

24. Closure and Rehabilitation

The purpose of this chapter is to describe the proposed approach to closure and rehabilitation of the Project. Unless otherwise stated, closure and rehabilitation information has been sourced from the Mt Todd Gold Project PFS Reclamation Plan (the Reclamation Plan) (Appendix Y). The Reclamation Plan focuses on the reclamation earthworks associated with closing existing and future mine features during and following the completion of mining operations.

The potential impacts and associated management measures identified in this chapter contribute to the closure and AMD components of the project risk assessment undertaken in Chapter 5. The project risk assessment includes consequence; likelihood and residual risk ratings for impacts associated with closure and AMD seepage after management measures are implemented.

24.1 Background

Historical mining at Mt Todd has impacted the surrounding environment through establishment of facilities such as the Batman Pit, WRD, TSF1 and water storages; and through the clearing of areas to accommodate plant, stockpiles and site roads. The site has been affected by AMD in stockpiled rock and the Batman Pit (AED 2008). Mine planning has focussed on the reuse of existing infrastructure and disturbed areas where possible to minimise the extent of new works on-site

Closure and rehabilitation will occur progressively throughout the life of the Project. Existing facilities and infrastructure that are not required will be decommissioned and rehabilitated as soon as possible after mining commences.

The DME has developed objectives to gauge the success of mine closure and rehabilitation (2008). The objectives, relevant to Mt Todd, include the following:

- ▶ Compatibility with agreed post mining land use:
 - specific criteria agreed upon for post mining land use at individual sites should be met;
 - monitoring trends should indicate that the ability of the site to support the post mining land use will be sustained.
- ▶ Physical safety:
 - excavations and subsidence to be rendered safe;
 - all drill holes, shafts, open cuts and other openings to be securely capped, filled or otherwise made safe;
 - access of people and livestock to be restricted as appropriate to site conditions.
- ▶ Low risk to biota:
 - the quality of water leaving the site should be such as to cause no significant deterioration of water quality to the downstream beneficial use(s) or water quality objectives of the receiving waters declared under Section 73 of the *Water Act 1992*;
 - production of polluted water (e.g. acidic or caustic runoff from pits, stockpiles, waste rock or tailings) should be minimised, and trends should indicate improvement;
 - continuing active intervention should not be required for site water management;

- residual toxic material, such as process chemicals, should be removed or contained, mobilisation of toxicants in general should be prevented and, in the case of acid rock drainage, minimised and controlled.
- ▶ **Stability:**
 - all disturbed areas should be stabilised, including the construction of stable landforms;
 - drainage should be consistent with post-mining land use (re-establishment of natural drainage patterns where appropriate);
 - erosion by wind and water should be at least comparable with background levels for the area;
 - storages left *in situ* should be stable (providing an adequate margin of safety which is dependent on material stored) against floods, erosion and subsidence.
- ▶ **Rubbish clean-up:**
 - facilities and equipment should be removed unless they are to remain for an agreed future use;
 - no rubbish should remain at the surface, or at risk of being exposed through erosion.
- ▶ **Revegetated or otherwise improved:**
 - If natural habitat regeneration is to occur:*
 - all surfaces should be revegetated to a self-sustaining condition similar to vegetation in comparable local areas (to a standard consistent with data obtained from pre-mining baseline environmental studies, where these have been done);
 - vegetation communities should be developed that will attract and support the re-colonisation by native fauna and flora species found in the region;
 - vegetation should be able to survive the local fire regime;
 - introduction and spread of weeds and pests particularly those of disease significance should be prevented and an active program in place to minimise their presence.
 - If other post mining land uses are to occur:*
 - site specific revegetation criteria may apply, as agreed during project planning and documented in mine / environment plans.
- ▶ **Visual amenity:**
 - long term visual impact should be minimised by creating acceptable landforms, preferably compatible with adjacent landscape.
- ▶ **Heritage and archaeological sites:**
 - condition of heritage and archaeological sites should meet requirements of relevant authorities.

