.11 describe the derivation of the individual components of the CBA, namely:
  - coal royalties accruing to New South Wales (Section 3.2);
  - company income and other tax payments attributable to New South Wales (Section 3.3);
  - the net producer surplus (Section 3.4);
  - economic benefits for existing NSW landholders (Section 3.5);
  - economic benefits to NSW workers (Section 3.6);
  - economic benefits to NSW suppliers (Section3.7);
  - net environmental, social and transport-related costs attributable to New South Wales (Section 3.8);
  - the foregone value of agricultural production (Section 3.9);
  - net public infrastructure costs (Section 3.10); and
  - the potential loss of surplus to other industries (Section 3.11).

3.1 Requirements in the 2015 Guidelines

CBA is a technique for assessing the economic merits of an initiative or course of action (such as undertaking a mining investment) from the perspective of society as a whole. A CBA compares all costs and benefits attributable to the initiative, discounted to a common point in time, to arrive at an overall assessment of whether the initiative is 'net beneficial'; that is, whether society will benefit from its implementation.

3.1.1 Net benefits of the project for the State of New South Wales

The 2015 Guidelines set out that the purpose of the CBA is to estimate the net benefits of a proposed development for the 'NSW community'; that is, the State of New South Wales. The analysis presented in this report follows the approach set out in the 2015 Guidelines. However, the specific focus of the CBA and the approach set out in the 2015 Guidelines raises some conceptual and practical issues.

First, the fact that only the NSW community has 'standing' in the CBA raises 'cross-border' questions,[1] including in relation to which costs and benefits that are directly or indirectly relevant to New South Wales should be counted as a cost or a benefit. This is an issue for some taxes, and (in the case of the LEA) for the surplus that can be attributed to local suppliers.

Second, there is a broader issue relating to the treatment of taxes, namely that government revenues accrued within a jurisdiction that represent an expense for another party within the jurisdiction represent a transfer, rather than a cost or a benefit (NSW Government 2017).[2] The same applies for expenditures on labour, which would generally represent a cost, but are, subject to a number of limitations, treated as a benefit in the 2015 Guidelines. As such the approach set out in the 2015 Guidelines departs from that applied in a conventional CBA.

To ensure that the approach adopted here is internally consistent, we have looked to the broader national accounting framework for guidance as to how to resolve ambiguities where they exist. Within the national accounting framework, the extent to which a project contributes to the welfare of a country or state differs from a conventional cost-benefit calculation, which focuses on the consumer and producer surplus. From a national accounting perspective, the contribution of economic activity to a country or state is measured with reference to 'value added'. Value added is the additional value of goods and services that are newly created in an economy, and that are available for domestic consumption or for export.

Value added is a central concept in the Australian System of National Accounts (ASNA), where it is referred to as 'gross value added' to emphasise that this measure is gross of the consumption of fixed capital (that is, depreciation). Gross value added is the difference between output and intermediate inputs (the value created by production), and equals the contribution of labour and capital to the production process (ABS 2015). Subject to adjustments that need to be made to ensure that valuations are internally consistent by accounting for various taxes and subsidies, the sum of gross value added

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[1] Standing refers to whose preferences are relevant, and hence whose costs and benefits are to be counted to determine an NPV result (Dobes 2017). Dobes (2017) gives a number of examples of the conceptual and practical complexities that arise in attempting to delineate benefits according to sub-jurisdictional boundaries.

[2] The issue of taxes as transfer payments is also raised by BISO (2017), for instance at P.6.

across all industries in a country or state equals gross domestic product (GDP) or gross state product (GSP), respectively.

Given that the objective of the CBA is to identify the net benefits accruing to the State of New South Wales, the economic impacts of the project can therefore be evaluated with reference to its contribution to NSW GSP. The focus on value added as a means of measuring the contribution of the project to NSW GSP is based on an internally consistent economic framework that reflects standard public accounting rules (United Nations 2003). In particular, this framework avoids double-counting and enables a clear line to be drawn as to the factors that constitute a public cost or a benefit, and those that do not. Where we have drawn on the ASNA framework for guidance to resolve ambiguities in the 2015 Guidelines, these instances are noted and any resulting benefits have been highlighted in the text.

BISO (2017) was critical of the reference to the ASNA framework, claiming that BAEconomics conflated GSP with economic welfare (P.16). However, BISO's comments reflect a misunderstanding of the rationale for looking to the (national accounting) value added framework for guidance.

First, as noted, the 2015 Guidelines set out a high-level approach for determining the net benefits to New South Wales but leave some questions unresolved, including the issue of tax transfers which was also noted by BISO (2017). The ASNA framework offers an internally consistent way forward here.

Second, as noted in BAEconomics' response in October 2017, it is clear that GDP or GSP are not direct measures of economic and social 'welfare' but measure the production of goods and services. However, production is an important dimension of welfare because it enables greater consumption, and because strong GDP/GSP growth generally goes hand in hand with declining unemployment (Lequiller and Derek 2007). In fact, the 'benefits' identified in the 2015 Guidelines are also components of GSP, and the criteria established by the NSW Government can therefore be viewed as supporting GSP and GSP growth.

3.1.2 Key assumptions in the CBA and LEA

As set out in the 2015 Guidelines, the LEA is intended to be complementary to the CBA by translating the effects estimated at the state level into impacts on the communities located near the project site. In the analysis presented in this EIA, both the CBA and the LEA draw on the same data set. The central assumptions that underpin the analyses are common to both:[3]

- the application of a central discount rate of 7 per cent per annum in order to discount all costs and benefits back to a common point in time;

[3] These assumptions are set out in Appendix A.

- the use of internally consistent prices, expressed in 2018 Australian dollars (AU$ 2018); and
- the use of a common timeframe, beginning in 2020 and ending in 2045, to enable all costs and benefits attributable to the project to be captured, including any residual values that may be relevant beyond this timeframe.

Both the CBA and the LEA require that the economic merits of a proposal are compared to a meaningful counterfactual. The CBA and the LEA prepared for the project consider the incremental (net) benefits that would arise if the project is approved, referred to as the 'Project Scenario', relative to the counterfactual, referred to as the 'Reference Case'. For the Hume Coal Project, the Reference Case is to 'do nothing', whereby the land owned by Hume Coal and required for the proposal would continue to be used for agricultural purposes.

3.1.3 Costs and benefits of the project for the State of New South Wales

A CBA requires a full accounting calculation whereby the costs and benefits of a project are compared in monetary terms, and therefore requires that costs and benefits should, as far as possible, be valued. Table 3.1 in the 2015 Guidelines contains a list of the potential costs and benefits of a proposal that are attributable to the State of New South Wales in the CBA. These are discussed in the following sections:

- coal royalties paid to the State of New South Wales;
- the NSW share of company income taxes paid to the Commonwealth;
- the NSW share of the net producer surplus;
- the economic benefits to existing NSW landholders;
- the economic benefits to NSW workers;
- the economic benefits to NSW suppliers;
- net environmental, social and transport-related costs; and
- any net public infrastructure costs.

As a general matter, a CBA relies on the 'opportunity cost' principle to value goods and services (NSW Government 2017). In practice, the opportunity cost concept is made operational with reference to the 'willingness-to-pay' criterion. For 'conventional', market-based transactions, such as the sale of coal outputs or the purchase of labour and other inputs, the relevant value is determined with reference to market prices.

With the exception of environmental costs, all of the benefits listed above can be determined using market prices, as prescribed by the 2015 Guidelines. As set out in Section 3.8, environmental costs have been assessed with reference to the 'Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (2018, 'the 2018 Technical Notes'), published by the NSW

Government.

3.2 Coal royalties

Estimating the royalties that will be paid by the Hume Coal Mine requires:[4]

- an estimate of future quantities of saleable thermal and coking coal that will be produced over the operating life of the mine;
- an estimate of future gross 'assessable' mining revenues; and
- determining the magnitude of a number of allowable deductions to calculate the 'disposal' value.

3.2.1 Assessable coal revenues

Assessable revenues were estimated by multiplying the product coal production schedules provided by Hume Coal with projected coal prices. Projected coal prices were sourced from the most recent forecasts for thermal and coking coal prices and US$/AU$ exchange rates published by the Office of the Chief Economist of the Department of Industry, Innovation and Science (DIIS, 2019).[5] These benchmark prices were adjusted by a price discount of 15 per cent for coking coal and 21.1 per cent for thermal coal, respectively, to reflect coal quality variations from the benchmark, and converted into Australian dollars.

3.2.1.1 Future coking coal price projections

In its deliberations around the economic merits of the project, the IPC considered future coal price projections, in particular those for coking coal. In this context the IPC noted that the 2017 EIA relied on a lower coking coal price than was being realised at the time. The IPC accordingly undertook its own review of the coking coal market. That review cited findings in December 2018 by DIIS which predicted growing demand for coking coal and similar conclusions by the International Energy Agency (IEA). Given these findings, the IPC recommended that a review of the market for coking coal should be prepared that should include the most recent forecasts by the Australian Government.

BAEconomics has accordingly prepared a review of the market for coking coal, contained in Appendix B. Appendix B summarises the most recent trends and Australian Government forecasts for market for coking coal, or more broadly, metallurgical coal, which includes coking coal, but also pulverised coal injection (PCI) coal.[6]

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[4] Within the ASNA national accounting framework, royalties make up a share of the 'Gross Operating Surplus' (GOS) which accounts for a share of GSP.

[5] Coal price and exchange rate assumptions are shown in Appendix A.

[6] While PCI is generally not classified as coking coal, it is used as a source of energy in the steelmaking process and can partially replace coke in some blast furnaces.

3.2.1.2 *Global seaborne trade in metallurgical coal*

The primary use of metallurgical coal (including soft and hard coking coal, as well as PCI) is as an input in the steel making process in integrated (blast furnace) steel mills. The demand for metallurgical coal is therefore 'derived' from the demand for steel, which in turn depends on economic activity such as the construction of roads, railways, buildings and other infrastructure, as well as the demand for consumer vehicles and appliances. This has two implications that are relevant for forecasting future metallurgical coal prices.

First, in the short run, the demand for metallurgical coal is relatively price inelastic. For a given steel demand, there are limited substitution possibilities for integrated steel mills who require metallurgical coal in fixed proportions to the amount of steel produced. The supply of metallurgical coal is similarly relatively price unresponsive in the short term. Bringing new mines onstream requires costly investments that are made over a long planning horizon. In fact, there have been a number of occasions where the supply of metallurgical coal has been curtailed as a result of infrastructure bottlenecks or natural disasters, and where few alternative supplies have been available.

The combination of relatively inelastic demand and supply (which may also be prone to disruptions) implies that metallurgical coal prices can be and have been very volatile and are therefore difficult to forecast. By the same token, prices that may be influenced by short-term events (for instance, the recent decision by the Chinese Government to impose import restrictions on coal) are not necessarily reflective of longer-term trends in demand and supply fundamentals.

Second, in order to project the future market prices that coking coal produced and exported by the Hume Coal Mine will be able to attract, it is necessary to assess demand and supply in the global seaborne market for metallurgical coal. Australia is by far the largest exporter of metallurgical coal, but competes for sales with the United States, Canada, Russia, Mongolia and Mozambique to mainly Asian customers such as China, India, Japan and South Korea. China is by far the largest steel producer and importer of metallurgical coal, followed by India and Japan. Forecasts of steel and metallurgical coal production trends, including government policies that may affect trends in these countries are therefore key for predicting global trade and metallurgical coal prices.

3.2.1.3 *Metallurgical coal price projections*

The interplay of the global demand and supply factors described above underpins metallurgical coal price forecasts, including the most recent price forecasts published by DIIS in March 2019 that have been used in this EIA. In its March 2019 forecast, DIIS notes that the outlook for Chinese metallurgical coal imports is uncertain, given questions around the extent of any economic slowdown, stimulatory macroeconomic policies and environmental and restrictions on imports. The demand by other major importers for metallurgical coal such as the European Union-28, Japan, South Korea and Taiwan is expected to remain flat or decline. The only source of import growth is predicted to come from India (and to a lesser extent Vietnam, Malaysia and Indonesia), given strong growth in the construction and manufacturing sectors and substantial government investment in infrastructure. At the same time, other exporters such as Canada, Russia and Mozambique are increasing their production capacity. Over the medium term to 2024, DIIS therefore projects a steady decline in metallurgical coal prices to around US$150 per tonne and then a modest increase to US$ 159 per tonne, reflecting growing global supply and moderating Chinese demand.

Similar views are expressed by the Reserve Bank of Australia (RBA, Cunningham et al. 2019) in its assessment of the global market for Australian coal. Cunningham et al. note that while Chinese steel production is expected to moderate, Indian steel production has been growing strongly. This is expected to continue over the next decade, underpinned by ambitious government target to triple output capacity to around 300 million tonnes by 2030, and plans to expand its manufacturing sector.

Cunningham et al. (2019) also raise the importance of changing demand for different coal qualities. Demand for higher-quality metallurgical coal has increased following reforms in China's steel industry and stricter environmental standards, which has contributed to a significant price premium for higher-grade coking coal. The ability to access higher quality coking coal is also an important consideration for POSCO/South Korea in the context of the commitment to reduce greenhouse gas (GHG) by 37 per cent relative to a business-as-usual scenario.

3.2.2 Royalty calculation

Given coal revenues derived from multiplying projected prices with Hume Coal's coal production schedule, coal royalties accruing to the New South Wales can be derived. The ad valorem royalty rate for underground coal mining is 7.2 per cent of the value of the coal recovered. Gross royalty payments accruing to NSW were calculated by multiplying gross mining revenues, net of allowable deductions for coal beneficiation, and net of estimated levies, with the royalty rate of 7.2 per cent applied to the net disposal value.

In the case of the Hume Coal Mine, there is a complication because the mining area incorporates coal mined from the 'Evandale' property of around 235 hectares. Coal recovered from within the Evandale boundary is a privately-owned mineral. According to the *Mining Act (1992)*, *Division 2*, 7/8ths of the royalty paid for the coal mined from Evandale is to be refunded to the owner. The implication is that overall royalties paid by Hume are reduced by 7/8ths of royalties paid for the Evandale property.

The coal royalty calculation for the Hume Coal Mine is shown in Table 3-1.

Table 3-1. Hume Coal Mine - Royalty calculation

Hume Coal Mine royalty calculation	NPV AU$ 2018	Notes
Main royalty calculation		
Assessable revenues	$2,234	40 Mt of thermal and coking coal multiplied with forecast coal prices
Less: Allowable deductions	$69	Beneficiation deduction, Coal Research Levy, Mine Subsidence Levy, Mines Rescue Levy
Net disposal value	$2,165	Assessable revenue, net of allowable deductions
Royalty	$156	7.2 per cent of net disposal value
Royalty deduction calculation (Evandale property)		
Assessable revenues	$139	2.3 Mt of thermal and coking coal multiplied with forecast coal prices
Less: Allowable deductions	$6	Beneficiation deduction, Coal Research Levy, Mine Subsidence Levy, Mines Rescue Levy
Net disposal value	$133	Assessable revenue net of allowable deductions
Royalty refund	$8	7/8ths of royalty payment of $9.6 million
Net royalty payable by Hume Coal Mine	$148	Main royalty ($156 million NPV) minus the royalty refund ($8 million NPV)

Notes: Allowable deductions included in this analysis are the cost of beneficiation of $3.50 for coal subjected to a full washing cycle, as well as estimated payments for the Coal Research Levy, the Mine Subsidence Levy and the Mines Rescue Levy.

Source: Hume Coal, BAEconomics analysis.

3.3 Company income and other tax payments

The 2015 Guidelines specify the approach to be adopted for company and personal income tax and payroll tax payments.

3.3.1 Company income taxes

The 2015 Guidelines require an estimate of the total annual company income tax payable for each year of the evaluation period of the project, of which a share corresponding to the proportion of Australia's population based in NSW should be attributed to NSW.

Aggregate Commonwealth company income tax payments were derived by deducting operating costs, wages & salaries, the costs of mitigating externalities, royalty and tax payments, and depreciation (of capital assets) from gross revenues to derive taxable income, as shown in Table 3-2. Tax depreciation was calculated using the diminishing value method,[7] assuming an average effective tax life of 20 years. An inflation adjustment is necessary to account for the fact that depreciation is determined on the basis of nominal asset values. Real ($2018) company tax payments were derived by adjusting for inflation, assumed to be 2.5 per cent per annum over the forecasting timeframe in line with the Reserve Bank of Australia's 2 to 3 per cent inflation target, on average.

As required in the 2015 Guidelines, the share of incremental company income taxes paid as a result of the project that accrues to NSW was determined on the basis of the NSW share of the Australian population (31.9 per cent).

Table 3-2. Hume Coal Mine - Income tax calculation

Hume Coal Mine income tax calculation	NPV AU$ 2018 million	Notes
Coal revenues	$2,234	40 Mt of thermal and coking coal multiplied with forecast coal prices
Less:		
Operating costs	$747	Operating costs include the costs of materials, consumables, services, power, insurance and others
Labour costs	$451	Wages & salaries for Hume employees; consultants and contractors; and the construction and rehabilitation workforce
Costs of mitigating externalities	$13	Cash costs of mitigating noise, visual amenity and other external effects, make-good provisions and biodiversity offsets
Royalties	$148	Royalty payments net of the royalty refund
All other taxes	$28	Payroll, land taxes, shire rates
Tax depreciation	$374	Depreciation on capital assets
Total assessable income	$475	
Company tax	$142	32% of total assessable income
Share of company tax attributable to NSW	$45	Company tax adjusted by the share of the NSW of the total Australian population as of June 2019 (31.9 per cent)

Notes: Totals may not sum precisely due to rounding.
Source: Hume Coal, BAEconomics analysis.

[7] The diminishing value method assumes the decline in value each year is a constant proportion of the amount not yet written-off and produces a progressively smaller decline in value over time. Assuming that all assets are held for a full year, the formula for the decline in value is: base value × (200% ÷ asset's effective life). https://www.ato.gov.au/Forms/Guide-to-depreciating-assets-2019/?page=7; accessed on 28 January 2020.

3.3.2 Personal income taxes

The 2015 Guidelines note that a new mine will also generate other taxes, such as payroll tax and personal income tax. However, according to the Guidelines, most of these taxes will have been generated without a project, as people would have been employed elsewhere (p.10). The Guidelines further note that to the extent that it can be demonstrated that these taxes are genuinely additional and will not be offset by tax payments elsewhere in the economy, they may be recognised. However, the impact of these taxes on the overall NPV of a project must be reported.

Whether an economic initiative such as the project can be deemed a source of additional personal income taxes (a share of which can be attributed to New South Wales) is therefore contingent on whether the wages & salaries paid to the Hume workforce are deemed additional. We discuss this issue in Section 3.6.

We note that BISO (2017, pp.11-12) criticised the inclusion of personal income taxes in the benefit calculation in the 2017 EIA. However, we interpret BISO's comments to be directed at the question of whether the additional income accruing to the Hume workforce should be included as a benefit in the first place. BISO's comments are therefore also addressed in in Section 3.6.

3.3.3 Payroll taxes

As noted above, the 2015 Guidelines allow for the inclusion of payroll taxes, provided that these taxes are shown to be additional and would not be offset by taxation payments elsewhere.[8] Whether a share of the payroll taxes paid by Hume Coal should be viewed as 'additional' is also directly related to the question of what share of the wages & salaries paid to the Hume workforce are additional, discussed in Section 3.6.

3.3.4 Local government rates

Local government or shire rates are levied on individuals and businesses located within a local government area and are collected by the local council to benefit the local region. As is the case for royalties and company income taxes, shire rates make up a share of the gross producer surplus, and represent transfers from the producer (Hume Coal) to the NSW Government, to the benefit of the local NSW community.[9] However, the 2015 Guidelines do not comment on the treatment of local government taxes.

BISO (2017, p.6) comment that including land tax and shire rate payments as a NSW benefit is reasonable, given that such taxes are incorporated within a gross producer

[8] Within the ASNA national accounting framework, payroll taxes constitute a tax on production and a contribution to NSW GSP.

[9] Within the ASNA accounting framework, shire rates constitute a tax on production and a contribution to NSW GSP (as well as to the gross regional product).

surplus.[10] According to BISO, the gross producer surplus approximates the value of pre-tax profits, a share of which is appropriated by government to the benefit of the NSW community.

In this EIA local government rates paid by Hume Coal have therefore been included as a benefit, but highlighted, so as to indicate what might be viewed as a departure from the 2015 Guidelines. Hume Coal is assumed to pay rates of around $150,000 per annum in the Project Scenario over the operating life of the mine. In the absence of the project, the site of the proposed development would continue to be used for agricultural purposes, and corresponding rate payments would accrue to local government. Estimated agricultural rate payments of around $90,000 per annum in the Reference Case have therefore been deducted from Hume Coal's estimated rate payments in the Project Scenario to arrive at a full opportunity cost calculation.

3.3.5 Land taxes

The 2015 Guidelines also do not comment on the treatment of land taxes. Land taxes are levied on the value of NSW land owned by individuals and businesses and accrue to the State of New South Wales.[11] If approved, the Hume Coal will pay land taxes, which would flow through to benefit the NSW community.

In this report we have assumed that Hume Coal would pay land taxes of around $114,000 per annum in the Project Scenario over the operating life of the mine. In the Reference Case, the site of the Hume Coal Mine would continue to be used for agricultural purposes. Section 10AA of the *NSW Land Tax Management Act, 1956* exempts land that is used for the dominant purpose of primary production. No offsetting land tax payments have therefore been incorporated. The inclusion of land taxes has been highlighted in the NPV calculation.

3.4 Net producer surplus

Table 3.5 in the 2015 Guidelines sets out the approach to be applied to determine the net producer surplus, in effect an approximation of cash profits.[12] The total direct net benefit to the producer is the difference between the value of the output (including any residual value of land and capital), and expected expenditures on inputs, i.e. the costs of production. This approach has been adopted here (Table 3-3), although we have also included labour costs as part of overall costs; these costs are not included in Table 3.5

[10] The NSW Government's 'Guide to Cost-Benefit Analysis' identifies the (gross) producer surplus – defined as the price that a producer receives and the cost of production – as a key benefit within a CBA.

[11] Within the ASNA national accounting framework, land taxes constitute a tax on production and a contribution to NSW GSP.

[12] The parallel to this calculation within the ASNA national accounting framework is that of the 'gross operating surplus' that constitutes a share of GSP.

in the Guidelines.

Table 3-3. Hume Coal Mine – Net producer surplus calculation

Benefits	NPV AU$ 2018 million	Costs	NPV AU$ 2018 million
Gross mining revenue	$2,234	Wages & salaries	$451
Residual value of land at end of the evaluation period	N/a	Operating costs, net of local contributions	$745
Residual value of capital at end of the evaluation period	N/a	Capital costs, net of rehabilitation expenditures, net of land acquisition costs	$631
		Decommissioning costs	N/a
		Environmental mitigation costs	$13
		Transport management costs	N/a
		Rehabilitation expenses	$3
		Purchase costs for land (land acquisition and legal costs)	$6
		Local contributions (VPA)	$2
		All taxes	$317
Net producer surplus			**$66**

Source: Hume Coal, BAEconomics analysis.

The 2015 Guidelines specify that the net producer surplus attributable to NSW is the economic rent attributable to NSW owners of capital, which depends on the Australian share of the project's ownership.

Hume Coal's ultimate parent company, POSCO, is listed on Korean and US stock exchanges. Whilst it is possible that NSW residents own shares in POSCO (both directly and via superannuation funds and index funds), this information is not available, and the profits attributable to residents of New South Wales arising from the project are not likely to be material in the scope of this CBA. For the purpose of this analysis, it has therefore been assumed that no share of project profits would accrue to NSW residents.

3.5 Economic benefits to existing landholders

The 2015 Guidelines note that a mining proponent may purchase or lease land from existing landholders at a price which may exceed the opportunity cost of the land, for instance when a proponent pays a premium above market prices for land acquisitions or leases. The corresponding surplus is an economic benefit that accrues to existing landholders and should be attributed to New South Wales.

In the case of the Hume Coal Project any future acquisitions, such as properties provided with voluntary acquisition rights as a result of the planning approval process, may include a slight premium to market value. However, the resulting net benefit accruing to landholders is insignificant relative to the overall net benefit to New South Wales generated by the project, and these premia often include a component of compensation to account for the costs of relocation. Therefore, the economic benefits accruing to local landholders have not been estimated. The approach adopted in this report is therefore conservative.

3.6 Economic benefits to workers

Determining the economic benefits to workers as a result of the project raises a number of conceptual issues that are discussed in the following.[13]

3.6.1 Incremental wages paid to the Hume workforce

The 2015 Guidelines place strict limitations on the extent to which higher than average salaries paid to a project workforce can be considered as a benefit in the CBA (although not in the LEA). We set out in the following that this approach does not accord with standard economic thinking about the nature of such 'wage premia', and is also not consistent with the approach adopted in the 'NSW Government Guide to Cost-Benefit Analysis' ('the NSW Treasury Guide', NSW Treasury 2017).

3.6.1.1 Wage premia in the 2015 Guidelines

If approved, the project would represent a source of additional employment and income to the regional workforce. The mining industry is a significant employer of skilled workers such as machinery operators, truck drivers, technicians and trades workers, as well as labourers, managers, professionals and support workers. In addition, as shown in Appendix D, average wages in the Australian mining sector are significantly higher than in all other industries that require similarly skilled workers, such as construction, transport, the utilities sector, and manufacturing.

The 2015 Guidelines discount any wage increase that might accrue to workers moving to a new mining project such as the Hume Coal Mine, an issue that was also emphasised throughout BISO (2017). According to the 2015 Guidelines, the starting point of any analysis should be that workers will not earn a 'wage premium' if they move to the mining industry from a different sector, even if they earn more working in the mining sector. The rationale for this approach is that:

- A mine that employs workers who are already working locally (but not in the mining sector), may need to offer higher wages to compensate for more physically demanding work or tougher conditions. Hence the Guidelines assert that the benefit to workers from higher pay will be offset by the (personal

[13] The detailed research underpinning the discussion of worker benefits is described in Appendix D.

opportunity) costs associated with greater hardship.

- A mine that attracts workers from other parts of NSW may need to offer higher wages to compensate for a worker relocating. Again, the Guidelines assert that the added monetary benefit to workers is not a valid wage premium but compensation for a personal opportunity cost.

We note that in discounting wage premia in this context of the CBA the 2015 Guidelines appear to adopt an inconsistent approach. Such wage premia are explicitly the focus of the LEA where the entire local workforce is assumed to receive such a premium.[14]

The approach in the 2015 Guidelines to discount any wage differentials also appears to conflict with that described in the NSW Treasury Guide (NSW Government, 2017, Table 2.2, p.13):

> *Labour surplus is the difference between a worker's actual wages and what they are willing to accept (their reservation wage). If an initiative increased hourly wage rates, the incremental increase would be a benefit.*

3.6.1.2 Wages and productivity

As summarised in the following and documented in detail in Appendix D, the position set out in the 2015 Guidelines is also not conceptually correct and does not accord with the empirical evidence in Australia.

The 2015 Guidelines assume that higher wages paid to workers are simply a function of the 'disutility' of working a particular job, such as physically demanding or otherwise difficult work, or poor working conditions. However, while labour markets are complex, there is near universal agreement that over a longer timeframe, the fundamental determinant of wages is labour productivity: the amount of output produced by a worker over a unit of time, say an hour.

Labour productivity does not evolve in a vacuum, but in turn depends on the amount or quality of capital and other factors of production that are available to workers. For instance, workers mining coal will be far more productive if they can access heavy, specialised equipment as opposed to using a pick and shovel. Hence growth in labour productivity (or the increase in output per hour worked) depends on (Productivity Commission 2019, Australian Treasury 2017):

- *The capital-labour ratio*: the quantity of capital inputs used per unit of labour input, also referred to as the contribution from 'capital deepening'. Increased capital deepening means that, on average, each unit of labour has more capital to work with to produce output, and so is an indicator of a firm's ability to augment labour.

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[14] The Guidelines note at p.22 that the recommended indicator of the net increase in income is the difference between incomes in the mining industry in the local area (based on gross wages) compared to the average level of income in the area.

- *The contribution from 'multifactor productivity' (MFP) growth*: the efficiency with which labour and capital are combined in the production process. MFP growth may reflect many factors, including innovation and technological improvements, efficiency improvements arising from economies of scale and scope, improvements in management practices, and others.

Recent empirical research from the Australian Treasury (2017) confirms the importance of this central economic relationship between wages and productivity. That analysis of Australian businesses across all industry sectors, for all sizes and other characteristics confirmed that:

- businesses with higher labour productivity pay higher real wages; and
- the relationship between real wages and labour productivity holds across all business characteristics examined, including size and export exposure.

The broad conclusions highlighted in the Australian Treasury (2017) analysis directly apply to the Australian mining sector. Average earnings in the mining sector far exceed those in sectors that require similar skills, and are matched by the underlying labour productivity which, in absolute terms, is higher in the mining industry than any other Australian industry. High labour productivity (and wages) in the mining sector in turn reflects substantial investment in capital assets. As a share of market sector investment expenditure, that of the mining sector accounted for 27 per cent as of June 2019.

3.6.1.3 Compensating wage differentials

It is possible that the claim in the 2015 Guidelines that differences in wages between the mining and other sectors of the economy merely compensate workers for greater hardship may refer to the theory of 'compensating wage differentials' originally articulated by Adam Smith. That theory postulates that wages in some industries are high because workers want to be compensated for job attributes that are dangerous or unpleasant or otherwise undesirable.

In practice, however, empirical support for the theory of compensating differentials is weak. Those studies that identify a compensating effect find large variations in how work-reward trade-offs are valued by workers, including as a function of income levels, job risk, age, immigrant status, race, gender, and other characteristics. The results of empirical research into the theory of compensating differentials in Australia are inconclusive at best. Indeed, a 2012 study by Cai and Waddoups using Household, Income and Labour Dynamics in Australia (HILDA) survey data to estimate the role of negative job characteristics (job stress, employment security, complexity and difficulty, control of the work process, commute times) found that these job characteristics have a negligible effect on wages.

