

# **Mount Gibson Gold Project Economic Assessment**

*Prepared for*

**Capricorn Metals Ltd**

**By**



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## **Disclaimer**

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## TABLE OF CONTENTS

|                                                                                                           |           |
|-----------------------------------------------------------------------------------------------------------|-----------|
| <b>KEY ECONOMIC DEFINITIONS</b>                                                                           | <b>4</b>  |
| <b>EXECUTIVE SUMMARY</b>                                                                                  | <b>6</b>  |
| <b>1 INTRODUCTION</b>                                                                                     | <b>8</b>  |
| 1.1 BACKGROUND AND PROJECT OVERVIEW                                                                       | 8         |
| 1.2 ECONOMIC ASSESSMENT                                                                                   | 8         |
| <b>2 COST BENEFIT ANALYSIS</b>                                                                            | <b>9</b>  |
| 2.1 INTRODUCTION                                                                                          | 9         |
| 2.2 IDENTIFICATION OF THE "WITHOUT" PROJECT SCENARIO                                                      | 9         |
| 2.3 IDENTIFICATION OF THE "WITH" THE PROJECT SCENARIO                                                     | 9         |
| 2.4 IDENTIFICATION OF BENEFITS AND COSTS                                                                  | 10        |
| 2.5 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS                                                        | 11        |
| 2.6 CONSOLIDATION OF VALUE ESTIMATES                                                                      | 16        |
| 2.7 DISTRIBUTION OF WESTERN AUSTRALIAN COSTS AND BENEFITS                                                 | 19        |
| 2.8 RISK AND SENSITIVITY ANALYSIS                                                                         | 20        |
| <b>3 REGIONAL AND STATE IMPACT ANALYSIS OF THE PROJECT</b>                                                | <b>23</b> |
| 3.1 INTRODUCTION                                                                                          | 23        |
| 3.2 CONSTRUCTION IMPACTS                                                                                  | 23        |
| 3.3 OPERATION IMPACTS                                                                                     | 26        |
| 3.4 OTHER ECONOMIC IMPACTS                                                                                | 29        |
| <b>4 CONCLUSION</b>                                                                                       | <b>30</b> |
| <b>5 REFERENCES</b>                                                                                       | <b>31</b> |
| <b>ATTACHMENT 1 - COST BENEFIT ANALYSIS</b>                                                               | <b>32</b> |
| <b>ATTACHMENT 2 – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES</b>                                  | <b>35</b> |
| <b>ATTACHMENT 3 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS</b> | <b>37</b> |

## TABLES

|           |                                                                                                |
|-----------|------------------------------------------------------------------------------------------------|
| Table 2.1 | Potential Incremental Economic Benefits and Costs of the Project                               |
| Table 2.2 | Alternative Frame of Potential Incremental Economic Benefits and Costs of the Project          |
| Table 2.3 | Net Production Benefits of the Project (\$M Present Values at 7% Discount Rate)                |
| Table 2.4 | Indirect Impacts of the Project (\$M Present Values at 7% Discount Rate)                       |
| Table 2.5 | Net Social Benefits of the Project (\$M Present Values @ 7% Discount Rate)                     |
| Table 2.6 | Incidence of Western Australian Costs and Benefits                                             |
| Table 2.7 | Western Australian CBA Sensitivity Testing (Present Value \$M)                                 |
| Table 3.1 | Average Annual Economic Impacts of the Construction on the Regional Economy (\$2024)           |
| Table 3.2 | Average Annual Economic Impacts of the Construction on the Western Australian Economy (\$2024) |
| Table 3.3 | Average Annual Economic Impacts of the Operation on the Regional Economy (\$2024)              |
| Table 3.4 | Average Annual Economic Impacts of the Operation on the Western Australian Economy (\$2024)    |

## FIGURES

|            |                                               |
|------------|-----------------------------------------------|
| Figure 2.1 | Indicative Production Profile for the Project |
|------------|-----------------------------------------------|

## KEY ECONOMIC DEFINITIONS

|                                |                                                                                                                                                                                                                                                                                                         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Consumption-induced flow-on    | the spending by households of the extra income they derive from the production of the extra \$1 of output and production induced effects. This spending in turn generates further production by industries.                                                                                             |
| Cost benefit analysis          | a method to assess the relative economic desirability (economic efficiency) of competing alternatives.                                                                                                                                                                                                  |
| Discount rate                  | the percentage rate of compound interest at which future benefits and costs are adjusted to their equivalent present-day values.                                                                                                                                                                        |
| Discounting                    | the process of adjusting future benefits and costs to their equivalent present-day values.                                                                                                                                                                                                              |
| Economic activity              | measures of economic activity include output, value-added, income and employment.                                                                                                                                                                                                                       |
| Economic efficiency            | is concerned with whether the well-being of society is improved by a proposal relative to without the proposal.                                                                                                                                                                                         |
| Economic impact                | refers to the effect of a project on economic activity within a local area or region.                                                                                                                                                                                                                   |
| Employment                     | the number of people employed (including full-time and part-time).                                                                                                                                                                                                                                      |
| Externalities                  | an outcome that arises when an activity between two parties affects the activity of a third, without any compensation to or payment by the third party.                                                                                                                                                 |
| Gross regional product         | one of several measures of the size of an economy. It is the market value of all final goods and services produced by all firms in an economy.                                                                                                                                                          |
| Household income               | the wages paid to employees including imputed wages for self-employed and business owners.                                                                                                                                                                                                              |
| Input-output analysis          | a method to assess the direct and indirect economic activity generated by a proposal through spending.                                                                                                                                                                                                  |
| Intermediate good              | a good that is used as an input into the production of other goods and services.                                                                                                                                                                                                                        |
| Multiplier                     | a summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry. There are many types of multipliers.                                                                                                             |
| Neoclassical welfare economics | a branch of economics that uses microeconomic techniques such as benefit cost analysis to evaluate the economic well-being of the society.                                                                                                                                                              |
| Net present value              | the sum of a flow of annual net benefits, each of which is expressed in present value. The sum is exactly equivalent to the difference between the present value of benefits and the present value of costs.                                                                                            |
| Net production benefit         | net benefits accruing from production which is based on revenues and costs to the proponent. It includes royalties, company tax and net producer surplus and any economic benefits to existing landholders, workers, and suppliers. It also takes account of mitigation, offset and compensation costs. |
| Net social benefit             | net production benefits plus any positive or negative environmental, social and cultural impacts that have not been mitigated, offset or compensated for.                                                                                                                                               |

|                              |                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Opportunity cost             | the potential return in the best, foregone alternative.                                                                                                                                                                                                                                     |
| Output                       | total revenue or business turnover.                                                                                                                                                                                                                                                         |
| Partial equilibrium analysis | the analysis of relationships within a particular subsector of the economy, holding relationships in other subsectors of the economy constant.                                                                                                                                              |
| Present value                | the equivalent value today of a future benefit or cost.                                                                                                                                                                                                                                     |
| Production-induced flow-on   | the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial change in output).                                                                                                    |
| Resource costs               | resource costs are costs where there is an exchange of goods and services (resources). They are distinct from transfer payments, such as royalties, which are a cost to an individual firm but do not involve any exchange of resources                                                     |
| Threshold value method       | a form of cost benefit analysis, where the quantified net benefits of a Project are compared to the unquantified costs. The quantified net benefits provide a threshold value that unquantified costs must exceed to make the Project questionable from an economic efficiency perspective. |
| Type 11a ratio multiplier    | summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.                                                          |
| Value-added                  | the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.                                                                                                           |

## EXECUTIVE SUMMARY

### Introduction

Capricorn Metals Ltd is proposing to develop, construct and operate multiple Open Pits, including a Process Plant and supporting infrastructure; located approximately 280 km northeast of Perth and less than 10 km east of the Great Northern Highway, in the Avon Wheatbelt region of Western Australia.

Gillespie Economics was commissioned by Capricorn Metals Ltd to complete an Economic Assessment of the Mt Gibson Mine Gold Project (the Project). The Economic Assessment will be appended to the Public Environment Report for the Project in support of an application seeking the Commonwealth Minister's approval under the *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act).

From an economic perspective, there are two important aspects of the Project:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Project) which is evaluated using cost benefit analysis (CBA); and
- its effects on the regional and Western Australian economy, which is evaluated using input-output (IO) analysis.

### Cost Benefit Analysis

A CBA of the Project indicates that it would have net production benefits to Australia and Western Australia of \$1,441M and \$304M, respectively. Provided the residual environmental, social, and cultural impacts of the Project that accrue to Australia and Western Australia are valued at less than the level of net production benefits, the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

The environmental, cultural, and social impacts were then considered qualitatively and where required valued using market data and benefit transfer<sup>1</sup>, and incorporated into an estimate of the net social benefit of the Project. Most residual environmental, cultural and social impacts of the Project after mitigation, compensation and offset, were immaterial from an aggregate economic efficiency perspective. The main quantifiable residual environmental impact of the Project, which have not already been incorporated into the estimate of net production benefits, relate to the impacts of scope 1 and scope 2 greenhouse gas (GHG) emissions. Scope 1 and Scope 2 GHG impacts to Australia and Western Australia from the Project are estimated at \$0.37M and \$0.04M, respectively. These economic costs are considerably less than the estimated net production benefits of the Project.

Combining the estimate of net production benefit with the residual environmental costs, the Project is estimated to have net social benefits to both Australia and Western Australia of \$1,440M and \$304M, respectively.