24.2 Objectives

With consideration to the DME guidelines and the Reclamation Plan, the following closure and rehabilitation objectives were developed for the Project:

- ▶ develop landforms that are consistent with post mining land use and the surrounding landscape;
- ▶ protect public safety;
- ▶ control acid-generating conditions;
- ▶ minimise erosion of facilities containing mine waste;

- ▶ reduce or eliminate the acid and metal loads of seepage and runoff water;
- ▶ minimise adverse impacts to the surface and groundwater systems surrounding Mt Todd;
- ▶ physically and chemically stabilise mine waste and other mine related disturbances or landforms;
- ▶ undertake progressive rehabilitation of the site during operations;
- ▶ develop an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes; and
- ▶ comply with Northern Territory Government regulations governing mine development and closure.

The final goal of closure and rehabilitation is to limit environmental impact and to leave Mt Todd with minimal or no ongoing management requirements once mining is complete. The final land use objective for the mine site is to re-establish pre-mining vegetation types where ever possible.

The planning, potential impacts and management of closure and rehabilitation, and final relinquishment of the site to the Northern Territory Government are contained in the following sections.

24.3 Closure and Rehabilitation Design

Vista Gold has adopted a whole of life approach to mining, planning for closure and rehabilitation before reopening the mine site. Responsibilities will be allocated during the mine life and trials and research will be undertaken to further understand the local environment and rehabilitation requirements.

The key on-site features requiring rehabilitation are:

- ▶ WRD;
- ▶ HLP and moat;
- ▶ TSF1 and TSF2;
- ▶ Batman Pit; and
- ▶ disturbance areas such as the process plant site, site roads and stockpile areas.

Proposed rehabilitation designs are summarised below in sections 24.3.1 to 24.3.8.

24.3.1 Waste Rock Dump

The WRD will be expanded to provide capacity for up to 510Mt. From its current area of 69ha, the WRD will be constructed at an effective angle of 30° with interbench slopes of 34° and will expand to a planned 3D surface area, following closure, of approximately 241ha. The WRD will be approximately 350m high at closure. The dump will be constructed in layers with each layer rehabilitated as the dump increases in size. The design and operations aim to promote clean water diversion and rapid surface water runoff, and erosion and seepage control measures.

Each lift will be constructed at 34 degrees with 8m wide benches at 30m vertical intervals on the face of the WRD. These benches will function as stormwater drainages and as access for rehabilitation activities and maintenance.

A minimum of 1m layer of NAF waste rock will be placed over the whole surface of the WRD.

Approximately 40-50% PAF waste rock will be encapsulated by between 40-50% NAF rock up to 100m thickness. A cover layer, composed of a 0.3m bedding layer of crushed rock, a GCL and a further 0.3m layer of finely crushed rock, will accompany the closure of the WRD once final grades are attained. The

GCL will assist in channelling seepage toward the outer edge of the WRD, toward the NAF material to prevent AMD.

An indicative closure cover design of the WRD is illustrated in Figure 24-1 and the cover layer without bedding layer is detailed in Figure 24-2.