3.6.1.4 BISO comments

BISO (2017) suggest that, as a matter of principle, no economic benefits to workers should be included in the CBA by pointing to the NSW Treasury's 'Guide to Cost-Benefit Analysis' ('the NSW Treasury Guide', NSW Government 2017). BISO say at p.6: "*Before addressing these however, it is worth noting that, on first principles grounds, a standard CBA considers labour to be an (opportunity) cost, not a benefit. The Treasury Guidelines (Appendix 7, p. 56) make this clear*."

However, BISO's comments reflect a misunderstanding of the purpose of the CBA described in the 2015 Guidelines. As discussed in Section 3.1, the CBA described in the Guidelines does not correspond to a conventional cost-benefit calculation. Rather, the focus of the CBA is to identify the net contribution of an initiative to the NSW community. For instance, a conventional CBA of a new highway project would compare the benefits of the new highway (say, in terms of shorter commute times) with the costs of that highway, which will include construction and maintenance costs, including the costs of labour. In the case of a mining project, the direct (construction and operational) costs are borne by the proponent and are not relevant from the perspective of the NSW community unless the activity imposes some opportunity cost on the NSW community. What is more relevant for the NSW community are any indirect costs that may arise (for instance, noise or air pollution) and direct and indirect benefits, such as royalty and other tax payments, but also higher wages paid to the workforce.

BISO also appear to misinterpret the NSW Treasury Guide. Appendix 7 merely states that the cost of labour in a CBA is the lowest wage rate that a worker would be willing to accept for doing a particular job. Moreover, as noted above, the NSW Treasury Guide (Table 2.2, p.13) list 'Labour Surplus' among 'common benefit categories', and state that increased hourly wages constitute a benefit.

3.6.2 Additional employment generated by the project

As a general matter, it can be expected that an initiative such as the Hume Coal Project will recruit labour from a range of sources:

- A share of the Hume workforce may be re-employed from other businesses operating in the mining sector. Here it can be assumed that workers with a given level of skills who move between businesses in the mining sector would more or less be paid the same (mining sector) wage.
- A share of the Hume workforce may be re-employed from other businesses operating in other (non-mining) sectors of the economy (such as construction, transport, manufacturing or others). Given that the mining sector offers significantly higher wage payments than many other sectors of the economy, it can be assumed that workers with a given level of skills moving from a non-mining business to a mining business would be paid a higher wage.
- A share of the Hume workforce may not have been previously been employed in New South Wales. This last category may include people who are just entering

the workforce, people who were previously unemployed or not working for other reasons, or people who have moved to New South Wales from interstate or from overseas. These workers would move from a situation of not earning a wage to one of earning a wage in the mining sector.

The relevance of these distinctions is that the economic benefits accruing to these workers depends on the respectively shares of 'newly employed' and 're-employed' workers. As the NSW Treasury Guide (2017, Table 2.2, p.13) explains:

- an incremental increase in workers' wages as a result of an initiative constitutes a benefit; while
- an increase in employment as a result of an initiative only counts as a benefit if the labour resources were previously unemployed or underemployed. Workers who are simply re-employed or 'displaced' do not represent additional employment.

The 2015 Guidelines do not discuss the issue of whether a proposal is a source of additional employment explicitly. In the context of the CBA, as noted above, the Guidelines only suggest that any wage premia should by and large be discounted, hence the question of the numbers of workers that any wage premia might apply to appears moot.[15]

3.6.2.1 Approach adopted in BAEconomics (2017, 2018)

As discussed in BAEconomics (2017, 2018), there is no reliable statistical information about the origin of the workforce if a new business opens or a new project is commissioned. In the absence of such information, BAEconomics (2017, 2018) assumed that 80 per cent of workers at the Hume Coal Mine would be drawn from other sectors of the NSW economy (i.e., they were 're-employed' or 'displaced), and that, conversely, 20 per cent of workers would be 'newly employed'. Sensitivities were then conducted to assess the impact on benefits to workers if the respective shares of job movers were changed to 70 per cent and 90 per cent, respectively.

3.6.2.2 BISO (2017) critique

BISO (2017) argued that the 80/20 per cent split between previously employed and newly employed workers lacked a strong empirical foundation. BISO furthermore noted that (pp.8-9):

> *It would be expected that the project workers would chiefly be drawn from the mining and rail sectors rather than from a workforce unfamiliar with such sectors. The converse is also true – in the absence of the project it seems unlikely that 80 percent of the project workforce would be employed in the*

[15] In the context of the LEA, the 2015 Guidelines recommend applying any wage premia to the entire local workforce, who are therefore all deemed to be re-employed.

> *nonmining/non-rail sector given the specialist nature of their skills and experience.*
>
> *As any jobseeker can attest, employers tend to prefer skilled and experienced staff members to fill roles. This would be no less true of the HCP and BRP, which will require large inputs of labour with skills and experience in the mining and rail sectors. ..*

BISO's critique of the assumption that mining industry employees are drawn from other sectors is not consistent with the available evidence.

The claim that workers moving to Hume Coal from another employer would '*chiefly be drawn from the mining and rail sectors, rather than from a workforce unfamiliar with such sectors*' reflects a misunderstanding of the skills and occupations required in mining. These occupations overlap to a significant extent with those required in the construction, utilities, transport, and manufacturing sectors. For instance (Appendix D):

- 9 per cent of employees in the mining sector are metal fitters and machinists, compared to 4 per cent in manufacturing;
- truck drivers make up 6 per cent of employees in mining, compared to 18 per cent in the transport sector and 8 per cent in the utilities sector; and
- 4 per cent of mining employees are electricians, compared to 8 per cent in construction and 5 per cent in the utilities sector.

It is therefore not the case that employees at a new mining project would mainly originate from other mining employers or from the rail sector.

Some limited information about labour mobility and the transferability of skills of the mining sector workforce is available from the 'Participation, Job Search and Mobility' survey undertaken by the ABS. The survey points to considerable movements between the mining and other industries, as well as between occupations. Of those workers employed in the mining sector who had been employed for at least a year and who had changed employer in the previous year, on average over the last five years:

- around 46 per cent had changed jobs from another employer in the mining industry (ranging from 35 per cent in 2017 to 59 per cent in 2019); and
- around 51 per cent had changed jobs from a non-mining sector employer (ranging from 41 per cent in 2019 to 70 per cent in 2017).

The 'Participation, Job Search and Mobility' survey further suggests that of those workers employed in the mining sector who had been employed for at least a year and who had changed employer in the previous year, on average over the past five years, around 27 per cent had changed major occupation group (ranging from 16 per cent in 2018 to 38 per cent in 2019).

Finally, as regards the share of newly employed workers, which BISO suggest would be negligible, the available evidence suggests that mining businesses hire a greater than average share of less skilled workers. According to the Minerals Council (2019):

- The mining sector is a significant employer of apprentices. As of 2019, apprentices made up 4 per cent of the workforce, compared to the national average of 2.1 per cent.
- The mining sector is also a significant employer of indigenous people who tend to have higher rates of unemployment. As of 2016, indigenous Australians made up 3.8 per cent of the mining industry workforce compared to the national average of 1.7 per cent, and mining had the highest indigenous employment share of all industries.

3.6.2.3 Shadow price of unemployed labour

BISO (2017, p.12) raised another issue that is related both to the question of wage premia and what share of the workforce should be assumed to be newly employed. BISO say that by assuming that the economic benefit accruing to newly employed workers is the average mining wage, BAEconomics failed to acknowledge the existence of a 'shadow price' of unemployed labour. The approach recommended by BISO is (p.12) is "*.. to quantify the shadow price of labour based on the difference between wages and shadow prices.*", or, if such quantification is not possible, to acknowledge the implications of such a shadow price.

So-called 'shadow prices' are applied in circumstances where a price does not reflect the actual value of a good or service (or where no market value exists). In the case of labour, the opportunity cost principle referenced above implies that for newly hired (previously unemployed) labour, the opportunity cost to the worker of entering employment is, at a minimum, the value of leisure foregone (Campbell et al. 2015). However, given that unemployed workers generally receive unemployment and/or other benefits, a worker who is to be persuaded to enter the workforce must be compensated not only for the loss of leisure time and any costs incurred as a result of working rather than being unemployed (for instance, the cost of child care), but also for the loss of income receipts that depend on being unemployed. Some economists therefore distinguish between the shadow price of labour (defined in terms of the opportunity cost) of employing a hitherto unemployed worker, and the 'reservation wage', which is the income that a worker must receive to be attracted into employment (Kirkpatrick and MacArthur 1990).

The NSW Treasury Guide comments as follows in relation to the shadow price of unemployed labour (p.62):

> *Shadow price adjustments for use of resources are not commonly used in the Australian context, and this Guide does not generally recommend their use due to the significant measurement complexities involved.*

Given the evident complexities involved in attempting to derive a shadow price of labour into the analysis, and the recommendations in the NSW Treasury Guide, we have not attempted to follow BISO's recommendation.

3.6.3 Approach for estimating economic benefits to workers in this EIA

The following sets out our approach for assessing worker benefits in this EIA. As for all other instances where it may be considered that we have departed from the 2015 Guidelines, the resulting benefits have been calculated and reported separately, and are highlighted.

3.6.3.1 Incremental employment benefits

As discussed, it is difficult to derive a robust estimate for the share of the Hume workforce that can be expected to be recruited from outside of the mining sector, and the share that can be expected to be a job starter, be they an apprentice or previously unemployed. At the same time, it would not be correct to assume that the entire Hume workforce will be recruited from the mining sector. The most recent data for Wingecarribee LGA indicates that only 1.1 per cent of the workforce was employed in the mining sector as of 2016. Unlike what may be the case in the Hunter Valley or other mining regions, there is therefore no large pool of mine workers that can be quickly recruited.[16]

As discussed in Section 3.6.2, the ABS 'Participation, Job Search and Mobility' survey suggests that there is considerable year-on-year variability in the movement of workers within the mining sector and from other sectors of the economy to the mining sector, but that over the last five years, 51 per cent of mining sector workers who changed employers came from a different industry. These estimates are also consistent with Hume's expectations, as described in the SIA (p.30 ff.). Thus, Hume expects to establish a training programs for 'inexperienced' workers who may not have significant underground coal mining experience, although they may have experience in a related occupation, with the aim of hiring around 70 per cent of the workforce locally.

Further, there is very little information about the share of 'newly employed' people, including apprentices, in a mining enterprise such as the Hume Coal Mine. As noted, the average share of apprentices in the mining sector overall is around 4 per cent; however, the 'Participation, Job Search and Mobility' survey does not allocate people working for less than a year to a particular industry.

Given BISO's criticism of our previous approach, and based on the limited information available we have therefore adopted the following assumptions in respect of the incremental employment generated by Hume Coal:

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[16] For instance, the share of employment in the mining sector in 2016 was almost 22 per cent, Narrabri 5.5 per cent, Singleton 23 per cent, and Upper Hunter almost 11 per cent.

- 51 per cent of the Hume operational workforce is assumed to move to the project from an employer in a different, non-mining industry; and
- 49 per cent of the Hume operational workforce is assumed to move to the project from an employer in the mining industry.

No allowance has therefore been made for 'newly employed' workers, including apprentices, and the estimated benefits to workers are likely to represent an underestimate.

3.6.3.2 *Treatment of wage premia*

As discussed above and in more depth in Appendix C, the 2015 Guidelines are mistaken in assuming that differentials between mining and non-mining wages represent compensation for workers' disutility. The NSW Treasury Guide (2017) also recognise wage differentials making up the 'labour surplus' as a legitimate benefit. In the present EIA, such benefits have been determined for the CBA, and their contribution separately noted.

For the purposes of calculating wage premia for the CBA, the same approach has been adopted as for the LEA (as described on p.22 in the 2015 Guidelines). The (net) wage premia accruing to NSW workers has been calculated as follows:

- Annual average gross wages paid to the workforce were estimated by Hume Coal, on the basis of a detailed, bottom-up calculation reflecting the mix of skills and qualifications required for the workforce over the life of the project. It is understood that the corresponding mix of wages and salaries reflects Hume Coal's estimates of the 'market rates' for the workforce composition that will be required.
- On this basis, average disposable income was calculated, defined as average gross income net of superannuation, Medicare and personal income tax payments.
- Paralleling the recommended approach for the LEA, the corresponding disposable income was calculated for the mean income in New South Wales in 2020, projected to be $64,963 in 2020 in 2018 Australian dollars.
- The resulting wage premium was applied to those Hume workers deemed to be recruited from other NSW industries (51 per cent). In this calculation, no allowance has been made for newly employed workers, and workers transferring to Hume from another employer in the mining sector are assumed not to receive a wage premium.

3.6.3.3 *Estimated disposable income benefits from the project*

Table 3-4 summarises the corresponding calculation for the project operational workforce. The presentation below parallels the approach for estimating employment benefits set out in the 2015 Guidelines for the LEA (p.22).[17] As also noted above, this calculation does not account for the additional disposable income received by newly employed workers, for instance apprentices. The corresponding net benefit has been included in the aggregate NSW net benefit calculation but marked so as to indicate what might be viewed as a departure from the 2015 Guidelines.

Table 3-4. Estimated economic benefits to workers (AU$ 2018)

Numbers of workers / economic benefits	Units	Magnitude
Average direct employment during operations phase	FTEs	266
Of which: re-employed from non-mining industries (51 per cent)	FTEs	136
Average personal disposable income in mining industry (project)	AU$	$95,115
Average personal disposable income in non-mining industries (NSW)	AU$	$50,848
Average increase in disposable income per re-employed worker	AU$	$44,268
Increase in disposable income per year due to direct employment	AU$ millions	$6
Increase over the life of the Hume Coal Mine (NPV)	AU$ millions	$63
Increase over the life of the Hume Coal Mine (Aggregate)	AU$ millions	$128

Notes: Average income in non-mining industries is assumed to increase by 1 per cent per annum in real terms.

Source: BAEconomics analysis.

3.6.3.4 *Estimated incremental personal income tax payments*

In the Project Scenario, the Hume workforce would make greater personal income tax payments to the Commonwealth than in the Reference Case. A share of these incremental personal income tax payments can be attributed to New South Wales (as is the case for company income taxes). The incremental personal income tax payments can be attributed to the share of the Hume Coal workforce that is assumed to be re-employed from a different (non-mining) business, and which is assumed to receive a wage increase (corresponding to the difference in wages paid by the Hume Coal Mine and the average wage in New South Wales).

As for net disposable income benefits, we have calculated the incremental personal income tax payments that would be paid by the two groups and multiplied these with the estimated respective shares of the Hume workforce. A proportion of the incremental personal income taxes (corresponding to the NSW share of population) have been included as a benefit but marked so as to indicate what might be viewed as a departure from the 2015 Guidelines.

[17] The approach in the Guidelines focuses on average, rather than median regional wages, as would normally be the case since median wage estimates place less weight on outliers.

3.6.3.5 *Estimated incremental payroll tax payments*

The incremental payroll taxes accruing to New South Wales have similarly been derived with reference to the respectively shares of workers that would be re-employed from a non-mining business and would thus receive an increase in wages. That is, incremental payroll taxes have been calculated with reference to:

- the additional payroll taxes that would be paid in the Project Scenario for the share of the workforce deemed to receive an increase in wages; and
- the additional payroll taxes paid in the Project Scenario to the share of the workforce assumed to be newly employed.

As is the case for incremental personal income taxes, land taxes and shire rates, incremental payroll taxes have been separately identified and highlighted in the net benefits calculation.

3.7 Economic benefits to suppliers

The 2015 Guidelines note that NSW suppliers may receive an economic benefit by achieving higher surpluses by supplying a mining gas project. The Guidelines recommend that the value of economic benefit to suppliers attributed to New South Wales should reflect expected input-shares for NSW and non-NSW suppliers for the project.

Determining this benefit poses practical difficulties, given that even at the state level there are no statistics on:

- which firms can be considered state- or NSW-owned businesses (which we understand to mean that these businesses' owners or shareholders are residents of New South Wales); and
- even if NSW-owned businesses could be identified, whether the goods and services supplied by these businesses are produced in New South Wales or whether they were 'imported' from elsewhere in Australia (or from overseas).

Expenditures (for instance, as a result of purchasing equipment, materials and services) are relevant for determining the net benefits of a project for the State of NSW only so far as they can be apportioned to the value added by other NSW industries. For example, a business supplying local materials and labour, but using equipment constructed interstate or overseas, only adds local value from wages and the surplus or profits made from the supply of the materials in question. The balance of the expenditure flows to wages and to profits to those who manufactured the equipment (who may be located in New South Wales or elsewhere). In addition, a change in surplus (or profits) in an industry is relevant for determining the net benefits of a project for New South Wales only so far as it accrues to NSW residents that own or have a share in the capital invested. If a local business supplying materials to a development is owned by an interstate or overseas corporation, then no profits would flow locally or to the State of New South Wales, and the only component of expenditure that benefited the State of NSW would be the wages paid to NSW residents and any taxes paid in New South Wales.

The limitations described above imply that the change in economic surplus in particular NSW industries arising from the project cannot be measured with any precision, and we have not attempted to do so in this EIA. However, overall, the impacts of the project on other NSW industries are likely to be positive:

- Hume Coal would incur overall operating expenditures (net of labour costs) of $747 million in NPV terms ($1,647 million in total). If it is assumed, for illustrative purposes, that 10 per cent of these expenditures represents additional margins to NSW suppliers, the additional surplus accruing to suppliers would be around $75 million in NPV terms ($165 million in total).
- In addition, the operating expenditures analysis shown in Section 5.2 indicates that the expenditures that Hume might undertake in the local region are potentially substantial. It is estimated that Table 5 3 summarises the results of the analysis. Hume estimate that 25 per cent ($147 million) of pit-top ROM materials & services, and 24 per cent ($203 million) of CHPP to FOB materials & services could be sourced locally.

3.8 Net environmental, social and transport-related costs

The direct impacts of a project that are relevant for society, but for which a market value is not available need to be accounted for as part of the economic benefits and costs considered in a CBA (NSW Treasury Guide 2017). Such 'externalities' or 'external effects' are spillovers (positive or negative) from the production of a good or service, for example, in the form of air pollution or noise (negative spillovers) or knowledge transfers (positive spillovers).

The 2015 Guidelines specify that external effects should be assessed on a cumulative basis; that is, taking into account the effects of existing and already approved (but not yet operational) projects. Where relevant, these have been considered in the specialist studies undertaken for the project. The externalities discussed in the following have been valued using the 'Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (2018, 'the 2018 Technical Notes'), published by the NSW Government. Potential agricultural impacts are discussed in Section 3.9.

3.8.1 Overview of predicted impacts

The predicted environmental impacts of the project, including those from the associated BRP, are summarised in Following a corresponding recommendation by BISO (2017, p.2), the IPC (Para. 361, 375) requested a greater degree of transparency in terms of the costings included in the CBA to account for the mitigation of external effects. The respective costs are therefore summarised in Table 3-5 and presented in the relevant subsections below. All of these cost items are assumed to have been 'internalised' by Hume; that is, included in the project costings and deducted from pre-tax revenues. Additionally, going forward, Hume expects to incur $380,000 per annum in groundwater, surface water, air quality monitoring, licence fees and other environmental monitoring costs. These costs have been incorporated in the discounted cash flow analysis.

Hume has already incurred significant outlays up to, but not including FY 2020 to address predicted future external effects, as summarised in Table 3-6. Given these past expenditures, for instance for the purchase of water access licenses and to mitigate potential visual impacts, future outlays will be reduced.

Table 3-5. Chapter 24 of the EIS provides a summary of the mitigation, management and monitoring measures proposed by Hume Coal. The approach to valuing the external effects is described in more detail below.

As set out in Following a corresponding recommendation by BISO (2017, p.2), the IPC (Para. 361, 375) requested a greater degree of transparency in terms of the costings included in the CBA to account for the mitigation of external effects. The respective costs are therefore summarised in Table 3-5 and presented in the relevant subsections below. All of these cost items are assumed to have been 'internalised' by Hume; that is, included in the project costings and deducted from pre-tax revenues. Additionally, going forward, Hume expects to incur $380,000 per annum in groundwater, surface water, air quality monitoring, licence fees and other environmental monitoring costs. These costs have been incorporated in the discounted cash flow analysis.

Hume has already incurred significant outlays up to, but not including FY 2020 to address predicted future external effects, as summarised in Table 3-6. Given these past expenditures, for instance for the purchase of water access licenses and to mitigate potential visual impacts, future outlays will be reduced.

Table 3-5, the external effects associated with the project are expected to be limited. No air quality impacts (6) are expected, and traffic impacts (8) are expected to be negligible. These predicted outcomes reflect a range of mitigation strategies incorporated in the design of the project, including:

- the design of the mining system such that there would be no damage to the water bearing zones in the sandstone so that inflows into the active mining area would be minimised;
- the use of 'non-caving' coal extraction methods such that surface subsidence impacts would be negligible;
- relatedly, the underground emplacement of reject material, which significantly reduces the potential for visual, dust and noise impacts, reduces the surface disturbance footprint, and eliminates the need for tailings ponds or cells on the surface;
- the use of covered rail wagons to transport product coal, reducing dust emissions from trains travelling to and from the project; and
- the use of advanced high-performance locomotives that use less fuel and generate less emissions than older locomotives commonly used in Australia, as well as giving rise to reduced vibration and noise emissions.

Following a corresponding recommendation by BISO (2017, p.2), the IPC (Para. 361, 375) requested a greater degree of transparency in terms of the costings included in the CBA to account for the mitigation of external effects. The respective costs are therefore summarised in Table 3-5 and presented in the relevant subsections below. All of these cost items are assumed to have been 'internalised' by Hume; that is, included in the project costings and deducted from pre-tax revenues. Additionally, going forward, Hume expects to incur $380,000 per annum in groundwater, surface water, air quality monitoring, licence fees and other environmental monitoring costs. These costs have been incorporated in the discounted cash flow analysis.

Hume has already incurred significant outlays up to, but not including FY 2020 to address predicted future external effects, as summarised in Table 3-6. Given these past expenditures, for instance for the purchase of water access licenses and to mitigate potential visual impacts, future outlays will be reduced.

Table 3-5. Hume Coal Project – Predicted external effects and mitigation strategies (including external effects attributable to BRP)

Aspect	Issue	Predicted impacts	Mitigation measures	Estimated cost ($2018 millions)
All external effects	Groundwater, surface water, air quality and noise monitoring, licence fees and other environmental monitoring costs	N/a	N/a	$380,000 per annum
Surface water	Residual of licenses (water demand minus existing licenses)	5.5 ML is required as residual.	Project mine design and water management system has been optimised to minimise water extraction, conserve and reuse water, minimise evaporation losses, and minimise discharge to surface water systems.	N/a (Hume Coal holds licenses, project design incorporated in project costings)
	Reduction in catchment area	Minimal reduction of approximately 94.2 ha in catchment areas: ▪ 0.8% of the total catchment for Medway Rivulet to its confluence with Wingecarribee River (totalling approximately 12,264ha); or ▪ 0.01% of the total catchment for Lake Burragorang (905,100ha).	Continued monitoring as a basis for triggers and thresholds Purchase of required surface water licenses	
Groundwater	Residual licensable groundwater take	Peak of approx. 2.156 Gl/annum from the Sydney Basin Nepean groundwater source	Project mine design and water management system has been optimised to minimise groundwater inflows. Purchase of required groundwater licenses	$1,265,000 for remaining groundwater licenses
	Private bores within zone of greater than 2m	AIP 2012 minimal impact criteria exceeded at 93 landholder bores.	Make good initiatives for landholders with / without licensed bores	$300,000 per annum for

Aspect	Issue	Predicted impacts	Mitigation measures	Estimated cost ($2018 millions)
	AIP minimal impact criteria Cultural heritage landscapes and gardens	Higher risk of impact during drought conditions for part of the pine windbreaks overlying the Hawkesbury Sandstone surface. Potential impacts on historic landscapes located on the Hawkesbury Sandstone outcrops during drought conditions Potential water stress during prolonged drought for 26 plant species typically observed in private gardens		monitoring and make good provisions
Visual amenity	Viewpoints in close proximity to the surface infrastructure area	Two viewpoints predicted to experience a moderate visual impact (private residence along Medway Road and the Hume Coal Highway at its intersection with Medway road). No further mitigation is recommended.	Screening through suitable vegetation Implementation of lighting protocols	$11,200 per annum for ongoing maintenance
Noise	Properties predicted to exceed project-specific noise levels (voluntary acquisition zone)	Number of properties is 2.	Various initiatives to minimise noise impact (including noise wall, cladding of equipment, use of silencers) Implementation of a noise management plan Implementation of a construction vibration management plan	$450,000 for noise mitigation of dwellings $1,207,500 for construction of noise mitigation wall
	Properties predicted to exceed project specific noise levels (voluntary mitigation zone)	Number of properties is 9.		
Ecology / biodiversity	Native vegetation to be removed	Clearing of 64 paddock trees (Brittle Gums and Scribble Gums) underlain by exotic pasture, resulting in an 'effective clearing	Biodiversity offset package providing for the required number of ecosystem credits	$150,000

Aspect	Issue	Predicted impacts	Mitigation measures	Estimated cost ($2018 millions)
		area' requiring offset of 8.3ha for the mine infrastructure. Clearing of 2ha of native vegetation (Broad-leaved Peppermint Narrow-leaved Peppermint grassy woodland and Snow Gum Woodland) for the BRP, requiring 0.2ha to be offset.		
	GDE to be impacted	No GDE to be removed. No impacts are expected to ecosystems on Belanglo Creek and south of Wells Creek if periods of prolonged drought are not experienced during mining.		
	EEC vegetation to be removed	None		
	Threatened species directly impacted	None		
	Habitat of threatened species to be removed	Loss of 17 hollow bearing trees.		
Air quality	Number of properties predicted to exceed dust criteria (acquisition zone)	Nil	Stockpile watering, management of stockpiles	N/a
	Number of properties predicted to exceed dust criteria (management zone)	Nil		

Aspect	Issue	Predicted impacts	Mitigation measures	Estimated cost ($2018 millions)
Greenhouse gases	Scope 1 and 2 emissions over the life of the project	1.8 Mt CO_2-e	N/a	N/a
Traffic	Level of service at assessed intersections (construction)	No or only marginal increases in wait times with no change to levels of service.	N/a	N/a
	Level of service at assessed intersections (operations)	No or only marginal increases in wait times with no change to levels of service.		
	Predicted safety implications	No perceptible change predicted.		
Aboriginal heritage	Aboriginal sites identified in the project area	No sites of high significance will be disturbed. 11 sites will be avoided and fenced. 20 sites will be impacted to some degree by the surface infrastructure area: ▪ 4 sites partially collected/fenced and avoided; ▪ 10 sites will be collected; ▪ 4 sites will be partially excavated with the remainder avoided; ▪ 2 sites will be subject to unmitigated impacts (subsurface sites of low significance which do not warrant further investigation or salvage). An additional 8 sites will be directly impacted by the Berrima Rail Project:	Project design to avoid areas of archaeological sensitivity Implementation of an Aboriginal Cultural Heritage Management Plan	Project design and management measures incorporated in costings

Aspect	Issue	Predicted impacts	Mitigation measures	Estimated cost ($2018 millions)
		▪ no sites of high significance; ▪ 2 sites of moderate significance; ▪ 6 sites of low significance.		

Notes: EECs refers to ‘endangered ecological communities’. GDEs refers to ‘groundwater dependent ecosystems. AIP refers to ‘Aquifer Interference Policy’.

Source: EMM.

Table 3-6. Costs incurred by Hume Coal to date to mitigate external effects up to (but not including) 2020 (AU$ 2018)

	Expenditures incurred					
Aspect	**Prior to 2018**		**2018**		**2019**	
Surface water licenses	$46,500	Purchase of 31 ML per annum of allocation in perpetuity	N/a		N/a	
Surface water monitoring	$165,000	Installation of surface water flow gauges				
Groundwater licenses	$4,393,484	Purchase of 1909 ML per annum of allocation in perpetuity	N/a		N/a	
Groundwater monitoring	$2,760,000	Drilling and construction of 23 groundwater monitoring piezometer holes				
Make-good provisions	N/a		$25,000	Monitoring	$25,000	Monitoring
Visual amenity	$143,000	Installation of fencing, planting of native tree screens	$10,000	Weed control, mowing, fence repairs	$10,000	Weed control, mowing, fence repairs
Noise	$1,500,000	Purchase of noise-affected property	N/a		N/a	
Ecology	$35,000	Flora and fauna surveys	N/a		N/a	
Air quality	$300,000	Installation of two TEOM monitoring devices for air quality assessments	N/a		N/a	
Air quality / noise	$70,000	Installation of two weather stations for inputs into air quality and noise assessments	N/a		N/a	
Aboriginal heritage	$225,000	Aboriginal archaeological surveys Fencing off Aboriginal heritage sites	N/a		N/a	
Other (general) expenditures	$1,900,000	Five years of environmental monitoring (noise, air quality, surface water flows and quality, groundwater heads and quality, weather)	$380,000	Groundwater, surface water, air quality monitoring, licence fees	$380,000	Groundwater, surface water, air quality monitoring, licence fees

	Expenditures incurred		
Aspect	**Prior to 2018**	**2018**	**2019**
		and other environmental monitoring costs	and other environmental monitoring costs

3.8.2 Surface water impacts

The nature and magnitude of the potential impacts of the project on surface water resources are described in Appendix E of the EIS.

3.8.2.1 Predicted surface water impacts

The impacts on surface water resources are predicted to be as follows:

- Minimal impacts on surface water resources are predicted as a result of the project. A temporary 0.8 per cent reduction in the catchment area of Medway Rivulet, in which the surface infrastructure area will be located, is predicted to occur as a result of project construction and operation.
- The predicted nutrient loads and concentrations in Oldbury Creek will fall within the applicable criteria.
- The water balance model demonstrates that the primary water dam has enough capacity to contain all surplus water and treatment and release of water is not required.
- Changes in flood levels and flood peak velocities as a result of the project for land not owned by Hume Coal are considered acceptable with reference to the assessment criteria.
- Cumulative impacts to surface water quality are not anticipated as a result of the project.

