5 Project Alternatives
Project Alternatives

5.1 Introduction

This Chapter of the EES provides detail on a number of alternative Project design, which were considered by SGM. An iterative design process enabled SGM to identify a range of project refinements which resulted in reduced mining time frames and a reduction in potential impacts of the Project.

This section also outlines the local and regional implications of the ‘No Project’ alternative. In addition, and as required by the Project Scoping Requirements, this section outlines how SGM through the current Project has addressed concerns raised by the Independent EES Panel and the Minister which resulted in the 1999 Big Hill proposal not being approved.

The Scoping Requirements (Section 3.5) specify that the:

‘EES should investigate and document the likely environmental effects of relevant alternatives, where these offer a distinct potential for superior environmental outcomes and are capable of meeting the objectives of the project.’

This should include:

- ‘The basis for selecting the two areas proposed to be mined within the broader boundaries of the mining licence, including alternatives for the layout and staging of the open cut operations;
- ‘The site selection process for the new ancillary activities, including the TWRS and roads; and
- ‘The technical feasibility and environmental implications of alternative construction mining and site rehabilitation methods.’

In addition, Section 3.3 of the Scoping Requirements states that:

‘The EES should explain how the current project responds to the issues identified in the Minister’s Assessment in 2000 of the previous proposal for development of an open cut gold mine at Big Hill.’

5.2 The ‘No Project’ Alternative

SGM has considered the Project in the context of a ‘no Project’ alternative. This alternative involves progressive winding down of the existing underground mining operation and effective closure of the current mining operation during 2014-15. This option will be the outcome if this Project does not receive the required approvals from Government. However, SGM has determined that the gold price and more detailed understanding of the gold resource at the site enables a viable and enhanced Big Hill development. Accordingly, the ‘no Project’ option is considered an under-utilisation of an existing resource which is readily accessible and can be cost-effectively mined and processed using existing mine infrastructure and personnel.

5.2.1 Implications of the Project Not Proceeding

Should the Project not proceed, processing of existing ore stockpiles is scheduled to cease in 2014-15. As a result, the beneficial impacts expected for the local, regional and state economy through output, income, employment and direct and indirect expenditure from the Project would not be realised.
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Chapter 8, Sections 8.17 and 8.18 assess in detail the potential positive and negative economic and social impacts associated with the Project which would not be realised should it not proceed. Some of the potential positive impacts include:

- direct and indirect employment of up to 286 people for approximately five years of mining and rehabilitation
- increase in the Gross Regional Product for the North Grampians-Stawell economy of up to 4.9 per cent, which is equivalent to $47 million
- increased total mining value-added in South Wimmera of up to $53.3 million
- net welfare gain of $38 million modelled over 12 years (discounted at five per cent)
- increased period of adjustment available for local businesses and employees to a post-mining economy.

While some of these benefits will extend for the duration of the Project only, this period will importantly allow the Stawell community a period in which to transition to either a post-mining economy or for other mining projects in the region to proceed.

5.3 Underground Method Alternatives

On the basis that the ‘no Project’ option was not under consideration, SGM considered the potential for extraction of the mineral resource via underground mining in order to minimise some potential social and environmental impacts associated with open-cut mining. However, the underground mining of the shallow pit resource was considered unviable for a number of reasons including:

- the relatively low grade of the ore bodies and their presence in dispersed outcrops meant extraction of the resource via underground mining methods would be both economically and technically prohibitive
- the relatively low intact rock strength in the upper weathered zones would lead to an excessive quantity of ground support and associated cost to make extraction of the up to 14 metres wide resource possible
- the proximity of the ore body to the surface would necessitate the closure and restriction of access to the Big Hill area for potentially a longer duration than the planned open pit operations to ensure public safety
- the ability to ensure that there would be no future stability issues with the affected area could also be greatly reduced with underground mining proximal to the surface
- the quantity of previous underground mining voids that would be encountered in the planned extraction area would increase the time, cost and safety requirements to a level that would be prohibitive.

On balance, it was considered that the nature of the ore bodies, the degree of technical difficulty, safety issues and certainty around long term stability of the rehabilitated landform meant continued underground mining of the resource was not a viable option despite offering potential to reduce some impacts such as dust and noise.
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5.4 Open Pit Mining Method

The development of the open pit mining method proposed for the Project has been developed by SGM via an iterative process, which has continually assessed and modified a range of practices to ensure potential impacts on the community are minimised as far as possible.

Initial assessments of the Project viability, assumed the use of standard excavator and truck haulage and typical open pit mining practices. These assessments assumed material would be extracted from a single bench level prior to excavating to the next level, which minimises the number of vehicle movements and maximises the operational area available to mining equipment and other ancillary pit operations (e.g. geological investigation, road works, void management or drill and blast activities). SGM also assumed the drill and blast activities would be used widely, to maintain excavator productivity rates. These assumptions were based on the most efficient extraction method for the resource, thereby minimising operational costs.

Detailed staging plans were developed based on the abovementioned assumptions to enable development of a mine design based on the optimised pit designs, TWRS location and haul road alignment. These plans also considered the findings of the Independent EES Panel and the Minister in relation to the 1999 proposal (refer to Section 5.6), which restricted mining activities in the North Pit in order to minimise noise impacts.

While the initial assessment of these detailed staging plans indicated the approach would be technically and economically viable, the potential amenity impacts on nearby residents were considered unacceptable. Additionally, the proposed construction method for the TWRS would expose nearby residents to significant noise-generating activities and would provide minimal protection from dust emissions. These findings necessitated the implementation of best and leading practice management and mitigation measures.

