CD915 Integrated Mining and Rehabilitation Plan

Happy Valley Mineral Sands Project

Document Reviewed by Strategen

August 2009

CD915 Integrated Mining and Rehabilitation Plan

Happy Valley Mineral Sands Project

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Suite 7, 643 Newcastle Street Leederville WA
ACN: 056 190 419

August 2009

Disclaimer and Limitation

This report has been prepared for the exclusive use of the Client, in accordance with the agreement between the Client and Strategen ("Agreement").

Strategen accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any person who is not a party to the Agreement.

In particular, it should be noted that this report is a qualitative assessment only, based on the scope of services defined by the Client, budgetary and time constraints imposed by the Client, the information supplied by the Client (and its agents), and the method consistent with the preceding.

Strategen has not attempted to verify the accuracy or completeness of the information supplied by the Client.

REVISION STATUS RECORD

Controlled Document:		**CD915**	
Document Title:		**IMRP – Happy Valley Project**	
Version	Issue Date	Reviewed by	Copies To
0	August 2008	Bemax	Internal
1	August 2008	Bemax	Bemax, EPA
2	September 2008	Bemax	
3	December 2008	Bemax, Strategen	
4a	March 2009	Bemax, Strategen	
5	April	EPA	
6	July 2009	Bemax/ Strategen	EPA/ DEWHA
7	August 2009	BEMAX/ Strategen	EPA/ DEWHA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 PURPOSE

The purpose of this Integrated Mining and Rehabilitation Plan (IMRP) is to describe the strategies and procedures that will be implemented by Bemax Resources Pty Ltd (Bemax) as per the rehabilitation commitments of the Happy Valley Mineral Sands Project.

The document has been prepared in accordance with the guidelines published by the Environmental Protection Authority (EPA 2006) and addresses the rehabilitation commitments provided in the Environmental Scoping Document for the proposal (Strategen 2007) and the subsequent Environmental Review and Management Program (Strategen & Bemax 2009).

1.2 SCOPE

The IMRP applies to the following areas and activities:

- the rehabilitation of areas, both vegetated and cleared, disturbed by the mining proposal
- the revegetation of identified abandoned gravel quarries in state forest
- the enhancement, management and protection of native vegetation within the mining tenements that will not be directly affected by the proposal
- performance monitoring, compliance auditing and the reporting of both.

1.3 CONTENTS

The IMRP contains the following information.

Environmental setting (Section 2)

The baseline information on the environment of the Happy Valley minesite and surrounds is presented in this section, to provide context to the rehabilitation program, its objectives and the constraints it faces. The information is grouped as follows:

- landforms and landscape elements, including drainage and topography
- landuse
- soils, soil profiles and groundwater
- vegetation distribution, patterns (communities), condition and taxa
- fauna and habitat.

Note that the IMRP applies only to the management of environmental factors associated with rehabilitation and final land use. Other environmental factors, such as Aboriginal heritage, water resources, radiation, greenhouse gases and visual amenity, are managed under the project Environmental Management and Monitoring Plan (EMMP and therefore are not detailed within this document.

Management objectives and key constraints (Section 3)

Part 1 of this section presents the final landuse plan, with standard and specific objectives that the IMRP is committed to pursuing. Subordinate to these objectives are the proposed completion criteria for the biotic and abiotic factors of the Happy Valley site. The proposed completion criteria have been developed to track progress towards the rehabilitation objectives.

Part 2 of this section describes the significance of limitations to successful rehabilitation (i.e. constraints) and how these limitations will be minimised over time through a number of targeted continuous improvement programs, including research and development efforts.

Implementation strategy (Section 4)

This section is the working end of the IMRP and includes prescriptions, responsibilities and implementation timeframes (schedules) for:

- mine and rehabilitation planning
- protection and enhancement of riparian corridors and other ecological linkages
- pre-clearing and clearing
- vegetation translocation
- topsoil and overburden management (removal, storage and return)
- stockpile management, including stabilisation and use as visual and noise screens
- soil profile reconstruction
- perimeter fencing
- deep ripping
- species lists and propagation methods
- erosion control
- vermin control
- dieback, weed and fire management
- fauna habitat restoration
- contingency measures.

The list of aspects addressed in this section is derived from the Environmental Scoping Document (Strategen 2007) and EPA Guidance No. 6 (2006).

Monitoring and reporting (Section 5)

The IMRP includes key performance indicators and monitoring schedules for obtaining the information necessary to assess performance and progress towards the desired end points. An audit program to track compliance with prescriptions and other management measures has been prepared. An external reporting strategy is also described in this section. The Bemax operation-wide Environmental Management System (EMS) includes procedures for review and continuous improvement of environmental performance. These procedures are summarised and specific,

additional review and improvement measures are also described, including research and development, change management and incorporating stakeholder inputs.

1.4 RELATIONSHIP TO ENVIRONMENTAL MANAGEMENT SYSTEM

Bemax operates in accordance with its Environmental Management System (EMS), which is certified in accordance with AS/NZ ISO 14001:2004. The purpose of the EMS is to ensure that company policy requirements relating to the environment are fulfilled and progress is made towards corporate environmental objectives. The EMS includes a framework for identifying environmental risks, applying appropriate controls and monitoring implementation and effectiveness. The EMS also includes continuous improvement programs to achieve key environmental objectives and targets.

Subordinate to the EMS is an extensive array of procedures, documents and work instructions for all aspects of the Bemax operations, including workforce training, document control, emergency preparedness, performance monitoring and review, and roles and responsibilities of staff and contractors.

This management plan is a directory to those EMS documents associated with rehabilitation. It also provides the objectives for mining and rehabilitation that must be adhered to when preparing or modifying EMS documents that relate to rehabilitation.

1.5 RELATIONSHIP TO OTHER DOCUMENTS

The ERMP outlines the background setting of the proposal and characteristics of the natural environment in the proposal area and surrounds. Preparation of the ERMP enabled identification of environmental risks that are manageable under this document. Rehabilitation experience gained from Bemax's previous minesites has been considered in the development of the document.

2. ENVIRONMENTAL SETTING

2.1 INFORMATION FRAMEWORK

The information presented in this section is for basic contextual purposes only. Readers are referred to specific studies and publications for in-depth information for specific elements of the environmental setting. Alternatively, Volume 1 of the Happy Valley Environmental Review and Management Program (ERMP) may be consulted for a more detailed synthesis and overview of relevant baseline environmental information.

2.2 LOCATION AND MINE PLAN

Bemax Resources Limited (Bemax) proposes to develop, mine and rehabilitate two deposits of titanium mineral ore along the Whicher Scarp, in the Locality of Gwindinup within the Shire of Capel, as shown in Figure 1. The proposal follows on from the existing Gwindinup Titanium Mineral Project, which is situated along the base of the escarpment, down-slope of the Happy Valley deposits.

2.2.1 Location

The proposal is located within the Shire of Capel, approximately 25 km south south-east of Bunbury and 10 km south of the town of Boyanup. The ore body designated as Happy Valley North (HVN) intersects Gavins Rd, while the Happy Valley South (HVS) ore body is located approximately 2 km south of Gavins Rd. The Happy Valley deposits are located approximately 500 m east of the Gwindinup South deposit and approximately 700 m south of the Gwindinup North deposit.

2.2.2 Land use and tenure

The mineral deposits are located across private land and the Argyle State Forest, and will necessitate the clearing of 155 ha of native vegetation, of which 63 ha will be within State Forest. The mining tenement details are provided in Table 1 and indicated in Figure 2.

2.2.3 Scales and assessment areas

Regional scale

Keighery et al. 2008 divide the Whicher Scarp[1] into three sectors: West, Central and North. The Happy Valley proposal is located in the North Whicher sector, which is described by Keighery et al. 2008 as:

> "North-west facing slopes, steepest slopes [of Whicher Scarp], laterite capping lowest in landscape, large area [of] associated foothills, ironstone surfaces on adjacent Swan Coastal Plain. Includes:

[1] Keighery et al. 2008 broadly define the Whicher Scarp by the Whicher Scarp soil-landscape system of DAWA, but acknowledge that Whicher Scarp vegetation can extend on to the Swan Coastal Plain and up into the Blackwood Plateau (p11)

Abba, Capel, Preston and Ferguson Rivers; Abba, Happy Valley, Argyle, Donnybrook, Boyanup and Dardanup forests. Large areas of public land centred on the five forest areas." (p. 6)

The North Whicher sector, as defined above, has been used as the basis for regional assessments in the ERMP.

Local scale

The assessment of the potential environmental impacts of the Happy Valley proposal and their management on local landforms and populations of flora, vegetation communities and fauna is complicated by the complexity of the landscape and position of the proposal across the interface of two bioregions: the Swan Coastal Plain and the Blackwood Plateau. However, it is generally recognised that the majority of variation in abiotic and biotic characteristics of the area follows the gradient from the plateau to the coastal plain below. Accordingly, studies commissioned or conducted by Bemax have focussed on the east-west axis for variability (typically as transects) and north-south axis for extent (as repeating patterns).

Local studies have largely restricted themselves to the mining tenements of the Happy Valley deposits (identified as the proposal area), while several studies have included the nearby Gwindinup tenements or adjacent state forest, road reserves and private property (where access permits). The study area of investigations that go beyond the proposal area are described in the relevant section.

Table 1 Tenement and cadastral details of the proposal

Deposit	Tenement	Land tenure
Happy Valley North	M70/901	State Forest (Argyle block)
	M70/479	Loc 215 (accessed by agreement) and road reserve
Happy Valley South	M70/899	Loc 4965, Loc 4485 and Loc 3829 (all owned by Bemax)
	M70/900	State Forest (Argyle block)

2.3 LANDFORMS

2.3.1 Information sources

A number of studies have been commissioned to assess the landforms of the proposal area, including:

- *Gwindinup Project - Dewatering Assessment* (Aquaterra 2005)
- *Supplement to the Gwindinup Consultative Environmental Review* (Cable Sands (WA) Pty Ltd (Cable Sands) 2003)
- *Gwindinup Vegetation Assessment* (Environmental Survey and Management Pty Ltd (ESM) 1998)
- *Gwindinup Landforms, Vegetation and Flora* (ESM 1999)
- *Dewatering Assessment, Happy Valley Mineral Sands Operation* (Parsons Brinkerhoff (PB) 2008)
- *Topsoil investigation, Happy Valley mining tenements* (Strategen 2007).

In addition to the commissioned studies listed above, other relevant resources were utilised in the assessment of landscape values within the proposal area, as listed in Appendix 1.

2.3.2 Key landscape features

Generally, the landscape consists of a number of typically localised features that are readily identifiable, within a mosaic that reflects the transition between upland lateritic crests and the foothills of the lower slopes. The role of the drainage lines in transporting fluvial materials is also dominant.

The aerial extent of the key surface features is shown in Figure 3 and related to geological cross-sections shown in Figure 4 to Figure 5.

Table 2 Key landscape features and their characteristics

Landscape feature	Location	Soil/landform characteristics
Upland laterite ridges and crests	Upslope areas (higher than ~110 mAHD) to the east of mineral sands deposits. Dominant feature	Surface expression of the laterite sheets and gravels of the Blackwood Plateau system/Kingia sub-system. Well-structured clayey sands and mottled sandy clays underlie the laterite and gravels, with plant roots recorded to 8 m (Cable Sands 2003).
Upland shallow sands over laterite	Upslope areas (higher than ~110 mAHD) to the east of mineral sands deposits. Exists in several localised areas	Shallow, highly leached grey sands over sandy clays over massive laterite at a depth of 2 m, with a saturated zone 0.8 – 2.0 m below the surface and impeded drainage.
Mid-slope gravel ridges	Midslope areas, as distinct from upland crests	Isolated lateritic outcropping soils within Whicher formations, similar to Kingia sandy gravels, but with massive brown-yellow sandy clay loam underlying the sandy gravel. Occasional mottles to a depth of at least 6 m, of very low permeability.
Yellow sandplain	Down-slope and adjacent to the shallow and surface lateritic crests	Well-oxidised pale yellow-grey to orange sands (2 – 5% clay), up to 5 m deep, overlying massive laterite that slopes from east to west and also from north to south. Topsoil is typically very thin (~20 mm) and poorly structured, containing numerous roots. High hydraulic conductivity. Gravel content is variable and seemingly independent of the overall depth to laterite.
Foothills and lower slopes	This landscape feature does not have a well-defined boundary; generally defined by prevalence of grey sands and gravelly sands in the upper soil profile, and also elevation and slope	Grey sands and gravelly sands in the upper soil profile, growing paler with depth. High hydraulic conductivity. Occasional lateritic boulders outcropping along the lower west-facing slopes (approx 90 mAHD) and along steep valley walls. Topsoil layer can be quite well defined and thick (up to 300 mm), with abundant roots and high organic carbon, or thinner (<50 m) and paler in other areas.
Drainage lines	Not well defined in the landscape by abrupt changes in soil characteristics, or by vegetation; typically identified by a trend from brown sandy loams to grey sands	Mixture of brown sandy loams and grey sands, with a substrate of silty, gravelly sands, as opposed to laterite or clay, as might be expected.
Wet flats	Lower slopes, downstream of drainage lines	Broad, seasonally wet flatlands of pale sandy colluvium, overlying gravels and yellow-brown clay loam

2.4 SOILS

2.4.1 Information sources

Landforms and soils of the proposal area have been mapped at a regional scale by several authors, including Tille (1996) and Churchward and McArthur (1980). The recognised current regional mapping dataset (which is based on the work of these and other authors) is *Soil and Landscape Zones*

of the Southwest of Western Australia (DAFWA-006), which is administered by the Department of Agriculture and Food (DAWA). The 1:100 000 scale soil-landscape mapping is a combination of soil types and landscape components.

Local soil studies conducted for the ERMP are:

- *Gwindinup – Vegetation and Soils* (ESM 1999)
- topsoil mapping and soil profile investigations (internal reports) by Strategen and Bemax (2007-2008).

2.4.2 Soil units

The soils map for the proposal area (Figure 6) is based on ESM (1999) and shows a catenary sequence of upland lateritic soils (Kingia subsystem) through gentle midslope duplex soils (Whicher Valley and Rosa subsystems) down to the low foothills and sandy flats (Cartis land unit). In addition, several small localised features or characteristics have been identified:

- occasional, localised shallow sheets of grey-brown sand overlying broad laterite horizons within the Kingia Subsystem, sometimes containing seasonal perched water (concave landform with impeded drainage) with vegetation markedly different to that of the surroundings
- the highest ridges of the Whicher Subsystem that extend out onto the Whicher Scarp are very similar to the geology and vegetation of the slightly higher ridges and crests of the Kingia subsystem, although the two are typically discontinuous.

2.4.3 Topsoils

To facilitate the on-ground mapping of vegetation communities, three datasets were generated:

- depth to laterite (including outcropping)
- saturated areas
- upper soil classification.

Data was derived from the results of hand-augering to a depth of 1 m on the following grid within the Happy Valley tenements:

- every 125 m for areas of native vegetation within the proposed disturbance footprint
- every 250 m for areas of native vegetation outside of the disturbance area.

For the 'depth to laterite' data set, results from the Bemax exploration database were also incorporated.

