



ENVIRONMENTAL MANAGEMENT PLAN (EMP) FOR THE ARGYLE UNDERGROUND PROJECT

FLORA & VEGETATION MANAGEMENT PLAN



TABLE OF CONTENTS

1.	INTRODUCTION	3
1.1	PURPOSE.....	3
1.2	SCOPE.....	3
1.3	AREA	3
2.	DEFINITIONS	4
3.	DETAILS	5
1.4	DISTURBANCE AND CLEARING	5
1.5	GROUNDWATER DRAWDOWN.....	6
1.6	GROUNDWATER LEVEL RISES	6
1.7	REHABILITATION	7
1.8	MONITORING.....	7
4.	RESPONSIBLE PEOPLE	9
4.1	SUPERINTENDENT ENVIRONMENT	9
4.2	MANAGER PROCESSING PRODUCTION AND MANAGER MINING PRODUCTION	9
4.3	LONG TERM PLANNER.....	9
4.4	MANAGER MINE PLANNING AND TECHNICAL SUPPORT.....	9
5.	RELATED DOCUMENTS	10
5.1	MANAGEMENT AND OPERATIONAL PLANS	10
5.2	PROCEDURES AND WORK INSTRUCTIONS	10
6.	RECORDS MANAGEMENT	10
7.	APPENDICES	11



1. INTRODUCTION

1.1 PURPOSE

The management of flora and vegetation will be carried out in accordance with the documents listed in Section . The main objectives of flora and vegetation management are to:

- Minimise disturbance to vegetation communities and significant flora;
- Identify rare and priority flora species and ensure they are protected during the mining operation; and
- Reinststate self-sustaining vegetation communities and ecosystems on disturbed lands.

Management actions, which will ensure that these objectives are met, are outlined in Table B6-1 Flora and Vegetation Management.

1.2 SCOPE

This Management Plan includes actions to minimise the impacts of underground mining operations on vegetation and flora, particularly Declared Rare and Priority species during mining and closure operations. Responsibilities are allocated, with timelines for completion and performance targets. Rehabilitation of flora and vegetation is covered in 5 Rehabilitation Management.

1.3 AREA

Argyle mining lease and miscellaneous licences.

2. DEFINITIONS

Flora	Flora refers to the plant species native to or adapted to a particular region or habitat.
Vegetation	Vegetation refers to communities of plants such as woodlands, sedgeland and grasslands.
Declared Rare Flora	The Minister for the Environment may declare species of protected flora to be "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection.
Priority Flora	<p>There are many species of Western Australian flora that are known from only a few collections, or a few sites, but which have not been adequately surveyed. Such flora may be rare or threatened, but cannot be considered for declaration as rare flora until such surveys have been undertaken. These species are included on a supplementary conservation list called the Priority Flora List.</p> <p>There are three categories of priority flora covering these poorly known species. The categories are arranged to give an indication of the priority for undertaking further surveys based on the number of known sites, and the degree of threat to those populations. A fourth category of priority flora is included for those species that have been adequately surveyed and are considered to be rare but not currently threatened.</p>

3. DETAILS

The mine is located in the Northern Botanical Province, within the Hall Botanical District. A total of 466 vascular plant species and 29 vegetation communities have been recorded on the Argyle lease.

Surface infrastructure and facilities for the Project will be constructed on land that has already been disturbed by mining activities. The main additional areas of disturbance are for the TSF2 and RCP3, which is 126 ha, and 133 ha, respectively.

The flora and vegetation of the areas proposed for the Project facilities was surveyed and 206 taxa from 124 genera and 51 families of vascular plants were recorded (Mattiske, 2004a). The vegetation is analogous to those communities on the rest of the mine lease, with one exception, the "HG3" Woodland that differs by having a dominant *Terminalia canescens* over storey. However, there are no species or vegetation communities restricted to this area or that are at risk due to the Project (Mattiske, 2004a).

No Declared Rare Flora Species pursuant to the Wildlife Conservation (Rare Flora) Notice 2004 under Subsection 23F(2) of the Wildlife Conservation Act Schedule 1 or the EPBC Act, 1999 have been recorded in the areas required for the Project. Nor have any threatened ecological communities pursuant to Schedule 2 of the EPBC Act, 1999 been recorded in the area.

Several priority species (CALM, 2004) occur on drainage lines south of the mining operations and may potentially extend into some of the watercourse areas. Six of the vegetation communities mapped in the area proposed for the new TSF2 (Mattiske, 2004a), and presented on Figure B6-1, may be influenced by changes in soil moisture levels as they occur in flow lines, creeks and other areas dependent on ground and surface water.