In recognition of the need to make a step-change in the proposed mining process to achieve compliance with relevant regulations, SGM is proposing a significantly different benching configuration to that typically employed in projects of this type. The use of multiple benches will ensure that nearby residents are shielded from noise and dust emissions at all times by at least two five metre benches. The use of multiple benches are typically only required when pit wall gradients are steep or where the operational area is large enough to enable simultaneous drilling / blasting and haulage in separate areas of the operation. In the case of the Project, the use of multiple benches is not optimal when viewed purely from a mining efficiency viewpoint and adds considerable cost to the Project. However, adoption of these measures results in a Project which is highly compliant with regulations and achieves amenity outcomes not achievable using normal mining practices.

A detailed comparison of the proposed pit design and the number of leading practices SGM are proposing is provided in Chapter 1, Section 1.4.2 and a staged description of the mining process throughout the Project is detailed in Chapter 6, Section 6.4.

5.5 Tailings Disposal Options

SGM’s existing licenced TSF (TSF No. 2) is currently the subject of an environmental risk audit to identify a remedial plan to mitigate environmental impacts associated with current and future tailings disposal. In this context, SGM has considered alternative disposal options for the tailings generated by the Project, including:
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- underground deposition of treated tailings
- building of a new tailings storage facility within the mine’s footprint in accordance with current best practice and standards.

The underground deposition of treated tailings would not only preclude the option of pursuing underground mining opportunities in the future should additional resources be identified, but would have potentially significant, and at this stage unknown environmental impacts as groundwater levels recover once dewatering ceases.

The costs associated with the construction of a new TSF would be prohibitive and would result in the Project not proceeding. Additionally, it is likely that the construction of a new storage facility would require the removal of a relatively significant area of native vegetation, with subsequent habitat loss for flora and fauna species.

SGM is confident that the current issues associated with the TSF are manageable and that the current audit process will show that the appropriate management and mitigation measures are being undertaken.

5.6 Comparison with the 1999 Proposal

As outlined in the previous section, open-cut mining is considered the only technically and commercially viable option for further development of the resource in the Big Hill area. It is important to note that, while the 1999 proposal was also an open-cut mine, there are significant improvements and enhancements in the current proposal designed to address and offset the concerns of the Independent EES Panel and the Minister which resulted in the 1999 proposal not being approved. The enhancements include both design aspects and the application of best practice mitigation measures to achieve compliance with relevant regulatory requirements. Table 5-1 compares some of the key metrics of the 1999 Big Hill proposal and the current Project.

Table 5-1 Comparison of project metrics for 1999 Big Hill proposal and current Project

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<thead>
<tr>
<th>Project metric</th>
<th>1999 proposal</th>
<th>Current Project</th>
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<tr>
<td>Project timeframe (including rehabilitation)</td>
<td>8 years</td>
<td>5 years</td>
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<tr>
<td>Size of pits (total)</td>
<td>Approximately 15 hectares</td>
<td>Approximately 15.8 hectares (excluding buffer areas)</td>
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<tr>
<td>Quantity of material handled (including backfilling)</td>
<td>12,759,380 tonnes</td>
<td>17,034,647 tonnes</td>
</tr>
<tr>
<td>Nearest resident</td>
<td>Approximately 50 metres</td>
<td>Approximately 40 metres</td>
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<tr>
<td>Box Ironbark Forest removal for waste rock storage</td>
<td>Approximately 9 hectares</td>
<td>Approximately 2 hectares</td>
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<tr>
<td>Rehabilitation state</td>
<td>Northern pit reformed and rehabilitated from waste created from southern void. Southern pit void to remain open.</td>
<td>All mined pit voids will be backfilled and re-contoured progressively throughout the Project.</td>
</tr>
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The current Project achieves a number improvements compared to the previous 1999 proposal in an effort to address key concerns raised by the Panel in 2000. Key improvements include a greatly reduced area of Box Ironbark Forest cleared for waste rock storage, complete backfilling and rehabilitation of both pits and a shortened timeframe to reduce the duration of potential amenity impacts on nearby residents.

Some of the improvements achieved by the Project will however have potential adverse impacts. The condensed Project timeframe, as well as the additional materials required to backfilling the South Pit may result in increased noise and dust levels at times.

The effective noise level from site activities may be reduced by limiting the hours of operation, and/or reducing equipment numbers. While reductions in operating hours have already been implemented through restricting extraction activity to day time hours during week days, any further time restrictions would have a significant impact on the duration of the Project and hence, viability of mining operations.

Halving the equipment requirements on-site would only result in a marginal noise level reduction of approximately three decibels, which is considered to be just noticeable. Additionally, reduced equipment numbers may extend the Project duration from five years to up to 10 years. This would double the duration of noise impacts. In terms of impacts on air quality, SGM will employ a number of best practice measures (and measures that are considered to be beyond best practice) during the day to day site operations to minimise the generation of particulate matter and reduce off-site impacts.

A key feature of Project is the mining sequence and methodology, which will optimise shielding of residents from noise and dust emissions. Additionally, the Project proposes to seal the haul road and implement a trigger action response plan to further reduce potential dust impacts. Based on meteorological forecasts and real-time dust monitoring to SGM will pro-actively manage site operations prior to the occurrence of adverse weather conditions. Site activities will be modified at a range of trigger response levels, and will cease completely in the most severe circumstances.

Additionally, the potential for direct health impacts caused by stress and anxiety amongst the impacted communities during the Project due to loss of amenity (acoustic, vibration and visual) is reduced by the condensed timeframe or the Project in comparison to the previous Big Hill proposal.

On balance, SGM believes that the current Project represents a net improvement on the previous Big Hill proposal with social and economic benefits for the Stawell community.

