



Final Report to Department of Natural Resources, Mines and Energy

Cost-Benefit Analysis of the Queensland Small Scale Mining Industry

May 2020

Synergies Economic Consulting Pty Ltd
www.synergies.com.au

Disclaimer

Synergies Economic Consulting (Synergies) has prepared this report exclusively for the use of the party or parties specified in the report (the client) for the purposes specified in the report (Purpose). The report must not be used by any person other than the client or a person authorised by the client or for any purpose other than the Purpose for which it was prepared.

The report is supplied in good faith and reflects the knowledge, expertise and experience of the consultants involved at the time of providing the report.

The matters dealt with in this report are limited to those requested by the client and those matters considered by Synergies to be relevant for the Purpose.

The information, data, opinions, evaluations, assessments and analysis referred to in, or relied upon in the preparation of, this report have been obtained from and are based on sources believed by us to be reliable and up to date, but no responsibility will be accepted for any error of fact or opinion.

To the extent permitted by law, the opinions, recommendations, assessments and conclusions contained in this report are expressed without any warranties of any kind, express or implied.

Synergies does not accept liability for any loss or damage including without limitation, compensatory, direct, indirect or consequential damages and claims of third parties, that may be caused directly or indirectly through the use of, reliance upon or interpretation of, the contents of the report.

Executive Summary

Queensland has a long history of small scale mining activity, particularly in relation to the mining of opals and sapphires and other gemstones in central and western Queensland. There has been considerable debate in relation to the regulatory framework applying to the industry, with industry stakeholders attributing the increasing costs and operational constraints of regulation as the primary driver of the industry’s decline.

The Queensland Government has previously committed to engage an independent entity to undertake an assessment of the benefits and costs associated with small scale mining, including any benefits the sector creates for regional communities and the State. The purpose of this project is to address this commitment by undertaking a cost-benefit analysis of the Queensland small scale mining industry to understand the industry’s net economic impact on the Queensland economy.

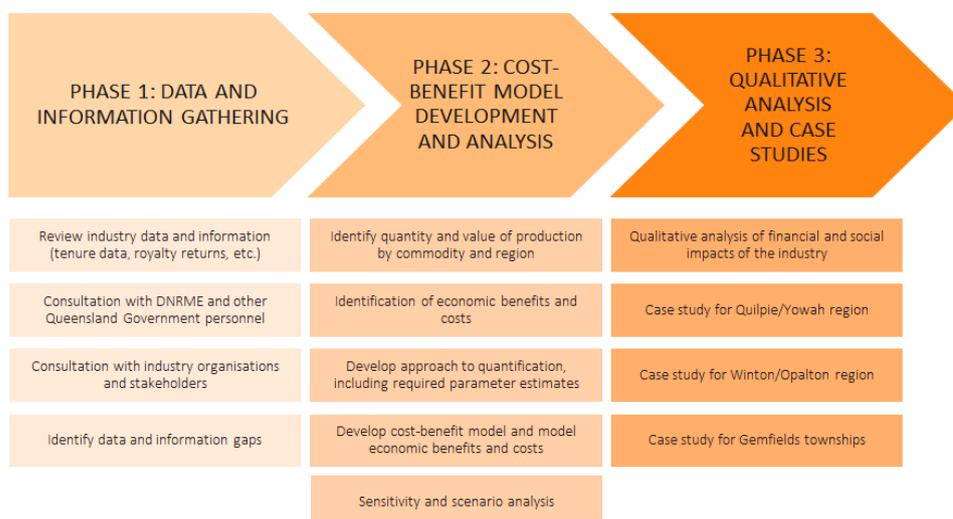
While the small scale mining sector is widely distributed throughout Queensland, there are two key regions which account for the majority of mining activity:

- 1) The opal fields in the south west region, centred predominantly around the townships of Winton, Quilpie, Yowah and Longreach; and
- 2) The gemfields region in Central Queensland.

Opals and sapphires are the dominant minerals mined by small scale miners, however there are a large number of other precious minerals that are mined in small quantities throughout the State, including zircon, chrysoprase and thundereggs.

The cost-benefit analysis of the small scale mining industry involved three key phases. The key tasks and activities under each phase are summarised in the figure below.

Overview of approach



There are significant issues with the data currently held by the Queensland Government on the small scale mining sector, with shortcomings in data collection and reporting processes meaning the data does not provide an accurate representation of the industry in terms of the number of miners or value of opal and gem production. Several stakeholders acknowledged that industry participants either do not submit their production information to the Queensland Government or under-report their levels of production.¹ Hence, the data is of limited use in developing a profile of the industry in terms of the number and location of miners and quantity and value of production.

The constraints associated with the data available on the structure and size of the industry have been addressed by adopting the following approach:

- 1) Modelling the economic benefits and costs of the small scale mining industry based on the statistical data on the level of production provided by the Queensland Government, as detailed above; and
- 2) Augmenting the statistical data provided by the Queensland Government with anecdotal information obtained through consultation with industry stakeholders, including indicative estimates of the number of small scale miners operating in each major region and the total value of sapphire and opal production in Queensland on an annual basis.

While the second scenario likely represents the more accurate picture of the small scale mining industry in Queensland, it is not underpinned by robust data. As a result, the results of the modelling under this scenario should be interpreted with caution.

The key economic impacts assessed and quantified in relation to the small scale mining industry were as follows:

- economic benefits:
 - the total value of industry production
 - the economic benefit derived from tourist visitations to mining regions
- economic costs:
 - capital, labour, operating and maintenance costs incurred by small scale miners
 - administrative and regulatory costs incurred by government
 - costs incurred by landholders.

¹ It is noted that industry participants are only required to pay royalties and hence submit royalty reports when their annual production exceeds \$100,000 in value.

The tables below summarise the results of the cost-benefit analysis under the two modelling scenarios – ‘DNRME production data’ and ‘industry consultation’.

Results of cost-benefit analysis under ‘DNRME production data’ scenario

Impact	Sapphire	Boulder opal	Other minerals	Totals
Benefits				
Total value of production				
Mining Leases	\$3,475,645	\$753,740 ^a	\$82,580	\$4,311,965 ^a
Mining Claims	-	-	-	-
Tourism benefits	\$262,968	-	-	\$262,968
Total benefits	\$3,738,613	\$753,740	\$82,580	\$4,574,933
Costs				
Capital costs	\$75,364	\$136,439	\$9,994	\$221,797
Labour costs	\$858,780	\$905,653	\$180,566	\$1,944,999
Other operating and maintenance costs	\$109,783	\$198,750	\$14,559	\$323,091
Administrative and regulatory costs	\$483,566	\$572,310	-	\$1,055,876
Total costs	\$1,527,492	\$1,813,151	\$205,120	\$3,545,763
NET PRESENT VALUE (NPV)	\$2,265,684	(\$1,095,454)	(\$141,060)	\$1,029,169
BENEFIT COST RATIO (BCR)	2.45	0.42	0.40	1.29

^a Includes an amount mined by holders of mining claims that could not be identified separately due to confidentiality requirements.

Note: Totals may not add due to rounding.

Source: Synergies modelling.

Results of cost-benefit analysis under ‘industry consultation’ scenario

Impact	Sapphire	Boulder opal	Other minerals	Totals
Benefits				
Total value of production	\$5,699,998	\$7,386,042	\$247,740	\$13,333,780
Tourism benefits	\$262,968	-	-	\$262,968
Total benefits	\$5,962,966	\$7,386,042	\$247,740	\$13,596,747
Costs				
Capital costs	\$102,973	\$849,524	\$37,757	\$990,253
Labour costs	\$1,173,382	\$5,703,751	\$682,140	\$7,559,273
Other operating and maintenance costs	\$150,000	\$1,237,500	\$55,000	\$1,442,500
Government administrative and regulatory costs	\$483,566	\$572,310	-	\$1,055,876
Total costs	\$1,909,921	\$8,363,085	\$774,896	\$11,047,902
NET PRESENT VALUE (NPV)	\$4,216,734	(\$1,013,085)	(\$654,803)	\$2,548,845
BENEFIT COST RATIO (BCR)	3.21	0.88	0.15	1.23

Note: Data limitations prevented the value of production from being quantified separately for mining claims and mining leases.

Source: Synergies modelling.

The above tables show that the total economic benefits derived from the small scale mining industry exceed economic costs on an annual basis, however the total NPV of

\$1.03 million and \$2.55 million per annum under the two modelling scenarios indicates the industry's net contribution to Queensland as a whole is relatively small.

The results of the analysis also show that the industry's contribution is concentrated in the Gemfields, with the economic benefits derived from opal mining insufficient to overcome the economic costs. This is primarily attributable to the lower capital and labour intensity of sapphire mining relative to opal mining (and, under the 'DNRME production data' scenario, the higher value of production recorded in the Gemfields relative to the opal mining regions).

In addition to the NPV and BCR estimates derived under the two modelling scenarios, it is also important to recognise the qualitative economic benefits and costs that were not quantified in this analysis:

- administrative and regulatory costs incurred by Office of State Revenue (OSR), Department of Environment and Science (DES) and the Land Court;
- costs incurred by landholders (typically agricultural producers) as a result of adverse impacts attributable to small scale miners; and
- negative environmental impacts attributable to small scale mining activities.

Sensitivity analysis, which demonstrates how the result of the cost-benefit analysis are affected by changes to key parameters or assumptions, has been performed on the following parameter estimates:

- hourly labour rate
- tourist visitor nights to the Gemfields region
- annual government administrative and regulatory costs.

The tables below set out the results of this sensitivity analysis under the two modelling scenarios.

Results of sensitivity analysis for 'DNRME production data' modelling scenario

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
Labour rate					
\$19.49 (national minimum wage)	\$2,516,766 (+11.1%)	(\$291,441) (+25.0%)	(\$516,748) (+26.9%)	(\$82,124) (+41.8%)	\$1,626,453 (+58.0%)
\$29.00 (base)	\$2,265,684	(\$388,771)	(\$706,683)	(\$141,060)	\$1,029,169
\$43.50 (+50%)	\$1,881,060 (-17.0%)	(\$537,868) (-38.4%)	(\$997,636) (-41.2%)	(\$231,344) (-64.0%)	\$114,213 (-88.9%)
Tourist visitor nights					
121,990 (base)	\$2,265,684	(\$388,771)	(\$706,683)	(\$141,060)	\$1,029,169

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
243,980 (+100%)	\$2,528,651 (+11.6%)	(\$388,771) (0.0%)	(\$706,683) (0.0%)	(\$141,060) (0.0%)	\$1,292,137 (+25.6%)
Government administrative and regulatory costs					
\$1,055,876 (base)					\$1,029,169
\$1,583,814 (+50%)					\$501,232 (-51.3%)

Source: Synergies modelling.

Results of sensitivity analysis for 'industry consultation' modelling scenario

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
Labour rate					
\$19.49 (national minimum wage)	\$4,559,797 (+8.1%)	(\$63,588) (+93.1%)	\$858,969 (+1,047.0%)	(\$432,153) (+34.0%)	\$4,923,025 (+93.1%)
\$29.00 (base)	\$4,216,734	(\$922,382)	(\$90,703)	(\$654,803)	\$2,548,845
\$43.50 (+50%)	\$3,691,208 (-12.5%)	(\$2,237,937) (-142.6%)	(\$1,545,470) (-1,603.9%)	(\$995,873) (-52.1%)	(\$1,088,072) (-142.7%)
Tourist visitor nights					
121,990 (base)	\$4,216,734	(\$922,382)	(\$90,703)	(\$654,803)	\$2,548,845
243,980 (+100%)	\$4,479,701 (+6.2%)	(\$922,382) (0.0%)	(\$90,703) (0.0%)	(\$654,803) (0.0%)	\$2,811,813 (+10.3%)
Government administrative and regulatory costs					
\$1,055,876 (base)					\$2,548,845
\$1,583,814 (+50%)					\$2,020,907 (-20.7%)

Source: Synergies modelling.

The key conclusions from the sensitivity analysis conducted is as follows:

- the cost of labour has a significant impact on the results of the cost-benefit analysis. Applying an hourly labour cost of \$19.49 (the national minimum wage rate) increases the annual net economic benefit attributable to the small scale mining industry by 58 per cent and 93 per cent under the 'DNRME production data' and 'industry consultation' modelling scenarios respectively;
- while doubling the number of tourist visitor nights in the Gemfields region increases the net economic benefit attributable to small scale mining in this region, the overall impact on the results of the cost-benefit analysis is not material; and
- the administrative and regulatory costs incurred by government also has a material impact on the net economic impact of the small scale mining industry on the State. Under the scenario in which the annual estimate for these costs are increased by 50

per cent,² the net economic benefit derived from the operation of the industry is reduced by over 51 per cent (under the DNRME production data scenario).

The report also contains case studies on the three key small scale mining regions in Queensland – the Quilpie/Yowah and Winton/Opalton opal mining regions and the Gemfields mining region in Central Queensland.