The aspects and potential impacts of the Project that may affect flora and vegetation are:

- Disturbance and clearing for the construction of infrastructure and during operations;
- Changes to the groundwater table, either through drawdown from dewatering for the underground or from groundwater levels rises from seepage and modification of drainage; and
- Changes to surface hydrology.

Management of these aspects of underground mining and their potential impacts on flora and vegetation are described in the following sections.

1.4 DISTURBANCE AND CLEARING

The site induction is provided to all new employees and contractors and contains reference to minimising land disturbance by using existing roads and tracks. It also states that clearing of vegetation will be limited to areas required for mining, sampling, borrow pits, firebreaks and construction. If clearing is necessary then a Clearance Permit will be obtained from the Environment Section following the Argyle Land Clearance Guidelines (Argyle, 2003m), which outlines the process for obtaining permission to clear land on site.

The area identified for clearing to construct the proposed TSF2 (126 ha) and RCP3 (133ha) does not contain any Declared Rare or Priority flora neither any Threatened Vegetation Communities. Alluvial mining has already disturbed a proportion of the proposed areas, although most of the disturbed area has been rehabilitated. The vegetation communities to be cleared for the new TSF2 and RCP3 are well represented throughout the surveyed areas of the site.

The growth medium recovered from constructing these facilities will be stockpiled in an appropriate location. Wherever possible growth medium and mulched vegetation from clearing operations will be

used immediately for rehabilitation works.

1.5 GROUNDWATER DRAWDOWN

Groundwater drawdown may impact plant species that are dependent on water directly, or indirectly through soil moisture. Riparian and wetland vegetation may be directly dependent on groundwater levels. Changes to soil surface moisture may influence the capacity of plants to establish and persist in different environments.

Studies were undertaken on the environmental water requirements of the vegetation at the site and it was observed that many species were dependent on soil moisture rather than free water (Muir, 2002). One example of the change to vadophytic species has occurred near Limestone Creek and Gap Creek where there have been changes in water levels near the creekline, which has resulted in shifts in the local tree species (Muir, 2002; Mattiske, 2003a and b).

Dewatering for the AK1 open cut mine has lowered the local groundwater level around the pit and surrounds and will continue to do so whilst dewatering continues. If the underground mine is developed, the drawdown area is predicted to further expand outward and along the east and west ridge lines for distances of around 4 and 7km, respectively, beyond the pit crest and in a southward direction for 1-2 kilometres south of the pit. Drawdown will also expand northward at a distance of around 2 km this lesser zone of influence is due to the presence of lower conductivity strata and the recharging effects of Gap Dam. Groundwater drawdown is described in more detail in the Groundwater Management Plan.

Dewatering drawdown may impact on vegetation at permanent springs, as they are dependent on the water table. Any decline in water supply to these springs may result in colonisation by more drought-tolerant species (Muir, 2002). This may be evidenced as gradual changes in plant community composition, or sudden and extensive mortality. Groundwater levels and vegetation that may be at risk due to groundwater level drawdown is located near Devil Devil Spring, which has already been impacted. Vegetation at Gap Dam, Smoke Creek and parts of Limestone Creek may also be impacted as a result of groundwater changes.

Wesley Spring may have a number of source areas since it is located on the confluence of a number of Wesley Spring Creek tributaries. The Spring appears to be sustained through the damming of creek flows behind a prominent quartz ridge situated on Wesley Flats. Seepage to Wesley Spring Creek is likely sourced from elevated groundwater storage on the West Ridge, which is depleted during the dry season. Bank seepage and surface flows have also been observed to feed the spring from the southwest following the wet season. Any decline in water supply to the spring may result in a loss to phreatophytic species and some xerophytic and vadophytic species (Muir, 2002). However, the spring has not been affected by the existing dewatering operations for the open cut pit and it is predicted that underground dewatering is unlikely to have any impact on it either (B1 Groundwater Management Plan). Dewatering drawdown is unlikely to affect vegetation communities on the hills, ranges and low spurs (Mattiske, 2004a).

Groundwater management will be in accordance with the Groundwater Management Plan. The measures include restricting groundwater abstraction to that required for safe and effective mining and within the allocated limits, and implementing extensive groundwater monitoring.

1.6 GROUNDWATER LEVEL RISES

Water logging and inundation of vegetation has occurred in some areas on the mine lease as a result of groundwater level rises and modified surface water drainage. These areas, in effect become permanent to ephemeral wetlands and support wetland vegetation such as the Bulrush (*Typha domingensis*) and

other semi – aquatic species. Groundwater levels may increase due to increased drainage into an area or from water mounding near TSF's, WRD's and dams.

