APPENDIX B2

BASIS OF DESIGN

BIRD IN HAND GOLD PROJECT

MINING LEASE PROPOSAL MC 4473

ABN | 66 122 765 708
Unit 7 / 202-208 Glen Osmond Road | Fullarton SA 5063

Bird in Hand Gold Project Site Organisation — Design Basis Report

SUBJECT	Bird in Hand Gold Project Site Organisation — Design Basis Report (Doc. No. 20155706R003A)				
REVISION	A – Issue for Information	**DATE**	10/04/2017	**JOB NO.**	20155706

Statement of applicable regulations

Work Health and Safety Act 2012 and the WHS Regulations (2012)

Environment Protection Act (1993)

Natural Resources Management Act (2004)

List of principal design codes

During the site organisation review process and subsequent design activities, consideration will be given to the relevant Australian Standards, Utility Service Provider Technical Standards, Guidelines and other design references.

Reference documentation

Site Organisation Summary BIH Gold Project, Terramin Australia (2017).

Bird in Hand Gold Mine Stormwater Management Plan, Terramin Australia Limited (2016), Document No. 20155706R002D.

Bird in Hand Gold Mine Transport Assessment, Terramin Australia Limited (2016). Document No. 20155706R001A.

Bird in Hand Gold Mine - Mine Access Road Concept Design Sheet 1, File Name 20155706_AT PLAN.DWG.

Preliminary Assessment of Treatment of Bird in Hand Groundwater Using Bioaqua Plus Additional Components, Global Aquatica (Aust.) Pty Ltd (2016).

Memorandum – Bird in Hand Mine Site Naming Convention, Jack Light, Terramin Australia Limited, 14 February 2017.

Site layout DWG files provided by Terramin Limited on 6 February 2017.

Site equipment specifications provided by Terramin Limited on 6 February 2017.

Area Schedule – Bird in Hand Gold Project provided by Terramin Limited on 6 February 2017.

Waste Management Plan, Angas Zinc Mine, November 2012.

Mining One BEBO Structure, provided by Terramin Limited on 6 February 2017. It is noted that the BEBO structure proposed for this project will be subject to further detail design by the manufacturer prior to construction.

Historic mine working files received 8 March 2017. It is noted that these files were provided to Tonkin Consulting on 17 October 2016 for use on previous elements of the project.

Baseline Contamination Assessment – 192 Pfeiffer Road, Woodside, South Australia (March 2017), Golder Associates. Document No. 1659870-001-R-Rev1.

Mine Rehabilitation - Leading Practice Sustainable Development Program for the Mining Industry, Department of Industry Tourism and Resources (October 2016).

Design inputs and assumptions

Integrated Mullock Landform (IML)

- Peak waste rock volume required = 104,000 m^3
- The IML shape proposed by Terramin has a volume capacity of 131,000 m^3. Following modification of the IML to allow for site constraints and benching requirements, the IML volume capacity will be approximately 108,000 m^3.
- The base of the IML shall sit approximately 5 m below the existing surface level (22,000 m^3 of existing soil to be removed) to ensure the top of the landform is below the site lines from the BiH winery
- The slope of the IML will be approximately 1V:2.6H (21°).
- A 3 m bench will be provided at approximately half the height of the IML (nominally 6 m).

Hillside Screening Bund

- The maximum height of the bund is approximately 8 m from the existing ground surface level
- The maximum crest width is 15 m
- The western batter slope will have an approximate gradient of 1V:3H (18°)
- Joe Ranford, Terramin Australia Limited, advised at the site visit on 13 February 2017 that this bund can exceed the current design height of 5 m if there is additional cut on the site.

Eastern Screening Bund

- Height of bund is 5 m from the existing ground surface level
- The current capacity is approximately 11,000 m^3
- The bund shall avoid the following.
    - Significant and heritage trees.
    - Existing linear tree plantings between paddocks where possible.
    - Primary ventilation shaft.
    - Nominated riparian zone on the eastern boundary.

  It is noted that the linear tree plantings identify the buffer zone between the operations site and the adjacent heritage agreement site on the neighbouring property (i.e. part of the EPBC Act agreement).

Southern Bund Extension

- The existing southern bund ("Bird-in Hand Road erosion control bund") can be extended if additional cut requires removal on site.
- Extending the bund will accommodate approximately 15,500 m^3 of additional material, with a gradient of approximately 1V:4H (14°) on the front face and 1V:4H (14°) on the back face (to avoid linear tree planting). This will be used to store topsoil. The maximum height will be 3 m to conform with the mining rehabilitation report.

Northern Topsoil Bund

- The nominal balance volume of topsoil on site will be approximately 3,600 m^3 and will be located on the northern topsoil bund located to the east of the main carpark.