Topsoils in proposed disturbance area

The datasets indicate three archetypal soil systems and one transitional system, which is a mosaic and/or combination of the three archetypes, being:

- shallow (typically grey or pale yellow) sands over laterite/laterite outcrops, on upper flats and crests (**Kingia unit**)

- deep (2 – 6 m) yellow to orange sands over laterite on upper slopes (**yellow sandplain unit**)
- deep (1+ m) grey sands on lower slopes and foothills (**foothills unit**).

The transitional soil system consists of a combination of grey and pale yellow sands and sandy gravels, over laterite (1 – 3 m depth) on upper and mid-slopes (**Whicher unit**). A fourth soil unit consisting of shallow pale grey sands over laterite associated with drainage lines and/or areas of impeded drainage was also recorded, but this unit will not be significantly affected by the proposal.

The disturbance area contains very little of the foothills unit, and disturbance is limited to clearing for infrastructure.

2.5 VEGETATION

2.5.1 Information sources

A number of studies have been commissioned to assess the vegetation values of the proposal area and surrounding remnants and state forest, including:

- *Gwindinup Landforms, Vegetation and Flora* (ESM 1999)
- *Vegetation Units - Gwindinup Mineral Sands Project* (Bennett 2003)
- *Flora and Vegetation of the Happy Valley Mining Leases* (Bennett 2006)
- *Numerical Analysis of Floristic Data from Vegetation Recording Sites, Happy Valley Western Australia* (Griffin 2008)
- *Flora and Vegetation - Selected Areas Happy Valley* (Bennett 2007)
- *Phytophthora Occurrence Gwindinup South* (Glevan Consulting 2008)
- *Gwindinup Mineral Sands Mine Consultative Environmental Review* (Cable Sands 2000)
- *Review of Happy Valley Vegetation Mapping and Vegetation Units, Parts I and II* (Ekologica 2008).

In addition to the commissioned studies listed above, other relevant resources were utilised in the assessment of vegetation values within the proposal area, as listed in Appendix 1.

2.5.2 Regional classification and mapping

Vegetation complexes

Landform-vegetation complexes (Heddle et al. 1980, Mattiske & Havel 1998) are based on the pattern of vegetation at a regional scale (1:250,000), reflecting the key determining factors of landforms, soils and climate. The four vegetation complexes within the proposal area are described in Table 3, along with the remaining extent of each.

Table 3 Vegetation complexes of the proposal area (after Mattiske & Havel 1998)

Complex	Description	Extent
Whicher Scarp Valleys (WCv)	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* with some *Xylomelum occidentale* on valleys dissecting escarpment in the humid zone	55% remaining 7% reserved
Whicher Scarp uplands (WC)	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on escarpment with some *Corymbia haematoxylon*, *Banksia attenuata* and *Xylomelum occidentale* in the humid zone	75% remaining 15% reserved
Cartis (Cs)	Low open forest of *Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* and *Corymbia haematoxylon* with some *Banksia attenuata* and *Xylomelum occidentale* on escarpment slopes	20% remaining 0 reserved
Rosa (Ro)	Woodland to open forest of *Corymbia calophylla* - *Eucalyptus marginata* subsp. *marginata* - *Xylomelum occidentale* on slopes and tall shrubland of *Agonis linearifolia* in valley floors in the humid zone	79% remaining 20% reserved

Whicher Scarp floristic communities

Keighery et al. (2008) classified the vegetation of the Whicher Scarp based on numerical ordination of 114 plots. They identified eight regional floristic groups and numerous sub-groups or community types.

Ordination undertaken by Griffin (2008) using vegetation data from 61 plots sampled by Bemax (Bennett 2006, 2007) identified that the significant majority of those plots within the proposed disturbance area shared similarities with the Whicher Floristic Group C: *Whicher Scarp woodlands of coloured sands and laterites* of Keighery et al. 2008, with many of these plots being specific to the sub-group/floristic community type C2. Three Bemax plots shared some similarities with floristic community type B1. Vegetation remnants on Lot 215, which has not been sampled, is likely to align with floristic community type C3. The descriptions for these groups designated by Keighery et al. 2008 are provided below in Table 4.

Table 4 Whicher Scarp floristic community types of Keighery et al. 2008 likely to be in proposed disturbance area (based on Griffin 2008)

Whicher Floristic Community Type of Keighery et al. 2008	Bemax plots within disturbance area	Conservation status of Whicher Floristic Community Type
B1: Swan Coastal Plain/North Whicher Scarp Banksia attenuata woodland	HV07, HV11, HV23	Very similar to the Priority 3 Community Southern Banksia attenuata woodlands (‘community 21b’)
C2: Whicher Scarp Jarrah woodland of deep coloured sands	HV01, HV12, HV17, HV18, HV24, HV30	Priority 1 community
C3: Whicher Scarp Jarrah and Mountain Marri woodlands on laterites	HV06, HV29	Shares similarities with the Priority 3 Community *Eucalyptus haematoxylon – E. marginata* woodlands on Whicher foothills (‘community type 1a’)

2.5.3 Local[2] vegetation mapping

Local scale impact assessment and rehabilitation planning has been undertaken using a vegetation community map generated by Bemax, based on the work undertaken by Bennett Environmental Consulting and Onshore Environmental Consulting (Bennett 2006, 2007) and using a combination of numerical classification and structural descriptions. The work has been subsequently reviewed and amended by Ekologica, with additional vegetation communities added. The vegetation communities are described in Table 5 and shown in Figure 8.

Table 5 Local vegetation communities of the Happy Valley tenements

Community	Description	Extent (Impact)
CcChXoPc	Open Low Woodland B of *Corymbia calophylla*, *Corymbia haematoxylon* and *Xylomelum occidentale* over Tall Sedges of *Phlebocarya ciliata* [on grey sands over laterite on upper slopes].	10 ha (42%)
EmCcAfChPeHh	Woodland of Eucalyptus marginata subsp. marginata over Open Low Woodland A of Corymbia calophylla and Allocasuarina fraseriana over Open Low Woodland B of Corymbia haematoxylon over Low Heath C of Pericalymma ellipticum over Open Dwarf Scrub D of Hibbertia hypericoides [on grey/brown/yellow sand].	47 ha (1%)
EmCcChXoKaMtPeKrSlHhMt	Low Woodland A of Eucalyptus marginata subsp. marginata and Corymbia calophylla over Open Low Woodland B of Corymbia haematoxylon over Open Scrub of Kingia australis and Xylomelum occidentale over Low Scrub B of Melaleuca thymoides, Pericalymma ellipticum and Kunzea recurva over Dwarf Scrub D of Hibbertia hypericoides and Stirlingia latifolia over Very Open Tall Sedges of Mesomelaena tetragona [on grey sand].	31 ha (0%)
EmCcChBaMtHhPc	Open Low Woodland A of Eucalyptus marginata subsp. marginata and Corymbia calophylla over Open Low Woodland B of Corymbia haematoxylon and Banksia attenuata over Open Low Scrub B of Melaleuca thymoides over Dwarf Scrub D of Hibbertia hypericoides over Very Open Low Sedges of Phlebocarya ciliata [on grey sand].	50 ha (13%)
EmAfChBaBgDhMtSlHhPc	Forest of Eucalyptus marginata subsp. marginata and Allocasuarina fraseriana over Open Low Woodland B of Corymbia haematoxylon, Banksia attenuata and Banksia grandis over Open Low Scrub B of Melaleuca thymoides and Dasypogon hookeri over Dwarf Scrub D of Hibbertia hypericoides and Stirlingia latifolia over Open Low Sedges of Phlebocarya ciliata	75 ha (26%)
EmChBaBgMtHhSlPc	Open Low Woodland A of Eucalyptus marginata subsp. marginata over Low Woodland B of Corymbia haematoxylon, Banksia attenuata and Banksia grandis over Low Scrub B of Melaleuca thymoides over Open Dwarf Scrub D of Stirlingia latifolia and Hibbertia hypericoides over Very Open Low Sedges of Phlebocarya ciliata.	12 ha (0%)
EmAfChMtHh	Low Forest A of Eucalyptus marginata subsp. marginata and Allocasuarina fraseriana over Open Low Woodland B of Corymbia haematoxylon over Open Low Scrub B of Melaleuca thymoides over Open Dwarf Scrub D of Hibbertia hypericoides	20 ha (16%)
EmCcChBgXoPlXpXaDhHhCsDl	Low Woodland A of Eucalyptus marginata subsp. marginata and Corymbia calophylla over Open Low Woodland B of Corymbia haematoxylon, Banksia grandis and Xylomelum occidentale over Open Scrub of Xanthorrhoea preissii, Xanthorrhoea acanthostachya and Persoonia longifolia over Open Low Scrub B of Dasypogon hookeri over Dwarf Scrub D dominated by Hibbertia hypericoides, Dryandra lindleyana subsp. lindleyana and Calothamnus sanguineus	257 ha (22%)
EmChXaXpAlBarmLpBpLp	Forest of Eucalyptus marginata subsp. marginata over Low Woodland A of Corymbia haematoxylon over Low Scrub A of Xanthorrhoea acanthostachya and Xanthorrhoea preissii over Dwarf Scrub C of Acacia lateriticola, Banksia armata and Leucopogon pulchellus over Dwarf Scrub D of Banksia bipinnatifida, Calothamnus sanguineus, (Hibbertia glomerata subsp. glomerata, Hypocalymma robustum and Isopogon sphaerocephalus) [on brown sandy loam].	15 ha (0%)

[2] Vegetation mapping included areas of state forest to the south of the Happy Valley tenements for the purposes of identifying additional populations of the key sandplain unit (see Ekologica 2008c).

Community	Description	Extent (Impact)
EmChKaDhXpAl	Open Woodland of Eucalyptus marginata subsp. marginata over Open Scrub of Corymbia haematoxylon and Kingia australis over Open Low Scrub A of Dasypogon hookeri and Xanthorrhoea preissii over Dense Tall Sedges of Anarthria laevis.	1 ha (0%)
EmAfChBgDhHh	Open Woodland of Eucalyptus marginata subsp. marginata over Open Low Woodland B of Allocasuarina fraseriana, Corymbia haematoxylon and Banksia grandis over Open Scrub of Dasypogon hookeri over Dwarf Scrub D dominated by Hibbertia hypericoides.	47 ha (24%)
EmCcChBgDhHhSl	Low Woodland A of Eucalyptus marginata subsp. marginata over Open Low Woodland B of Corymbia calophylla, Corymbia haematoxylon and Banksia grandis over Low Scrub A of Dasypogon hookeri over Dwarf Scrub D of Hibbertia hypericoides and Stirlingia latifolia.	35 ha (53%)
EmChBgXpLmHg	Low Woodland A of Eucalyptus marginata subsp. marginata over Open Low Woodland B of Corymbia haematoxylon, Banksia grandis and Persoonia longifolia over Low Scrub A of Lambertia multiflora subsp. occidentalis and Xanthorrhoea preissii over Dwarf Scrub D of Hibbertia glomerata subsp. glomerata and Platytheca sp Argyle (G.J. & B.J. Keighery 281)	13 ha (0%)
EmChXoBgRcDnSlHhSwDl	Low Woodland A of Eucalyptus marginata subsp. marginata over Open Low Woodland B of Corymbia haematoxylon, Banksia grandis and Xylomelum occidentale over Open Dwarf Scrub C of Daviesia nudiflora subsp. nudiflora, Ricinocarpos cyanescens and Stirlingia latifolia over Dwarf Scrub D of Hibbertia hypericoides, Synaphea whicherensis and Dryandra lindleyana subsp. lindleyana	133 ha including off-lease populations (24%)

2.5.4 Condition

The most recent assessment of vegetation condition was conducted by Bennett and Onshore in 2006/2007, on which the current map (Figure 9) is based. Vegetation condition has been mostly impacted by grazing, logging and dieback, although low numbers of weeds have been recorded in State Forest (Bennett 2006)

Dieback

The most recent mapping of *Phytophthora cinnamomi* extent in the proposal area was completed by Glevan Consulting Pty Ltd in August 2008. Approximately forty per cent of the study area was considered unmappable for Phytophthora disease (consisting mainly of pasture, Tasmanian blue gum plantations and some recently burnt remnant native forest). Of the mappable area, approximately fifty five percent has been assessed as infested and forty five percent as uninfested (Figure 10). All streams, gullies and riparian zones within the assessment area have been assessed as infested. Many upland ridges and midslope areas are also infested, but more so within the state forest area adjacent to Gavins Road. The largest sections of uninfested area were found to be in the mid and upper slope areas of remnant forested area of locations 4485 and 4965.

2.6 FLORA

2.6.1 Information sources

A number of studies have been commissioned to investigate the flora values of the Happy Valley tenements and surrounds, including:

- *Gwindinup Landforms, Vegetation and Flora* (ESM 1999)
- *Vegetation Units - Gwindinup Mineral Sands Project* (Bennett 2003)
- *Search for Significant Species Gwindinup* (Bennett 2004)

- Flora and Vegetation of the Happy Valley Mining Leases (Bennett 2006)
- Flora and Vegetation- Selected Areas Happy Valley (Bennett 2007).

In addition to the commissioned studies listed above, other relevant resources were utilised in the assessment of flora values within the proposal area, as listed in Appendix 1.

2.6.2 Floristic diversity

Studies indicate the proposal area is floristically rich, as are most areas located on the Whicher Scarp. The key vegetation surveys undertaken within the proposal area by Bennett and Onshore (2006, 2007) identified a combined total of 381 taxa, belonging to 182 genera and 56 vascular families.

2.6.3 Conservation significant taxa

Declared Rare Flora

One Declared Rare Flora species (*Daviesia elongata* subsp. *elongata)* was identified to occur within the proposal area (Bennett 2004) and is associated with the EmChXoBgRcDnSlHhSwDl (yellow sands) vegetation unit. The population of *D. elongata* subsp. *elongata* recorded within the proposal area was small, ranging from 1-30 plants[3] (Bennett 2004). More abundant populations in healthier condition were recorded outside the proposal area to the south in State Forest (Bennett 2004), where over 1000 plants were recorded in several populations. *D. elongata* subsp. *elongata* is a spreading shrub, 0.4-1 m high, with yellow, red and orange flowers that occurs on yellow and grey sandy soils overlying laterite, or red-brown or yellowish-brown sandy loam and is geographically restricted to the Jarrah Forest of the south-west of Western Australia. Regeneration of the taxa is more prolific after disturbance given that the species is common in disturbed areas e.g. along tracks, road verges and very common after a fire.

Priority flora

A number of Priority Flora species have been identified to occur within and surrounding the Happy Valley mining tenements. Their identification and reasoning behind their Priority classification and the potential impacts to each are listed in Table 6. The locations where Priority Flora have been recorded within and surrounding the mining tenements are mapped in Figure 7.

Table 6 Priority flora recorded within the Happy Valley tenements

Priority Flora	PX	Reason for Listing	Potential Impact
Acacia flagelliformis	P4	Prefers moisture-gaining situations on sandy soils, but may also contain loams and/or gravels. Observed in valleys, creek beds and roadside drains in surrounding areas	One of six occurrences recorded in tenements is within footprint.

[3] This number varies between studies (depending on search method) and over time as populations are known to decrease following germination (D. Brearley pers. Comm..)