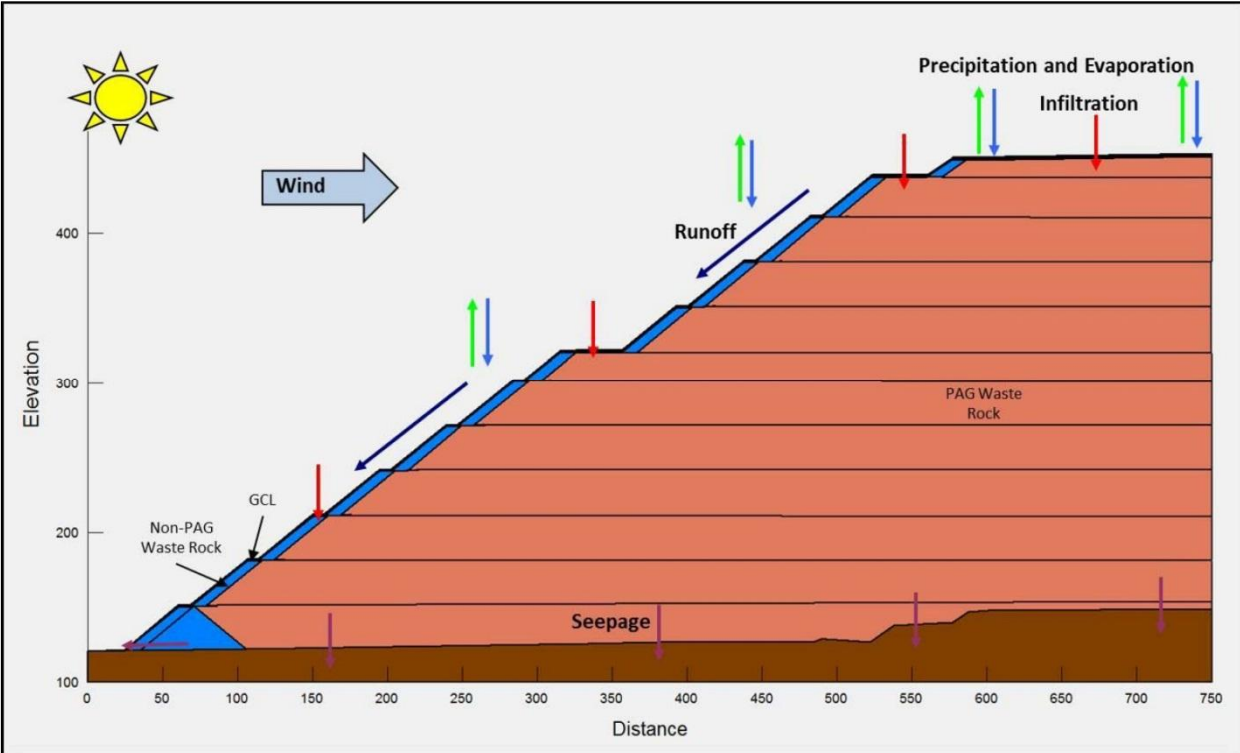


Figure 24-1 Waste Rock Dump Design

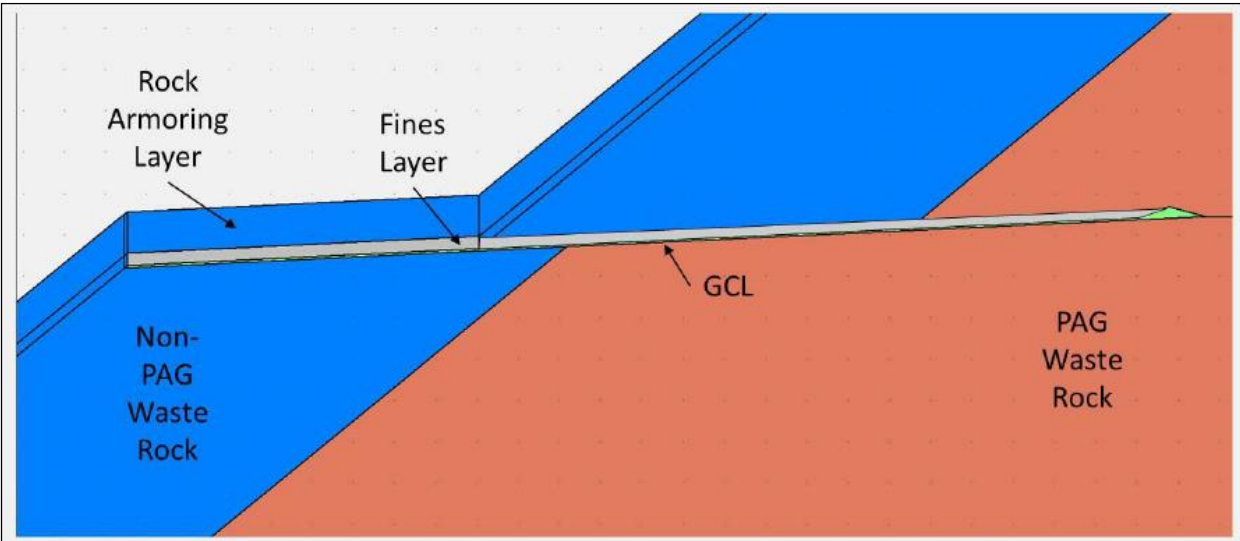


Figure 24-2 Waste Rock Dump Cover Layer

A Waste Rock Management Plan will be developed that specifies how waste rock is to be handled to minimise the potential for AMD and maximise the beneficial use of NAF waste rock for closure. The Waste Rock Management Plan will include:

- ▶ routine waste rock testing procedures such as collecting monthly samples for analysis of carbon and sulfur that can be used to confirm data from the blast hole database;
- ▶ staging dump construction to minimise the contact of PAF rock with air and water;
- ▶ selective handling and isolation of the highest sulfide material;
- ▶ contouring WRD surfaces to shed precipitation and runoff away from PAF materials during production and at closure; and
- ▶ sequential closure of inactive dump areas and faces as mining progresses.

