Mangana Gold Mine
ENVIRONMENTAL EFFECTS REPORT

Final
Mangana Gold Mine

Environmental Effects Report

July 2013
TABLE OF CONTENTS

INTRODUCTION AND PURPOSE ................................................. 1
PART A – PROPOSED PROponent INFORMATION ...............................2
PART B – PROJECT DESCRIPTION .............................................3
1.0 Proposed Gold Mine Project ..............................................3
  1.1 General Description ..................................................3
  1.2 Resource ..................................................................3
  1.3 Mining Plans .............................................................6
  1.4 Processing ...............................................................8
  1.5 Timeframe ................................................................9
  1.6 Operating Hours .......................................................9
  1.7 Production ...............................................................9
  1.8 Workforce ...............................................................9
2 Planning ...........................................................................9
  2.1 Location and access ....................................................9
  2.2 Planning Issues .........................................................10
3 Project Area Description .......................................................12
  3.1 General description ....................................................12
  3.2 Surface Waters ........................................................14
  3.2.1 Catchments and water bodies ..................................14
  3.2.2 Water management plans .......................................15
  3.2.3 Water quality ........................................................16
  3.3 Geology and Soils ......................................................17
  3.3.1 Geology ...............................................................17
  3.3.2 Soils ..................................................................18
  3.4 Groundwaters ..........................................................18
  3.4.1 Groundwater Resource and Uses .............................18
  3.4.2 Groundwater in likely mine area ..............................19
  3.4.3 Recharge/Discharge ...............................................19
  3.5 Climate ..................................................................19
  3.6 Site history .............................................................22
  3.7 Land tenure ..............................................................25
  3.8 Land-use .................................................................26
  3.9 Flora and Fauna ........................................................26
  3.10 Weeds and Pathogens .................................................27
4 Map and site plan ...............................................................27
PART C – POTENTIAL ENVIRONMENTAL EFFECTS ..................28
  1 Flora and fauna, weeds ..................................................28
     1.1 Flora and fauna .......................................................28
     1.2 Weeds and pathogens ..............................................28
     1.3 Management ........................................................28
  2 Stormwater ..................................................................29
     2.1 Site conditions .......................................................29
     2.2 Management ........................................................29
  3 Significant areas and/or land features ..............................30
  4 Air emissions ...............................................................30
  5 Liquid Wastes ................................................................31
     5.1 Sources .................................................................31
     5.2 Management ........................................................31
  6 Groundwater ...............................................................32
  7 Solid wastes ...............................................................32
# TABLE OF CONTENTS

7.1 Sources .............................................................................................................. 32
7.2 Management .................................................................................................... 34
8 Noise emissions (blasting) .................................................................................. 34
  8.1 Noise emissions ............................................................................................. 34
  8.2 Blasting .......................................................................................................... 35
9 Transport impacts ............................................................................................... 35
10 Cultural heritage ............................................................................................... 35
  10.1 Background and studies ............................................................................ 35
  10.2 Sailors Gully area ..................................................................................... 35
  10.3 Sovereign workings .................................................................................... 36
  10.3 Management ............................................................................................... 37
11 Other off-site impacts ....................................................................................... 37
12 Dangerous goods and chemicals ..................................................................... 37
13 Site Contamination ......................................................................................... 37
14 Sustainability and climate change .................................................................. 37
15 Sites of high public interest ............................................................................ 37
16 Rehabilitation .................................................................................................. 37
  16.1 Vegetation stripping .................................................................................. 38
  16.2 Topsoil stockpiling .................................................................................... 38
  16.3 Landform Creation .................................................................................... 38
  16.4 Surface Preparation .................................................................................. 38
  16.5 Revegetation ............................................................................................. 38
  16.6 Nutrients ................................................................................................... 38
  16.7 Monitoring and Maintenance .................................................................. 38
PART D – MANAGEMENT COMMITMENTS ......................................................... 39
PART E – PUBLIC CONSULTATION ................................................................... 39
References ............................................................................................................ 40
# TABLE OF CONTENTS

## LIST OF FIGURES AND TABLES

<table>
<thead>
<tr>
<th>Figure No</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regional Location</td>
</tr>
<tr>
<td>2</td>
<td>ML Boundaries -</td>
</tr>
<tr>
<td>3</td>
<td>Mine Location Plan</td>
</tr>
<tr>
<td>4</td>
<td>Argyle, Golden Entrances and Mangana Reefs Plan</td>
</tr>
<tr>
<td>5</td>
<td>Argyle Mine Workings</td>
</tr>
<tr>
<td>6</td>
<td>Golden Entrance Mine Workings</td>
</tr>
<tr>
<td>7</td>
<td>Mangana Mine Workings</td>
</tr>
<tr>
<td>8</td>
<td>Gold Recovery Process Flow Sheet</td>
</tr>
<tr>
<td>9</td>
<td>Sailors Gully Plant Area Site Plan</td>
</tr>
<tr>
<td>9A</td>
<td>Sailors Gully Plant Area Drainage Plan</td>
</tr>
<tr>
<td>10</td>
<td>Topography</td>
</tr>
<tr>
<td>11</td>
<td>Vegetation Communities</td>
</tr>
<tr>
<td>12</td>
<td>Surface Water Catchment</td>
</tr>
<tr>
<td>13</td>
<td>Geology</td>
</tr>
<tr>
<td>14</td>
<td>Groundwater Prospectivity</td>
</tr>
<tr>
<td>15</td>
<td>Groundwater Bores</td>
</tr>
<tr>
<td>16</td>
<td>Monthly Rainfall and Temperature</td>
</tr>
<tr>
<td>17</td>
<td>Monthly Highest Daily Rainfall</td>
</tr>
<tr>
<td>18</td>
<td>Monthly Evaporation</td>
</tr>
<tr>
<td>19</td>
<td>Annual Wind Rose</td>
</tr>
<tr>
<td>20</td>
<td>Historical Workings</td>
</tr>
<tr>
<td>21</td>
<td>Section Through Mangana Reef Workings</td>
</tr>
<tr>
<td>22</td>
<td>Land Tenure</td>
</tr>
<tr>
<td>23</td>
<td>Land Use – Google Image</td>
</tr>
<tr>
<td>24</td>
<td>Sailors Gully Features</td>
</tr>
</tbody>
</table>

## Table No.

<table>
<thead>
<tr>
<th>Table No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1:</td>
<td>Exploration Potential of The Three Reefs</td>
</tr>
<tr>
<td>Table 2:</td>
<td>Historic Mine Production</td>
</tr>
<tr>
<td>Table 3:</td>
<td>Planning Schemes Codes Applicable to the Rural Resource Zone</td>
</tr>
<tr>
<td>Table 4 :</td>
<td>Water Quality</td>
</tr>
<tr>
<td>Table 5:</td>
<td>Summary Of Commitments.</td>
</tr>
<tr>
<td>Table 6:</td>
<td>Monitoring Plan</td>
</tr>
</tbody>
</table>

## Appendices

<table>
<thead>
<tr>
<th>Appendix A</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>EPA ERR Guidelines</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Flora and Fauna Report (Philip Milner)</td>
</tr>
<tr>
<td>Appendix C</td>
<td>Wash weed hygiene proforma and guidelines</td>
</tr>
<tr>
<td>Appendix D</td>
<td>Forest Practice Code (part)</td>
</tr>
<tr>
<td>Appendix E</td>
<td>Geotechnical Report (Pitt and Sherry)</td>
</tr>
<tr>
<td>Appendix F</td>
<td>Geochemistry Assessment (Geo-Environmental Management)</td>
</tr>
<tr>
<td>Appendix G</td>
<td>Noise Assessment (Vipac)</td>
</tr>
<tr>
<td>Appendix H</td>
<td>Archaeological Assessment (Kostoglou)</td>
</tr>
</tbody>
</table>
Glossary of Terms and Abbreviations

ANC Acid Neutralising Capacity
Adit Horizontal tunnel
AMD Acid and Metalliferous Drainage
Arsenopyrite Iron arsenic sulfide (FeAsS)
Auriferous Gold bearing
Breccia A rock composed of broken fragments of minerals or rock cemented together by a fine-grained matrix,[1] that can be either similar to or different from the composition of the fragments.
BODC Break O’Day Council
DIER Department of Infrastructure Energy and Resources
DPEMP Development Proposal and Environmental Management Plan
DPIPWE Department of Primary Industries Parks Water and the Environment
EC Electrical Conductivity
EMPCA Environmental Management and Pollution Control Act 1994
EPA Environment Protection Authority
EER Environment Effects Report
FT Forestry Tasmania
LIST Land Information System Tasmania
LUPAA Land Use Planning and Approvals Act 1993
MRT Mineral Resources Tasmania
NAF Non Acid Forming
NAG Net Acid Generation
NAPP Net Acid Production Potential
PAF Potentially Acid Forming
PEV Protected Environmental Value
Portal Mine or adit entrance
Pyrite Mineral pyrite, or iron pyrite, is an iron sulfide with the formula FeS2
Stoping The process of extracting the desired ore or other mineral from an underground mine, leaving behind an open space known as a stope. Stoping is used when the country rock is sufficiently strong not to cave into the stope, although in most cases artificial support is also provided
TDS Total Dissolved Solids
TSPA Tasmanian Threatened Species Protection Act 1995
Vein A distinct sheetlike body of crystallized minerals within a rock. Veins form when mineral constituents carried by an aqueous solution within the rock mass are deposited through precipitation
INTRODUCTION AND PURPOSE

Webb Mining Services (Webb Mining) are a Tasmanian mining services company who hold several exploration licences near Mangana in NE Tasmania and have applied for a mining lease over a number of small abandoned gold mines to the east of the township.