The established database on species and communities will be maintained and expanded and will include the different tolerances of these respective species and communities to changes in soil moisture regimes. This will assist in the development of consistent, focused and comprehensive monitoring systems.

The location of the proposed new TSF2 is downstream of the existing TSF1 and the construction of the second TSF presents an opportunity to minimise seepage and inundation of the lower lying areas and watercourses.

Additional groundwater and vegetation monitoring sites will be established where ground and surface water issues may arise. More detailed consideration of these issues is included in Groundwater Management Plan and the Surface Water Management Plans. Monitoring data will be included in the AER during operations. Where vegetation is impacted by elevated water tables remedial actions will be evaluated and implemented where practical. Measures may include pumping and drainage earthworks.

1.7 REHABILITATION

Rehabilitation is discussed in greater detail in 5 Rehabilitation Management Plan, however the primary aim is to develop safe and stable decommissioned landforms that support self-sustaining ecosystems. The flora and vegetation will comprise native local provenance species collected as seed from within a 100 km radius of the mine site. Closure criteria are still being formulated however vegetation community structure and diversity will emulate analogue sites suitable for the created soil profile and drainage.

1.8 MONITORING

Vegetation monitoring sites have been established and are monitored on the Lease Area in a range of valley systems flats and gullies. Some of these sites, particularly those along the creeks and near the springs can be used to identify changes in vegetation due to surface or groundwater flow (See Figures B6-2, B6-3. and B6-4 of the Environmental Protection Statement (EPS)). The monitoring programme may be expanded to include a greater number of sites, possibly at Smoke Creek, beyond the rehabilitated alluvial areas, and downstream from the new TSF2.

A vegetation monitoring trial was established in the Wesley Spring area in 2003 as a baseline to identify any impacts of water drawdown on the vegetation. A series of transects were established and baseline data recorded to provide information on types and health of the vegetation in each transect (Bennett, 2003). These sites will be monitored on a triennial basis and on an as needed basis if observations indicate rapid changes.

The species and communities database will be maintained and expanded to include evaluations of plant species and communities tolerance to changes in soil moisture. This will assist in the development of consistent, focused and comprehensive monitoring systems.

Groundwater levels and water quality are monitored at more than 112 groundwater monitoring bore at 80 sites on the Lease Area. Additional monitoring bores were installed in 2003 to provide further groundwater baseline data for dewatering operations for the exploratory decline and the proposed underground mine. These included two bores in proximity to Devil Devil Spring, six bores near Wesley Spring, three bores located to the west along the Matsu Range, and deeper bores adjacent to Bores 21 and 59. Further bores may be established if vegetation changes indicate further monitoring is required. All monitoring data and analyses will be reported in the AER.



4. RESPONSIBLE PEOPLE

The following people are responsible for actions to manage Flora and Vegetation:

4.1 SUPERINTENDENT ENVIRONMENT

The Superintendent Environment will ensure that areas proposed to be cleared are inspected prior to clearance approval and after pegging out; and that the Land Clearance Guidelines and Topsoil Management Procedure have been followed accordingly. The Superintendent Environment will ensure that the requirement to minimise disturbance on site is retained in induction presentations and is periodically covered in posters and presentations. The Superintendent Environment will ensure that water quality; levels and vegetation communities are monitored in areas potentially impacted by the Project.

4.2 MANAGER PROCESSING PRODUCTION AND MANAGER MINING PRODUCTION

The relevant Manager is responsible for clearing of areas required for new facilities such as the proposed TSF2, RCP3 and WRD extensions and will ensure that the operation complies with the Land Clearance Guidelines and Topsoil Management Procedure.

4.3 LONG TERM PLANNER

The Long Term Planner is responsible for estimating the volume of growth medium recoverable from the proposed clearing operation and thus the area required for topsoil stockpiles. The Long Term Planner is also responsible for determining a suitable location for growth medium that will minimise erosion and loss due to exposure to adverse conditions, but that will be within close proximity to areas to be progressively rehabilitated.

4.4 MANAGER MINE PLANNING AND TECHNICAL SUPPORT

The Manager Mine Planning and Technical Support is responsible for investigating measures to reduce groundwater levels in areas where remedial works are feasible and for liaising with other departments to schedule progressive rehabilitation.

5. RELATED DOCUMENTS

5.1 MANAGEMENT AND OPERATIONAL PLANS

- Nil

5.2 PROCEDURES AND WORK INSTRUCTIONS

- Nil

Flora and vegetation research references and other background documents are listed in Part C References of the Environmental Protection Statement (EPS).