The results of this planning effort will include managing waste rock disposal so the outer layers of the WRD at closure are composed of NAF waste rock. The Waste Rock Management Plan will also emphasise the implementation of operational techniques and dump designs that encourage clean water diversion, rapid internal surface runoff, and seepage control during operations and at closure.

Seepage to surface (and potentially much of the groundwater seepage) is proposed for management in RP1. RP1 waters will be treated in the WTP prior to discharge during mining.

24.3.2 Heap Leach Pad and Moat

The HLP covers an area of approximately 39ha and is 20 to 25m thick. Side slopes are as steep as 58° (1 Horizontal: 1.6 Vertical) and are covered by a dense network of rills and gullies. Vista Gold intends to reprocess the HLP however if the economics do not make sense then the HLP will be rehabilitated as follows.

Testing of the HLP will be undertaken, however it is expected that the HLP will be NAF material as inferred from the acidic seepage stored in the HLP ponds. Leached ore in the HLP will be removed and processed during year 12 and 13 of production. Following this the HDPE liner will be removed and disposed in TSF2. Contaminated material below the HDPE liner will also be removed and disposed in TSF2. The remaining approximate 156,000m³ of material at the HLP will be graded to promote drainage and capped with a 0.8m layer of LPM and NAF waste rock and a subsequent 0.2m layer of PGM. The PGM layer will be sown with native seed and ultimately revegetated. The closure cover design of the HLP is illustrated in Figure 24-3.

24.3.3 Tailings Storage Facilities

The expected final elevation of TSF1 is 34m. Surface area at closure will be approximately 239ha (which includes an impounded surface area of 214ha and TSF dam surface area of 25ha).

The expected final elevation of TSF2 is 60m. Surface area at closure will be approximately 301ha (which includes an impounded surface area of 179ha and dam surface area of 122ha).

To close the impounded surfaces of TSF1 and TSF2, a 1m thick cover composed of NAF waste rock will be installed to bridge thixotropic tailings. A 0.8m cover layer of LPM and NAF waste rock will then be applied. Finally, a 0.2 m layer of PGM will be applied. The PGM layer will be sown with native seed and ultimately revegetated.

Modifications to TSF1 and TSF2 to control seepage will be made at closure, including the installation of seepage collection ditches and routing of water to the WTP or passive treatment system, depending on the year of mine operation. Closure of TSF2 will include removal of tailings delivery line spigot piping and on-site disposal. TSF2 will be rehabilitated progressively with the impoundment surface reclaimed in year 14, following completion of all processing activities.

The proposed closure cover design of TSF1 and TSF2 is illustrated in Figure 24-4.