Raw Water Dam

- The raw water dam will be located in the southern paddock and shall have rectangular geometry.
- An operation volume of approximately 15 ML is required based on current water management predictions.
- A freeboard of 600 mm is assumed.
- Internal batters of 1V:3H (18°) is assumed.
- External batters of 1V:3H (18°) is assumed.
- The water surface area will be less than the existing dams located at Bird in Hand Winery and Petaluma vineyard (i.e. less than 6,500 m^2).

- Assume a “turkey’s nest” type dam configuration as this minimises additional cut material on site and provides the opportunity to integrate the dam batters into the adjacent natural landform.
- The dam will allow for stormwater runoff from the IML.
- A ramp will be provided from the eastern bund to the water storage for intermittent light vehicle access and small crane access for the purposes of pump maintenance, etc.
- Access will be provided to the dam for light maintenance vehicles and larger service and construction vehicles.
- The raw water dam will merge into the hillside screening bund for screening purposes.

Water Treatment Plant

- Nominal dimensions for the plant is 70 m x 70 m based on currently predicted water management requirements.
- The water treatment plant tank arrangement will be modified to suit the available space and operational vehicle movements, accounting for the volume of water required to be treated during operation.

Access and Haul Road

- The haul road will be cut into the existing ground surface to ensure suitable grades for the nominated design vehicles and ease of access where possible.
- All significant trees will be avoided where possible.
- The haul road will incorporate a flat grade section adjacent to the proposed entrance security check point, i.e. potential vehicle standing zones.
- The design speed for the haul road is 20 km/h.
- The haul road will be designed to accommodate B-double vehicles.
- The haul road turnaround loop will cater for the storage of approximately 4x B-doubles vehicles, however, during operation the storage of 2x B-doubles will likely be the practical limitation of this turnaround loop.
- Road batters will be designed to avoid the riparian zone where possible. Localised shaping may occur to match natural ground surface.
- The roadway configuration will provide separation between delivery access and operational vehicle movement requirements where possible. It is assumed that the operations area ring road will be one-way around the workshop (clockwise) to cater for delivery vehicles and mining vehicles.
- A stormwater detention basin will be located within the haul road turnaround with the assumption that this area will remain uncovered, which is consistent with the stormwater management plan philosophy the site
- The main site access will be via Pfeiffer Road; however emergency access will be provided at the southern end of the site onto Bird in Hand Road.

Heavy Vehicle Go-Line

- The Go-Line will be designed to cater for a maximum vehicle standing space consisting of 2x underground loaders, 3x underground trucks, 2x underground jumbos and 1x delivery truck.
- The facility will provide a turnaround function.
- Parking for underground light vehicles will be accommodated adjacent to the workshop.

Wash Pad

- The wash pad will be sized for a B-double vehicle.
- A service corridor will be required from the wash pad to the raw water pond to allow wastewater to be captured on site.

Fuel Deliveries

- Semi-trailers will be accommodated on access roads to allow for fuel deliveries.

Backfill Plant

- The backfill plant will be sized to fit three horizontal cement silos and a 12 m x 12 m bay.

- The location of the backfill plant will accommodate deliveries from a concrete agitator or a flatbed truck.

Workshop

- The workshop will be 6 m tall in accordance with Terramin document titled 'Site Organisation Summary_SUR_INF_V9_170203'. The proposed construction consists of two standard shipping containers stacked with a gable roof, access doors that can be sealed and an overhead gantry crane.
- The workshop will have drive-through access through a minimum of one bay.

Laydown Areas

- A laydown area will be located on top of the box cut. The extent of this area will be subject to confirmation of the extent of BEBO Arch and load capacity of these structures.
- The BEBO Arch will not extend above natural surface level.
- A temporary laydown area will be located at the proposed main carpark location (adjacent the site access point) during construction.

Car Park

- The car park area will have provision for a nominal 20 seat (8.8 m) bus to turnaround.
- The car park will have provision for a shelter for staff.
- The car park will be designed to facilitate approximately 60 off-street car parks (light vehicles) in accordance with AS2890.1 with provision for contingency for light vehicle public parking.
- Carpark will include lighting that is consistent with 24-hour operation and in accordance with AS1158 Road Lighting, but minimises light spill.

Security

The main access checkpoint will be located adjacent to the carpark and another will be located adjacent to the haul road turnaround loop (for delivery vehicles).

- The main access check point will consist of a boom (or sliding) gate which will be operated via remote control or an intercom system including CCTV infrastructure.
- The main access check point will be unmanned; hence no gatehouse structure is required.
- The access route will cater for 3x B-doubles queuing

Administration Office, Stores and Ablutions Areas

- 200 m^2 of office space will be required based on 20 personnel utilising the space with an allowance of 10 m^2 per person.
- Two 60 m^2 areas to accommodate kitchen, crib and muster rooms will be provided.
- Structures are proposed to be proprietary demountable structures.
- Car parking is required close to the muster room for underground light vehicles. A total of seven carparks will be provided.