Table 5-2 outlines the concerns raised by the EESP Panel for the 1999 project that were considered to be potential constraints to endorsement of the proposal and the way in which these concerns have been addressed in the current Project.
## Table 5-2  Key issues arising from the 1999 Big Hill Proposal

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<tr>
<td>Inter-relationship with planning scheme strategies</td>
<td>The concept of seeking to undertake mining of a known gold resource is appropriate and in keeping with State policy, subject to meeting the required range of environmental and other planning considerations found in the planning scheme. The EES review examines such matters. Some modifications to MSS documentation could be appropriate in regard to future uses of rehabilitated land.</td>
<td>Should not constrain endorsement as all policy requirements are met.</td>
<td>The current Project has been assessed and is consistent with State and Local policies in the Northern Grampians Planning Scheme. Potential future uses of the rehabilitated surfaces of the Project are in keeping with the general Planning Scheme intent of maintaining public land for community and environmental purposes.</td>
</tr>
<tr>
<td>Concept of open pit mining</td>
<td>The use of open pit mining is recognised in Victoria as a valid process for resource mining. Closer appraisal of the appropriateness of such a mining approach adjoining an urban setting will emerge from detailed review of submissions. The possibility of a long term southern void is a major issue for careful consideration.</td>
<td>Could constrain endorsement consideration</td>
<td>An assessment of alternative mining methods found that underground mining of the Big Hill resource was not a viable option. Refer to Section 5.3 for further details. The open pit designs have been refined so as to minimise impacts on surrounding sensitive land uses and to comply with regulatory requirements as described in detail in the technical studies. Refer to Section 5.7.1 for further details. The southern void is no longer a relevant issue as all mining voids are to be completely backfilled and contoured to a similar topography and current height within five years leaving no long term voids.</td>
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<td>Alternative processes or a 'no Project' approach</td>
<td>The highly weathered nature of the rock would not allow mining in safety at shallow levels. The ‘no develop’ option will emerge if the project does not gain endorsement. Formal requirement for ongoing investigation and associated reporting should be embodied in endorsement documentation.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>The ‘no Project’ alternative remains the only option should the Project not be approved under the EES process. Due to geological conditions at the site, underground mining of the Big Hill resource has been ruled out as an option for further mining operations. The implications of the Project not proceeding are outlined in Section 5.2.1 and include the loss of $47 million of Gross Regional Product for the Northern-Grampians – Stawell economy.</td>
</tr>
<tr>
<td>Buffers and the 100 metre rule</td>
<td>Outline plan produced by proponent of 100 metres boundary and survey based plan supported for administrative purposes. Adequate notice was given. Specific impact appraisal of land within buffer area is undertaken in subsequent issue reviews. No substantive ground for negating Mining Licence has been found and the Minister’s attention is drawn to submission documents on this aspect. Deed of Consent to embody a range of agreed matters. Includes structural assessment and valuation aspects.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented. However due to the endorsement process under the MRSD Act consent of owners within 100 metre buffer required. If consent is not forthcoming requires appraisal by the Minister.</td>
<td>While the Mineral Resources (Sustainable Development) Act 1990 (MRSD Act) typically requires consent to be sought for mining from landowners within 100 metres of operations, consultation with the government has since established that this is not the case for the Project (refer to Chapter 3, Section 3.2.3 for further detail).</td>
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<tr>
<td>Noise</td>
<td>Requirement for a detailed noise management strategy and the use of ongoing time and noise monitoring program. Adherence to management strategy was vital and cost elements of such approach may lead to reconsideration of project.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented but will necessitate extremely tight controls over operating conditions.</td>
<td>The current proposal is the result of considerable evaluation of optimum pit design, haul road location and attenuation measures for equipment to minimise noise levels at nearby receptors. Noise management is addressed in the Environmental Management Plan (EMP) (refer to Chapter 11).</td>
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<td>Blasting</td>
<td>Proposed blasting techniques &amp; monitoring principles accepted subject to embodiment in EMP and endorsement by DEPI. ERC to have ability to comment on Plan through ERC. Blast Strategy to involve designation of zones in which specified blasting techniques can be used. Issues of structural assessment &amp; valuation dealt with in Buffers and the 100 metre rule.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented but will necessitate extremely tight controls over blasting techniques.</td>
<td>Potential blasting impacts have been thoroughly examined in this EES for the current Project. Areas of 'special blasting' have been identified where a charge mass reduction may be required to limit the ground vibration to five millimetres per second at the nearest sensitive receptors. The regulatory limit for blasting is based on human annoyance. The vibration levels at which people become annoyed is well below levels at which houses are damaged. Refer to Chapter 8, Section 8-6 for more details. Upon application to SGM, an existing conditions assessment will be undertaken by an independent building inspector prior to the commencement of the Project. Any property damage that is attributable to the Project will be repaired at SGM’s cost. The existing conditions assessment will assist that determination in the event of a claim. Blasting techniques and management measures are detailed in the EMP for the Project.</td>
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The noise monitoring program will include continuous noise monitoring at critical locations. The potential noise impacts and proposed noise monitoring program are detailed in Chapter 8, Section 8.5. Compliance with the EMP will be reported at the quarterly SGM Environment Review Committee (ERC) meetings.
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<td>Air Quality*</td>
<td>A need to achieve extremely high management standards was recognised. Prescribed controls include real time monitoring for PM$_{10}$ particulates. All control measures were related to SEPP requirements. Detailed air quality management plan required to prescribe associated mitigation measures and triggers for monitoring.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented but will necessitate extremely tight controls over operating conditions.</td>
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### Issue