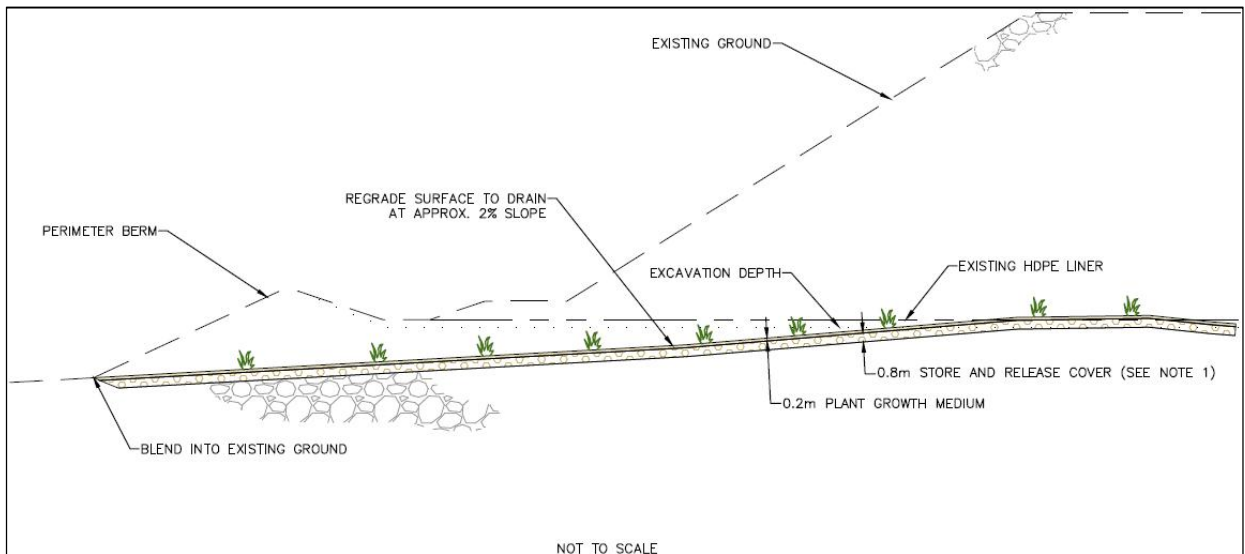


Figure 24-3 Heap Leach Pad Closure Cover Design

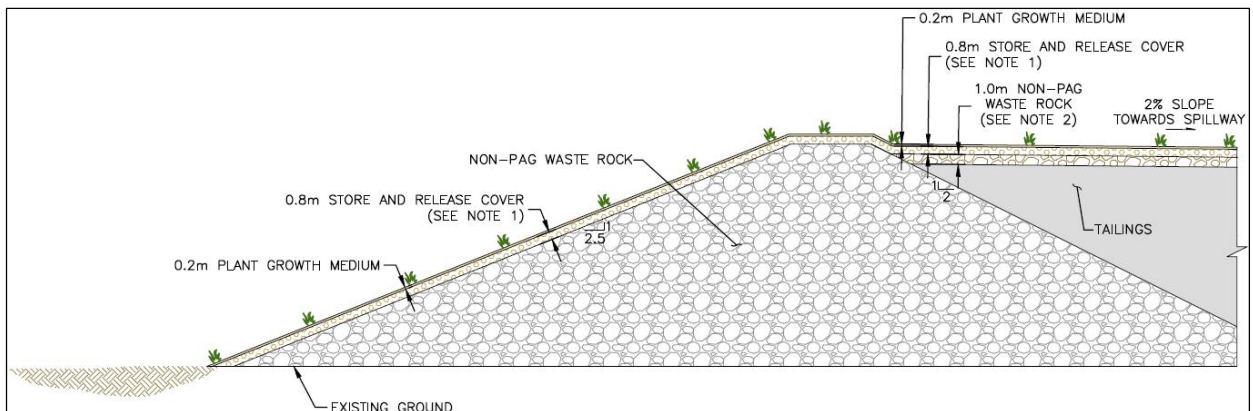


Figure 24-4 Tailings Storage Facility Closure Cover Design

24.3.4 Batman Pit Void

The Batman Pit will have an ultimate depth of 588m and surface area of 137ha. At closure the pit perimeter will be approximately 4,500m. The design of the pit includes 6m benches that are 12m high.

Conceptual water balance models indicate post-mining pit lake would be a terminal sink, with net evaporation from the pit exceeding the contributions from precipitation and runoff into the pit once a steady-state is achieved. Steady-state is indicated to be achieved 345 years after the cessation of pit

dewatering with an approximate steady-state elevation of 15m AHD. Active dewatering and pit water treatment will therefore not be required post closure (Chapter 11).

A safety bund will be constructed around the entire perimeter of the Batman Pit to impede human access. The safety bund will be constructed with a 5m base and 2m height with a 10m offset from the potentially unstable pit edge zone.

24.3.5 Process Plant and Pad Area

A new processing plant will be built at the current Process Plant and Pad Area. The current plant and pad area is approximately 35ha. It is not anticipated the area of disturbance will change significantly due to the construction of the new processing plant. Once processing ceases the process plant will be decommissioned, decontaminated, demolished and any reusable equipment and materials will be salvaged and resold.

Concrete foundations, walls, bridges and other non-reactive, non-combustive, non-corrosive and non-hazardous demolition waste will be broken up and:

- ▶ placed in the WRD; and / or
- ▶ buried in-place or backfilled against cutbanks and highwalls throughout the Process Plant and Pad Area, as well as other areas that will be reclaimed at Mt Todd.