3.8.2.2 Mitigation and management measures

The project mine design and associated water management system has been optimised to minimise water extraction, conserve and reuse water, minimise evaporation losses, and minimise discharge to surface water systems. The mine design initiatives include:

- the diversion of runoff from undisturbed catchments back into the natural system to minimise unnecessary water capture;
- the first workings mining method and design of barrier pillars prevents losses from surface water systems due to cracking;
- the use of water required for mine operations from within the void such that water from an external source is not required for the mine;
- scour protection measures downstream of the conveyor piers and box culverts so that water quality in Medway Rivulet is not impacted by erosion and sedimentation; and
- the installation of vegetated swales along the two mine access roads located outside of the water management system to result in acceptable nutrient loads

and concentrations in Oldbury Creek.

Monitoring of the extensive surface water network will continue, and will form the basis for determining triggers and thresholds when management measures are required. Two overarching water management plans will be developed for the project, one for the construction phase and one for the operational phase.

3.8.2.3 Valuation approach

The 2018 Technical Notes suggest that the economic significance of potential impacts on water resources can be measured primarily with reference to the market price of water and, if relevant, other factors potentially not captured by the market price. These impacts need to be assessed on a project-by-project basis, including by considering:

- the location, seasonal demand and supply factors, and the number and nature of participants in the (water) market;
- any likely quantitative and qualitative impacts on water resources, and the likely cost implications for third parties.

The surface water impacts of the project require Hume Coal to hold license allocations from the Medway Rivulet Zone of the Upstream Warragamba and Upper Nepean Unregulated River Water Source. There are no trades of surface water that would permit a market assessment of the value of licenses; there are only about six licences in the zone, of which Hume Coal holds two. The value of the surface water licenses required by the project has therefore been assessed at Hume Coal's purchase prices. As noted in Table 3-6, Hume Coal has already purchased the required licenses at a cost of $46,500 prior to 2018.

There is no indication that the water requirements for the project would impact third parties in a manner that is not already captured by market prices. As noted, the analysis of potential surface water impacts indicates that:

- the impacts on surface water resources are predicted to be minimal; and
- cumulative impacts to surface water quality are not anticipated as a result of the project.

3.8.3 Groundwater impacts

The nature and magnitude of the potential impacts of the project on groundwater water resources are described in Appendix E of the EIS.

3.8.3.1 Predicted groundwater impacts

The impacts on groundwater resources are predicted to be as follows:

- Groundwater inflows to the mine will occur during the period when the project causes stress on the groundwater system, which will be throughout the operational mine life and continuing for three years after coal extraction ceases.

93 private landholder bores on 71 properties are predicted to be subject to a project impact drawdown of 2 m or more.

- With the implementation of various proposed mitigation measures, the project is not anticipated to result in a lowering of the beneficial use category of the groundwater source beyond 40 m from the activity.
- Cumulative impacts to groundwater quality are not anticipated as a result of the project.

Groundwater requirements

Table 3-7 provides an overview of the groundwater Water Access Licences (WALs) required by Hume and those that Hume already holds. Hume holds 93 per cent of the WALs it will require from Nepean Management Zone 1 (Sydney Basin Nepean Groundwater Source, and 63 per cent of those required from Nepean Management Zone 2 of the same source.

Table 3-7. Groundwater licenses required and held by Hume

Water source	WALs required (ML)	Amount controlled by Hume (ML)	Shortfall (ML)	Percent of required WALs held by Hume
Nepean Management Zone 1 Sydney Basin Nepean Groundwater Source	2,059	1,909	150	93%
Nepean Management Zone 2 Sydney Basin Nepean Groundwater Source	8	5	3	63%
Sydney Basin South Groundwater Source	7	25	0	100%
Total	2,074	1,939		93%

Cultural heritage landscapes and gardens

The groundwater dependence assessment for cultural heritage landscapes and gardens identified 83 separate heritage items listed on the Wingecarribee LEP 2010 or the State Heritage Register, including two significant landscapes – Sutton Forest and the Exeter/Sutton Forest landscape conservation areas. To assess the potential impacts on these heritage resources, the assessment considered:

- native vegetation (forested hills and ridges, remnant vegetation);
- non-native vegetation (gardens, plantations and windrows); and
- grasslands (undulating and flat pastoral lands).

The groundwater dependence concluded that:

- There is no predicted impact on landscape conservation areas occurring on Wianamatta Group shale that rely on groundwater perched above the regional water table.
- Part of the pine windbreaks at Mereworth House and Garden overlying the Hawkesbury Sandstone surface geology is inferred to have access to shallow groundwater. At the maximum predicted drawdown, 0.1 ha of gardens with low groundwater interaction would be at a higher risk of impact during drought conditions.
- In historic landscapes located on the Hawkesbury Sandstone outcrops, the project is predicted to result in various impact risks during drought conditions:
  - a low risk of impact to 79.3 ha of native vegetation, 23.5 ha of non-native vegetation and 29.5 ha of grasslands;
  - a moderate risk of impact to 15.5 ha of native vegetation and 5.2 ha of non-native vegetation; and
  - a high risk of impact ns to 28.8 ha of native vegetation, 19.8 ha of non-native vegetation and 39.7 ha of grasslands.
- 26 plant species typically observed in private gardens are considered sensitive to reduced water availability. Where these overlie areas of shallow groundwater outside the shale layer, they may be subject to water stress during prolonged drought.

3.8.3.2 Mitigation and management measures

Groundwater management system

The project mine design and associated water management system has been optimised to minimise groundwater inflow. The mine design initiatives include:

- the first workings mining method and design of barrier pillars minimises groundwater depressurisation and drawdown;
- sealing of panels as mining progresses to allow the groundwater system to begin recovering immediately after a panel is sealed and provide more rapid recovery to overlying landholder bores that may be impacted; and
- the use of water required for mine operations from within the void such that water from an external source is not required for the mine.

As is the case for surface water, monitoring of the groundwater network will form the basis for determining triggers and thresholds when management measures are required. Two overarching water management plans will be developed for the project, one for the construction phase and one for the operational phase.

Cultural heritage landscapes and gardens

Hume Coal propose to undertake a range of mitigation measures consistent with the requirements of the NSW Aquifer Interference Policy (AIP):

- Hume Coal propose to enter into make good agreements with landholders with existing licensed bores who are predicted to experience drawdown exceeding the minimal impact criteria. This will ensure that landholders have continued access to water.
- Where impacts are predicted to exceed the minimal impact criteria on properties containing cultural heritage landscapes and gardens, the make good agreements proposed by Hume Coal will ensure landholders have access to water to mitigate the impacts on these gardens and landscapes.
- For privately and publicly owned land without existing licensed bores, Hume Coal will enter into individual agreements with directly affected landholders. Mitigation methods for each respective agreement will be determined between the applicable landholder and Hume Coal.

3.8.3.3 Valuation approach

As is the case for surface water impacts, the 2018 Technical Notes suggest that the groundwater impacts should be measured primarily with reference to the market price of water, but that other potentially relevant factors also need to be taken into account. These factors include locational and seasonal conditions, the nature of the water market, as well as quantitative and qualitative impacts on water resources and any impacts on third parties.

Direct groundwater impacts

The great majority of Hume Coal's groundwater licensing requirement (2,059 Ml per annum) will be sourced from Management Zone 1 of the Sydney Basin Nepean Groundwater Source.[18] Groundwater allocation cannot be transferred from another zone into Management Zone 1, and this zone is also under an embargo on new licence allocations so that the licence pool is fixed.

Hume Coal holds the great majority of the necessary groundwater water licenses under the relevant water sharing plans to meet its expected licensing requirements during the project and post-mining. As noted in Table 3-6, Hume Coal has already purchased the rights for 1,909 ML per annum of allocation in perpetuity prior to 2018 at a cost of around $4.4 million (an average cost of $2,230 per ML). It is estimated that Hume will need to acquire an additional 253 ML of groundwater allocation by 2022.

[18] Hume Coal additionally requires 8 Ml per annum and 7 Ml per annum from Management Zone 2 of the Sydney Basin Nepean Groundwater Source and the Sydney Basin South Groundwater Source, respectively.

Establishing the (future) value of license allocations from the Sydney Basin Nepean Groundwater Source is not straightforward. There are relatively few dollar trades in this market. Most transfers in Zone 1 are zero-dollar transfers indicating that the water was sold with a property, or refers to a change in company name, or is another non-financial transfer. Table 3-8 summarises the available data on prices achieved for WAL transfers within the Sydney Basin Nepean Groundwater Source between FY 2012 and FY 2018. From the limited data available, it appears that prices have been trending upwards over the years, reaching as high as $4,000 per Ml in 2018. However, the most recent purchase in April 2019 was for 190 ML and a markedly lower price of $2,892. To be conservative, Hume Coal's purchases of the remaining required groundwater licenses (253) as of FY 2018 have been valued at a price of $5,000 per Ml.

Table 3-8. Recorded prices for groundwater licence transfers within the Sydney Nepean Groundwater Source Zones 1 and 2 (October 2011 to November 2019, $2018)

Financial year	ML transferred	Transaction price ($2018)
FY 2012	100	$1,685
	120	$1,685
FY2015	104	$1,577
	14	$1,577
	488	$1,577
	17	$1,577
	75	$1,577
FY2017	15	$3,437
	180	$2,842
	30	$3,158
	20	$3,000
	25	$3,685
	30	$3,105
	19	$3,000
	15	$3,000
	60	$3,000
	78	$3,263
	50	$2,947
	40	$3,567
FY2018	5	$1,300
	25	$1,320
	125	$4,000
	45	$4,000

Financial year	ML transferred	Transaction price ($2018)
	190	$2,892

Source: Hume Coal.

Third party bores

The 2018 Technical Notes set out a number of options for estimating the cost borne by third parties, including the owners of potentially impacted bores. These include water treatment costs, the cost of drawing on an alternative groundwater sources, the costs of reducing water requirements (for instance, by installing water saving technology), or the corresponding value of lost income.

A 'make good' assessment was conducted to address the bores that may be impacted by the project. Hume Coal propose to apply a range of 'make-good' measures so that landholders have access to a reasonable quantity and quality of water that aligns with the bores' authorised use. These options include:

- compensation for additional electricity costs for pumping;
- adding a rising main to lower the pump intake in the bore;
- installing new headworks and piping to create a more efficient system;
- changing the pump so that it is better suited/more efficient to a decreased water level in the bore;
- deepening the bore to allow it to tap a deeper part of the aquifer;
- reconditioning the water bore to improve its hydraulic efficiency;
- drilling a new bore to a different depth or wider diameter;
- providing an alternate water supply;
- constructing a farm dam (within existing licensing constraints);
- installing tank/s and providing water (pipeline/carting/dams); and/or
- installing additional infrastructure to better capture and store rainfall.

The 2018 Updated EIA assumed outlays to make good any impacts on third party bores of $25,000 per annum for monitoring activities and almost $200,000 per annum to undertake the various remedial options described above. To be conservative, we have assumed that Hume would incur $300,000 per annum for monitoring and make good initiatives from 2020 onwards.

Cultural heritage landscapes and gardens

The potential impacts of the project on cultural heritage landscapes and gardens during drought conditions would similarly be addressed by Hume Coal via 'make good' initiatives, irrespective of whether the affected landowner has access to a licensed bore or not. As noted above, Hume Coal would ensure that landholders with bores exceeding the minimal impact criteria have access to water to mitigate the impacts on these gardens and landscapes. For landholders without licensed bores, Hume Coal propose individual agreements to mitigate any impacts. The costs of the corresponding make good and other agreements are estimated at [...] and have been incorporated in Hume's costings as part of the CBA.

3.8.3.4 Other matters raised in the 2018 Technical Notes

There is no indication that the water requirements for the project would impact third parties in a manner that is not already captured by market prices. As noted, the analysis of potential surface water impacts indicates that:

- the impacts on surface water resources are predicted to be minimal;
- the project would not lower the beneficial use category of the groundwater source beyond 40 m from the activity; and
- cumulative impacts to groundwater and surface water quality are not anticipated as a result of the project.

3.8.4 Biodiversity

Appendix H of the EIS contains the Biodiversity Assessment Report and Biodiversity Strategy for the project.

3.8.4.1 Predicted biodiversity impacts

Ecological field surveys completed between 2012 and 2016 have informed the selection of a non-caving mining method that has negligible surface impacts, and minor residual impacts on native vegetation, threatened species, populations, communities and their habitats. The practices adopted by Hume Coal are consistent with the requirements of the *Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects (OEH 2014) (FBA)* to avoid and minimise most biodiversity impacts and to propose offsets to compensate for the minor residual impacts.

The primary ecological impact from the project, including the BRP component, would be the clearing of vegetation, including native vegetation and 64 paddock trees. Other biodiversity impacts are predicted to be minor:

- the project is not predicted to result in significant impacts for any terrestrial threatened species and communities;
- no threatened aquatic species were recorded or are predicted to occur; and
- Platypus habitat was found to be absent from the project area, and the breeding population of Platypus on the Wingecarribee River will not be impacted by changes to base flow as a result of the project.

The small areas to be removed are predicted to provide habitat for a number of ecosystem and species credit species. Offset calculations have been undertaken in the BioBanking Calculator to determine the number of credits required to compensate for the project's residual surface impacts and enable the project to have a net positive effect on biodiversity.

3.8.4.2 Mitigation and management measures

Monitoring and mitigation strategies are proposed to manage potentially affected ecosystems in the event of prolonged drought.

A biodiversity offset strategy is proposed to source offset areas containing the required ecosystem and species credits and will be finalised into a biodiversity offset package within 12 months of development consent. To compensate for the clearing impacts, the project would require 103 ecosystem credits for the removal of vegetation and 'ecosystem credit species' habitat, and a total of 640 species credits for the removal of habitat and 'potential habitat'. An assessment of an offset area which would potentially satisfy this credit requirement was undertaken as part of the biodiversity assessment, and suitable credits were found in an area of 32 ha of native vegetation.

The Total Fund Deposit, the estimated cost of managing the biobank site, has been estimated with reference to the Biodiversity Credits Pricing Spreadsheet, administered by the NSW Office of Environment and Heritage. The Total Fund Deposit estimate incorporates the costs of a range of management actions, including for bush regeneration, fencing maintenance, and signage installation, as well as other recurring costs, such as monitoring and reporting costs, council rates and targeted surveys.

3.8.4.3 Valuation approach

The 2018 Technical Notes set out that the requirement to assess and quantify impacts that are then reflected in an offset requirement (or biodiversity credit) means that key impacts on biodiversity have a direct and quantifiable economic cost. The ecological impacts associated with the project have therefore been valued at the cost of implementing the offsets and associated initiatives, and the costs included in the CBA analysis.

The 2018 Updated EIA relied on an estimated Total Fund Deposit of $121,467, estimated using the Biodiversity Credits Pricing Spreadsheet (administered by the NSW Office of Environment and Heritage), including management and other recurring costs extrapolated over the 20 year period over which these actions would be carried out.[19] To be conservative, we have assumed that Hume would need to provide a Total Fund Deposit of $150,000, divided equally over the 20 year period.

[19] These recurring costs include bush regeneration (weed control); bush regeneration (weed maintenance); fencing maintenance; signage installation; annual reporting fees; monitoring and reporting; council rates; and targeted Squirrel Glider surveys.

3.8.5 Noise

Appendix I of the EIS contains the Noise and Blasting Assessment for the project.

3.8.5.1 Predicted noise and blasting impacts

The noise and vibration assessment of the project found the following predicted impacts:

- During adverse weather conditions and with all the feasible mitigations applied:
  - nine dwellings will experience residual noise levels between 3 to 5 dB above project-specific noise levels (PSNLs) and are entitled to voluntary mitigation upon request; and
  - two assessment locations will experience residual noise levels greater than 5 dB above PSNLs and are entitled to voluntary acquisition upon request.
- The sleep disturbance assessment concluded that the predicted internal noise levels at the assessment locations will be well below those likely to cause awakenings.
- Construction noise levels during standard construction hours will exceed the noise management level (NML) at several assessment locations across the various construction stages. The 'highly affected' noise limit of 75 dB will not be exceeded at any time. Construction noise levels from proposed out of hours' activity are predicted to satisfy the evening and night NML at all assessment locations, with mitigation in place.
- Based on the safe working distances for typical construction plant items and the location of surrounding privately owned residential properties, human response vibration criteria are unlikely to be exceeded, as is likely to be the case for cosmetic damage criteria.
- Given that underground mine construction will occur at depths of approximately 110 m under the Hume Coal Highway, it is highly unlikely vibration levels will cause structural vibration impacts to the Hume Coal Highway.
- All roads that will be used to access the mine site where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases.

3.8.5.2 Mitigation and management measures

Hume Coal propose a range of mitigation measures to minimise noise impacts, including:

- the construction of a noise wall;
- the use of low noise conveyor idlers, and of underground conveyor transfers;
- the cladding of the CPP and application of 'tuneable' soft-start equipment in the

CPP;

- the cladding of conveyors;
- the placement of silencers on main vent fans; and
- the selection of alternative stockpile equipment that does not require the use of dozers to minimise noise and dust.

A noise management plan will be developed for the project, which will identify noise-affected properties, outline mitigation measures, specify protocols for routine noise monitoring, establish a protocol to handle noise complaints and specify procedures for undertaking independent noise investigations.

Hume Coal will manage construction noise levels where NMLs are exceeded by generally limiting construction activities to standard hours only. Hume Coal will also manage construction vibration, which will include preparing a construction vibration management plan. Blasting activities during construction will be designed to satisfy relevant air blast and ground vibration criteria at all surrounding privately owned assessment locations.

3.8.5.3 Valuation

The 2018 Technical Notes require that the current and future cost of any mitigation measures, negotiated agreements or land acquisition to mitigate noise impacts should be noted and included in the proponent's operating and capital costs.

Conservative estimates of the relevant property purchase costs have been allocated and included in Hume Coal's costings. As noted in Table 3-6, Hume Coal has incurred around $1.5 million to date for the purchase of noise-affected properties, and expects to incur an additional $2 million for similar purchases (assumed to occur in 2020).

The costs of preparing the requisite management plans, associated monitoring and forecasting activities, and any equipment modifications have been incorporated in Hume Coal's capital and operating expenditure costings. These costings also include the estimated purchase costs of properties eligible for voluntary acquisition and outlays for costs for noise mitigation measures at other potentially affected properties. Hume Coal expects to incur around $450,000 in or around 2022 to undertake noise mitigation at nine dwellings at an estimated cost of $50,000 per dwelling. In addition, Hume expects to incur $1,072,500 for the construction of a noise wall along the rail loop.

No material residual noise impacts that cannot be mitigated through the NSW *Noise Policy for Industry (2017)* and the NSW *Voluntary Land Acquisition and Mitigation Policy* are predicted.

3.8.6 Air quality

Appendix K of the EIS contains the Air Quality and GHG Assessment for the project.

3.8.6.1 *Predicted air quality impacts*

The results of the dispersion modelling conducted for the construction and operational phases of the project indicate the following predicted impacts from the project:

- project-only related particulate matter, gaseous pollutant and odour concentrations, and dust deposition rates will be well below applicable air quality impact assessment criteria and minor;
- when project incremental concentrations are combined with concentrations from neighbouring emission sources, the combined concentrations are well below applicable impact assessment criteria; and
- the analysis of cumulative impacts shows that the potential for an exceedance of applicable NSW EPA impact assessment criteria to occur as a result of the project is very low.

3.8.6.2 *Mitigation and management measures*

The mitigation measures incorporated into the project design accord with industry best practice dust control standards. The range of measures that will be implemented include stockpile watering on continuous cycle to reflect the prevailing weather conditions, the shaping and orientation of stockpiles to minimise emissions of particulate matter, watering at transfer points, and the full enclosure of conveyor transfer stations.

3.8.6.3 *Valuation approach*

Given that the project would not breach air quality standards, no material compliance costs are expected.

The ongoing costs of air quality monitoring and compliance initiatives described above have been incorporated in Hume Coal's ongoing operating expenditures for monitoring and compliance. As noted above, these costs will amount to around $380,000 per annum. The costs of installing air quality monitoring devices and weather stations (for the purpose of monitoring air and noise impacts) prior to 2018 amounted to $300,000 and $70,000 (Table 3-6).

3.8.7 Visual amenity

Appendix N of the EIS contains the Visual Amenity Assessment for the project.

3.8.7.1 *Predicted impacts*

Given existing mature vegetation in the community and the landscape/topography, the project will not have significant adverse visual impacts. While infrastructure will generally be sited so that it is shielded by existing topography and vegetation, visual amenity is expected to be affected at two viewpoints along Medway Road.

3.8.7.2 Mitigation and management measures

Hume Coal has planted vegetation screening consisting of native vegetation species that are common to the area, in order to mitigate potential views from Medway Road and the Hume Coal Highway. Planting has already been undertaken to maximise the time available for establishment of the trees and plants, thereby ensuring the effectiveness of the screening as early as possible. The cost of the associated fencing, trees and labour has been spent and is a sunk cost, and has therefore not been included in the analysis.

Hume Coal will develop lighting protocols to ensure that any mobile lighting plant is directed away from external private receptors, lighting sources are directed to minimise potential light spill, where possible lighting will be screened from external viewers, and lighting of reflective surfaces will be avoided. Suitable colours will be chosen for the project infrastructure to minimise visual impacts.

3.8.7.3 Valuation approach

Given that that the visual impacts of the project are expected to be minimal, no material compliance costs are expected. The ongoing costs of maintaining the vegetation screening have been incorporated in Hume Coal's ongoing operating expenditures. As noted in Table 3-6, Hume Coal has incurred $143,000 prior to 2018 for the installation of fencing, native tree screens, and the corresponding maintenance. Going forward, Hume Coal expects to incur around $11,200 per annum for ongoing weed control, mowing and fence repairs.

3.8.8 Aboriginal heritage impacts

Appendix S of the EIS contains the Aboriginal Cultural Heritage Assessment for the project.

3.8.8.1 Predicted impacts

The project's impact on Aboriginal cultural heritage values at a landscape level will be relatively small. 206 Aboriginal heritage sites were identified in the project area, of which 20 sites will be disturbed to some degree by the surface infrastructure area, comprising:

- six sites of moderate significance, two of which are of higher moderate significance; and
- 14 sites of low significance.

No sites of high significance will be directly impacted by the project. No subsidence impacts are expected for any of the 89 sites within the underground mining footprint.

3.8.8.2 Mitigation and management measures

The project's surface infrastructure area has been designed to avoid the areas of highest archaeological sensitivity close to Medway Rivulet and Oldbury Creek. Mitigation measures have been identified to mitigate impacts to the Aboriginal sites identified within the surface infrastructure footprint of the project, including test excavation and artefact collection. An Aboriginal Cultural Heritage Management Plan will be developed in consultation with stakeholders to provide for the active and passive management of Aboriginal sites, ongoing monitoring requirements and site salvage procedures. A range of Aboriginal heritage management measures will apply to the remaining identified sites for the duration of the project, including:

- active protection of Aboriginal sites that are located close to the surface infrastructure area through fencing;
- passive management by avoidance of Aboriginal sites that are located within the project area, but more than 25 meters from surface infrastructure;
- the collection of all surface stone artefacts in the surface infrastructure area disturbance footprint, and archaeological excavation of four sites of moderate significance;
- the monitoring of sites that may be susceptible to subsidence for the most significant sites above the underground mining area;
- procedures that specify actions to be taken in the event that human remains or Aboriginal sites are discovered; and
- procedures for the ongoing care of salvaged Aboriginal objects within a keeping place.

3.8.8.3 Valuation approach

Consistent with the 2018 Technical Notes, compliance with Aboriginal culture, heritage assessments and permit processes have been included in the project costings. As shown in Table 3-6, the costs of undertaking two Aboriginal archaeological surveys and fencing off Aboriginal heritage sites amounted prior to FY 2018 amounted to $200,000 and $25,000, respectively.

Given the limited scope of any impacts, no material indirect costs and benefits to the NSW community, for instance on cultural tourism, are expected.

3.8.9 Greenhouse gas emissions

Appendix K of the EIS contains the Air Quality and Greenhouse Gas Assessment for the project.

3.8.9.1 Predicted GHG emissions

Between FY 2021 and FY 2043 the project is predicted to give rise to around 1.8 Mt COe-2 in Scope 1 and 2 GHG emissions in total. It is not expected that material annual variations in emissions from those that have been forecast will occur.

3.8.9.2 *Valuation approach*

The 2018 Technical Notes state that market prices should be referenced in order to value GHG emissions and refer to the forecast price of European emission allowances (EUAs) as reflected in futures prices published by the European Energy Exchange (EEX). This approach has been adopted here, as shown in Table 3-9. Table 3-9 summarises total estimated (Scope 1 and 2) GHG emissions for the project, and the valuation of these emissions at 'central', 'high' and 'low' carbon prices, as recommended in the 2018 Technical Notes:

- The central forecast relies on the prices of EUA futures, as published by EEX (2020), and which are projected to increase from AU$ 39.31 in December 2021 to AU$53.12) in December 2044. EUA futures prices are not published beyond 2028; it has therefore conservatively been assumed that prices from that year onwards will increase by 1.3 per cent in real terms, consistent with current trends in the evolution of futures prices.
- The high price forecast relies on carbon prices derived from the Australian Treasury Clean Energy Future Policy Scenario, in accordance with the NSW Government's 'Greenhouse Gas Emissions Valuation Workbook' (Department of Planning & Environment 2018a). These prices are assumed to increase from AU$ 37.30 in 2021 to AU$ 124.51 in 2044 ($2018 prices).
- The low price forecast relies on carbon prices derived from the US EPA Social Cost of Carbon (Department of Planning & Environment 2018a). These prices are assumed to increase from AU$ 20.24 in 2021 to AU$ 38.06 in 2044 ($2018 prices).

The 2018 Technical Notes require that the economic impact of GHG emission should be estimated for NSW only. In Table 3-9, the NSW share of costs associated with increased GHG emissions has therefore been calculated with reference to NSW GSP as a percentage of world GDP, which is around 0.31 per cent. On that basis, the social costs of the GHG emissions associated with the project using futures prices for EUA futures amount to around $110,000 in NPV terms.

Table 3-9. Hume Coal project emissions valuation (AU$ 2018 prices)

Total emissions / valuation			
Total scope 1 & 2 emissions (Mt CO_{2-e})	European Emission Allowances - Futures prices (NPV AU$ 2018 million)	Australian Treasury Clean Energy Future Policy Scenario (NPV AU$ 2018 million)	US EPA Social Cost of Carbon (NPV AU$ 2018 million)
1.7	$36	$53	$20
NSW share of emissions / valuation			

Scope 1 & 2 emissions ($Mt\ CO_{2-e}$)	European Emission Allowances - Futures prices (NPV AU$ 2018 million)	Australian Treasury Clean Energy Future Policy Scenario (NPV AU$ 2018 million)	US EPA Social Cost of Carbon (NPV AU$ 2018 million)
0.005	$0.1109	$0.1645	$0.0616

Notes: NSW share of emissions has been calculated with reference to relative GDP/GSP. The Australian share of world GDP as of 2018 was 0.95%, and the NSW GSP share of Australian GDP as of 2018-19 was 32.6%. The €/AU$ exchange rate was assumed to be 1.6.

Source: Hume Coal; World Bank 2019; EEX 2020; ABS, 2018; 5220.0 Australian National Accounts: National Income, Expenditure and Product; Table 1 & Table 26.

3.9 Foregone value of agricultural production

This section describes the direct agricultural impacts that are expected as a result of the project. The analysis on this section draws on the 'Agricultural Impact Statement technical notes' (2018) published by the NSW Government. The flow-on effects that are expected to arise from a reduction in agricultural activity are described in Section 5.4.5.

3.9.1 Context

The Southern Highlands SA3 Region, comprising the SA2 regions of Southern Highlands, Hill Top – Colo Vale, Mittagong, Moss Vale – Berrima, Robertson - Fitzroy Falls and Bowral, has a diverse range of agriculture dictated by rainfall, soils and amenity values. The distribution of the gross value of agricultural production (GVA, a measure of the market value of the agricultural products produced) across the Southern Highlands SA3 Region is shown in Table 3-10.

Table 3-10 highlights the relative importance of the Roberson – Fitzroy Fall region, as well as the limited level of agricultural production in the other regions making up the Southern Highlands SA3 Region, particularly in the Bowral and Hill Top – Colo Vale regions. The project area is located to the northwest of Moss Vale, with most of the mine infrastructure located northwest of the Hume highway, on land predominantly used for grazing but in proximity to relatively highly populated areas. In this area, potential stocking rates are at the lower end of the NSW range for a high rainfall zone (defined by average annual rainfall in excess of 550mm), due to its having lower levels of rainfall and relatively poor soils.

Table 3-10. Southern Highlands SA3 Region – Gross value of agricultural production, by SA4 region (2015-16)

	Crops ($ millions)	Livestock ($ millions)	Total agriculture ($ millions)	Population density (Persons/ km^2)
Southern Highlands SA3 Region	$17.4	$101.6	$119.0	63.2
Comprising:				

	Crops ($ millions)	Livestock ($ millions)	Total agriculture ($ millions)	Population density (Persons/ km²)
Southern Highlands SA2 Region	$2.7	$6.2	$8.9	4.7
Hill Top-Colo Vale SA2 Region	$0.4	$8.0	$8.4	34.6
Mittagong SA2 Region	$3.1	$0.3	$3.3	122.0
Bowral SA2 Region	$0.8	$0.6	$1.4	233.0
Moss Vale-Berrima SA2 Region	$0.1	$4.8	$4.9	82.9
Robertson-Fitzroy Falls SA2 Region	$3.1	$18.7	$21.8	7.0
New South Wales	$6,897	$6189	$13,086	9.3

Note: The total of the SA2 regions does not align with the SA3 region, which may reflect movements of products inside and outside of the Southern Highlands, sampling errors and differences in the data sources used to compile the estimates.

Source: ABS, 7503.0 - Value of Agricultural Commodities Produced, Australia, 2010-11; 3218.0 Regional Population Growth, Australia.