While the major environmental, cultural, and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural, or social impacts that remain unquantified would need to be valued at greater than \$1,440M and \$304M for Australia and Western Australia, respectively, for the Project to be questionable from an economic efficiency perspective.

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<sup>1</sup> Benefit transfer refers to transferring economic values that have been determined for other study sites.

## Regional and State Impacts

The Project is located in the Yalgoo Shire Local Government Area within the Mid-West Statistical Area Level 3 (the regional economy). The construction and operation of the Project will provide economic activity for the regional and Western Australian economy.

The average annual construction impacts of the Project on the regional economy are estimated at up to:

- \$80M in annual direct and indirect output (\$34M of which accrues to the region).
- \$27M in annual direct and indirect value added (\$9M of which accrues to the region).
- \$18M in annual direct and indirect household income (\$7M of which accrues to the region).
- 191 direct and indirect jobs (87M of which accrues to the region).

The average annual construction impacts of the Project on the Western Australian economy are estimated at up to:

- \$137M in annual direct and indirect output.
- \$56M in annual direct and indirect value added.
- \$38M in annual direct and indirect household income.
- 387 direct and indirect jobs.

In total, the operation phase of the project is estimated to make up to the following annual contribution to the regional economy:

- \$878M in direct and indirect regional output or business turnover (\$169M of which accrues to the regional).
- \$623M in direct and indirect regional value-added (\$78M of which accrues to the region).
- \$101M in direct and indirect household income (\$47M of which accrues to the region).
- 834 direct and indirect jobs (549 of which accrues the region).

For the Western Australian economy, the operation phase of the project is estimated to make up to the following annual contributions:

- \$1,047M in direct and indirect output.
- \$708M in direct and indirect value-added.
- \$162M in direct and indirect household income.
- 1,368 direct and indirect jobs.

Impacts for the Australian economy would be greater than those for the Western Australian economy because of the greater ability of the Australian economy to provide the goods and services required for production and demand by workers.

# 1 INTRODUCTION

## 1.1 Background and Project Overview

Gillespie Economics was commissioned by Capricorn Metals Ltd to complete an Economic Assessment for the Mt Gibson Mine (the Project).

The Economic Assessment will be appended to the Public Environment Report for the Project in support of an application seeking the Commonwealth Minister's approval under the *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act). The Commonwealth Minister's approval is required because the Project was declared to be a "controlled action" due to its potential to impact upon on the following matters of national environmental significance (MNES).

The Project is to develop, construct and operate an Open Pit Gold Mine, including Process Plant and supporting infrastructure; located approximately 280 km northeast of Perth and less than 10 km east of the Great Northern Highway, in the Avon Wheatbelt region of Western Australia.

The Proposal includes:

- the development of above and below water table Open Pits, via cutbacks of historically mined open pits.
- ore processing facilities
- mineral waste management (Waste Rock Landform and Tailings Storage Facility)
- associated infrastructure (Haul Roads, borefield, pipeline corridors, workshops, offices etc.)
- airstrip.

The Proposal is expected to process five (5) million tonnes per annum (Mtpa) of ore and extract approximately 215 million tonnes (Mt) of waste over an 11-year mine life. Mining will occur concurrently across ore bodies. Rehabilitation and closure will be progressive and in accordance with the approved Mine Closure Plan.

The Proposal is located within a 4,082 hectares (ha) Development Envelope and will require the clearing of up to 1,296 ha of native vegetation. It will have a total Disturbance Footprint of up to 1,686 ha.

## 1.2 Economic Assessment

From an economic perspective, there are two important aspects of the Project:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Project) which is evaluated using cost benefit analysis (CBA); and
- its effects on the regional and Western Australian economy, which is evaluated using input-output (IO) analysis.

A CBA of the Project is reported in Section 2 of this report while the regional and State economic activity impacts are reported in Section 3. Conclusions are drawn in Section 4.



## **2 COST BENEFIT ANALYSIS**

### **2.1 Introduction**

CBA of the Project involves the following key steps:

- identification of the “with” and “without” Project scenarios.
- identification and valuation of the incremental benefits and costs.
- consolidation of value estimates using discounting to account for temporal differences.
- application of decision criteria.
- sensitivity testing.
- consideration of non-quantified benefits and costs.
- consideration of the distribution of costs and benefits.

A key aspect of CBA is the definition of the society whose costs and benefits are included in the CBA (known as “standing”). The most inclusive definition of society includes all people, no matter where they live or to which government they owe allegiance too (Boardman et al. 2001). However, in practice most analysts define society at the national level based on the notion that the citizens of a country share a common constitution that sets out fundamental values and rules for making collective choices and that the citizens of other countries have their own constitutions that make them distinct societies (Boardman et al. 2001). The Commonwealth Office of Impact Analysis (2023) follows this approach,<sup>2</sup> identifying that “for most proposals, measuring the national costs and benefits is appropriate, rather than measuring any international impacts. That is, as far as is practical, you should count the costs and benefits to all people residing in Australia.”

What follows is a CBA of the Project based on the financial, technical, and environmental advice provided by Capricorn Metals Ltd and its specialist consultants. An explanation of the CBA methodology is provided in Attachment 1.

### **2.2 Identification of the “Without” Project Scenario**

A starting point for CBA is to establish the “without” Project scenario, or base case, for the land the subject of the Project. This becomes the base case against which to assess the potential incremental changes of any economic, social, and environmental impacts due to the Project.

The Project is located on Unallocated Crown Land under the Land Administration Act 1997 (WA) underlying Mining Tenements granted under the Mining Act 1978 (Mining Act). The land has historically been used for mining but is currently unused. Under the base case, this land is assumed to continue in an unused state. The Projects disturbance footprint of 1,686 ha includes 1,296ha of native vegetation, approximately 390 ha of existing disturbance (open pits, waste rock landforms, heap leach landform and access roads), with the remainder being cleared land.

### **2.3 Identification of the “With” the Project Scenario**

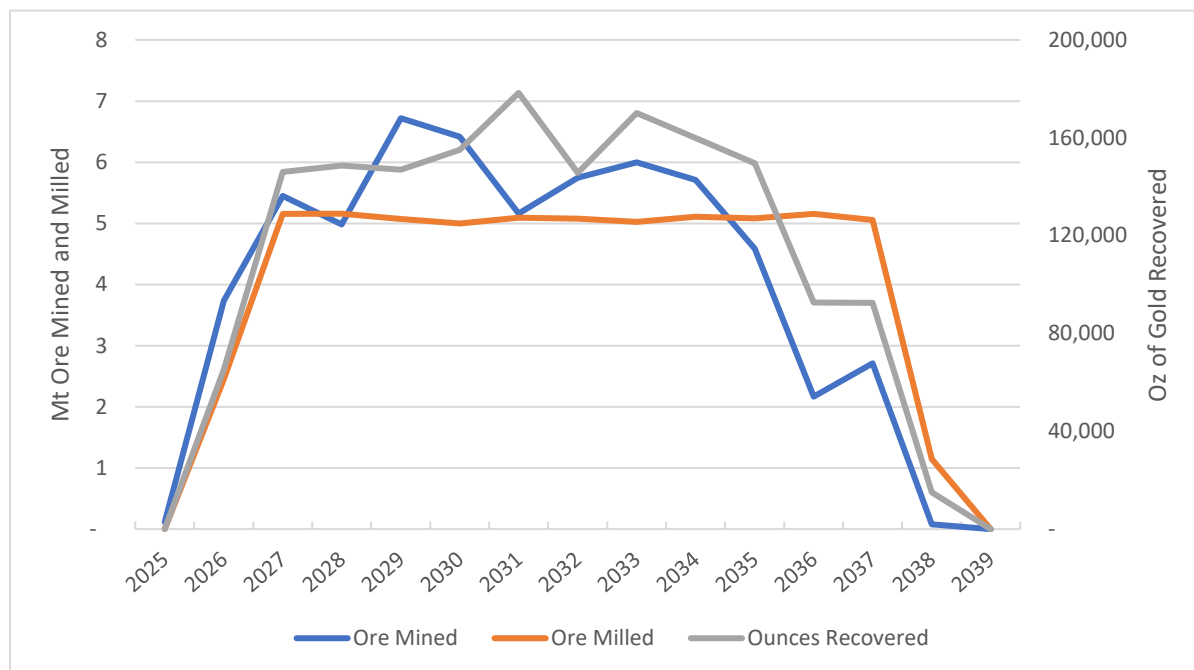
The Project is to develop, construct and operate and open pit gold mine, processing 5Mtpa of ore for 1.34 million ounces of gold.

Figure 2.1 provided an indicative production profile for the Project.

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<sup>2</sup> It is recognized that these guidelines apply to the evaluation of regulatory measures. However, the principles are relevant to private sector projects.

**Figure 2.1 – Indicative Production Profile for the Project**



Alternatives to the Project are essentially limited to different scales, designs, technologies, processes, modes of transport, timing, impact mitigation etc. However, these alternatives are variants of the Capricorn Metal's preferred Project rather than distinct alternatives. Consequently, this CBA focuses on Capricorn Metal's preferred Project, which it considers to maximise resource utilisation while minimising adverse impacts.

## 2.4 Identification of Benefits and Costs

Relative to the base case, the Project has potential incremental economic benefits and costs as shown in Table 2.1.