The Process Plant and Pad Area will be graded to blend into the surrounding topography and drain towards Batman Creek. The Process Plant and Pad Area will be covered with a 0.8m cover layer of LPM and NAF waste rock, if AMD material is identified in the area. A 0.2m layer of PGM will then be applied. The PGM layer will be sown with native seed and ultimately revegetated.

Stormwater drainage controls and erosion and sediment controls will be designed and constructed to minimise erosion and channel scour.

Reclamation of the Process Plant area will also include closure of RP2 and RP5 in year 13 of mine operation. The closure of these retention ponds will include removal of sediments, cutting, folding and disposal of liners in place, and backfilling of the pond using surrounding material. The pond surfaces will be covered and revegetated as per the Process Plant and Pad Area.

Closure of RP2, RP5 and the equalisation pond (part of the proposed WTP system) will involve:

- ▶ removal of sediments;
- ▶ cutting, folding and disposal of liners in place; and
- ▶ backfilling of the pond utilising NAF material.

24.3.6 Low Grade Ore Stockpiles

LGO1 will be eliminated by expansion of the Batman Pit. Closure of LGO2 will include removal of residual ore from the stockpile areas with a nominal quantity of 100,000m³ remaining. LGO2 will be covered with a 0.8m cover layer of LPM and NAF waste rock. A 0.2m layer of PGM will then be applied. The PGM layer will be sown with native seed and ultimately revegetated.

Stormwater drainage, erosion and sediment controls will be designed and constructed to minimise erosion and channel scour.

The proposed closure cover design of LGO2 is illustrated in Figure 24-5.

24.3.7 Mine Roads

Mine access roads will remain in place to provide access to the area. Haul roads totalling 17ha will be closed by grading into surrounding topography and ripping subgrade materials. A 0.2m layer of PGM will then be applied. The PGM layer will be sown with native seed and ultimately revegetated. The proposed closure cover design of TSF1 and TSF2 is illustrated in Figure 24-6.

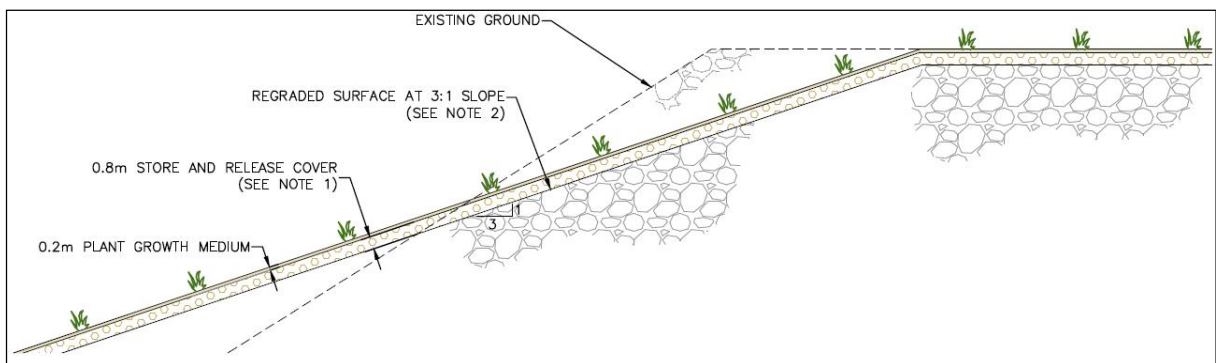


Figure 24-5 Low Grade Ore Stockpile Closure Cover Design

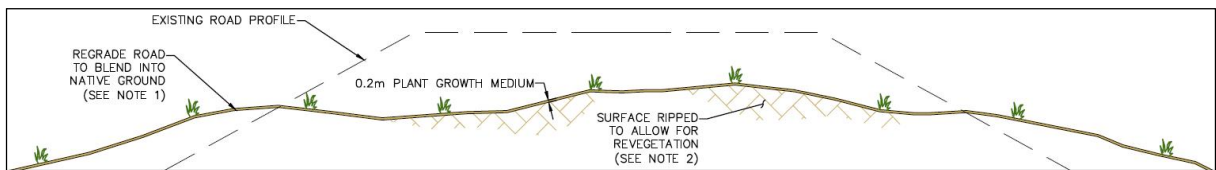


Figure 24-6 Haul Road Closure Cover Design

24.3.8 Design Summary

Table 24-1 provides a summary of closure and rehabilitation specifications described in Section 24.3.