Exploration on three of the reefs (Argyle, Golden Entrance and Mangana (located in Sailors Gully)) have been sufficiently encouraging to justify further exploration by underground development and commence small scale mining. This is not possible under the exploration licence and it is proposed that this will be done under a Mining Lease. Webb Mining have purchased several properties in and near Mangana for locating its workforce offices and services.

Underground development by several adits (horizontal drives) will be small scale and a small gravity plant will be constructed to treat the ore in Sailors Gully. All processing will be on site and no ore etc is expected to be carted on public roads. Later possible mining at other sites in the area are possible in the future and this would involve carting ore to the plant via Forestry Tasmania roads.

It is anticipated that the project will commence immediately on obtaining the Permit and mining lease and directly employ 10-30 people in the local area.

The ore deposits are located some 7km north-west of Fingal in North–Eastern Tasmania.

The location of the Mining Lease Application (MLA) is shown in Figure 1.

FIGURE 1 REGIONAL LOCATION – Fingal TASMANIA – Source The List
The proposal is for the mining and processing of approximately 10-50,000 tonnes of gold ore per year. This classifies the proposal as a level 2 activity according to Schedule 2 of the Environmental Management and Pollution Control Act 1994. The application has been assessed by the Environment Protection Authority (EPA) as a Level 2 Class 2A activity (low environmental impact) as defined in the Environmental Management and Pollution Control Act 1994 (EMPC Act).

The EPA have determined that the activity is “a small scale project on already disturbed land, with environmental impacts minor in consequence and local in extent, and is unlikely to generate any significant public interest”.

This document has been prepared to supply the Break O’Day Council, the Environmental Protection Agency (EPA), Mineral Resources Tasmania (MRT), the Department of Primary Industries, Parks, Water and Environment, (DPIPWE), Forestry Commission, residents in the area and the general community with the following information:

- a description of the proposal,
- the area's environment, and
- the possible environmental impacts and the proposed environmental management controls for the extraction and transport of the tailings

The Environmental Effects Report (EER) has been prepared using guidelines prepared by the EPA (Appendix A).

**PART A – PROONENT INFORMATION**

*Proponent – Webb Mining Services Pty Ltd (ACN 12106029618)*

Contact details are; Nigel Webb, Managing Director, Webb Mining Services, 41 Davey Street Hobart Tasmania 7000. Phone 0407306867

Email nigelwebb4@gmail.com

Webb Mining Services Pty Ltd. (Webb Mining) is a private company established in 1996. It has 29 years of experience in underground mining and engineering construction and specialises in narrow vein underground mining, including airleg and jumbo development. A major recent project has been as contract miner at the Beaconsfield Gold Mine. Webb Mining is a major shareholder and Nigel Webb a Director of BCD Resources, the company which owns the existing Beaconsfield operations.
PART B – PROJECT DESCRIPTION

1.0 Proposed Gold Mine Project

1.1 General Description

Webb Mining have recently purchased Exploration Licence 12/2011 near Mangana and applied for a mining lease over an area of 400 ha covering a number of old narrow vein (thin layer of gold) gold mines, mainly adits (horizontal tunnels) in the lease area (Figure 2). Exploration activities and underground geological sampling and mapping has been encouraging, although variable. This sampling is sufficient to justify Webb Mining planning to open a narrow vein underground gold mine based on the three reefs investigated to date (Argyle, Golden Entrance and Mangana). Figures 3 and 4 shows the location plan of the reefs in Sailors Gully. It is planned to explore and develop these reefs simultaneously.

The mine will be of small production, but high grade and ore will be treated in a small gravity plant constructed on site to recover gold as a saleable concentrate, possibly to the Beaconsfield mine or an interstate smelter. Most, if not all development waste rock and tailings will be returned underground. Mining will occur in the oxidised part of the orebodies and above the water table with the mine being accessed by existing adits (and a new adit for the Mangana Reef development). Ore will be processed by a small gravity plant located in Sailors Gully and no chemicals (such as cyanide) will be used. Process waters will be recycled and sourced from on the site and from a local landowner’s dam. Office, accommodation and services facilities will be located on Webb Mining’s property in Mangana. This is subject to a separate building application from Break O’Day Council.

Annual production is expected to be in the vicinity of 10-50,000 tonnes per year, depending on mining methods and ore recoveries. Until the underground workings are developed and the potential ore identified, actual mining methods are uncertain but will be by stoping methods with backfill (stoping is the process of extracting the desired ore or other mineral from an underground mine, leaving behind an open space known as a stope. These will be backfilled with materials from the development and tailings.

The mine will be accessed via the existing access road to Mangana Road and the Esk Highway at Fingal.

It is also proposed to conduct similar exploration on other reefs located in the mining lease as a future potential source of feed to the gravity plant to be located in Sailors Gully. Webb Mining have purchased several properties in Mangana including private land where several other reefs are located (ie Fingal, Pincher Reefs etc).

1.2 Resource

The Mangana goldfield is at the south end of a ‘gold belt’ that runs from Waterhouse on the north coast of Tasmania 80kms south to Fingal and includes the Golden Gate Mine at Mathinna.

The Mangana goldfield was the site of the first discovery of payable gold in Tasmania in 1852. Gold production since then has totalled about 6500 ounces from reef mining and
ML notice E574465, N 5392488 (GDA)

Access Road - see separate plan

FIGURE 2

Webb Mining
Mangana Gold Mine
MLA Area
5/13
Figure 3: Mangana Gold Mine – Location Plan (for detail see Fig 4)
Figure 4  Mangana Gold Mine – Argyle, Golden Entrances and Mangana Reefs Plan.
about between 5,000 and 15,000 ounces from alluvial mining. The geology and history etc are discussed in more detail in Section C 3.6.

Gold occurs in quartz-rich veins and breccias within the Mathinna Beds. These veins are usually small although often very high grade (Twelvetrees, 1907 reported grades as high as 1354g/t) and typically are erratic in grade and size. The quartz is usually white and glassy, but where auriferous is dense and milky to blue grey in colour with minor sulphides, or iron oxides where weathered. The sulphides include pyrite and arsenopyrite with minor chalcopyrite, galena and sphalerite. minor mica, chlorite and carbonates (ankerite and siderite) may also be present. The veins vary in thickness from a few centimeters to about eight metres, and in length from about 10 to 500 metres or longer in the case of Golden Entrance. The veins are commonly bedding parallel, striking 315-345 degrees, and usually steeply dipping (ie from horizontal – see photograph below). The veins are commonly extensional in fold limbs and hinges. Some lodes such as Golden Entrance are breccia zones and these breccias are cemented by cherty to medium grained quartz.

Photograph – Steeply dipping gold bearing quartz vein in Argyle workings

The variable nature of the quartz veining hosting the gold, and the “nuggety” nature of the gold makes any systematic estimation of the gold resource difficult, with traditional drilling and assaying. However, the sampling program initially conducted by Wesknight Mining in the Golden Entrance and Argyle Reefs has resulted in the sampling and representative assaying of some 9000 kilograms. The assays average over 32 gms/tonne. Some small scale gravity recovery trials resulted in a high grade gravity concentrate (albeit in small quantities) grading some 2500g/t (806 ounces/tonne).

More recent exploration by Webb Mining has also had some encouraging results.

These results are sufficient to indicate that a small scale predominantly hand held mining method can be sustainable and economic at today’s gold price.
Webb Mining engaged Pitt and Sherry to digitise all available information and determine the likely “exploration potential” of the three existing mines located in Sailors Gully. These are:

- Argyle;
- Golden Entrance and;
- Mangana.

The assessment of the mineral exploration potential is shown in **Table 1**.

**Table 1: Exploration Potential of The Three Reefs**

<table>
<thead>
<tr>
<th>Mine</th>
<th>Grade g/t</th>
<th>Tonnes 10%</th>
<th>Ounces 10%</th>
<th>Tonnes 20%</th>
<th>Ounces 20%</th>
<th>Tonnes 30%</th>
<th>Ounces 30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argyle</td>
<td>24</td>
<td>6500</td>
<td>5200</td>
<td>13000</td>
<td>8400</td>
<td>19500</td>
<td>9600</td>
</tr>
<tr>
<td>Golden Entrance</td>
<td>127</td>
<td>6000</td>
<td>7300</td>
<td>12000</td>
<td>14600</td>
<td>18000</td>
<td>21800</td>
</tr>
<tr>
<td>Mangana</td>
<td>8</td>
<td>26100</td>
<td>6100</td>
<td>52200</td>
<td>12200</td>
<td>78300</td>
<td>18300</td>
</tr>
</tbody>
</table>

Pitt & Sherry have emphasised that the estimates of mineral exploration potential are based on tonnes and grades which are conceptual in nature and do not represent any form of mineral resource estimate since at this stage there has been insufficient exploration work done to be able to define a mineral resource compliant with the JORC (Joint Ore Reserves Committee) Code guidelines. It is uncertain whether further exploration work will result in the determination of such a mineral resource.

**Assumptions:**

- The tonnes and grade have been derived using the following parameters:
  - Reef Density (SG) 2.8
  - Average reef width Estimated from historic reports: Argyle 0.7m, Golden Gate 0.3m, and Mangana 4.0m
  - Tonnes That the ratio between reef mined and reef made accessible by development is consistent within the confines of the reef in the enrichment zone.