Apart from the surface infrastructure area of 117 ha, the Hume project, being an underground mine, will not impact the surface agricultural integrity of the project area. Also, the land on which the mine is located is not biophysical strategic agricultural land (BSAL) as it does not meet the requirements for high value, or prime, rural land. The Land and soil capability (LSC) class across the project area ranges from predominately Class 4 (moderate capability land), with smaller areas of Class 3, Class 6 and Class 7, all of which are not classed as high value (generally Class 1 and Class 2 land).

3.9.2 Direct agricultural impacts

The agricultural impacts of the project, including those associated with the BRP, relate to the displacement of agriculture during construction of the mine and the associated rail infrastructure, the displacement of agriculture as a result of the life-of-mine infrastructure, as well as any permanent impacts on soil productivity. Subsidence is not expected to disturb agricultural activities. Some drawdowns of the water table are predicted (Following a corresponding recommendation by BISO (2017, p.2), the IPC (Para. 361, 375) requested a greater degree of transparency in terms of the costings included in the CBA to account for the mitigation of external effects. The respective costs are therefore summarised in Table 3-5 and presented in the relevant subsections below. All of these cost items are assumed to have been 'internalised' by Hume; that is, included in the project costings and deducted from pre-tax revenues. Additionally, going forward, Hume expects to incur $380,000 per annum in groundwater, surface water, air quality monitoring, licence fees and other environmental monitoring costs. These costs have been incorporated in the discounted cash flow analysis.

Hume has already incurred significant outlays up to, but not including FY 2020 to address predicted future external effects, as summarised in Table 3-6. Given these past expenditures, for instance for the purchase of water access licenses and to mitigate potential visual impacts, future outlays will be reduced.

Table 3-5); however, under the NSW Aquifer Interference policy, 'make good' provisions will apply, and have been included in the project costings.

The displacement of agriculture during the construction and operation of the project, including as a result of the rail infrastructure, as well as any permanent productivity losses due to the disturbance of land are internal costs to Hume Coal. These foregone values are also costs from a NSW perspective, and are counted as an offset against the direct and flow-on benefits of the project on the local economy. As noted, the land that would be disturbed by the project is currently used for livestock production. Cropping in the project area is for fodder production. Current stocking rates (shown in Table 3-11) are considerably higher than when the land was initially purchased by Hume Coal owing to various pasture activities that have been undertaken.

Table 3-11. Current livestock enterprises on the properties in the project area

Property	Land (ha)	Cattle[1]	Sheep[1]	DSE[2]	DSE/ha
Mereworth	500	500	0	3,750	7.5
Evandale	580	166	0	1,245	2.1
Stonnington	120	0	0	0	0
Eastern properties	80	140	0	1,050	13.1
Other freehold[3]	26	0	0	0	0

Notes: 1) Estimates as per Princess Pastoral Farm Management Plan (2015). 2) Calculated using the assumption that cattle correspond to 7.5 Dry Sheep Equivalents (DSE). 3) Land that will be disturbed by the project on other properties.

Source: Hume Coal.

3.9.3 Foregone value added of agricultural production

To estimate the foregone value of agricultural production from these properties (the net value added to the state economy), gross margins per hectare for typical livestock enterprises were taken from budgets compiled by the NSW Department of Primary Industry (2019). Gross margins are calculated as sales revenues less operating costs for representative livestock production systems. The systems selected are conservative, being amongst the highest returning per DSE:

- the fattening of weaner calves at $52.3 per DSE; and
- Merinos ewes 20 micron at $59.7 per DSE.

The gross margins (or value per hectare, per annum) for the relevant properties and for farm properties applying 'typical' farm management practices are shown in Table 3-12. Current margins on Hume Coal managed properties are, on average, $396 per hectare. This is less than for a typical farm management system, and most likely due to poor seasonal conditions. In estimating the foregone coast of agricultural production, it is more appropriate to use the typical farm gross margin per hectare applied to all the impacted property areas, regardless of whether they are currently stocked.

The NPV of gross margins is an approximate indicator of the foregone value of agricultural production that is analogous to the concept of value added in national and state accounts. Agricultural gross margins refer to revenues less variable costs but exclude capital costs and a return to owner-operator labour, and hence overstate the opportunity cost of the project. The degree to which opportunity costs are overestimated increases with the length of time considered, hence the estimates of foregone production values are conservative. This overestimation may be offset to some degree because the restoration of full agricultural productivity may not occur within the two-year rehabilitation period. However, these costs are not expected to be material, as the majority of the rehabilitation takes place at the end of the mine life. At an annual discount rate of 7 per cent, these costs are heavily discounted.

Table 3-12. Agricultural gross margins, $ per hectare (A$ 2018)

	Hume farm management			Typical farm management		
Property	DSE/ha	$/DSE	$/ha/year	DSE/ha	$/DSE[1]	$/ha/year
Mereworth	7.5	53.2	399	9	53.2	479
Evandale	2.1	53.2	109	9	53.2	479
Stonington	0	0	0	N/a	N/a	N/a
Eastern properties	13.1	53.2	697	9	53.2	479
Other freehold[2]	0	0	0	N/a	N/a	N/a

Notes: 1) $/DSE is influenced by the percentage of sheep and cattle on the property. 2) Land that will be disturbed by the project on other properties.

Source: Hume Coal / BAEconomics analysis.

The estimated foregone value added of agriculture production – the land removed from production multiplied by the corresponding gross margins – is shown in Table 3-13. The foregone value added of agriculture is estimated at around $1 million in NPV terms (rounded to the nearest million).

Table 3-13. Foregone agricultural value added (A$'000s,

Project phase	Hectares	Foregone value added (NPV, 000s)
Construction phase	279	$301
Operational phase	135	$574
In perpetuity (post operational phase)	3	$16
Total		$891

Notes: NPVs calculated using an annual discount rate of 7 per cent.

Source: BAEconomics analysis.

3.9.4 Foregone income and employment

Income in the form of wages and salaries derived from agriculture is a component of agricultural value added; it can therefore be expected that there may be some limited local impacts on income and employment due to agricultural land being removed from production. According to the ABS 2016-17 input output requirements table (ABS 2019a), employee compensation makes up about 14 per cent of the value added by agriculture. The foregone income for the Southern Highlands SA3 Region, assuming that farm labour is sourced locally, would be approximately $124,000 in NPV terms. Converting this estimate of foregone agricultural income to an annual amortised value over the life of the project corresponds to approximately $10,000 per annum. At an average regional wage of about $60,000, this represents a loss of less than 0.2 FTE jobs per annum.

3.9.5 Potential broader agricultural land use impacts of the project

The project has been designed to avoid impacts on agricultural land as much as practicable, primarily through the mine design and mining method to be used so as to avoid subsidence impacts, and the emplacement of rejects underground so as to eliminate the need for a permanent surface waste emplacement. Disturbance of agricultural land will be limited to areas required for construction and operation of surface infrastructure (117 ha), representing approximately 2 per cent of the total project area. This land will be rehabilitated after the cessation of mining to restore the pre-mining agricultural land-use of grazing on improved pastures. The remainder of the project area during operations will remain available for the continuation of current agricultural land uses.

3.9.5.1 Agriculture in the Wingecarribee Shire LGA

As noted in Section 2.2, the Wingecarribee Shire LGA boundary essentially aligns with that of the Southern Highlands SA3 Region. The Wingecarribee Shire LGA covers 269,000 ha, of which 73,000 ha (around 27 per cent) is classed as agricultural land (ABS 2011).[20] Within the actively productive land:

- approximately 1,900 ha is cropped, with less than approximately 1,000 ha cultivated; and
- approximately 15,000 ha is managed for grazing.

While the beef cattle industry is the largest agricultural industry in the Wingecarribee LGA, it represents less than 1 per cent of the beef cattle industry in New South Wales, while horse studs in Wingecarribee LGA account for almost 2.5 per cent of horse studs in New South Wales. According to the ABS (2015-16), total agricultural groundwater

[20] The Hume project area of 5,051 ha therefore accounts for around 7 per cent of agricultural land in Wingecarribee LGA.

volume used in the Wingecarribee LGA is approximately 1,500 ML annually, out of a total volume from all water sources of approximately 3,300 ML.

3.9.5.2 Agricultural properties and production

The gross value of agricultural production (GVP) for the Wingecarribee LGA was $44.8 million in 2010-2011 (ABS 2011), representing 0.38 per cent of the gross value of agricultural production in NSW.

Agricultural properties with an estimated value of agricultural operations (EVAO) greater than $5,000 per annum only cover a combined area of about 16,900 ha, less than a quarter of the available agricultural land in Wingecarribee LGA. This indicates that some 77 percent of agricultural land is not dedicated to productive agricultural enterprises generating a material EVAO, but instead represent 'lifestyle' properties with limited or no agricultural output.

In terms of the value of GVP in 2011, there were only six substantive enterprises in the Wingecarribee LGA: cattle, milk, nurseries and cut flowers, vegetables and hay. The majority of businessessurroumall in the LGA, with an annual turnover of less than $50,000, in the major agricultural production regions. Further, the great majority of agricultural businesses are non-employing, using only owner operator and family labour, throughout the Wingecarribee Shire LGA. In the Fitzroy Falls and Southern Highlands regions roughly 10 per cent of businesses have a turnover in excess of $500,000; in the remaining SA2 regions they are generally less than 5 per cent of farms. Very few farms employ more than four individuals on an FTE basis.

3.9.5.3 Moss Vale - Berrima SA2 Region

Additional insights can be gained by analysing the attributed value of agriculture and water use at a smaller (SA2 Region) level, encompassing the major part of the Hume underground mining area. The Hume project is located mostly in Moss Vale - Berrima SA2 Region and partially within the adjoining Southern Highlands SA2 Region. Some two-thirds of the underground mining area is wholly with the Moss Vale - Berrima SA2 Region.

The Moss Vale - Berrima SA2 Region is significantly larger than the Hume project area and encompasses the major towns of Moss Vale and Berrima. Around 10 per cent of the area is occupied by the Moss Vale Enterprise Zone, dedicated to major employment activities and heavy industry.

Agricultural land in the Moss Vale - Berrima SA2 Region totals 4,316 ha or 6 per cent of all agricultural land in the Wingecarribee LGA. Cattle production (4,500 head) is the principal agricultural activity on approximately 31 properties; however, some 1,400 head of those are dairy cattle are located some distance to the east of the project area. Other commodities are hay, silage, wine grapes, alpacas and exotic breeds to a lesser extent. There are a limited number of horse studs within the area.

Within the Moss Vale - Berrima (SA2) region (total area 4,300 ha) there are 39 agricultural businesses, reported to utilise water from all sources of 717 ML (ABS 2015-16). Of those, only 5 businesses were using groundwater for irrigation purposes. Total reported use of groundwater, including basic land-owner rights and irrigation, was 563 ML annually from 14 property owners.

3.10 Net public infrastructure costs

As noted in the 2015 Guidelines, the incremental cost of public infrastructure (such as utilities and communications expenditures) and transport infrastructure required due to a proposal should be included in the CBA.

No public infrastructure costs are expected to be incurred for the project, and none have therefore been included in the CBA.

3.11 Loss of surplus to other industries

The 2015 Guidelines specify that the CBA should incorporate changes in economic surplus arising in other NSW industries. The potential impact of the project on regional tourism is discussed in Section 5.3.

3.11.1 Project design

As noted, the Hume project area amounts to 5,051 ha, of which 69 per cent is surface area above the underground mine while the remainder consists of surface infrastructure or buffer areas owned by Hume. Approximately 117 ha (2 per cent of the project area) will be used for mine surface infrastructure and associated facilities. The only material surface disturbance above the underground mine will consist of drilling and ventilation infrastructure and access tracks.

The project's main surface infrastructure area design avoids surface disturbance in the state forest and the disturbance of biodiversity and cultural heritage resources above the mine. The proposed first workings mining method will offer a significant level of protection to both existing surface features and the groundwater system by preventing overburden caving and its associated mining-induced fracturing of the overlying Hawkesbury Sandstone. The predicted maximum level of subsidence is so low that subsidence related impacts on surface features will be imperceptible. Further, with maximum surface settlement across the project area predicted to be less than 20 mm (and significantly less in many areas), the potential for significant three-dimensional horizontal shear effects to occur as a direct result of mining subsidence is negligible.

3.11.2 Surrounding industries

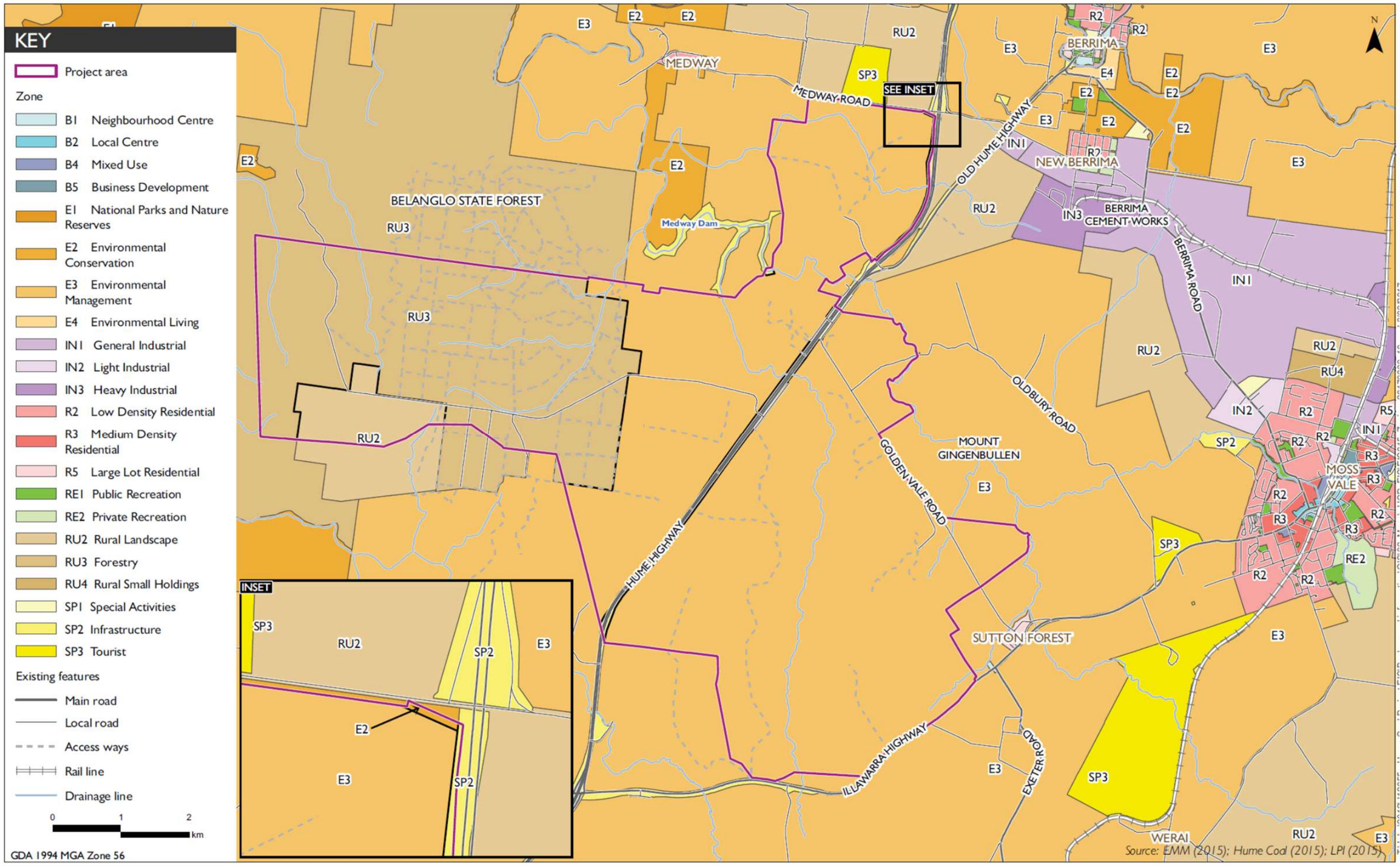
A variety of land uses exist in and surrounding the project area, including grazing properties, small-scale farm businesses, natural areas, forestry, the Hume Highway, but also a number of industrial operations to the east of the project area.

A large portion of the area between New Berrima and Moss Vale is zoned IN1 General Industrial, and is part of the Moss Vale Enterprise Corridor, a portion of land set aside for employment generating development under the Wingecarribee LEP. Industrial facilities in the area include (Figure 3-1):

- the Berrima Cement Works, with approval to produce up to 1.56 Mtpa of cement products;
- the Berrima Feed Mill;
- Omya's Moss Vale plant, a high-volume producer of bulk products for the glass, agriculture, mining and manufacturing industries;
- the Dux hot water plant, which produces solar and electric hot water heaters;
- the WSC resource recovery centre, comprising a waste recycling, collection and transfer facility; and
- the new Austral Brickworks Site.

However, given that the underground workings of the project would not take place beneath these facilities, and that subsidence impacts are in any case expected to be minimal, no adverse effects on surrounding industries are expected.

Figure 3-1. Land zoning around the project



Source: EMM.

4 Results of the CBA and sensitivities

This section presents:

- the results of the CBA in terms of the net benefits that can be attributed to New South Wales (Section 4.1); and
- the sensitivity of these results to changes in key variables (Section 4.2).

4.1 NPV of the project attributable to New South Wales

As set out in the 2015 Guidelines, the project's net present value to the NSW community accounts for direct and indirect costs and benefits.

4.1.1 Attribution of benefits to New South Wales

Table 4-1 summarises (gross) benefits, and the share of these benefits that has been attributed to New South Wales.

Table 4-1. Attribution of benefits to New South Wales

Benefit	Total value (NPV, AU$ 2018 millions)	Share attributed to NSW (per cent)	Value for NSW (NPV, AU$ 2018 millions)
Items prescribed in the 2015 Guidelines			
Royalties	$148	100%	$148
Company income tax	$142	31.9%	$45
Economic benefit to NSW landholders	N/a	100%	$0
Economic benefit to NSW suppliers	N/a	100%	$0
Net producer surplus	$0	0%	$0
Items reflecting a broader interpretation of the 2015 Guidelines			
Economic benefit to NSW workers	$63	100%	$63
Land taxes	$1	100%	$1
Local government rates	$1	100%	$1
Personal income taxes	$42	31.9%	$14
Medicare payments	$2	31.9%	$1
Payroll taxes	$18	100%	$18

Source: BAEconomics analysis.

4.1.2 Net benefits of the projects for New South Wales

Table 4-2 summarises the net benefits to New South Wales:

- Adopting a strict interpretation of the 2015 Guidelines, the NPV of the net benefits accruing to New South Wales is estimated at $192 million in NPV terms, consisting of royalties of $148 million in NPV terms and the NSW share of company income tax of $45 million in NPV terms.
- If a broader interpretation of the 2015 Guidelines is adopted, the NPV of the net benefits accruing to New South Wales is estimated at $290 million, consisting additionally of economic benefits to NSW workers of $63 million in NPV terms, taxes accruing directly to New South Wales of $21 million in NPV terms, and the NSW share of personal income taxes and Medicare payments of $14 million in NPV terms.

As discussed in Section 3.8, the great majority of potential external effects that have been identified would be internalised by Hume. Given that this is the case, the only two items that would represent a 'cost' to New South Wales would be the NSW share of GHG emissions and potential agricultural impacts, amounting to around $1 million in NPV terms in total.

Table 4-2. Net benefits of the project for New South Wales

Direct and indirect costs	(NPV, AU$ 2018 millions)	Direct and indirect benefits	(NPV, AU$ 2018 millions)
Items prescribed in the 2015 Guidelines:			
External effects (GHG)	$0.119	Royalties	$148
Loss of agricultural value added	$0.891	NSW share of company income tax	$45
		Economic benefit to NSW landholders	N/a
		Economic benefit to NSW suppliers	N/a
		Net producer surplus	$0
Total direct and indirect costs	$1.010	Total direct and indirect benefits	$193
Net benefits to New South Wales			$192
Items reflecting a broader interpretation of the Guidelines:			
		Economic benefit to NSW workers	$63
		Land taxes	$1
		Local government rates	$1
		Payroll taxes	$18
		NSW share of personal income taxes	$14

Direct and indirect costs	(NPV, AU$ 2018 millions)	Direct and indirect benefits	(NPV, AU$ 2018 millions)
		NSW share of Medicare payments	$1
		Total direct and indirect benefits	$98
Net benefits to New South Wales			**$290**

Notes: Totals may not sum precisely due to rounding.

Source: BAEconomics analysis.

4.2 Sensitivity analysis

The 2015 Guidelines require a proponent to undertake sensitivity analyses of a range of variables as part of the CBA. Accordingly, variations in key parameters were used to assess the sensitivity of the net benefits generated by the project.

4.2.1 Variations in the discount rate

In accordance with the 2015 Guidelines, a discount rate of 7 per cent per annum has been assumed for the analysis, and the sensitivity of the results of the CBA has been tested by applying a discount rate of 4 per cent and 10 per cent, respectively (Table 4-3). Reducing the discount rate to 4 per cent implies net benefits to NSW of around $276 million ($398 million for a broader interpretation of the 2015 Guidelines) in NPV terms, while increasing the discount rate to 10 per cent implies net benefits to NSW of around $138 million ($207 million).

Table 4-3. Net benefit to NSW – Discount rate sensitivity (NPV A$ 2018)

Discount rate assumption	Incremental benefits of the project for NSW (NPV A$ m 2018)	
	As prescribed in the 2015 Guidelines	Broader interpretation of the Guidelines
7 per cent	$192	$290
4 per cent	$276	$398
10 per cent	$138	$207

Source: BAEconomics analysis.

4.2.2 Variations in coal prices and exchange rates

Most of the project's coal production would be exported and is priced in US dollars. The results of the CBA incorporate coal price forecasts from DIIS (2019) corresponding to a quality-adjusted coking coal price of US$134.5 per tonne and a quality-adjusted thermal coal price of US$64.8 per tonne from FY 2025 onwards. The US$/AU$ exchange rate is assumed to remain at 0.81 from 2024 onwards.

Different combinations of coal prices and US$/A$ exchange rates will affect company income tax payments and royalty payments to NSW. Table 4-4 shows the net benefits accruing to NSW as a function of various combinations of coal prices and exchange rates:

- for the coal price sensitivity, product (thermal and coking coal prices have been varied by +20 per cent and –30 per cent over the life of the mine, respectively; and
- for the exchange rate sensitivity, the US$/AU$ exchange rate has been varied by +30 per cent and –20 per cent, respectively, over the life of the mine.

Table 4-4 shows that in the 'worst case' scenario of a combination of a low coal price and a high exchange rate, sustained over the entire life of the project, the net benefits to NSW would amount to $31 million in NPV terms ($122 million in NPV terms if a broad interpretation of the 2015 Guidelines is adopted). We note that such a low coal price and high exchange rate combination is unlikely, given that the Australian dollar is a 'commodity currency' that tends to appreciate and depreciate in line with the price of Australia's key exports – iron ore and coal (Cayen et al. 2010).

Table 4-4. Net benefit to NSW – Coal price and exchange rate sensitivity (NPV A$ m 2018)

Coal price assumptions / Exchange rates (US$/A$)	All coal prices reduced by 30 per cent	Central coal price assumptions	All coal prices increased by 20 per cent
All exchange rates increased by 30 per cent	$31 ($128)	$112 ($209)	$166 ($263)
Central exchange rate assumption	$87 ($185)	$192 ($290)	$263 ($361)
All exchange rates reduced by 20 per cent	$149 ($246)	$281 ($378)	$368 ($466)

Notes: NPVs have been derived using an annual discount rate of 7 per cent. NPVs for a broad interpretation of the 2015 Guidelines are shown in brackets.

Source: BAEconomics analysis.

The 2015 Guidelines require proponents, where practicable, to undertake a sensitivity analysis of how much output prices would need to fall for a project to have a zero NPV, and to report on whether such a scenario is either likely or unlikely. The analysis suggests that all coal prices over the life of the project would need to be reduced by 65 per cent to result in a net benefit to New South Wales of $0, assuming a narrow interpretation of the Guidelines.

4.2.3 Variations in royalty payments

The 2015 Guidelines require an assessment of the royalties derived from the project if mining revenues are 25 per cent lower or higher than in the central case. Table 4-5 shows that an increase (decrease) in mining revenues by 25 per cent would result in project royalties of around $186 million and $110 million in NPV terms, respectively.

Table 4-5. Net benefits to NSW and net royalty receipts – Variations in mining revenues (NPV A$ 2018)

	Net royalty receipts (NPV A$2018 m)
25 per cent increase in mining revenues	$186
Central case mining revenues	$148
25 per cent decrease in mining revenues	$110

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

4.2.4 Variations in company income tax payments

The 2015 Guidelines require an assessment of a variation in company income tax by +/- 50 per cent. Table 4-6 summarises the results of the analysis.

Table 4-6. NSW share of company income tax payments – Sensitivity (NPV A$ 2018)

	Net company income tax payments (NPV A$2018 m)
50 per cent increase in company income tax	$68
Central case company income tax	$45
50 per cent decrease in company income tax	$23

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

4.3 Distributional impacts

The 2015 Guidelines recommend commenting on the distributional impacts of a proposal, for instance by identifying the most likely 'winners' and 'losers' and reporting qualitatively on the extent of any expected material impacts.

At an aggregate level, approval of the project is expected to result in a positive net benefit for NSW (narrowly defined) of $192 million in NPV terms, or $290 million in NPV terms if a broader interpretation of the 2015 Guidelines is applied. Either way, the NSW community would clearly benefit from the implementation of the project.

We have not identified industries or particular types of businesses that would be materially negatively affected by the project. As discussed in Section 3.11, the design of the project is such that visual and subsidence impacts are expected to be minimal. No adverse impacts are therefore expected for industrial facilities in the vicinity of the project (3.11.2), for agricultural enterprises in the region (Section 3.9.5), or for tourism establishments (Section 5.3.2).

The eventual Hume workforce would be clear winners if the project is approved, as would be local suppliers in the Southern Highlands SA3 Region:

- for NSW workers, the estimated disposable income benefits from higher rates of pay than are typically available from non-mining industries are estimated at $63 million in NPV terms; while
- the analysis in Section 5.2 suggests that up to $350 million in operating expenditures for materials & services could be sourced locally.

4.4 NSW flow-on effects

Flow-on effects refer to the adjustments in the economy that follow from initial changes in the level of demand for goods, services and labour arising from a significant development (such as the project).

4.4.1 The economic modelling framework

The economy-wide impacts of the proposed development have been assessed using a computable general equilibrium (CGE) model. The CGE model applied in this analysis is the Cadence Economics General Equilibrium Model, or CEGEM.

CEGEM is a recursive dynamic model that solves year-on-year over a specified timeframe. The model is used to project the relationship between variables under different scenarios over a predefined period. A typical scenario is comprised of a 'do nothing' scenario that forms the basis of the analysis. In this instance, the Reference Case assumes that there is no proposed development investment or coal output. Set against this scenario is the Project Scenario.

CGE modelling is the preferred technique to assess the impacts of large projects as they are based on a more detailed representation of the economy, including the complex interactions between different sectors of the economy. As a CGE model is able to analyse the impacts of the proposed development in a comprehensive, economy-wide framework meaning the modelling captures:

- direct increases in demand associated with the proposed development (short term construction activity) as well as the increases in coal output;
- indirect increases in demand, or flow-on effects associated with increased economic activity relating to both the construction phase of development and additional coal production;

- labour market displacement caused by the direct increase in demand from a project of this nature (and the associated investment) on other sectors of the economy bidding up wages and 'crowding out' other sectors of the economy; and
- revenue leakage associated with the transfer of profits from the southern highlands to interests outside the region.

The model projects change in macroeconomic aggregates such as real GSP, which is an output measure of the NSW economy, and real gross state income (real GSI) which is a welfare measure for NSW residents. The model also projects state-wide and regional employment, export volumes, investment and private consumption. A brief description of the model is presented in Box 4-1.

Box 4-1. An overview of CEGEM

CEGEM is a multi-commodity, multi-region, dynamic model of the world economy. Like all economic models, CEGEM is a based on a range of assumptions, parameters and data that constitute an approximation to the working structure of an economy. Its construction has drawn on the key features of other economic models such as the global economic framework underpinning models such as GTAP and GTEM, with state and regional modelling frameworks such as VURM and TERM.

Labour, capital, land and a natural resource comprise the four factors of production. On a year-by-year basis, capital and labour are mobile between sectors, while land is mobile across agriculture. The natural resource is specific to mining and is not mobile. A representative household in each region owns all factors of production. This representative household receives all factor payments, tax revenue and interregional transfers. The household also determines the allocation of income between household consumption, government consumption and savings.

Capital in each region of the model accumulates by investment less depreciation in each period. Capital is mobile internationally in CEGEM where global investment equals global savings. Global savings are made available to invest across regions. Rates of return can differ to reflect region specific differences in risk premiums.

The model assumes labour markets operate where employment and wages adjust in each year so that, for example, in the case of an increase in the demand for labour, the real wage rate increases in proportion to the increase in employment from its base case forecast level.

CEGEM determines regional supplies and demands of commodities through optimising behaviour of agents in perfectly competitive markets using constant returns to scale technologies. Under these assumptions, prices are set to cover costs and firms earn zero pure profits, with all returns paid to primary factors. This implies that changes in output prices are determined by changes in input prices of materials and primary factors.

Importantly, in terms of interpreting the results as well as for consistency with the CBA analysis, real GSI represents the preferable welfare measure to the commonly reported change in real GSP (a measure of production). As a measure of income, Pant et al.

(2000) shows how the change in real GSI is a good approximation to the equivalent variation welfare measure in global CGE models such as CEGEM. This measure is widely used by practitioners and can also be decomposed into various components to assist in the analysis of results. Real GSI is computationally more convenient than an equivalent variation, and a more familiar concept to explain to decision makers (Layman, 2004).

As noted by Pant et al. (2000), in considering welfare results in global CGE models such as CEGEM, the main components are the changes in output (as measured by real GSP), the terms of trade, and payments to foreigners. Of particular relevance in the discussion around estimating the net benefits of the proposed development are the terms of trade effects. These can be closely linked to changes in labour market conditions because any increase in real wages as a result of higher levels of coal exports will result in an improvement in the terms of trade and, hence, welfare.