24.3.9 Estimate Closure Costing

To minimise the financial and associated environmental risk around closure, it is important that the cost of closure and rehabilitation is understood and that a mechanism for funding exists. The current costing approach is detailed in Appendix Y. Closure costs are estimated at \$155 million. Annual reviews of security bond calculations will be undertaken.

Progressively rehabilitating the mine will reduce the environmental and financial risk of closure. Opportunities to reclaim facilities simultaneously with mining, i.e. concurrent reclamation will be investigated.

Table 24-1 Summary of Rehabilitation and Closure Approach

Task	Facility							
	Batman Pit	WRD	HLP	TSF1 & 2 Impounded Surface	TSF1 & 2 Dams	Process Plant and Pad	LGO2	Haul Roads
Surface of facility at cessation of production composed of NAF material		✓			✓			
Final overall slopes > 3H:1V	✓	✓			✓			✓
Final overall slopes < 3H:1V			✓	✓		✓	✓	✓
Benches created during construction	✓	✓			✓			
Install +1.0m thick layer of NAF material		✓						
Install 0.8m thick store and release cover			✓	✓	✓	✓	✓	✓
Install 0.2m thick PGM cover		✓	✓	✓	✓	✓	✓	✓
Revegetate with native seed mix			✓	✓	✓	✓	✓	✓
Install GCL Liner (with under and over layer of fines)		✓						
Install erosion and sediment controls		✓	✓	✓	✓	✓	✓	✓
Construct access restriction bund	✓							
Additional remedial measures (as necessary)	✓	✓	✓	✓	✓	✓	✓	✓

24.3.10 Reclamation Materials and Plant Growth Media

Reclamation materials utilised will include

- ▶ ROM NAF waste rock;
- ▶ imported low permeability materials;
- ▶ GCL;
- ▶ PGM from existing stockpiles;
- ▶ PGM salvaged from construction; and
- ▶ crushed NAF waste rock to supplement PGM.

PGM will be used as the top layer of reclamation cover for vegetation establishment. PGM will be obtained from existing stockpiles at the Mt Todd site, as well as through salvaging surficial soils within the footprints of new facility construction, including TSF2 and expansion areas of the WRD. The latter method will reduce the time soil is stockpiled and thereby maximise its viability to support vegetation.

As needed, NAF waste rock will be crushed and used as supplemental PGM. It is assumed that PGM from existing stockpiles, new salvage and crushed NAF waste rock will be of sufficient quality to facilitate plant growth and will not require any additional soil amendments.

Information on the volume requirement and availability of these materials is provided in Appendix Y.

24.3.11 Revegetation Approach

As part of risk management, as little vegetation will be cleared as possible. Revegetation will begin as soon as an area becomes available in order to give plants as much time to establish as possible. An area to be rehabilitated will be capped with un-reactive material followed by the addition of topsoil. The area will then be landscaped with “pitting”, to create pockets that will hold topsoil and water. This will then be seeded and treated with a low application of fertiliser if required.

Seeds will be of native plants where possible, and multiple applications of seed may be required to obtain the level of diversity required. This would involve beginning with grasses and small shrubs, and moving to larger plants and trees. A staggered application of types of plant will allow faster stabilisation of topsoil.

In order for rehabilitation to be successful, plants will be monitored and cared for initially to give them time to become established. Planting will also occur at the end of the dry season, to allow plants the entire wet season to become established.

Regular visual monitoring will be undertaken to identify whether further maintenance is needed in the form of additional seeding or weed management. Burning off will not be undertaken in established areas as it will be detrimental to new plants.

Class A and B weeds have been found on the mine site. Weed management will be tailored to identified weed species, and focus on ensuring they are at low levels. Adjacent roads and highways are weed infested, so control of weed colonisation is critical. Movement of weed species will be reduced by cleaning shoes and vehicles upon site entry.

Weeds will be monitored and their management will become part of the mines' EMP. Class A weeds will be eradicated and the growth and spread of Class B weeds will be controlled. Weed management focuses on gamba grass, mission grass, rubber bush and stinking passion vine.

24.4 Closure and Rehabilitation Planning

24.4.1 Life of Mine Closure Planning

All closure and rehabilitation planning considers the entire life of the mine, from pre-mining site preparation to final closure and rehabilitation. In line with standard practice, the Reclamation Plan and other aspects of closure and rehabilitation will be updated and refined throughout mining operations, to improve the level of detail, accuracy and scope of these plans. This process will continue up to approximately the end of mine operations so that the Reclamation Plan remains up to date and consistent with ongoing research.