Grade Average grade from historical records are shown in **Table 2** below.

**Table 2: Historic Mine Production**

<table>
<thead>
<tr>
<th>Mine</th>
<th>Gold production (kg)</th>
<th>Tonnes ore</th>
<th>Average grade (g/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argyle</td>
<td>0.241</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Golden Entrance</td>
<td>91.41</td>
<td>718</td>
<td>127</td>
</tr>
<tr>
<td>Mangana</td>
<td>24.6</td>
<td>3106</td>
<td>8</td>
</tr>
</tbody>
</table>

1.3 Mining Plans

Webb Mining have engaged Pitt and Sherry to assist with mine planning and design. All historical data has been digitised and presented in the form of 3D models. Figures 5, 6 and 7 show digital models of the old workings, likely location of the reefs and the location of the proposed development drives. Green represents the existing mine workings, yellow mined (stoped) areas, purple ore bodies /veins and blue the proposed development drives. The views are from NE to SW and the location of the reefs on a plan are shown in Figure 4. Geologically and structurally the Argyle and Golden Entrance workings are on the same reef system.

![Figure 5: Argyle Mine Workings (View to SW)](image)

![Figure 6: Golden Entrance Mine Workings (View to SW)](image)
Detailed mining plans have not been prepared as these cannot be engineered until there is more knowledge of the reef locations, grades and widths. This can only be known after the exploration drives are developed and these can only be done under a Mining Lease (and not under the Exploration Licence) and land use Permit (and EPA approval).

The gold occurs in quartz rich veins and breccia zones, often in shoots, that are usually small and, although often very gold-rich, are typically erratic in size and grade.

Mining will initially consist of the exploration drives (via adits). This will involve the enlarging of the existing Argyle No 2 and Golden Entrance adits (approx 2x2m to 3.5x3.5m approximately) and the entrances improved and strengthened in accordance with Pitt and Sherry recommendations (Appendix E). Because of the poor condition of the Mangana Adit, a new portal will be constructed (3.5mx3.5m).

To accommodate the erratic distribution of the gold, the mining method proposed is an iterative one in which the area is explored with horizontal development driven on structure, mapped and sampled, and then selectively mined utilising one of several possible narrow vein mining methods depending on grade, width, and accessibility. Some of the mining methods that could be utilised include:

- Cut and fill (mechanised or handheld). Cut and fill mining is a selective method of mining in which horizontal slices of ore are removed advancing upwards and the void left is filled with waste material.

- Shrinkage stoping. Shrinkage stoping is a mining method used for steeply dipping, narrower ore bodies with self supporting walls and ore. It is an overhand mining method that relies on broken ore being left in the stope to be used as the “working floor” and to support the walls. During the mining cycle, only 30 – 35% of the ore blasted is extracted being equivalent to the swell factor of in-situ ore to broken. When mining is complete to the next upper horizon, the ore is extracted. Although
it is not necessary to fill the resulting voids, they are commonly filled with waste rock from development.

Keeping waste development to a minimum will be essential to keeping the operation economic. Where possible development will be placed within reef to allow better reef definition, to win more ore, and to minimise waste generation.

The ore will initially be mined by accessing the reefs at the lower levels (see Figures 5, 6 & 7). Mining will be highly selective with minimal waste rock generated and that generated will be replaced as mine fill (with tailings). All waste rock (slates and sediments) and ore are expected to be non sulphidic (ie not reactive) and have little or no acid producing capacity. This is also demonstrated by previous mining mullock and tailings where there has been no evident oxidation or acid drainage generation. Water sampling from the Argyle No 2 lower adit also shows good quality. This is the only groundwater evident in any of the workings.

The mine(s) will be accessed by an adit(s) above the water table and no mine dewatering will be required.

Annual production is expected to be in the vicinity of 10-50,000 tonnes per year, depending on mining methods and ore recoveries. Ongoing exploration within the lease may also identify other areas for potential mining and these will also be pursued in the future (ie Fingal Reef etc).

Access for mining purposes will be via existing tracks where possible which will be widened as required, with a cleared area of approximately 5mx 10 m at each adit entrance for working platforms. Figure 5 shows possible access alignments as detailed by a site survey. Access to the Mangana, Golden Entrance and Argyle No 2 Adit is via the existing track in Sailors Gully.

An alternative access is being considered. However, the existing track will be upgraded and fitted with culverts to minimize sediment movement.

### 1.4 Processing

Processing will involve a simple gravity separation plant with no cyanide or chemicals involved. The plant will consist of a jaw crusher, cone crusher, ball mill, gravity tables, with final product a gold ore concentrate and tailings (Figure 8 shows the process flow sheet). The plant will be in Sailor Gully in proximity to the mine adits (Figure 9 shows a site plan) and the major components (tables etc) roofed. The location is in existing previously disturbed (cleared and filled) areas.

The products will consist of a gold concentrate consisting of the gold and heavy materials (sulphides etc), comprising less than 0.1% of the ore. The concentrate will be processed elsewhere – possibly Beaconsfield.

The tailings will be relatively coarse and permeable and will discharge to concrete lined settling basin(s) where the tailings will settle and be removed by front end loader. They are expected to be suitable for construction (road and hardstanding) and be used for this purpose underground.
Mangana Gold Mine Process Flow Sheet

Figure 8  Mangana Gold Mine Process Flow Sheet
Possible Collection Water Tanks

Diversion channel/bund

450 Culvert

Existing creek channel to be cleared and stabilised

Location of plant elements indicative only and may be varied to suit site conditions (foundations etc)

Settling sumps
to site discharge via new settling dams (Fig 9A)

Existing creek channel to be cleared and stabilised

Site Plan

Webb Mining Mangana Gold Mine

Sailors Gully Plant Area Site Plan

John Miedecke and Partners Pty Ltd
Webb Mining Mangana Gold Mine
Sailors Gully Plant Area Drainage Plan

Creek to realigned and provided with a new channel and culverts where none existing (see Figure 9)

1 or 2 new settling ponds to be constructed

Possible new road alignment (to be investigated)

ROM and Waste Rock Pad

RL 300

Processing Plant Area

RL 309

No2 Adit

No2 N Adit

No2 S Adit

Argyle Mine

No1 S Adit

Drawn By: DM
Scale 1:1500 (A3)
Contour Interval: 1.0m

NOTES:
Surveyed using RTK GPS & UTS
Coordinates are GDA/AHD based on a 'Fix Here' solution

First Issue

Northern Surveying Services
495 Melrose Road, Eugenana 7310
Telephone (03) 6427 2765
Mobile 0418 141 244
Fax (03) 6427 3040
e-mail: surveyns@bigpond.com

Mangana Mine
Workings Area

JOHN MIEDECKE AND PARTNERS PTY LTD

Fig. 9 A

0 15 30 45 60 75
Metres

Mangana Gold Mine

18/5/2012
All waters will be returned to the process water tanks as the plant will be a net water consumer. All drainage from the plant will similarly be collected (see Figure 9 and Section 1.4).

1.5 Timeframe

Construction of the gravity plant will commence as soon as the permit is granted as will underground development on the Argyle and Golden Entrance Reefs.

It is difficult to estimate the likely mine life as there are numerous potential ore sources from historical workings in the area which have not been worked since the early 1900’s.

There is potential for at least 5-10 years operations, depending on exploration results.

1.6 Operating Hours

It is anticipated that processing will be daylight hours – nominally 6.30am to 6.30pm 6 days per week. Maintenance may be outside these hours. Mining may occur on a two shift basis (24 hours) but will be confined to underground workings.

As there is only one residence within 1km of the mine and processing operations should not create residential amenity issues.

1.7 Production

Mining and processing rates will be depend on the grade, mining method and access to the ore. It is expected that production rates may vary between 10,000 to 50,000 tonnes per annum. Gold concentrate production will be less than 10 tonnes per annum and will be transported offsite by light vehicles. The processing plant will be capable of crushing potentially 80 tonnes per hour.

1.8 Workforce

Mining and processing is expected to have a workforce of from 10 – 30, depending on the nature and size of the orebodies.

2 Planning

2.1 Location and access

The mining lease is located to the east and south–east of Mangana. The areas of the lease are either on property owned by Webb Mining or State Forest. The lease area can be accessed by public roads via Mangana and to the northern end to Webb Minings property, and via Mangana Road and an unsealed road across private property in the SW corner.

A mining lease has been applied for over this access. This will be the main access route.

It is planned that in the future, any ore haulage would be via Tower Hill road and internal access roads through State Forest and may be subject to separate approvals. The appropriate access licences with Forestry Tasmania will be applied for when required.
2.2 Planning Issues

The ML area is zoned as Rural Resource under the new planning scheme which came into force in June 2013.

The proposed offices, accommodation (both on Webb Mining owned properties) and the proposed mine sites are located within the Rural Resource Zone, with the Use listed as Extractive Industries, a Discretionary Use Class.

The Break O’Day planning scheme has both general and specific objectives.

The purpose of the zones are to:

26.1.1 To provide for the sustainable use or development of resources for agriculture, aquaculture, forestry, mining and other primary industries, including opportunities for resource processing.

26.1.2 To provide for other use or development that does not constrain or conflict with resource development uses.

26.1.3 To provide for economic development that is compatible with primary industry, environmental and landscape values.

26.1.4 To provide for tourism-related use and development where the sustainable development of rural resources will not be compromised.