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<td></td>
<td>Some concerns held at the possibility of later collapses in southern void – considered under Rehabilitation. General pit design principles were sound. Embody monitoring in sensitive northern area. DEPI requires independent geotechnical overview of pit design in conjunction with approved plan. Proponent to fund independent assessment.</td>
<td>No constraint on the endorsement of Panel proposed requirements implemented.</td>
<td>The South Pit will be completely backfilled and rehabilitated, eliminating the risk of void collapse.</td>
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| Traffic & transport | Series of conditions prescribed to handle traffic matters. Further detail planning required for car parking and access as outlined by the Council. | No constraint on the endorsement if Panel proposed requirements implemented. | Additional measures to manage traffic and parking over and above those already in place are not relevant to the current Project. This is because there is an overall reduction in the number of staff from those currently employed in the underground mining operation. As employees account for the majority of vehicle movements, further traffic management is not required. In addition, all truck movements associated with the mining and processing of ore are contained within the site, with the exception of Year 5, when materials will be transported between Mt Micke (or alternative source of backfill material) and the South Pit. Additional directional signage to direct tourists to the mine will be installed in the main road network surrounding the Project site and at the Western Highway. The End Use Master Plan will address traffic and parking issues associated with the rehabilitated Project site. |
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<td>Water related issues</td>
<td>Comprehensive management plan proposed. Monitoring results to ERC. Groundwater investigation required. Detail appraisal of detailed water balance appraisal prior to any Work Plan endorsement.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>Detailed investigations into water management for the current Project have been undertaken as part of this EES. A water balance model was developed and hydraulic modelling undertaken as part of the surface water assessment. Potential impacts associated with water are minimised by the containment of all water within the operating site and reuse of water for operational purposes. Preliminary design of treatment measures have been incorporated into final system design for the Work Plan Variation required under the MRSD Act. Monitoring of surface water has been recommended in the surface water report and will be undertaken as part of the EMP. Compliance with the EMP will be reported at the quarterly ERC meetings.</td>
</tr>
<tr>
<td>Flora and Fauna</td>
<td>Concerns held at waste rock emplacement impacts but accepted in conjunction with compensatory land. Stringent controls to be embodied in EMP to minimise impacts and to ensure sensitive rehabilitation program. If any major modifications to proposal emerge through review then reappraisal of waste rock management could be desirable.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented. Has an inter-relationship with proposals to refill southern void.</td>
<td>The TWRS will be located in an area comprised of the former Davis Open Cut overburden dump (devoid of remnant vegetation) and on adjacent GWMWater pasture land. This is a significant change to the proposal contained in the 1999 EES, which proposed storage of the TWRS on an area comprising of high value Box Ironbark Forest with attendant loss of nine hectares of this important vegetation. The objective of protecting the Box Ironbark Forest was central to SGM seeking alternative locations for waste rock storage. The ability to use GWMWater land is significant in terms of protecting flora and fauna.</td>
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<td>Big Hill and its attributes</td>
<td>The ‘icon’ attributes of Big Hill must be capable of being reinstated in any rehabilitation program. Concern held at the possibility of a long term southern void.</td>
<td>Could constrain endorsement consideration.</td>
<td>Potential loss of the “iconic” value of Big Hill once mining is completed is no longer an issue as the entire Project area will be rehabilitated to approximated current topography and height, leaving no long term voids. Historic memorials will be temporarily removed and stored off-site for the duration of the Project and reinstated as part of the rehabilitation program. This will be detailed in the Master Plan, with an overview provided in Chapter 10.</td>
</tr>
<tr>
<td>Aboriginal sites</td>
<td>Extensive review undertaken to appraise Aboriginal association with Big Hill. No substantial evidence provided or found to justify any specific constraints on this aspect.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>Detailed cultural heritage assessments conducted during preparation of the CHMP for the current Project found that there were no Aboriginal cultural heritage places within the Project area.</td>
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<td>Heritage</td>
<td>The loss of a number of heritage sites acknowledged as a result of mining. Such loss deemed acceptable but range of requirements stipulated in regard to processes to be observed. Reinstatement of memorials required.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>The reinstatement of historic memorials following the completion of mining is proposed as part of this Project. Procedures for storage and reinstatement are subject to discussion with the NGSC. All sites that will be permanently destroyed (e.g. historic mine workings) will be photographed prior to destruction in order to create permanent records of these places and conducted in consultation with relevant regulatory authorities.</td>
</tr>
<tr>
<td>Waste rock management</td>
<td>Details obtained on obviating a waste rock emplacement. Management requirements broadened and need for height control.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented. Has an inter-relationship with proposals to refill southern void.</td>
<td>Complete backfilling of the pits will eliminate the need for a waste rock emplacement beyond the end of the Project.</td>
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<td>Health and Social</td>
<td>Strategies to be implemented to deal with a range of perceived impacts. Information programs to undertaken. Monitoring results to be freely available and process for dealing with complaints.</td>
<td>No constrain on the endorsement of Panel proposed requirements implemented.</td>
<td>Environmental and social investigations conducted as part of this EES have been designed to address the concerns raised during the 1999 EES process and those raised as part of the extensive community consultation process for the current Project. The intent of this EES, as outlined in Chapter 8, Section 8.18, is to demonstrate that the Project will not have unacceptable social, health or environmental impacts. Mine site design and operational strategies have been developed which are not the optimal outcome for commercial returns but seeks to find a balance between project viability and community impacts. Through the EMP and existing ERC process, procedures are proposed for the monitoring of potential impacts, recording and resolution of complaints. Monitoring results will be reported at the quarterly ERC meetings.</td>
</tr>
<tr>
<td>Economics</td>
<td>The general elements of assessment deemed satisfactory. Scenarios for short and long term and associated expenditure patterns strongly contrast. Implications for city future.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>A detailed Economic assessment has been conducted as part of this EES. The study has identified both short and long term positive and negative impacts associated with the Project and has clearly enunciated these for assessment purposes. The study also clearly outlined the economic costs and benefits for the township of Stawell and the wider regional economy. The short and long term impacts of a ‘no Project’ option have also been evaluated. The Economic assessment is found in Chapter 8, Section 8.17 of this EES.</td>
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<td>Impact upon property value</td>
<td>A process was proposed for dealing with situations where nearby residents sought to sell. Use to be made of database to assess any loss of value and negotiations would be related to such value.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>An independent property valuation has been undertaken to determine the potential for any changes to property values related to the changing scale and type of mining operations over time. To date, the assessment has focussed on general property values prior to announcements by SGM and any potential changes since announcements and during the EES process. In the event that the Project is approved, values will also be monitored during mining operations. Consistent with requirements of the MRSD Act, SGM has committed to compensate for realised loss of property value as a result of mining operations. The Economics assessment conducted as part of this EES considered that closure of SGM operations could result in reduced commercial and residential property values by 10 - 20 per cent due to an oversupply of the property market as vendors seek to sell their homes and relocate to other areas for employment.</td>
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<tr>
<td>Visual amenity</td>
<td>Suggestions made in regard to amelioration of acoustic fencing in some sections. General rehabilitation program considered to result in acceptable visual form, with reservations in regard to the southern void.</td>
<td>Could constrain endorsement consideration.</td>
<td>The current Project does not involve the construction of a noise wall and includes complete backfilling and rehabilitation of all voids to current topography. This eliminates any potential post-mining visual amenity impacts for the current Project which was of concern to the Panel for the 1999 proposal.</td>
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<td>Environmental management and risk assessment</td>
<td>Proposed principles in EES for Hazards and Risks and Environmental Management System were deemed to be appropriate for the proposed project. Some minor additional requirements proposed.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>The risk assessment process adopted for the current Project and outlined in this EES is considerably more advanced than that adopted for the 1999 project. All risks and hazards have been assessed using a rigorous process and management strategies developed to ensure compliance with regulatory requirements (refer to Chapter 9).</td>
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<tr>
<td>Rehabilitation and future land use</td>
<td>Supports general principles of rehabilitation program with exception of the concept of the southern void. Significant filling (approx. 80 per cent and to relate to 267.5 -270 AHD or thereabouts) was considered as being a minimum requirement. Such requirement could threaten the project. Rehabilitation auditor to be appointed.</td>
<td>Would constrain endorsement consideration.</td>
<td>As outlined earlier in this table, complete rehabilitation of mining voids and a return to original topography completely removes this concern.</td>
</tr>
<tr>
<td>Tourism</td>
<td>No adverse impacts should occur and endeavours should be made to generate tourist interest both in mining project and the extensive rehabilitation program.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>The Rehabilitation Plan has the potential for SGM to work closely with the NGSC and the local community to enhance local recreation and tourism facilities as part of the reinstatement of Big Hill. SGM may consider the construction of a viewing platform to enable residents and visitors to view the mining operations and the outlook to the Grampians for the duration of the Project. This would be undertaken separate to the EES process if it is to proceed.</td>
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<td>Project timing</td>
<td>Time frame identified with two years period for commencement and 10 years finish time.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented. Has an inter-relationship with proposals to refill southern void.</td>
<td>In developing the Project, SGM has given serious consideration to the concerns raised in relation to the 10 years mine life of the 1999 project. Accepting that a 10 years open cut mining operation close to the Stawell township may be considered an excessive operational timeframe, the Project has a significantly shorter life span and improved operational measures to protect amenity. The Project aims to achieve continuity with the processing of existing ore reserves from underground mining which are due to be exhausted in 2014-15. The Project will include approximately four years of mining and a further year for backfilling and rehabilitation and will be completed within five years of commencement, a significant reduction when compared to the 1999 project.</td>
</tr>
<tr>
<td>ERC and Monitoring</td>
<td>The general concepts of the DEPI requirements for ERC were supported including four local representatives. Proposed monitoring program endorsed. Community Information system proposed by proponent was endorsed. Auditor to be appointed.</td>
<td>No constraint on the endorsement if Panel proposed requirements implemented.</td>
<td>The EMP proposed as part of the Project includes a comprehensive monitoring program. Compliance with the EMP will be reported at the quarterly ERC meetings. The existing SGM complaints register will be maintained for the duration of the Project, with a response protocol established to ensure all complaints are addressed appropriately.</td>
</tr>
</tbody>
</table>