24.4.2 Commitment to Research

The following will be undertaken to promote further development and refinement of the closure and rehabilitation plan:

- ▶ characterisation and analysis of waste and cover material hydraulic properties;
- ▶ tailings trafficability testing;
- ▶ improvement of the watershed hydrologic data collection system to enable an update of precipitation-yield characteristics of the site;
- ▶ development of a Tailings Management Plan;
- ▶ completion of the site-wide soils and closure cover materials inventory and characterisation to identify material sources, properties, and balance; and
- ▶ erosion and sediment control analysis.

Ongoing revegetation and weed management trials are also proposed to build on work conducted from 1989 to 1991 on spoil dumps in the Mt Todd area (NSR Environmental Consultants 1992a). Seeds from grasses and native trees were sown in 100-150mm of topsoil, and a small amount of general fertiliser. The trial also considered two slopes, 3H:1V and 50H:1V. Pitting was also carried out on some plots to investigate the effect of ground roughness.

The preceding commitments to further studies and investigations around closure and rehabilitation are reflected in the project-wide commitments (Chapter 23).

24.4.3 Developing Rehabilitation Completion Criteria

The final completion criteria for the site will be developed with the involvement of stakeholders closer to closure of the mine. They will be based on closure criteria recommended in legislation and the objectives mentioned in Section 24.2. Good completion criteria:

- ▶ represent acceptable environmental outcomes;
- ▶ realistic and feasible;
- ▶ based on baseline data; and

- ▶ quantifiable.

Table 24-2 shows an example of how these completion criteria can be formulated. Completion criteria will be developed and finalised as the Project progresses.

Table 24-2 Example Potential Rehabilitation Completion Criteria for Mt Todd Gold Mine

Goal	Objective	Indicator	Completion Criteria
Control existing acid-generating conditions	Groundwater and surface waters are uncontaminated	Groundwater and surface water monitoring	Groundwater and surface water quality outside the mine void is consistent with seasonal baseline data
Reduce or eliminate the acid and metal loads in seepage and runoff water		Suspension Peroxide Oxidation Combined Acidity & Sulphur testing included in groundwater and surface water monitoring	
Minimise adverse impacts to the surface and groundwater systems surrounding Mt Todd	Groundwater and surface water monitoring		

24.4.4 Contingency Planning

The closure and rehabilitation strategy will include plans and strategies for the Project is forced or otherwise unanticipated early closure. As a minimum, unexpected closure would result in the following:

- ▶ environmental audit of the entire site;
- ▶ review of the Care and Maintenance Plan; and
- ▶ submission of the reviewed Care and Maintenance Plan to relevant authorities for their information.

In order for this to occur, the Care and Maintenance Plan will include:

- ▶ Emergency Response Procedure;
- ▶ mine access and security review;
- ▶ geotechnical monitoring program to monitor stability of Batman Pit, the WRD, TSF1 and TSF2;
- ▶ program to address incomplete rehabilitation and remediation works; and
- ▶ environmental monitoring and inspection program, which includes:
 - license requirements;
 - chemical and hydrocarbon storage;
 - treatment plant condition;
 - pit water monitoring;
 - erosion monitoring; and
 - rehabilitation monitoring.

24.4.5 Knowledge Management

The closure and rehabilitation plan will also identify the location and responsibility of the filing and cataloguing of important documents. Documentation related to closure and relinquishment includes:

- ▶ operational documents;
- ▶ environmental documents; and
- ▶ stakeholder consultation documents.

24.4.6 Closure and Relinquishment

Vista Gold will ultimately close the Mt Todd Gold Mine and hand over commitments and responsibility to the Northern Territory Government. As a result, the successful closure would result in minimal to no ongoing management, and minimal ongoing monitoring.

Closure objectives and goals will be developed at a later date with stakeholders.

Unsuccessful closure could result in the site being left unsafe, unstable or continuing to impact the surrounding environment. This would result in a failure to meet completion criteria and therefore failure to successfully close the Project; which would mean that Vista Gold could not relinquish responsibility for Mt Todd back to the Northern Territory Government.