The potential externality impacts listed in Table 2.1 are only economic costs to the extent that they affect individual and community well-being. If the potential impacts do not occur or are mitigated, compensated, or offset (i.e. costs are borne by the applicant), to the extent where community wellbeing is immaterially affected then no environmental costs should be included in the CBA apart from the mitigation, compensation, or offsetting costs.

**Table 2.1 - Potential Incremental Economic Benefits and Costs of the Project**

| Category                                                                                                      | Costs                                                                                                                                                                                                                                                                                                                                                                                     | Benefits                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Production                                                                                                    | <ul style="list-style-type: none"> <li>• Opportunity cost of land</li> <li>• Opportunity cost of capital</li> <li>• Development costs</li> <li>• Operating costs, including administration, mining, processing, transportation, mitigation measures and offsets (but excluding royalties)</li> <li>• Decommissioning and rehabilitation costs at cessation of the Project</li> </ul>      | <ul style="list-style-type: none"> <li>• Sale value of gold</li> <li>• Residual value of capital and land at the cessation of the Project</li> </ul> |
| Indirect Impacts – Residual environmental, social, cultural impacts after mitigation, offset and compensation | <ul style="list-style-type: none"> <li>• Greenhouse gas generation</li> <li>• Operational noise impacts</li> <li>• Road transport impacts</li> <li>• Air quality impacts</li> <li>• Groundwater impacts</li> <li>• Surface water impacts</li> <li>• Biodiversity impacts</li> <li>• Aboriginal heritage impacts</li> <li>• Historic heritage impacts</li> <li>• Visual impacts</li> </ul> |                                                                                                                                                      |

Framed in another, but equivalent way, the potential incremental costs and benefits of the Project are as per Table 2.2. The net production benefits generated from subtracting direct productions costs from the production benefits can be decomposed into royalties, company tax and residual net producer surplus. This aids in the apportionment of the net production benefit to Australia and Western Australia.

**Table 2.2 - Alternative Frame of Potential Economic Benefits and Costs of the Project**

| Costs                                                                                      | Benefits                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Indirect costs</b>                                                                      | <b>Direct benefits</b>                                                                                                                                                     |
| Residual environmental, social, cultural impacts after mitigation, offset and compensation | Net production benefits <ul style="list-style-type: none"> <li>• <i>Royalties</i></li> <li>• <i>Company tax</i></li> <li>• <i>Residual net producer surplus</i></li> </ul> |

## 2.5 Quantification/Valuation of Benefits and Costs

Consistent with Office of Impact Assessment (2023), the CBA was undertaken from a national perspective, using a central discount rate of 7% and sensitivity testing at 3% and 10%. The CBA was undertaken in 2024 real values over an analysis period is 16 years, coinciding with the construction and operation of the Project including 1-year pre mining and 1-year post mining for final rehabilitation. Where impacts occur after this period they are included in the final year of analysis as a terminal value.

Where competitive market prices are available, they have generally been used as an indicator of economic values. This was the case for direct mining costs and benefits. Environmental, cultural, and social impacts have initially been left unquantified and interpreted using the threshold value method.<sup>3</sup>

The environmental, cultural, and social impacts were then considered qualitatively and where necessary valued using market data and benefit transfer<sup>4</sup>, and incorporated into an estimate of the net social benefit of the Project. This estimated net social benefit of the Project provides another threshold value

<sup>3</sup>The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.

<sup>4</sup> Benefit transfer refers to transferring economic values that have been determined for other study sites.

that any residual or non-quantified economic costs would need to exceed to make the Project questionable from an economic efficiency perspective.

### **2.5.1 Production Costs and Benefits<sup>5</sup>**

#### ***Economic Costs***

##### *Opportunity Cost of Land and Capital*

Under the base case, the land would continue to be Unallocated Crown Land, and remain unused. Consequently, there is no material opportunity cost of using this land for the Project.

All capital equipment required for the Project will be purchased or leased (included in the capital costs below) and hence there is no opportunity cost of continuing to use capital equipment that has already been purchased.

##### *Capital Cost of the Project*

Capital/Development costs associated with the Project construction and equipment are estimated at in the order of \$260M.

##### *Annual Operating Costs of Project*

Operating costs (excluding royalties) of the Project during production are estimated at in the order of \$220M per annum. These costs include:

- Mining.
- Milling and lab.
- Administration.
- Landowner compensations.
- Rehabilitation.
- Sustaining capital.

While royalties are a cost to the proponent, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project.

Depreciation has also been omitted from the estimation of operating costs since depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. The economic capital costs are included in the years in which they are proposed to occur.

##### *Decommissioning and Rehabilitation Costs*

Rehabilitation will be progressive over the life of the project and continue for several years post mining cessation. These costs are included in the operating costs above.

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<sup>5</sup> All values reported in this section are undiscounted unless specified.

## **Economic Benefits**

### *Revenues*

The main benefit of the Project is the revenue associated with sale of gold. For the purpose of this analysis, the current spot price of AUD\$5,000 is assumed for the life of the Project.

There is obviously considerable uncertainty around future gold prices in USD and the AUD/USD exchange rate and hence the value of incremental revenue has been subjected to sensitivity analysis (Section 2.8).

### *Residual Value at End of the Evaluation Period*

At the end of the Project, the land and capital equipment required for the Project could have some residual value that could be realised by sale or alternative uses. For the purpose of this analysis, it is assumed that the residual value of capital and land are both zero.

## **2.5.2 Indirect Costs and Benefits**

### **Greenhouse Gases**

Scope 1 and Scope 2 emissions are estimated at 105,496 tCO<sub>2</sub>-e, and 893 tCO<sub>2</sub>-e respectively in year 1 of construction. Over the life of the mine, average annual Scope 1 and Scope 2 emissions are estimated at 108,979 tCO<sub>2</sub>-e and 478 tCO<sub>2</sub>-e, respectively.

To place an economic value on CO<sub>2</sub>-e emissions, a shadow price of CO<sub>2</sub>-e is required that reflects the social cost of carbon to the referent group community the subject of the CBA, in this case the residents of Australia and Western Australia.

One recommended approach (NSW Treasury, 2023) is to use prices from the European Union Emissions Trading Scheme (EUETS). The Technical Note to this guidance (NSW Treasury 2023b) provides an Australian dollar value estimate for the year 2023 of \$123/t CO<sub>2</sub>-e increasing in real terms by 2.5% per annum.

However, the EUETS permit price is an “exchange price” that reflects the regulations and rules of the trading scheme. It is also a financial price rather than an economic value i.e. no real resources are exchanged for payment. This price is therefore far removed from the appropriate value for an Australian and Western Australian CBA which is the value of emission impacts to the households and businesses of Australia and Western Australia. Even if the EUETS scheme were designed efficiently, the price of a permit would reflect the global social damage cost of carbon (i.e. the cost of carbon emissions to the population of the whole world), not the damage cost to Australian and Western Australian residents.

The global damage cost of carbon is the sum of damage cost of carbon to each country (Ricke et al, 2018, p. 896). The national (and provincial) level damage costs of carbon are therefore much smaller than the global damage costs (Tol, 2019).

Consistent with the Commonwealth Office of Impact Analysis (2023), the focus of the CBA is on the costs and benefits to all people residing in Australia. In the absence of any studies that have focused on the social damage cost of carbon emissions to Australian and Western Australian residents, some means of apportioning global damage costs borne by Australians is required. For the Economic Assessment, this has been undertaken using Australia’s share of the global population (around 0.32%) and Western Australia’s share of the Australian population (10%).

On this basis, the present value (at 7% discount rate) of the cost of greenhouse gas emissions to Australian and Western Australia from the Project is estimated at \$0.37M and \$0.04M, respectively.

Scope 3 emissions are indirect greenhouse gas emission that occur in a company's value chain, outside of its direct control. They are generally excluded from consideration of the costs and benefits of a project.

### ***Operational Noise***

Noise and blasting from a project can impact the amenity of nearby properties. These impacts can potentially be valued using the property value method where the change in property value as a result of the noise and blasting impacts is estimated. Alternatively, it can be estimated using the defensive expenditure method where the costs of mitigation actions to protect a property from adverse noise impacts and blasting are estimated.

The primary source of noise emissions from the Project are associated with processing plant and mining equipment. However, noise modelling under worst-case meteorological conditions indicated that there will be regulatory compliance of assigned day and night LA10 noise levels at all sensitive receptors.

Assessment of blasting noise and vibration levels indicated that levels would be below the relevant blasting noise and vibration criteria. Consequently, there are no material acoustic or blasting related economic impacts for inclusion in the analysis.

### ***Road Transport***

The Project will result in some increase in traffic movement on the road network from workers, suppliers and transport of the gold product. From an economic perspective this could be associated with a number of externalities including capacity and safety issues, road wear and tear and vehicle emissions.

However, road usage would not exceed the capacity of the existing road network and no safety concerns have been identified. Wear and tear of haulage trucks on arterial roads is internalised in the registration costs of heavy vehicles. Consequently, there are no material traffic related economic impacts for inclusion in the analysis.

### ***Air Quality***

Air quality impacts of a project can potentially adversely impact amenity of adjoining properties and the health of the occupants.

The impact of the Project emissions can potentially be valued using the:

- the property value method, where the change in property value because of the air quality impacts are estimated.
- the cost of illness method where changes in health episodes as a result of emissions are estimated.
- the willingness to pay of impacted people to avoid the impacts.
- the defensive expenditure method, where the costs of mitigation are estimated.