Priority Flora	PX	Reason for Listing	Potential Impact
Acacia inops	P3	Uncommon shrub of sumplands of the Margaret River Plateau and Yelverton (Poole Swamp) area (Keighery et al. 2008), not recorded in Whicher surveys. Habitat preference is black peaty sand, clay surrounding swamps, creeks.	Not recorded in HV surveys. The preference for swampy areas with we sands greatly reduces the likelihood of the Proposal affecting this taxon as these areas will be well-protected within creek buffers.
Acacia semitrullata	P3	Preferred habitat is sandplains and swampy areas, where it grows on white/grey sand, sometimes over laterite and/or clay. Keighery et al. (2008) lists the taxon as having a distinct habitat preference (sands) with disjunct populations along the Whicher Scarp.	Recorded by ESM on lower sandy slopes (Gwindinup). Not recorded in Happy Valley (HV) tenements. The preference for swampy areas with wet sands greatly reduces the likelihood of the Proposal affecting this taxon, as these areas will be well-protected within creek buffers.
Andersonia ferricola MS	P1	Described by Webb et al (2006) as a 'Busselton ironstone endemic', i.e. that its distribution is centred upon the ironstone landform. Keighery et al (2008) confirms that populations have been identified in the Argyle forest laterites.	Recorded in 3 BEC quadrats located in or close to creeklines. Floristically similar quadrats (at 20 group) are also associated with creeklines. All those in proximity to footprint are in creek buffers and will not be affected.
Aotus cordifolia (Swamp Aotus)	P3	Prefers peaty soils and swamps, Augusta to Bullsbrook. Closest records are Camp Gully Rd and Brilliant Rd (brown moist loam on road verge – Paluslope wetland).	Not recorded in HV tenements. Potentially may occur in creek buffer zones. Considered very low likelihood of disturbance.
Aponogeton hexatepalus	P4	Aquatic herb with preference for freshwater ponds, rivers and claypans. Closest record is Capel.	Not recorded in surveys despite targeted searches of creeklines. If present, will be protected by creek buffers. Considered very low likelihood of disturbance.
Boronia humifusa	P1	Recorded in gravelly clay loam over laterite and also sandy soils associated with lateritic outcropping, loamy or clayey sand or gravel, usually associated with Jarrah – Marri forest. Keighery et al. (2008) states it is a North Whicher endemic, which is locally common but restricted. Herbarium records include Perth foothills.	Widespread across the HV tenements, typically on the laterite ridges and crests, but also on the deeper yellow and grey sands of HV South and North, respectively. Occurs in 9 of the 14 site vegetation types and is a common taxon (i.e. 50 – 75% occurrence) within the C2 floristic community of Keighery et al. (2008). High risk of local disturbance.
Boronia tenuis	P4	Habitat preferences include laterite, stony soils and granites. Records include Moora, Kalamunda, Boddington and Yallingup. Mostly damp sites. Not recorded by Keighery et al. (2008).	Recorded in two quadrats (HV10 and HV25), both of which are well upslope and downslope of the footprint. Considered unlikely to be on sandy midlsopes but could be present on ridges of Loc 215.
Caustis sp. Boyanup	P1	Habitat preference is white or grey sand in association with Banksia or Banksia/Jarrah woodland and has been recorded from the Whicher Scarp, Donnybrook and as far east as Kojonup and Albany, where it is recorded as locally abundant. Keighery et al. (2008) states there are 3 known populations in the Whicher Scarp: the Boyanup forest (the most northern population), Argyle forest, and the Whicher National Park (most southern population). The taxon was only recorded in a single quadrat of that study.	*C.* sp. Boyanup was not found in any of the Happy Valley quadrats. Bennett (2004a) conducted a targeted search for the plant and found a single population along the verges of Hyder Road, south of the Happy Valley mining tenements. It is not considered to be at risk from the Proposal.
Dillwynia sp. Capel	P1	Littered grey loamy sand, rocky soils. Valleys, rangelands. Whicher Scarp/Blackwood Plateau. Not recorded by Keighery et al. (2008). Not recorded in any other studies.	Not recorded during site surveys. Presumably associated with upland areas owing to Blackwood Plateau affinities (recorded at Nannup, Pemberton, Donnybrook), which will not be disturbed to any great extent by the Proposal. Considered very low likelihood of disturbance.

Priority Flora	PX	Reason for Listing	Potential Impact
Franklandia triaristata	P4	White or grey sand. Boyanup, Happy Valley and Abba forest blocks (Keighery et al. 2008). Other records to Jarrahwood, Capel and Argyle, including two Whicher surveys conducted for Iluka (Mattiske 2006, 2009).	Reported by Bennett from 1 location downslope of HVS footprint. Potential for presence on lower sandy slopes along western edge of HVS and areas of HVN is considered to be reasonably moderate.
Hemigenia rigida	P1	Habitat preferences are sandy soils and lateritic gravelly soils on hillslopes, granite outcrops, flats and ironstone ridges. Records extend from north of Perth to Walpole.	Recorded in four of the Happy Valley quadrats (and twice by Ekologica), none of which are within the proposed disturbance area or its proximity. These sites are associated with the upland lateritic crests and flats or the upper slopes of creeklines (moisture shedding) and are not replicated within the mining area. Considered very low likelihood of disturbance.
Hypolaena robusta	P4	Found on white sand north of Perth and Geraldton sandplains. Not recorded by Keighery et al. (2008) or Mattiske (2006, 2009). No records south of Perth.	Recorded in creekline HVN (2007-01). Not located in other creeks, but may be present. Ranking is elevated to reflect the possibility of a new population being present in or around the mine area.
Logania wendyae	P1	Habitat includes brown clay to sandy clay and lateritic gravel. Believed to be restricted to the northern Whicher Scarp (Keighery et al. (2008), with the authors noting that specimens have not been located south of the Argyle Forest.	The plant is locally common in the areas of the Happy Valley tenements associated with the lateritic uplands and gravelly mid-slopes. Approximately one-third of its recorded occurrences across the proposal site will be disturbed.
Lomandra whicherensis (formerly L. sp. Dardanup)	P1	Newly described species normally found along lateritic or quartzite ridges under low woodlands of C. haematoxylon. Currently known from Dardanup, Boyanup and Argyle forests on the Whicher Scarp and near Collie (Keighery et al. 2008) and recorded in 5 quadrats.	Recorded from two quadrats at HVN, one upslope from the footprint or laterite and one to the west on the laterite ridge on Gavins Rd. Considered low likelihood of disturbance as laterite ridges and crests will not generally disturbed but may occur in remnants at HVN (Loc 215).
Platytheca anasima	P2	Habitat preference is sandy soils and gravel along creeklines or in areas of impeded drainage, endemic to Whicher Scarp (Keighery et al. 2008). Not recorded by Mattiske 2006, 2009).	Recorded in 8 plots including outside of HV tenements. One of the plots may be affected by mine.
Pultenaea skinneri	P4	Associated with winter-wet depressions/margins of basin wetlands. Recorded from Kemerton east to Collie and south to the Blackwood Plateau. Recorded by Keighery et al. (2008) in Abba block.	Not recorded in any of HV studies. Although no wetlands in project area, there are areas of damp sands on upper flats and lower slopes, both of which are largely excluded from mining, as will be creek buffers. Considered very low likelihood of disturbance.
Rhodanthe pyrethrum	P3	Habitat preference is clay, sandy clay associated with winter-wet depressions, clay pans, swamps. Distributed from Albany to Bullsbrook. Not recorded by Keighery et al. (2008) or Mattiske (2006, 2009).	Not recorded in any of HV studies. Although no wetlands in project area, there are areas of damp sands on upper flats and lower slopes, both of which are largely excluded from mining, as will be creek buffers. Considered very low likelihood of disturbance.
Stenanthemum sublineare	P2	Habitat preference is white sands, including coastal. Disjunct populations in Perth, Augusta and Albany. Not recorded by Keighery et al. (2008) or Mattiske (2006, 2009).	Recorded from one quadrat on Bassendean Sands to NW of HVS deposit outside of footprint. Only impact to this landform is access road and specific search will be conducted prior to construction. Considered very low likelihood of disturbance but ranked as high due to regional significance.
Stylidium barleei	P3	Habitat includes grey, white or brown sand over laterite, in upland areas including Eucalyptus woodland and Allocasuarina shrubland. It endemic to the southwest and has been found between Margaret River, Nannup and south of Busselton. Keighery et al. (2008) recorded the species in the Treeton Forest and the Whicher National Park.	One of the two recorded locations lies less than 10 m from the edge of the HVN footprint. All measures will be taken to protect the quadrat from disturbance, however, it is considered to be at high risk. Floristically, the two quadrats have been assigned as the C3 community type, which is widespread in the area. The mosaic of soil and vegetation patterns at HVN includes several small areas where suitable habitat may occur, both within and outside of the proposed footprint. Considered high likelihood of disturbance.

Priority Flora	PX	Reason for Listing	Potential Impact
Stylidium striatum	P4	Brown clay loam over laterite. Hill-slopes. Jarrah/Marri forest, Wandoo woodland. Majority of records Darling Scarp and Plateau (Beverly, Boddington) but also Capel and Boyanup. Recorded at Yoganup by Mattiske in 2006 but not at Tutunup in 2009. Recorded from 3 sites by Keighery et al. (2008) but not mentioned in the text.	Not recorded in any surveys of HV tenements or surrounds. However, may be present across the area in low numbers.
Synaphea hians	P3	Present on sandy soils and rises, with populations are found between Collie, Busselton and Cranbrook. A population recorded for the Treeton forest by Keighery et al. (2008).	Not recorded in any surveys of HV tenements or surrounds. However, may be present across the area in low numbers.
Synaphea polypodioides	P3	Newly described species recorded in Dardanup, Boyanup and Argyle (Gavins Road) forest by Keighery et al. (2008), but not in quadrats. Habitat preference is Light brown loam, red-brown sandy loam, gravelly, brown sandy clay over laterite. In undulating areas.	Not recorded in any surveys of HV tenements or surrounds. However, may be present across the area in low numbers.
Tetratheca parvifolia	P3	Relatively uncommon species recorded in open jarrah forest from Yallingup to Capel to Collie, on lateritic sands. Recorded from a single quadrat of Keighery et al. (2008) on lower central slopes. Recorded at Gwindinup by Bennett (2005), also on mid slopes in *E. marginata, C. haematoxylon* open woodland. Not found in Mattiske studies.	Not recorded in any surveys of HV tenements or surrounds. However, may be present across the area in low numbers.
Villarsia submersa	P4	Aquatic perennial herb, in freshwater 0.05-0.6 m deep. Pools, lakes, swamps, winter-wet depressions, claypans. Several records from Boyanup area.	Not recorded in HV tenements. Unlikely to occur in creeks or buffer zones. Considered very low likelihood of disturbance.

Potential impacts and proposed management

Priority Flora identified within the Proposal disturbance area are listed in Table 7. For all of the taxa, avoidance options have already been exhausted, so management responses rely heavily of relocation of the Priority taxa and/or the implementation of best practice rehabilitation, such as direct and seasonal return of topsoil.

Table 7 Proposed management of Priority Flora

Priority taxa	Proposed management
Acacia flagelliformis (P4)	Plants will be targeted for seed collection prior to disturbance. Good returns expected for topsoil return/regeneration.
Boronia humifusa (P1)	Responds to physical disturbance. Occurrences throughout orebody, including areas earmarked for 90% direct and seasonal return of topsoil. Plants will be targeted for seed collection prior to disturbance.
Logania wendyae (P1)	Appears to respond to disturbance. Occurrences within Yellow Sandplain and Whicher Slopes rehabilitation management zones, so direct and seasonal return of topsoil will be principle rehabilitation measure, followed by seedlings. L. serpyllifolia, which is taxonomically very similar to L. wendyae (Keighery et al 2008), has been successfully rehabilitated by the Proponent at its Jangardup minesite (Bennett 2004b), using direct seeding and block translocation.
Platytheca anasima	As this species is commonly associated with drainage lines and the mine proposal has been designed to avoid these areas it is not expected that this will be a key species for regeneration. If required proposed topsoil management from these areas should ensure successful regeneration.

Priority taxa	Proposed management
Stylidium barleei	S. barleei has been listed as a priority for seed collection. While numerous Stylidium spp. have been successfully rehabilitated by Bemax and other mining companies in W.A., specific research will be conducted to ensure that S. barleei.can be successfully regenerated.
Stenanthemum sublineare (P2)	The quadrat will be demarcated and avoided. If disturbance is unavoidable or evident, the taxon will be relocated to a safer location within the same habitat. The taxon will also be targeted for nursery reproduction.

2.6.4 Taxa of other conservation significance

Several available floristic investigations of the Whicher Scarp (Bennett 2004; Keighery et al. 2008, Keighery, Keighery & Gibson 2008) have identified additional flora species that are considered to be of conservation significance for the reasons listed in Appendix 2, Table 1. About 256 flora species of significance were identified, 36 of which occur within the proposal area. The locations at which these taxa were observed are indicated in Appendix 2, Figure 2.

2.7 FAUNA

2.7.1 Information sources

A number of studies have been commissioned to assess the fauna values of the proposal area, including:

- *Fauna Values of Bemax's Happy Valley mineral sands deposit* (Bancroft & Bamford 2008)
- *Proposed Gwindinup mineral sands mine - fauna surveys August and December 1999* (Bamford & Bamford 2000)
- *The use of the proposed sand mining area at Gwindinup by threatened species* (Bamford & Wilcox 2004).

In addition to the commissioned studies listed above, other relevant resources were utilised in the assessment of fauna values within the proposal area, as listed in Appendix 1.

2.7.2 Survey results

Multiple surveys over the preceding eight years within the Happy Valley proposal area and surrounds have confirmed the presence of 13 conservation significant fauna species, including nine conservation significance 1 species (Table 8).

The fauna survey programme did not identify any fauna species that are restricted to the proposal area or its immediate surrounds. Results from outside the proposal area and from desktop reviews clearly demonstrate that the proposal area does not contain critical or rare habitats, although it does contain certain landscape features that are associated with higher levels of fauna abundance. The impact of introduced fauna is expected to pose the most significant threat to fauna in the proposal area.

Table 8 Fauna recorded within proposal area and surrounds

Group	Number recorded within proposal area	Conservation significant species	Representation outside proposal area
Short-range endemic (SRE) invertebrates	None (despite three site surveys being conducted). 5 potential SREs recorded	None	Potential SREs are well-represented outside of the proposal area.
Frogs	8	None	All frogs recorded are widespread throughout the region.
Reptiles	25	South-West Carpet Python (CS1)	
Birds	76 native, two introduced	Forest Red-tailed Black Cockatoo (CS1) Baudin's Black Cockatoo (CS1) Carnaby's Black Cockatoo (CS1) Rainbow Bee-eater (CS1) Peregrine Falcon (CS1) Square-tailed Kite (CS3) Western Yellow Robin (CS3)	The three Black Cockatoo species are regularly seen in the area in moderate to large numbers; however, there is limited nesting habitat within the proposal area, and foraging habitat is well-represented in surrounding areas. The Rainbow Bee-eater is widespread across surrounding areas. The Peregrine Falcon was recorded during one survey only (in 2000) and relative risk of impact to this species is expected to be low. All CS2 and CS3 species were identified as 'possible regular users' of the area.
Mammals	14 native, five introduced	Chuditch (CS1) (sighted in 1999 only) Western Ringtail Possum (sighted in 1999 only) (CS1) Brush-tailed Phascogale (CS1) Quenda (CS2) Western Brush Wallaby (CS2)	Both the Chuditch and Western Ringtail Possum have not been observed in subsequent surveys. Project area does not contain rare habitats features of significance for mammals. Native mammal populations are known to be affected by introduced predators (particularly foxes but possibly also cats).