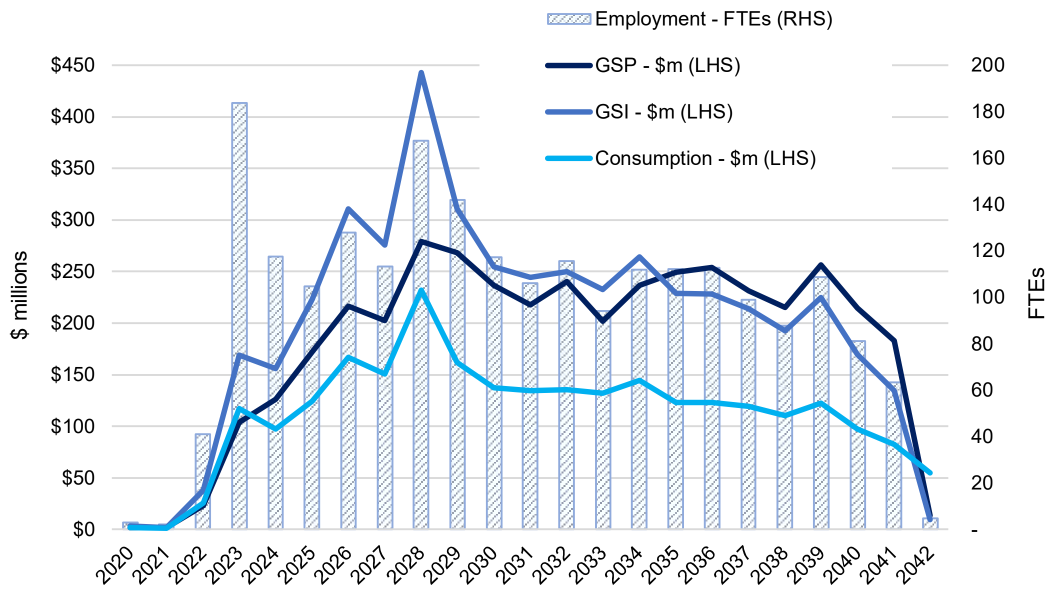
That noted, real GSI does not capture some non-market effects that can have an impact on the living standards of NSW residents. These could include, for example, the noise impacts for residents or pollution as considered in the detailed CBA above. In that context, by assessing the economic impacts of the Project, the CGE modelling undertaken should not be considered a replacement for the detailed CBA, rather another lens through which to estimate the potential benefits of the Project under consideration.

4.4.2 Economy-wide modelling of the project

A summary of the key macroeconomic variables projected under the project is shown in Figure 4-1. The results are reported as deviations from the Reference Case and represent the change in a particular variable as a result of investing in and operating the project:

- At the state level, real GSP for New South Wales is projected to peak at $279 million higher than in the Reference Case in FY 2028. Real GSI is projected to peak at $442 million in FY 2028, and the economy wide increase in employment will peak at 184 FTE in FY 2028. Household consumption is expected to peak in FY 2028 with an increase in $232 million above baseline.
- Over the period from 2020 to 2042 GSP is projected to increase by around $1.9 billion relative to the Reference Case and GSI by around $2.2 billion in NPV terms. Over the same period, household consumption over the same period is forecast to increase by around $1.3 billion in NPV terms. The corresponding increase in NSW employment relative to the Reference Case is 184 FTE, on average, over the period.

Figure 4-1. Projected economy-wide impacts of the project on NSW



Source: Cadence Economics.

4.5 Major risks and unquantified impacts

In addition to noting distributional impacts, the 2015 Guidelines require a discussion of major risks and unquantified impacts relevant to the CBA.

All resources projects are exposed to the risk of a major and sustained downturn in the price of the underlying commodity, in this case, coal prices. Beyond generic risks of this nature, we are not aware of major risks or potential impacts that have not been quantified in the CBA described in the preceding sections.

5 Local effects analysis

This section describes the LEA prepared for the project. The LEA is intended to complement the CBA by translating the effects estimated at the State level to the impacts on the communities located near the mine site. For the purpose of undertaking the LEA, the 2015 Guidelines require proponents to adopt a study area that should match a SA3 geographical definition. In the case of the project, the relevant SA3 area is the Southern Highlands SA3 Region (Figure 2-4).[21]

This section is structured as follows:

- Section 5.1 derives the benefits relating to local employment;
- Section 5.2 estimates effects from non-labour project expenditures;
- Section 5.3 discusses broader impacts on the local region, including:
  - effects on other local industries;
  - effects onthe local housing market;
  - effects on local tourism;
  - the extent of any unmitigated externalities;
  - a critical mass analysis of agricultural impacts; and
  - other net benefits attributable to the local region
- Section 5.4 investigates flow-on benefits for the local region; and
- Section 5.5 summarises the results.

5.1 Effects relating to local employment

According to the 2015 Guidelines, employment benefits accruing to the local economy as a result of a project derive as follows:

- A proposal directly employs workers, some share of which are ordinarily resident in the locality. These local workers are likely to experience an increase in labour earnings, which constitutes a local economic benefit.
- The remainder of workers who may be temporary residents or commute do not create a local economic benefits for the purpose of a LEA. However, both groups of workers will spend some of their earnings in the local economy, which could give rise to some flow-on employment in the local economy. This also constitutes

[21] The Southern Highlands SA3 Region comprises the five SA2 areas of Southern Highlands, Hill Top, Mittagong, Bowral, Moss Vale, and Robertson Fitzroy Falls. The Southern Highlands SA3 Region (population 50,451 in 2018) largely aligns with the Wingecarribee LGA (population 50,493).

a local economic benefit of a proposal.

Following the approach set out in the 2015 Guidelines, estimating employment effects requires determining:

- total direct employment;
- the proportion of workers that are local residents;
- the net increase in local workers' income; and
- the flow on employment that local expenditure of increased income will create.

5.1.1 Total direct operational employment

Between 2022 and 2042 the Hume operational workforce will consist of, on average, 228 FTE Hume Coal employees and 38 FTE consultants, contractors and development contractors (Figure 2-3).

5.1.2 Share of the operational workforce that are local residents

Attributing income benefits to the local region requires assumptions to be made about the share of the workforce expected to reside in the Southern Highlands SA3 Region. The assumptions made in this report are consistent with those developed in the Social Impact Assessment (SIA) for the project (Appendix R, EIS).

Where the construction workforce is concerned, the SIA assumes that 90 per cent of construction personnel will temporarily relocate to the local region, so that only 10 per cent of the workforce would be recruited locally. For the purpose of estimating local employment benefits for the LEA, we have not considered local construction workers.

Where the operational workforce is concerned, for health and safety reasons, Hume Coal will require all workers, including those involved in the mine closure, to live within a 45-minute travel time from the Project. The 45-minute travel catchment (the 'workforce catchment area') includes most of the Wingecarribee LGA, as well as the following localities in adjoining LGAs:

- Douglas Park, Picton, Thirlmere, Tahmoor and Wilton (Wollondilly LGA);
- Carrington Falls (Kiama LGA);
- Kangaroo Valley (Shoalhaven LGA); and
- Goulburn and Marulan (Goulburn Mulwaree LGA).

To estimate the local income benefits we have focused on the operational workforce. The SIA considers two local recruitment scenarios:

- *Scenario 1 (High local recruitment)*: In Year 1 of the project, 70 per cent of experienced workers would be recruited from outside the SA3 Region and the remaining 30 per cent would be locally recruited. At peak of operations, 70 per cent of the workforce would be recruited locally.

- *Scenario 2 (Low local recruitment)*: In Year 1 of the project, 70 per cent of experienced workers would be recruited from outside the SA3 Region and the remaining 30 per cent would be locally recruited. At peak of operations, 50 per cent of the workforce would be recruited locally.

We note that Hume Coal consider Scenario 1 (High local recruitment) to be more realistic, given that:

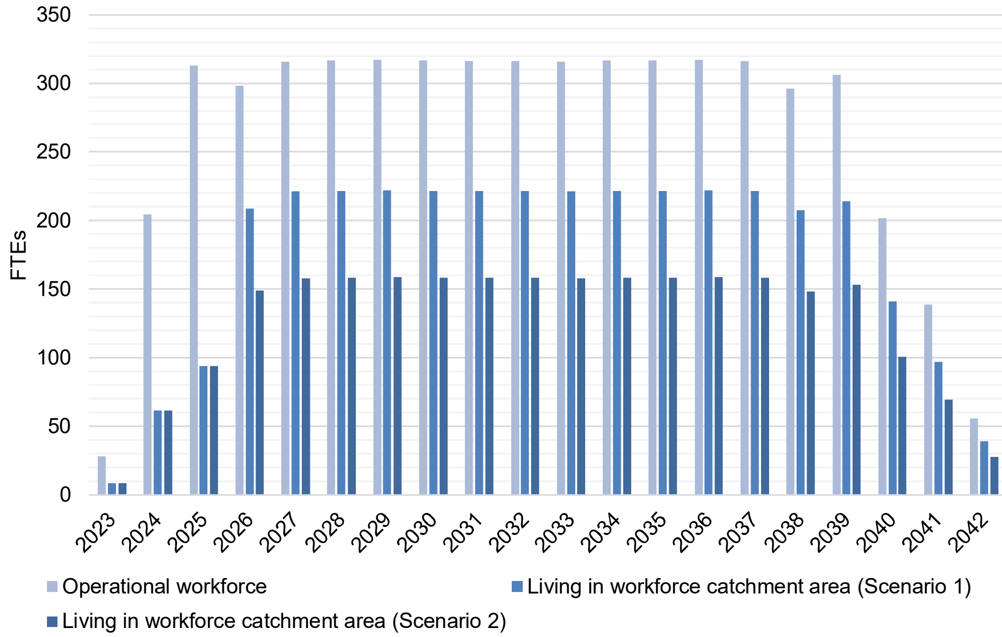
- there is an existing skills base in heavy manufacturing that would be directly transferrable in the Southern Highlands SA3 Region, and that may be attracted to the project workforce; and
- training programs provided by Hume Coal are expected to increase the potential to recruit local workers.

We have applied the base assumptions in the SIA to derive the respective shares of the workforce deemed to live in the workforce catchment area, on the basis that peak production would be reached in FY 2026.[22] Figure 5-1 shows the corresponding local workforce profiles:

- Between FY 2023 and FY 2042, Hume would employ on average 38 FTE consultants and 228 FTE Hume employees, for a combined FTE average of 266 over that time horizon.
- In Scenario 1, on average 175 FTEs would live in the workforce catchment area, consisting of an average of 24 FTE consultants and 151 FTE Hume employees.
- In Scenario 2, on average 128 FTEs would live in the workforce catchment area, consisting of an average of 18 FTE consultants and 110 FTE Hume employees.

[22] Product coal production is assumed to begin in FY 2023 and reach output of around 2.0 Mt in FY 2025 and 2.6 Mt in FY 2026.

Figure 5-1. Operational workforce and workforce in the workforce catchment area



Source: Hume; BAEconomics analysis.

Given that the various localities considered within a 45-minute driving distance of the project do not strictly align with the Southern Highlands SA3 Region, further adjustments need to be made. An assessment of the respective populations suggests that the population in the Southern Highlands SA3 Region accounts for around 53 per cent of the population in the workforce catchment area. We have then approximated the share of the workforce in the workforce catchment area that is 'local' (in the sense that they live in the SA3 Region) on the basis of these relative populations. On that basis, we estimate that:

- in Scenario 1 (High local recruitment), on average 93 FTEs (175 people living in the workforce catchment area x 53 per cent) would be deemed local; and
- in Scenario 2 (Low local recruitment), on average 68 FTEs (128 people living in the workforce catchment area x 53 per cent) would be deemed local.

Table 5-1 summarises these findings, as required in the 2015 Guidelines.

Table 5-1. Hume Coal Mine – Direct labour inputs (FTE averages of the operational workforce, FY 2023 to FY 2042)

	Ordinarily resident in Southern Highlands SA3 Region	Not ordinarily resident in Southern Highlands SA3 Region	Total
Scenario 1 (High local recruitment)	93	173	266
Scenario 2 (Low local recruitment)	68	198	266

Source: Hume, BAEconomics analysis.

5.1.3 Net increase in workers' income

The 2015 Guidelines say that the net increase in workers' income should be calculated as the difference between incomes in the mining industry in the local area, and the mean level of income in the area.

Table 5-2 summarises this calculation for the Hume Coal Mine for the two scenarios, corresponding to Table 4.2 in the 2015 Guidelines. We have interpreted references to 'net income' in the 2015 Guidelines to mean disposable income; that is, gross wages, net of superannuation, Medicare and income tax payments. In Table 5-2, disposable income has been estimated by deducting superannuation, tax and Medicare payments from the estimated mean gross income of the Hume operational workforce and from the mean gross employee income in the Southern Highlands SA3 Region.

Table 5-2. Hume Coal Mine – Net income increase (annual)

	Units	Scenario 1: Ordinarily resident in Southern Highlands SA3 Region	Scenario 2: Ordinarily resident in Southern Highlands SA3 Region
Direct employment during operations phase	FTEs	93	68
Average disposable income in mining industry	$	$94,989	$95,028
Average disposable income in other industries	$	$48,286	$48,286
Average increase in net income per employee	$	$46,703	$46,742
Increase in net income per year due to direct employment	$ millions	$4.3	$3.2
FTE	FTEs	27	20
Increase over the life of the Hume Coal Mine (NPV)	$ millions	$42	$31
Increase over the life of the Hume Coal Mine (Aggregate)	$ millions	$87	$63

Source: BAEconomics analysis.

5.2 Effects related to non-labour project expenditure

The 2015 Guidelines require a proponent to quantify (non-labour) construction and operating expenditures and to attribute that expenditure to the relevant local region. Hume Coal have prepared an analysis of the local operating expenditures that is likely to be sourced locally, that is, from suppliers based in Bowral, Marulan, Moss Vale and Medway. The analysis encompasses the operational expenditures that make up around 87 per cent of operating costs, namely:

- ‘pit-top to ROM’ expenditures, which encompass, among other things, maintenance services, equipment hire, fuel and lubricants, administration and compliance services, and general consumables; and
- ‘CHPP to FOB’ (freight on board) expenditures, which also covers fluids and lubricants, maintenance and equipment hire services, as well as transport services.

Table 5-3 summarises the results of the analysis. Hume estimate that:

- of $576 million expected expenditures for pit-top ROM materials & services, around 25 per cent – or $147 million – could be sourced locally; and
- of $861 million expected expenditures for CHPP to FOB materials & services, around 24 per cent – or $203 million – could be sourced locally.

Table 5-3. Analysis of direct expenditures (excluding labour)

Cost category	Potential NSW supplier location	Within Southern Highlands SA3 Region	Outside Southern Highlands SA3 Region	Total	Percent local expenditures
Pit-top ROM materials & services					
Supports	Narellan, Bennetts Green	$0	$55	$55	0%
Relocations	Narellan, Bennetts Green	$0	$3	$3	0%
Fluids, Lubricants	Unanderra	$0	$12	$12	0%
Maintenance	Moss Vale, Thornton, Maraylya, Wyong, Rathmines	$71	$197	$268	27%
Equipment Hire	Mossvale, Picton, Wyong	$2	$2	$4	50%
Power & Diesel	N/A	$0	$17	$17	0%

Cost category	Potential NSW supplier location	Within Southern Highlands SA3 Region	Outside Southern Highlands SA3 Region	Total	Percent local expenditures
Consumables	Marulan, Bowral, Wollongong	$12	$25	$38	33%
Air, Water & Ventilation	Campbelltown, Singleton, Morisset	$0	$60	$60	0%
Other Outbye Services	Bowral, Moss Vale, Unanderra, Wollongong, Rutherford, Sydney, Marulan, Morisset	$19	$33	$52	37%
Gas Management	Arndell Park	$0	$2	$2	0%
Environment	NSW government	$0	$5	$5	0%
Admin & Compliance	Bowral, Unanderra	$39	$0	$39	100%
Projects	Medway, Newcastle, Bowral	$3	$3	$6	53%
Underground Reject Emplacement	Picton, Singleton, Sydney	$0	$17	$17	0%
Total pit-top ROM materials & services		$147	$429	$576	25%
CHPP to FOB materials & services					
Fluids, Lubricants and Other plant process agents	Botany, Wollongong, Marulan, Bowral, Newcastle, Underra, North Sydney	$3	$37	$40	7%
Maintenance	Bowral, Moss Vale, Sydney, Bathurst	$127	$0	$127	100%
Equipment Hire	Newcastle, Sydney, Unanderra	$0	$12	$12	0%
Other	Botany, Wollongong	$0	$101	$101	0%
Transport	Bowral, Moss Vale, Sydney	$73	$152	$225	32%
Port	Port Kembla	$0	$357	$357	0%
Total CHPP to FOB materials & services		$203	$659	$861	24%

Source: Hume Coal.

5.3 Effects on other local industries

The 2015 Guidelines require a qualitative discussion of the effects of a project on other local industries, including whether a project would displace specific land uses, affect tourism, or whether short run market adjustments, for instance in housing markets, might be expected.

5.3.1 Local housing market

The potential impacts of the project on the local housing market are discussed in the SIA (Appendix R, EIS). Overall, no significant adverse impacts are predicted:

- The construction workforce for the project (including for the BRP) would be housed in a purpose-built construction accommodation village (CAV), and would therefore not add to the demand for local housing.
- Given current availability and the forecast supply of new housing in the region, the operational workforce would also not significantly impact the local housing market. It is probable that there will be adequate capacity to cater for relocated workers and their families, so that mitigation measures would likely not be needed.

5.3.2 Local tourism

In 2018, Wingecarribee LGA recorded around 1.74 million visitors (including overnight and day-trip visitors), or 1.7 per cent of the NSW total (Austrade 2020). According to the ABS 2016 Census, employment in accommodation and food services in the Wingecarribee LGA amounted to 1,858 in 2016, or 9 per cent of total employment.

The Hume project is located mostly in Moss Vale - Berrima SA2 Region (covering around two thirds of the underground mining area), and partially within the adjoining Southern Highlands SA2 Region. Table 5-4 below provides an overview of the number of tourism establishments and rooms, as well as associated accommodation revenues in Wingecarribee LGA, including the Bowral, Mittagong, Moss Vale – Berrima and Southern Highlands SA2 regions.[23] This represents the most recent ABS data available. It is apparent that as of June 2016, there were three tourist accommodation establishments with 15 rooms or more in the Southern Highlands SA2 region (15 per cent of all establishments in Wingecarribee LGA) and four tourist accommodation establishments in the Moss Vale – Berrima (20 per cent of all establishments in Wingecarribee LGA). As of 2015-16, revenues from tourist accommodation in these two regions accounted for 22 per cent of total for the Wingecarribee LGA.

Table 5-4. Tourism establishments, rooms and accommodation revenues

	No. of establishments (June 2016)	Percentage WCB LGA	No. of rooms (June 2016)	Percentage WCB LGA	Revenues from accommodation (2015-16)	Percentage WCB LGA
Bowral SA2 Region	8	40%	293	45%	$8,442,673	52%

[23] As shown in Figure 2-4, Wingecarribee LGA largely aligns with the Southern Highlands SA3 Region.

	No. of establishments (June 2016)	Percentage WCB LGA	No. of rooms (June 2016)	Percentage WCB LGA	Revenues from accommodation (2015-16)	Percentage WCB LGA
Mittagong SA2 Region	5	25%	151	23%	$4,327,817	27%
Moss Vale – Berrima SA2 Region	4	20%	114	18%	$3,108,807	19%
Southern Highlands SA2 Region	3	15%	87	13%	$424,183	3%
Total Wingecarribee	20		645		$16.3 million	
Capital Country total	63		2,118		$51.3 million	
New South Wales	1,424		75,235		$3,499.1 million	

Notes: WCB refers to Wingecarribee LGA.

Source: ABS, 86350DO002_201415 Tourist Accommodation, New South Wales, 2014-15.

Table 5-4 suggests that, at least as of 2016, the Southern Highlands and Moss Vale – Berrima SA2 regions where the project would be located account for a little more than a third of tourism establishments of more than 15 rooms, and a smaller share of revenues from tourism accommodation in the Wingecarribee LGA. These high-level indicators suggest that negative impacts on tourism of the project would be limited.

There are other aspects of the project that would support this conclusion. The additional visual impacts of the project will be very limited. The project is an underground mine, and of the total project area of 5,051 ha, only 2 per cent (117 ha) will be taken up with surface infrastructure. The only material surface disturbance above the underground mine will consist of drilling and ventilation infrastructure and access tracks. In addition, the project will be located close to the towns of Berrima and Moss Vale, and in the vicinity of land zoned and used for general, light and heavy industrial activities. It is therefore not the case that the limited visual impact of the project would arise in a pristine natural environment.

5.3.3 Externalities

The 2015 Guidelines require that the LEA should focus on the externalities considered in this context the CBA, and identify those that create material, unmitigated effects within the local region.

Table 5-5 summarises the external effects that are predicted to occur as a result of the project, the extent to which they are expected to occur locally, and how they would be mitigated. Table 5-5 suggests that all external effects will occur within the local region. With the exception of a small agricultural income and employment impact, these effects will be mitigated:

- where surface and groundwater impacts are concerned, Hume holds the majority of required licenses and will acquire the remaining ones;
- given the nature of an underground mine, visual amenity impacts will be minimal and managed via appropriate local fencing and native plant screens;
- Hume will acquire noise affected properties or mitigate any noise impacts;
- a biodiversity offset will be established to mitigate the loss of native vegetation and hollow-bearing trees;
- while there will be some impacts on Aboriginal sites, no sites of high significance are involved, and existing sites will be preserved as far as possible; and
- no material air quality or traffic impacts are expected.

Table 5-5. Hume Coal Project – Predicted external effects (including external effects attributable to BRP)

	Externality benefit (cost)	Within Southern Highlands SA3 Region	Mitigation	Outside Southern Highlands SA3 Region
1	Surface water	Surface water licenses corresponding to 19 ML required	Hume holds requisite surface water licenses	As for within Southern Highlands SA3 Region
2	Groundwater	Groundwater licenses corresponding to 2074 ML required	Hume will acquire requisite groundwater licenses	As for within Southern Highlands SA3 Region
		93 private bores within zone of greater than 2m AIP minimal impact criteria.	Make-good provisions for private landholders apply.	N/a
3	Visual amenity	Two viewpoints are predicted to experience a moderate visual impact (private residence along Medway Road and the Hume Coal Highway at its intersection with Medway road).	Installation of fencing, visual amenity native tree screens and ongoing maintenance.	N/a
4	Noise	2 properties in the voluntary acquisition zone are predicted to exceed project-specific noise levels.	Purchase of noise affected properties	N/a
		9 properties in the voluntary mitigation zone are predicted to exceed project specific noise levels.	Noise mitigation measures	N/a
5	Ecology	Clearing of 64 paddock trees resulting in an 'effective clearing area' requiring offset of 8.3ha for the mine infrastructure. Clearing of 2ha of native vegetation for the BRP, requiring 0.2ha to be offset. Loss of 17 hollow bearing trees.	Biodiversity offset will be established	N/a

	Externality benefit (cost)	Within Southern Highlands SA3 Region	Mitigation	Outside Southern Highlands SA3 Region
6	Air quality	No properties predicted to exceed dust criteria (acquisition zone)	N/a	N/a
		No properties predicted to exceed dust criteria (management zone)	N/a	N/a
7	Greenhouse gas	Nil	N/a	1.8 Mt CO2-e Scope 1 and 2 emissions over the life of the project
8	Traffic	No or only marginal increases in wait times with no change to levels of service.	N/a	N/a
9	Aboriginal heritage	No sites of high significance will be disturbed. 11 sites will be avoided and fenced. 20 sites will be impacted to some degree by the surface infrastructure area. 2 sites will be subject to unmitigated impacts (subsurface sites of low significance which do not warrant further investigation or salvage). An additional 8 sites will be directly impacted by the Berrima Rail Project: ▪ no sites of high significance; ▪ 2 sites of moderate significance; ▪ 6 sites of low significance.	None	N/a ▪

Source: EMM.

5.3.4 Critical mass analysis of agricultural impacts

The NSW Guidelines for Agricultural Impact Statements (NSW Government 2012) require that if a project reduces the proportion of agricultural enterprises within a locality or region by more than 5 per cent, a 'critical mass threshold' analysis is required. The potential reduction in livestock production as a result of the project would be less than 5 per cent of total cattle production in the Southern Highlands region, and hence falls below the threshold for conducting a critical mass analysis.

5.3.5 Other net benefits attributable to the local region

In addition to the incremental income benefits discussed above, net rate payments accruing to Wingecarribee Shire LGA also represent direct benefit to the local region. As discussed in Section 3.3, it has been assumed that Hume Coal would pay local government rates of around $150,000 per annum in the Project Scenario over the operating life of the mine. These rate payments have been reduced by the rates that

Hume Coal or another land owner would pay in the reference case (i.e., if agricultural production were to continue).

5.4 Flow-on benefits for the local region

Flow-on effects refer to the adjustments in the economy that follow from initial changes in the level of demand for goods, services and labour arising from a significant development (such as the project). The economic framework described in the following has been applied to estimate these flow-on effects for the NSW and the local economy, and is documented in detail in Appendix D.

5.4.1 Choice of input-output analysis

There are a number of methods that can be used for calculating the flow-on effects for resources projects. They all face a singular issue in that the relative importance of a project increases when moving from a national to a state, and then to a regional perspective. At the same time, the degree of difficulty in estimating flow-on effects increases when moving from the national to the state and the regional level. For the most part, this reflects a general lack of information about the specific composition and source of intermediate inputs used by an industry, as well as about trade at a state and regional level. In addition, there may also be local rigidities in employment, capital assets and other fixed resources that are not consistent with the assumptions that underpin methodologies for measuring flow-on effects.

The methodology used here relies on input-output analysis to derive various multipliers. The primary reasons for selecting this methodology are the simplicity and clarity with which the underlying assumptions can be set out and appropriate caveats made. Further, when compared to more complex methods such a general equilibrium (GE) analysis:

- The gross value of the project is small in relation to the Australian and NSW economies. Unlike an input-output analysis, a GE analysis takes into account the price impacts of a project on inputs and outputs. However, given the relatively small size of the project (relative to the NSW economy), material price impacts would not be expected and the difference between the results of a GE and an input-output analysis should also be small.
- Given the lack of information about industry structure and trade at a regional and state level, there is no reason to think that one method would be materially more accurate than another. Both GE and input-output analysis depend critically on accurately modelling flows of production and expenditure.

5.4.2 Adjusting regional/state industry composition and trade

Regional impact analysis depends, in large part, on adjusting the flows of production and expenditure, as represented by national input-output tables, to represent a state or local economy.[24] However, industries at a local or state level have differing compositions of inputs and outputs than is the case for the national average; the same difficulty arises for specific projects within a local region. Hence, a consistent set of ancillary information that is specific to national, state and regional economies is required to apportion national aggregates. The most commonly used information for this purpose (which is also recommended by the ABS) is industry employment.

As of 2011, the ABS has conducted a census of employment by industry and at the LGA level. This employment information can be used to calculate location quotients (LQs) to adjust national industry structure and trade flow data to derive the corresponding state and regional aggregates. Employment based LQs are ratios that indicate the percentage of people employed in a particular industry at a state or regional level, relative to the percentage of people employed in that industry in the national economy. Employment based LQs are then used to proportionally adjust the contribution of an industry to the use of intermediate inputs in a state or region. The consequent shortfall in intermediate inputs is made up by increasing 'imports' from outside the state or region across all industries.

The use of employment LQs has a critical limitation. Input-output tables do not explicitly account for fixed capital, human or physical, although the returns to these assets are implicitly reflected in wages and operating surpluses (profits). As the impact analysis becomes more granular, the geographic location of these assets becomes increasingly important. A local region may simply not have the fixed capital needed to cost-effectively produce the input required by a local industry. The input will be then be 'imported' from other regions, states, or from overseas.

5.4.3 Interpretation of input-output multipliers

A change in demand sets the economy in motion as the productive sectors buy and sell goods and services from one another and households earn additional incomes, which gives rise to further flow-on effects (Coughlin et al. 1991). These relationships cause the total effects on the regional and state economy to exceed the initial change in demand.

Economic flow-on impacts can be measured in terms of income, value added and employment, which in turn gives rise to income, value added and employment

[24] Input-output tables capture the flows of intermediate inputs between producers and form the basis for deriving multipliers. These tables are generally prepared at a national level; national input-output multipliers are essentially derived from a weighted average of enterprises at the national level. Thus the Australian input-output tables reflect a snapshot in time of the entire Australian economy and the inter-relationships between producers, households, governments, and the outside world. However, while the ABS publishes national input-output tables, similar information about the relationships between economic agents within a region and flows into and out of a region ('imports' and 'exports') is not available.

multipliers.[25] In the case of the project:

- the income multiplier refers to the percentage change in total income arising per dollar change in the wages and salaries paid by Hume Coal;
- the employment multiplier corresponds to the change in total employment (in numbers of FTEs) arising per additional person employed by Hume Coal; and
- the value added multiplier refers to the percentage change in total value added arising per dollar change in the value added created by Hume Coal.

Multipliers are classified into 'types'. Type I multipliers refer only to flow-on effects in the production sectors, while Type II multipliers incorporate subsequent impacts on households. Hence Type IA multipliers refer to the 'initial' and 'first-round' effects arising from an increase in demand from the project, where the initial effect refers to the additional output from the project. The first-round effect captures the immediate subsequent impacts on income, employment or value added from all industries whose output is required to produce the additional output from the project. In contrast, Type IB multipliers refer to the initial and 'production induced' effects, which encompass first-round effects and additionally 'industrial support' effects, and Type IIA multipliers incorporate the effects of the initial increase in output from the project on households, and refer to the sum of production induced and consumption induced effects.