² This sensitivity was modelled to account for the administrative and regulatory costs that were not quantified in the cost-benefit analysis, including costs incurred by other areas within DNRME; costs incurred by DES and the Land Court Registry; and costs incurred by local governments.

Contents

Executive Summary	3
1 Introduction	12
2 Queensland small scale mining industry	14
2.1 Definition of small scale mining	14
2.2 Regulation of small scale mining	15
2.3 Industry overview	16
3 Approach	19
3.1 Cost-benefit analysis	19
3.2 Approach to the study	20
3.3 Stakeholder consultation	20
3.4 Data limitations and constraints	22
4 Economic benefits	24
4.1 Value of mineral production	24
4.2 Economic value of tourism activities	28
5 Economic costs	34
5.1 Capital costs	34
5.2 Operating and maintenance costs	36
5.3 Government administrative and regulatory costs	39
5.4 Landholder costs	39
6 Results	41
6.1 Net Present Value and Benefit Cost Ratio	41
6.2 Sensitivity and scenario analysis	42
7 Financial impact on government	45
7.1 Queensland Government	45
7.2 Local governments	45
8 Case studies	47
8.1 Case study 1: Quilpie/Yowah	47

8.2	Case study 2: Winton/Opalton	48
8.3	Case study 3: Sapphire Gemfields	49
A.	Overview of opal and sapphire mining sectors	51
B.	Small scale miner data and information request	55

Figures and Tables

Figure 1	Map of Queensland gemstone mining locations	17
Figure 2	Overview of approach	20
Table 1	Overview of opal and sapphire mining in Queensland	17
Table 2	Summary of key themes from stakeholder consultation	21
Table 3	Data on annual production from the small scale mining industry	25
Table 4	Summary of economic benefit estimates	28
Table 5	Estimates used to derive average value add for tourism expenditure	30
Table 6	Estimates for capital costs for small scale mining by region and mining activity	35
Table 7	Breakdown of small scale miners by mining activity under two production scenarios	35
Table 8	Annualised capital cost of small scale mining under 'DNRME production data' scenario	36
Table 9	Annualised capital cost of small scale mining under 'industry consultation' scenario	36
Table 10	Inputs for labour requirements for small scale mining operations	37
Table 11	Total labour cost estimates for small scale mining industry (DNRME production data scenario)	37
Table 12	Total labour cost estimates for small scale mining industry (industry consultation scenario)	38
Table 13	Other operating and maintenance costs for small scale mining industry (DNRME production data scenario)	38
Table 14	Other operating and maintenance costs for small scale mining industry (industry consultation scenario)	38
Table 15	Parameters for estimating administrative and regulatory costs	39

Table 16	Results of cost-benefit analysis under ‘DNRME production data’ scenario	41
Table 17	Results of cost-benefit analysis under ‘industry consultation’ scenario	42
Table 18	Results of sensitivity analysis for ‘DNRME production data’ modelling scenario	43
Table 19	Results of sensitivity analysis for ‘industry consultation’ modelling scenario	43
Table 20	Case study for the Quilpie/Yowah region	47
Table 21	Case study for the Winton/Opalton region	48
Table 22	Case study for the Sapphire Gemfields region	49
Table B.1	Small scale mining data and information request	55

1 Introduction

Queensland has a long history of small scale mining activity, particularly in relation to the mining of opals and sapphires and other gemstones in central and western Queensland. There has been considerable debate in relation to the regulatory framework to apply to the industry, with industry stakeholders attributing the increasing costs and operational constraints of government regulation as the primary driver of the industry's decline.

In 2018, the Queensland Government conducted a public consultation process to investigate opportunities to improve the efficiency and timeliness of assessment processes in the resource sector, with the aim to improve processes and deliver efficient services (Government Election Commitment 853). Several submissions received during this process indicated a broad concern about the appropriate level of regulation for small scale miners.

In response to submissions, the Queensland Government released the *Resource authority regulatory efficiency and duplication report*³ (the Report), which outlines nine key actions to address the issues raised by submitters. Under action three of the Report, the Department of Natural Resources, Mines and Energy (DNRME) committed to engage an independent entity to undertake an assessment of the benefits and costs associated with small scale mining, including any benefits the sector creates for regional communities and the State.

The purpose of this project is to address this commitment by undertaking a cost-benefit analysis of the Queensland small scale mining industry to understand the industry's net economic impact on the Queensland economy. This includes understanding how the economic impacts of the industry differ by location, tenure type and the gems and minerals produced. The assessment also considers the qualitative impacts of the sector on local economies and communities, including landholders in regions where small scale mining occurs.

The Queensland Government, through DNRME, has identified data gaps such as output and value of production, which are key to assessing the effectiveness of regulatory frameworks of this sector. A better understanding of the size of the industry and its contribution to economic output, both at the State level and in relation to the local communities in which it is located, is the first step in assessing the appropriateness of the regulatory framework applying to the Queensland small scale mining industry.

³ Department of Natural Resources, Mines and Energy (2019). Resource authority regulatory efficiency and duplication – Investigation, outcomes and actions. Queensland Government.

The rest of this report is structured as follows:

- section 2 provides an overview of the Queensland small scale mining industry;
- section 3 sets out the approach to undertaking the analysis and summarises the stakeholder consultation process;
- section 4 assesses the economic benefits attributable to the small scale mining industry;
- section 5 assesses the economic costs attributable to the small scale mining industry;
- section 6 assesses the qualitative impacts of the industry on local councils, the Queensland Government, and regional and rural communities;
- section 7 contains the results of the cost-benefit analysis; and
- section 8 details the case studies undertaken on the small scale mining industry in specific regions.

The report also includes the following attachments:

- Attachment A contains a detailed overview of the opal and sapphire mining sectors in the Queensland small scale mining industry; and
- Attachment B contains the one-page data and information request sheets that were provided to the relevant industry bodies (i.e. Queensland Small Miners Council, Queensland Sapphire Miners Association and Queensland Boulder Opal Association).

2 Queensland small scale mining industry

This section sets out the definition of small scale mining in Queensland and provides an overview of the current industry structure and operation in key regions.

2.1 Definition of small scale mining

The definition of 'small scale mining' is set out in Schedule 4 of the *Environmental Protection Act 1994* (EPA).⁴ In summary, for an activity to be included within the scope of the small scale mining industry, it must satisfy the following key requirements:

- be carried out under a mining claim for corundum, gemstones or other precious stones in an area that is not more than 20 hectares;
- does not involve the significant disturbance of more than 5 hectares of land at any one time;
- is not carried out:
 - in a designated precinct in a strategic environmental area;
 - in a watercourse or riverine area;
 - within 1 km of a category A environmentally sensitive area;
 - within 500 metres of a category B environmentally sensitive area;
 - in an area described as a designated environmental area;
 - as part of a petroleum activity for which there is aggregate environmental score prescribed under a regulation; and
 - by more than 20 persons at any one time.

Activities conducted under an exploration permit are also included in the definition of small scale mining, provided it relates to the exploration of minerals other than coal and is confined to an area of not more than four sub-blocks. In addition, these activities must comply with all of the requirements relating to the areas in which activities cannot be carried out as set out above, and must not cause more than 1,000m² of land to be disturbed at any one time.

Small mining leases have also been included within the scope of this cost-benefit analysis. While not included in the definition set out in the EPA, the *Mineral and Other Legislation Act 2016* (MOLA) provided for opal and gemstone miners on mining leases

⁴ *Environmental Protection Act 1994*, Schedule 4, p 746.

of 20 hectares or less to convert to a mining claim and be subject to the same regulatory framework as applies to holders of mining claims.⁵

Finally, any activities carried out under a prospecting permit are also included in the definition of small scale mining.

It is important to note that fossicking is not included within the scope of the small scale mining industry. Individuals or groups seeking to fossick within the designated fossicking areas in the opal fields and gem fields are required to apply and purchase a fossicking licence, however their activities are not regulated under the Small Scale Mining Code (see below). While the impact of fossicking is relevant to this analysis, particularly in assessing the economic benefits and costs that can be attributed to the small scale mining industry, the economic benefits and costs derived from fossicking activities has not been considered in the cost-benefit analysis of the industry.

In addition to fossicking, alluvial gold mining is also excluded from the scope of the Queensland small scale mining industry as it involves mining activity in watercourses or riverine areas.

2.2 Regulation of small scale mining

Small scale mining activities are regulated under the *Small Scale Mining Code*. The Code is provided for under Section 391C of the *Mineral Resources Act 1989* (MRA). The key guidelines and requirements applicable under the Code are summarised in the box below. As noted above, the MOLA provided for smaller lease holders to be subject to the same regulatory framework as applies to mining claims under the Small Scale Mining Code. This significantly reduced the regulatory requirements imposed on mining lease holders, which are typically more mechanised and larger scale operators than mining claim holders.

Box 1 Overview of guidelines and requirements under the Small Scale Mining Code

The Small Scale Mining Code states guidelines for small scale mining activities to:

- Ensure the activities are carried out in an environmentally responsible way;
- Ensure land subject to the activities is managed responsibly;
- Minimise conflicts about land use because of the carrying out of the activities; and
- Ensure land is rehabilitated, and improvements on the land are restored to an appropriate condition, after the small scale mining activities carried out on the land are completed.

The Code also imposes on the mining claim or exploration permit mandatory conditions concerning the conduct of authorised activities on the land.

⁵ Department of Natural Resources and Mines (2013). Reducing Red Tape for Small Scale Alluvial Mining – Stakeholder discussion paper.

Small scale miners remain subject to compliance with the general environmental duty of the EPA and the relevant monitoring and enforcement provisions of that legislation. In addition, the Environmental Protection Regulation 2008 may prescribe conditions for small scale mining activities about the carrying out of the mining operation (e.g. rehabilitating land and giving financial assurance or provision). Any prescribed condition under this Regulation or existing condition relating to rehabilitation overrides any guidance provided under the Code.

Source: Department of Natural Resources, Mines and Energy (2013). Small Scale Mining Code.

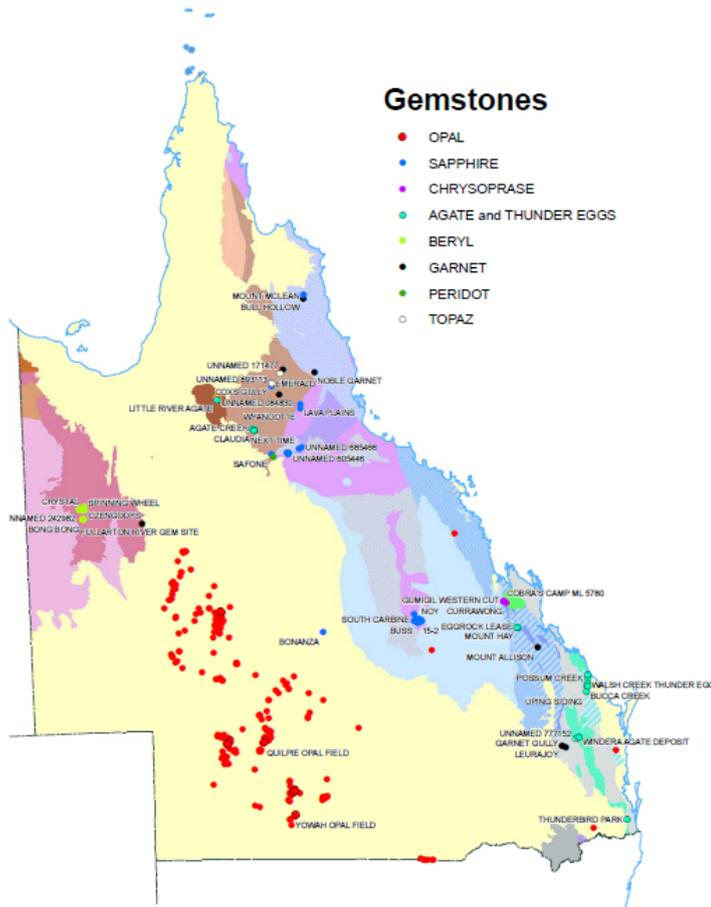
2.3 Industry overview

While the small scale mining sector is widely distributed throughout Queensland, there are two key regions which account for the majority of mining activity:

- 1) The opal fields in the south west region, centred predominantly around the townships of Winton, Quilpie, Yowah and Longreach; and
- 2) The gemfields region in Central Queensland.

Opals and sapphires are the dominant minerals mined by small scale miners, however there are a large number of other precious minerals that are mined in small quantities throughout the State, including zircon, chrysoprase and thundereggs. The map below shows the geographic spread of the mining of gemstones across Queensland.

Figure 1 Map of Queensland gemstone mining locations



Source: Department of Natural Resources and Mines (2016). Queensland Minerals 2016.