*Note: The Protocol for Environmental Management: Mining and Extractive Industries (PEM) was introduced following the Big Hill project proposed in 1999 and raises the required standards for mining with respect to air quality. The PEM is detailed in Chapter 3, Section 3.4.2 and the expected air quality impacts resulting from the Project area assessed against this new regulation in Chapter 8, Section 8.7.*
5.7 **Consideration of Project Design Alternatives**

Several design alternatives for the Project were considered as outlined below. In considering design alternatives for the Project, SGM took into account the key concerns of the Independent EES Panel and the Minister from the 1999 proposal. Design iterations were also closely aligned with the various impact assessment studies being undertaken in parallel with a view to finding the appropriate balance between technical and commercial optimisation and attainment of acceptable social and environmental impacts.

### 5.7.1 Alternative Open Pit Designs

The design of the open pits aimed to minimise environmental impacts while optimising Project economics. The ‘Whittle Optimisation’ process was used in the development of a range of alternative pit designs. This process considers the known mining, geometric and economic parameters to generate a range of pit shells used as a basis for the design.

These designs are then assessed in terms of the expected economic return for a given set of costs of production including the mining sequence, mining and milling rates, bench advance rates, the appropriate discount rate.

Considering the proximity of the North and South Pits to surrounding residences and infrastructure, the decision regarding the selection of the preferred pit design included, but was not limited to, the following criteria:

- sustaining capital cost
- environmental rehabilitation costs
- potential cash flow
- net present value
- internal rate of return
- project duration, including rehabilitation
- open pit footprint / size
- proximity to surrounding residences and infrastructure.