Local area objectives are:

1) Primary Industries:

Resources for primary industries make a significant contribution to the rural economy and primary industry uses are to be protected for long-term sustainability.

The prime and non-prime agricultural land resource provides for variable and diverse agricultural and primary industry production which will be protected through individual consideration of the local context.

Processing and services can augment the productivity of primary industries in a locality and are supported where they are related to primary industry uses and the long-term sustainability of the resource is not unduly compromised.

Use and development in this zone is to conform with relevant planning scheme standards and in codes listed in the planning scheme. **Table 3** is set out below showing compliance with the Codes.
<table>
<thead>
<tr>
<th>Code</th>
<th>Application</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1.4 Bushfire Prone Areas Code</td>
<td>Development of land in bushfire prone area</td>
<td>Only buildings will be Class 10, which are exempt. Plant area will be protected by provision of a defensible space and fire fighting equipment.</td>
</tr>
<tr>
<td>E1.5.2 Hazardous Uses</td>
<td>Potential storage of hazardous materials</td>
<td>None will be stored on site, no chemicals will be used and only small quantities of fuels etc will be stored. All explosives will be stored offsite and brought on site as required.</td>
</tr>
<tr>
<td>E2.0 Potentially Contaminated Land Code</td>
<td>Only potential contamination is tailings</td>
<td>Does not impact on human health or environment</td>
</tr>
<tr>
<td>E3.0 Landslip Code</td>
<td>Potentially landslip hazard</td>
<td>None identified (see geotechnical report)</td>
</tr>
<tr>
<td>E4.0 Road and Railways Assett Code</td>
<td>Intensification of use of existing access.</td>
<td>Existing road access will be used. Site distances are adequate for proposed level of use.</td>
</tr>
<tr>
<td>E6.0 Car Parking and Sustainable Transport Code</td>
<td>Use of land for mining and processing</td>
<td>Car parking will be provide as shown in Figure 9.</td>
</tr>
<tr>
<td>E8.0 Biodiversity Code</td>
<td>Applicable to removal of native vegetation</td>
<td>Only limited disturbance will be required and of no conservation value (see Section C1)</td>
</tr>
<tr>
<td>E9.0 Water Quality Code</td>
<td>Applies to development within 50 of a watercourse</td>
<td>Area has already been disturbed and filled with waste rock Appropriate measures will be adopted to protect water quality (Section B3.2)</td>
</tr>
<tr>
<td>E11.0 Environmental Impacts and Attenuation Code</td>
<td>Applies to sensitive used within attenuation distance of proposed use</td>
<td>No surface blasting is required and noise from processing will meet EPA standards (Section C8)</td>
</tr>
<tr>
<td>E13.0 Local Historic Heritage Code</td>
<td>Applies to a place of identified archaeological significance</td>
<td>Only limited features have values and these will be protected Section C10</td>
</tr>
<tr>
<td>E15.0 Signs Code</td>
<td>Applies to a new sign or replacement/renewal</td>
<td>Direction signs to the mine site and offices etc will be erected in compliance with the Code.</td>
</tr>
<tr>
<td>E15.0 On-Site Wastewater Management Code</td>
<td>Applies to development for which reticulated sewerage is not available</td>
<td>Mine site will have porta-loos and offices will have approved septic tanks systems Section C5)</td>
</tr>
<tr>
<td>E9.0 Water Quality Code</td>
<td>Applies to development within 50 of a watercourse</td>
<td>Area has already been disturbed and filled with waste rock Appropriate measures will be adopted to protect water quality Section C2)</td>
</tr>
</tbody>
</table>
3  Project Area Description

3.1  General description

The proposed Mining Lease on the eastern slopes of the sharp crested hills formed on sandstone-mudstone deposits of the Mathinna Beds to the east of Mangana. They are described as the Golden Gate Land System. The main topographic feature immediately to the north is Tower Hill at an elevation of approximately 1000m. Figure 10 shows a topographic map of the area.

![Lease Area](image)

*FIGURE 10: TOPOGRAPHY*

Drainage is to a broad flat lying valley where Mangana is located and then to the South Esk River valley.

The proposed mine(s) are located in a steep sided valley called Sailors Gully located to the south-east of the Mangana township (see Figure 2). Other possible ore sources are located immediately to north in Sharkeys, Harrisons and Grants Creek valleys.

Sailors Gully has been extensively disturbed by a number of adits, a shaft, access roads, former infrastructure and waste rock disposal. Further down the gully, the bed has been extensively “pot holed” by alluvial mining, and the old tailings still exist at the mouth of the gully.

Sailors Gully creek only flows intermittently into Richardsons Creek and then into Tower Rivulet before entering the South Esk River to the west of Fingal. Fingal is approximately 7 km away.
An existing vehicular track, which extends off Mangana Road (B52) provides access to the site.

The vegetation community present across most of the survey area is described as *Eucalyptus viminalis* Grass Forest and Woodland (DVG). Figure 11 shows the TasVeg mapping.

**FIGURE 11: VEGETATION COMMUNITIES**

Vegetation communities as per TasVeg mapping program within 1,000 metres of reference point: GRID REF: 574800E – 5392900N.

**CODE:**
- DAC ..........*Eucalyptus amygdalina* Coastal Forest & Woodland .......... bright green
- DSG ..........*Eucalyptus sieberi* Forest & Woodland on Granite......... mid-green with vertical lines
- DOB ..........*Eucalyptus obliqua* Dry Forest & Woodland .......... dark green
- NAD ..........*Acacia dealbata* Forest .......... olive green with horizontal white lines
- NAL ..........*Allocasuarina littoralis* Forest .......... olive green with diagonal white lines
- SBR ..........*Broadleaf Scrub* .......... cerise with vertical lines
- FAG ............*Agricultural Land* .......... cream
The area would have been extensively disturbed and cleared during the time of the original mining activities in the early 1900’s and this vegetation has re-established since then. No vegetation community, flora or fauna listed as threatened were present in the areas surveyed around Sailors Gully (see Section 3.9).

In the Fingal Adit area, one species of threatened flora was present. *Bossiaea obcordata* the Spiny Bossia is listed as being rare under the Tasmanian Act. This is within the ML but not part of this application.

### 3.2 Surface Waters

#### 3.2.1 Catchments and water bodies

The nearest permanent water bodies are those of the South Esk River, with the lease area within the Towers Rivulet catchment. This catchments includes many creeks; including on the Mangana side of the catchment, Majors Gully and Grants Creek which drain former mining areas (including major alluvial mining in Majors Gully) to Richardsons Creek above Mangana (see Figure 10).

The headwaters of these streams are characterised as erosional environments due to the high energy of water as it passes from steep to less steep country. The lower reaches of streams are usually depositional - that is, they tend to deposit material scoured from the upper catchment forming floodplains and deltas on the flatter land south of Mangana.

Richardsons Creek flows through Mangana and receives drainage from Sharkeys Gully before flowing into Tower Rivulet (see Figure 10).

Sailors Gully is ephemeral and flows are infrequent. The gully floor has been filled with waste rock from previous mining operations and in addition, there has been previous alluvial mining in the valley floor below the adit portals and the filled and levelled area. This area has numerous excavations and “potholes” and has a very high infiltration capacity as any runoff has to fill all these depressions and excavations. In addition some surface waters flowing down Sailors Gully flow into the Mangana Reef adit.

There is no defined channel after the creek reaches the valley floor. Flood waters follow the path shown in Figure 12 and pond in the cleared paddock and either soak into the floor, evaporate, or in extreme circumstances flood over the road (see photographs below). The land owner has reported that there has only been 2-3 occasions when this has occurred since he has owned the property (approx 15years).
3.2.2 Water management plans

The draft South Esk River Catchment Plan Water Management Plan (September 2009) applies to the area.
Under this Plan, the management of water resources in the South Esk River catchment aims to:

a) provide secure access to water for stock and domestic supply;

b) maintain a flow regime to meet the needs of aquatic ecosystems and maintain identified ecosystem values; and

c) provide secure and certain access to water for irrigation and other commercial purposes, and for further development of the water resource for these purposes.

This Plan includes management provisions that aim to ensure a water regime that is able to meet its environmental and other relevant objectives. The main provisions of this Plan are linked to either the allocation of water for consumptive purposes, or the access rules that govern the taking of allocated water on a daily basis.

Water quality objectives for the project therefore relate purely to water reuse and/or livestock. There are no aquatic ecosystem values as there are no permanent water bodies.

### 3.2.3 Water quality

There are no permanent waters and surface water flows are rare and of short term events. All of the underground workings are above the water table and therefore dry. A seep with a very low flow rate exists in the floor of the Argyle No 2 Adit. This results from a seepage in the roof of the adit in the gold reef. This area is close to the only geochemistry sample which has potential acid forming capacity.

This is the only semi-permanent water in Sailors Gully.

Water samples have been taken from the adit and two other locations. These are:

- Argyle No 2 Adit;
- Farm dam at entrance to Sailors Gully (which had been deepened and is believed to reflect groundwater quality); and
- Richardsons Creek (near Mangana Road Bridge).

Results are shown in Table 4. The water sample from the farm dam, which is fed predominantly from groundwater flows appears to be good with respect to the metals analysed and salinity. The high suspended solids reflects recent earthworks. Quality is suitable for livestock and process water use.