The table below provides an overview of the opal mining and sapphire mining sectors of the Queensland small scale mining industry. A more detailed overview is included in Attachment A.

Table 1 Overview of opal and sapphire mining in Queensland

Characteristic	Opal mining	Sapphire mining
Location	<ul style="list-style-type: none"> • Based around the mining of boulder opal in the south western region of the state. • Deposits located within 300 km belt known as the Winton Formation, which encompasses the townships of Cunnamulla, Quilpie, Longreach and Winton (see Figure 1). • Opal mining activity is concentrated in two key regions – Winton/Opalton and Quilpie/Yowah. The latter contain some of the more productive opal fields while the former are considered to contain higher quality mineral resources.^a 	<ul style="list-style-type: none"> • Sapphires are predominantly mined in the Central Highlands region in the area known as 'the Gemfields', which contains the townships of Rubyvale, Sapphire, Anakie and the Willows. • A wide variety of sapphires are recovered from the gemfields, including blue, yellow, green and parti-coloured sapphires.
Mining activities	<ul style="list-style-type: none"> • The majority of opal mining in Queensland involves open cut operations using heavy machinery (i.e. 20 and 40 tonne excavators and bulldozers). • There are a small number of hand miners operating around the Opalton township in addition 	<ul style="list-style-type: none"> • Majority of miners are hand miners, some of which operate light machinery to conduct underground mining.

Characteristic	Opal mining	Sapphire mining
	to some miners using light machinery to mine underground in the Quilpie/Yowah region. ^b	<ul style="list-style-type: none"> • Hand miners mostly operate on mining claims between the townships of Rubyvale and Sapphire. • Small number of larger scale open cut sapphire miners that operate heavy machinery.^a
Industry size	<ul style="list-style-type: none"> • Australia is estimated to account for around 95 per cent of world opal production, however the industry has been in decline in recent years. • While several hundred opal mining tenures are held in Queensland, industry stakeholder estimates of active miners ranges from 40 to 100. • Statistical production information provided by DNRME estimates the total value of opal production at around \$740,000 per annum,^c however, based on consultation with industry stakeholders and a review of historical estimates of opal production, actual production is likely to be significantly higher (potentially over \$5 million per annum) due to the limitations of data collection processes and issues with under-reporting. 	<ul style="list-style-type: none"> • Sapphire mining sector has contracted significantly in recent decades. • Industry stakeholders provided an estimate for annual sapphire production from the Gemfields in the 1970s of around \$50 million per annum. DNRME production data estimates the total value of sapphire production at around \$3.48 million per annum.^c • As with opals, stakeholders reported significant gaps in the data, with actual production estimated at between \$5 and \$10 million per annum.^a • Stakeholders estimate there are around 20 operational sapphire miners in the Gemfields.^a
Marketing	<ul style="list-style-type: none"> • Opals can be marketed as a range of products, ranging from rough opal to refined jewellery products. • After an extended period of low prices, the industry benefited from strong growth in opal prices in the late 2000s (estimated that average prices doubled between 2005 and 2010).^a • Strong growth in demand, particularly from Asian and European markets, has seen this growth maintained over the last decade. • Key marketing trends include the increasing use of the internet as a sales platform and more opal miners are performing basic value adding on their rough product to enhance marketability.^a 	<ul style="list-style-type: none"> • Majority of sapphires sold to overseas buyers as rough product, with buyers visiting the Gemfields in April and December each year. • Only a small number of miners undertake any value adding (i.e. cutting, polishing, jewellery manufacturing).

^a Based on consultation with industry participants.

^b Neville, B., Horton, D., and Cooper, W. (2000). Opal – Mineral Information Leaflet No 16. Queensland Government.

^c DNRME gem production data.

As noted above, while the majority of the activity in the small scale mining industry is attributable to opals and sapphires, there are also small quantities of other minerals that are mined by small scale miners throughout Queensland. These include thundereggs, which are rocks that usually contain centres of chalcedony that may have been fractured followed by the deposition of agate; zircon;⁶ topaz; and chrysoprase.

⁶ Zircon is often recovered with sapphires.

3 Approach

This section describes the approach to undertaking the analysis, including the purpose of cost-benefit analysis and the approach to identifying and assessing the economic benefits and costs attributable to the Queensland small scale mining industry.

3.1 Cost-benefit analysis

The purpose of cost-benefit analysis is to estimate the net economic impact of a policy, project or in this case an industry. Cost-benefit analysis seeks to compare the economic benefits of an industry to the economic costs. That is, the net value that is derived from the operation of the industry to the costs incurred, including production costs incurred by industry participants, landholders, government, etc.

It is important to distinguish between cost-benefit analysis and economic impact analysis. The objective of economic impact analysis is to estimate the impact of an industry, policy or project on the level of economic activity – total output, value added, employment – in a region. Unlike with cost-benefit analysis, economic impact analysis does not attempt to estimate the net economic benefit of an industry or project, but rather the overall economic impact.

This distinction is important as the same impact will be considered differently under cost-benefit analysis and economic impact analysis. For example, consider expenditure by a small scale miner in a regional town on inputs such as fuel and machinery parts. Under an economic impact analysis, this expenditure is included as an economic output that is attributable to the small scale mining industry, as the presence of the small scale miner has generated demand for the goods and services. However, in a cost-benefit analysis, this expenditure represents a resource cost that is incurred in the process of mining the precious minerals, which is the economic benefit derived from the industry.

Hence, while an economic impact assessment will provide an estimate as to how the industry impacts on regional economies in terms of the total level of economic activity and employment, cost-benefit analysis is the appropriate tool for assessing the net economic impact of the industry on the community (i.e. whether the economic benefits derived exceed the economic costs incurred by industry, government and the community).

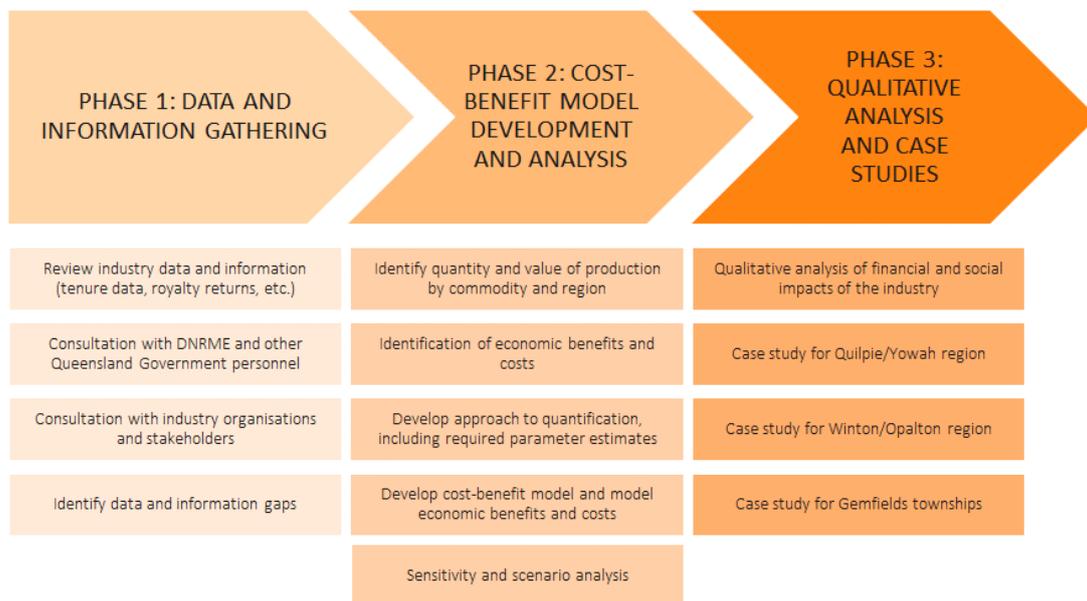
It is also important to note the difference between financial analysis and cost-benefit analysis. Financial analysis includes all financial cash flows relevant to a project, policy, or industry. Alternatively, cost-benefit analysis only includes impact to the extent that they represent an economic benefit or cost. For example, financial transactions such as

regulatory fees or rates paid by small scale miners, while relevant to a financial analysis, are not considered in a cost-benefit analysis of the industry.⁷

3.2 Approach to the study

The cost-benefit analysis of the small scale mining industry involved three key phases. The key tasks and activities under each phase are summarised in Figure 2.

Figure 2 Overview of approach



3.3 Stakeholder consultation

Extensive stakeholder consultation was undertaken to inform the cost-benefit analysis. Stakeholders consulted with included:

- industry bodies in the mining and resources sector, including the Queensland Small Miners Commission (QSMC), the Queensland Boulder Opal Association (QBOA), the Queensland Sapphire Mining Association (QSMA), the Australian Minerals Exploration Council (AMEC), and the Queensland Resources Council (QRC);
- industry participants, including gem and opal miners, marketers and retailers;

⁷ Noting that regulatory fees and charges are levied on small scale miners by state and local governments to recover the costs incurred in administering and regulating the industry, which are within the scope of a cost-benefit analysis.

- representatives from Queensland Government departments, including DNRME, Office of State Revenue, Department of Environment and Science, and the Land Court Registry;
- local government representatives;
- other relevant industry bodies and organisations, including AgForce and the Central Highlands Development Corporation (CHDC); and
- operators of other businesses relevant to the small scale mining industry, including operators of hotels and caravan parks in the gemfields and townships in opal mining regions.

Consultation involved one-on-one telephone discussions and email exchanges to obtain data and information to inform the cost-benefit analysis.⁸ Table 2 summarises the key themes from the stakeholder consultation for both opal and gem mining.

Table 2 Summary of key themes from stakeholder consultation

Theme	Opal mining	Sapphire mining
Significant decline in profitability and industry production in recent decades	<ul style="list-style-type: none"> • Number of operational miners has decreased from several hundreds to 50-100 in recent years – driven by increasing costs and regulatory burden • Opal prices experienced strong growth in early 2000s which has been maintained in recent years – strong demand from Asian and European markets for Australian opal, however high costs prevent significant industry growth. 	<ul style="list-style-type: none"> • Prior to crash in sapphire prices in late 1970s, value of gem production in the Gemfields was around \$50 million per annum – now only ~20 miners with annual production totalling \$5-\$10 million • Prices have since recovered but increasing operational costs and regulatory restrictions have made it harder to mine profitably and constrained industry growth • Ongoing viability of the gem mining industry is contingent upon miners performing more value adding to extract the full resource value from sapphires.
Limitations of available industry data	<ul style="list-style-type: none"> • Production from Queensland opal fields significantly higher than reported • Combination of shortcomings with data collection processes and nature of industry participants • Significant quantity of opals sold to domestic and overseas buyers in cash. 	<ul style="list-style-type: none"> • Similar to opal industry, significant under-reporting of production (although perhaps not to the same extent). • Majority of opal sold to overseas buyers who visit the Gemfields in April and December each year and negotiate directly with sapphire miners – significant proportion of sales conducted in cash.
Majority of tenures not operational	<ul style="list-style-type: none"> • While still ~100 opal miners operating in Queensland, majority of leases and claims are not worked • In addition, miners hold several leases and claims and work one at a time – means a small proportion of total tenures are operational at any one point in time. 	<ul style="list-style-type: none"> • Vast majority of mining leases and claims in the Gemfields are not worked – only ~20 commercial sapphire miners • Significant number of claims are used as cheap residences with little or no actual mining activity being undertaken.
Minimal value adding conducted	<ul style="list-style-type: none"> • Historically boulder opal miners performed limited value adding with opals being sold 	<ul style="list-style-type: none"> • Majority of sapphire mined in Queensland sold to overseas buyers as rough product

⁸ Data requests were provided to the QSMA, QSMC and QBOA for distribution to members, however no responses were received.

Theme	Opal mining	Sapphire mining
by industry participants	<ul style="list-style-type: none"> rough, predominantly to Asian and European buyers Increase in primary value adding in recent years out of commercial necessity, with some miners 'opening up' opals and performing some primary value adding prior to selling. 	<ul style="list-style-type: none"> Small number of miners conducting their own cutting, polishing and jewellery manufacturing Lack of value adding is a significant constraint on the value of industry output – value of sapphire increases significantly as a refined production – not currently being captured by miners.
Significant contribution to regional economies	<ul style="list-style-type: none"> Miners represent a material source of economic activity in towns in the opal mining regions (e.g. Quilpie, Yowah, Winton) however geographic spread of miners means they are self-contained on tenures for significant periods of time. Other industries in the region (large scale mining, agriculture, outback tourism) represent more important drivers of local economic activity Industry is not a significant driver of tourist visitations or expenditure. 	<ul style="list-style-type: none"> The Gemfields townships are sustained by gem mining and related activities. No businesses would be viable in the absence of the industry (noting that several industry stakeholders categorised tourism and fossicking activities as being within the scope of the gem mining sector).
Conflicts with landholders	<ul style="list-style-type: none"> Some issues with landholders reported in terms of securing access to tenures, however less interaction compared to the Gemfields. 	<ul style="list-style-type: none"> Several cases where cattle graziers have experienced significant loss of income as a result of insufficiently rehabilitated small scale mining leases and claims Gem miners lack the resources to ensure that sites are sufficiently rehabilitated – financial assurances provided are insufficient and there is little to no proactive compliance monitoring undertaken.