ROM Pad, Silo

- ROM pad dimensions will be assumed as per the concept layout provided, i.e. 11 m diameter x 24 m high.
- Access to the grizzly for regular removal of skip bin via a telehandler and skid steer vehicle will be considered during subsequent phases of design.

Site access location

- The location defined as *Alternative Access Location #3* in the Transport Assessment Report will generally be adopted for access into the proposed mine site.

Operations Area Ring Road

- The ring road around the workshop, office and amenities facilities will accommodate 26 m B-double vehicles. Other roads within the operations area will accommodate 19 m semi-trailers.
- The ring road will be 8 m wide to accommodate B-double vehicle movements.
- The grade of the ring road will not exceed 1V:10H (6°).

Underground Magazine

- Access is required to the underground magazine; however, this is outside of the scope this report. Materials will either be delivered to surface and transferred directly underground or taken directly underground by suitable vehicles.

Access Roads and Fire Tracks

- Access roads will be provided around the perimeter of the site for the purpose of security and provision of emergency fire tracks.
- Access tracks will accommodate light vehicles only.
- Access tracks will be two wheeled dirt tracks. No formal earthworks will be identified on the concept layout drawings.

Construction Staging

- Initial construction activities will be staged generally as follows.
    - The site will be stripped of topsoil
    - Cut outs will be constructed
    - Bunds will be constructed
    - IML pad will be dug out to cater for waste rock

  A detailed staging methodology is not within the scope of this report, however this will be considered in subsequent phases of design.

Security Fencing

- Security fencing will be provided around the perimeter of the operational area. The type of fencing will be considered following detailed noise modelling; however, it is likely be constructed using a cyclone fence with barb wire or an acoustic fencing option.

Ventilation Shafts

- A 10 m x 10 m area will be provided for the primary ventilation shaft and the magazine exhaust shaft.
- Access and power supply (via underground cables) will be provided to ventilation shafts.

Pedestrian Path

- A pedestrian path will be provided from the car park to the operations area. The path is likely to be located adjacent to historic mining infrastructure. Confirmation of the location and details of the pedestrian path is outside of the scope of this report.
- Pedestrian access to the operational area will be accommodated via a secure gate with swipe card access on the northern side of the operational area.

Site Services

- High voltage power will be provided from the site boundary (assumed power supply point) to the proposed workshop transformer site.
- Low voltage power will be reticulated across the site via underground cables.
- It is assumed that all required services (i.e. water, power and telecommunications) will be connected at the site boundary.
- It is assumed that sewer and gas connections are not required.
    - It is proposed that effluent and grey water will be treated separately on site. Grey water will be treated via the proposed water treatment plant and black water (effluent) will be treated on site via an aerobic system or similar and discharged via an onsite land application system. A nominal irrigation area will be identified on the drawings; however, this is subject to outcomes of detailed design.
    - It is assumed that onsite hot water will be accommodated via an electrical hot water service.

Heritage Listed Infrastructure

- A buffer distance of 25 m will be provided from the heritage listed chimney and flue (Lone Hand site) and a 5 m buffer will be provided from all other physical heritage items such as engine mounts and the lone hand processing area. All buffer distances are in accordance with the AutoCAD file bih_sur_inf_v9_buff.dxf provided by Terramin.

Eastern Site (Hisee) Boundary

- A 30 m buffer zone will be provided between the eastern side of the operations area and the eastern site boundary to accommodate the historic drainage scour that is remnant from previous mine operations. The drainage scour is not considered a water course and works adjacent to this area are not considered 'water affecting'.
- The 30 m buffer zone to the Hisee property boundary will also be required to protect the vegetation heritage agreement zone identified on this boundary.

Historic Underground Workings

Currently no allowance has been made in the design for remedial activities that may be required as a result of the construction of new infrastructure in the vicinity of historic underground mine workings. The exact locations of historic infrastructure and their potential impact on new infrastructure shall be reviewed further during detailed design activities. Refer proposed risk management strategy for working adjacent existing underground mine infrastructure below.

Significant Trees

- Whilst significant trees will be avoided where possible, all trees on site are subject to a detailed arborist assessment. A nominal 5 m buffer zone has been adopted around significant trees in accordance with the Site Organisation Summary (2017).

Other service requirements

The depth of top soil stripping is assumed to be 200 mm as detailed in email from Jack Light dated 10 February 2017.

Considerations will be given to reducing site lines from neighbouring properties to the proposed operations area.

Risk management strategy for working adjacent to existing underground infrastructure

The information made available during this phase of the project suggests that previous (currently not active) underground mining activity, including shafts and possibly boreholes, has the potential to affect the proposed Bird in Hand Mine infrastructure in the zones shown on the site layout plan (i.e. a small section of the access road and car park) developed by Tonkin Consulting.