Three potential designs (Figure 5-1) were selected for design and assessment. These options were selected based on maximum cash flow potential, community impact and optimal internal rate of return. The options considered were as follows:

**Option 1** – Maximum cash flow potential which involves mining of 20 million tonnes of ore and waste rock but involved a longer period of mining

**Option 2** – Maximum internal rate of return potential which involves mining of 10 million tonnes of ore and waste rock

**Option 3** – Mining operations in which the pit boundaries are at least 100 metres from surrounding residential properties at any point.
Figure 5-1  Alternative pit designs and expected financial results
Option 2 was selected as the preferred option as it effectively balances cash flow potential and pit size. This selected pit would yield a favourable operating cash flow (Figure 5-2), and based on findings of environmental studies running in parallel with the mine optimisation study, was deemed likely to not have unacceptable impacts on surrounding residences and infrastructure. By contrast, while Option 1 would have a higher operating cash flow potential, the single pit would preclude the progressive rehabilitation process proposed as part of the Project. This would result in the pit remaining unfilled for a longer period, resulting in prolonged amenity impacts and loss of open space for the Stawell community. While additional gold extraction would be possible under this option, disruption to the township was considered unacceptable and this option was not considered further.

**Figure 5-2  Cash flow and pit size for alternative open pit designs – Options 1 & 2**

Alternatively, the much smaller size of the pits considered under Option 3 would result in a much lower operating cash flow (Figure 5-3), which is not economically viable considering the costs of production.

**Figure 5-3  Cash flow and pit size for alternative open pit design – Option 3**

On the basis of economic viability and the likelihood that community impacts are manageable based on the environmental and social studies conducted up to the time of Option evaluation, Option 2 is the only viable pit design alternative and is therefore the preferred option for the Project.
5 Project Alternatives

5.7.2 Alternative Temporary Waste Rock Stockpile (TWRS) Locations

Approximately 8.4 million tonnes of waste rock will be excavated during mining operations for the Project. A number of options for storage of this waste rock were assessed when formulating the waste rock management strategy and emplacement design.

The 1999 proposal planned to locate waste rock on the former Davis cut overburden and adjoining forested land which contains Box Ironbark Forest. The loss of 9 hectares of high quality Box Ironbark Forest was a major concern of the Panel reviewing the 1999 proposal. While this option remained open to SGM, it was considered an unacceptable environmental impact and project planning involved considering options which did not result in loss of this vegetation.

Two options for the temporary storage of waste rock between the mining and rehabilitation phases of the Project were considered (Both options are shown in Figure 5-4):

**Option 1** – placement of waste rock at both the former Davis cut overburden dump and at Wonga Pit.

**Option 2** – placement of waste rock in a single stockpile on the former Davis cut overburden dump and adjoining land owned by GWMWater.

Option 2 involved consultations with GWMWater as to the availability of this land for temporary use, and on the basis of these discussions, has been selected as the preferred TWRS option. While this GWMWater land was originally preserved for reservoir construction purposes, it has been determined that it is not required for this purpose the duration of the Project. This option has commercial benefits to the Project and, importantly, has significant social and environmental benefits in that it substantially reduces the length of each of the 100,000 truck movements projected over the life of the Project. Substantially shorter truck movements over the life of the project has the effect of reducing the generation of dust, noise and GHG when compared with the longer haul distances for Option 1. Amenity impacts of additional rock storage on the GWMWater land are considered minimal due to the low residential density in adjacent areas and the local topography which restricts views into the proposed stockpile area. Potential impacts of the proposed TWRS are discussed in more detail in Chapter 8, Section 8.13, and potential impacts on GWMWater infrastructure and the quality of the potable water supply have been assessed in Chapter 8, Section 8.10.
5 Project Alternatives

Figure 5-4  Alternative temporary waste rock stockpile locations
5 Project Alternatives

5.7.3 Alternative Material Haulage Methods

The Project design process considered the use of conveyor belts for the transportation of excavated materials as an alternative to truck haulage. This would avoid the potential impacts associated with truck haulage including dust, noise, GHG emissions, amenity and vegetation loss. However, this option was not considered feasible in the context of the two-pit design, the requirement for progressive rehabilitation, multiple material deliveries and handling points and Project duration. Conveyor belt systems were considered to be insufficiently flexible given the requirements of the Project; economically prohibitive; and would result in alternative impacts, resulting from, for example, in-pit crushing.

In lieu of this option, a number of other aspects of the Project design have been optimised so as to reduce the impacts of material haulage:

- As outlined in the previous section, the TWRS site has been changed from the original proposal to GWMWater land nearer to the North and South Pits to reduce the horizontal haul distance and attendant amenity and greenhouse gas impacts
- Above-ground mining enables optimisation of truck size and volume of material to be transported to ensure an appropriate balance between commercial considerations and attainment of acceptable social and environmental impacts
- Above-ground mining avoids a 1.6 kilometre vertical haul (i.e. from underground to the surface) with attendant reductions in fuel usage and GHG emissions.

Multiple options were also considered in the selection of a mobile equipment fleet. Fleets that would meet the requirements of the Project range from smaller haul trucks and excavation equipment to much larger equipment.

The use of a smaller capacity haulage fleet for the operation would ultimately require more vehicle movements to transport the waste rock and ore, resulting in either a longer project duration or greater equipment numbers. Moreover, the noise levels created by some smaller haul truck are greater than that of the 90 and 100 tonne trucks selected. This is due mainly to the older generation engine and drive train specifications in these smaller vehicles. Noise levels created by the 90 and 100 tonne truck is in the order of 83-84dB(A) (A-weighted decibels) for 100 tonne compared to 86dB(A) for 70-80 tonne trucks.

Older series, low capital cost equipment would typically be selected for the Project on the basis of the volume of material to be excavated, the restricted working hours and the significant number of non-mining hours available for service and repairs. However, late model Caterpillar 777 (F or G series) haul trucks have been selected for the Project due to their advanced engine management systems and subsequent reductions in noise emissions compared to earlier models.