3.4 Data limitations and constraints

The data provided by the Queensland Government to inform the cost-benefit analysis included:

- tenure data, including details on all small scale mining tenures held throughout Queensland (e.g. areas of mining leases and mining claims by region and minerals mined; lease and claim permits granted by region and area); and
- statistical information on the quantity and value of production by precious mineral (e.g. opal, sapphire, zircon, garnet, etc.) for the period 2015/16 to 2017/18.⁹

While informative, there are significant limitations associated with this data. In relation to the tenure information, while the data is useful for showing the location and scale of the tenures by mine type, the majority of small scale mining tenures are not mined on a regular basis. Hence, the tenure data is of limited use in attempting to derive an estimate for the level of production of various segments of the small scale mining industry.

⁹ OSR advised DNRME that data on the royalties collected from small scale miners is unable to be provided due to confidentiality protection provisions under the *Mineral Resources Act 1989*.

Similarly, while the DNRME statistical production data provides an indication of the quantity and value of production of minerals by small scale miners, there is limited compliance monitoring performed on the submission of this data to the Queensland Government. Several stakeholders acknowledged that industry participants either do not submit their production information to the Queensland Government or under-report their levels of production. Hence, the data is of limited use in developing a profile of the industry in terms of the number and location of miners and quantity and value of production.

The constraints associated with the data available on the structure and size of the industry have been addressed by adopting the following approach:

- 1) Modelling the economic benefits and costs of the small scale mining industry based on the statistical data on the level of production provided to Synergies by the Queensland Government, as detailed above; and
- 2) Augmenting the statistical production data with anecdotal information obtained through consultation with industry stakeholders, including indicative estimates of the number of small scale miners operating in each major region and the total value of sapphire and opal production in Queensland on an annual basis.

While the second scenario likely represents the more accurate picture of the small scale mining industry in Queensland, it is not underpinned by robust data. As a result, the results of the modelling under this scenario should be interpreted with caution.

4 Economic benefits

There are two key economic benefits attributable to the small scale mining industry:

- the value of mineral production
- the economic value derived from the provision of mining-related tourism activities.

During the consultation phase of this cost-benefit analysis, several stakeholders identified the economic activity, including expenditure, generated by small scale miners as a key benefit, highlighting the importance of this expenditure to businesses in small rural communities. As described in section 3.1, the purpose of cost-benefit analysis is not to estimate the overall impact of an industry on economic activity in a region, but rather to determine whether the industry generates a net economic benefit to the State, taking into account the resource costs required to achieve industry output.

Under the cost-benefit analysis framework, expenditure related to goods and services required to generate output in an industry (e.g. fuel requirements of small scale miners) represents a cost of production. As such, this expenditure, while beneficial for service providers in rural communities, represents an economic cost rather than a benefit.

This is not to diminish the significance of expenditure by small scale miners to the economic well-being of businesses in rural communities. A significant proportion of the small scale mining industry is located in regions with small townships. As such, expenditure by small scale miners can represent a material proportion of total economic activity in these regions. While not an economic benefit from the perspective of the State, this expenditure may play a critical role in sustaining these regional communities. This has been assessed in detail for the case studies of the specific communities (see section 8).

4.1 Value of mineral production

As discussed in section 3.4, there are significant limitations in terms of the production data available with which to derive an estimate for the total value of production in the Queensland small scale mining industry. To address these limitations, two estimates of the annual production of the small scale mining industry have been derived:

- 1) based on production data collected by the Queensland Government; and
- 2) an 'alternative' estimate, based on the Queensland Government production data, augmented with information obtained from consultation with industry participants.

The following sections detail the quantification of the economic benefit derived from mineral production by the small scale mining industry under these two approaches.

4.1.1 Total value of production based on DNRME gem production data

Table 3 sets out the value of production estimates derived from Queensland Government statistics by mineral type and mining region (based on average of 2015/16 to 2017/18 data).

Table 3 Data on annual production from the small scale mining industry

Mineral and mining region	Number of small scale miners		Annual production value	
	Mining leases (ML)	Mining claims (MC)	Mining leases (ML)	Mining claims (MC)
Sapphire				
Gemfields and surrounds	13	-	\$3,475,645	-
Boulder opal				
Quilpie/Yowah	9	1	\$430,449 ^b	-
Winton/Opalton	6	-	\$287,248	-
Other	2	-	\$36,042	-
Other minerals^a				
Central Queensland	9	-	\$54,563	-
North Queensland	3	-	\$28,017	-
Totals	42	1	\$4,311,965^b	-

^a Other minerals included in the DNRME production data were thunderegg, zircon, garnet, topaz, chalcedony, crystal quartz, and rhyolite.

^b Includes a small amount mined by holders of a mining claim that cannot be identified separately due to confidentiality reasons.

Note: The total number of miners may overstate the actual number reflected in the production data as some miners may produce more than one mineral (e.g. sapphire miners often mine small quantities of zircon).

Source: Based on gem production data for the 2015/16 to 2017/18 period provided by DNRME.

As shown in the table above, the total value of production from the small scale mining industry in Queensland, based on the gem production data provided by DNRME, is estimated at around \$4.31 million per annum. Based on available data, the industry is highly concentrated. Over the period from 2015/16 to 2017/18, based on the DNRME production data, the four largest small scale miners accounted for almost 90 per cent of total production.¹⁰

4.1.2 'Alternative' estimate for total value of production

Of the total value of production estimate of \$4.31 million per annum set out in Table 3, a relatively small proportion was attributable to production on mining claims.¹¹ While

¹⁰ Based on Synergies analysis of historical gem production data provided by DNRME.

¹¹ Noting that this production could not be separately identified due to confidentiality concerns.

consultation confirmed that production values generated by claim holders are typically lower than for mining leases and that gem production does not occur on the majority of mining claims (there are 1,454 mining claims in Queensland)¹², the production data appears to significantly understate gem production from mining claims. In addition, stakeholder consultation indicated the total value of production on mining leases was also likely to be under-reported. The sections below set out the rationale for developing alternative estimates for the value of gem production by mineral.

Sapphire

The estimate for total sapphire production in the Gemfields region derived from the DNRME gem production data was \$3,475,645 per annum, attributable to 13 miners operating on mining leases. None of the sapphire production data related to activity on mining claims.

DNRME small scale mining tenure data indicates there are over 1,000 mining claims in the Gemfields and surrounding regions. While stakeholders indicated the vast majority of these claims are not worked, there are some claim holders that do produce material quantities of sapphire, albeit in smaller quantities and values than mining lease holders. In addition to the production from mining claims, stakeholders also advised the production totals for mining leases was likely to be understated.

While it is not possible to derive a robust estimate for actual sapphire production by small scale miners, various stakeholders estimated the total annual value at between \$5 million and \$10 million, with the majority of production attributable to the larger scale open cut miners operating on mining leases. The following assumptions have been applied to estimate the total value of sapphire production under this modelling scenario:

- total production on mining claims in the Gemfields region of \$1.0 million per annum, attributable to an additional 10 miners;¹³ and
- 30 per cent additional production from mining leases (i.e. additional production under-reported in DNRME gem production data).

¹² Based on small scale mining tenure data provided by DNRME.

¹³ Based on stakeholder consultation. While the modelling is based on an additional 10 miners, this estimate could include a number of part time miners (i.e. recreational miners or hobbyists) that work their mining claims on an ad hoc or occasional basis.

Applying these assumptions to the DNRME production data results in an 'alternative' estimate for sapphire production in the Gemfields region of \$5.7 million per annum,¹⁴ with 23 operational miners.

Boulder opal

Stakeholders reported widescale under-reporting of production in both the Quilpie/Yowah and Winton/Opalton opal mining regions.¹⁵ According to one large miner consulted with, the total value of opal production in the Winton/Opalton region is estimated at around \$3 million per annum, with around 50 miners operating.

No information was obtained from stakeholders to inform the development of indicative estimates for opal production in the Quilpie/Yowah region. However, it is noted that this region includes some of the more productive opal mines in Queensland in recent years. The DNRME production data indicates that the total value of opal production in the Quilpie/Yowah region is 1.45 times greater than in the Winton/Opalton region. Applying this factor to the estimate of \$3 million per annum for opal production from the Winton/Opalton region results in an indicative estimate for the total value of opal production from the Quilpie/Yowah region of \$4.35 million. According to DNRME production data, there is also a small quantity of boulder opal producers in other regions (\$36,042 per annum).

On this basis, the total 'alternative' estimate for the value of opal production in Queensland is estimated at around \$7.39 million per annum.

Other minerals

While no detailed investigation has been undertaken in terms of the actual value of production of other minerals produced by small scale miners, it is reasonable that similar issues of under-reporting and gaps in the data exist for these minerals as have been identified in relation to sapphires and boulder opals. Based on the 'alternative' estimates for sapphire and boulder opal, it is estimated that total production of other minerals by small scale miners could be around three times the estimate included in the DNRME gem production data. This would equate to an 'alternative' total production estimate of \$247,740 per annum.

¹⁴ Noting there are also small quantities of other minerals mined in the Gemfields and surrounding areas (e.g. zircon) that are included in total output of the small scale mining industry for the Gemfields region.

¹⁵ It is noted that industry participants are only required to pay royalties and hence submit royalty reports when their annual production exceeds \$100,000 in value.

4.1.3 Summary

Table 4 summarises the estimates for the economic benefit derived from gem and opal production by the small scale mining industry under the two approaches. There was insufficient information available to estimate the breakdown of production between mining claims and mining leases under the 'alternative' scenario.

Table 4 Summary of economic benefit estimates

Mineral and region	DNRME gem production data scenario		'Industry consultation' scenario
	Mining leases	Mining claims	
Sapphires			
Gemfields	\$3,475,645	-	\$5,699,998
Boulder opal			
Quilpie/Yowah	\$430,449 ^b	-	\$3,000,000
Winton/Opalton	\$287,248	-	\$4,350,000
Other	\$36,042	-	\$36,042
Other minerals^a			
Central Queensland	\$54,563	-	\$163,689
North Queensland	\$28,017	-	\$84,051
Totals	\$4,311,965^b	-	\$13,333,780

^a Other minerals included in the DNRME production data were thunderegg, zircon, garnet, topaz, chalcedony, crystal quartz, and rhyolite.

^b Includes a small amount of production from holders of mining claims that cannot be identified due to confidentiality issues.

Note: Totals may not add due to rounding.

Source: Based on gem production data for 2015/16 to 2017/18 provided by DNRME and information obtained through industry consultation.

The above table shows that, based on consultation with industry stakeholders, the 'actual' value of production in the small scale mining sector is estimated at \$13.33 million per annum, around three times the total estimated based on DNRME gem production data (totalling \$4.31 million).

4.2 Economic value of tourism activities

Several stakeholders identified tourism as a source of significant economic benefit attributable to the small scale mining industry. This was particularly relevant to the Gemfields region, with industry stakeholders expressing the view that the presence of small scale miners in the regions was a significant factor that attracted tourists to the region, particularly during the winter months, with expenditure by these tourists generating significant benefits for the Gemfields townships (Sapphire, Rubyvale, Anakie).

Similar benefits were not reported in the opal mining regions. The geographic spread of opal miners and lack of an epicentre means that commercial opal mining is not considered to generate significant tourism activity. While stakeholders in Winton and Quilpie noted that tourists often expressed an interest in the opal mining history of the

region, it was not considered a factor in attracting tourists to the region or extending the duration of tourists' stay in the region.

On this basis, the assessment of the economic benefit from tourism expenditure attributable to the small scale mining industry was limited to the Gemfields region.

4.2.1 Approach

A two-step approach has been applied to estimate the economic benefit from tourism expenditure in the Gemfields region that is attributable to the small scale mining industry:

- 1) Estimate the total economic benefit derived by tourist visitations to the Gemfields region; and
- 2) Apply an estimate for the proportion of this benefit that can be attributed to the presence of small scale miners in the Gemfields region.

4.2.2 Total economic benefit of tourism visitations to the Gemfields region

The following parameter values are required to derive an estimate for the total economic benefit from tourism visitations to the Gemfields region:

- number of tourist visitor nights to the region
- average expenditure per visitor night
- net margin derived from provision of tourism services.

Number of visitor nights

There is no current estimate available of the total number of tourism visitor nights for the Gemfields region. A submission to the '*Inquiry into developing Queensland's rural and regional communities through grey nomad tourism*' from the Central Highlands Regional Council (CHRC) reported a total of 121,990 tourist visitor nights to the Gemfields region in 2010.¹⁶ This estimate has been applied to estimate the annual economic benefit derived from tourist visitation to the region.