An evaluation of air quality impacts found that there were five exceedances of the 24-hour criterion for TSP, however there were no exceedances of the annual average criteria. There were no exceedances at the human sensitive receptors at any of the other modelled pollutants (PM10, PM2.5, NO2, SO2, CO, and VOCs). Consequently, there are no material air quality related economic impacts for inclusion in the analysis.

## **Groundwater**

The Project will result in drawdown of groundwater aquifers. This could potentially impact groundwater users, Inland Water ways and Groundwater Dependent Ecosystems (GDEs). The economic impacts are the values that people have for the use of water, protection of GDEs and the outcomes of changes in flows and water quality in waterways.

However, local pastoral bores tend to be associated with discrete fracture systems disconnected from drawdown in the Project area. The Proposal is also expected to result in negligible difference in surface water quantity and therefore negligible impact to surface water flows reporting to downstream receptors (Advisian 2023). There is also unlikely to be any Groundwater Dependent Vegetation which would be impacted as a result of the Proposal. Control of contamination will be managed through other environmental approvals including a Mining Proposal (under the Mining Act) and Works Approval (under the EP Act Part V). Consequently, there are not likely to be any material residual groundwater impacts for inclusion in the CBA.

## **Surface Water**

As identified above, the Project will require dewatering and subsequent drawdown of the water table. The Project will also require alteration of the landscape and surface water flows as a result of pit and waste landform development. Impacts on water uses, water flows and water quality can impact economic values.

However, the Project is outside of any Rights in Water and Irrigation Act 1914 (RIWI Act) Proclaimed Surface Water or Public Drinking Water Source Areas. There are also no wetlands of national importance or significant surface water drainage features in the vicinity of the Project. Existing surface water flow regimes will be maintained via the installation and maintenance of surface water/drainage infrastructure across the site and the Project is expected to result in negligible difference in surface water quantity and therefore negligible impact to surface water flows reporting to downstream receptors. There will be no discharge of pit dewater or potentially contaminated surface water to the environment. Consequently, there are not likely to be any material residual surface water impacts for inclusion in the CBA.

## **Biodiversity**

The Project will result in the direct disturbance of seven species of conservation significance. However, the Project is not expected to cause any of the species to be elevated to a Threatened status. Removal of conservation significant individuals within the Disturbance Footprint will have a negligible impact on each species overall, given their known distribution range and number of records located outside the Development Envelope. The individuals in the Project area are not regionally significant and regional populations may be larger than indicated by current survey efforts.

The Project will negligibly reduce the current extent remaining of Pre-European vegetation associations. Both Vegetation Associations will remain above the 30% retention threshold in a State, regional and subregional context (EPA 2008).

The Critically Endangered 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC (Federal conservation status, State P3 PEC) and the Vulnerable Malleefowl (*Leipoa ocellata*) occur within the Disturbance Footprint. However, no significant residual impacts are anticipated.

The impacted vegetation and associated fauna are likely to have non-use values to the community that can potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is

also likely to have non-use values to the community. The cost of paying an annual amount for the LoM, as part of an MOU with the Gunduwa Regional Conservation Association and an annual amount for the LoM as part of an agreement with the Australian Wildlife Conservancy (AWC) and the National Malleefowl Recovery Group has been included in the operating costs of the Project.

To the extent that the offsets provided by these payments result in community values that are equivalent to the values lost from clearing, there will be no net loss in community values

### ***Aboriginal Heritage***

Impacts on Aboriginal cultural heritage can have use and non-use values to both Aboriginal and non-Aboriginal people that can be potentially estimated used nonmarket valuation methods such as choice modelling.

The Proposal will unavoidably impact two Artefact Scatter sites. Approval to impact these two sites under Section 18 of the Aboriginal Heritage Act 1972 has been agreed to by the Badimia (Badimia Land Aboriginal Corporation and Badimia Bandi Barna Aboriginal Corporation) and granted. The scatter items at these sites have been relocated by the Badimia to a culturally acceptable alternative location. A Heritage Agreement was signed with the Badimia in June 2023. A letter of support for the Proposal has also been provided by the Badimia people. Consequently, there are no material residual economic impacts for inclusion in the CBA.

### ***European Heritage***

Impacts on European heritage can have use and non-use values to the community that can be potentially estimated using nonmarket valuation methods such as choice modelling. However, there are no historic sites located within the Project Disturbance Footprint. Consequently, there are no economic impacts for inclusion in the CBA.

### ***Visual Impacts***

Visual impacts can potentially impact the amenity of nearby properties. These impacts can potentially be valued using the property valuation method. However, the Project is visually isolated from nearby sensitive receptors and hence there are no material visual costs for inclusion in the CBA.

## **2.6 Consolidation of Value Estimates**

### ***2.6.1 Net Production Benefits***

The present value of production costs and benefits, using a 7% discount rate, is provided in Table 2.3. The Project is estimated to have global net production benefits of \$3,179M (present value at 7% discount rate).

Capricorn Metals Ltd is estimated to be 19% Australian owned. Consequently, the net production benefits that accrue to Australia are the mining royalties, company tax, i.e. 30% of taxable income in accordance with the Commonwealth Income Tax Rates Act 1986, and 19% of the residual net production benefits. On this basis, the net production benefits of the Project that accrue to Australia are estimated at \$1,441M (present value at 7% discount rate).

The net production benefits can be further apportioned to Western Australia by assuming that company tax benefits, and residual net production benefits accrue to Western Australia based on its population share and that all mining royalties accrue to Western Australia. On this basis, the net production benefits



of the Project that accrue to Western Australia are estimated at \$304M (present value at 7% discount rate).

The estimated net production benefits that accrue to Australia and Western Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, offset and compensation, may be assessed.

Provided the value of the residual environmental impacts of the Project, to Australian and Western Australia households, after mitigation, offset and compensation, does not exceed the respective net production threshold values, then the Project will have net benefits to the Australian and Western Australian communities.

**Table 2.3 - Net Production Benefits of the Project (\$M Present Values at 7% Discount Rate)**

|                                                                             | <b>\$M</b>     |
|-----------------------------------------------------------------------------|----------------|
| <b>Costs</b>                                                                |                |
| Opportunity cost of land                                                    | \$0            |
| Opportunity cost of capital equipment                                       | \$0            |
| Capital costs                                                               | \$238          |
| Operating cost (ex-royalties), including rehabilitation and decommissioning | \$1,712        |
| Decommissioning and rehabilitation costs                                    | \$0            |
| <b>Sub-total</b>                                                            | <b>\$1,950</b> |
| <b>Benefits</b>                                                             |                |
| Revenue                                                                     | \$5,129        |
| Residual value of land                                                      | \$0            |
| Residual value of capital equipment                                         | \$0            |
| <b>Sub-total</b>                                                            | <b>\$5,129</b> |
| <b>Global Net Production Benefits</b>                                       | <b>\$3,179</b> |
| Royalties to Western Australian Government                                  | \$171          |
| Company Tax                                                                 | \$872          |
| Residual net production benefits                                            | \$2,136        |
| <b>Global Net Production Benefits</b>                                       | <b>\$3,179</b> |
| Royalties to Western Australian Government                                  | \$171          |
| Company Tax                                                                 | \$872          |
| Residual net production benefits                                            | \$398          |
| <b>Australian Net Production Benefits</b>                                   | <b>\$1,441</b> |
| Royalties to Western Australian Government                                  | \$171          |
| Company Tax                                                                 | \$91           |
| Residual net production benefits                                            | \$42           |
| <b>Western Australian Net Production Benefits</b>                           | <b>\$304</b>   |

### 2.6.2 Indirect Impacts

The CBA qualitatively considered and where possible quantified the main environmental, cultural, and social impacts of the Project to Australia and Western Australian. Table 2.4 summarises the results of the consideration of indirect impacts in Section 2.5.2.

**Table 2.4– Indirect Impacts of the Project (\$M Present Values at 7% Discount Rate)**

| <b>Costs</b>                             | <b>Australia</b>                                                                                                                                                      | <b>Western Australian</b> |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Greenhouse gas emissions (Scope 1 and 2) | \$0.37                                                                                                                                                                | \$0.04                    |
| Operational noise                        | No material residual impact*                                                                                                                                          |                           |
| Road transport and traffic               | No material residual impact*                                                                                                                                          |                           |
| Air quality                              | No material residual impact*                                                                                                                                          |                           |
| Groundwater                              | No material residual impact*                                                                                                                                          |                           |
| Surface water                            | No material residual impact*                                                                                                                                          |                           |
| Biodiversity                             | Some impact but offset via payments to the Gunduwa Regional Conservation Association, the Australian Wildlife Conservancy, and the National Malleefowl Recovery Group |                           |
| Aboriginal heritage                      | Some impact but offset via a Heritage Agreement*                                                                                                                      |                           |
| Historic heritage                        | No material residual impact*                                                                                                                                          |                           |
| Visual                                   | No material residual impact*                                                                                                                                          |                           |
| <b>Sub-total</b>                         | <b>\$0.37</b>                                                                                                                                                         | <b>\$0.04</b>             |

\* Western Australian regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures mitigate, offset or compensate then no material residual impacts occur, and all impacts are borne by the proponent.

From Section 2.5.2, it is evident that the main potential impacts of the Project are internalised into the production costs through project design and mitigation, offset and compensation measures. Other costs not already included in the production costs of the Project are associated with Scope 1 and Scope 2 GHG costs. Although from Table 2.4, it is evident that these impacts to Australia and Western Australian are small or immaterial.