To enable selective mining of the relatively narrow ore zones, excavator sizes in the order of 120 tonnes would be appropriate for the Project. However, to ensure that mechanical excavation of the maximum amount of material without the use of drill and blast the initial excavator employed will be approximately 200 tonnes in size, with an additional, smaller unit subsequently used where possible. This will allow greater breakout force to be applied to the waste rock and ore, reducing the need for drill and blast activities.

Electric excavation equipment was also considered, however this equipment is in much larger size (i.e. in excess of 300 tonnes) and generally not meet the requirements of the Project.
5 Project Alternatives

5.7.4 Alternative Haul Road Options

Haul road design

Two options for the haul road alignment connecting the North and South Pits with the existing processing plant, TWRS and Mt Micke were considered (Figure 5-5):

**Option 1** – utilisation of the existing haul road alignment, widened in parts to enable movement of haulage vehicles

**Option 2** – a straightened alignment which follows a more direct route between the pits and Mt Micke and reroutes trucks from Leviathan Road to avoid the Albion Road / Leviathan Road / Bulgana Road / Jubilee Road intersection.

The two haul road options were assessed by the technical specialists conducting the EES studies with a view to identifying the potential social and environmental impacts associated with construction and operation of each option.

The assessments considered potential air quality, noise, GHG, visual and amenity impacts. The studies confirmed that Option 2 is the preferred option on the basis that the straightened haul road will minimise braking and turning activities associated with mining vehicles. This will improve safety and reduce dust, noise and GHG emissions generated by vehicles when compared with Option 1.

To further contain dust and noise emissions from the haul road, the road will be located below the ridge line on the eastern side of Big Hill. This will provide at least three metres of shielding (covering the noise source height on haul trucks) for the residences to the west of the Project area. In order to provide similar shielding for residences to the east of the Project area, a minimum three metre bund (or timber wall where required along the edge of GWMWater Reservoir 6) will be constructed where the natural topography does not provide at least that level of cover.

Pit ramps would typically be dual lane in projects of this size, in order to maximise efficiency and extraction rates. However, single lane ramps will be used to access the North Pit and the lower half of the South Pit during the Project to reduce the area of disturbance and overall material movement volumes.
5 Project Alternatives

Figure 5-5 Alternative haul road options
5 Project Alternatives

Option 2 results in the removal of 2.41 hectares of Box Ironbark Forest compared to 2.93 hectares for Option 1. The vegetation loss associated with Option 2 will be offset in compliance with the regulatory requirements for vegetation offsets.

Haul road surface

Two options for the haul road surface were considered as outlined below:

**Option 1** – unsealed haul road, graded road with water and chemical dust suppression

**Option 2** – sealing the following sections of the haul roads with sealing agents to reduce dust generation:
- top half of the North and South Pit in-pit roads
- North and South Pit exits to the TWRS
- TWRS inner haul road and
- haul road section between pits and TWRS

Note: some sections will only be in use during some stages of the Project (e.g. haul road section between TWRS and Mt Micke will only be in use during Year 5).

The two haul road surfaces were assessed as part of the Air Quality Impact Assessment to quantify the benefits of sealing sections of the haul road in terms of particulate emissions. Table 5-3 summaries the PM$_{10}$ results for Year 2 and Year 5.

**Table 5-3 Modelled 24 hour PM$_{10}$ results for Year 2 and Year 5 operations**

<table>
<thead>
<tr>
<th></th>
<th>Year 2</th>
<th></th>
<th>Year 5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unsealed haul roads</td>
<td>Sealed haul road</td>
<td>Unsealed haul roads</td>
<td>Sealed haul road</td>
</tr>
<tr>
<td>Number of receptors exceeding the PEM criterion</td>
<td>19</td>
<td>7</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Total number of days in which PEM criteria exceeded</td>
<td>11</td>
<td>2</td>
<td>33</td>
<td>11</td>
</tr>
<tr>
<td>Maximum 24 hour concentration (micrograms per cubic metre)**</td>
<td>79.1</td>
<td>61.3</td>
<td>96.8</td>
<td>89.9</td>
</tr>
</tbody>
</table>

* modelling results assume no active management to reduce or cease activities on days with high background particulate emissions

**Includes background and site contributions

Option 2 was selected as the preferred option given the reduced air quality impacts on the surrounding environment compared to Option 1. Despite the cost of sealing and maintaining the haul road for the duration of the Project, SGM have committed to best practice dust management to reduce the potential impacts on adjoining residents.
5 Project Alternatives

5.7.5 Alternative Communications Tower and Fire Watch Building

The communications tower and fire watch building currently located on Big Hill lie between the North and South Pits in the Project. Consideration was given to whether mining activities could take place while maintaining this infrastructure in its current location with modified North and South Pit designs. However, detailed geotechnical assessment advised that this infrastructure will require relocation due to the risk of instability that the mined areas could possibly pose to the structures based on the preferred configurations of the North and South Pits. The assessment found that the area required to ensure the stability of the structures would significantly impinge on the ability to develop and operate a commercially viable mining operation. After consultation with relevant authorities and operators of the facilities, it is proposed that the infrastructure will be relocated to the existing SGM stores area located approximately one kilometre southeast of the current tower location along the ridgeline. This location was chosen as it is already cleared of vegetation and is the next closest high point to the existing location.

There is a height difference of 13 metres between their current location on Big Hill and the stores area meaning the new communications tower must be constructed to a height of 50 metres to provide the same elevation and coverage as the existing Big Hill tower (336.5 metres AHD). The new fire watch tower will incorporate a raised supporting structure to maintain the same viewing elevation, making the new fire watch building a total of 15.5 metres in height.