2.7.3 Fauna habitat

Several habitats within the Happy Valley proposal site and surrounds are considered likely to be important to fauna diversity, abundance and productivity (Figure 11) and are described below (Table 9).

Table 9 Important fauna habitats identified within the proposal area and surrounds

Habitat	Fauna associated with habitat	Comments
Yellow sandy soils	Reptiles (especially fossorial or semi-fossorial)	Reptiles are more abundant in yellow sandy soils; however species richness is not affected
Vegetation thickets	Brush Wallaby	Uses thickets for shelter
Dense understorey vegetation near wetlands	Quenda	
Forested areas containing logs with hollows	Chuditch	
Complex vegetation structures	Phascogale	Particularly favoured if mid-storey contains small trees (such as *Allocasuarina* and *Banksia*) under eucalypts
Riparian areas	Birds and frogs	
Linear features and vegetated sequences	All species	Provides support for diverse range of fauna

Hollow-bearing eucalypts	Black Cockatoos	Limited number within proposal area. Potentially further reduced by wild European Honey Bee hives occupying the hollows

2.8 HYDROLOGY

2.8.1 Information sources

A number of studies have been commissioned to assess the hydrological values of the proposal area, including:

- *Vegetation Units - Gwindinup Mineral Sands Project* (Bennett 2003)
- *Flora and Vegetation - Selected Areas Happy Valley* (Bennett 2007)
- *Dewatering Assessment, Happy Valley Mineral Sands Operation* (PB 2008).

In addition to the commissioned studies listed above, other relevant resources were utilised in the assessment of hydrological values within the proposal area, as listed in Appendix 1.

2.8.2 Surface water

Surface water resources

Three locally significant water courses have been identified within the Happy Valley proposal area:

- a seasonal stream that flows northwest from state forest through the HVN deposit, under Gavins Road, through a gully dam on Loc. 215 and into another gully dam on Lot 217, where it terminates (GWSW2)
- two seasonal tributaries that flow northwest from state forest, through cleared blue gum plantations on which the HVS deposit is partially situated - both of these tributaries flow through small dams on Loc. 4965 and then down through the Gwindinup South mining area, where they both disappear into the sandy soils (HVSW2 and HVSW3).

Results of a site investigation conducted in September 2007 to identify and record surface water features are mapped in Figure 12.

Downstream water users

The Happy Valley mineral sands mining proposal will only impact on two catchments containing surface water features accessed by other users:

- GWSW2 (local catchment C2) has been previously identified as an important supply to a farm dam on Loc. 217, where it terminates. Monitoring records show, however, that the stream has only flowed on three occasions for the period 2000 – 2008 and that water levels in the dam on Loc. 215 upstream along the same watercourse are often quite low and require supplementation from a windmill on the property
- the proposal will affect a miniscule proportion (~1%) of the edge of the catchment of a farm dam on Loc. 214 (local catchment C1B).

Riparian ecosystems

The vegetation surrounding creeks typically mimics that of the surrounding vegetation. The P1 plant species *Boronia humifusa* was located in two of the creek quadrats, but the taxon is considered to be widespread across the proposal area.

The dams into which HVSW2 and HVSW3 flow, whilst not natural, may provide a valuable resource to native fauna over the summer period.

The availability and reliability of surface water flows in the proposal area are limited by the small size of the catchments and the relatively rapid infiltration through the sandier soil profiles. Water quality is generally good, although the presence of faecal material and harmful bacteria reduce the potability of any water supplies.

2.8.3 Groundwater

There are three key groundwater resources associated with the Happy Valley proposal, namely:

- the superficial aquifer (including the Ridge Hill Formation)
- the Leederville Formation
- the Yarragadee Formation.

The proposal does not intersect the Leederville Formation and there is little significant variation of the Yarragadee formation on a local scale. Parsons Brinkerhoff (PB 2008) found that, for the superficial formation:

- there is no permanent water table of any significance within the depth of mining
- local clay/rock horizons have the potential to cause seasonal perching, particularly after heavy rains, which may cause localised pit inflows
- the risk of acid sulfate soils being present in the orebody is low.

PB (2008) concluded that inflows of groundwater to the pit are likely to be minor and are not expected to impact the regional groundwater system, neighbouring groundwater users and groundwater-dependent ecosystems. These inflows and other stormwater will be captured by the mine water circuit and used for processing, thus reducing draw on the Yarragadee production bore. Abstraction of water from the production bore PB2 (Gwindinup North mine site) is proposed to continue at 1.5 GL/annum as per Groundwater Licence No. 161841(3), as long-term drawdown effects are anticipated to be negligible (Rockwater 2007).

No specific groundwater-dependent ecological communities were identified within the vicinity of the proposed impact area.

Previous Bemax studies have found that, on average, mined soils retain similar hydrological properties to unmined soils and that effective management of the sand and clay tails is integral to ensuring the scale of any differences is kept as localised as possible. To further minimise this potential constraint, Bemax will only use unprocessed material (i.e. not mine tails) for the top 5 – 6 m of the rehabilitated soil profile for areas of native vegetation.

3. MANAGEMENT OBJECTIVES AND PERFORMANCE INDICATORS

3.1 PRINCIPAL ENVIRONMENTAL OBJECTIVE

The principal environmental objective for the Happy Valley mining proposal is to maintain and, where possible, enhance the social, environmental and economic values and services of the proposal area and surrounds, through a combination of the following efforts:

- minimisation of disturbance impacts
- rehabilitation of all areas proposed to be disturbed, with a net increase in vegetation extent
- revegetation of 14 ha of abandoned gravel quarries and access tracks in state forest
- long-term protection of 150 ha of native vegetation through conservation covenants
- ongoing support for local and regional conservation initiatives.

With the exception of the last dot point, these efforts are shown through the post-mining landscape concept plan, which is described below.

3.2 POST-MINING LANDSCAPE CONCEPT PLAN

The conceptual post-mining landscape plan for the Happy Valley proposal area is outlined in Figure 13. The plan represents the project's final vision for rehabilitation and other landscape management efforts, as per the principal environmental objective. During development of the final plan, the following guiding principles were adhered to:

- all areas disturbed by the proposal would be rehabilitated
- all areas currently containing native vegetation would be rehabilitated using prescriptions specifically developed to maximise the opportunities for returning native vegetation to have as many of the values and functions of the original vegetation as possible
- areas of currently cleared land would be replanted with native vegetation, where this would result in an achievable environmental benefit in return for the effort involved (including 14 ha of quarries and tracks in State Forest)
- landscape planning would maximise restoration/protection of vegetated sequences up the face of the Whicher Scarp, with a particular focus on creeklines, and minimise opportunities for the spread of disease and weeds by aiming to reduce uncontrolled access and edge-effects.

3.3 GENERAL REHABILITATION OBJECTIVES

Arising from the principal environmental objective and the landscape planning principles, the following general or standard rehabilitation objectives will be committed to by Bemax:

1. to minimise overall (direct and indirect, short and long-term, on-site and off-site) disturbance impacts

2. to return to those areas disturbed by mining, stable and appropriate topography, hydrology, soil profiles and topsoils (i.e. abiotic factors) determined by pre-disturbance studies as being best able to satisfy the final land-use concepts and rehabilitation objectives
3. to return normally self-sustaining native vegetation communities that are as close to the original as possible (in terms of composition, extent and abiotic characteristics), comprising habitats capable of supporting a diverse biota, and that are capable of being managed without unwarranted additional expense
4. to maximise the use of rehabilitation resources available on-site
5. to improve the condition of vegetated sequences from the foothills and flats to the upper slopes and plateau.

3.4 COMPLETION CRITERIA

To enable assessment of progress towards the principal environmental and general rehabilitation objectives, Bemax has developed a number of completion criteria (Table 10), to be assessed in the following stages:

- planning
- pre-clearing
- pre-rehabilitation
- early (0 – 15 months)
- mid (15 months – 5 years)
- late (5 – 15 years).

The completion criteria are matched to specific aspects of rehabilitation and may apply to native vegetation areas, farmland areas, or both.

The completion criteria developed have been matched to currently achievable technology. It is acknowledged that with technological advancement, rehabilitation techniques may change during the mining operation, and where these changes facilitate an improvement in the rehabilitation outcome, associated completion criteria may be reviewed. Therefore, completion criteria (and associated standards, performance indicators, and contingency actions) will be subject to periodic review, with amendments made to the satisfaction of the Department of Environment and Conservation (DEC) and the Department of Industry and Resources (DOIR).

3.5 STANDARDS

Bemax has developed a comprehensive suite of Rehabilitation Work Instructions applicable to the Happy Valley proposal. These Work Instructions and additional, site-specific instructions are described in Section 4. Each completion criterion is linked to one or more Work Instructions or other instructions (Table 10).

3.6 PERFORMANCE INDICATORS

For each completion criterion, performance indicators have been identified to enable progress (expressed as a quantitative or qualitative target) to be measured, assessed and reported on (Table 10).

Table 10 Draft Completion Criteria for rehabilitation within the Happy Valley project area

ASPECT	COMPLETION CRITERION	STANDARD	PERFORMANCE INDICATOR	RESPONSIBILITY
1. PLANNING				
Access	1. Stakeholders have been consulted with proposed mine access plans	Section 5.6	Emails, letters, minutes of meetings	Rehab Advisor
Fire	6. Fire management strategies are incorporated into the IMRP aimed at protecting developing rehabilitation and integrating older rehabilitation into wider forest management	WI225 Section 4.14.3	IMRP	Rehab Advisor
Heritage	7. Heritage surveys have been completed ahead of clearing, and permission sought from relevant authority where sites are to be disturbed	Appropriate archaeological and ethnographic surveys completed to satisfaction of DIA	Native Title Agreement for State Forest areas Heritage survey report, project schedule, Section 18 approval	Rehab Advisor
Landuse	8. Area meets landuse purposes as defined in Forest Management Plan	Forest Management Plan	Forest Management Plan compared to end landuse of proposal area	Rehab Advisor
Vegetation and flora	9. Area has been mapped for dieback, and dieback management zones have been agreed with regulatory authorities	WI279 Section 4.14.4	Dieback survey maps/report, emails/letters showing endorsement of management zones by regulatory authorities	Rehab Advisor
Vegetation and flora Fauna	10. Flora & fauna surveys have been completed, and management strategies for any rare taxa recorded and implemented	WI224	Flora and Fauna survey reports, management strategies for recorded rare flora and fauna developed, correspondence/ photographs of implementation of management strategies	Rehab Advisor
2. PRE-CLEARING				
Hydrology Landform and soils	11. Prior to commencement of clearing, drainage plan developed for implementation in cleared area	WI225 Section 4.3	Drainage Plan, mining schedule	Mining Engineer

Miscellaneous	12. Disturbance boundaries delineated with white sighter wire	WI224 Section 4.3	Site inspection, photographs	Mine Supervisor
Miscellaneous	13. Machinery operators informed of clearing measures	WI225 Section 4.3	Meeting minutes, correspondence	Mine Supervisor
Vegetation and flora	14. Search for DRF (and other significant flora) completed prior to clearing	WI224 Section 4.3	Flora survey report, photographs of flagged DRF	Rehab Advisor
Vegetation and flora	15. Seed and plant material required for propagation removed and appropriately stored	WI224 WI279 Section 4.3	Site inspection, photographs, invoices/receipts regarding storage	Rehab Advisor
Vegetation and flora	16. Plants to be translocated shall be removed and appropriately stored or direct returned to prepared rehabilitation surfaces	WI224 WI279 WI068 Section 4.4	Site inspection, photographs, invoices/receipts regarding storage	Rehab Advisor
Vegetation and flora	17. Commercially viable timber removed	WI224 Section 4.3	Correspondence, site inspection, photographs	Rehab Advisor
Vegetation and flora Fauna	18. Habitat logs and vegetation debris to be used as fauna habitat removed and appropriately stored	WI224 Section 4.3	Site inspection, photographs	Rehab Advisor
Vegetation and flora	19. Mine path and stockpile areas approved for clearing surveyed and pegged	WI224 Section 4.3	Site inspection, photographs, survey/site plans, approval documents	Mine Supervisor
Vegetation and flora Landform and soils	20. Open area kept to a workable minimum	WI225 WI377	Site plan, site inspection	Mining Engineer
3. PRE-REHABILITATION				
Landform and soils	21. Topsoil segregated on basis of vegetation type and dieback status	WI223 WI279 Section 4.5	Site inspection, photographs, map of segregations and comparison to vegetation type and dieback status	Rehab Advisor

Landform and soils	22. Native vegetation topsoil stripped in two layers: 0 – 50 mm and 50 – 150 mm	WI223 Section 4.5	Site inspection, photographs	Mine Supervisor
Landform and soils	23. Native vegetation topsoil stripped during dry conditions wherever practicable	WI223 Section 4.5	Mining schedule	Mine Supervisor
Landform and soils	24. Upper topsoil stripped with GPS buckets and stockpiled into pre-determined locations	WI223 Section 4.5	Site inspection, photographs	Mine Supervisor
Landform and soils	25. Native vegetation topsoil stockpiled separately to farmland topsoil	WI223 Section 4.5	Site inspection, photographs, site plan	Mine Supervisor/ Rehab Advisor
Landform and soils	26. Native vegetation topsoil stockpiled over cleared native vegetation areas to a maximum height of 1 m	WI223 Section 4.5	Site inspection, photographs, site plan	Mine Supervisor
Landform and soils	27. Native vegetation topsoil stockpiles reshaped and surfaces ripped to promote native species establishment where topsoil will not be direct and seasonal returned	WI223 WI377 Section 4.5	Site inspection, photographs, site plan, map of segregations and comparison to vegetation type and dieback status	Mine Supervisor/ Rehab Advisor
Landform and soils	28. Farmland topsoil stripped to a depth of 200 mm in one layer	WI223 Section 4.5	Site inspection, photographs	Mine Supervisor
Landform and soils	29. Farmland topsoil stockpiled over cleared farmland areas to a maximum height of 4 m and stabilised with annual grasses where required	WI377 Section 4.5	Site plan, Site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils	30. Overburden to be stockpiled as separate piles based on soil profile, soil type, and dieback status	Section 4.6 WI377	Site plan, stockpile location plan	Mine Supervisor/ Rehab Advisor
Landform and soils	31. Landform design is integrated with surrounding forest landscape, and will not cause an impediment to access for longer term management by regulatory authorities	Section 4.6	Survey plan for proposal area (showing contours before and after mining)	Mining Engineer/Rehab Advisor
Vegetation and flora	32. Nursery seedlings inoculated with mycorrhizal fungi	Section 4.12	Photographs	Rehab Advisor
Vegetation and flora Landform and soils	33. Clear and stockpile understorey vegetation	WI225	Site inspection, photographs	Mine Supervisor/ Rehab Advisor