### 2.6.3 Net Social Benefits to Australia and Western Australia

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

The results from Table 2.3 and Table 2.4 are combined in Table 2.5 to estimate the net social benefits of the Project to Australia and Western Australian.

**Table 2.5 – Net Social Benefits of the Project (\$M Present Values @ 7% Discount Rate)**

| Benefits                                 | Australia                                                                                                                                                             | Western Australian |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Net Production Benefits</b>           |                                                                                                                                                                       |                    |
| Royalties to Government                  | \$171                                                                                                                                                                 | \$171              |
| Company Tax                              | \$872                                                                                                                                                                 | \$91               |
| Residual net production benefits         | \$398                                                                                                                                                                 | \$42               |
| <b>Sub-total</b>                         | <b>\$1,441</b>                                                                                                                                                        | <b>\$304</b>       |
| <b>Costs</b>                             |                                                                                                                                                                       |                    |
| Greenhouse gas emissions (Scope 1 and 2) | \$0.37                                                                                                                                                                | \$0.04             |
| Operational noise                        | No material residual impact*                                                                                                                                          |                    |
| Road transport and traffic               | No material residual impact*                                                                                                                                          |                    |
| Air quality                              | No material residual impact*                                                                                                                                          |                    |
| Groundwater                              | No material residual impact*                                                                                                                                          |                    |
| Surface water                            | No material residual impact*                                                                                                                                          |                    |
| Biodiversity                             | Some impact but offset via payments to the Gunduwa Regional Conservation Association, the Australian Wildlife Conservancy, and the National Malleefowl Recovery Group |                    |
| Aboriginal heritage                      | Some impact but offset via a Heritage Agreement                                                                                                                       |                    |
| Historic heritage                        | No material residual impact*                                                                                                                                          |                    |
| Visual                                   | No material residual impact*                                                                                                                                          |                    |
| <b>Sub-total</b>                         | <b>\$0.37</b>                                                                                                                                                         | <b>\$0.04</b>      |
| <b>Net Social Benefits</b>               | <b>\$1,440</b>                                                                                                                                                        | <b>\$304</b>       |

\* Western Australian regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures mitigate, offset or compensate then no material residual impacts occur and all impacts are borne by the proponent.

Overall, the Project is estimated to have net social benefits to both Australia and Western Australian and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural, and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural, or social impacts that remain unquantified would need to be valued at greater than \$1,440M and \$304M for the Project to be questionable from an Australian and Western Australian economic efficiency perspective, respectively.

## 2.7 Distribution of Western Australian Costs and Benefits

CBA is primarily concerned with the single objective of economic efficiency. CBA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, CBA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed.

The costs and benefits of the Project to Western Australian are potentially distributed among a range of stakeholders as identified in Table 2.6.

**Table 2.6 - Incidence of Western Australian Costs and Benefits**

| BENEFITS AND COSTS                               | INCIDENCE OF COSTS AND BENEFITS                                                                                                     | (\$M Present Value @ 7% Discount Rate)                                                                                                                                |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Share of net production benefits</b>          |                                                                                                                                     |                                                                                                                                                                       |
| Royalties                                        | Western Australian Government and Western Australian households                                                                     | \$171                                                                                                                                                                 |
| Company tax                                      | Western Australian Government and Western Australian households                                                                     | \$91                                                                                                                                                                  |
| Residual net production benefits                 | Western Australian Shareholders                                                                                                     | \$42                                                                                                                                                                  |
| <b>Environmental, social and cultural costs*</b> |                                                                                                                                     |                                                                                                                                                                       |
| Greenhouse gas emissions (Scope 1 and 2)         | Local and Western Australian households                                                                                             | \$0.04                                                                                                                                                                |
| Operational noise                                | Adjoining landholders                                                                                                               | No material residual impact*                                                                                                                                          |
| Road transport                                   | Local residents and road users                                                                                                      | No material residual impact*                                                                                                                                          |
| Air quality                                      | Adjoining landholders                                                                                                               | No material residual impact*                                                                                                                                          |
| Groundwater                                      | Users of groundwater and those who value the protection of GDEs and the outcomes of changes in flows and water quality in waterways | No material residual impact*                                                                                                                                          |
| Surface water                                    | Users of surface water and those who value the outcomes of changes in flows and water quality in waterways                          | No material residual impact*                                                                                                                                          |
| Biodiversity                                     | Local and Western Australian households                                                                                             | Some impact but offset via payments to the Gunduwa Regional Conservation Association, the Australian Wildlife Conservancy, and the National Malleefowl Recovery Group |
| Aboriginal heritage                              | Aboriginal people and other local and Western Australian households                                                                 | Some impact but offset via a Heritage Agreement                                                                                                                       |
| Historic heritage                                | Local and Western Australian households                                                                                             | No material residual impact*                                                                                                                                          |
| Visual amenity                                   | Adjoining landholders and passing motorists                                                                                         | No material residual impact*                                                                                                                                          |

\* Western Australian regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset, or compensate then no residual impacts occur, and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation are imperfect.

## 2.8 Risk and Sensitivity Analysis

The main areas of environmental risks associated with mining projects relate to:

- the financial viability of a project from unexpected downturns in gold prices and any consequent environmental impacts from premature cessation of operations.
- ecological risk associated with whether the biodiversity offsets will adequately compensate for the direct ecological impacts.
- other environmental, social, and cultural impact estimations and required mitigation measures.

The financial viability of projects is a risk assumed by the project owners. Any risk that the Project may commence and then cease operation for financial reasons leaving unmet rehabilitation liabilities is mitigated by the fact that the Department of Mines, Industry Regulation and Safety (DMIRS) requires mining projects to provide financial assurance to cover the costs of rehabilitating the sited. This financial

assurance is referred to as a “rehabilitation bond” or “security deposit”. The rehabilitation bond or security deposit is reviewed periodically to ensure it remains adequate to cover the rehabilitation costs.

The provision of biodiversity offsets can be associated with several risks, including in relation to the biodiversity benefits of additional management of offsets, success in reconstruction of ecological communities, time-lags between impacts and provision of offsets as well as between management actions and achievement of ecological outcomes. These risks are mitigated through offset ratio requirements in the provision of/payment for offsets and commitment to the offset actions/payments prior to the impacts occurring.

In relation to the estimation of environmental, social, and cultural impacts of the Project, these impacts have generally been assessed based on the maximum annual levels of production and hence are likely to be overstated and very conservative. The relevant technical studies have not identified any material residual environmental, social, or cultural impacts.

The NPV of the Project to Western Australia (presented in Table 2.5) is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a CBA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie 2002) to determine the effect on the NPV<sup>6</sup>.

In this sensitivity analysis, the CBA results for Western Australia were tested for changes to the following variables at a 3%, 7% and 10% discount rate:

- operating costs.
- capital costs.
- revenue (which reflects production levels, USD gold price and exchange rate).
- GHG costs.

Results are reported in Tables 2.7. What this analysis indicates is that CBA is most sensitive to changes in revenue (reflecting production levels, the value of gold in USD and the USD/ AUD exchange rate) and to a lesser extent, operating costs. This is because changes in revenue directly impact royalties which is the main component of net production benefits to Western Australian. Changes in revenue also impact company tax estimates and residual net production benefits, only a component of which accrues to Western Australian. Changes in operating costs do not impact royalties but do impact the estimates of company tax and residual net production benefits.

The sensitivity analysis indicated that the CBA results are not sensitive to changes in capital costs or GHG costs. Since mitigation, offset and compensation costs are a small component of the capital and operating costs of the Project, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results.

Under all scenarios examined, the Project, has net social benefits to Western Australian.

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<sup>6</sup> Quantitative risk analysis could also potentially be undertaken. However, this requires information on the probability distributions for input variables in the analysis. This information is not available and so the sensitivity testing is limited to uncertainty analysis.

**Table 2.7 - Western Australian CBA Sensitivity Testing (\$M Present Value @ Various Discount Rates)**

|                         | <b>3% Discount Rate</b> | <b>7% Discount Rate</b> | <b>10% Discount Rate</b> |
|-------------------------|-------------------------|-------------------------|--------------------------|
| <b>CENTRAL ANALYSIS</b> | \$402                   | \$304                   | \$250                    |
| <b>INCREASE – 20%</b>   |                         |                         |                          |
| Operating costs         | \$382                   | \$289                   | \$238                    |
| Capital costs           | \$398                   | \$301                   | \$248                    |
| Revenue                 | \$505                   | \$383                   | \$316                    |
| Greenhouse gas costs    | \$402                   | \$304                   | \$250                    |

|                       | <b>3% Discount Rate</b> | <b>7% Discount Rate</b> | <b>10% Discount Rate</b> |
|-----------------------|-------------------------|-------------------------|--------------------------|
| <b>DECREASE – 20%</b> |                         |                         |                          |
| Operating costs       | \$422                   | \$320                   | \$263                    |
| Capital costs         | \$405                   | \$307                   | \$253                    |
| Revenue               | \$298                   | \$225                   | \$185                    |
| Greenhouse gas costs  | \$402                   | \$304                   | \$251                    |

### 3 REGIONAL AND STATE IMPACT ANALYSIS OF THE PROJECT

#### 3.1 Introduction

The CBA in Section 2 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Project compared to 'without' it. This section examines gross regional and State economic activity impacts of the construction and operation of the Project in terms of a number of specific direct and indirect indicators of economic activity, namely gross regional output, value-added, household income and employment. The region for analysis was the Mid-West Statistical Area Level 3 within which the Project is located.