¹⁶ Central Highlands Regional Council (2010). Reference: Submission - Inquiry into developing Queensland's rural and regional communities through grey nomad tourism.

Average expenditure per visitor night

Regional tourism statistics released by Tourism Research Australia (TRA) reported an estimate for average tourism expenditure per visitor night in Central Queensland of \$114 in 2015.¹⁷ Inflating to 2020 dollars results in an estimate of around \$122.

Net margin

Deriving an estimate for the economic benefit derived from total tourism expenditure requires a measure to be applied to account for the costs incurred in supplying goods and services to visitors. That is, the economic benefit is the profit or value add derived from the supply of these goods and services as opposed to the total expenditure. To address this issue, ABS industry value add data is applied to estimate the net margin from tourism goods and services. The estimation of the average net margin for the supply of tourism goods and services is set out in Table 5.

Table 5 Estimates used to derive average value add for tourism expenditure

Industry category	% total tourism expenditure	% value add
Accommodation	42.7%	19.7%
Hospitality – food beverages	17.3%	9.9%
Tourist activities	20.7%	21.4%
Transport – taxis and car hire	3.5%	14.1%
Other	15.8%	16.6%
Weighted average value add		17.7%

Source: Value Add – ABS 81550.0 Australian Industry 2016-17; Synergies estimates of breakdown of tourism expenditure.

Total benefit estimate

Applying the above parameter values results in the following estimates:

- total tourism expenditure in the Gemfields region of \$14.88 million per annum
- economic benefit from tourism expenditure of \$2.63 million per annum.

As identified in stakeholder consultation, the Gemfields is one of the primary tourism attractions in the Central Highlands region (along with the Carnarvon Gorge). Tourism contributes around \$235 million annually to the Central Highlands regional economy.¹⁸ As such, in addition to the economic benefit derived from direct tourism expenditure within the Gemfields region, the attractions in the Gemfields region may also make a

¹⁷ 'Tourism Research Australia'. DOA: 15 May 2020. See: https://www.tra.gov.au/tra/2016/Tourism_Region_Profiles/Region_profiles/index.html

¹⁸ Central Highlands Development Corporation (2019). Central Highlands Qld Visitor Economy Strategy 2020-2022.

significant contribution to tourism expenditure throughout the rest of the Central Highlands region.¹⁹ This rationale indicates the contribution of the Gemfields to the economic benefit derived from tourism expenditure expands beyond tourism expenditure in the Gemfields region itself. This has been addressed in the sensitivity and scenario analysis (see section 6.2).

4.2.3 Estimating the economic benefit attributable to small scale mining

The previous section estimated the economic benefit derived from tourist visitations to the Gemfields region. However, this benefit cannot be entirely attributed to the small scale mining industry. As set out in the box below, the extent to which benefits derived from tourism expenditure within a region are attributed to a specific industry or location requires an analysis of the drivers of tourist visitations and expenditure in the region.

Box 2 Attributing tourism benefits to specific industries

Where it is considered the operation of an industry generates tourism activity in a region, the economic benefit derived from expenditure by visitors is attributable to that industry. For example, where a convention centre attracts interstate and international tourists to a region, the benefit derived from expenditure by these visitors on goods and services can be directly attributed to the existence and operation of the convention centre. That is, in the absence of the convention centre, the interstate and international visitors would not have been attracted to the region and hence no economic benefit would have been derived.

The attribution of the economic benefit derived from tourism expenditure to an industry is more complicated where there is not such a clear link between the operation of the industry and the attraction of tourist visitors to the region. Under this scenario, unless a detailed study of the significance of various attractions and characteristics to tourism visitations to the region has been undertaken, assumptions must be applied in attributing the economic benefit derived from tourism expenditure to that industry/characteristics.

It is clear from consulting with stakeholders in the Gemfields region that the vast majority of tourism visitations to the region can be attributed to sapphire mining. The caravan park operators in the region, which accommodate most of the tourist visitors, estimated that over 90 per cent of their business was driven by mining-related activities. However, stakeholders expressed differing views in terms of the importance of commercial small scale mining in terms of attracting visitors to the region. The two main views expressed were:

- 1) While tourists are primarily attracted by fossicking (which is not within the scope of the small scale mining industry), the operation of commercial small scale miners in the region contributed to the attractiveness of the region as a tourist destination and provided a 'unique' experience to tourists; and

¹⁹ That is, visitors travel to the Central Highlands region due to the attractions in the Gemfields region.

- 2) The presence of commercial small scale mining has a minimal impact on tourist visitations to the region, with the majority of tourists only interested in fossicking. While some miners do contribute bags of wash to fossicking parks, this represents a small cost saving to park operators rather than attracting tourists to the region.

The first of these arguments indicates that, while most tourists are attracted by fossicking areas and parks, it is appropriate to attribute a proportion of the economic benefit derived from tourism expenditure in the Gemfields to the small scale mining industry. Alternatively, the second argument implies that the presence of commercial small scale miners in the region has little impact on the economic benefit derived from tourism. The box below presents two case studies of regional towns that derive significant benefit from tourist activity related to historical mining activities while not hosting a commercial mining sector.

Box 3 Case studies of tourism activity in historical mining towns

Walhalla, Victoria

Walhalla is a historical township in regional Victoria that was founded as a gold-mining town in the 1860s. While there is no longer a commercial gold mining industry in Walhalla, the township has developed into a major tourist attraction. The historical town centre has been restored and several heritage mining sites have been converted into tourist attractions, including a tour of the Walhalla Long Tunnel Extended Gold Mine; a train ride on the historical Walhalla Goldfields Railway, and the Walhalla Tramline Walk, which includes historic gold mines. Tourists also visit the Walhalla to engage in alluvial gold fossicking activities. It has been estimated that around 100,000 tourists visit the Walhalla township annually.

Arrowtown, New Zealand

Arrowtown is a historic gold rush village located in the South Island of New Zealand. While no longer a gold mining town, Arrowtown has developed into a small township with a population of around 2,000 people. The region is a popular tourist destination, with gold panning one of several popular visitor activities. There are several businesses in Arrowtown that supply gold panning equipment to tourists. The township has also been developed in a manner that maintains the heritage character of the original gold mining town, with many of the town's main buildings have been restored from the gold mining era. Annual tourist visitations to Arrowtown have been estimated at 400,000.

Sources: Walhalla Heritage and Development League Inc (2014). Mobile Coverage Programme Discussion Paper; New Zealand Department of Conservation (2014). Arrowtown Chinese Settlement Survey 2013.

Furthermore, it is noted that tourist visitations to the Gemfields have not declined significantly in recent years. As noted by stakeholders, the Gemfields region is one of the main tourist attractions within the wider Central Highlands region and attracts thousands of tourists during the winter months. This is despite the region's gem mining industry having undergone a prolonged period of decline. Were there a significant relationship between the level of tourist visitations and expenditure in the region and the presence of small scale miners, it would be anticipated that the tourism industry would have been adversely affected by the industry's decline.

Noting the above, it is reasonable to conclude that the small scale mining sector does make a contribution to the attractiveness of the region as a tourist destination. For example, Gemfest is a four-day festival held in August each year in the Anakie township. In addition to attracting several thousand visitors to the Gemfields, the festival provides a marketing platform for gem miners and jewellery makers and generates awareness of the Gemfields as a gem mining and fossicking location. Without commercial small scale miners operating in the region, it is unlikely this event would be held and hence the marketing and awareness benefits would be lost.

In addition to the impact of Gemfest, it is also likely the presence of commercial small scale miners in the region does make some contribution to the attractiveness of the Gemfields region as a tourist destination, as per the views of some stakeholders. Accurately estimating the proportion of the total economic benefit from tourism expenditure that is attributable to the small scale mining industry would require a survey of a sample of visitors to the Gemfields to determine the proportion that are attracted by the existence of the industry.

In the absence of such a study, an estimate of 10 per cent has been applied. That is, 10 per cent of tourist visitations (and hence economic benefit derived from tourism expenditure) is attributable to the present of the small scale mining industry in the region. This translates to an annual economic benefit of \$263,000.

5 Economic costs

The key economic costs identified as attributable to the small scale mining industry are:

- capital costs incurred by small scale miners;
- operating and maintenance costs incurred by small scale miners;
- costs incurred by the Queensland Government in relation to the administration and regulation of the industry; and
- the costs imposed on landholders as a result of small scale mining activities.

5.1 Capital costs

There is significant variability across the small scale mining industry in terms of the capital equipment used in mining.

In the opal mining regions, the majority of miners operate under the open cut method, with a small number of larger operators using several excavators, bulldozers and dump trucks, with a larger number of smaller operators using single excavators. There are also a limited number of hand opal miners in the area surrounding the Opalton township.

In the Gemfields, the majority of miners are underground miners, using light machinery and hand mining instruments. There are also a small number of open cut miners, using heavy machinery similar to the opal miners.

Given the limited information available regarding the current operations of sapphire and opal miners, assumptions were made regarding the level of capital investment required for the different mining activities and the breakdown of miners between these categories.²⁰

5.1.1 Capital investment

Table 6 sets out the parameter values applied for the capital costs of the different operations.

²⁰ Capital cost assumptions were based on limited information provided by gem and opal miners regarding the capital equipment required and the cost of capital equipment.

Table 6 Estimates for capital costs for small scale mining by region and mining activity

Mining region	Large open cut mining ^a	Small open cut/light machinery underground	Hand mining
Gemfields	\$300,000	\$30,000 ^b	\$10,000
Winton/Opalton	\$300,000	\$100,000 ^c	\$10,000
Quilpie/Yowah	\$300,000	\$100,000 ^c	\$10,000

a Estimate based on cost of two excavators, bulldozer and dump truck, based on consultation with industry participants.

b Capital cost of equipment required for underground gem mining with light machinery (i.e. drilling equipment).

c Estimate based on cost of one excavator, based on consultation with industry participants.

Note: These estimates have been derived based on limited information provided by industry stakeholders. It is acknowledged that capital costs will vary significantly across operations and that these estimates may not be correct for several miners within each category.

Source: Estimates based on desktop research and information obtained from industry participants.

The following assumptions were also applied in relation to the capital requirements of the small scale miners:

- useful life for all capital equipment of 25 years²¹
- a real interest rate of 7 per cent (real, pre-tax).²²

5.1.2 Industry breakdown

As the economic benefits were modelled under two scenarios in terms of the industry size and output, it was necessary to develop two scenarios in terms of the breakdown of small scale miners across different types of operation. Table 7 sets out the assumptions applied for the two scenarios.

Table 7 Breakdown of small scale miners by mining activity under two production scenarios

Mining region	Breakdown based on production data			Breakdown based on industry consultation		
	Large open cut	Small open cut/light machinery	Hand miners	Large open cut	Small open cut/light machinery	Hand miners
Gemfields	2	4	11	3	5	15
Winton/Opalton	-	4	1	2	38	10
Quilpie/Yowah	-	10	-	2	48	-
Others	-	1	8	-	5	29

Note: The industry breakdown for the 'production data' scenario has been developed based on an assessment of the size of the mining operations as reported in the DNRME production data. The industry breakdown for the 'industry consultation' scenario has been developed having regard for both the DNRME production data and information provided by industry participants.

Source: Synergies estimates.

²¹ Based on consultation with industry participants.

²² In accordance with the Queensland Treasury Project Assessment Framework and other best practice business case and cost-benefit guidelines.

5.1.3 Annualised capital costs

The tables below set out the estimates derived for annualised capital costs by region and mine type under the two modelling scenarios.

Table 8 Annualised capital cost of small scale mining under ‘DNRME production data’ scenario

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Totals
Gemfields	\$56,523	\$9,421	\$9,421	\$75,364
Winton/Opalton	\$5,835	\$36,956	\$973	\$43,763
Quilpie/Yowah	\$10,297	\$82,378	-	\$92,675
Others	-	\$3,407	\$6,587	\$9,994
Totals	\$72,655	\$132,162	\$16,980	\$221,797

Source: Based on assumptions in relation to capital costs and industry breakdown.

Table 9 Annualised capital cost of small scale mining under ‘industry consultation’ scenario

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Totals
Gemfields	\$77,229	\$12,872	\$12,872	\$102,973
Winton/Opalton	\$51,486	\$326,080	\$8,581	\$386,147
Quilpie/Yowah	\$51,486	\$411,890	-	\$463,377
Others	-	\$12,872	\$24,885	\$37,757
Totals	\$180,202	\$763,714	\$46,338	\$990,253

Source: Based on assumptions in relation to capital costs and industry breakdown.

5.2 Operating and maintenance costs

Operating and maintenance costs incurred by small scale miners are categorised as follows:

- labour
- other operating and maintenance costs (fuel, spares, maintenance, consumables).