Access	34. Access routes retained across the mining lease, as required for ongoing fire and weed management	Section 4.14.3	Site plan showing access routes throughout mining lease, correspondence from FESA that access is adequate	Mine Supervisor/ Rehab Advisor
		4. EARLY (<15 months)		
Fauna	35. Five fauna habitats/ha re-established across the reconstructed landscape from stored materials	WI067	Site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils	36. Topsoil spread over 100% of the rehabilitated mine path	WI223 Section 4.5	Site plan, schedule, site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils	37. Direct and seasonal return of topsoil[4] achieved over 50% of the Whicher Slopes community in State Forest at HVN, and 90% of the Sandplain community in State Forest at HVS	WI223 Section 4.5	Site plan, schedule, site inspection, photographs	Rehab Advisor
Landform and soils	38. Clearing, mine schedule, and topsoil handling plans to be updated at six monthly intervals and compared with on-ground survey to ensure compliance	Section 4.5		Rehab Advisor
Landform and soils	39. Specific overburden types replaced at defined points within the post-mining soil profile	Section 4.6; 4.7	Mine plan, monitoring results, photographs	Mine Supervisor
Landform and soils	40. Surface re-contoured with grader following survey (in line with pre-mining contours)	Section 4.6; 4.7	Survey report (including pre- and post-mining contours), site inspection, photographs	Mine Supervisor
Landform and soils	41. Re-contoured surface deep ripped with conventional triple-tine attachment at half machine width (D9) intervals	WI069 Section 4.6; 4.7	Site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils	42. 'Lower topsoil' material replaced at 150 mm depth using tractors and GPS buckets	WI223 Section 4.7	Monitoring results, site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils	43. 'Upper topsoil' material replaced at 50 mm depth using tractors and GPS buckets	WI223 Section 4.7	Monitoring results, site inspection, photographs	Mine Supervisor/ Rehab Advisor

[4] Direct topsoil return is defined as removed from one area and replaced onto another area almost immediately. Seasonal Return is return within a single summer /autumn period, without requirement for stockpiling over winter / spring months

Landform and soils	44. No hazards resulting from mining (pollutants, debris etc.) to be present over the mining lease	Occupational Health and Safety Audits	Site inspection, safety / hazard assessment forms	Mine Supervisor
Landform and soils	45. For each stage of mining, test pits established post soil reconstruction to assess the following chemical and physical parameters to confirm they are capable of supporting the proposed revegetation cover: - nutrients, pH and EC - particle size distribution (proportions of sand, silt and clay) - bulk density	Section 5.1	Schedule, site inspection, photographs	Rehab Advisor
Landform and soils Hydrology	46. No uncontrolled surface runoff or soil erosion that restricts access by four wheel drive, is unstable and degrading, and/or compromises landuse objectives	WI377 Section 4.14.1	Site inspection, photographs, monitoring results	Mine Supervisor/ Rehab Advisor
Landform and soils	47. Risk of dieback spread minimised	WI279 Section 4.14.4	Work Instruction, meeting minutes, monitoring results	Rehab Advisor
Vegetation and flora	48. Harvested blocks and individual recalcitrant species translocated	WI068 WI279 Section 4.4	Site inspection, photographs	Mine Supervisor/ Rehab Advisor
Vegetation and flora	49. Perimeter of each year's rehabilitation block fenced	WI098 Section 4.8	Site plan, site inspection, photographs	Rehab Advisor
Vegetation and flora	50. Prepared rehabilitation areas direct seeded with a native species mix, with seed mix composition specific to vegetation type and individual seeding rates determined by seed quality and germination testing and feedback from annual monitoring program of plant biodiversity parameters	WI152 Section 4.11	Seed list outlining collection numbers and sowing rates for each species within separate rehabilitation block	Rehab Advisor
Vegetation and flora	51. Nursery propagated seedlings (from a mixture of seed, cuttings, root divisions, and tissue culture) replanted throughout the rehabilitation area at a density >1,000 seedlings ha^{-1}	WI152 Section 4.13	Seedling list outlining propagation details and planting rates for each species within separate rehabilitation blocks	Rehab Advisor
Vegetation and flora	52. Tree density >1,000 plants per ha	Section 4.13	Annual monitoring data	Rehab Advisor
Vegetation and flora	53. At 15 months individual conservation species abundance to be at least 60% of that recorded in pre-mining assessment plots	Section 5.1.2	Site inspection, photographs, monitoring results	Rehab Advisor

Vegetation and flora	54. At 15 months species richness to be at least 60% of that recorded in pre-mining assessment plots, with not more than 10 percent of the annual assessment plots failing to record this level of diversity	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	55. Risks to young vegetation from fire, vermin, and weeds minimised	WI095 WI225 WI378 WI279 Section 4.14.2; 4.14.3; 4.14.5	WI's	Mine Supervisor/ Rehab Advisor
		5. MID (15 months-5 years)		
Landform and soils	56. Surfaces stable with no evidence of surface erosion that is likely to limit establishment of a native vegetation cover	WI377 Section 4.14.1	Monitoring results (erosion and vegetation)	Mine Supervisor/ Rehab Advisor
Landform and soils Vegetation and flora	57. Reconstructed soil profile does not restrict vertical root development of tree species	Section 4.7 Section 4.10 (deep ripping)	Monitoring results (vegetation health and soil profile)	Rehab Advisor
Landform and soils Vegetation and flora	58. Dieback survey and mapping indicates that dieback management procedures have effectively contained dieback spread.	WI279 Section 4.14.4	Monitoring results, mapping	Rehab Advisor
Vegetation and flora	59. Average tree density at 5 years will meet standards developed for Kingia, Whicher Slope and Sandplain communities (quantitative targets to be set following assessment of analogue sites), with not more than 10 percent of the assessment plots failing to record this overstorey density	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	60. At 15 months no areas greater than 0.01 ha without understorey	Section 5.1.2	Monitoring results, site inspection	Rehab Advisor
Vegetation and flora	61. At 15 months species richness of native plant species to be at least 60% of that recorded in pre-mining assessment plots, with not more than 10 percent of the annual assessment plots failing to record this level of species richness	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	62. Ground coverage of weed species to be equivalent or less than corresponding State Forest communities	Section 4.14.5	Monitoring results, site inspection	Rehab Advisor

Vegetation and flora	63. No Declared Plants as defined by DAFWA (2007) present within rehabilitation areas	Section 4.14.5	Monitoring results, site inspection	Rehab Advisor
		6. LATE (5-15 years)		
Access	64. The agreed access plan has been implemented	Section 5.5	Access plan, site inspection, correspondence from regulatory authorities	Mine Supervisor/ Rehab Advisor
Access	65. Roads / tracks have been retained or constructed under the agreed access plan	WI225 Section 4.14.3	Access plan, site inspection	Mine Supervisor/ Rehab Advisor
Landuse	66. The site meets the agreed end land use	Section 3.2	Site inspection, photographs, correspondence from regulatory agencies	Rehab Advisor
Landform and soils	67. The rehabilitation surface is stable and vegetated, with no uncontrolled run-off	WI377 Section 4.14.1	Monitoring results, site inspection, photographs	Mine Supervisor/ Rehab Advisor
Landform and soils Vegetation and flora	68. Dieback survey and mapping indicates that dieback management procedures have effectively contained dieback spread.	WI279 Section 4.14.4	Monitoring results, mapping	Rehab Advisor
Vegetation and flora	69. Average tree density at 15 years will meet standards developed for Kingia, Whicher Slope and Sandplain communities (quantitative targets to be set following assessment of analogue sites), with not more than 10 percent of the assessment plots failing to record this overstorey density	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	70. At 5 years no areas greater than 0.01 ha without understorey	Section 5.1.2	Monitoring results, site inspection	Rehab Advisor
Vegetation and flora	71. At 5 years species richness of native plant species to be at least 60% of that recorded in pre-mining assessment plots, with not more than 10 percent of the assessment plots failing to record this level of species richness	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	72. At 15 years, rehabilitation is progressing towards success, as evidenced by predicted trends for plant biodiversity values monitored annually, i.e. variation in parameters over time does not show statistically significant differences	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora Fauna	73. Insect attack is no more vigorous within the mine site rehabilitation than adjacent areas of unmined State Forest	Section 5.1.2	Monitoring results, site inspection, correspondence with regulatory agencies	Rehab Advisor

Vegetation and flora	74. Marri (or other dieback resistant tree species) is present at minimum density of 100 stems per hectare	Section 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	75. Ground coverage of weed species to be equivalent or less than corresponding State Forest	WI378 Section 4.14.5; 5.1.2	Monitoring results	Rehab Advisor
Vegetation and flora	76. No Declared Plants as defined by DAFWA (2007) present within rehabilitation areas	Section 4.14.5	Monitoring results, site inspection	Rehab Advisor
Vegetation and flora	77. The site is capable of being integrated into the larger control burning program with surrounding State Forest	WI225 Section 4.14.3 Monitor plant biodiversity parameters post-control burn within an agreed trial area that is determined to be representative of the larger rehabilitation blocks	Positive trends in monitoring data	Rehab Advisor

3.7 CONSTRAINTS TO SUCCESSFUL REHABILITATION OUTCOMES AT HAPPY VALLEY

A summary of the scale of rehabilitation constraints is provided below (Table 11), as per the EPA Guidance on rehabilitation (EPA 2006). The criteria used in the table are discussed further in the following sections, with various controls and management measures described for reducing the impact of these potential rehabilitation constraints, as far as practicable.

Table 11 EPA scale of rehabilitation constraints (from EPA 2006)

Criteria	1	2	3	4	5	Score
1. Land clearing scale	a few m^2	a few ha	many ha	a few km^2	many km^2	**3**
2. Drought/rainfall unpredictability	very low risk, or not relevant	low risk, but of some relevance	moderate risk – some problems are expected	substantial problems are expected	major problems are expected	**2**
3. Temperature harshness and unpredictability						**2**
4. Disease and pests						**3**
5. Weeds						**2**
6. Seed germination/ availability						**2**
7. Soil/ landform stability						**2**
8. Soil structure and chemistry	unaltered	minor/ temporary impacts	some long-term impacts expected	substantial impacts expected	unlikely to support original veg'n	**2**
9. Hydrology						**2**
10. Landform structure						**2**
11. Connectivity for seed dispersal, etc	continuous	some cleared land	good linkages	poor linkages	fully isolated	**3**
12. Ecosystem resilience	highly resilient	resilient	fairly resilient	susceptible	highly susceptible	**3**
					AVERAGE SCORE	**2.3**

3.7.1 Scale of land clearing

The Happy Valley proposal will result in the clearing of 155 ha of native vegetation. However, the proposed clearing is itself spread in pockets across a larger area of the landscape, lessening the localised effects of clearing and the task of rehabilitation.

Bemax has put in place the following controls and design approaches in an effort to address this constraint:

- minimum practicable total clearing footprint
- staged clearing and progressive rehabilitation
- retention and enhancement of vegetated corridors.

In essence, this constraint can be best overcome by ensuring rehabilitation efforts and expertise are adequate to the task. In recent years, Bemax has successfully undertaken rehabilitation of similarly-sized areas of native vegetation, including Jangardup (43 ha) and Ludlow (110 ha).

3.7.2 Rainfall or temperature unpredictability

The proposal area is subject to relatively mild and predictable weather patterns and reasonably-predictable changes in temperature or rainfall are not expected to be a significant constraint to

rehabilitation in the early years. Seeding and planting is typically undertaken in early-mid autumn to maximise the germination and establishment period, prior to the start of the dry summer season.

Given the rehabilitation efforts will occur over a number of years, there is the potential for climate change to affect the rehabilitation outcomes. Monitoring will be undertaken and adaptive management will be practiced to minimise the extent to which this factor affects rehabilitation outcomes.

3.7.3 Diseases and pests

The proposal site includes large areas that have been infested with dieback disease, *Phytophthora cinnamomi,* and show large numbers of deaths of indicator species such as *Banksia attenuata*, *Banksia grandis*, *Persoonia longifolia*, *Xanthorrhoea gracilis*, *Xanthorrhoea preissii*, *Xylomelum occidentale* and *Isopogon sphaerocephalus*. Several areas of high impact were observed with large numbers of jarrah (*Eucalyptus marginata*) trees affected.

Much of the dieback infection occurs on elevated slopes above the rehabilitation areas. As the *P. cinnamomi* fungi can be dispersed within surface and shallow soil water, down slope locations inevitably will be prone to subsequent infection. The rate of infection is likely to be reduced in well drained sandy soils such as the Whicher and Cartis subsystems.

Bemax plans to address this significant constraint by:

- demarcating and managing separately materials from infested areas
- implementing strict hygiene controls
- altering the propagation prescription for dieback-infested areas to increase the relative proportion of non-sensitive taxa
- liaising with DEC in regards to any other potential management measures (e.g. phosphite treatment).

In terms of pests, herbivory of rehabilitated plants is a well-documented hazard and Bemax will fence rehabilitation areas until they are sufficiently re-established to withstand grazing by native animals. In addition to fencing, rabbits will also be controlled using baits.

3.7.4 Weeds

The proposal area includes State Forest and vegetated farmland, both of which contain various species of weeds. A total of 11 weeds were identified within the proposal area, none of which are considered Declared Plants by the Department of Agriculture and Food WA. One species, *Romulea rosea* (Guildford grass) is considered by the DEC to have a ‘High’ rating, which indicates this weed is prioritised for control and/or research. Hygiene controls will be in place during clearing operations to reduce the risk of introducing new weeds and/or spreading existing weeds, and this hygiene will continue to be in place during recreation of the soil profile and topsoil spreading. Once the topsoil has been spread, weed control will be undertaken to ensure performance criteria are achieved.

3.7.5 Seed germination and availability

Seed germination and availability is a potential constraint to rehabilitation efforts. Seed collection is currently being undertaken in the area to ensure sufficient volumes of seed are available to undertake revegetation activities. When preparing and estimating the application rate for seed mixes, factors

such as sample purity, seed quality, final germination (nursery tested) and seed size are carefully considered.

Additionally, topsoil management, block translocation and a targeted research and development program are being implemented as tools to overcome potential limitations posed by seed germination and availability.

3.7.6 Topsoil management

The timing of removal and relocation of topsoil will aim to be specific to the species; i.e. seeding species are best relocated during drier conditions and rhizomatous species are best relocated in moister conditions. Native vegetation topsoil (top 200 mm) will be stripped in two layers; the upper layer being the first 50 mm and the lower layer being the next 150 mm. Topsoil will be relocated to an area of appropriate landscape position and soil profile, also acknowledging dieback status.

Given the limited land available for stockpiling rehabilitation materials and the multiple spoil types associated with the mining, it is not possible to achieve 100% direct replacement of topsoil across the mine path. However, to maximise the success of rehabilitation utilising topsoil material, the focus will be on maximising direct and seasonal return of the upper topsoil onto areas currently supporting the Whicher Sandy Slopes community and the Sandplain community. The overall target is 50% direct and seasonal return of topsoil for the Whicher slopes community in State Forest at HVN, with 90% direct and seasonal return for the Sandplain community in State Forest at HVS. Where direct and seasonal return is not possible, the following actions will be undertaken:

- use some of the topsoil to rehabilitate quarries (maximum of 25% of upland community soils), assuming appropriate areas are available
- for upper topsoil only that is required to be stored, topsoil stockpiles will be low profile (less than 1 m), shaped and scarified.