The drainage from Argyle No 2 adit is high in conductivity, sulphate and manganese. This indicates that sulphide oxidation has occurred as a result of previous mining activity. The high pH and low levels of the more harmful metals suggest that this water has been effectively neutralised. It is probable that the sulphidic rock has been closely associated rock of high neutralisation capacity. Iron staining (iron precipitation) at the mouth of the adit also reflects this.
**MANGANA**

<table>
<thead>
<tr>
<th>Date sampled</th>
<th>Location</th>
<th>NOTES</th>
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<tr>
<td>27/05/13</td>
<td>Lower Argyle</td>
<td>This drainage from an old mine adit very low flows</td>
</tr>
<tr>
<td>27/05/13</td>
<td>Farm Dam</td>
<td>Farm dam which will be water supply - mainly groundwater inflows</td>
</tr>
<tr>
<td>27/05/13</td>
<td>Richardson Creek near Mangana rd bridge</td>
<td>Drainage from Mangana area and old mining and alluvials</td>
</tr>
</tbody>
</table>

**NOTES**

<table>
<thead>
<tr>
<th>Flow</th>
<th>Suspended Solids (SS)</th>
<th>Total Alkalinity as CaCO3</th>
<th>Acidity as CaCO3</th>
<th>Sulfate</th>
<th>Chloride</th>
<th>Calcium</th>
<th>Magnesium</th>
<th>Sodium</th>
<th>Potassium</th>
<th>EG020F: Dissolved Metals by ICP-MS</th>
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<tr>
<td>0.002L/sec</td>
<td>26</td>
<td>224</td>
<td>10</td>
<td>822</td>
<td>233</td>
<td>94</td>
<td>244</td>
<td>103</td>
<td>4</td>
<td>Aluminium mg/L: 0.04</td>
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<td>standing</td>
<td>95</td>
<td>44</td>
<td>10</td>
<td>8</td>
<td>16</td>
<td>10</td>
<td>5</td>
<td>13</td>
<td>1</td>
<td>Arsenic mg/L: &lt;0.001</td>
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<tr>
<td>5L/sec</td>
<td>&lt;5</td>
<td>32</td>
<td>5</td>
<td>10</td>
<td>22</td>
<td>10</td>
<td>5</td>
<td>14</td>
<td>1</td>
<td>Cadmium mg/L: &lt;0.0001</td>
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<td>Chromium mg/L: &lt;0.001</td>
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<td>Copper mg/L: 0.002</td>
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<td>Lead mg/L: &lt;0.001</td>
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<td>Manganese mg/L: 2.02</td>
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<td>Iron mg/L: &lt;0.05</td>
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</tbody>
</table>
The water sample taken from Richardson's Creek, which is the receiving water, is of good quality. There is low contamination from prior mining activity, which includes the drainage from the Mangana area and disturbance from alluvial mining.

### 3.3 Geology and Soils

#### 3.3.1 Geology

The area is underlain by the Mathinna Beds comprising quartz wacke to pelitic turbidite sequences of Ordovician- Early Devonian age that are correlated with the Lachlan Fold Belt of SE Australia that hosts the Bendigo and Ballarat goldfields. **Figure 13** shows the geology of the area. Quaternary alluvials (yellow) exist in the flats near Mangana and the South Esk River.

![Figure 13: GEOLOGY (source The List)](image)

None of these goldfields (including any in Tasmania) are known to have acid mine drainage issues.

The gold belt is characterised by close folding, axial plane shears, strongly cleaved slates and abundant multi-generational quartz veining. The gold occurs in quartz-rich veins and breccias within the Mathinna Beds with minor sulphides, or iron oxides where weathered. The sulphides include pyrite and arsenopyrite with minor chalcopyrite, galena and sphalerite. Most of the sulphides are only slightly reactive, or unreactive. Minor mica, chlorite and carbonates (ankerite and siderite) may also be present.

The quartz/carbonate/sulphide host veins are oxidised above the water table. The water table depth varies with the steep topography but most historical mining was above the base of oxidation. There has been some suggestion that there has been supergene enrichment of gold grades and that gold grades diminish below the base of oxidation. Oxidation is characterised by the destruction of carbonates and sulphides. The host rocks generally
have excess alkalinity and sufficient acid neutralizing capacity (ANC) to counter any acid generation (see also Section C7). The gold mineralisation is mesothermal probably related to Devonian orogenesis and granite emplacement.

3.3.2 Soils

Outcrop of the Mathinna Bed country rock slates and quartz arenites is good and outcrop of the host veins generally is poor. Soil development is poor with shallow (less than metre) and poorly developed subsoil.

Soils are described as sandy gradational and are prone to sheet gully and rill erosion. The soils have little value for agriculture.

3.4 Groundwaters

3.4.1 Groundwater Resource and Uses

Information on groundwater in the area is limited. The DPIPWE NE Tasmania Groundwater Map shows prospectivity for groundwater (Figure 14). The Lease area is defined as Fractured Rock, with Moderate to High Prospectivity. Average yields for bores (total 300) are listed as 1.5L/sec. Water quality salinity range is listed as varying from 64-3330 mg/L.

The WIST data base shows only one bore in the area – this is located in Mangana as shown in Figure 15. This is located on the alluvial flats and no elevation is recorded. These areas are categorised as Low- Moderate Prospectivity and water quality good. The bore (40789) was drilled in 2006 to a depth of 9m and yielded 0.13L/s, standing water level was 4m in quaternary alluvium. Water quality was good (TDS 420mg/l).

The lack of bores indicates that groundwater resources are not adequate for major users in the area.
3.4.2 Groundwater in likely mine area

There is no information on standing water levels in the ML area, but it would be expected that it would be slightly above the alluvial flats (ie 4m below the surface in the Mangana flats). The only mine that has workings below the water table is believed to be the Mangana Reefs mine with workings extending some 250 m below surface. The paper by Twelvetrees makes no mention of significant groundwater and it can be assumed that inflows were low. (Twelvetrees, W H (1907). The Mangana Goldfield. Bull. Geological Survey: Tasmania I.)

No exploration drilling results record any standing water levels. However, based on the LIST contours the mine adits will be some 40m above the groundwater level recorded in the bore at Mangana. Some of the surface flows may flow to groundwater given the documented lack of stream flows from Sailors Gully (see Section 3.2).

All mining will be in the oxidised zone and above the water table. Drainage from the Argyle Adit may be representative of the mine area water quality below the water table. A diamond drill hole is planned into the Mangana Reef workings to test both standing water depth and water quality.

3.4.3 Recharge/Discharge

Given the above, it reasonable to assume that groundwater recharge occurs by surface infiltration and by fractures and faults in the hills surrounding Mangana. Discharges would occur in the streams draining the area and eventually to the South Esk River. The streams themselves in high flow conditions would recharge surrounding aquifers and these would slowly drain as river levels decline.

3.5 Climate

The nearest detailed climatic data available is from Fingal, with detailed data from
Powrana, where evaporation data is available. This station is some distance away and Mathinna is more elevated and closer to mountain and therefore evaporation is expected to be slightly lower. Fingal has a temperate climate with rainfall of 610 mm. Figure 16 shows the monthly rainfall and temperature data

**FIGURE 16: MONTHLY RAINFALL AND TEMPERATURE – Source: BOM**

Mean monthly maximum temperatures vary from 23°C in January to 13°C in July. Minimums vary from 10°C to 0.5°C.

Rainfall is reasonably evenly spread throughout the year but with more in winter months. Highest daily totals are most likely in April (Figure 17). Figure 18 shows the evaporation for Powranna.

**FIGURE 17: MONTHLY HIGHEST DAILY RAINFALL – Source: BOM**
This shows that evaporation is highest in summer months AND would exceed rainfall potentially from November to March. In these periods runoff is therefore less likely (except for storms) and that dust generation is most common.

Wind directions show that winds are mostly from the North- North East quadrant but also gentle westerlies prevail (Figure 19).

**FIGURE 18**:  MONTHLY EVAPORATION – Source: BOM

**FIGURE 19**:  WIND ROSE ANNUAL 3PM – Source: BOM
3.6 Site history

The Mangana area is locally highly mineralised with at least 70 significant known gold deposits within or in close proximity to the area. Figure 20 shows some of the former mines.

The deposits that are the subject of the proposed mine include the Argyle, Golden Entrance and Mangana Reefs (see Figure 20). Other potential mines are the Fingal, Pincher and Union Jack reefs. These are all within the MLA.

The Argyle reef was discovered and worked briefly in the period 1927-1928 by three adits, shafts and open stopes. Recorded production was 10 tonnes grading about 24g/t. The prospect worked a sulphidic quartz vein up to 1.7m wide, an extension of the Golden Entrance reef. The vein strikes about 327 degrees and dips about 55-70 degrees NE.

The Golden Entrance deposit was discovered in 1896. There are a number of adits to 55 metre depth, shafts and open stopes. Production is recorded as 2939 ounces from 718 tonnes with an average grade of 125 g/t. The Golden Entrance reef consists of a quartz reef striking about 333 degrees and dipping steeply to NE or SW. the reef is up to 2.1 metres thick and may be up to 2 km in length.

The Mangana Gold Reef was discovered in 1859. There are four adits at different levels up to 220m long and a shaft. Production is recorded as 791 ounces from 3106 tonnes at an average grade of 9.7g/t. The reef strikes 329 degrees and dips 68 degrees SE, is up to 350 metres long and 7.6 metres wide.

Figure 21 shows a section through the Mangana Reef workings. The photograph below shows the surface workings on top of the hill and an historical photo of the shaft headframe is shown below. The shaft still exists, although it is blocked at depth.