5.2.1 Labour

The table below summarises the parameter values applied to estimate the cost of labour attributable to small scale mining activities. The estimates of number of Full Time Equivalents (FTEs) were based on consultation with industry participants.

Table 10 Inputs for labour requirements for small scale mining operations

Mining region	Annual FTE requirements		
	Large open cut	Small open cut/light machinery	Hand miners
Gemfields	1.7	0.8	0.4
Winton/Opalton	1.7	0.8	0.4
Quilpie/Yowah	1.7	0.8	0.4
Others	1.7	0.8	0.2

Note: A lower FTE allowance was applied for hand miners in other regions due to the lower levels of output recorded by these miners.

Source: Based on stakeholder consultation.

As shown in the above table, there is a direct relationship between the capital-intensity of mining activities and the number of FTEs required to sustain the operation. This is based on consultation with industry participants, which indicated that most larger open cut operations involve two FTEs, while the majority of hand miners are single operators and mine on a part-time basis.

The following assumptions and parameter values were also used to derive an estimate for labour costs:

- hourly rate of \$28.99²³
- leading hand allowance²⁴ of \$9.99 per hour²⁵
- on cost allowance of 22 per cent.²⁶

The tables below set out the annual labour cost estimates derived based on the above assumptions and parameters for the two modelling scenarios.

Table 11 Total labour cost estimates for small scale mining industry (DNRME production data scenario)

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Total labour costs
Gemfields	\$349,344	\$203,774	\$305,661	\$858,780
Winton/Opalton	\$36,064	\$239,816	\$31,555	\$307,435
Quilpie/Yowah	\$63,643	\$534,575	-	\$598,218
Others	-	\$73,701	\$106,866	\$180,566
Totals	\$449,051	\$1,051,866	\$444,082	\$1,944,999

Source: Synergies modelling.

²³ Queensland Mining Industry Award 2020 – Level 7 Dual Trade Instrumentation.

²⁴ Applies to heavy machinery operators at larger open cut mines, in accordance with industry standards.

²⁵ Queensland Mining Industry Award 2020 – Leading hand allowance.

²⁶ ‘Human Resources’. University of New South Wales. DOA: 2nd May 2020; See: <https://www.hr.unsw.edu.au/services/salaries/oncosts.html>

Table 12 Total labour cost estimates for small scale mining industry (industry consultation scenario)

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Total labour costs
Gemfields	\$477,321	\$278,424	\$417,636	\$1,173,382
Winton/Opalton	\$318,214	\$2,116,025	\$278,424	\$2,712,663
Quilpie/Yowah	\$318,214	\$2,672,873	-	\$2,991,088
Others	-	\$278,424	\$403,715	\$682,140
Totals	\$1,113,750	\$5,345,747	\$1,099,776	\$7,559,273

Source: Synergies modelling.

As shown in the above tables, labour costs are significantly higher under the 'industry consultation' modelling scenario, consistent with the higher industry output under this scenario relative to the 'DNRME production data' scenario.

5.2.2 Other operating and maintenance costs

There was limited information available in relation to the other operating and maintenance costs incurred by small scale miners in both the Gemfields region and opal mining areas. Based on consultation with industry participants, the assumption was adopted that other operating and maintenance costs were equivalent to 12.5 per cent of capital investment. The tables below set out the annual estimates for other operating and maintenance costs for the two modelling scenarios based on this assumption.

Table 13 Other operating and maintenance costs for small scale mining industry (DNRME production data scenario)

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Total costs
Gemfields	\$82,337	\$13,723	\$13,723	\$109,783
Winton/Opalton	\$8,500	\$53,833	\$1,417	\$63,750
Quilpie/Yowah	\$15,000	\$120,000	-	\$135,000
Others	-	\$4,963	\$9,596	\$14,559
Totals	\$105,837	\$192,519	\$24,735	\$323,091

Source: Synergies modelling.

Table 14 Other operating and maintenance costs for small scale mining industry (industry consultation scenario)

Mining region	Large open cut	Small open cut/light machinery	Hand miners	Total costs
Gemfields	\$112,500	\$18,750	\$18,750	\$150,000
Winton/Opalton	\$75,000	\$475,000	\$12,500	\$562,500
Quilpie/Yowah	\$75,000	\$600,000	-	\$675,000
Others	-	\$18,750	\$36,250	\$55,000
Totals	\$262,500	\$1,112,500	\$67,500	\$1,442,500

Source: Synergies modelling.

5.3 Government administrative and regulatory costs

The administrative and regulatory requirements relating to the small scale mining industry span several Queensland Government departments, including DNRME, DES, Queensland Treasury, and the Land Court. Key personnel from each of these departments was included in the stakeholder consultation process.

While acknowledging the costs incurred by DES, Queensland Treasury and the Land Court in administering the necessary regulatory and administrative requirements in relation to the small scale mining industry, consultation with government stakeholders indicated that DNRME accounts for the majority of government costs in relation to the sector. This, combined with the limited information available to quantify the costs incurred by other departments, resulted in the quantification of this cost being limited to those incurred by DNRME. The table below sets out the parameter values used to derive an impact for DNRME's annual regulatory and administrative costs.

Table 15 Parameters for estimating administrative and regulatory costs

Position	FTEs by region/area				Award rate per FTE and per annum ^a
	Central QLD	Outback QLD	Quilpie	Management	
AO8	-	-	-	1	\$126,035.96
AO6	1	1	-	-	\$103,286.35
AO5	1	-	-	-	\$91,702.84
AO4	1	1	1	-	\$80,406.30
AO3	1	-	2	-	\$69,292.38

^a The assumed 22 per cent on costs was also applied to these wage rates.

Source: FTE estimates provided by Queensland Government.

Applying these parameters results in an estimate for annual regulatory and administrative costs of \$1,055,875. This estimate applies under both scenarios modelled.

5.4 Landholder costs

Several stakeholders reported issues between small scale miners and landholders, particularly between sapphire miners and cattle producers in the region surrounding the Gemfields townships. Adverse impacts on landholders as a result of small scale mining activity includes:

- loss of cattle stock as a result of the insufficient rehabilitation of mine shafts and pits, with cattle becoming stuck in pits and unable to be rescued;
- disruptions to business operations, including changes to grazing practices, burn-off strategies, etc.; and

- increased biohazard risks due to presence of small scale miners on cattle grazing properties.

While land access disputes between opal miners and farmers are also relatively common, it appears based on the stakeholder consultation that the adverse impacts from small scale mining on landholders are more significant in the region surrounding the Gemfields. One cattle producer near Rubyvale has reported losing around 20 cattle at a total cost of around \$30,000 in recent years due to insufficiently rehabilitated sapphire mine pits.

Although this is a significant cost to individual landholders, given that these impacts are being experienced by a relatively limited number of producers, and the lack of information available to develop a robust estimate of the total cost across the population of affected farmers, this cost has not been quantified in this cost-benefit analysis.

6 Results

This section summarises the results of the cost-benefit analysis on the small scale mining industry, including the results of sensitivity and scenario analysis undertaken on key assumptions and parameters.

6.1 Net Present Value and Benefit Cost Ratio

The tables below summarise the results of the cost-benefit analysis under the two modelling scenarios – ‘DNRME production data’ and ‘industry consultation’. Results are provided in terms of the Net Present Value (NPV) and Benefit Cost Ratio (BCR) estimated for the small scale mining industry under the two modelling scenarios. The NPV represents the Present Value of total economic benefits attributable to the industry less the Present Value of total economic costs.²⁷ BCR is calculated by dividing total economic benefits by total economic costs. For a project or industry to be economically feasible, it must return an NPV of above 0 and a BCR of greater than 1.

Table 16 Results of cost-benefit analysis under ‘DNRME production data’ scenario

Impact	Sapphire	Boulder opal	Other minerals	Totals
Benefits				
Total value of production				
Mining Leases	\$3,475,645	\$753,740 ^a	\$82,580	\$4,311,965 ^a
Mining Claims	-	-	-	-
Tourism benefits	\$262,968	-	-	\$262,968
Total benefits	\$3,738,613	\$753,740	\$82,580	\$4,574,933
Costs				
Capital costs	\$75,364	\$136,439	\$9,994	\$221,797
Labour costs	\$858,780	\$905,653	\$180,566	\$1,944,999
Other operating and maintenance costs	\$109,783	\$198,750	\$14,559	\$323,091
Administrative and regulatory costs	\$483,566	\$572,310	-	\$1,055,876
Total costs	\$1,527,492	\$1,813,151	\$205,120	\$3,545,763
NET PRESENT VALUE (NPV)	\$2,265,684	(\$1,095,454)	(\$141,060)	\$1,029,169
BENEFIT COST RATIO (BCR)	2.45	0.42	0.40	1.29

^a A small proportion of production was attributable to holders of mining claims, which could not be individually identified due to confidentiality reasons.

Source: Synergies modelling.

²⁷ Noting that as the cost-benefit analysis has been conducted for one year of the operation of the industry, it has not been necessary to apply a discount rate to calculate Present Value estimates.

Table 17 Results of cost-benefit analysis under ‘industry consultation’ scenario

Impact	Sapphire	Boulder opal	Other minerals	Totals
Benefits				
Total value of production	\$5,699,998	\$7,386,042	\$247,740	\$13,333,780
Tourism benefits	\$262,968	-	-	\$262,968
Total benefits	\$5,962,966	\$7,386,042	\$247,740	\$13,596,747
Costs				
Capital costs	\$102,973	\$849,524	\$37,757	\$990,253
Labour costs	\$1,173,382	\$5,703,751	\$682,140	\$7,559,273
Other operating and maintenance costs	\$150,000	\$1,237,500	\$55,000	\$1,442,500
Administrative and regulatory costs	\$483,566	\$572,310	-	\$1,055,876
Total costs	\$1,909,921	\$8,363,085	\$774,896	\$11,047,902
NET PRESENT VALUE (NPV)	\$4,216,734	(\$1,013,085)	(\$654,803)	\$2,548,845
BENEFIT COST RATIO (BCR)	3.21	0.88	0.15	1.23

Source: Synergies modelling.

The above tables show that the total economic benefits derived from the small scale mining industry exceed economic costs on an annual basis, however the total NPV of \$1.03 million and \$2.55 million per annum under the two modelling scenarios indicates the industry’s net contribution to Queensland as a whole is relatively small.

The results of the analysis also show that the industry’s contribution is concentrated in the Gemfields, with the economic benefits derived from opal mining insufficient to overcome the economic costs. This is primarily attributable to the lower capital and labour intensity of sapphire mining relative to opal mining (and, under the ‘DNRME production data’ scenario, the higher value of production recorded in the Gemfields relative to the opal mining regions).

In addition to the NPV and BCR estimates derived under the two modelling scenarios, it is also important to recognise the qualitative economic benefits and costs that were not quantified in this analysis:

- administrative and regulatory costs incurred by OSR, DES and the Land Court;
- costs incurred by landholders as a result of adverse impacts attributable to small scale miners; and
- negative environmental impacts attributable to small scale mining activities.

6.2 Sensitivity and scenario analysis

Sensitivity analysis demonstrates the impact of changes to key parameters or assumptions on the net economic impact (i.e. NPV) of the proposed project or policy. It is appropriate to conduct sensitivity analysis on those parameters and assumptions over

which there is significant uncertainty, and which have a material impact on the results of the cost-benefit analysis.

As reported in the previous sections, the economic impacts of the small scale mining industry have been modelled based on two scenarios in relation to the scale of the industry. In addition to the two industry scenarios modelled, sensitivity analysis has been performed on the following parameter estimates:

- hourly labour rate
- tourist visitor nights to the Gemfields region
- annual government administrative and regulatory costs.

The tables below set out the results of this sensitivity analysis under the two modelling scenarios.

Table 18 Results of sensitivity analysis for 'DNRME production data' modelling scenario

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
Labour rate					
\$19.49 (national minimum wage)	\$2,516,766 (+11.1%)	(\$291,441) (+25.0%)	(\$516,748) (+26.9%)	(\$82,124) (+41.8%)	\$1,626,453 (+58.0%)
\$29.00 (base)	\$2,265,684	(\$388,771)	(\$706,683)	(\$141,060)	\$1,029,169
\$43.50 (+50%)	\$1,881,060 (-17.0%)	(\$537,868) (-38.4%)	(\$997,636) (-41.2%)	(\$231,344) (-64.0%)	\$114,213 (-88.9%)
Tourist visitor nights					
121,990 (base)	\$2,265,684	(\$388,771)	(\$706,683)	(\$141,060)	\$1,029,169
243,980 (+100%)	\$2,528,651 (+11.6%)	(\$388,771) (0.0%)	(\$706,683) (0.0%)	(\$141,060) (0.0%)	\$1,292,137 (+25.6%)
Government administrative and regulatory costs					
\$1,055,876 (base)					\$1,029,169
\$1,583,814 (+50%)					\$501,232 (-51.3%)

Source: Synergies modelling.