3.7.7 Block translocation

Block translocation will be undertaken as an integral component of the rehabilitation activities; specifically, selected blocks of vegetation supporting dense ground covers dominated by sedges will be moved *in situ*. This technique has been successfully implemented for revegetation where recalcitrant and untested taxa at other mineral sands mine rehabilitation sites. See also Sections 3.7.12 and 4.4.

3.7.8 Research and development

Seven keystone ground cover or low shrub genera/species that are included in the list of 117 potentially problematic species (Appendix 3) have been selected as priorities for further research in order to improve rehabilitation outcomes and vegetation quality in the southwest:

- *Hibbertia* spp. – four species potentially within the proposal area
- *Lepidosperma* spp. – eight species potentially within the proposal area, at low abundance
- *Lomandra* spp. – two species potentially within the proposal area, but uncommon
- *Stirlingia latifolia* – one of several keystone species associated with the yellow sandplain unit
- *Phlebocarya ciliata* – a keystone species dominant in at least three vegetation types

- *Tetraria* spp. – three species potentially within the proposal area, in varying abundance.

Bemax will commit to a research program focussed on the successful propagation and planting of these species for use in rehabilitation projects. As part of this program, a controlled burn will be undertaken on the Baljieu property adjacent to the Happy Valley minesite in April 2009, with the objective of collecting material from selected taxa for use in nursery propagation trials.

A research-based Honours level project will also be supported by Bemax to review current literature concerning rehabilitation with the abovementioned priority species and evaluate the outcomes and significance of Bemax's planned nursery trials. This will be undertaken by a suitable candidate studying at a Perth-based university.

3.7.6 Soil and landform stability

The proposal area contains some steep slopes (up to 40%) and is dissected or within proximity to a number of creeks. A 30 – 50 m buffer has been applied to all creeks, with no clearing permitted in these areas and rehabilitation occurring progressively. A drainage plan will be prepared prior to any ground disturbance to address potential water erosion, with bunds created around the rehabilitation areas to avoid incursion of surface flows. Additionally, within the rehabilitation areas, the approach to water erosion will comprise:

- sheet flow should be limited in sandy soil areas
- in other areas the sites will be surveyed, then the surface will be ripped/furrowed cross-contour to slow the movement of water downslope.

The potential for wind erosion of the rehabilitated areas will be reduced by the location and geometry of surrounding stockpiles, with vegetation surrounding most of the sites also shielding the exposed surfaces.

3.7.7 Soil structure and chemistry

Loss or dilution of topsoil

Topsoil will be stripped in two layers and the aim is for direct replacement of 50% of topsoil for the Whicher slopes community in State Forest at HVN, and 90% of topsoil for the Sandplain community in State Forest at HVS, as outlined previously in Section 3.7.6. However, some material may be required to be stockpiled depending on the progression of mining. Where this is necessary, the period of stockpiling will be minimised as far as practicable and the stockpiles will be low to reduce the material drying out and becoming susceptible to wind erosion.

Removal of laterite

As a result of mining, the laterite layer of the soil profile will be removed. The laterite and primarily clayey soils beneath it currently reduce downward hydrological movement, with moisture captured and building up at this point. Following the removal of this layer and replacement with sandier soils; moisture is unlikely to accumulate and it is expected that the vegetation community composition will shift to more dry, sandplain species. There is the possibility, however that free-draining soil reduces the risk of dieback becoming established in the area.

Soil profiles

Mining activities are expected to affect approximately two-thirds of the area of disturbance, meaning that the soil profile of one-third of the disturbance area will not be affected. Where the soil profile is required to be recreated, the following actions and principles are likely to apply:

- original soil profile to be documented
- no mine tails within 5 m of the surface for the yellow sandplain and 6 m for other native vegetation; 1 m for pasture (however, the upper 1 m may contain blended clay fines to improve productivity)
- an overburden plan to be developed, with some overburden potentially sourced from nearby Gwindinup South operations
- to reduce compaction, once the lower layers of the soil profile have been reinstated (prior to topsoil replacement) they shall be deep ripped.

Soil chemistry

There are no acid sulphate soils or sodic soils in the proposal area. The established procedures for removing, storing and replacing the different types and layers of soils and subsoils will minimise the potential for this aspect to inhibit rehabilitation outcomes. Additionally, the topsoil nutritional status will be monitored (see Section 5).

3.7.8 Hydrology

A drainage plan will be prepared prior to any ground disturbance. Surface flows will be excluded from rehabilitation areas for at least the first wet season, until the risk of sediment transport into the catchment is at a reasonably minimal level.

3.7.9 Landform structure

The proposal area shall be surveyed prior to excavation commencing to ensure accurate measurement of contours. This information will be utilised after mining completion to reinstate the landform.

3.7.10 Connectivity for seed dispersal

The rehabilitation areas generally have good linkages, with existing native vegetation surrounding all sites (though some areas are not directly adjacent to native vegetation).

3.7.11 Ecosystem resilience

The rehabilitation areas are considered fairly resilient, however they have been stressed by logging, dieback, fire, weeds and potentially in the future, climate change. Management measures (e.g. weed control) and a monitoring program will be implemented to minimise potential impacts from these existing stressors.

3.7.12 Capacity and experience of proponent

Cable Sands and Bemax have previously successfully rehabilitated mineral sands mines to native vegetation at Jangardup, Yarloop, and Ludlow minesites, which are also located in southwest Western Australia. A review of the proponent's capacity to rehabilitate the proposal area was undertaken by URS (2008). This review found that rehabilitation was likely to be successful, given the proponent's demonstrated ability to rehabilitate mineral sands mines with appropriate soil profiles to support a diverse flora.

As part of its commitment to achieving optimal rehabilitation outcomes, Bemax has developed a number of innovative rehabilitation techniques through experience with prior projects. These will be implemented to improve rehabilitation outcomes at the Happy Valley site, and are briefly discussed below.

Block translocation

Block translocation involves lifting 2.5 x 1.5 m blocks of intact topsoil and vegetation off the minesite surface, and then placing them directly on a rehabilitation surface or onto a storage area for later use. This technique was pioneered at the Jangardup site, and has been found to increase regeneration from roots, bulbs, and corms, as well as from soil seed banks and seed attached to vegetation. Establishment of recalcitrant species such as those of the Xanthorrhoeaceae, Cyperaceae, and Restionaceae families was aided by translocation.

Weed control

Weed seed banks in topsoil caused a high abundance of weeds during the 2001 and 2002 seasons at Yarloop rehabilitation site. This was addressed by applying glyphosate at a low rate (0.5 L ha^{-1}) to the affected areas, without a wetting agent. *Hypochaeris glabra*, *Oxalis pes-caprae*, and *Arctotheca calendula* were successfully controlled without harming planted native seedlings. This technique will be employed at the proposed Happy Valley site if required; however, improved management of topsoil should reduce the likelihood of weed species proliferating (see Section 4.14.5).

Additional measures are proposed to be implemented in the rehabilitation of the Happy Valley site to further improve rehabilitation outcomes. Details on each of these measures are provided in Sections 4 and 5. Measures include:

- direct and seasonal return of topsoils: at least 50% for Whicher vegetation unit in State Forest and 90% direct and seasonal return for yellow sandplain soils is State Forest
- direct return of translocated blocks wherever possible
- double stripping of topsoil with laser-controlled scoops to separate upper soil profiles into 0 – 50 mm and 50 – 200 mm strata
- relocation of *Xanthorrhoea gracilis* and *Xanthorrhoea preissii* with a tractor-mounted tree spade
- relocation of *Macrozamia riedlei* with a loader
- vegetative propagation of suitable species as an alternative to germination from seed.

All rehabilitation works will be carried out by suitably qualified professionals employed by Bemax.

Further research and development of rehabilitation programs will be undertaken as part of the proposed rehabilitation effort at Happy Valley, including field studies, nursery trials, and an Honours level research project (see Section 3.7.5).

4. IMPLEMENTATION STRATEGY

4.1 OVERVIEW

On-site mine operations will commence with delineation of the disturbance boundary, clearing and subsequent earthmoving activities. The mining process will only disturb the absolute minimum area of native vegetation required for mining operations, that is the area required to access ore reserves (97 ha) plus an additional 49 ha of critical mine site infrastructure. After the removal of heavy mineral products, the landform will be reconstructed by replacing specified *in situ* overburden strata that were removed to expose the orebody, returning topsoil, and undertaking secondary treatments such as deep ripping and habitat development. The revegetation process will commence at the start of mining, by preserving vegetative and soil materials for use on the reconstructed landscape. Bemax will commit to returning self-sustaining plant communities that maintain representative species composition and structure, based on existing vegetation types, in those areas where native vegetation currently exists. The revegetation objective will be to reinstate three native vegetation communities across disturbed vegetated areas of the project area, and annual pasture within existing cleared farmland areas on privately owned land. Revegetation techniques that will be implemented to achieve the above objective are outlined below.

A description of the above activities follows in chronological order. These descriptions include a level of detail that can be easily understood by mining supervisors and machine operators alike, while ensuring that important issues raised in the pre-mining surveys have been adequately addressed. Relevant Bemax Work Instructions[5] for each activity are listed. These Work Instructions constitute Bemax's current best practice rehabilitation standard.

4.2 PLANNING AND SCHEDULE

Mining of the Happy Valley deposits is planned to commence in 2010 and will last for approximately 5 – 6 years depending upon mining rates. It is envisaged that the mine will operate on a 24 hours per day and 7 days per week basis. Table 12 represents the preferred annual chronology for specific rehabilitation activities.

[5] Within the EMS, there are a number of documents applicable to the management of rehabilitation for occupational health and environmental reasons. These documents are listed in the References (Section 7).

Table 12 Schedule of activities associated with rehabilitation of the Happy Valley mining leases

	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
Pre-mining												
Seed & cutting collection												
Delineation of clearing boundaries												
Removal of translocation species												
Clearing of timber and brush												
Topsoil stripping												
Landform Restoration												
Replacement of overburden & spoil												
Landform recontouring												
Deep ripping												
Translocation of selected plant taxa												
Topsoil replacement												
Replace fauna habitat												
Surface ripping / scarification												
Revegetation												
Fencing												
Direct seeding												
Planting tube stock												
Maintenance												
Baiting for vermin (rabbits)												
Weed control												
Fire breaks												
Monitoring												
Soil profile reconstruction												
Topsoil nutrition												
Vegetation												

4.3 CLEARING

Principle Work Instructions:

- **WI 224 – Native Vegetation Pre-clearing checklist**
- **WI 225 - Management of clearing operations.**

The proposal includes the clearing of 155 ha of native vegetation, on both private land and State Forest. The removal of vegetation is necessary to access the ore reserves and for the construction of critical infrastructure, including access roads and topsoil stockpiles.

Prior to any clearing activities commencing at site, disturbance boundaries will be clearly delineated with a white sighter wire, to ensure that clearing of native vegetation does not exceed that proposed.

Pre-clearance checks will be undertaken by the Minesite Supervisor or his delegate in liaison with the Rehabilitation Advisor to ensure that:

- seed and plant material required for nursery propagation activities has been removed
- plant species identified for translocation have been removed
- commercially valuable timber has been extracted
- machinery operators have been familiarised with the objectives of the clearing program and importance of retaining logs and vegetation debris of fauna habitat value, and are aware of relevant stockpile locations for cleared material.

Clearing will occur in discrete stages aimed at maintaining rate of mining while minimising environmental considerations, such as dust generation and surface erosion events. Locations associated with stockpiling and storage of cleared infrastructure required for later use in rehabilitation activities forms part of the mine plan.

The clearing protocol will involve five broad steps outlined below:

- Selected plant species identified for translocation will be removed and transplanted either directly onto prepared rehabilitation surfaces, or placed into storage for later use.
- All trees of commercial value will be harvested and removed from the site by Forest Products Commission (FPC), in accordance with the Fauna Management Plan (CD911).
- Habitat logs and vegetation debris identified for use in the post-mining rehabilitation will be removed and stockpiled.
- All other standing vegetation and vegetation debris remaining at ground level will then be cleared and pushed into wind rows located within the disturbance area.
- Excessive quantities of cleared vegetation debris may only be burnt if specifically permitted by the Bemax Environmental Officer.

The Bemax Minesite Supervisor will be responsible for implementing appropriate surface drainage measures immediately following each clearing stage. An engineered drainage plan for each stage of clearing will be developed by the Bemax Mining Engineer prior to each stage of clearing commencing.

4.4 TRANSLOCATION

Principle Work Instructions:

- **WI 068 - Block harvesting procedure**
- **WI 279 - Dieback and weed hygiene.**

Translocation will be undertaken following demarcation of clearing boundaries, but prior to removal of commercially valuable timber. The Rehabilitation Advisor will be responsible for identifying and marking out areas of vegetation and individual plants that will be targeted for translocation ahead of the mine path.

There will be two types of translocation occurring as an integral component of rehabilitation activities at Happy Valley:

- selected blocks of vegetation supporting dense ground covers dominated by sedges will be moved *in situ*
- recalcitrant or slow growing plant species will be targeted as individual plants.

Bemax has successfully implemented both translocation methods at the Jangardup, Ludlow and Gwindinup North mine sites for a variety of plant taxa including *Anarthria scabra, Xanthorrhoea gracilis, Xanthorrhoea preissii* and *Macrozamia riedlei*.

A major goal will be to undertake translocation in a single process directly onto prepared rehabilitation surfaces. Where this cannot be achieved, short-term storage will occur on stockpiles comprising 'lower topsoil' material.

Block translocation

Current best practice will involve the use of a front-end loader with modified bucket (neoprene base and hydraulic arm) to relocate selected blocks of vegetation. A number of blocks will be relocated together onto prepared re contoured rehabilitation surfaces to provide a minimum consolidated footprint greater than 100 m^2 (10 m x 10 m). This will result in a mosaic of grouped translocation blocks across the rehabilitation surface, referred to as 'clumps', prior to replacement of lower and upper topsoil. Replacement of topsoil will aim to ensure the upper surface of relocated blocks is at the same finished level (RL) as relocated topsoil, to ensure a consistent surface hydrological status across the rehabilitation. The preference will be for translocation to occur during late autumn and early winter months, however, this may not always be achievable given the complicated schedules associated with mining and progressive rehabilitation.

Plant translocation

A front-end loader will be used to excavate topsoil and rootstock material around the drip zone of selected plant species, and direct return individual plants onto prepared rehabilitation surfaces following return of lower and upper topsoil, but prior to final scarifying. Translocated plants will be returned in discrete blocks to create a mosaic across the rehabilitated landscape. The timing of translocation activities will be species-dependent. However it is likely that most activity will occur during the late summer and autumn months when the majority of plants are in a dormant growth stage. It is noted that successful translocation of *Xanthorrhoea preissii* was achieved during late spring at the nearby Gwindinup mine site.

Bemax intends to trial a new device at Happy Valley, the 'tree spade'. This attachment has been specifically designed for harvest and transplantation of ornamental tree species, and will be adapted to increase the efficiency of harvesting a variety of native plant taxa at Happy Valley.