Economic activity impacts were assessed using input-output analysis. This involved:

- development of an appropriate IO tables (regional and State transaction table) that can be used to identify the economic structure of the region and multipliers for each existing sector of the economy. IO tables for the regional and Western Australian economy were developed using the Generation of Regional Input Output Tables (GRIT) procedure developed by the University of Queensland and recognised internationally - Refer to Attachment 2.
- identification of the direct impact or stimulus of the Project, in a form that is compatible with the IO equations, so that the IO multipliers and flow-on effects for the impacts or stimulus of the project can then be estimated (West, 1993). The direct impact of the project was estimated from data provided by the proponent and production ratios in the IO tables. Indirect effects were estimated using the *EconImp* program.<sup>7</sup>

#### 3.2 Construction Impacts

##### 3.2.1 Introduction

Construction expenditure is associated with manufacturing of equipment and expenditure across the following three construction sectors of the IO industry classification:

- The *Heavy and Civil Engineering Construction Sector* which includes businesses involved in engineering construction and project management services for a diverse range of activities including road construction, mine site construction, on-site assembly of heavy electrical machinery from prefabricated components etc.
- The *Construction Services Sector* which includes businesses involved in earthmoving work such as levelling of construction sites, excavation of foundations, trench digging, concreting services, electrical services, hire of earthmoving plant with operator etc.
- The *Non-Residential Building Construction Sector* which includes businesses engaged in the construction of industrial buildings.

Conservatively, all machinery manufacturing is assumed to occur outside the region/Western Australia.

Construction is anticipated to occur over a 15-month period with an average quarterly construction workforce over this period 130 people.

Based on the IO coefficients of the abovementioned three construction sectors in the regional IO table, \$47M of expenditure would be required across these sectors to generate an average annual construction workforce of 130.

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<sup>7</sup> The *EconImp* program uses the Leontif Inverse Matrix to estimate indirect effects.

### 3.2.2 Impacts

The estimated direct and indirect regional economic impact of \$47M expenditure in the regional and Western Australian economy is reported in Tables 3.1 and 3.2.

**Table 3.1 – Average Annual Economic Impacts of the Construction on the Regional Economy (\$2024)**

|                          | Direct   | Production induced | Consumption induced | Total Flow on | TOTAL EFFECT |
|--------------------------|----------|--------------------|---------------------|---------------|--------------|
| <b>OUTPUT (\$M)</b>      | 47       | 31                 | 3                   | 34            | 80           |
| <i>Type 11A Ratio</i>    | 1.00     | 0.66               | 0.06                | 0.72          | 1.72         |
| <b>VALUE ADDED (\$M)</b> | 19       | 7                  | 2                   | 9             | 27           |
| <i>Type 11A Ratio</i>    | 1.00     | 0.38               | 0.09                | 0.47          | 1.47         |
| <b>INCOME (\$M)</b>      | 12 (2)   | 4                  | 1                   | 5             | 18           |
| <i>Type 11A Ratio</i>    | 1.00     | 0.35               | 0.07                | 0.42          | 1.42         |
| <b>EMPL. (No.)</b>       | 130 (26) | 48                 | 13                  | 61            | 191          |
| <i>Type 11A Ratio</i>    | 1.00     | 0.37               | 0.10                | 0.47          | 1.47         |

Note: Totals may have minor discrepancies due to rounding.

**Table 3.2 – Average Annual Economic Impacts of the Construction on the Western Australian Economy (\$2024)**

|                          | Direct | Production induced | Consumption induced | Total Flow on | TOTAL EFFECT |
|--------------------------|--------|--------------------|---------------------|---------------|--------------|
| <b>OUTPUT (\$M)</b>      | 47     | 50                 | 41                  | 91            | 137          |
| <i>Type 11A Ratio</i>    | 1.00   | 1.08               | 0.88                | 1.96          | 2.96         |
| <b>VALUE ADDED (\$M)</b> | 19     | 15                 | 22                  | 38            | 56           |
| <i>Type 11A Ratio</i>    | 1.00   | 0.83               | 1.18                | 2.01          | 3.01         |
| <b>INCOME (\$M)</b>      | 12     | 13                 | 12                  | 25            | 38           |
| <i>Type 11A Ratio</i>    | 1.00   | 1.04               | 1.00                | 2.04          | 3.04         |
| <b>EMPL. (No.)</b>       | 130    | 101                | 156                 | 257           | 387          |
| <i>Type 11A Ratio</i>    | 1.00   | 0.78               | 1.20                | 1.98          | 2.98         |

Note: Totals may have minor discrepancies due to rounding.

In estimating the average annual economic impacts, it is important to separate the direct effects, flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these three effects operate in different ways and have different spatial impacts.

Direct effects refer to the metrics that summarise the direct impact (in this case the construction activity). While this direct output, value-added, income and employment occur in the region, it may not accrue to regionally based businesses or regionally based labour. In Tables 3.1 the direct income and employment accruing to regionally based labour is provided in brackets. For Western Australia, all direct effects are assumed to accrue to the State.

Both production-induced effects and consumption-induced effects accrue to the region based on local purchases for production and wage spending.

Production-induced effects occur in a near-proportional way to expenditure within a region, whereas the consumption-induced flow-on effects only occur in a proportional way to income if workers and their families are in the region or migrate into the region. Where workers commute from outside the region, some of the consumption-induced flow-on effects leak from the region.



It is estimated that approximately 20 per cent of the construction workforce would be sourced from the region, with the remainder residing outside the region and commuting.

Based on the above, it is assumed for this analysis that approximately 80 per cent of the consumption induced expenditure leaks from the region. Consequently, Table 3.1 has been adjusted to only include 20 per cent of consumption-induced flow-ons. All the workforce is assumed to come from Western Australia and all of consumption induced impacts are included in Table 3.2.

The average annual construction impacts of the Project on the regional economy are estimated at up to:

- \$80M in annual direct and indirect output (\$34M of which accrues to the region).
- \$27M in annual direct and indirect value added (\$9M of which accrues to the region).
- \$18M in annual direct and indirect household income (\$7M of which accrues to the region).
- 191 direct and indirect jobs (\$87M of which accrues to the region).

The average annual construction impacts of the Project on the Western Australian economy are estimated at up to:

- \$137M in annual direct and indirect output.
- \$56M in annual direct and indirect value added.
- \$38M in annual direct and indirect household income.
- 387 direct and indirect jobs.

The impacts are larger for the Western Australian economy because there is less leakage of direct and indirect expenditure out of the Western Australian economy compared to the regional economy and hence greater production induced and consumption induced flow-on effects. The impacts would be even larger for the Australian economy.

### 3.2.3 Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from IO analysis (refer to Attachment 3). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

At the regional level, the adjusted type 11A ratio multipliers for the construction workforce of the Project range from 1.42 for income up to 1.72 for output. The Western Australian type 11A ratio multipliers for the construction workforce range from 2.57 for income up to 3.01 for value added. The multipliers are large for the Western Australian economy because of the greater level of intersectoral linkages in the larger economy and hence larger level of flow-on impacts i.e. less leakages compared to the regional economy.

### 3.2.4 Main Sectors Affected

The IO analysis indicates construction is most likely to directly impact the *Heavy and Civil Engineering Construction Sector*, *Construction Services Sector* and *Non-Residential Building Construction Sector*. Flow-on impacts from the construction of the Project are likely to affect several different sectors of the regional and Western Australian economy.

The sectors of the regional economy most impacted by output, value-added, income and employment production induced flow-ons are likely to be as follows:

- *Professional, Scientific and Technical Services.*
- *Wholesale and Retail Trade.*
- *Road Transport.*
- *Transport Support Services and Storage.*
- *Cement, Lime and Ready-Mixed Concrete Manufacturing.*
- *Employment, Travel Agency and Other Administrative Services*
- *Building Cleaning, Pest Control and Other Support Services.*

For the Western Australian economy, the *Finance sector*, and *Auxiliary Finance and Insurance sector*, are also important production induced flow-on sectors.

Consumption induced flow-on effects in the region will be mainly in the following sectors:

- *Retail and Wholesale Trade.*
- *Food and Beverage Services.*
- *Health Care Services.*
- *Actual Rent for Housing.*
- *Primary and Secondary Education.*
- *Residential Care and Social Assistance.*
- *Automotive Repairs and Maintenance.*

For the Western Australian economy, the *Finance; Professional, Scientific and Technical Services; Employment, Travel Agency and Other Administrative Services*, are also important consumption induced flow-on sectors.

### 3.3 Operation Impacts

#### 3.3.1 Introduction

For the analysis of the Project, a new regional and State Project sector, reflecting average annual production levels was developed from financial information provided by the proponent and inserted into the IO tables<sup>8</sup> for the region and State.

For these new sectors:

- the estimated gross annual revenue of the project was allocated to the *output* row.
- the estimated wage bill of employees residing in each of the regions was allocated to the *household wages* row with any remainder allocated to a *secondary household wages* row not linked to wages expenditure in the region.
- non-wage local expenditure was initially allocated between total intermediate expenditure and imports in proportion to the *non-ferrous metal ore mining* sectors of the relevant regions.
- allocation was then further made between *intermediate sectors* based on the ratios of intermediate expenditure for the *non-ferrous metal ore mining sector* in the relevant regions.
- the difference between total revenue and intermediate expenditures was allocated to the *other value-added* row.
- direct employment in the project was allocated to the *employment* row.