When abandoned mine shafts and stopes, etc. have the potential to affect new infrastructure, as might occur if a cavity were to develop as a result of the collapse of mining remnants and undermine the new infrastructure, there are generally four risk management options.

1. **Avoid the risk.** Move the infrastructure to a location or locations that cannot be affected by the mine shafts. This is unlikely to be reasonably practical at the Bird in Hand Gold project site, but should be considered. Realigning the road to avoid all known areas of historical mining will remain an option, but does not necessarily eliminate the risks associated with unknown workings.
2. **Accept the risk.** The decision to do this is likely to be based on a detailed desktop survey of all known information on the shafts – their date, documented location(s), probable size and form of construction, local geology and the possibility of the shafts either expanding or collapsing from natural processes, combined with a walkover of the site to ground-truth the desktop information. Comparing the outcomes of this study with the proposed infrastructure may indicate that the risk is acceptably low to the client. It is noted that a desktop survey has been undertaken and details of this are available in GIS format and have been used when considered main access routes into the site.
3. **Engineer the risk prior to construction.** Following the desktop and walkover survey described above, undertake intrusive investigations to identify the abandoned mine artefact location, size and construction, etc. and treat the area appropriately.

   One detection and identification method would be geophysics, although it should be noted that shafts, adits and boreholes are relatively small targets compared to the area surrounding them and may have collapsed or been backfilled in a way that would effectively camouflage them from seismic geophysics, electro-magnetism or ground penetrating radar. It is also noted that existing fence lines, bore lines, etc. can make this process challenging.

Another method would involve drilling at a spacing equivalent to the largest cavity collapse that the proposed infrastructure could withstand. This doesn't have to involve elaborate drilling methods as loss of return during air drilling is a reliable indicator of voids in ground and air drilling is quick and relatively inexpensive. Defining the area to drill would involve a risk-based assessment of the desktop and walkover survey data.

There will be an indeterminate residual risk that the method(s) used will not, for some reason, detect a cavity that subsequently reveals itself.

4. **Engineer the risk during construction.** Although it would be prudent to undertake the desktop and walkover survey referred to above, that would not be strictly necessary.

   At an appropriate time before the infrastructure is scheduled to be built, proof roll the construction area with sufficiently heavy or energetic machinery (impact rolling or something similar might be an option) to deliberately collapse any underground cavity where the backfill is too weak to withstand the infrastructure loads.

   If a collapse occurs, treat the area. Assuming the collapse is relatively small in area, this would probably be accomplished by choking the cavity using a geogrid such as Tensar backfilled with a 20 mm to 40 mm ballast (the Tensar acts to contain the ballast, which might otherwise be lost into the cavity) overlain by a structural layer intended to bridge over the cavity. This structural layer might be another Tensar/coarse fill layer or concrete/Controlled Low Strength Material (CLSM) over lost formwork (Bondek, Comdek etc. depending on the inferred or demonstrated unsupported span). CLSM has an advantage in this context that it can be dug to install services, etc. as long as the construction excavation stability can be managed and subsequent backfill is also CLSM.

Again there will be an indeterminate residual risk that the method(s) used will not, for some reason, detect a shaft that subsequently reveals itself.

As always with ground, risk conditions will vary over time. It is unlikely that the ground will become more stable over time, although that is a possibility. Mine cavities typically collapse from internal erosion when sufficient water enters the existing backfill to carry it away in suspension or solution or when the ground rearranges in response to stress changes. Often this is progressive, involving subsidence at surface prior to rupture, but brittle failure does occur. Therefore, the risk of collapse generally increases over time and even cavities that have been stable for a very long time may collapse without warning, particularly if runoff or groundwater enters the backfill.

Occupational health and safety requirements

The design will be reviewed with respect to Safety in Design principles and any specific Client requirements throughout design development.

Environmental and sustainability considerations

Informal consideration of environmental and sustainability factors throughout design development will be completed to minimise potential consequences of construction activities or operational incidents.

The Baseline Contamination Assessment report undertaken by Golder Associated in March 2017 has identified a number of zones within the project site that may contain contaminated soils. Key works that may interfere with existing contaminated soils are the access road into the site and the stormwater detention pond area. The design has minimised works in these areas where possible in accordance with the proposed management strategies detailed in the aforementioned report.

Approximate volumes of contaminated material are as follows:

- Access Road – 2,875 m^3
- Detention Basin – 2,359 m^3.

The exact extent of contaminated soils will need to be identified and a detailed management strategy prepared prior to construction. This is currently outside of the scope of this report.

Operation and maintenance requirements

Accessibility will be considered for all new facilities including the water dam, mining operations facilities and the car park to allow for future maintenance requirements.

Statutory requirements and approvals

Terramin will review documentation produced progressively through the design process.