5.4.4 Limitations of input-output analysis

The principal advantage of the impact multiplier method is the simplicity with which levels of mining investment, employment and output can be translated into measures of changes in regional income and employment. However, the accounting conventions that form the basis of input-output models and hence how multipliers are derived impose a number of restrictive assumptions. Some of these assumptions pertain to input-output analysis generally while others relate to the use and interpretation of input-output analysis at a regional or state, as opposed to a national level. The key assumptions are set out below.

5.4.4.1 Key assumptions

Fixed capital stocks

The National Accounts, on which input-output analysis is based, do not explicitly

[25] It is also possible to calculate output multipliers, as representing the amount of additional output induced by the need for other industries to produce the output to meet the demand for an extra dollar of output from a project. However, the value of total business activity implied by output multipliers is larger than the market value of the goods and services that are produced, because some of the re-spending is used for the purchase of intermediate goods and services. Because of the implied double-counting, some commentators consider output multipliers to be misleading, and we do not report them here.

account for fixed capital stocks. This is an issue with input-output analysis generally, as fixed capital has a significant impact on how an industry adjusts over time. A corollary to this is that input-output analysis is static in the sense that it takes no account of the time required for the composition of inputs and outputs of production to shift to a changed level in output. Industries that require large amounts of fixed capital and labour adjust slowly, particularly when they are near full employment or when the supply of skilled labour is tight. These dynamics are hard to predict, but the implication over the short- to medium-term is that input-output effects will be overstated to varying degrees across industries.

The fixed nature of the capital stock is a critical issue in local impact assessments. In moving from the national to a state or local level, the location of fixed assets becomes increasingly important in establishing the goods and services that are supplied locally and those which are imported. Moreover, there is no information as to whether fixed assets are owned locally or whether the owners are located outside the region or state. As a consequence, determining the valued added by local industry becomes increasingly problematic.

Supply constraints

Relatedly, when the initial impact considered is an increase in production, the assumption of fixed production patterns requires that there is a sufficient endowment of resources that is either available in (or able to migrate to) a local region to meet the increase in demand for inputs whose supply is fixed. These inputs include resources such as land and water, as well as labour with adequate skills.

Homogenous and fixed production patterns

The input coefficients that measure inter-industry flows between sectors are 'fixed' in input-output models; at any level of output, an industry's relative pattern of purchases from other sectors is unchanged. These assumptions are likely to be inconsistent with production patterns in the local economy, since the local economy may not have on offer the range of inputs required for a given industry. Therefore, the impact of the change in output on the local economy will differ from that implied by a national multiplier.

Fixed prices

Input-output analysis assumes that prices in the economy in question are held constant, so that the additional material and labour inputs are available at existing prices and wage rates. In reality, prices of inputs may change with substantive changes in their demand. To the extent that there is an impact on prices, imputed output effects will be overstated. However, this is only a problem in input-output analysis for projects of a sufficient scale to materially shift the demand for production inputs and the total supply of industry output.

5.4.4.2 *Implications for the LEA*

Many of the above assumptions can lead to an overstatement of the impacts of a project; the resulting regional impact estimates should therefore be interpreted as an upper bound of the likely effects (Bess and Ambargis 2011, Coughlin et al. 1991).

Furthermore, and while, from a theoretical perspective, the total (Type IIA) multiplier is the appropriate choice for calculating flow-on effects (since this measure takes into account the full adjustment of the economy to a change in economic activity), total multipliers are calculated in a manner that compounds any measurement errors and breaches in the assumptions that underpin the analysis. For example, total multipliers are calculated as a progression of first, second and successive round effects, with each embodying any errors in earlier effects. From this perspective, a more conservative approach is to rely only on multipliers that capture only first-round effects (Type IA multipliers).

As noted above, there are additionally specific issues that arise in deriving local value added multipliers. Value added includes profits that are distributed on the basis of ownership of capital assets, which becomes increasingly uncertain as the analysis becomes more granular.[26] The calculation of value added multipliers at a local level is therefore not meaningful.

5.4.5 Flow-on effects of the project for the Southern Highlands SA3 Region

The flow-on effects of the project for the local region consist of the positive flow-on effects generated by the project, but also a small offsetting impact arising from a reduction in agricultural activities.

5.4.5.1 *Agricultural flow-on impacts*

As noted in Section 3.9, we have assumed that all agricultural labour is sourced locally. Applying Type 1A multipliers for Wingecarribee Shire LGA (Appendix D), the local flow-on effects arising from land removed from agricultural production are approximated as:

- around $50,000 for the flow-on arising from foregone agricultural income; and
- 0.2 FTE jobs for the flow-on effects corresponding to foregone agricultural employment.

5.4.5.2 *Combined flow-on benefits on the local region*

Table 5-6 shows the estimated flow-on effects from the project for the Southern Highlands SA3 Region. The employment flow-on effects take into account the small

[26] For instance, there is no way of knowing from generally available public information whether a productive asset (say, a factory) that is located in the Southern Highlands SA3 Region is owned by persons living in that region, or in NSW, or elsewhere. It then becomes very difficult to attribute the value added generated by the factory on a regional and even state basis.

reduction in flow-on impacts that is attributable to the displacement of agriculture by the project. Depending on the share of the Hume workforce that is are locals of the Southern Highlands SA3 Region:

- the flow-on benefits in terms of additional disposable income generated by the project are estimated at between $28 million and $38 million ($2 to 3 million annually) in NPV terms; and
- the employment flow-on effects are estimated at an annual average of between 37 and 51 FTE jobs.

Table 5-6. Initial flow-on effects (Type IA) for the project – Southern Highlands SA3 Region (NPV A$ m 2018)

	Scenario 1 (High local recruitment)		Scenario 2 (Low local recruitment)	
	Total	Annual	Total	Annual
Disposable income ($ millions)	$38	$3	$28	$2
Employment (Annual average FTE jobs)	51	N/a	37	N/a

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

5.5 Net benefits of the project for the local region

Table 5-7 summarises the net effects of the project for the local region, as derived in the previous sections of the LEA.

Employment-related benefits refer to the additional employment and the additional disposable income that the project would bring to the local region:

- The project would have an average operational workforce of 266 FTE. Between 128 and 175 FTEs of the operational workforce are expected to live in the 'workforce catchment area'; of these, between 68 and 93 FTEs are expected to live in the Southern Highlands SA3 Region. If broader employment flow-on effects are taken into account, the total employment effects are estimated at between 105 and 144 FTEs.
- The disposable income accruing to the operational workforce is estimated at $234 million in NPV terms. The disposable income accruing to the 128 to 175 FTEs of the operational workforce expected to live in the 'workforce catchment area' is estimated at $58 to $79 million in NPV terms. The disposable income accruing to the 68 to 93 FTEs expected to live in the Southern Highlands SA3 Region is estimated at $31 to $42 million in NPV terms. If broader disposable income flow-on effects applicable to the Southern Highlands SA3 Region workforce are taken into account, the total local income effects are estimated at $59 to $80 million in NPV terms.

As described in Section 5.2, total operating expenditures for the project are estimated to amount to $747 million in NPV terms. Of these expenditures, up to $349 million in NPV terms could be sourced from suppliers in the Southern Highlands SA3 Region. Local government rates are expected to amount to $160,000 per annum, or $2 million in NPV terms over the life of the project. The potential loss of agricultural income has been estimated at around $124,000 in NPV terms.

Table 5-7. LEA Summary ($2018)

	(A)	(B) Project direct: Total	(C) Project direct: Local	(D) Net effect: Local	(E) Total Local Effects: Low	(F) Total Local Effects: High
(1)	Employment related:					
(2)	FTEs	266	128-175	68 - 93	105	144
(3)	Disposable income (NPV, AU$ m)	$272	$58 - $79	$31 - $42	$59	$80
(4)	Other, non-labour expenditure (NPV, AU$ m)	$747	$349	$349	$0	$349
(5)	Local government rates (NPV, AU$ m)	$2	$2	$2	$2	$2
(6)	Externality benefit/cost – Loss of agricultural income (NPV, AU$ m)	(-) $0.1	(-) $0.1	(-) $0.1	(-) $0.1	(-) $0.1

Source: BAEconomics analysis.

Economic Impact Assessment of the Hume Coal project - Appendices

Prepared for Hume Coal Pty Ltd

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Abbreviations

2015 Guidelines	Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2015)
2017 EIA	BAEconomics, Economic Impact Assessment of the Hume Coal project (20 February 2017)
2018 Updated EIA	BAEconomics, Updated Economic Impact Assessment of the Hume Coal project (7 November 2018)
2018 Technical Notes	Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2018)
ABS	Australian Bureau of Statistics
AIP	Aquifer Interference Policy
ASNA	Australian System of National Accounts
BISO	BIS Oxford Economics
BRP	Berrima Rail Project
CAV	Construction accommodation village
CBA	Cost benefit analysis
CEGEM	Cadence Economics General Equilibrium Model
CPP	Coal preparation plant
DIIS	Department of Industry, Innovation and Science
DSE	Dry sheep equivalent
EEC	Endangered ecological communities
EIS	Environmental impact statement
EVAO	Estimated value of agricultural operations
FTE	Full-time equivalent
GDE	Groundwater dependent ecosystem
GDP	Gross domestic product
GE	General equilibrium
GHG	Greenhouse gas
GL	Gigalitre
GRI	Gross regional income
GRP	Gross regional product
GSI	Gross state income
GSP	Gross state product
GVA	Gross value of agricultural production
ha	Hectare
HCC	Hard coking coal
IEA	International Energy Agency
LEA	Local effects analysis

LGA	Local government area
LQ	Location quotient
MIA	Mine Infrastructure Area
Mt	Million tonnes
Mtpa	Million tonnes per annum
NSW Treasury Guide	NSW Government Guide to Cost-Benefit Analysis (2017)
PCI	Pulverised coal injection
ROM	Run of mine
SEARs	Secretary's Environmental Assessment Requirements
SIA	Social Impact Assessment

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Appendix A General assumptions CBA and LEA

This appendix describes the key assumptions underpinning the CBA and LEA analysis. Additional detail is provided in the 'Basis of Estimate' report prepared by palaris on behalf of Hume Coal (February 2020).

A.1 General assumptions

A.1.1 Discount rate

Consistent with the 2015 Guidelines, a central discount rate of 7 per cent was applied.

A.1.2 Prices

All prices are expressed in constant 2018 Australian dollars.

A.1.3 Coal price and exchange rate forecasts

Production at the Hume Coal Mine is expected to begin in financial year (FY) 2023. Forecasts for coking and thermal coal prices, and for the US$ AU$ exchange rate are based on the most recent – March 2019 – forecasts prepared by the Office of the Chief Economist of the Department of Industry, Innovation and Science (DIIS). The March 2019 forecasts contain a medium-term outlook that extends to 2023-24 for the US$ AU$ exchange rate, and to December 2024 for premium hard coking coal prices.

The coal price and exchange rate forecasts are shown in Table A-1. Thermal coal and hard coking coal prices were derived by:

- applying a 21.1 per cent discount to the benchmark price for thermal coal and a 15 per cent discount to the benchmark price for hard coking coal;
- averaging across two calendar years to convert the forecasts to FYs; and
- assuming that forecasts remain unchanged from FY 2025 onwards.

Table A-1. Coal and exchange rate forecasts

Estimate	Units	FY 2023	FY 2024	FY 2025 to FY 2042
Coking coal (quality adjusted)	US$/tonne	$128.2	$132.0	$134.5
Thermal coal (quality adjusted)	US$/tonne	$60.3	$62.5	$64.8
Exchange rate	US$/AU$	$0.78	$0.81	$0.81

Source: Australian Government, 2019. Resources and Energy Quarterly, March 2019.

A.2 Mean employee income

Mean employee income estimates for New South Wales and the Southern Highlands SA3 Region were sourced from ABS 2016 Census data (Table A-2). Mean income from

FY 2023 onwards was derived as follows:

- The 2017 ABS mean income figures were converted to 2018 Australian dollars using the NSW wage price index.
- The AU$ 2018 (2017) ABS mean income figures were converted to mean income figures for 2018 and future years by assuming annual real wage growth of 1 per cent. According to the Australian Treasury (Andrews et al. 2019), real wage growth has been close to or below zero in recent years. From the perspective of calculating employment benefits, this assumption is therefore conservative.

Table A-2. Mean employee income assumptions

Jurisdiction	Mean employment income estimates			
	2017, AU$ 2017	2017, AU$ 2018	2018, AU$ 2018	All years thereafter
New South Wales	$58,645	$59,877	$60,475	Annual real increase of 1 per cent
Southern Highlands SA3 Region	$62,373	$63,683	$64,320	

Sources: Mean employee income: https://itt.abs.gov.au/itt/r.jsp?RegionSummary&region=11402&dataset=ABS_REGIONAL_ASGS2016&geoconcept=ASGS_2016&measure=MEASURE&datasetASGS=ABS_REGIONAL_ASGS2016&datasetLGA=ABS_REGIONAL_LGA2018&regionLGA=LGA_2018&regionASGS=ASGS_2016; https://itt.abs.gov.au/itt/r.jsp?RegionSummary&region=1&dataset=ABS_REGIONAL_ASGS2016&geoconcept=ASGS_2016&measure=MEASURE&datasetASGS=ABS_REGIONAL_ASGS2016&datasetLGA=ABS_REGIONAL_LGA2018&regionLGA=LGA_2018&regionASGS=ASGS_2016; accessed 20 January 2020.

Wage price index: 6345.0 - Wage Price Index, Australia, Sep 2019; Table 2a. Total Hourly Rates of Pay Excluding Bonuses: All Sectors by State.

A.3 Carbon prices

The 2018 Technical Notes say that, given that there is no identified carbon price in Australia, proponents should refer to the NSW Government Guide to Cost-Benefit Analysis (2017), which recommends that market prices should be used as a basis for valuing the costs of carbon emissions. The 2018 Technical Notes further state that an appropriate reference price for the cost of carbon is the forecast price of emission allowances (EUAs) with the European Union Emissions Trading System (EU ETS) based on futures derivatives published by the European Energy Exchange.

Table A-3 summarises EUA futures prices as of 26 January 2020, beginning in December 2020 (assumed to correspond to FY 2020-21) and extending through to December 2028 (FY 2028-29). EUA futures prices were converted into Australian dollars using an exchange rate of 1.6. Given that no futures prices are available for dates beyond December 2028, we have assumed that EUA prices will continue to increase in real terms at their historic rate of 1.3 per cent per annum through to FY 2043.

Table A-3. EUA futures prices (26 January 2020)

Delivery dateSettlement date	Settlement Price (€)	Settlement Price (AU$)
Dec-20	€ 24.39	$39.02
Dec-21	€ 24.57	$39.31
Dec-22	€ 24.88	$39.81
Dec-23	€ 25.23	$40.37
Dec-24	€ 25.59	$40.94
Dec-25	€ 25.95	$41.52
Dec-26	€ 26.31	$42.10
Dec-27	€ 26.67	$42.67
Dec-28	€ 27.03	$43.25

Source: EEX, EUA Futures Products, EU Allowances (EUA) permitting the emission of one tonne of carbon dioxide equivalent; https://www.eex.com/en/market-data/environmental-markets/derivatives-market/european-emission-allowances-futures#; 20 January 2020.

A.4 Share of local workforce

Table A-4 shows the population for the likely catchment area for the Hume workforce.

Table A-4. Population in the Hume workforce catchment area (2016 Census)

Locality	Local government area	Population	Percentage total workforce catchment area (Per cent)
Southern Highlands SA3 Region catchment:			
	Wingecarribee LGA	47,882	53
Remaining workforce catchment area:			
Douglas Park	Wollondilly LGA	1,362	
Picton		4,816	
Thirlmere		4,046	
Tahmoor		5,067	
Wilton		3,080	
Kangaroo Valley	Shoalhaven LGA	879	
Carrington Falls	Kiama LGA	20	
Goulburn	Goulburn Mulwaree LGA	22,419	
Marulan		1,178	
Total		42,867	47
Total catchment area		90,749	100

Notes: Data for localities refers to state significant suburbs (SSCs).
Source: ABS 2016 Census.

Appendix B Review of the coking coal market

B.1 Coking coal and metallurgical coal

Coking coal is a high energy content coal that includes hard coking coal, as well as soft or semi-soft coking coals. Coking coal is frequently referred to as metallurgical coal, which includes coking coal and pulverised coal injection (PCI) coal. Given that the analysis of key institutions such as DIIS and the Reserve Bank of Australia (RBA) focus on the market for metallurgical coal and do not consider coking coal separately, the analysis presented in the following also incorporates metallurgical coal.

Metallurgical coal is overwhelmingly used as an input for the production of coke in coke ovens. Coke is in turn used to produce blast furnace iron (BFI or pig iron) in a blast furnace, the first step in the steelmaking process in integrated steel mills. In contrast, steel production from electric arc furnaces uses scrap steel as a feedstock and does not require metallurgical coal.[1] The International Energy Agency (IEA) therefore defines coking coal as coal (EIA 2019, p.29) ".. *with a quality that allows the production of a coke suitable to support a blast furnace charge*".

B.1.1 Demand for metallurgical coal

The fact that metallurgical coal is used as an input in industrial processes has important consequences for the nature of demand for this raw material, and for forecasting metallurgical coal prices. The demand for metallurgical coal is derived from the demand for steel. The demand for steel, in turn, depends on many factors. Steel is widely used in the construction of roads, railways, other infrastructure and buildings, as well as for the production of vehicles and appliances. The demand for steel then depends factors such as government and private sector infrastructure investment and construction, as well as consumer demand for vehicles and appliances. The demand for goods such as vehicles and appliances tends to be cyclical and varies with economic growth, but other end uses, for instance, for infrastructure also depend on a country's stage of development.

As a general matter, the elasticity of demand for coking coal – that is, the extent to

[1] Although there are variations, steel is generally produced via two main routes: the blast furnace-basic oxygen furnace (BF-BOF) route and the electric arc furnace (EAF) route (https://www.worldsteel.org/about-steel.html, accessed 22 Jan 2020). These processes differ in the type of raw materials they consume. The BF-BOF route predominantly uses iron ore, coal, and recycled steel, while the EAF route produces steel using mainly recycled steel and electricity. Globally, about 75 per cent of steel is produced using the BF-BOF route, and around 25 per cent via the EAF route.

which demand responds to changes in prices – is expected to be low. This reflects the essential role that coking coal plays today as an input in the steelmaking production process (Graham, Thorpe and Hogan 1988). Given that the demand for coking coal is a 'derived' demand, the 'Hicks-Marshall rules of derived demand' provide some general guidance about the elasticity of the derived demand for inputs (Berndt and Wood 1975). The derived demand for inputs such as coking coal depends, among other things, on the substitution possibilities among inputs allowed by the production technology, the share of costs represented by the particular input, and the demand for the final output (steel). The fewer the substitution possibilities, the less important the share of coking coal costs in steel making and the less elastic the demand for steel, the more inelastic the derived demand for coking coal is likely to be.

In the short run, when the capital stock using an existing technology is fixed, there are very limited substitutes for coking coal in common steel making processes. BFI (integrated) steel mills rely on coking coal as an essential input for steel production; coking coal is used in direct proportions to output according to fixed metallurgical relationships.[2] As such, this input is generally used very efficiently, making cost reductions through input substitution difficult (Crompton and Lesourd 2008). Inelastic demand from limited substitution possibilities implies that at any given point in time, steel producers – i.e. consumers of metallurgical coal – will require a fixed quantity of metallurgical coal to manufacture the quantity of steel they intend to produce.

At the same time, the supply of metallurgical coal is relatively unresponsive and depends on the capacity of existing mines. Bringing new mines onstream to produce greater quantities of metallurgical coal requires costly investments made over a long planning horizon. Supply may also be curtailed as a result of infrastructure bottlenecks or natural disasters, as has occurred a number of times in Australia in the past. The combination of a relatively inelastic demand and supply that responds only slowly (and may be prone to disruptions) implies that metallurgical coal prices can be very volatile and therefore difficult to forecast, and this has been the experience over the last 20 years, as discussed below.

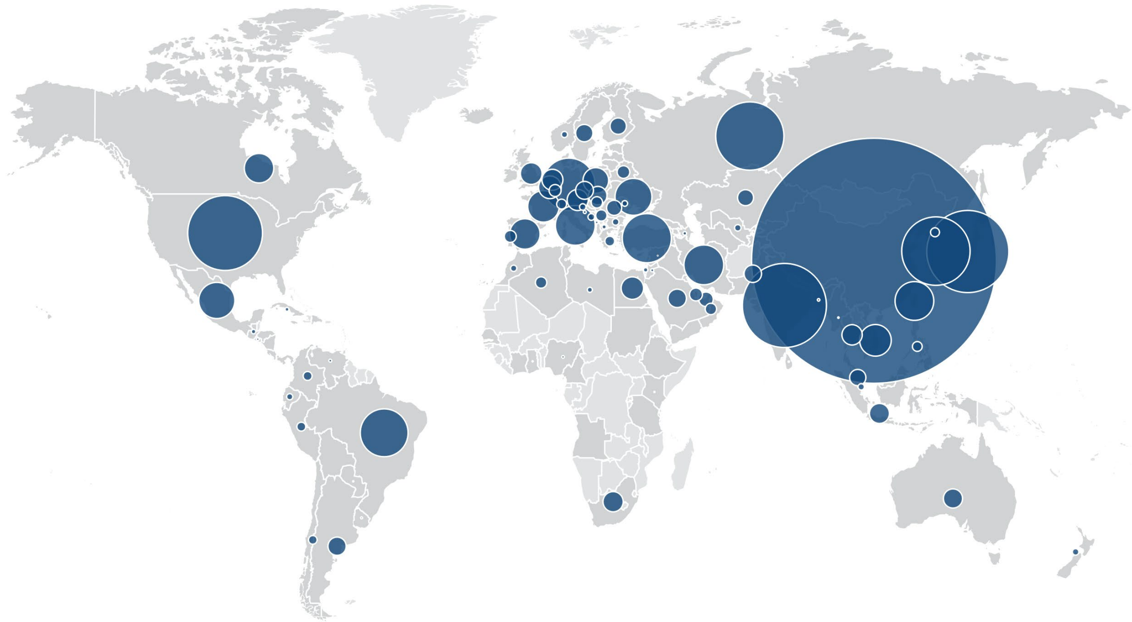
B.1.2 World steel production

Figure B-1 provides an overview of world steel production. China is by far the largest steel producer, and produced more than half of the world's steel in 2018. More than 90 per cent of crude steel made in China is produced in integrated steel mills that require metallurgical coal as a feedstock; globally, more than 75 per cent of crude steel output

[2] If there are insufficient supplies of coking coal, a furnace has to be shut down for subsequent restarting – a very expensive process.

came from integrated blast furnaces in 2018 (World Steel Association 2019).

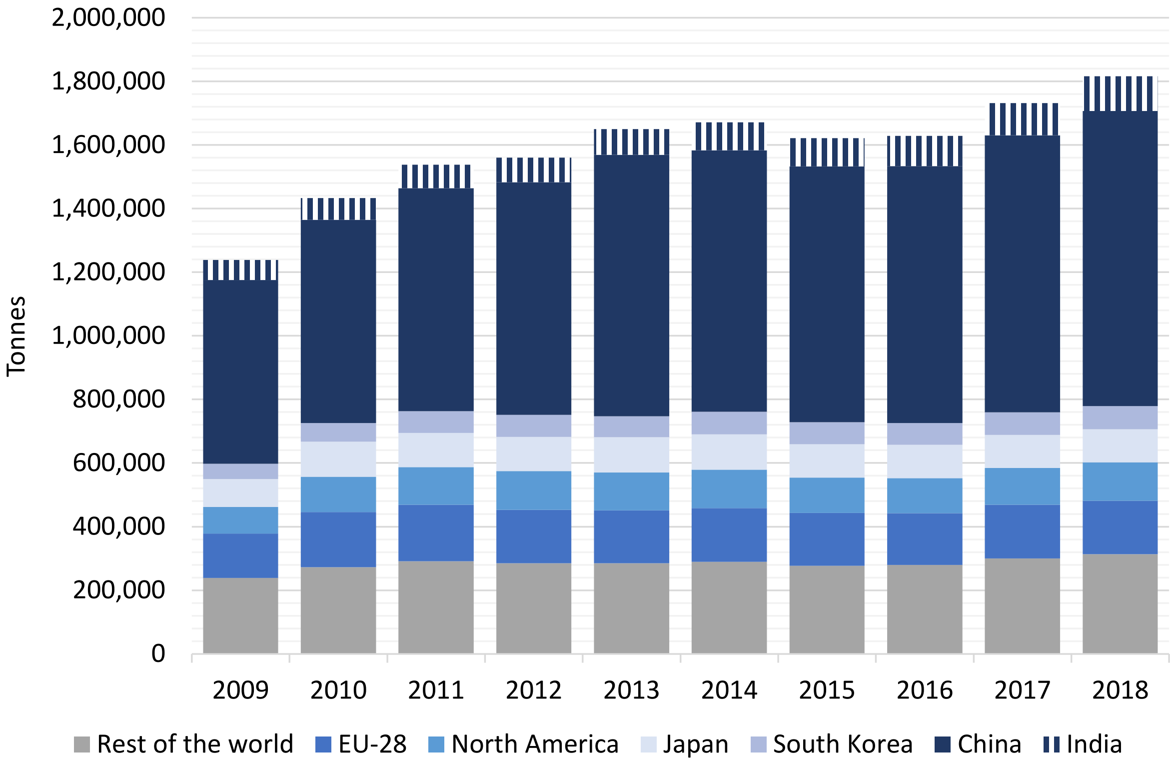
Figure B-1. Crude steel production2018 (thousand tonnes)



Source: World Steel Association, 2020.

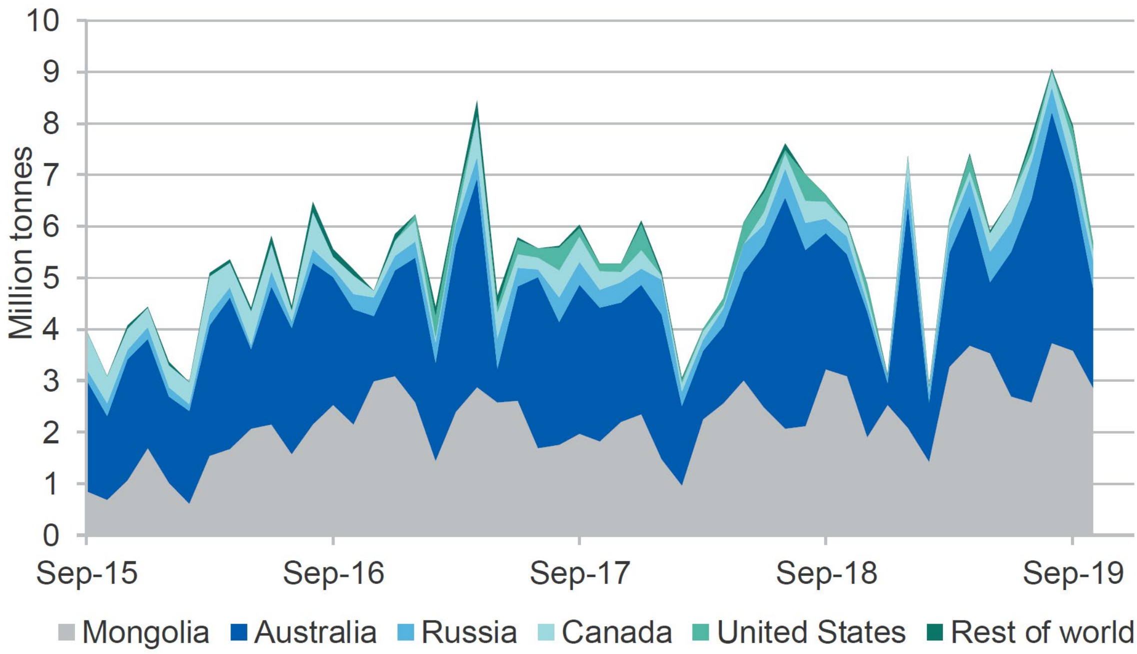
Figure B-2 shows trends in world steel production over the last 10 years. Beginning in the early 2000s, China's demand for steel increased as rapid industrialisation and urbanisation drove high lenvels of investment in infrastructure and construction, and as manufacturing exports grew (RBA). Indian demand for metallurgical coal has also increased strongly over the same timeframe. In contrast, steel production from other major producers has declined over the last few years (the European Union, Japan) or remained more or less flat. These shifting trends in steel output have implications for the seaborne trade in metallurgical coal, and the evolution of prices.

Figure B-2. Trends in steel production (tonnes)



Source: World Steel Association.

Figure B-3. China's metallurgical coal imports



Source: DIIS, 2019. Metallurgical Coal, Resources and Energy Quarterly, December.