The major difference between the sectors generated for the region and Western Australia was the greater intermediate expenditure and wages that could be captured in the larger economy. The smaller the economy, the greater reliance on imports.

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<sup>8</sup> Inflated to 2024

### 3.3.2 Impacts

The total and disaggregated annual impacts of the operation of the Project on the region and Western Australian economy are shown in Tables 3.3 and 3.4.

**Table 3.3 – Average Annual Economic Impacts of the Operation on the Regional Economy (\$2024)**

|                          | <b>Direct Effect</b> | <b>Production Induced</b> | <b>Consumption Induced</b> | <b>Total Flow-on</b> | <b>TOTAL EFFECT</b> |
|--------------------------|----------------------|---------------------------|----------------------------|----------------------|---------------------|
| <b>OUTPUT (\$M)</b>      | 709                  | 137                       | 32                         | 169                  | 878                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 0.19                      | 0.05                       | 0.24                 | 1.24                |
| <b>VALUE-ADDED (\$M)</b> | 545                  | 60                        | 19                         | 78                   | 623                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 0.11                      | 0.03                       | 0.14                 | 1.14                |
| <b>INCOME (\$M)</b>      | 57 (3)               | 34                        | 10                         | 44                   | 101                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 0.60                      | 0.17                       | 0.77                 | 1.77                |
| <b>EMPLOYMENT (No.)</b>  | 300 (15)             | 392                       | 142                        | 534                  | 834                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 1.31                      | 0.47                       | 1.78                 | 2.78                |

Note: Totals may have minor discrepancies due to rounding.

Source: Generated from EconImp

**Table 3.4 – Average Annual Economic Impacts of the Operation on the Western Australian Economy (\$2024)**

|                          | <b>Direct Effect</b> | <b>Production Induced</b> | <b>Consumption Induced</b> | <b>Total Flow-on</b> | <b>TOTAL EFFECT</b> |
|--------------------------|----------------------|---------------------------|----------------------------|----------------------|---------------------|
| <b>OUTPUT (\$M)</b>      | 709                  | 222                       | 116                        | 338                  | 1,047               |
| <i>Type 11A Ratio</i>    | 1.00                 | 0.31                      | 0.16                       | 0.48                 | 1.48                |
| <b>VALUE-ADDED (\$M)</b> | 545                  | 100                       | 63                         | 163                  | 708                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 0.18                      | 0.12                       | 0.30                 | 1.30                |
| <b>INCOME (\$M)</b>      | 57                   | 70                        | 35                         | 105                  | 162                 |
| <i>Type 11A Ratio</i>    | 1.00                 | 1.22                      | 0.62                       | 1.84                 | 2.84                |
| <b>EMPLOYMENT (No.)</b>  | 300                  | 627                       | 442                        | 1,068                | 1,368               |
| <i>Type 11A Ratio</i>    | 1.00                 | 2.09                      | 1.47                       | 3.56                 | 4.56                |

Note: Totals may have minor discrepancies due to rounding.

Source: Generated from EconImp

In total, the operation phase of the Project is estimated to make up to the following annual contribution to the regional economy:

- \$878M in direct and indirect regional output or business turnover (\$169M of which accrues to the regional).
- \$623M in direct and indirect regional value-added (\$78M of which accrues to the region).
- \$101M in direct and indirect household income (\$47M of which accrues to the region).
- 834 direct and indirect jobs (549 of which accrues the region).

For the Western Australian economy, the operation phase of the Project is estimated to make up to the following annual contributions:

- \$1,047M in direct and indirect output.
- \$708M in direct and indirect value-added.

- \$162M in direct and indirect household income.
- 1,368 direct and indirect jobs.

Impacts for the Australian economy would be greater than those for the Western Australian economy because of the greater ability of the Australian economy to provide the goods and services required for production and demand by workers.

Businesses that can supply the goods and services required by the Project or demanded by locally sourced workers and their families will benefit from increased economic activity. However, due to intersectoral linkages many other business will also benefit.

### 3.3.3 Multipliers

The Type 11A ratio multipliers for the operation of the Project are provided in Tables 3.3 and 3.4. For the regional economy, the Type 11A ratio multipliers range from 1.14 for value-added up to 2.78 for income. For the Western Australian economy the Type 11A ratio multipliers range from 1.30 for value-added up to 4.56 for employment.

Capital intensive industries tend to have a high level of linkages with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to relatively high ratio multipliers for employment. A lower ratio multiplier for income (compared to employment) also generally occurs because of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the project. Capital intensive mining projects also typically have a relatively low ratio multiplier for output and value-added, reflecting the relatively high direct output and value-added for the project compared to that in flow-on sectors.

### 3.3.4 Main Sectors Affected

The sectors of the regional economy most impacted by output, value-added, income and employment production induced flow-ons are likely to be as follows:

- *Construction Services.*
- *Exploration and Mining Support Services.*
- *Other Repairs and Maintenance.*
- *Professional, Scientific and Technical Services.*
- *Wholesale and Retail Trade.*
- *Road Transport.*
- *Transport Support Services and Storage.*

For the Western Australian economy, the *Exploration and Mining Support Services, Non-Residential Property Operators and Real Estate Services, Transport Support Services and Storage, Heavy Engineering Construction, Employment, Travel Agency and Other Administration Services* are also important production induced flow-on sectors.

Consumption induced flow-on effects in the region will be mainly in the following sectors:

- *Retail and Wholesale Trade.*
- *Food and Beverage Services.*
- *Health Care Services.*
- *Actual Rent for Housing.*
- *Primary and Secondary Education.*
- *Residential Care and Social Assistance.*

- *Automotive Repairs and Maintenance.*

For the Western Australian economy, the *Finance; Professional, Scientific and Technical Services; Employment, Travel Agency and Other Administrative Services*, are also important consumption induced flow-on sectors.

### **3.4 Other Economic Impacts**

#### **3.4.1 Potential Contraction in Other Sectors**

Economic impacts for regional and Western Australian economies, modelled using input-output analysis, represent the gross or positive economic activity associated with the Project. Where employed and unemployed labour resources in the region are limited and the mobility of in-migrating or commuting labour from outside the region is restricted, there may be competition for regional labour resources that drives up regional wages. In these situations, there may be some 'crowding out' of economic activity in other sectors of the regional economy.

'Crowding out' would be most prevalent if the regional and Western Australian economies were at full employment and they were closed economy with no potential to use labour and other resources that currently reside outside the region. However, the regional and Western Australian economies are not at full employment and they each have access to external labour resources. Ninety-five per cent of the operation workforce is expected to be sourced from outside the region and fly-in-fly out. Consequently, little 'crowding out' of economic activity in other sectors would be expected as a result of the Project. 'Crowding out' would be most prevalent for Western Australia, but the impacts would be dispersed.

However, even where there is some 'crowding out' of other economic activities this does not indicate losses of jobs but the shifting of labour resources to higher valued economic activities. This reflects the operation of the market system where scarce resources are reallocated to where they are most highly valued and where society would benefit the most from them. This reallocation of resources is therefore considered a positive outcome for the economy not a negative.

#### **3.4.2 Wage Impacts**

In the short-term, increased regional demand for labour because of the Project could potentially result in some increased pressure on wages in other sectors of the economy. The magnitude and duration of this upward wages pressure would depend on the level of demand for additional labour, the availability of labour resources in the region and the availability and mobility of labour from outside the region. However, because 80% of the construction workforce and 95% of the direct operational workforce is estimated to be non-local hires, wage impacts because of the Project alone are not likely to be significant. Where upward pressure on regional wages occurs, it represents an economic transfer between employers and owners of skills and would attract skilled labour to the region leading to downward pressure on wages.

#### **3.4.3 Housing Impacts**

Housing impacts in the region are anticipated to be negligible due to the predominantly fly-in fly-out nature of the Project operation.

## 4 CONCLUSION

A CBA of the Project has determined that the Project would have net production benefits to Australia and Western Australian of \$1,441M and \$304M, respectively. Provided the residual environmental, social, and cultural impacts of the Project that accrue to Australia and Western Australian are considered to be valued at less than the level of net production benefits, the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

The environmental, cultural, and social impacts were then considered qualitatively and where required valued using market data and benefit transfer and incorporated into an estimate of the net social benefit of the Project. Most residual environmental, cultural and social impacts of the Project after mitigation, compensation and offset, were immaterial from an aggregate economic efficiency perspective. The main quantifiable residual environmental impact of the Project, which have not already been incorporated into the estimate of net production benefits, relate to the impacts of scope 1 and scope 2 greenhouse gas (GHG) emissions. Scope 1 and Scope 2 GHG impacts to Australia and Western Australia from the Project are estimated at \$0.37M and \$0.04M, respectively. These economic costs are considerably less than the estimated net production benefits of the Project.

Combining the estimate of net production benefit with the residual environmental costs, the Project is estimated to have net social benefits to both Australia and Western Australian of \$1,440M and \$304M, respectively.

While the major environmental, cultural, and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural, or social impacts that remain unquantified would need to be valued at greater than \$1,440M and \$304M for Australia and Western Australian, respectively, for the Project to be questionable from an economic efficiency perspective.