4.5 TOPSOIL MANAGEMENT

Principle Work Instructions:

- **WI 223 - Topsoil management**
- **WI 279 - Dieback and weed hygiene**
- **WI 377 - Erosion and sediment control.**

For all areas of native vegetation that will be disturbed at Happy Valley, specific topsoil blocks will be handled separately on the basis of vegetation type and dieback status. There will be six native topsoil groups in total, as defined in Figure 14.

All native topsoil will be double stripped under dry conditions, preferably between the months of April and May. The upper 50 mm of topsoil (referred to as 'upper topsoil') will be stripped using scrapers or tractors with GPS buckets, and stockpiled separately to the lower 150 mm of topsoil (referred to as 'lower topsoil'); lower topsoil will also be stripped using scrapers or tractors with GPS buckets.

The focus of the mine plan on minimising clearing, places restrictions on the area available for stockpiling rehabilitation materials, while the depth of the pit and multiple spoil types precludes direct replacement of topsoil across 100% of the mine path. These limitations have resulted in a focus on maximising direct and seasonal return (i.e. within the same summer period, November – April) of the 'upper topsoil' resource onto areas currently supporting the highest plant species richness; the Whicher Sandy Slopes community and the Sandplain community. It is estimated that direct and seasonal return of upper topsoil will be achieved across 50% of the Whicher Sandy Slopes community and 90% of the Sandplain community, for State Forest areas.

To facilitate direct and seasonal return of topsoil, some overburden will potentially be sourced from nearby Gwindinup South operations.

Where direct and seasonal return of the upper topsoil resource is not practicable, care will be taken to ensure that native topsoil is stockpiled separately and distanced to that sourced from cleared farmland, to prevent weed infestation. Further segregation based on vegetation community boundaries, and the presence/absence of dieback (*Phytophthora cinnamomi*) will also be implemented to mitigate the potential for secondary contamination. Progressive rehabilitation will also ensure the duration of topsoil stockpiling is minimised. Native topsoil stockpiles will be constructed over cleared native vegetation areas on the mine path, with upper topsoil stockpile height not exceeding 1 m, and lower topsoil stockpile height not exceeding 2 m.

In farmland areas, topsoil will be stripped in a single pass to a depth of 200 mm using scrapers, stockpiled to a maximum height of 4 m, and stabilised with a fast growing cover comprising of annual grasses.

4.6 OVERBURDEN HANDLING

Overburden is of sufficient depth to be handled independently of the ore, and will be removed by a combination of conventional earthmoving equipment, e.g. front-end loaders, bulldozers, scrapers, excavators and dump trucks.

Overburden will be classed into different groups according to soil profile, soil characterisation and dieback classification and stockpiled accordingly in preparation for its use in soil profile reconstruction. Overburden stockpiles will be managed for dust in accordance with the Environmental Management and Monitoring Program (CD913).

4.7 SOIL PROFILE RECONSTRUCTION

Principle Work Instructions:

- **WI 074 – Soil Profile Reconstruction**
- **WI 069 – Site preparation procedures**
- **WI 223 - Topsoil management**
- **WI 377 - Erosion and sediment control**
- **WI 279 - Dieback and weed hygiene.**

A total of four post-mining soil profiles have been determined appropriate for mined areas within the Happy Valley project area following reference to vegetation mapping, exploration (drill hole) data base, surface soil mapping to 1 m depth, test pit excavations to 8 m depth by Oracle Soil and Land, and test pits to 6 m depth by Bemax.

Three native soil profiles will be reconstructed post-mining, Kingia, Whicher Slope, and Sandplain, along with a dedicated pasture profile on privately owned and presently cleared farmland (Figure 14). The Kingia and Whicher Slope profiles will comprise two *in situ* overburden material types replaced to approximately 5 - 6 m depth from surface. Mineral to surface constraints within the Sandplain complex at HVS will require importation of a lower overburden resource to ensure direct and seasonal return of upper topsoil resource, which is seen as being critical to reestablishment of species richness at the site. Topsoil (double stripped to 200 mm depth) along with a further 500 mm of *in situ* overburden (containing mineralised ore) will be stripped and then replaced at the same position within the remade profile; understorey plant taxa were found to concentrate root development within the upper 500 mm of the pre-mining profile within the Sandplain complex. Additional overburden required to reconstruct the lower profile will be sourced from the adjacent Gwindinup South mine site. This lower overburden resource will be of similar physical and chemical character to the *in situ* material mined.

Kingia (laterite)

The Kingia profile will comprise a double stripped topsoil resource including upper topsoil stripped to 50 mm, and a second lower topsoil strip of 150 mm; total topsoil resource will be removed to 200 mm depth. Underlying the topsoil layers will be two overburden strata. The upper overburden stratum will comprise ‘gravelly sandy loam’ mixed with consolidated massive laterite that will be shattered during removal and stockpiling. On the basis of test pit and drill hole data, it is anticipated that the upper overburden layer will extend to approximately 2 m depth in the remade profile. The lower overburden stratum will comprise ‘mottled sandy clay’ down to approximately 5-6 m depth (Figure 15). This layer is likely to play a hydrological function by maintaining localised water-holding lenses for part of the season in the remade profile.

Whicher Slopes

The Whicher Slopes post-mining soil profile will comprise a double stripped topsoil resource including upper topsoil stripped to 50 mm, and a second lower topsoil strip of 150 mm; total topsoil resource removed to 200 mm depth. Underlying the topsoil layers will be two overburden strata. The upper overburden stratum will comprise 'grey yellow sand' to approximately 1.5 m depth in the remade profile. The lower overburden stratum will comprise 'mottled sandy clay' down to approximately 5-6 m depth. The lower stratum will be mixed with consolidated massive laterite shattered during removal and stockpiling (Figure 15).

Sandplain (HVS)

The Sandplain unit at HVS comprises ore to surface, and hence, there will be limited ability to remove *in situ* overburden for later replacement as a rehabilitation medium. The post-mining Sandplain profile will comprise a double stripped topsoil resource comprising upper topsoil to 50 mm, and a second lower topsoil strip of 150 mm; total topsoil resource removed will be to 200 mm depth. A 500 mm *in situ* surface overburden layer will then be removed for later replacement, making the total depth of *in situ* material removed 700 mm (representing a greater depth than the current plant root zone on the Sandplain complex). The lower overburden layer required during reconstruction of the soil profile will be sourced from the neighbouring Gwindinup South mine site. Loamy sand will be replaced at a minimum depth of 4.5 m (making total depth of the reconstructed profile 5.2 m, see Figure 15). This strategy will facilitate direct and seasonal return of topsoil at the Sandplain complex and ultimately increase plant biodiversity.

Pasture

The pasture landforms present within privately owned and currently cleared sections of the project area will be restored with the objective of creating a minimum of 1 m of freely draining soil beneath the final remade surface. The underlying spoil blend will comprise elevated clay content (mixture of dried fines and tailings sand) and play an important hydrological function by maintaining localised seasonal water-holding lenses in the remade profile. An indicative post-mining soil profile is represented in Figure 15 to illustrate how overburden, tailings sands and fines will be managed to achieve this criterion.

The pre-existing topsoil and subsoil (referred to as 'upper sand' in Figure 15) will be removed prior to mining at depths of 200 mm and 800 mm respectively. These materials will be stockpiled separately for later replacement to the same position within the post-mining soil profile. Following reshaping of the final landform, topsoil will be returned using scrapers and the surface then graded to ensure it is smooth enough to accommodate normal agricultural activities.

4.8 FAUNA HABITAT

Principle Work Instruction:

- **WI 067 – Fauna habitat development for native vegetation rehabilitation.**

Habitat logs, mulched vegetation and leaf litter removed prior to mining occurring within the proposal area, will be replaced within the rehabilitation areas. There will be a target density of five fauna habitats per hectare, e.g. ground stockpile, habitat log.

4.9 PERIMETER FENCING

Principle Work Instruction:

- **WI 095 - Protection of native vegetation rehabilitation from grazing.**

Cable Sands will fence the perimeter boundary of annual rehabilitation areas in small and discrete blocks aimed at reducing incursion by kangaroos, and hence grazing pressure on developing revegetation. Fencing will be completed using 'Griplock' mesh to approximately 1.2 m in height. The perimeter fencing will be maintained until rehabilitation has developed to a stage that is determined to be resilient to local grazing pressures. Consideration will be given to the inclusion of one-way escape pockets at corner locations within the design to facilitate the exit of larger animals, such as kangaroos, if they are encountered at nuisance levels.

4.10 DEEP RIPPING

Principle Work Instruction:

- **WI 069 – Site preparation procedures (ripping).**

There will be two stages of ripping in the rehabilitation process; deep ripping to relieve compaction in the upper profile following overburden replacement, and shallow contour ripping following topsoil replacement aimed at reducing potential for surface erosion and promoting a seed bed for establishing plants .

Deep ripping will be conducted with a D9 bulldozer and conventional triple tyne attachment to a minimum depth of 1 m, at half machine width intervals.

Surface ripping will be completed with either a conventional triple tyne attachment to a maximum depth of 0.2 m; the winged tyne attachment used successfully at the Ludlow mine site will be trialled in sandier topsoils where consolidation of ripline shape may be compromised by ripping with the triple tyne configuration. Rip lines will be oriented along landform contours and conducted during late autumn / early winter, immediately prior to direct seeding.

4.11 DIRECT SEEDING

Direct seeding will be used to provide a fast establishing vegetative cover, while also enhancing overall plant biodiversity. Native seed will be supplied by experienced operators, familiar with the Whicher Scarp region. All collections will be local provenance and harvested under an appropriate permit issued by DEC.

Three native vegetation communities will be re-established on mined ground at the Happy Valley project area; Kingia, Whicher Slopes and Sandplain. The seed mix composition for each community will reflect differences recorded in the pre-mining environment with sowing rates reflecting dominance of the structural units required. Sowing rates for individual species in the final mix will be influenced by seed availability, seed quality and germination characteristics, and the relative importance of each taxa desired in the revegetation.

Optimising the success of direct seeded species will require a good knowledge base for plant species present within each of the three communities identified, including appropriate pre-treatments to overcome seed dormancy. Germination during the first growing season will be maximised by pre-treating hard seeded species with boiling water or mechanical scarification prior to sowing. Smoke treatment will also be applied to all seed collections.

Application of seed in the field will be completed by hand at a rate of approximating 4 kg/ha and as soon as practicable following surface ripping of the topsoil cover; likely to occur between April and June annually.

4.12 INOCULATION WITH MYCORRHIZAL FUNGI

Seed and seedlings used for rehabilitation will be inoculated with mycorrhizal fungi collected from the project area as outlined in the following stages:

1. Collection of mycorrhizal fungi as inoculum: Putative mycorrhizal fungi will be collected during the fruiting season (July-September) from the undisturbed forest floor.
2. Preparation of mycorrhizal inoculum and inoculation: Mycorrhizal fruit bodies will be air dried and prepared for inoculation in the nursery. Inoculum will be watered into sand trays prior to trays being sown (seed also mixed with mycorrhizal fungi), and mixed into the potting mix prior to pricking out of germinants and potting up.
3. Monitoring mycorrhizal development: To ensure that the mycorrhizal species have established, mycorrhizal development will be monitored in the nursery and/or in the field after planting (see also Section 5.1.1). The presence of mycorrhizal fungi will be established by recognition of fruit bodies.

4.13 PLANTING

Principle Work Instruction:

- **WI 152 - Planting Native Seedlings.**

A number of species occurring within the mining lease survive fire and other disturbance by resprouting from epicormic buds, lignotubers, rhizomes, corms, tubers or bulbs. Some of these resprouters also regenerate readily from seed, while for others this is rare (recalcitrant species). Regeneration from seed may be limited by low or infrequent seed set, low seed viability, the requirement for specific germination stimuli, or a short-lived seed bank. For species that only set small quantities of viable seed, seedlings will be propagated from this resource in the nursery and then planted into prepared rehabilitation areas (Appendix 3). For species where seed collection or germination of seed is not possible, plants will be produced by vegetative propagation using cuttings or rootstock material (Appendix 3). Commercial nurseries will be contracted to supply much of the required stock, with the balance supplied by Bemax's own nursery in Bunbury. All nurseries will be required to operate in accordance with the Nursery Industry Association of Australia's NIASA Best Practice Guidelines.

Because of the short period between collection of seed (usually completed by April each year) and planting time (May-July), seed and cuttings for tubestock production of understorey species will be collected in the year prior to planting to ensure a sufficient period for propagation. Seedlings for understorey species will be planted evenly across the entire rehabilitation site at a rate >1,000 plants

ha^{-1}. With a variety of other understorey species also developing from seed, the re-established vegetation is expected to have a suitably randomised distribution.

4.14 MAINTENANCE

4.14.1 Erosion Control

Principle Work Instructions:

- **WI 224 – Native vegetation pre-clearing checklist**
- **WI 377 – Erosion and sediment control.**

The Happy Valley deposits lie on the Whicher Scarp and include almost fully-cleared land on the Coastal Plain, and dense intact native vegetation on the scarp proper. Potential erosion impacts associated with mining-related disturbance are discussed below.

Surface Water

The quality of surface waters will be protected by planning and enforcement of a minimum 30 m buffer zone adjacent to significant watercourses, except where disturbance to those watercourses is unavoidable (Figure 12). In those instances, diversion and re-establishment to the satisfaction of the government regulators will be undertaken. During the rehabilitation phase, areas disturbed and subsequently rehabilitated will be isolated from the catchment for at least the first wet season, until the risk of sediment transport into the catchment is at a reasonably minimal level.

To increase the water quality protection functions of the buffers, additional infill planting will be undertaken, using nursery seedlings of plant taxa already found in the buffers, including both wet and dryland species. Additionally, habitable debris such as hollow logs and rotting timber will be placed in the buffer areas to enhance their functions as wildlife refuge and corridors.

Groundwater

Re-establishment of important groundwater processes, especially those associated with groundwater recharge will be a priority of soil management. Potential off-site groundwater impacts will be ascertained and managed through the Water Resources Management Plan (CD916).

Soil and vegetation

Disturbance, stockpiling and replacement of soils will increase the likelihood of loss through wind and water erosion. The following proven controls will be used to maintain soil qualities and minimise loss through erosion (dust is managed under the EMMP):

- consideration will be given to capping upper overburden stockpiles with clay to reduce the potential for wind erosion (this has been successfully implemented at the Gwindinup North mine site)
- the perimeter of stockpiles will be appropriately bunded to ensure that any eroded material remains localized and can be managed
- topsoil stockpiles that are identified for longer term storage will be appropriately shaped, scarified and sown with an appropriate native species seed mixture

- staged clearing and progressive rehabilitation of mined areas will minimise the time that cleared areas remain exposed. Stockpiling of topsoil on the mine path will ensure that progressive rehabilitation occurs immediately behind the mine path, with native plant species providing a fast growing and permanent cover
- rehabilitation surfaces will be surveyed prior to final contour ripping with a dozer to reduce the risk of rill and gully erosion forming
- hydromulching and hydroseeding of steep slopes such as stockpile faces will be considered where necessary.