Table 19 Results of sensitivity analysis for 'industry consultation' modelling scenario

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
Labour rate					
\$19.49 (national minimum wage)	\$4,559,797 (+8.1%)	(\$63,588) (+93.1%)	\$858,969 (+1,047.0%)	(\$432,153) (+34.0%)	\$4,923,025 (+93.1%)
\$29.00 (base)	\$4,216,734	(\$922,382)	(\$90,703)	(\$654,803)	\$2,548,845
\$43.50 (+50%)	\$3,691,208 (-12.5%)	(\$2,237,937) (-142.6%)	(\$1,545,470) (-1,603.9%)	(\$995,873) (-52.1%)	(\$1,088,072) (-142.7%)
Tourist visitor nights					
121,990 (base)	\$4,216,734	(\$922,382)	(\$90,703)	(\$654,803)	\$2,548,845

Parameter	Gemfields	Winton/Opalton	Quilpie/Yowah	Other regions	Totals
243,980 (+100%)	\$4,479,701 (+6.2%)	(\$922,382) (0.0%)	(\$90,703) (0.0%)	(\$654,803) (0.0%)	\$2,811,813 (+10.3%)
Government administrative and regulatory costs					
\$1,055,876 (base)					\$2,548,845
\$1,583,814 (+50%)					\$2,020,907 (-20.7%)

Source: Synergies modelling.

The key conclusions from the sensitivity analysis conducted is as follows:

- the parameter estimate used for the cost of labour has a significant impact on the results of the cost-benefit analysis. Applying an hourly labour cost of \$19.49 (the national minimum wage rate) increases the annual net economic benefit attributable to the small scale mining industry by 58 per cent and 93 per cent under the 'DNRME production data' and 'industry consultation' modelling scenarios respectively. The impact is particularly significant in the two opal mining regions;
- while doubling the number of tourist visitor nights in the Gemfields region increases the net economic benefit attributable to small scale mining in this region, the overall impact on the results of the cost-benefit analysis is not material. This is due to the existence of the small scale mining sector not being a key driver of the economic benefit that is derived from tourist expenditure in the Gemfields region (and having no impact on tourist in the opal mining regions); and
- the administrative and regulatory costs incurred by government also has a material impact on the net economic impact of the small scale mining industry on the State. Under the scenario in which the annual estimate for these costs are increased by 50 per cent,²⁸ the net economic benefit derived from the operation of the industry is reduced by over 51 per cent (under the DNRME production data scenario).

²⁸ This sensitivity was modelled to account for the administrative and regulatory costs that were not quantified in the cost-benefit analysis, including costs incurred by other areas within DNRME; costs incurred by DES and the Land Court Registry; and costs incurred by local governments.

7 Financial impact on government

This section provides an overview of the financial impact of the small scale mining industry on government, both at the state and local level.

7.1 Queensland Government

The financial impacts of the small scale mining industry on the Queensland Government can be summarised as follows:

- the collection of royalty revenue from small scale miners, noting that small scale miners are only required to pay royalties in years when their total value of production exceeds \$100,000;
- the main source of administrative and regulatory burden is DNRME. Based on estimates for FTEs required to perform these functions provided by the Department, annual administrative and regulatory costs attributable to the small scale mining industry are estimated at \$1.06 million; and
- in addition to these costs, the DES incurs costs in terms of monitoring the remediation of small scale mine sites, including monitoring and enforcement activities; OSR incurs costs administering the collection of royalties and data recording; and the Land Court Registry incurs costs associated with managing disputes between small scale miners and landholders. There are also likely other areas within the Queensland Government that incur costs as a result of interaction with small scale miners.

Based on the above, it is concluded that the Queensland Government does not currently derive any financial benefit from the administration and regulation of the small scale mining industry.

7.2 Local governments

Consultation with local governments indicated that small scale mining has limited financial impact on local government. In relation to the Gemfields region, the Central Highlands Regional Council (CHRC) noted the importance of the region's gem mining history as a driver of tourist visitations and economic activity, while noting the issues that are caused by the holders of mining claims and leases in the region, including illegal dumping, conflicts with landholders, and issues with miners accessing water supplies to which they are not entitled. CHRC stated that while imposing some compliance burden on Council, the costs incurred were not overly material. Similarly, the revenue collected from small scale miners was also not material.

Similar conclusions are drawn based on consultation in relation to the opal mining regions, with stakeholders, including a representative from Quilpie Shire Council, indicating that the self-sufficient nature of opal miners means they impose little if any costs on local governments. The rates and other revenues collected from opal miners is also not a material source of revenue for local governments.

8 Case studies

This section contains case studies for the three regions in which the small scale mining industry is most heavily concentrated – the Quilpie/Yowah region; the Winton/Opalton region; and the Sapphire Gemfields region (encompassing the townships of Rubyvale, Sapphire, and Anakie and the Willows Gemfields).

It is important to note that the quantitative analysis contained within these studies differs to that set out in the cost-benefit analysis of the Queensland small scale mining industry in the previous sections. The purpose of these case studies is to demonstrate the impact of small scale mining on these rural communities, as opposed to the cost-benefit analysis which assesses the net economic impact of the industry on the State. For example, the treatment of expenditure by small scale miners on goods and services necessary to support mining activity is treated as follows under the two assessments:

- in the cost-benefit analysis, this expenditure represents an economic cost incurred to derive the economic benefit from the production of gems and opals; and
- in the case studies, this expenditure represents a source of economic activity and employment for businesses and service providers in these rural communities.

8.1 Case study 1: Quilpie/Yowah

Table 20 Case study for the Quilpie/Yowah region

Regional overview	<ul style="list-style-type: none"> • Quilpie is a rural township located in the Shire of Quilpie in Western Queensland <ul style="list-style-type: none"> – The town has an estimated population of 654 (ABS 2016 Census) – Key attractions include museums, galleries, opal fossicking areas – Main tourism attraction to the region is ‘outback tourism’, focused on the region’s natural environment – Major businesses in the town include the Heritage Inn, homestead hotel, caravan parks and motels • Yowah is a small rural town in the Shire of Paroo, with an estimated population of 141 (ABS 2016 Census) <ul style="list-style-type: none"> – The town contains a tourist information centre, caravan park, opal fossicking area and heritage trail and general store and a camping area • Livestock production and mining (oil and gas) are the dominant industries in the region.
Small scale mining activities	<ul style="list-style-type: none"> • The Quilpie opal field contains significant resources of boulder opal with the field possessing some of the more productive opal mines of recent times • The Yowah opal field is the southern-most opal mining field in Queensland. • The Yowah Fossicking Area is particularly popular with hobby miners and is jointly managed by DNRME and the Shire of Paroo. • There are currently 161 mining claims and 47 mining leases within the Quilpie/Yowah mining region. • All opal mining in the Quilpie/Yowah region is undertaken using the open cut mining method, with all miners using heavy machinery (i.e. excavators, bulldozers, etc.).
Economic benefits of small scale mining	<ul style="list-style-type: none"> • Based on DNRME production data for 2015/16 to 2017/18, the total value of opal production derived from the region is estimated at \$430,000 per annum. • Stakeholders consulted with estimated that actual production was significantly higher than this estimate, noting that the region contains some highly productive opal mines.

Economic costs of small scale mining	<ul style="list-style-type: none"> • An estimate of \$4.35 million per annum was derived for the value of opal production from the Quilpie and Yowah opal fields (and surrounding region), based on industry consultation. • No economic benefit from tourism was attributed to the small scale mining industry, based on the outcomes of stakeholder consultation.
Contribution to the regional economy	<ul style="list-style-type: none"> • The majority of total economic costs of opal mining in the region were attributable to labour. Total labour costs were estimated at \$598,000 and \$2.99 million per annum under the two modelling scenarios. • When combined with the capital costs incurred by opal miners in the region (noting that all miners in the region operate under the more capital-intensive open cut method), the other operating and maintenance costs incurred and the costs of administrating and regulating the industry, the industry in the region does not produce a net economic benefit to the State (noting that this is largely a function of the hourly cost of labour assumed in the cost-benefit analysis). • Excluding labour costs, the industry returns an annual net economic benefit of around \$2.9 million (under the 'industry consultation' scenario).
Qualitative impacts	<ul style="list-style-type: none"> • Several stakeholders highlighted the importance of the opal mining industry to the regional economy, noting that opal miners represent a material source of turnover for local businesses. • Based on the industry modelling undertaken, annual expenditure by opal miners in the Quilpie and Yowah townships is estimated at \$135,000 under the 'DNRME production data' scenario and \$675,000 under the 'industry consultation' scenario. • However, several stakeholders also acknowledged that most opal miners are located significant distances from the townships and hence the industry's impact on the local economy and community may be lower than in other small scale mining regions. Stakeholders were not of the view that opal mining represented an important attraction to the industry, although a proportion of visitors do express an interest in learning about the region's opal mining history.
Qualitative impacts	<ul style="list-style-type: none"> • Several stakeholders highlighted the significance of opal mining to the heritage of the region. For example, the Yowah opal festival is an annual festival held to promote and celebrate mining in the region. • Several stakeholders expressed the view that the region was not realising the full value of the potential attraction of opal mining for visitors. • Stakeholders also acknowledged that due to the geographic spread of opal miners, there is a relatively small connection between the commercial opal miners and the towns in the region. • Noting this, opal miners do represent a material source of economic activity to the region, particularly during periods when government and other commercial activity is low.

8.2 Case study 2: Winton/Opalton

Table 21 Case study for the Winton/Opalton region

Regional overview	<ul style="list-style-type: none"> • Winton is the largest town in the Winton Shire Council with an estimated population of 954 (ABS 2016 Census). • Livestock production, specifically cattle and sheep, is the biggest industry in Winton. Other major industries include transport and logistics (the town has become a significant transport hub), coal seam gas, opal and gypsum mining and outback tourism. • Winton contains a full range of services, including a hospital, chemist, several accommodation service providers, schools, and retail shops. • Opalton is a historic township located 123 km from Winton. • The township has a very small permanent population (around 25), however does contain a camping area (the Opalton Bush Park) at which tourist visitors are able to visit and use the dedicated opal fossicking area. • The township continues to accommodate a small number of commercial opal miners.
Small scale mining activities	<ul style="list-style-type: none"> • The Winton/Opalton district is typically regarded as having lower quantities of opal resource with higher quality levels • While there are over 300 current small scale mining tenures in the district, stakeholders estimated there to be only around 50 operational opal miners. Several of these miners hold multiple MC and ML and work one at a time.

Economic benefits of small scale mining	<ul style="list-style-type: none"> • There is significant variability in terms of the intensity with which tenures are mined, with some miners working tenures full time for eight months of the year, while other miners only mine on a part time basis for limited periods during the winter months. • While most of the opal miners in the region operate under the open cut method and use heavy machinery (i.e. excavators, bulldozers and dump trucks), there are a small number of hand miners in the area surrounding the Opalton township.
Economic costs of small scale mining	<ul style="list-style-type: none"> • According to DNRME production data, around \$287,000 worth of opal is mined in the Winton/Opalton jurisdiction annually. • Stakeholders reported this to be a significant underestimate of the actual value of total production. One stakeholder reported that opal buyers estimated total output of the opal fields in the region at around \$3 million per annum. • There are no economic benefits related to tourist visitations that are attributable to the small scale mining industry.
Contribution to the regional economy	<ul style="list-style-type: none"> • The economic costs of small scale mining in the Winton/Opalton region are dominated by labour costs. Under the 'DNRME production data' scenario, in which the total value of opal production is estimated at \$287,000 per annum, total labour costs are estimated at \$307,000 per annum (i.e. the value of production is insufficient to cover the economic cost of labour). • Under the 'industry consultation' modelling scenario, labour costs are estimated at \$2.7 million per annum (compared to region-wide production of \$3.0 million). • Government administrative and regulatory costs are the other major cost attributable to the small scale mining industry in the region. These costs are estimated at \$261,000 per annum. • The labour intensity and other economic costs attributable to the small scale mining industry in the Winton/Opalton region means that the industry does not return a net economic benefit under either modelling scenario.
Qualitative impacts	<ul style="list-style-type: none"> • As with the opal industry in the Quilpie/Yowah, while the geographic spread of opal miners in the Winton/Opalton region means opal miners are largely self-sufficient and reside on their tenures during opal mining season, they still represent a material source of turnover for businesses in the region. • Under the 'industry consultation' modelling scenario, under which the total value of opal production in the region is estimated at \$3 million per annum, it is estimated that miners spend approximately \$562,500 on consumables and other inputs annually.
Qualitative impacts	<ul style="list-style-type: none"> • Several stakeholders consulted with highlighted the significance of opal mining to the heritage of the region. As with Quilpie/Yowah, stakeholders also acknowledged that due to the geographic spread of opal miners, there is a relatively small connection between the commercial opal miners and the towns in the region.