Photograph : Sovereign Hill Shaft

Ore processing was by gravity means with tailings disposed of by dry stacking (see cover for an historical photograph of the Mangana plant). These tailings still remain at the
entrance to Sailors Gully. Only low tonnages were treated as the ore was high grade (1-3 ounces per tonne). No evidence of oxidation is evident.

**FIGURE 20:** HISTORICAL WORKINGS – Source: Bottrill Tasmanian Department of Mines Report 1992/29.
FIGURE 21  SECTION THROUGH MANGANA REEF WORKINGS – Source Twelvetrees
3.7 Land tenure

The land tenure of the mining lease is State Forest and to the north, private land owned by Webb Mining (see Figure 2). Figure 22 shows the land tenure in the Mangana area (green is State Forest, yellow private land). Surrounding land tenure is all private land to the west (generally the gentle slopes and plains).

FIGURE 22: LAND TENURE (THE LIST)
3.8 Land-use

Figure 23 shows a google image.

![Map of land use](image)

**FIGURE 23: LAND USE (GOOGLE IMAGE)**

The nearest house is to the south–east approximately 0.8 km away.

The Sailors Gully and both sides of the valley and adjacent slopes and ridgelines are well forested. Freehold land mainly consisting of established pasture extends along both sides of Mangana Road south-west of the site and the township of Mangana is within a few hundred metres of the entrance to the site.

Because of the poor soils (for agriculture), which restrict land uses, the land use in the area is typically forestry, with areas of pasture on private land with the best soils. Land capability mapping (The List) of the lease area category is 6 (land marginally suited to grazing due to severe limitations) for the lease area.

Most of the agricultural areas are on alluvials to the west, and in the valley draining to the South Esk to the north and east.

3.9 Flora and Fauna

The flora and fauna report of the Sailors Gully area has been included in Appendix B. The report includes natural values as well as a field survey of vegetation and weeds. Figure 12 shows the vegetation communities sourced from Tasveg mapping around the Sailors Gully area.
THREATENED VEGETATION COMMUNITIES:

No vegetation community listed as threatened under the Tasmanian Nature Conservation Act 2002 was present in the areas surveyed and any areas likely to be affected by the project.

THREATENED FLORA:

No species of flora listed under the Tasmanian Threatened Species Protection Act 1995 or the Commonwealth Environment Protection & Biodiversity Conservation Act 1999 were observed during the survey.

THREATENED FAUNA:

No species of threatened fauna were observed on the day of the survey. No evidence of the presence of other threatened species such as scats of Tasmanian Devils or Spotted-tailed Quolls, or soil scratching of Bandicoots was observed during the survey.

THREATENED FAUNA HABITAT:

No specific threatened fauna habitat was observed during the field survey.

3.10 Weeds and Pathogens

3.10.1 Introduced plants

No weeds were observed in the survey area on the slopes of Napkin Hill however two species of weeds were present in the operations area along Sailors Creek.

- Spear Thistle, *Cirsium vulgare* was observed within the work, plant and storage areas. This is a common biennial weed of pasture and cultivation which responds to ground disturbance and will become more of an issue during mining and with the formation of the vehicular tracks if left unmanaged.

- Great Mullein *Verbascum thapsus*. This is a perennial plant which is a prolific seeder and has the potential to further establish along the roadside and wherever there is ground disturbance. A number of plants of this weed were observed within and adjacent to the existing operations area.

- Spear Thistle, English Broom and Hawthorn as well as the single plant of Holly were observed near the entrance along the access road

3.10.2 Phytophthora cinnamomi

There was no symptomatic field evidence observed of the root pathogen *Phytophthora cinnamomi* during this field survey.

4 Map and site plan

Maps and site plans are included in Sections B1 and B3.
PART C – POTENTIAL ENVIRONMENTAL EFFECTS

1 Flora and fauna, weeds

1.1 Flora and fauna

The project will have a small negative impact on existing flora in the short term. The proposed mining and processing will result in the disturbance of approximately 1-4 ha of mostly previously cleared areas, as mining will be underground. Most of the disturbed area will be caused by access roads to Adits and Shafts and access pads at the entrances. All of the process plant area is located in existing areas in Sailors Gully, which have been filled with waste rock.

No eagle nests were observed in the vicinity of Sailors Gully and no threatened fauna is expected to be affected. The threatened vegetation community is located away from all planned workings and will be fenced with barrier tape.

1.2 Weeds and pathogens

Only minor weed occurrences were observed and no Phytophthora. However, site works and road construction may result in increased infestation and will need control. Machinery, equipment etc have the potential to carry and spread weeds and pathogens (*Phytophthora cinnamomi*) between worksites.

1.3 Management

1.3.1 Flora and fauna

To avoid necessary impacts on flora and fauna, it is proposed to:

- align any disturbance and track formation to ensure the minimum of cut and fill is required;
- avoid mature standing trees where ever possible; and
- limit the clearing of the grassy ground layer vegetation to the minimum necessary to accommodate the track formation.

1.3.2 Weed control

The priority weeds for management and control are Spear Thistle, English Broom and Hawthorn as well as the single plant of Holly.

The areas being disturbed during the mining operations will be monitored for establishment of Spear Thistle and other weeds and necessary action taken as needed. The others weeds will be either manual removal or a targeted herbicide applications such as cut and paste with woody weeds

Follow up herbicide-based weed control and site inspections will be implemented annually.

All herbicide application will be undertaken by certified and experienced weed control contractors according to the relevant legislation [Weed Management Act 1999, and Agricultural and Veterinary Chemicals (Control of Use Act) 1995]. Appropriate herbicides will be selected and applied based on the relevant Tasmanian legislation and on the herbicide manufacturer’s on-label specifications/instructions. Control guidelines for most declared weeds are available from the DPIW website – [www.dpipwe.tas.gov.au](http://www.dpipwe.tas.gov.au)
Weed management for the access road will include:

- All maintenance or upgrading of the access road such as grading and spreading gravel, or slashing of verges which involves machinery or equipment will be undertaken only in an outwards direction from the work and operational area towards Mangana Road to ensure that soil borne weed seeds are not carried in to the site.
- Ensure that all gravels brought onto the site are sourced from pits or quarries which are certified to be clear of environmental weeds.

1.3.3 **Hygiene**

*Prior to works*

All machinery, equipment etc will undergo thorough wash down prior to entering the site in accordance with the DPIPWE Washdown Guidelines (*Appendix C*).

2 **Stormwater**

2.1 **Site conditions**

As discussed in Section B 3.2, Sailors Gully Creek is ephemeral and flows are infrequent. The gully floor has been filled with waste rock from previous mining operations and runoff from the gully is infrequent due to surface waters being intercepted by the topography and old mine workings (including diversion underground). On infrequent occasions, surface waters flow and pond on adjacent agricultural (grazing land).

As a result there is very limited capability to effect downstream uses or values with no permanent waters or wetlands in the area.

However, the plant and adit sites are located in a steep sided gully and there is potential for erosion from unsealed tracks and other disturbed areas of the site. Runoff velocity is expected to be high in high intensity storms and will require management.

2.2 **Management**

2.2.1 **Sailors Gully plant site area drainage plan**

The existing creek line is unformed over the areas which have been filled by previous mining operations and there are no culverts under the access road(s). Surface waters flowing down the creek previously flowed over the filled areas uncontrolled and into the original creek bed which has been previously disturbed and consist of numerous “pot holes” and excavations.

There is no sign of significant erosion or sediment transport.

**Figure 9** shows the plant area and proposed culverts and channel to control runoff from the creek upstream. **Figure 9a** shows a more general plan.

The ROM pad area, waste rock stockpiles etc will be protected by a drainage bund to separate the creek from these working areas and the access road will be provided with culverts (450mm min). The creek flows will also be directed around the plant site area on
settling basins (approx 100-200m³) will be constructed to collect these waters and act as a sediment basin prior to release.

All drainage from the ROM pad, plant area will be collected and used as process waters.

The proposed diversion channels and culvert sizes (min 450 dia) are based on the existing stream channels cross sectional areas.

Provision is made to also collect stormflows and reuse in the process waters and the process will be a net water consumer.

A detailed stormwater management plan will be prepared (sizes etc) and provided to EPA prior to commencement of mining and processing.

### 2.2.2 Adits

There are potentially three adit entrances to the ore bodies off Saillors Gully, which will be the main focus of drive development and ore haulage. Potential surface water ingress will be controlled by interception bund/drains and slope of adit floors (upwards). All drainage will be collected and piped for process water, although this is expected to be very small quantities.

Culverts (min 450mm dia) will be provided where access is required over the creek bed. Sediment basins will be provided to avoid sedimentation from any vehicle movements.

### 2.2.3 Access roads

Access roads will require modification/construction to access adits and shafts. These will all be constructed in accordance with the Forest Practices Code. The relevant section is included in Appendix D. Figure 9A shows the existing access road to the Argyle and Golden Entrance and upgrade and an alternative will be investigated to remove traffic from near the Creek.

Forestry Tas will be consulted about access location and construction. Potential access locations are shown in Figure 4.

### 3 Significant areas and/or land features

The lease is not located close to any significant areas or features.

### 4 Air emissions

There will be no air emissions other than exhausts of the diesel powered equipment and underground fans. All processing is gravity (and therefore with water). Therefore air emissions will not be an issue as the area is well sheltered and remote from residences which are almost a km away.

Dust emissions may result from traffic on the access road, as this is unsealed. However, this will only be light traffic and well away from the nearest residence.