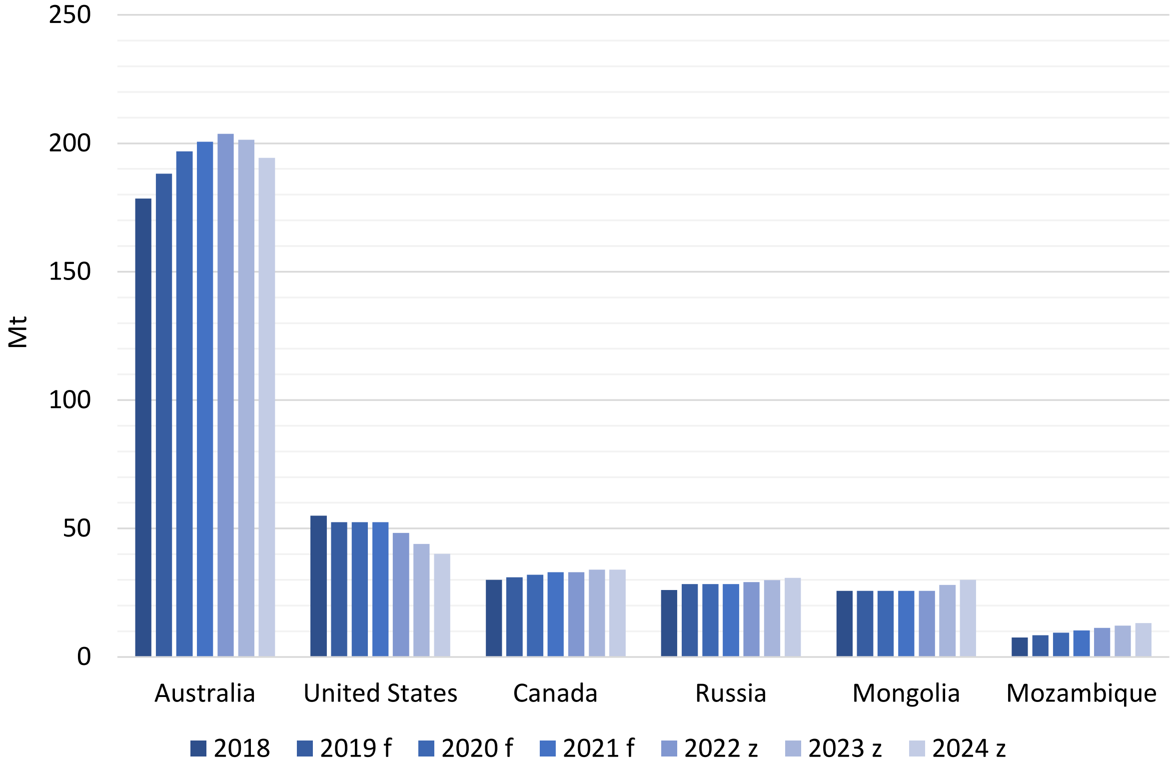
B.2 Global seaborne metallurgical coal trade

B.2.1 Exports

Australia is one of the world's largest producers and exporters of coal, and coal has been Australia's largest export for most of the past decade (Cunningham et al. 2019). In 2018-19, the value of Australian coal exports was almost $70 billion, $44 billion of which was metallurgical coal.

Figure B-4 shows recent and projected metallurgical coal exports by the most significant exporting countries. Australia is by far the largest exporter of metallurgical coal, followed by the United States, Russia and Mongolia. Supply shortfalls out of Australia — or increase in global demand beyond Australia's capacity — have historically been serviced by U.S. coal producers, considered to be 'swing' suppliers to the international metallurgical coal market (Australian Government 2019). U.S. metallurgical coal exports compete with Australian metallurgical coals that are generally produced at lower cost, but are geographically disadvantaged to supply Western Europe. Conversely, Australian production has a much shorter logistical route to East Asian customers.

Figure B-4. Major metallurgical coal exporting countries

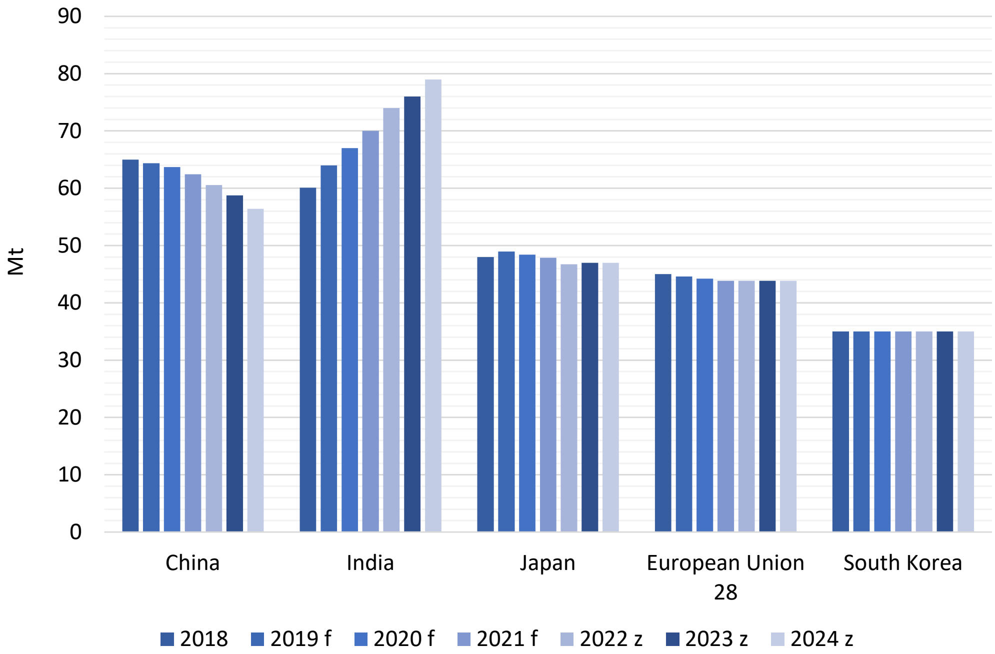


Notes: f Forecast z Projection
Source: Australian Government, 2019.

B.2.2 Imports

Figure B-5 shows recent and projected imports for the largest importing countries. Although China historically produces roughly half of the global metallurgical coal production, China is also the largest metallurgical coal consumer, consuming nearly all of its own metallurgical coal production. India has a rapidly growing steel industry, but very limited domestic reserves of metallurgical coal, and demand has to be met by imports.

Figure B-5. Major metallurgical coal importing countries

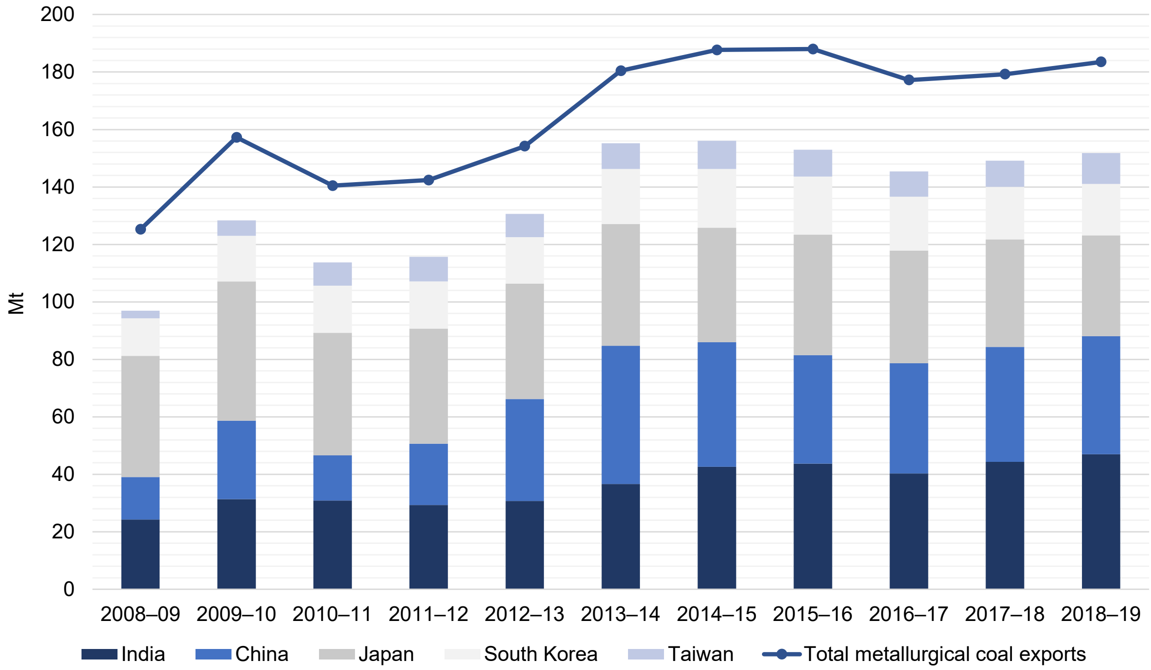


Notes: f Forecast z Projection
Source: Australian Government, 2019.

B.2.3 Australian metallurgical coal export destinations

Australia's major export markets for metallurgical coal are India, China and Japan, which collectively account around two-thirds of exports (Figure B-6) rba). Metallurgical coal exports to China and India have increased strongly over the past decade, in line with their expanding steel sectors, while the relative importance of Japan and South Korea as export destinations has declined.

Figure B-6. Australian metallurgical coal exports

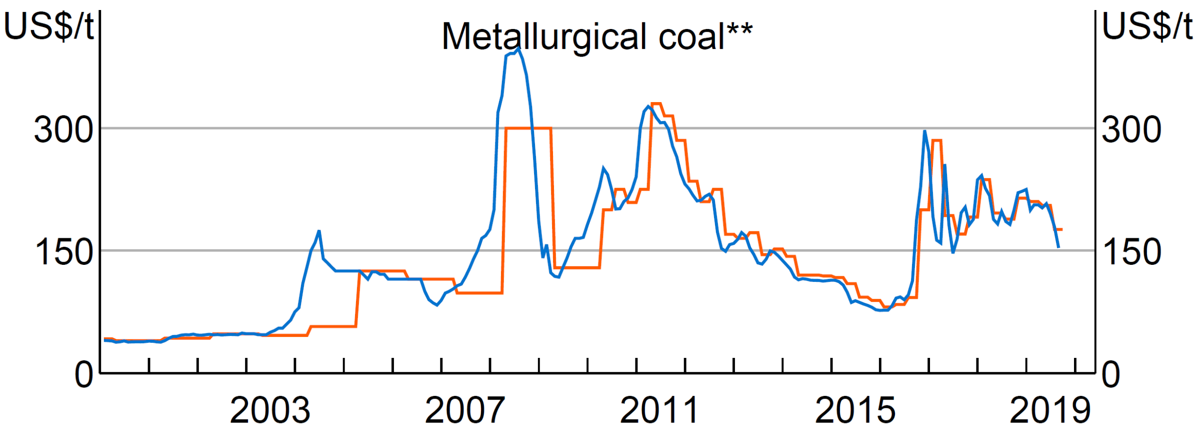


Source: Australian Government, 2019.

B.3 Trends in metallurgical coal prices

Changing demand and supply conditions for metallurgical coal have resulted in large swings in prices over the past 20 or so years (Figure B-7). Metallurgical coal prices increased strongly over most of the 2000s as increasing global demand outpaced the additional supply coming online. By 2012 production capacity had increased globally and more coal was available from Australia, Indonesia and Russia. Prices subsequently declined, and reached a trough in early 2016.

Figure B-7. Metallurgical coal - Spot- and contract prices (free on board)



Notes: ** Prices refer to premium hard coking coal. The blue line refers to spot prices (monthly average). The orange line refers to contract prices.

Source : Cunningham et al. 2019.

The increase in metallurgical coal prices since 2016 reflects the interplay of many different factors that also illustrate the difficulties in forecasting globally traded commodity prices:

- Increasing steel production in China and India. Since around 2016, macroeconomic policy settings in China have encouraged property construction and infrastructure investment, which in turn boosted the demand for steel. Indian steel production also grew rapidly over the same timeframe.
- Chinese Government policies vis a vis the coal and steel sectors. In early 2016, the Chinese Government instituted various measures aimed at rationalising the domestic metallurgical coal sector by closing older and inefficient domestic capacity, as well as addressing safety and environmental concerns. As a result, Chinese metallurgical coal output fell by as much as 10 per cent (BHP). At the same time, Chinese demand for metallurgical coal for steel production rose, so that prices increased significantly. Some of these policies were reversed in late 2016, causing prices to decline again. One of the effects of the decision to reform China's steel industry to close smaller, inefficient steel mills has been to increase the price premia for high-quality metallurgical coal.
- Limited supply growth in the seaborne metallurgical coal market. Lower prices between 2011 and 2015 resulted in producers scaling back production and closing higher cost mines. When demand for metallurgical coal rebounded in 2016, there was insufficient supply capacity and prices rose.
- Supply disruptions. Given that Australia is the largest supplier in the metallurgical coal seaborne market, the reduction in exports as a result of Cyclone Debbie in April 2017 had a significant impact on global supply. Spot prices briefly spiked to near US$ $300 per tonne.

From early 2017 through the middle of 2019, the weakening of the U.S. dollar, stronger global economic growth and unexpected strong steel production in China combined to cause seaborne metallurgical coal prices to stay high, with prices in the range of US$ 200 per tonne. In the second half of 2019, metallurgical coal prices fell sharply, largely due to the negative impact of the Chinese Government to impose import restrictions,[3] likely reflecting broader global trade tensions.

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[3] In mid-July, Chinese officials began restricting customs clearance declarations to only local end-users; effectively barring overseas trading entities from unloading their imported coal cargoes at multiple ports. Prolonged customs clearance and cargo discharge delays at many other ports, particularly those in the south, dampened demand by Chinese buyers for seaborne metallurgical coal. https://www.steel-360.com/stories/coal/lacklustre-demand-dampen-global-coking-coal-prices

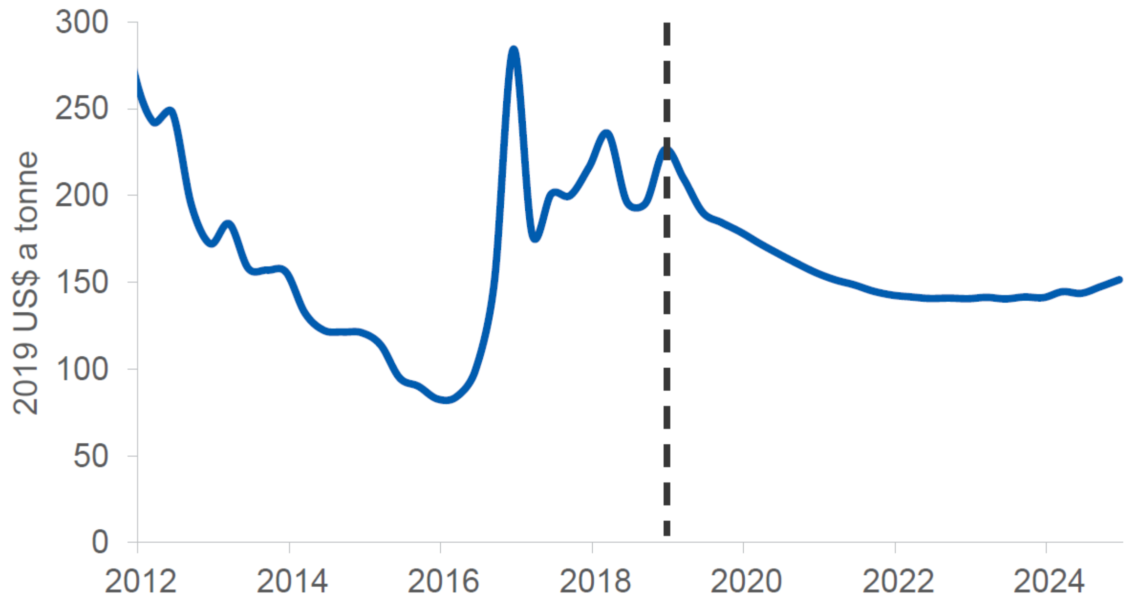
While the March 2019 edition of DIIS' commodity projections expected supply to remain relatively tight in 2019 and forecast an average price of US$190 a tonne, the December 2019 edition adopted a somewhat less optimistic perspective. DIIS noted that metallurgical coal prices had declined more than previously anticipated, given muted demand growth, weaker Chinese steel output, Chinese Government policies, but also weaker than expected Indian steel production.

B.4 Future price projections

B.4.1 DIIS

In its most recent (March 2019) forecast, DIIS notes that the outlook for Chinese metallurgical coal imports is uncertain, with questions around the extent of any economic slowdown, stimulatory macroeconomic policies and environmental and restrictions on imports. The demand by other major importers for metallurgical coal such as the European Union-28, Japan, South Korea and Taiwan is expected to remain flat or decline. The only source of import growth is expected to come from India, given strong growth in the construction and manufacturing sectors and substantial government investment in infrastructure. At the same time, other exporters such as Canada, Russia and Mozambique are increasing their production capacity. Over the medium term to 2024, DIIS therefore projects a steady decline in metallurgical coal prices to around US$150 and then a modest increase to US$ 159 a tonne, reflecting growing supply and moderating Chinese demand (Figure B-8).

Figure B-8. Projected Australian premium HCC spot price, quarterly



Source: Australian Government 2019.

B.4.2 Reserve Bank of Australia

The predictions by the Reserve Bank of Australia (RBA, Cunningham et al. 2019) broadly echo those of DIIS. The RBA expects demand for metallurgical coal from China to slow as population growth slows and there is less demand for residential housing and infrastructure, and as steel production processes move to use more scrap. The Chinese Government has a target of increasing the share of scrap steel sed in steel production to 20 per cent by 2025, although the RBA notes that there is considerable uncertainty around how fast and how much Chinese steel production might shift towards the required electric arc furnace technology.

The RBA also notes that Indian steel production has been growing strongly, and that this is expected to continue over the next decade. The Indian Government has set a target of tripling steel output capacity to around 300 million tonnes by 2030 (using blast furnace capacity), and expanding the Indian manufacturing sector. Given that India has few domestic metallurgical coal reserves, rising demand will need to be met from imports. Growing steel production capacity in Vietnam, Malaysia and Indonesia is also expected to support demand for seaborne metallurgical coal.

Appendix C Benefits to workers

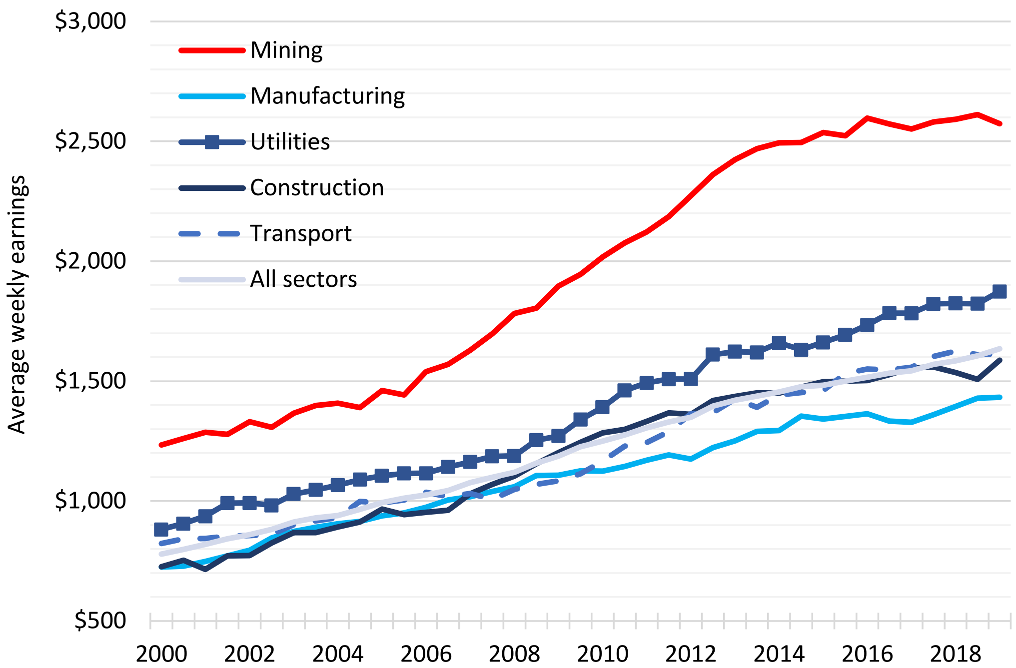
C.1 Wage premia

C.1.1 Comparison of wages across industry sectors

A share of project jobs will be filled by workers moving from other, non-mining sectors of the economy to the mining sector. The construction, transport, utilities and manufacturing secors, in particular, employ workers in many of the same occupations as the mining sector. Table C-1 below shows the percentage of employees in the top 10 occupations in the mining sector, on the one hand, and the construction, transport, utilities and manufacturing sectors, on the other. The table shows that there is a significant degree of overlap in terms of the occupations and skills required.

At the same time, as shown in Figure C-1, average remuneration in the mining sector is significantly higher than in many other sectors of the economy, including in the utilities, construction, transport and manufacturing sectors. It can therefore be expected that workers moving to the Hume Coal Mine from another industry would earn more than they did in their previous industry of employment. From the perspective of preparing the CBA/LEA for the Hume Coal Mine, the question is then whether such a 'wage premium' should be considered a benefit that accrues to workers at the Hume Coal Mine and subsequently contributes to the net benefits flowing to the Sate of NSW.

Figure C-1. Average weekly earnings by industry sector



Source: ABS, 6302.0 Average Weekly Earnings, Australia; May 2019.

C.1.2 2015 Guidelines

The position set out in the 2015 Guidelines is essentially that any wage differential between what a worker newly employed in a mining project would earn, and what they earned in their previous employment does not constitute a benefit to the worker.

Wage premia

The 2015 Guidelines say that the economic benefit to workers is the difference between the wage paid in the mining project and the minimum ('reservation') wage that workers would accept for working elsewhere in the mining sector (p.13 ff.), as illustrated in Figure C-2). Further, the 2015 Guidelines state that it should be assumed that workers drawn to a mining project from another industry do not receive a wage premium even if they earn more working in the mining sector. This is because:

- A new mine that pays local workers more than they would earn in another industry is simply compensating for 'more physically demanding work' and 'tougher conditions'.
- A new mine that hires workers from other parts of NSW and pays them more than they would earn otherwise is simply compensating the workers for the cost of relocating.

Figure C-2. 2015 Guideline - Economic benefit to workers

Source: 2015 Guidelines.

In effect, the 2015 Guidelines attribute any differences in wages between the mining sector and other sectors of the economy as simply an offset to compensate for the disutility or personal cost experienced by workers in mining sector jobs (relative to jobs in other industries). According to this reasoning, there would be no benefit to the local or NSW workforce from a new employer such as Hume Coal offering better wages, since higher pay in the mining sector is simply a reflection of poorer working conditions, so that workers are no better off overall.

2015 Guidelines and NSW Government Guide to Cost-Benefit Analysis

We note that by discounting any wage increases arising from a new project as a source of benefits for workers, the 2015 Guidelines appear to contradict the '*NSW Government Guide to Cost-Benefit Analysis*' (2017). The NSW Government Guide states (p.13):

> *Labour surplus is the difference between a worker's actual wages and what they are willing to accept (their reservation wage). If an initiative increased hourly wage rates, the incremental increase would be a benefit.*

The NSW Government Guide further states (p.32):

> *In the case of labour, the opportunity cost is generally the value of the worker's forgone output. That is, in a competitive market the opportunity cost is their highest wage in an alternative job.*

C.1.3 Wages and productivity

More broadly, the reasoning that underpins the treatment of wage differentials in the 2015 Guidelines does not accord with standard economic thinking as to how wages are determined and how differences in wages between industries come about.

Labour markets are complex, and many supply and demand factors play a role in determining how wages evolve in different industries in the short run.[4] However, over a longer timeframe, the fundamental determinant of wages is labour productivity. Put simply, labour productivity is the amount of output produced by a worker over a unit of time, say an hour.[5] If workers become more productive relative to their cost to the firm (for example, by producing more coal per hour), firms find it profitable to hire more workers. This increased demand for labour places upward pressure on wages

[4] For instance, wages are 'sticky' and adjust only slowly to changes in economic conditions. Also, there are a number of circumstances when workers' pay may be higher than the minimum that economic theory would predict, for instance because firms want to minimise staff turnover by paying their employees a higher wage, or in unionised industries.

[5] The link between wages and productivity is the reason why the Productivity Commission publishes regular updates on trends in productivity in the Australian economy. In its June 2019 'Productivity Bulletin', for instance, the PC notes that (p.27) in Australia, the association between real product wages and labour productivity has been more stable from the 1990s to 2017-18 than it was from the mid-1970s to the early 1980s.

(and vice versa).

Labour productivity does not evolve in a vacuum, but depends on the amount or quality of capital and other factors of production that are available to workers. For instance, workers mining coal will be far more productive if they can access heavy, specialised equipment as opposed to using a pick and shovel. Hence growth in labour productivity (or the increase in output per hour worked) depends on (Productivity Commission 2019, Treasury 2017):

- The capital-labour ratio: the quantity of capital inputs used per unit of labour input, also referred to as the contribution from 'capital deepening'. Increased capital deepening means that, on average, each unit of labour has more capital to work with to produce output, and so is an indicator of a firm's ability to augment labour.
- The contribution from 'multifactor productivity' (MFP) growth: the efficiency with which labour and capital are combined in the production process. MFP growth may reflect many factors, including innovation and technological improvements, efficiency improvements arising from economies of scale and scope, improvements in management practices, and others.

Australian Treasury research

Recent research from the Australian Treasury (2017) confirms the importance of the central economic relationship between wages and productivity. The analysis of wage growth prepared by the Australian Treasury considered, among other things, the key drivers of wage growth, and the relationship between wage growth and the characteristics of employing businesses using firm-level tax data from the Business Longitudinal Analysis Data Environment (BLADE). The analysis showed that (p.53):

> *.. businesses with higher labour productivity pay higher real wages. The relationship between real wages and labour productivity holds across all business characteristics examined: business size (measured in terms of turnover), export participation and foreign ownership status.*

More specifically:

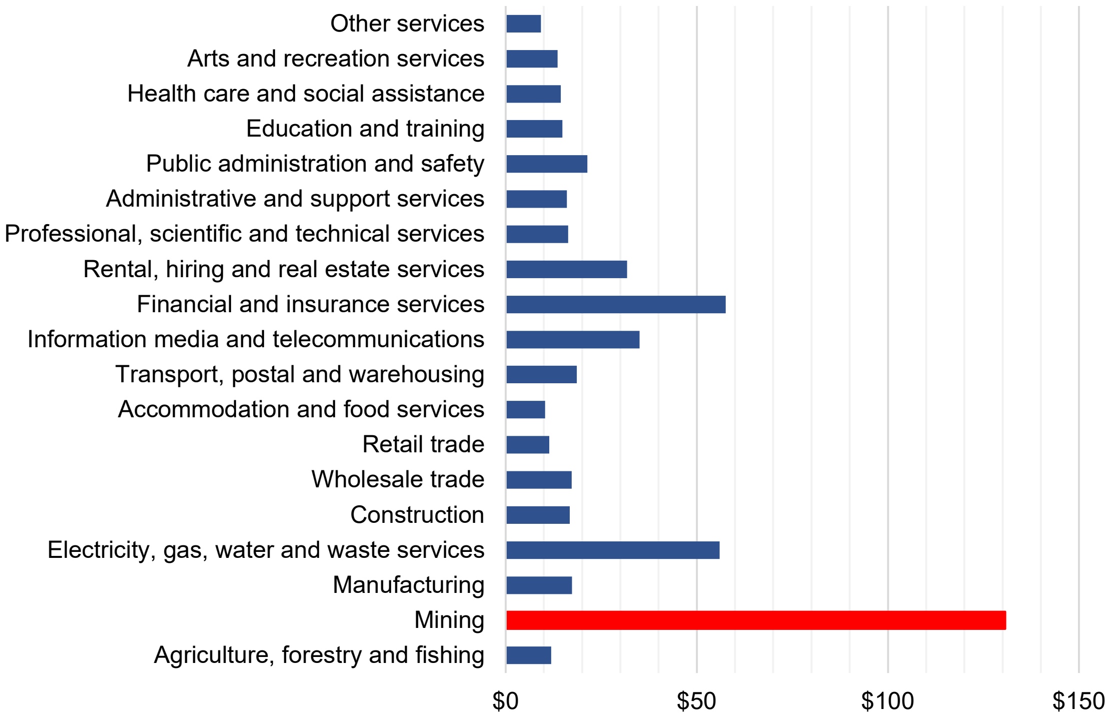
- High labour productivity businesses — and the most productive 10 per cent of businesses in particular — pay markedly higher average real wages (in *level* terms). On average over 2001-02 to 2013-14, the high productivity category paid average real wages 1.4 times as high as the low productivity category and 1.3 times as high as the mid productivity category.
- Larger businesses paid higher average real wages and had higher real wage growth. On average over 2001-02 to 2013-14, businesses with more than $50 million turnover paid average real wages 1.5, 1.2 and 1.1 times as much as the $0-$2 million, $2-$10 million and $10-$50 million categories respectively.

- Exporting businesses paid higher average real wages than non-exporting businesses. Exporters paid their employees, on average, 1.3 times as much as non-exporters over 2001-02 to 2013-14.

Labour productivity in the mining sector

The broad conclusions highlighted in the Treasury (2017) analysis directly apply to the Australian mining sector. As shown in Figure C-1, average earnings in the mining sector far exceed those in sectors that require similar skills. High earnings in that sector are matched by the underlying labour productivity which, in absolute terms, is higher in the mining industry than any other Australian industry (Figure C-3).[6]

Figure C-3. Labour productivity by sector (2019)



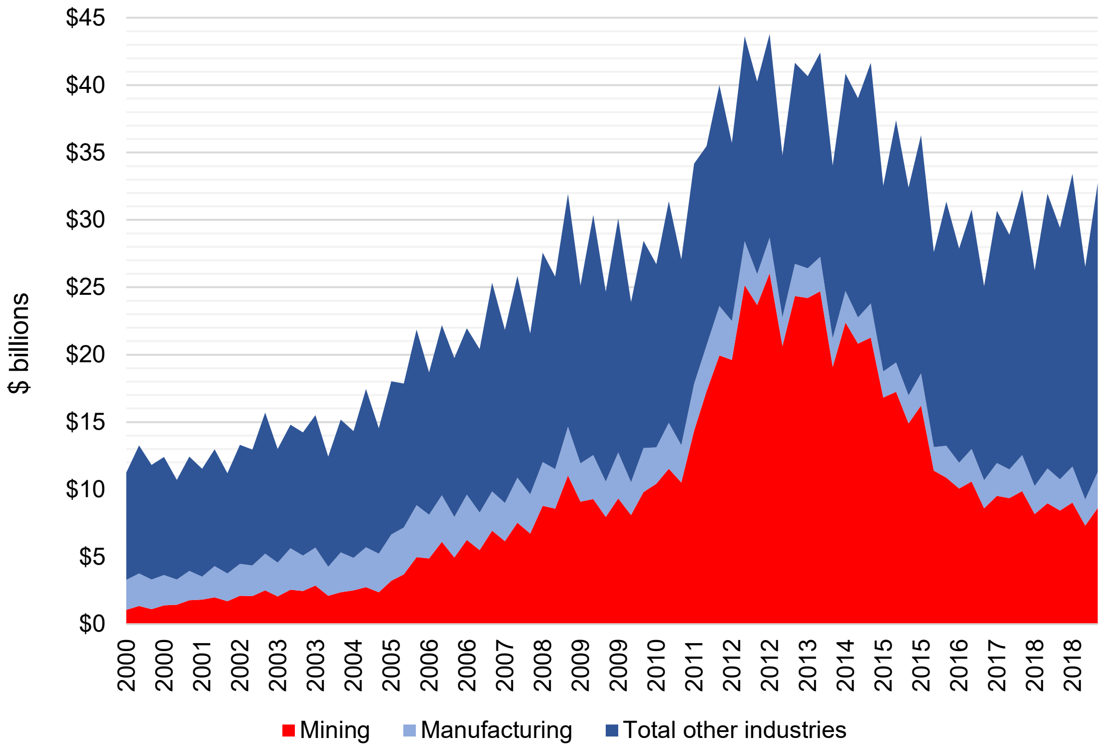
Notes: Labour productivity is estimated as gross value added (GVA) by sector per hour worked.