6. RECORDS MANAGEMENT

As subsequent revisions of this document are carried out, previous versions are retained within DM5 for records management purposes in accordance with the **Management of Controlled Documents Procedure #AD-226750**.

7. APPENDICES**7.1 TABLE: FLORA AND VEGETATION MANAGEMENT**

Action	Issue	Objective	Management Action	Timing	Responsibility	Target	Work Instruction - Procedure
B.6.1	Clearing and disturbance of flora and vegetation.	To ensure that clearing and disturbance of flora and vegetation is minimised.	The Land Clearance procedure is implemented prior to any land disturbance. Survey and peg land prior to clearing. Inspect clearing operations during operations to ensure adherence to pegged area. Review Land Clearance guidelines.	Ongoing Ongoing Ongoing Annually	Relevant Manager Superintendent Environment	All clearing conducted in accordance with the Land Clearance guidelines. Land Clearance guidelines are reviewed.	Argyle Land Clearance Guidelines (Argyle, 2003m).
B.6.2			Ensure requirement to minimise land disturbance is presented in Site Inductions. Provide information about minimising land disturbance in environmental posters	Ongoing	Superintendent Environment	Personnel are aware of need to minimise disturbance.	Nil
B.6.3	Inadequate growth medium material for rehabilitation operations.	To ensure retention and management of growth medium.	Estimate volumes of growth medium salvageable from areas to be cleared. Locate suitable stockpiling areas for growth medium. Remove between 200-300 mm of growth medium during clearing for the Project and store appropriately according to procedures.	Ongoing	Superintendent Environment	Quantity of growth medium estimated (based on area to be cleared and depth) is stockpiled in areas not subjected to inundation, erosion or mechanical disturbance.	Topsoil Management Procedure (Argyle, 2001c)



Action	Issue	Objective	Management Action	Timing	Responsibility	Target	Work Instruction - Procedure
B.6.4	Impact of groundwater drawdown on vegetation.	To minimise the impact of groundwater drawdown on vegetation.	Monitor groundwater levels, particularly near vulnerable vegetation communities. Report monitoring data and an analysis of impacts of drawdown on vegetation to Government through the AER.	Ongoing	Superintendent Environment	Analyse groundwater levels and determine whether drawdown has impacted the vegetation.	Procedure for Measurement and Monitoring (Argyle, 2004f)
B.6.5			Establish new vegetation monitoring sites at springs and low lying areas downstream of the new TSF2.	As required	Superintendent Environment	Vegetation-monitoring sites are established where drawdown impacts are noted or are likely based on declines in groundwater levels.	Nil
B.6.6	Impact of groundwater drawdown on vegetation.	To minimise the impact of groundwater drawdown on vegetation.	Monitor vegetation transects at Wesley Spring. Analyse data and compare with water level and quality data.	Triennially	Superintendent Environment	Triennial data are obtained, analysed and reported in AERs.	Nil
B.6.7	Impact of groundwater level rises on vegetation.	To locate where groundwater level rises have or may impact flora and vegetation and manage the impacts.	Monitor vegetation communities adjacent to TSFs, WRDs and other areas likely to be affected by groundwater level rises.	Annual	Superintendent Environment	Areas likely to be affected by groundwater level rises are mapped and monitored.	Nil



APPENDICES

Action	Issue	Objective	Management Action	Timing	Responsibility	Target	Work Instruction - Procedure
B.6.8	Impact of groundwater level rises on vegetation.	To locate where groundwater level rises have or may impact flora and vegetation and manage the impacts.	Assess possible restorative actions (eg: drainage and pumping) where rising groundwater levels are affecting vegetation.	As required		Groundwater levels are reinstated or improved where feasible.	Nil
B.6.9			Assess engineering (drainage and pumping) measures to reduce groundwater levels where possible.	As required and during decommissioning.	Superintendent Environment		Nil
B.6.10	Impact of contaminated water on flora and vegetation	To minimise the impact of contaminants in ground and surface water on flora and vegetation.	Monitor water quality and impacts on vegetation.	Ongoing	Superintendent Environment	No impacts on vegetation due to contaminants in water.	Groundwater MP, Surface Water MP, ARD MP
B.6.11	Rehabilitation of disturbed lands.	Successful rehabilitation	Rehabilitate disturbed areas in accordance with Life of Mine Rehabilitation Schedule.	Annual	Manager Planning and Technical Support	100% of scheduled annual rehabilitation completed.	5 Rehabilitation MP.