There will be negligible dust from mining or processing as the ore will be quartzite rock and the process is a gravity one (ie water).
5 Liquid Wastes

5.1 Sources

The only “waste water sources” are expected to be from process waters and drainage from the plant area and stockpiles. Very limited quantities are expected from underground workings as all mining will be above the water table and drainage occurs through the fractured and porous ore veins to depth. There will be no discharge of liquids other than surface runoff. A portable toilet will be installed. All waste oils etc will be stored on site prior to disposal.

The process is simple and uses no chemicals, being a gravity gold plant. It will also be a net water consumer with waters lost in the process stream (evaporation, entrainment with tailings etc) and no discharges are proposed. Water required in the processing circuit is estimated at between 2-3 kL per hour when operating and will be recycled and made up with external sources.

The plant site area has been designed to collect drainage from all work areas, including ore/waste rock stockpiles and this may mean excess waters in heavy rainfall conditions. Under these conditions, the settling ponds/sumps may discharge to Sailors Gully Creek and the settling basins below the work area (refer Figures 9 and 9A).

Water quality is expected to be good, as there is no indication of acid waters in underground waters from the Argyle No 2 Adit (waters had residual alkalinity) and ore and tailings are both non acid forming (NAF).

There are no expected water parameters, which will be exceeded that would prevent water reuse. The ore is basically quartz and arsenopyrite, pyrite, galena and sphalerite, with no clays, so turbidity and suspended solids which do not readily settle are not expected. Because the ore is NAF buildup in sulphates (salinity) is not expected. Periodic addition of lime to the process water circuit may be required if acidity does develop. Due to the low capacity of the ore/tailings to generate acid condition, lime addition is expected to be only small (bags). Process waters will be maintained at pH 6.5 - 7.5. Assuming the ore has a S content of 0.5%, approximately 1.5 kg of lime per tonne will be required.

Runoff from ore/waste rock stockpiles is not expected to be acid (refer Section C7) but water quality will be monitored and is to be included in the process water circuit.

5.2 Management

Figures 9 and 9A show the process plant area layout. It provides for:

- All plant area drainage contained and directed to settling basins for reuse;
- Ore and waste rock stored on hardstand areas and drainage collected for reuse (refer section C 7 also) and will be monitored;
- Adit drainage collected for reuse;
- Tailings basins with provision for cleaning out;
• Collection of upstream drainage for water supply

• Maintenance of pH 6.5-7.5 in the circuit by lime addition if required; and

• Overflow discharge to main settling ponds in Sailors Gully Creek under extreme conditions.

A portable toilet will be installed and all toilet wastes will be disposed of at local Council facilities. All waste oils etc will be disposed of to a licensed facility by a certified controlled waste transporter.

In the event of power failures or unplanned event (such as water spillage etc) waters will drain to Sailors Gully Creek settling basins.

Potentially only in extreme flooding events will waters discharge from the site and down the existing drainage route to the farmland. In this event, there will be general flooding in the area. A lease agreement has been drawn up and signed with the landowner regarding access road, water supply and possible flow of waters to agricultural land.

6 Groundwater

The proposed mining operations will be confined to the oxidised part of the ore bodies (the treatment process is only suited to oxidised ore) and will be confined to ore above the water table. No shafts or declines involving dewatering below the water table are proposed and if such dewatering the EPA will be notified and consulted. Any adit drainage will be collected for water supplies.

Water supplies will include on – site sources including site runoff. Waters which previously ran underground to the Mangana mine workings may be intercepted and used as process waters. At some stage, water supplies may be sourced from the underground workings by a bore hole.

Therefore, there will be minimal impacts on groundwater.

A geotechnical survey has been conducted and is attached in Appendix E. Recommendations have been made by Pitt and Sherry regarding ground support and adit entrances. Disturbance to ground surrounding the existing adit entrances will be avoided.

Water ingress into the adits will be controlled by diversion of surface waters and adit floor gradients from the entrance sloped upwards, as is standard practice.

7 Solid wastes

7.1 Sources

Other than waste rock from exploration drives and tailings from the gravity gold recovery plant, no solid wastes will be generated, other than the normal domestic wastes, plus some maintenance materials, which will be disposed to the Council garbage service on a regular basis. There will be no garbage disposal facilities on site and employees and contractors will be required to dispose of any wastes to the Council facilities elsewhere on a daily basis.
Clayton Rumble (Geo-Environmental Management) has completed characterisation of the waste rock, ore and tailings. His report is included in Appendix F.

7.1.2 Tailings
Tailings will be the product of the gravity plant. These are non acid generating (NAG) (see below) and will consist of mostly crushed quartz. The heavier sulphide materials will be removed as part of the process of generating a gold concentrate.

The tailings will be relatively coarse and free draining. They will be directed initially into settlement dams (sumps) (concrete lined), which will be periodically cleaned out and tailings stacked and allowed to drain. The tailings will be suitable as a construction material and will be used on roads or placed underground as fill or roadway. As discussed above all waters will be recycled. Provision is made to maintain pH in the circuit between 6.5-7.5.

7.1.3 Waste rock from underground
Waste rock will be temporarily stored in the existing pad areas near the Mangana Shaft. This will consist of mineralized waste rock near the ore zone (and not ore grade) and other Mathinna Bed sediments (shales, slates, mudstones etc.)

It is not expected that significant quantities of waste rock will require disposal on the surface as it is planned to use mine development waste from development of the adits as mine backfill. Some material may require temporary storage during mining of the construction drives. This is expected to be a period of less than 1-2 months.

Existing open shafts and stopes on the Mangana Reef will be backfilled as they are dangerous. Actual quantities to be mined is uncertain at this stage as it will depend on the success of the development drive and the gold resource identified. As mining progresses, stopes (open spaced) will be developed underground and they will be backfilled with the waste rock from adit development for stability purposes and therefore, no waste rock is expected to be removed from the adits long term.

The geochemical assessment concluded that the waste rock (from the Argyle Adit), ore and tailings from the Mangana Gold Mine Project are expected to have a relatively low sulfur content and low acid neutralizing capacity (ANC), and therefore likely to be relatively barren in terms of acid generation and neutralisation. However, because of the low ANC, these materials are expected to be only poorly buffered and therefore susceptible to developing low pH conditions. Although low pH conditions may develop, due to the low sulfur content of these materials they are expected to have nil to a low capacity to generate acid. Therefore, although these materials have a high risk of developing low pH conditions, they have a low risk of producing acid rock drainage (ARD).

The one sample, which was potentially acid forming (PAF), was mineralised wall rock from the Argyle No 2 Adit.

The geology and ore body (veins) of both the Argyle and Golden Entrance reefs are identical and therefore the geochemical sampling results for Argyle is representative of the Golden Entrance mine.
The Mangana Reefs are of the same geology (ie Mathinna Beds) and similar results are expected from additional sampling and analysis which has been commissioned.

7.2 Management

There will be no garbage disposal facilities on site and employees and contractors will be required to dispose of any wastes to recycling/disposal to the Council facilities elsewhere on a daily or regular basis.

The tailings will be directed initially into settlement dams (concrete lined), which will be periodically cleaned out and tailings stacked. The tailings will be suitable as a construction material and will be used on roads or placed underground as fill or roadway. As discussed above all waters will be recycled. Provision is made to maintain pH in the circuit between 6-7.

Waste rock, in particular any low grade ore or mineralised materials will be stored in the ROM ore pad area on a hard stand area as shown in Figure 9 with drainage collected to be used as process water.

Water quality will be monitored from the settling basin to identify any water quality trends. Future drilling programs will include Total Sulfur and ANC (carbonate) in analyses to identify potential problematic PAF materials and will be expanded to include other geochemical parameters, if increased sulfur is recorded.

8 Noise emissions

There will only be noise emissions from the processing plant – a jaw crusher, screen, generator (silenced) and ball mill. There is only one residence within 1km.

An assessment of the likely noise emissions by Vipac was commissioned and the report is included in Appendix G.

Vipac concluded:

*The nearest residential dwellings are some 600 to 900 metres from the processing plant and have no view of the plant with the natural terrain offering strong screening of it.*

*A desktop noise assessment of the operations has been conducted based on:*

- Daytime operation only of the plant
- The processing plant comprises mobile crushing equipment, a small ball mill, and several pumps.
- Site noise emissions predicted using the ISO 9613 algorithms.

*The assessment has shown that:*

- The natural terrain offers strong acoustic screening of the plant.
- The plant noise emissions will have a low frequency component at two locations.
• Worst case noise levels, when penalised for annoying character, are 5 to 10 dBA below the criteria.

The noise assessment then concludes the proposed mine site noise emissions are acceptable and unlikely to cause unreasonable noise levels.

Therefore any specific noise control measures are not required.

9 Transport impacts
Access to the site will be via the existing access road off Mangana Road across private land. A mining lease has been applied for across this land with an agreement with the landowner.

The process plant is to be located in Sailors Gully and at this stage all ore production will from the reefs in the gully and no transport on public roads will be required. A concentrate will be generated and this will transported by light vehicle (expected annual production of between 1 – 10 tonnes).

In the future, ore production from the reefs to the North (such as Pincher etc) may require transport, but this would most likely be on private and Forestry roads (such as Tower Hill).

10 Cultural heritage
10.1 Background and studies
The Mangana gold field was significant in that it was the first gold discovery in Tasmania. However, the workings described are vestiges of the re working of the Mangana area by more intensive hard rock mining during the late 19th and early 20th century rather than the older alluvial works. Therefore as physical remnants of historic mining activities, these workings (above the ground anyway) are mostly unremarkable examples of early 20th century hard rock mining.