Source: ABS 2019, 5206.0 Australian National Accounts; Table 45. Gross Value Added by Industry, Current prices, June; Labour Account 2019, hours actually worked in all jobs.

[6] While mining labour productivity is high in absolute terms, it has varied over time. The mining sector responded to the mining boom by installing productive capacity, which required substantial inputs of capital and labour ahead of actual production (PC 2019). For these and other reasons, labour productivity for the mining industry fell by over 40 per cent between 2003-04 and 2011-12, but then subsequently rose by more than 60 per cent between 2011-12 and 2017-18.

High labour productivity (and wages) in the mining sector are in turn a reflection of substantial investment in capital assets. Figure C-4 shows new capital expenditures by the mining sector, the manufacturing sector, and other selected industries since 2000. Together, these sectors account for virtually all private capital investment. As a share of market sector investment expenditure, mining increased from around 10 per cent in 2000 to 59 per cent in 2013, to around 27 per cent as of June 2019. As noted above, capital deepening is one of the key factors that raises labour productivity.

Figure C-4. Private new capital expenditure



Notes: New capital expenditure refers to actual expenditure on buildings and structures; and equipment, plant and machinery. Other selected industry Other selected industries include electricity, Gas, Water and Waste Services, Construction, Wholesale Trade, Retail Trade, Transport, Postal and Warehousing, Information Media and Telecommunications, Finance and Insurance, Rental, Hiring and Real Estate Services, Professional, Scientific and Technical Services,.

Source: ABS 2019. 5204.0 Australian System of National Accounts.

C.1.4 Compensating wage differentials

The claim in the 2015 Guidelines that differences in wages between the mining and other sectors of the economy merely compensate workers for greater hardship may refer to the theory of 'compensating wage differentials' originally articulated by Adam Smith that workers will want to be compensated for job attributes that are dangerous or unpleasant or otherwise undesirable (Duncan and Holmlund 1983).

In practice, however, empirical support for the theory of compensating differentials is weak, at best (Sullivan and To, 2014; Lavetti 2018). Workers vary in their preferences as to how they assess risk-reward trade-offs, as well as in terms of other factors that cannot easily be observed or measured, such as worker ability. Furthermore, the risk of injury is occupation specific, and does not necessarily apply to all workers in an establishment or industry (Lane et al. 2007). Those studies that identify a compensating effect then suggest large variations in how risk-reward trade-offs are valued, including as a function of income levels, levels of job risk, age, immigrant status, race, gender, and other characteristics (Viscusi 2015).

The results of empirical research into the theory of compensating differentials in Australia are inconclusive at best. Cai and Waddoups (2012) use Household, Income and Labour Dynamics in Australia (HILDA) survey data to estimate the role of negative job characteristics (such as job stress, employment security, complexity and difficulty, control of the work process and commute times) as a determinant of wages. They find that controlling for job characteristics has a negligible effect on wages. Many studies have been done to identify a 'penalty' effect associated with casual or part-time work, but here the results have been contradictory Preson and Yu (2015).

C.2 Additional employment

C.2.1 Employment in a growing labour force

Over the last 20 year, the NSW labour force has increased by 38 per cent from around 3.2 million in December 1999 to around 4.4 million in December 2019. Over the same timeframe, the number of employed persons has increased by 40 per cent from around 3 million to 4.2 million. Setting aside the role of government as an employer, this increase in employment represents the net effect of existing businesses expanding their workforce and new business employing workers, while other businesses have shrunk or closed. Existing and new businesses that hired workers may have hired workers who had previous not been employed in New South Wales, or hired workers that had existing jobs in New South Wales. In the majority of cases, it is likely that an existing employer who 'loses' a worker to a different employer would replace that worker, either from a third employer or from the pool of people who are not employed (including school leavers, or unemployed people). While it is then correct to say that workers who simply move employers do not represent an immediate source of additional employment, they can nonetheless also be viewed as setting in motion a chain of events whereby subsequently moving workers are replaced by other employed, but also by unemployed workers.

There is some evidence to support this perspective on aggregate jobs creation. A recent economic analysis by the Grattan Institute of economic trends in Australia's regions found that populations, employment and incomes in mining regions grew significantly faster than in non-mining regions (Daley et al. 2017). The Grattan analysis also found that new immigrants to Australia tended to settle predominantly in the major cities, but also in mining areas. The analysis by the Grattan Institute is consistent with earlier research conducted by the RBA (Cunningham and Davis 2011). Cunningham and Davis found that over the previous decade, regional areas that were heavily focused toward mining tended to have unemployment rates that were lower than average. This suggests that jobs created by mining projects in Australia's regions are a source of additional employment in those regions, even if a share of the workforce may have previously been employed elsewhere.

C.2.2 Skills overlap

Top 20 mining occupations – Overlap with other sectors

The skills and occupations required in the mining sector overlap to a significant extent with those required in the construction, utilities, transport, and manufacturing sectors (Table C-1). For instance, 9 per cent of employees in the mining sector are metal fitters and machinists, compared to 4 per cent in manufacturing. Truck drivers make up 6 per cent of employees in mining, compared to 18 per cent in the transport sector and 8 per cent in the utilities sector. 4 per cent of mining employees are electricians, compared to 8 per cent in construction and 5 per cent in the utilities sector. It is therefore not the case that employees at a new mining project would originate from other mining employers or from the rail sector.

Table C-1. Top 20 employing occupations in the mining industry – Overlap with selected other sectors

Top employing occupations	Mining	Construction	Transport	Utilities	Manufacturing
Drillers, Miners and Shot Firers	18%				
Metal Fitters and Machinists	9%				4%
Truck Drivers	6%		18%	8%	
Other Building and Engineering Technicians	5%				
Electricians	4%	8%		5%	
Production Managers	3%				3%
Structural Steel and Welding Trades Workers	3%				5%
Mining Engineers	2%				
Other Stationary Plant Operators	2%			3%	
Earthmoving Plant Operators	2%	3%			
Accountants, accounting clerks	2%	2%	1%	4%	2%
Geologists, Geophysicists and Hydrogeologists	2%				
Contract, Program and Project Administrators	2%			2%	

Top employing occupations	Mining	Construction	Transport	Utilities	Manufacturing
Other Construction and Mining Labourers	2%				
Purchasing and Supply Logistics Clerks	1%		2%		2%
Store persons	1%		4%		3%
Structural Steel Construction Workers	1%	2%			
Motor Mechanics	1%				
Human Resource Managers	1%			1%	
Occupational and Environmental Health Professionals	1%				

Notes: Transport refers to 'transport, postal and warehousing'. Utilities refers to 'electricity, gas, water and waste services'.

The top 20 occupations cover 69 per cent of employees in the mining sector, 72 per cent in the construction sector, 73 per cent in the transport sector, 52 per cent in the utilities sector, and 47 per cent in the manufacturing sector.

Source: https://australianjobs.employment.gov.au/jobs-industry/mining; accessed 20 January 2020.

C.2.3 Labour mobility in the mining sector

Participation, Job Search and Mobility survey

Some information about labour mobility and the transferability of skills of the mining sector workforce is available from the 'Participation, Job Search and Mobility' survey undertaken by the ABS. The results of this survey do not provide a full picture of the origin of workers moving to a new employer, because it only records a worker's industry if that worker was employed in February of a given year and the February of the prior year. It is therefore not informative of people who may not have been employed a year earlier, for instance job starters, unemployed people, or people who were not working a year earlier for other reasons. The survey nonetheless suggests that of those workers employed in the mining sector as of the current and previous February, and who had changed employers in the last year:

- on average over the last five years, around 46 per cent had changed industry (ranging from 41 per cent in 2019 and 70 per cent in 2017); and
- on average over the last five years, around 27 per cent had changed occupation (ranging from 16 per cent in 2018 and 38 per cent in 2019).

Figure C-5. Labour mobility in the mining sector

Source: 6226.0 Participation, Job Search and Mobility, Australia, February 2016, various years.

RBA analysis of labour mobility

Doyle (2014) analysed employment in the resources sector, and how the resources sector was able to rapidaly increase employment from the mid 2000s. Doyle notes reports received by the RBA that many employers reported losing workers to the resources sector during the investment boom period, especially from the construction, agricultural, manufacturing and business services industries.

Data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey suggested that resource construction workers were largely recruited from other types of construction work. From 2008 to 2012, around 45 per cent of the people who started a new construction job were previously employed in the construction industry, compared with around 35 per cent in the five years prior, and resource construction workers were likely to have been recruited from the same broad occupations as other construction industry workers. Resource firms also filled vacancies through the temporary skilled visa program, such that just over 2 per cent of the construction workforce and around 3.5 per cent of the mining workforce in the resources states were on such visas, compared to 1 per cent of the total workforce.

C.2.4 Share of newly employed workers in the mining sector

It appears that there are no consistent statistics on the share of 'newly employed' workers' in the economy (which we assume to be job entrants, previously unemployed or non-working people, or migrants). However, the evidence is that mining businesses do hire less skilled workers. According to the Minerals Council (2019):

- The mining sector is a significant employer of apprentices. As of 2019, apprentices made up 4 per cent of the workforce, compared to the national average of 2.1 per cent.
- The mining sector is also a significant employer of indigenous people, who tend to have higher rates of unemployment than non-indigenous people. As of 2016, indigenous Australians made up 3.8 per cent of the mining industry workforce compared to the national average of 1.7 per cent. Mining had the highest indigenous employment share of all industries.

Appendix D Analysis of flow-on effects

D.1 Derivation of multipliers

This annex describes the methods used to calculate the flow- on effects of changes in the level of mining investment and production in NSW and the Mid and Upper Hunter region.

A number of practical difficulties arise in estimating regional or state-wide input-output multipliers for the purpose of conducting a regional impact analysis. Regardless of the approach that is adopted, regional impact analysis depends on national account statistics that, in Australia, are derived for the economy as a whole. The difficulty that then arises in assessing regional economic impacts is the inability to accurately account for the flow of goods and resources within and between regions.

In the past, apportioning national input-output multipliers to a regional or state level required assumptions that could not be verified. However, the collection of regional employment statistics in the 2011 census now provides a consistent and transparent method of deriving regional economic impacts at a reasonably granular level. The approach we have adopted here therefore makes use of 2011 census figures at an LGA level and the most recent national accounts figures compiled by the ABS for 2016-17, as set out below.

D.2 Concordance of the national accounts with census employment data

The Australian National Accounts input-output tables set out the flows of industry inputs (columns) and outputs (rows) for 114 industry classifications. The ABS census records employment an aggregated level with 19 industry classifications. The concordance between the census and the accounts is set out in Table B-1.

Table B1. Industry concordance between the industries in the National Accounts and industry level employment data in the 2016 Census

2011 ABS census Aggregate Industry	ABS National Accounts industry codes	
	Starting from	Ending with
Agriculture, forestry and fishing	101	501
Mining	601	1001
Manufacturing	1101	2502
Electricity, gas, water and waste services	2601	2901
Construction	3001	3201
Wholesale trade	3301	3301
Retail trade	3901	3901
Accommodation and food services	4401	4501
Transport, postal and warehousing	4601	5201

Information media and telecommunications	5401	6001
Financial and insurance services	6201	6401
Rental, hiring and real estate services	6601	6702
Professional, scientific and technical Services	6901	7001
Administrative and support services	7210	7310
Public administration and safety	7501	7701
Education and training	8010	8210
Health care and social assistance	8401	8601
Arts and recreation services	8901	9201
Other services	9401	9502

Source: 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17. 2016 ABS Census.

To construct the flows of industry inputs and outputs at the same level of the census, the rows and columns are summed. For example, there are seven industries classified as being part of the broader agriculture classification. Summing the seven rows aggregates the outputs of agriculture as a whole into each of the 114 industries. Summing the resulting new rows across the seven individual agricultural industries give the total input requirements for agriculture as a whole from each the 114 regions. The final result is a balanced flow table with 19 industry classifications.

The balancing items include rows and columns that are important for the regional impact analysis:

- there are rows for wages and salaries, imports and value added, respectively; and
- there are columns for household consumption, as well as for other final demands.

D.3 Requirements matrix and first-round (Type IA) output multipliers

The initial requirement for an extra dollar's worth of output of a given industry is called the initial output effect. It equals one in total for all industries, since an additional dollar's worth of output from any industry will require the initial one dollar's worth of output from that industry plus any induced extra output. The first-round effect is the amount of output required from all industries of the economy to produce the initial output effect.

First-round effects can be measured by deriving the 'direct requirements matrix'. In this matrix, the coefficients in a given industry's column show the amount of extra output required from each industry to produce an extra dollar's worth of output from that industry. The requirements matrix has been constructed from the Australian input-output (flows) table by standardising the inputs into each industry to produce one unit of output in each industry. This is achieved by dividing each row of the table by the total output on an industry-by-industry basis.

The first-round impact multiplier is then the sum of the standardised inputs for a given industry. For example, each element of the column for agriculture is divided by total agricultural output and then summed to obtain the total input requirement for one addition unit of output. The initial multiplier can be interpreted as the direct costs of an additional unit of production at current prices. Given these inputs are supplied domestically, the costs are other industry outputs and therefore contribute to total economic output. The sum of the initial output effect (which equals one) and the first-round effect is the Type IA output multiplier. This is simply the total first-round contribution of a project to the economy. For a project that is small when compared to the size of the industry, the first-round and Type IA impact multipliers are valid given the requirements are representative of those used in the project.

D.4 Simple output or Type IB multiplier

The simple Type IB multiplier takes into account the inputs required for the increased agricultural output (for example) that must also be produced, which requires the expansion of these industries and those that support them. These may be seen as series of flow-on effects that continue until the overall industry flows are again balanced.

Calculation of the simple multipliers requires solving a matrix equation. Let A be the 19 by 19 matrix of industry requirements (as discussed above), x a vector of inputs used in each of the industries and y a vector of net outputs from the economy. Net output can be standardised to 1 for each industry, giving rise to the simple linear input-output equation:

$$Ax - x = 1$$

Solving for the overall input requirement to one additional unit of output from each industry:

$$x = (I - A)^{-1}$$

where I is an identity matrix with ones along the main diagonal and zeros elsewhere, and the superscript -1 denotes the matrix inverse. Summing the columns of $(1 - A)^{-1}$ gives the simple multipliers. For example, summing the agricultural column gives the total inputs from all industries needed to sustain the production of one additional unit of net agricultural output at the national level.

The simple multiplier represents a shift in the composition of industry output, as well as the total level of industry output assuming constant prices. This may be reasonably valid for a small increase in, for example agricultural, output. However, for large change like what has occurred in the Australian mining industry, output prices for most industries will adjust in an offsetting manner. That is, the relative prices for the outputs that are used more extensively in mining will rise, while prices for those that are less extensively use will fall. The implication is that the simple multiplier will, for a given increase in mining output, overstate the flow-on effects in industries where relative prices rise and understate flow-on effects where relative prices fall.

For a project that is small relative to the size of industry the price effects will be small and the bias in the simple multiplier may be ignored. However, the composition of flow effects will vary if the input requirements for the project differ from those of the industry. A comparison can lead to useful caveats regarding the simply multiplier effects on other industries.

D.5 The total or Type IIA output multiplier

The total multiplier takes into account the relationship between wages and household demand, that is, the increase (decline) in household demand that results from a rise (fall) in household income. This is derived by adding the wages row and the household expenditure column to the A matrix from the requirements table. Let the expanded matrix be denoted B. The total multipliers are analogous to the simple multiplier and given by the column sums of the matrix $(I-B)^{-1}$.

The key issue with the total multiplier is that wage rates and output price changes will tend to offset the effect. In a limiting case, an increase in wage rates will result in an increase in output prices and leave total output and real household expenditure unchanged. However, if the project is small relative to the size of the economy the effects on household income and wages can be ignored.

D.6 Employment, income and value added multipliers

First-round, simple and total employment, income and value add multipliers can be calculated in much the same way as the output multipliers. The caveat noted for wage rates and employment in the previous section applies.

D.7 Employment multipliers

To calculate employment multipliers requires information about employment by industry that is provided in the ABS National Accounts (Table 20). For each industry, the FTE level of employment is divided by total industry output. This creates a vector of employment requirements per unit of output (denoted h) that can be used to convert the physical input requirements per additional unit of industry output into requirements for labour. The sum of these labour requirements constitute the employment multipliers, written in matrix notation as:

Type IA: hA;

Type IB: $h(I-A)^{-1}$; and

Type IIA: $h(I-B)^{-1}$.

These multipliers give the FTEs of employment needed to support an additional unit of output. These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total employment needed per person directly employed on the project. This is done by dividing each of the multipliers above by the number of workers required per unit of output. They are not the number of jobs created as this will be impacted by the number of part-time work that are converted to full-time workers or vice versa.

D.8 Income multipliers

The calculation of the income multiplier is done in the same way. The wage and salary requirement per unit are given in the requirements table. Designating these as a vector w the income multipliers written in matrix notation are:

Type IA: $\boldsymbol{w}A$;

Type IB: $\boldsymbol{w}(I-A)^{-1}$; and

Type IIA: $\boldsymbol{w}(I-B)^{-1}$.

These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total income per dollar of salaries and wages expended directly on the project. This done by dividing each of the multipliers above by the salaries and wages required per unit of output.

D.9 Value added multipliers

Value added is the value of industry output less the costs of inputs, whether produced domestically or imported (the contribution to regional GDP). This can again be calculated, as a vector, v, from the requirements table as value added per unit of industry output. The multipliers are then calculated in an identical way to employment and income:

Type IA: vA;

Type IB: $v(I-A)^{-1}$; and

Type IIA: $v(I-B)^{-1}$.

These multipliers can be adjusted to Type1A, Type 2a multipliers by expressing the multiplier as the total income per dollar of value added by the project. This done by dividing each of the multipliers above by the valued added per unit of output.

D.10 Regional impacts

It is not possible to maintain the level of consistency that exists in national input output tables at a regional level. Comprehensive data on industry composition, household consumption and the flow of goods and services to and from regions is not available.

A standard approach that can be reproduced across different regional definitions in a consistent manner is to use employment by industry data to form what are known as location quotients (LQs). LQs are used to translate economy-wide input-output relationships into regional relationships. For instance, while coal mining only accounts for a small share of employment at a national level, employment in coal mining in the Mid and Upper Hunter region is very significant. Hence national input-output tables need to be adjusted to better reflect the characteristics of the local economy.

Locational quotients

A raw LQ is simply the percentage of FTE employment in a given industry and region, divided by the percentage of FTE employment in a given industry at the national level. This may be written for the i^{th} industry and the j^{th} region as:

$$LQ_{i,j} = \frac{\dfrac{\text{employment}_{i,j}}{\sum_i \text{employment}_{i,j}}}{\dfrac{\sum_j \text{employment}_{i,j}}{\sum_i \sum_j \text{employment}_{i,j}}}$$

The LQ has a natural interpretation for an industry within a region:

- if the LQ is less than one, the goods and services from that industry will tend to be imported into the region to meet demand; while
- if the LQ is greater than one, the goods and services from that industry will tend to be exported into the region to meet demand elsewhere.

Given that goods and services and labour requirements are the same in all regions, the relationship will tend to be proportional so long as the actual size of the labour force does not represent a constraint. These are standard assumptions in an input output analysis. However, at the regional level, the violation of these assumptions can often be more apparent. For example, specialised good or services demanded for a project may simply not be produced domestically and may have to imported, with a consequent reduction in regional flow-on effects. However, this can be addressed within the context of the requirements table if project information on where purchases are made is available.

Total employment may not be a constraint for a large region, such as a state. However, while a large proportion of people may be employed in an industry in a small region, the overall workforce in that industry may not be sufficient to meet labour requirements. While this may in part be offset by migration, it can simply be more efficient to import goods and services into the region.

It is recommended practice (Bess and Ambargis 2011) to adjust the raw LQs in small regions by the following formula:

$$LQ_{i,j} = \begin{cases} LQ_{i,j} & if \;\; LQ_{i,j} < 1 \\ 1 & if \;\; LQ_{i,j} >= 1 \end{cases}$$

LQs consist of the ratio of an industry's share of regional earnings to the industry's share of national earnings. This adjustment has the effect of holding constant or reducing regional flow-on effects. The basic idea is that industries in the region are not likely to produce all of the intermediate inputs required to produce the change in final demand. In these cases, local industries must purchase intermediate goods and services from producers outside the region, thereby creating leakages from the local economy.

D.11 Regional multipliers

Given LQ is a vector of location quotients, the regionally adjusted Type IA and Type IB input multipliers are calculated by multiplying the industry requirements by the quotients. The output multipliers are the column sums of:

Type IA: $LQ \times A$;

Type IB: $(I - LQ \times A)^{-1}$; and

Type IIA: $(I - LQ \times B)^{-1}$.

Where $\times$ denotes element-by-element multiplication of each column of A by LQ.

The income, employment and value add multipliers are calculated in the same manner as the national multipliers.

D.12 Adjusted mining and agricultural industry expenditures

The LQ adjusts for locally sourced intermediate inputs. Therefore, the expenditure column of the input-output matrix, which includes wages, gross operating surplus, taxes and imports needs to be rebalanced to sum to total industry output. The balancing item is imports. The adjusted State and regional mine and agricultural expenditure are shown in Table B-2.

Table B-2. NSW and Southern Highlands LQ adjusted mine and agricultural expenditures

	NSW		SA3 Region	
Expenditure	Mining	Agriculture	Mining	Agriculture
Agriculture, forestry and fishing	0.1%	14.4%	0.3%	16.7%
Mining	3.7%	0.2%	3.8%	0.2%

Expenditure	NSW Mining	NSW Agriculture	SA3 Region Mining	SA3 Region Agriculture
Manufacturing	3.2%	4.8%	4.8%	5.3%
Electricity, gas, water and waste services	1.9%	1.9%	0.1%	1.8%
Construction	5.2%	3.3%	4.3%	3.4%
Wholesale trade	1.6%	3.6%	3.5%	3.1%
Retail trade	0.5%	0.8%	1.8%	0.8%
Accommodation and food services	0.4%	0.3%	5.3%	0.3%
Transport, postal and warehousing	2.3%	3.1%	1.4%	2.8%
Information media and telecommunications	0.2%	0.2%	0.5%	0.1%
Financial and insurance services	4.0%	4.8%	0.4%	3.0%
Rental, hiring and real estate services	1.8%	1.4%	2.1%	1.4%
Professional, scientific and technical Services	3.6%	2.8%	0.1%	2.5%
Administrative and support services	0.7%	1.2%	2.6%	1.2%
Public administration and safety	0.7%	0.1%	1.8%	0.1%
Education and training	0.1%	0.0%	3.3%	0.0%
Health care and social assistance	0.0%	0.0%	0.7%	0.0%
Arts and recreation services	0.1%	0.0%	0.5%	0.0%
Other services	1.5%	0.7%	0.1%	0.7%
Total domestic inputs	31.5%	43.6%	0.0%	43.6%

D.13 Estimates of multipliers

D.13.1 Mining

The multipliers reported in the following were derived from national level multipliers in accord with guidelines provided by the ABS (n.d.). State and regional multipliers were derived using employment LQs to translate economy-wide input-output relationships into regional relationships. Table B-3 shows the NSW mining multipliers derived from the 2013-14 National Accounts tables for:

- gross output (production);
- income;
- employment (FTE equivalent); and
- value added (contribution to GDP).

Table B-3. NSW input-output multipliers (mining)

Multiplier	NSW		
	Type IA	Type IB	Type IIA
Income	1.96	3.76	5.82
Employment	1.59	3.09	4.14
Value added	1.24	2.79	2.87

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17; 6291.0.55.003 - Labour Force, Detailed, Quarterly, August.

Table B-4 shows the corresponding multipliers for the Southern Highlands SA3 Region.

Table B-4. Southern Highlands SA3 Region input-output multipliers (mining)

Multiplier	Southern Highlands SA3 Region		
	Type IA	Type IB	Type IIA
Income	1.91	3.61	5.45
Employment	1.55	2.98	3.90

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17; ABS, 2016 Census.

D.13.2 Agriculture

Table B-5 shows the NSW agriculture multipliers; Table B-6 shows these multipliers for the Southern Highlands SA3 Region.

Table B-5. NSW input-output multipliers (agriculture)

Multiplier	NSW		
	Type IA	Type IB	Type IIA
Income	1.42	2.76	3.40
Employment	1.91	3.78	5.19
Value added	1.44	2.79	3.39

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17; 6291.0.55.003 - Labour Force, Detailed, Quarterly, August.

Table B-6. Southern Highlands SA3 Region input-output multipliers (agriculture)

Multiplier	Southern Highlands SA3 Region		
	Type IA	Type IB	Type IIA
Income	1.42	2.75	3.32
Employment	1.88	3.66	4.90
Value Add	1.43	2.75	3.27

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17; ABS 2016 Census.

Appendix E Discounted cash flow calculation

Table E-1. Hume project – New South Wales net benefit cash flow calculation

		BENEFITS								COSTS	BENEFITS - COSTS
		Royalties	NSW share of company tax	Payroll tax	Shire rates	Land taxes	Disposable income to NSW workforce	NSW share of net personal income tax	NSW share of net Medicare payments	GHG emissions	
		$M	$M	$M	$M	$M	$M	$M	$M	$M	$M
	NPVs	**$147.6**	**$45.4**	**$18.4**	**$0.9**	**$1.3**	**$62.9**	**$13.5**	**$0.7**	**$0.1**	**$290.5**
FY	**Year**										
2020	0	$0.0	-$0.2	$0.0	$0.1	$0.1	$0.0	$0.0	$0.0	$0.0	$0.0
2021	1	$0.0	-$0.3	$0.0	$0.1	$0.1	$0.0	$0.0	$0.0	$0.0	-$0.1
2022	2	$0.0	-$2.8	$0.6	$0.1	$0.1	$1.8	$0.4	$0.0	$0.0	$0.2
2023	3	$0.0	-$10.2	$1.9	$0.1	$0.1	$5.8	$1.0	$0.1	$0.0	-$1.2
2024	4	$1.7	-$6.6	$1.8	$0.1	$0.1	$6.1	$1.3	$0.1	$0.0	$4.6
2025	5	$11.9	-$1.3	$2.2	$0.1	$0.1	$7.9	$1.7	$0.1	$0.0	$22.6
2026	6	$19.4	$7.2	$2.0	$0.1	$0.1	$7.1	$1.5	$0.1	$0.0	$37.5
2027	7	$17.3	$5.1	$2.1	$0.1	$0.1	$7.4	$1.6	$0.1	$0.0	$33.8
2028	8	$25.8	$15.0	$2.1	$0.1	$0.1	$7.4	$1.6	$0.1	$0.0	$52.2
2029	9	$24.2	$14.8	$2.1	$0.1	$0.1	$7.3	$1.6	$0.1	$0.0	$50.3
2030	10	$20.0	$9.6	$2.1	$0.1	$0.1	$7.3	$1.6	$0.1	$0.0	$40.8
2031	11	$16.0	$6.7	$2.1	$0.1	$0.1	$7.2	$1.6	$0.1	$0.0	$33.8
2032	12	$21.9	$10.1	$2.1	$0.1	$0.1	$7.1	$1.6	$0.1	$0.0	$43.0
2033	13	$16.4	$5.0	$2.1	$0.1	$0.1	$7.0	$1.6	$0.1	$0.0	$32.3

		BENEFITS								COSTS	BENEFITS - COSTS
		Royalties	NSW share of company tax	Payroll tax	Shire rates	Land taxes	Disposable income to NSW workforce	NSW share of net personal income tax	NSW share of net Medicare payments	GHG emissions	
		$M	$M	$M	$M	$M	$M	$M	$M	$M	$M
2034	14	$21.2	$10.1	$2.1	$0.1	$0.1	$7.0	$1.5	$0.1	$0.0	$42.2
2035	15	$23.3	$12.7	$2.1	$0.1	$0.1	$6.9	$1.5	$0.1	$0.0	$46.8
2036	16	$23.8	$13.0	$2.1	$0.1	$0.1	$6.9	$1.5	$0.1	$0.0	$47.5
2037	17	$20.3	$9.4	$2.1	$0.1	$0.1	$6.8	$1.5	$0.1	$0.0	$40.3
2038	18	$18.1	$8.0	$1.9	$0.1	$0.1	$6.3	$1.4	$0.1	$0.0	$36.0
2039	19	$24.0	$14.0	$2.0	$0.1	$0.1	$6.4	$1.4	$0.1	$0.0	$48.1
2040	20	$18.7	$11.3	$1.3	$0.1	$0.1	$4.3	$1.0	$0.0	$0.0	$36.8
2041	21	$14.5	$9.0	-$0.3	$0.1	$0.1	$2.9	$0.7	$0.0	$0.0	$27.0
2042	22	$0.2	-$17.3	$0.4	$0.1	$0.1	$1.3	$0.3	$0.0	$0.0	-$14.9
2043	23	$0.0	-$0.7	$0.1	-$0.1	$0.1	$0.1	$0.0	$0.0	$0.0	-$0.5
2044	24	$0.0	$0.5	$0.0	-$0.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.4
2045	25	$0.0	-$0.9	$0.0	-$0.1	$0.0	$0.0	$0.0	$0.0	$0.0	-$1.0