Two options for the relocated fire watch building and communications tower were proposed, namely:

**Option 1** – separate fire watch building and tower.
**Option 2** – combined fire watch and tower.

Option 1 has been selected as the preferred fire watch building / communications tower configuration due to commercial leasing arrangements between the owner of the communications tower (Crown Castle International) and the five communication companies that have services and radio systems installed on the tower, which include restrictions on access to the tower. Amenity, visual, flora and fauna impacts of the respective options were not considered to differ significantly and are not considered to be unacceptable.

5.7.6 Alternative Grampians Wimmera Mallee Water Infrastructure options

In order to protect the structural integrity of GWMWater water supply tank 1 as shown in Figure 5-6, it has been determined that the tank cannot remain operational in its current location for the duration of the Project. In order to minimise the potential risk posed to the potable water supply three options for the supply of potable water to the Stawell community were considered:

**Option 1** – Move tank 1 to a new location and manage uninterrupted water supply during the construction period with a temporary pump and a buffer tank

**Option 2** – Empty tank 1 and install alternative infrastructure and pump system for use during mining and rehabilitation activities and bring tank 1 back on line at the conclusion of the Project

**Option 3** – Install alternative storage infrastructure and pump system at a secure elevated location and dismantle tank 1. Reassemble tank 1 at the temporary tank location at the conclusion of the Project.
5 Project Alternatives

It was determined that Option 2 is the preferred option in terms of the long term reliability of potable water supply. In order to maintain supply for the duration of the Project with Tank 1 offline, two replacement five megalitre tanks (i.e. 10 megalitre total volume storage) will be constructed.

Water storage tank 2 is to be drained and retained in-situ for the duration of the Project for re-commissioning at the completion of the re-establishment of Big Hill. Water storage tank 3 will be decommissioned and dismantled and will not need to be reinstated at the completion of the Project.

Two locations were considered for the construction of the replacement 5 megalitres tanks (Figure 5-6):

**Option 1** – Approximately 50 metres north of the existing water supply tank 1

**Option 2** – Approximately 100 metres north-east of the existing water supply tank 1, to the east of water reservoir 4.

Option 2 was selected as the preferred option by GWMWater as the more feasible of the two options.

![Figure 5-6 Replacement tanks location options](image_url)
5 Project Alternatives

While water reservoirs 4 and 6 will be drained prior to the commencement of mining works adjacent to the reservoirs, this will be staged, rather than having both storages non-operational for the duration of the whole Project. It is expected that raw water reservoir 4 would be offline during the mining of North Pit and reservoir 6 during the mining of South Pit. This will reduce the risk of relying on a single water storage (reservoir 7) should water quality issues arise. Potential impacts on potable water supply are discussed in Chapter 8, Section 8.10.

5.7.7 Alternative Project Timeframe

An option available to SGM was to have a larger, single pit as the basis for mining prior to ultimate rehabilitation. This was given consideration, however, an alternative mine configuration was adopted based on a variety of factors including amenity and duration of operations. A reduced period of open-cut mining has been achieved by developing the North Pit and the South Pit separately. While some gold resource is lost in the areas between the bottom of the pits and the upper extent of the underground mining, and in retention of some of the Big Hill infrastructure (i.e. reservoirs), the proposed design allows for viable resource extraction and a shorter (approximately four years) period of open cut mining (plus a further one year to complete backfilling and rehabilitation).

In addition, the North and South Pits will be progressively mined and backfilled under the preferred option. This is on the basis that mining and backfilling will progressively move away from the nearest residences. The North Pit will be excavated first then backfilled with waste rock from the South Pit reducing final rehabilitation times and impact on community. This staged mining process enables progressive rehabilitation of mined areas, so that the North Pit will be backfilled prior to the completion of mining of the South Pit as outlined in Table 5-4. This proposed mining and backfilling process means that operational areas of the mine are not proximal to all adjacent residences at any one time.

Table 5-4 Description and mining schedule for staged landform

<table>
<thead>
<tr>
<th>Approximate Production Period (Quarterly)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 Quarters 1 and 2</td>
<td>Mining commences in North Pit.</td>
</tr>
<tr>
<td>Year 1 Quarters 3 and 4</td>
<td>Mining continues in North Pit with vegetation clearance across the South Pit area.</td>
</tr>
<tr>
<td>Year 2 Quarters 5 and 6</td>
<td>Mining continues in North Pit and commencement of mining in South Pit.</td>
</tr>
<tr>
<td>Year 2 Quarters 7 and 8</td>
<td>Mining completed and backfill commences in North Pit with material generated from mining in South Pit.</td>
</tr>
<tr>
<td>Year 3 Quarters 9 and 10</td>
<td>Backfill continues in North Pit and continued mining of South Pit.</td>
</tr>
<tr>
<td>Year 3 Quarters 11 and 12</td>
<td>Backfill and rehabilitation of North Pit completed. Mining of South Pit continues.</td>
</tr>
<tr>
<td>Year 4 Quarters 13 and 14</td>
<td>Mining of South Pit is completed in Quarter 14.</td>
</tr>
<tr>
<td>Year 4 Quarters 15 and 16</td>
<td>Backfilling of South Pit commences with material from the TWRS</td>
</tr>
<tr>
<td>Year 5 Quarters 17 and 18</td>
<td>Backfilling of South Pit continues.</td>
</tr>
<tr>
<td>Year 5 Quarters 19 and 20</td>
<td>Backfilling and rehabilitation of South Pit completed. Complete rehabilitation of Big Hill and its surrounding.</td>
</tr>
</tbody>
</table>
5 Project Alternatives

5.7.8 Summary

SGM has given serious consideration to a range of alternatives in developing the preferred mining operation for the Project. The primary objective of considering options for pit design, ore transportation and waste rock storage was to find an acceptable balance between a commercially viable project and acceptable social and environmental outcomes. The mine and commercial outcomes could have been further optimised but it is believed that the Project which is the subject of this EES represents a balanced outcome for SGM and the community.