The Project will also provide considerable direct and indirect economic activity, including jobs, to the regional and Western Australian economy.

## 5 REFERENCES

Australian Bureau of Statistics (1995) *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*. Cat. No. 5246.0.

Boardman, A., Greenberg, D., Vining, A., Weimer, D. (2001) *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall, USA.

Commonwealth Office of Impact Analysis (2023) *Cost Benefit Analysis Guidance Note*, Australian Gover, Department of the Prime Minister and Cabinet.

James, D. and Gillespie, R. (2002) *Guideline for Economic Effects and Evaluation in EIA*. Prepared for NSW Department of Urban Affairs and Planning.

NSW Treasury (2023) *NSW Government Guide to Cost-Benefit Analysis*, TPG23-08, NSW Government.

NSW Treasury (2023b) *Technical Note to NSW Government Guide to Cost-Benefit Analysis*, TPG23-08: *Carbon value in cost benefit analysis*, NSW Government.

Ricke, K. Drouet, L., Caldeira, K. and Tavoni, M. (2018) Country – level social cost of carbon, *Nature Climate Change*, V. 8, p. 895-900. <https://doi.org/10.1038/s41558-018-0282-y>

Tol, R. (2019) A social cost of carbon for (almost) every country, *Energy Economics* V. 83, p. 555-566, <https://doi.org/10.1016/j.eneco.2019.07.006>

## ATTACHMENT 1 - COST BENEFIT ANALYSIS

### Introduction to CBA

Cost Benefit Analysis (CBA) has its theoretical underpinnings in neoclassical welfare economics. Applications in Australia are guided by these theoretical foundations as well as various government guidelines, including the Commonwealth Office of Impact Analysis (2023) *Cost Benefit Analysis Guidance Note*.<sup>9</sup>

CBA is concerned with a single objective of economics and governments i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These costs and benefits are defined and valued based on the microeconomic underpinnings of CBA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

While CBA can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and CBA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about equity are subjective and are therefore left to decision-makers.

Similarly, CBA does not address other objectives of governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by CBA, alongside the performance of a project in meeting other conflicting goals and objectives of governments.

### Definition of Society

CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

As a tool of investment appraisal for the public sector, CBA can potentially be applied across different definitions of society such as a local area, state, nation, or the world. However, most applications of CBA are performed at the national level. This national focus extends the analysis beyond that which is strictly relevant to a State government planning authority. However, the interconnected nature of the Australian economy and society creates significant spill-overs between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Where major impacts spill over national borders CBA can also be undertaken from the global as well as the national perspective (Boardman *et al.*, 2001). For mining projects, impacts that spill over national borders include greenhouse gas costs and producer surplus benefits to foreign owners.

The Commonwealth Office of Impact Analysis (2023) follows this approach, identifying that “for most proposals, measuring the national costs and benefits is appropriate, rather than measuring any international impacts. That is, as far as is practical, you should count the costs and benefits to all people residing in Australia.”

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<sup>9</sup> While these guidelines are for the purpose of evaluating regulatory proposals the principles can still be applied to private sector projects.



A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to a State jurisdiction.

### **Definition of the Project Scope**

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a CBA is undertaken from a global perspective and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For gold mining projects, typically only the costs and benefits from mining the gold and delivering it to Port or domestic users, are relevant.

Gold is an intermediate good i.e. it is an input to other production processes. However, these other production processes themselves require approval and, in CBA, would be assessed as separate projects.

### **Net Production Benefits**

CBA of mining proposals invariably involves a trade-off between:

- the net production (producer surplus) benefits of a project; and
- the environmental, social and cultural impacts (most of which are costs of mining but some of which may be benefits).

Net production benefits can be estimated based on market data on the projected financial value of the mined produce less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

### **Environmental, Social and Cultural Impacts**

The consideration of non-market impacts in CBA relies on the assessment of other experts contributing information on the biophysical impacts. The environmental impact assessment process results in detailed (non-monetary) consideration of the environmental, social, and cultural impacts of a project and the proposed means of mitigating the impacts.

At its simplest level, CBA may summarise the consequences of the environmental, social, and cultural impacts of a project (based on the assessments in the relevant assessment document), for people's well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

These environmental, social, and cultural impacts generally fall into three categories, those which:

- can be readily identified, measured in physical terms and valued in monetary terms;
- can be identified and measured in physical terms but cannot easily be valued in money terms; and
- are known to exist but cannot be precisely identified, measured or value.

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In attempting to value the impacts of a project on the well-being of people, there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA.

Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner.

### **Consideration of Net Social Benefits**

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social, and cultural impacts.

In combining these considerations, it should be noted that the estimates of net production benefits of a project generally include accounting for costs aimed at mitigating, offsetting, or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs effectively internalises the respective and otherwise, non-monetary environmental, social, and cultural costs. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social, and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefit of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the relevant assessment document), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural, or social costs that remain unquantified in the analysis<sup>10</sup> can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural, and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

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<sup>10</sup> Including potential impacts that were unknown at the time of the preparation of the relevant assessment document or arise during the Environmental Impact Assessment process due to differences in technical opinions.

## ATTACHMENT 2 – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

The GRIT system was designed to:

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

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the other mining sector. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study. An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A2.1 (Powell and Chalmers, 1995).

**Table A2.1 The GRIT Method**

|           |    |                                                                                                                     |
|-----------|----|---------------------------------------------------------------------------------------------------------------------|
| Phase I   |    | Adjustments To National Table                                                                                       |
|           | 1  | Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values). |
|           | 2  | Adjustment of national table for updating.                                                                          |
|           | 3  | Adjustment for international trade.                                                                                 |
| Phase II  |    | Adjustments For Regional Imports                                                                                    |
|           |    | <i>(Steps 4-14 apply to each region for which input-output tables are required)</i>                                 |
|           | 4  | Calculation of 'non-existent' sectors.                                                                              |
|           | 5  | Calculation of remaining imports.                                                                                   |
| Phase III |    | Definition of Regional Sectors                                                                                      |
|           | 6  | Insertion of disaggregated superior data.                                                                           |
|           | 7  | Aggregation of sectors.                                                                                             |
|           | 8  | Insertion of aggregated superior data.                                                                              |
| Phase IV  |    | Derivation of Prototype Transactions Tables                                                                         |
|           | 9  | Derivation of transactions values.                                                                                  |
|           | 10 | Adjustments to complete the prototype tables.                                                                       |
|           | 11 | Derivation of inverses and multipliers for prototype tables.                                                        |
| Phase V   |    | Derivation of Final Transactions Tables                                                                             |
|           | 12 | Final superior data insertions and other adjustments.                                                               |
|           | 13 | Derivation of final transactions tables.                                                                            |

|                                |    |                                                          |
|--------------------------------|----|----------------------------------------------------------|
|                                | 14 | Derivation of inverses and multipliers for final tables. |
| Source: Bayne and West (1988). |    |                                                          |

## REFERENCES

- Bayne, B. and West, G. (1988) *GRIT – Generation of Regional Input-Output Tables: Users Reference Manual*. Australian Regional Developments No. 15, Office of Local Government, Department of Immigration, Local Government and Ethnic Affairs, AGPS.
- Jensen, G. (1980) The concept of accuracy in regional input-output models. *International Regional Science Review*, 5:2, pp.139-54.
- Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorriggo National Park*. A Report for the NSW National Parks and Wildlife Service.

### ATTACHMENT 3 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

"The *basic assumptions* in IO analysis include the following:

- there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between IO tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
- all products of an industry are identical or are made in fixed proportions to each other;
- each industry exhibits constant returns to scale in production;
- unlimited labour and capital are available at fixed prices; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); and
- there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

The multipliers therefore describe *average effects, not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

The IO tables underlying multiplier analysis only take account of one form of *interdependence*, namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

The combination of the assumptions used and the excluded interdependence means that IO multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device" (ABS 1995, p.24).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS, 1995). Conventional output, employment, value-added and income multipliers show the output, employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

- *Initial effect* - which is the initial output stimulus, usually a \$1 change in output from a particular industry (Powell and Chalmers, 1995; ABS, 1995).
- *First round effects* - the amount of output from all intermediate sectors of the economy required to produce the initial \$1 change in output from the particular industry (Powell and Chalmers, 1995; ABS, 1995).
- *Industrial support effects* - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers, 1995; ABS, 1995).
- *Production induced effects* - the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial \$1 change in output) (Powell and Chalmers, 1995; ABS, 1995).
- *Consumption induced effects* - the spending by households of the extra income they derive from the production of the extra \$1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers, 1995; ABS, 1995).
- The *simple multiplier* is the initial effect plus the production induced effects.
- The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

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

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

A description of the different ratio multipliers is given below.

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

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11A Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced} + \text{Consumption Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11B Ratio Multiplier} = \frac{\text{Flow-on Effects}}{\text{Initial Effects}}$$

Source: Centre for Farm Planning and Land Management (1989).

## REFERENCES

Australian Bureau of Statistics (1995) Information Paper Australian National Accounts Introduction to Input-Output Multipliers. Cat. No. 5246.0.

Centre for Farm Planning and Land Management (1989) *Consultants report to State plantations impact study*. CFPLM, University of Melbourne.

Jensen, R. and West, G. (1986) *Input-output for Practitioners: Theory and Applications*. Prepared for Department of Local Government and Administrative Services, Local Government and Regional Development Division, Australian Government Publishing Service.

Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.