Parry Kosto was commissioned to carry out heritage surveys of the Sailors Gully area (Argyle, Golden Entrance and Mangana) and the Sovereign Hill workings (ie above Mangana Reef). These were done on two separate occasions and the reports are attached in Appendix H.

10.2 Sailors Gully area
Of the eleven features recorded and described, three are deemed to have sufficient significance to warrant further management related activities. These are:

• Old south adits track section
• The Mangana mine settlement
• Mangana mine settlement timber bridge

The location of these are shown in Figure 25.
10.3 Sovereign workings

These workings are on the hill as a surface expression of the Mangana Reef and are described as vestiges of the reworking of the Mangana area by more intensive hard rock mining during the late 19th and early 20th century rather than the older alluvial works.

However, the dry stone walling accompanying some of the shafts and adits is both well preserved and aesthetically pleasing. In association with their companion shafts and adits this stone work signposts historic mining activities in a location that will not impact on the proposed mining blueprint.

Kosoglou therefore recommended that the best examples of dry stone walling be protected from proposed mining activities (see photograph below)
10.3 Management

The working identified in the reports and discussed above will be protected by barrier tape or similar. If stonewalling has to be disturbed, representative areas will be selected for protection.

Should any unanticipated discoveries, which are likely to be significant be found, these will photographed and the merits of protection will be discussed with Parry Kostoglou.

11 Other off-site impacts

There is no potential to generate any other off-site impacts that may affect the amenity of residences or other sensitive uses as other than one house they are over 2.5 km distant.

The plant and mine area is not visible from any nearby road or viewpoints due to the flat topography and vegetation.

12 Dangerous goods and chemicals

No dangerous goods or chemicals will be used on site other than fuels and lubricants. All oils, lubricants and fuels will be handled within bunded areas and all wastes and containers will be removed and disposed of to licensed facilities. No explosives etc will be store on site. Oils spills kits will be maintained on site and used if spills occur.

13 Site Contamination

The area has been previously used for gold extraction and tailings disposal. The tailings are the product of a gravity plant and are stockpiled near the entrance to Sailors Gully. They are substantially revegetated. As no chemicals will used in the process (ie no cyanide) no contamination issues are expected.

14 Sustainability and climate change

The project has been designed to minimise energy consumption and wastes by the most efficient machinery, as this is also the most cost effective. Greenhouse emissions will be low due to the scale of the operation.

15 Sites of high public interest

The lease area is not in the vicinity of any site of high public interest.

16 Rehabilitation

The objective of the rehabilitation plan is to return the site to a stable condition with native vegetation. As mining is proposed to be underground with limited surface expression and disturbance only a small program is expected. A conceptual plan is set out below.

The proposed plan will be discussed with Forestry Tasmania prior to closure.
16.1 Vegetation stripping
Vegetation will be stripped to the perimeter of areas to be disturbed, separate from any topsoil located. The vegetation will be stockpiled in windrows for later re-use.

16.2 Topsoil stockpiling
Only limited topsoils are located on-site. They will be left intact on the outer embankments or stripped and stockpiled. Topsoil and vegetation are to remain separate.

The windrow of topsoil should be no deeper than 1 m, where space allows and where it will remain biologically active.

16.3 Landform Creation
Following closure, the disturbed surfaces will be developed into a series of undulations and/or level areas. Roads, which are expected to be the major disturbance will be closed and reformed to return the original drainage. Tailings umps, sediment ponds etc will be backfilled to approximately the original contour, unless needed for erosion control.

16.4 Surface Preparation
Disturbed areas in the lease – hardstanding, roads etc will be ripped and roads gripped to direct drainage off site, in accordance with the Forestry Code of Practice.

Parallel mounding will be constructed over the surface. As a generalisation the mounding will be constructed along the contours.

The parallel mounding not only limits access but also harvests run-off assisting plant establishment.

Any topsoil available is to be placed prior to mound construction. The mounds are usually constructed up to 500 mm in height.

Following mound construction, any stockpiled vegetation will be returned over the undulating surface. The vegetation will provide a seed source, assists surface stability and provides fauna habitat and protection for emerging plants from browsing.

16.5 Revegetation
The undulating landform will be sown with a general seed mix containing a range of species, suitable for the areas.

16.6 Nutrients
Nutrients will be required and will be applied as required.

Follow-up nutrient applications may be required until a nutrient pool develops and the vegetation community is deemed self-sustaining.

16.7 Monitoring and Maintenance
The site will be monitored annually, preferably in autumn. Monitoring inspections will identify any weed colonisation, stability and drainage issues and revegetation success.
Based on the inspection remedial measures if required can be conducted immediately after the inspection in the appropriate season.

**PART D – MANAGEMENT COMMITMENTS**

The Mining Lease will be operated in accordance with the EER, the land use Permit and Mining Lease conditions.

Table 5 shows the summary of commitments. Table 6 shows the monitoring plan.

**PART E – PUBLIC CONSULTATION**

Webb Mining, John Miedecke and Partners and its consultants have consulted with Mangana residents, state and local government authorities- including MRT, DPIPWE, EPA, Forestry Tasmania and Break ODay Council during site studies and project planning.

All indications are that the reopening of the mine is of considerable public interest and will be welcomed by the local community.
<table>
<thead>
<tr>
<th></th>
<th>Potential Impacts</th>
<th>Management measure commitments</th>
<th>Time frame</th>
<th>By who m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td>Operate the mine in accordance with the EER, the land use Permit and Mining Lease conditions and the Forest Code of Practice</td>
<td>Ongoing</td>
<td>Webb Mining (WM)</td>
</tr>
<tr>
<td>2</td>
<td>General</td>
<td>Consult with Forestry regarding road construction, rehabilitation and maintenance</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
<tr>
<td>3</td>
<td>Roads</td>
<td>Site, construct and maintain all new access roads in accordance with Forest Code of Practice</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
<tr>
<td>4</td>
<td>Flora and fauna</td>
<td>Align roads to minimise cut and fill Avoid large trees Limit clearing.</td>
<td>Prior to disturbance</td>
<td>WM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implement the weed and Phytophthora, hygiene management plan.</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
<tr>
<td>5</td>
<td>Stormwater</td>
<td>Collect site water for reuse Collect adit drainage for process water Construct settling basins in creek Install culverts etc Investigate alt. access Provide plan to EPA</td>
<td>Continuous Ongoing. Prior Prior Prior Prior</td>
<td>WM</td>
</tr>
<tr>
<td>6</td>
<td>Process waters and site drainage</td>
<td>Recycle process water Maintain closed water circuit Maintain process water pH between 6.5 and 7.5 Overflows to settling basins</td>
<td>Ongoing.</td>
<td>WM</td>
</tr>
<tr>
<td>7</td>
<td>Adit entrances</td>
<td>Adopt P&amp;S recommendations for ground support and adit entrances as per App B of EER</td>
<td>Ongoing.</td>
<td>WM</td>
</tr>
<tr>
<td>8</td>
<td>Tailings</td>
<td>Dispose of underground or use for hardstanding</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
<tr>
<td>9</td>
<td>Waste Rock</td>
<td>Store waste rock (or at least mineralized waste) in ROM pad area as temporary site, before disposal underground. Monitor drainage, adit sampling</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
<tr>
<td>10</td>
<td>Wastes</td>
<td>Dispose of liquid and solid wastes at a licensed facility.</td>
<td>Ongoing</td>
<td>WM</td>
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<tr>
<td>11</td>
<td>Heritage</td>
<td>Protect sites as identified by installation of barrier fencing.</td>
<td>Ongoing</td>
<td>WM</td>
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<tr>
<td>12</td>
<td>Rehabilitation</td>
<td>Salvage vegetation, topsoils and subsoils</td>
<td>Ongoing</td>
<td>WM</td>
</tr>
</tbody>
</table>
### Table 5  Summary of Commitments

<table>
<thead>
<tr>
<th></th>
<th>Management</th>
<th>Liaise with contractor(s) to implement management measures. Co-operate with EPA, MRT and Forestry officers in site inspections Seek professional advice when required.</th>
<th>Continuous</th>
<th>WM</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Plan</td>
<td>Time frame</td>
<td>Location</td>
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<td></td>
</tr>
<tr>
<td>1 Water Quality</td>
<td>• Field pH and EC and Monthly alkalinity, acidity, sulphate, Mg, Ca, TSS, and filtered metals Ag, As, Cd, Cr, Cu, Co, Ni, Pb, Sb, Zn, Fe, Mn, and Annual report</td>
<td>Continuous Review after 3 months then 3 monthly then 6mths</td>
<td>ROM pad, Adits, Process waters, Site drainage to Creek</td>
<td></td>
</tr>
<tr>
<td>2 Site drainage</td>
<td>• Record any discharges to creek and any outflows to surrounding agricultural land</td>
<td>Continuous</td>
<td>Off lease</td>
<td></td>
</tr>
<tr>
<td>3 AMD generation</td>
<td>• Routine total S and ANC of ore/mineralised waste rock • Expand analyses if increased S recorded (geochem) Annual report</td>
<td>Continuous Review after 3 months then 3 monthly then 6mths</td>
<td>Initially all drill core and geologist selected new development waste</td>
<td></td>
</tr>
<tr>
<td>4 Public complaints</td>
<td>• Public complaints</td>
<td>Continuous</td>
<td></td>
<td></td>
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</table>
References