8.3 Case study 3: Sapphire Gemfields

Table 22 Case study for the Sapphire Gemfields region

Regional overview	<ul style="list-style-type: none"> • Gemfields region in Central Queensland is made up of the following townships – Rubyvale, Sapphire, Anakie and the Willows. • The region has an estimated population of 1,449 (2016 ABS Census). Rubyvale is the largest of the townships with an estimated population of 640. • Tourism is the region's main industry, with each township containing a caravan park and several fossicking parks and dedicated fossicking areas. • Rubyvale contains gem shops and galleries, a business operating mine tours and a hotel. Other businesses in the region include post offices, convenience stores, service stations, newsagencies, a bottle shop, and a library. • Sapphire, which has an estimated population of 572, also contains a wetlands reserve with walking and cycling tracks.²⁹
Small scale mining activities	<ul style="list-style-type: none"> • Gemfields region accounts for almost all sapphires mined in Queensland.

²⁹ 'Sapphire Gemfields, Queensland.' Central Highlands Development Corporation. DOA: 12 May 2020, See: <https://centralhighlands.com.au/about/interactive-map/sapphire-gemfields-queensland/>

Economic benefits of small scale mining	<ul style="list-style-type: none"> • There are over 1,000 MC and ML held in the Gemfields and surrounding areas, however industry stakeholders indicated there are only 20-30 active commercial gem miners in the region, ranging from full time to part time miners. • Small number (2-3) largescale open cut sapphire miners using heavy machinery. Remaining miners use light machinery and/or hand mining instruments to mine underground. • A large number of claims are used as cheap residences by recreational/hobby miners. The vast majority of these claim holders do not produce material quantities of sapphire. • Economic benefits from gem production from the Gemfields modelled at \$3.53 million per annum under the 'DNRME production data' scenario and \$5.86 million per annum under the 'industry consultation' scenario. • Economic benefit from tourism expenditure in the Gemfields region estimated at \$263,000 per annum, noting that total annual tourism expenditure in the Gemfields region is around \$14.9 million per year, which corresponds to an annual economic benefit of \$2.63 million, however it is assumed only 10 per cent of this total benefit is attributable to the presence of small scale miners in the region. • The attractions of the Gemfields region may have flow-on impacts for the rest of the Central Highlands regional economy in relation to tourism expenditure (i.e. tourists may be attracted to the region by the Gemfields and also visit other areas within the Central Highlands). Total tourism expenditure in the Central Highlands region is estimated at \$235 million per annum (i.e. annual economic benefit of \$41.6 million). If the Gemfields region was to account for 10 per cent of this region-wide benefit, and the 10 per cent assumption was maintained for the small scale mining industry, the economic benefit attributable to the industry would be \$416,000 per annum.
Economic costs of small scale mining	<ul style="list-style-type: none"> • As most miners in the Gemfields region use light machinery or hand mining techniques, the majority of the economic costs attributable to the industry are accounted for by labour. Annual labour costs were estimated at \$859,000 under the 'DNRME production data' scenario and \$1.17 million under the 'industry consultation' scenario. • The Gemfields region also accounted for almost half of the quantified government administrative and regulatory costs, estimated at \$483,600 per annum. • Several stakeholders also reported material costs being incurred by agricultural producers as a result of the presence of small scale mining on their properties. While not sufficiently material to warrant inclusion in the cost-benefit analysis (noting the lack of data available to develop a robust industry-wide cost estimate), it is important to acknowledge that these costs can be significant to individual landholders.
Contribution to the regional economy	<ul style="list-style-type: none"> • The industry modelling undertaken as part of the cost-benefit analysis estimated annual expenditure on fuel, spares and other consumables by small scale miners within the Gemfields region at between and \$109,783 and \$150,000. In addition to these expenditure, small scale miners also account for expenditure on non-mining related goods and services within the Gemfields townships. • However, while small scale miners make a material contribution to the regional community, the majority of economic activity is attributable to tourists and hobbyists who visit the region to use the fossicking parks and dedicated fossicking areas during the winter months. The contribution to the local economy attributable to these activities cannot be attributed to the small scale mining industry, as the scope of the industry does not include fossicking activities.
Qualitative impacts	<ul style="list-style-type: none"> • Gem mining is critical to the viability of the townships within the Gemfields. All stakeholders consulted with acknowledged that without gem fossicking as a tourist attraction, the region would lose the majority of its tourist visitations and the businesses would not be viable • While there was universal agreement regarding the significance of the region's gem mining history and tourist offerings, there were divergent views in terms of the role played by the commercial small scale sapphire miners. Some stakeholders held the view that the presence of operational sapphire miners adds an authenticity that makes a significant contribution to the uniqueness and hence attractiveness of the region, while other stakeholders considered this impact to be minimal or non-existent.

A. Overview of opal and sapphire mining sectors

A.1 Opal mining

A.1.1 Location

The Queensland opal mining sector is based around the mining of boulder opal. Queensland's opal fields cover a significant area of the south western region of the state, with deposits located within a 300 kilometre belt of cretaceous sedimentary rock known as the Winton Formation. This formation extends from the New South Wales in a north-west direction (approximately 1,000 kilometres in total), encompassing the townships of Cunnamulla, Quilpie, Longreach and Winton (see Figure 1).

The majority of opal mining occurs around Winton and the Opalton township and around Quilpie and Yowah. The Quilpie/Yowah opal fields contain some of the more productive opal mines in recent times and typically contains more minerals than the Winton/Opalton fields, however the latter is considered to contain higher quality mineral resource.³⁰

A.1.2 Mining activities

Boulder opals vary in size from less than a few centimetres to greater than 20 centimetres. Boulder opal also occurs in smaller ironstone concretions of up to 5 centimetres. These are referred to as 'Yowah nuts'. The majority of opal mining involves open cut operations using heavy machinery (i.e. 20 and 40 tonnes excavators and bulldozers), with only a small number of hand miners remaining in the region surrounding Opalton. There are also some miners using light machinery to mine underground in the Quilpie/Yowah opal fields.³¹

A.1.3 Size of the industry

Australia is estimated to account for around 95 per cent of world opal production. However, consistent with the Australian industry as a whole, the Queensland opal mining sector has been in decline in recent years. While several hundred opal mining tenures are held across South West and Western Queensland, estimates for the number of active opal miners from industry stakeholders ranged from 40 to 100, with the

³⁰ Based on consultation with industry participants.

³¹ Neville, B., Horton, D., and Cooper, W. (2000). Opal – Mineral Information Leaflet No 16. Queensland Government, Department of Mines and Energy.

intensity of mining ranging from part-time during the winter months to full-time mining over an eight month period every year.

While ascertaining the total quantity and value of opal production in Australia has always been challenging, past estimates from various State Governments have supported an annual estimate of around \$100 million.

South Australia is the largest jurisdiction in terms of opal production and has previously been estimated to account for around 50 per cent of total Australian opal production, with the remainder accounted for by New South Wales and Queensland. In 2013, opal production in South Australia was estimated at around \$12.6 million,³² indicating the Australian opal industry is around 25 per cent of its peak during the 1980s and 1990s.

The value of Queensland opal production is difficult to estimate due to shortcomings in data collection and reporting processes.³³ Based on statistical information provided by the Department, the current total value of opal mined in Queensland is around \$750,000 per annum. This is not consistent with the views of industry participants obtained through the stakeholder consultation process, with one stakeholder estimating total production from the Winton/Opalton region at around \$3 million per year.

While caution needs to be exercised in relation to anecdotal information and estimates provided by stakeholders, these estimates appear more realistic given the reported number of opal miners operating in Queensland and the historical production estimates.

A.1.4 Marketing

Opals can be marketed as a range of products, including as solid gemstones, doublets, triplets, carvings, beads, watch faces, etc. Queensland opal miners have historically preferred to sell rough opal to domestic and overseas buyers who then perform value adding and manufacture jewellery. However, in recent years, economic necessity (i.e. increasing costs and declining profitability) has resulted in an increasing number of miners performing primary value adding (i.e. splitting or opening up the boulder opal and polishing the opal) prior to selling.

While the value of opal is determined by a range of factors, including size, carat weight, body tone, clarity, perfection of the cut and polish, presence of flaws, industry participants reported strong demand for Australian opal products, with prices experiencing strong growth in the late 2000s after an extended period of decline. One

³² 'Opal'; Department of Energy and Mining, Government of South Australia; DOA: 7 May 2020; See: http://energymining.sa.gov.au/minerals/mineral_commodities/opal

³³ It is noted that industry participants are only required to pay royalties and hence submit royalty reports when their annual production exceeds \$100,000 in value.

opal miner estimated that the average price of opal sold from Queensland increased by 100 per cent between 2005 and 2010, with prices remaining strong over the following decade, driven by strong demand in Asian and European markets. Opal miners are increasingly using the internet to market and sell their product to both domestic and overseas buyers.

A.2 Sapphire mining

A.2.1 Location

Sapphire is a variety of mineral corundum, a rock-forming and naturally transparent mineral. Sapphires are predominantly mined in the Central Highlands region in the area surrounding the townships of Sapphire, Rubyvale, Anakie, and the Willows, known collectively as the Gemfields. A wide variety of sapphires are recovered from the Gemfields, including blue, yellow, green and parti-coloured sapphires.

A.2.2 Mining activities

The majority of Queensland sapphire miners are hand miners that operate underground on small mining claims. These claims are mostly located between Sapphire and Rubyvale. The techniques employed by these miners range from rudimentary hand sieving and washing to the use of light machinery in underground shafts.

There are also a small number (i.e. two or three) larger operators that use heavy machinery for open cut sapphire mining. The majority of sapphire production from these miners is lower grade sapphires that are sold to gem processors in Asian markets.

A.2.3 Size of the industry

Similar to the opal industry, the Queensland sapphire mining industry has contracted significantly over the past three or four decades. One industry participant estimated that prior to a collapse in sapphire prices in the late 1970s, the annual value of sapphire production in the Gemfields was around \$50 million.³⁴

There are a large number of mining claims held for gem mining in the Gemfields region. However, the majority of these claims are either not used or are used primarily for residential purposes with minimal mining activity being undertaken. Industry sources

³⁴ Based on industry consultation.

estimate there are around 20 to 30 operational gem miners in the Gemfields region producing material quantities of sapphire.

As with the opal mining industry, data on the total value of mineral production from the Gemfields is unreliable due predominantly to reporting issues.³⁵ Based on the data provided by the Department, annual gem production in Queensland (of which the vast majority is from the Gemfields region) is around \$3.5 million per annum. However, industry stakeholders estimate that the actual value of total production is around \$5 to \$10 million per annum. The majority of this production is attributable to the larger machinery open cut gem miners.³⁶

A.2.4 Marketing

As with opals, the majority of sapphires recovered from the Gemfields are sold as rough product to overseas buyers. Most buyers visit the gemfields in April and December each year and negotiate purchase prices with gem miners. A small number of the hand miners perform their own value adding, including cutting and polishing the gems and manufacturing jewellery products. For example, the Rubyvale Gem Gallery is owned by a gem miner who mines sapphires and produces jewellery products for retail sale.³⁷

³⁵ It is noted that industry participants are only required to pay royalties and hence submit royalty reports when their annual production exceeds \$100,000 in value.

³⁶ Based on industry consultation.

³⁷ 'Rubyvale Gem Gallery'; DOA: 7 May 2020; See: <https://rubyvalegemgallery.com/the-gallery/>

B. Small scale miner data and information request

Table B.1 Small scale mining data and information request

Parameter	Unit	Value
Type of Mining operation (Underground/open-cut)		
Mining district		
Size of mining operation:		
Area	(ha, km ²)	
Depth of Shaft	metres	
Proprietors labour input	Hrs/day	
Volume excavated	m ³ /yr, tonnes/yr	
Past and current investment:		
Existing Machinery – Current replacement cost		
Item 1 e.g. Bulldozers	\$	
Item 2 e.g. Excavators	\$	
Item 3 e.g. Trucks	\$	
Item 4 e.g. Processing plant and equipment	\$	
Other equipment e.g. Small plant and equipment	\$	
Current market value of mine (excluding equipment)	\$	
Operating Costs (\$/annum):		
Fuel and oil	\$	
Machinery Repairs and Maintenance	\$	
Paid labour	\$	
Marketing cost	\$	
Insurance and finance	\$	
Consumables	\$	
Gem production:		
Gems produced per annum (average last 3 years):		
Mineral 1 (please specify)	Volume	Carats/other
	Value	\$
Mineral 2 (please specify)	Volume	Carats/other
	Value	\$
Mineral 3 (please specify)	Volume	Carats/other
	Value	\$
Mineral 4 (please specify)	Volume	Carats/other
	Value	\$
Rehabilitation costs		
Estimated cost of rehabilitating mine sites (one-off cost)	\$/unit of area	