4.14.2 Vermin control

Principle Work Instruction:

- **WI 095 - Protection of native vegetation rehabilitation from grazing.**

The fauna survey identified a number of introduced species existing within the project area that are known to directly compete with native fauna for habitat including rabbits, black rats, foxes and feral cats. To reduce environmental pressure and encourage re-colonisation of native fauna into rehabilitation areas, there will be baiting programs undertaken in conjunction with DEC.

The close proximity of cleared agricultural land to the Argyle State Forest block has supported an increase in population numbers of some fauna species to nuisance levels. The increased numbers of rabbits and kangaroos in particular, produces heavy grazing pressure on native vegetation and has the potential to impact significantly on rehabilitation areas within the project area. Grazing pressure will be reduced within newly rehabilitated areas by:

- baiting for rabbits annually in and around rehabilitation areas, as described in WI095
- fox and feral cat control will be conducted in accordance with the Fauna Management Plan (CD911)
- perimeter fencing will be constructed around the mining area, with internal fencing of discrete rehabilitation blocks to reduce grazing pressure during establishment.

4.14.3 Fire Management

Principle Work Instruction:

- **WI 225 - Management of clearing operations.**

Appropriate fire management strategies will be important in conserving biodiversity of the forest, providing protection to developing revegetation and enhancing rehabilitation resources available. Management will address fire in terms of its implementation as a tool (controlled burns), and as a threat (bushfire).

Bemax will liaise with DEC to ensure that fuel loads within State Forest areas of the mining leases remain at acceptable levels throughout the mining life, and that any controlled burns undertaken within the mining lease areas are integrated with the surrounding State Forest. These management goals will be achieved by adopting the following strategies.

Planning - Conservation

Develop and implement a schedule of controlled burns for native vegetation managed by Bemax, in consultation with appropriate stakeholders.

The following stakeholders have been identified:

- DEC Blackwood Region
- Capel Bushfire Brigade
- Elgin Bushfire Brigade
- Capel LCDC.

Planning - Rehabilitation

The necessary measures will be implemented to ensure that fires do not threaten rehabilitated areas until those areas are deemed able to withstand uncontrolled fire. Firebreaks will be established to a minimum width of 3 m and maintained at strategic points within the mining lease. All prescribed burning at site is to be approved by the DEC District Manager, when weather conditions permit and following guidelines outlined in WI225.

Safety and prevention

The following on-site measures will be implemented:

- all vehicles on-site will be equipped with operational fire extinguishers
- no naked flames or sparks (hot work) near vegetation without prior assessment and hot work permit
- update Emergency Preparedness and Response Plan (CD118) and training procedures to include Happy Valley operations, prior to works commencing.

Monitoring

There will be annual monitoring of fuel loads and requirement for control burn implementation in conjunction with DEC.

4.14.4 Dieback management

Principle Work Instruction:

- **WI 279 - Dieback and weed hygiene.**

Management of dieback during mining operations will:

- adopt a formal approach to managing the dieback threat
- ensure that the severity of infestation does not increase as a result of company actions
- ensure that uninfected areas remain protected during mining operations
- ensure that rehabilitation of infected or high-risk areas takes into account potential dieback impacts.

These management goals will be achieved on-site by adopting the following strategies:

Identification and assessment

The dieback status across the Happy Valley project area has most recently been assessed by Glevan in 2008, with areas mapped as infected, uninfected, or uninterpretable. For management purposes, the Precautionary Principle will be adopted at Happy Valley requiring that uninterpretable areas be considered uninfected and actions be taken to prevent the spread of dieback into and out of these areas. Bemax will follow strict hygiene protocols whenever entering areas of native vegetation within the mining leases, unless the area has been confirmed by a qualified interpreter as infected.

Quarantine areas

Access into areas of native vegetation that are not to be cleared or disturbed will be strictly controlled by a combination of locked gates and barricaded access. There will be clear signposting informing of restricted access at these points. These areas will be clearly demarcated on a site map and included into the formal site induction process. Entry into these areas will be restricted to environmental activities, such as monitoring, seed collection and fire control; appropriate hygiene measures will apply prior to entry (as described below).

Demarcation

There will be clear field demarcation between infected and uninfected areas using sighter wire (or equivalent), with green and red sign boards constructed at boundaries along access points - green representing infected and red representing uninfected. Appropriate hygiene measures will be installed at all red access points, and there will be a requirement to wash-down all vehicles prior to entering.

Hygiene

It is important that all vehicles and machinery entering areas mapped as dieback-free or uninterpretable enter and exit through controlled points and follow established wash-down procedures. The establishment and maintenance of these points and facilities will be the responsibility of the Mine Site Supervisor.

Plant stock used for rehabilitation works in uninfected areas will be certified dieback-free.

Soil handling

Soils from dieback-free areas will be stripped and stockpiled separately and replaced into similar locations. As it is unknown to what depth *P. cinnamomi* infects the soil profile, overburden from the root zone of uninfected areas will also be managed separately.

Drainage

Water from roads, stockpiles and other soil disturbances/trafficked areas will be diverted away from uninfected areas. Where appropriate, culverts will be constructed across small waterways to reduce disturbance by vehicles. All stockpiles will have perimeter bunding to localise the spread of any surface erosion.

Monitoring

There will be soil testing completed from selected topsoil stockpiles to confirm that dieback-free stockpiles have not become infected during storage.

Contingency actions

In the event that management actions are deemed insufficient to meet management objectives, the following actions shall be employed following consultation with relevant stakeholders:

1. Halt vehicle access into designated protection areas for a specified period.
78. Review hygiene procedures and their implementation.
79. Review rehabilitation objectives and/or plans.
80. Utilise more aggressive dieback control measures, such as phosphite spraying.

4.14.5 Weed Control

Principle Work Instructions:

- **WI 378 - Weed management within native vegetation rehabilitation**
- **WI 279 - Dieback and weed hygiene.**

The major objectives of weed management will be the exclusion of weed species from native rehabilitation areas, and preventing importation of weed propagules into undisturbed forest areas. These management goals will be achieved by adopting the following strategies:

Understanding current conditions

A comprehensive database has now been compiled on the composition and distribution of introduced flora within the project area. Areas of native vegetation occurring within State Forest will be handled separately to native vegetation and pasture areas occurring on privately owned land.

Hygiene

Weed hygiene will operate in a similar manner to dieback hygiene. All vehicles and machinery will be required to 'wash down' before entering native vegetation / rehabilitation areas. Wash-down facilities will be provided at strategic access points that will be clearly signposted, and requirements will be addressed during site inductions.

Topsoil stockpiles

Topsoil removed for native vegetation areas will be stockpiled on the mine path surrounded by intact native vegetation and distanced from annual pasture. Stockpiles will have their origin (stripping location) recorded and this will be clearly labelled to ensure the material is replaced at the same location.

Topsoil removed from annual pasture will be stockpiled separately to native topsoil, with stockpiles distanced from cleared native rehabilitation areas.

Monitoring

Weed establishment across the project area will be routinely monitored qualitatively by the Bemax Rehabilitation Advisor, with appropriate spray programs implemented as required.

5. MONITORING AND REPORTING

5.1 MONITORING

The rehabilitation monitoring program is designed to assess the effectiveness of rehabilitation strategies and the progression towards completion criteria (Table 13). Monitoring will be the responsibility of the Bemax Rehabilitation Advisor, and will be conducted in accordance with the appropriate procedures.

Impact and reference sites for monitoring rehabilitation progress will be selected prior to ground disturbance. Sites will be selected on the basis of having similar soil–landform associations, vegetation communities, and fauna habitats to allow comparison between impact and reference sites with replication. Off-site impacts will also be monitored by establishing monitoring sites in susceptible areas adjacent to the mining proposal (e.g. near watercourses potentially receiving waterflow from the proposal area, areas downslope of the mining proposal).

In rehabilitation areas, measures of vegetation recovery (species richness and diversity, plant density, percentage cover) will be used as proxies for ecosystem recovery, which is endorsed by the EPA (EPA 2006). Measures of soil fungal diversity and abundance will also be taken, although there is currently insufficient knowledge concerning fungal biodiversity in Western Australia to use this data for comparative purposes (EPA 2006). Collection of data on the response of fungal communities to disturbance and rehabilitation will establish a valuable resource for use in future rehabilitation projects.

Rehabilitation monitoring data will be retained by the proponent along with baseline environmental assessment data for a minimum of seven years from the date of survey completion.

Table 13 Summary of monitoring program for the rehabilitation areas

General Rehabilitation Objectives	Parameter	Frequency/Duration	Location	Purpose
To return to those areas disturbed by mining, stable and appropriate topography, hydrology, soil profiles and topsoils (i.e. abiotic factors) determined by pre-disturbance studies as being best able to satisfy the final land-use concepts and rehabilitation objectives. To return normally self-sustaining native vegetation communities that are as close to the original as possible (in terms of composition, extent and abiotic characteristics) and that are capable of being managed without unwarranted additional expense. To improve the condition of vegetated sequences from the foothills and flats to the upper slopes and plateau.	Soil profile including fungi	Prior to topsoil replacement (see Section 5.1.1 for additional information)	Random locations within established sampling plots	To ensure completion criterion are met
	Topsoil nutritional status	Biennially (see Section 5.1.1 for additional information)	Test pits constructed within annual rehabilitation blocks	To determine long-term trends in soil nutrition
	Vegetation (seed germination, plant establishment and survival, species diversity, weed establishment, insect and fungus attack, cover (through permanent photographic monitoring points)	Qualitative assessment up to 15 months of age Quantitative assessment commence in second spring following rehabilitation (15 months) and continue on an annual basis until the third assessment, at which time the monitoring interval will be extended to a triennial basis (once every three years) (see Section 5.1.2 for additional information)	Assessment transects established randomly throughout annual rehabilitation blocks (number of transects determined by species area curves)	To ensure performance targets are met
	Dieback	Prior to respreading from storage area	Within stockpiles	To ensure stockpiles have not become dieback infested during storage
		Annually	Within rehabilitation areas and surrounds	To determine the spread of existing dieback affected areas and identify any introductions of dieback
	Fauna	Monitor use of fauna habitat on a triennial basis	Within rehabilitation blocks	To determine whether fauna are utilising the fauna habitats relocated within rehabilitation areas
		Evidence of vermin assessed every 3 months (tracks, scats, fence still in-tact etc.)	Within rehabilitation areas	To determine effectiveness of control measures and ensure completion criterion are met
	Fire (fuel loads)	Annually	Within rehabilitation areas	To ensure fire loads are not excessive and determine requirement for a controlled burn
	Erosion	Monthly for first two years during the months from June – August Annually following initial two years	Within rehabilitation areas	To ensure erosion is not occurring so rehabilitation areas are not adversely affected by sedimentation loss, and ensure completion criterion are met
	Groundwater	Water levels monitored monthly (See Section 5.1.3 for additional information)	In piezometers	To determine prevailing groundwater conditions

5.1.1 Soil monitoring

Soil profile

The techniques used will largely mirror those used in the pre-mining studies of soil characterisation including the annual excavation of test pits to allow analysis of physical and chemical soil parameters down the reconstructed soil profile.

Topsoil nutritional status

In addition to a detailed assessment of the soil profile prior to topsoil replacement, revegetated topsoil will also be sampled at two year intervals to determine long-term trends in soil nutrition. Parameters to be analysed will include:

- % organic carbon
- pH
- electrical conductivity
- nitrate and ammonium nitrogen
- phosphorus
- potassium
- exchangeable cations
- trace elements (e.g. Cu, Zn, Mn, Bo).

5.1.2 Vegetation monitoring

The sampling strategy chosen for the Happy Valley rehabilitation reflects the objectives of the site, and allows for assessment of revegetation progress towards achieving completion criteria.

Qualitative assessment of rehabilitation will be undertaken on a regular basis during the first growing season following establishment, and up to 15 months of age. Seed germination, plant establishment and survival, species diversity and weed establishment will be key parameters monitored during this period.

Quantitative monitoring of rehabilitation will commence in the second spring following rehabilitation (15 months) and continue on an annual basis until the third assessment, at which time the monitoring interval will be extended to a triennial basis (once every three years). This will supply information for evaluation of completion criteria (see Table 10).

Two monitoring procedures will be utilised to facilitate assessment of the overstorey and understorey strata respectively (see Figure 16).

Overstorey assessment

Permanent 10 x 10 m plots will be established to sample tree density, tree height and stem diameter at breast height (DBH) by species. Percentage cover from overstorey vegetation will also be recorded. Crown health will be scored via a visual assessment, giving particular consideration to symptoms of insect or fungus attack.

Understorey assessment

Permanent belt transects of 20 contiguous 1 m x 1 m quadrats will be established to sample plant density, % ground cover, and maximum height by species.

Rehabilitation blocks (as distinguished by vegetation type and rehabilitation age) will be sampled with adequate replication to ensure the data is representative of the vegetation present. This will be demonstrated via graphing of 'species-area curves' for the understorey vegetation.

5.1.3 Groundwater monitoring

The water level in piezometers will continue to be monitored on a monthly basis allowing for comparison with pre-mining conditions; details are fully outlined in the 'Water Resources Management Plan' (CD916).

Quarterly internal reporting of groundwater levels will assist in the assessment of rehabilitation success. Progress of vegetation towards the stated performance criteria may then be reviewed giving consideration to the prevailing groundwater conditions. A higher level of confidence that the revegetated landscape is sustainable over the long-term will be possible where monitoring indicates that groundwater has returned to approximate pre-mining levels.

5.2 COMPLIANCE REVIEW

Bemax operates a certified ISO 14001:2004 Environmental Management System. The core of which is the company's Environmental Policy, which has been approved and signed by the Operations Manager. Bemax routinely conducts internal audits (SP15 Internal Audits) to assess the compliance with, and effectiveness of various components of its EMS, including Environmental Management Plans. In addition, the entire EMS is audited externally every six months, with a full re-certification audit every three years. Audit findings are fed back into the EMS in order to improve environmental performance.

The Environmental Policy also requires that Bemax regularly monitor and audit its environmental compliance. Auditing of performance occurs via a series of compliance, internal and external audits that occur via the Integrated Management System.

The auditing of compliance with this management plan and any conditions or commitments related to management of mining and rehabilitation will be conducted on a 12-monthly basis throughout the project's life. The auditing will be conducted as per the Project Audit Schedule (CD490) and it the responsibility of the Senior Environmental Officer – Compliance/Operations.

5.2.1 Non-compliances

The EMS contains procedures for managing internal and external communications of environmental matters. Environmental hazards and incidents are reported using an incident report (CD018). All external complaints automatically generate an incident report that is forwarded to and dealt with by the Environmental Department (SP13 Non-Conformance and Preventative Action).

Non-compliances identified during the auditing process, through the EMS, or by stakeholder consultation will be brought to the attention of the Operations Manager and an incident report will be

completed. Non-compliances will be reported to the DEC, along with any measures that will be or have been taken to prevent recurrence of the conditions leading to the non-compliance.

5.3 PERFORMANCE REVIEW

Monitoring results will be reviewed by Bemax staff as they are recorded, to enable a response to be implemented immediately if required. The results of the entire monitoring program will be reviewed internally every three months as part of the EMS procedures.

5.4 CONTINGENCY ACTIONS

Contingency actions shall be employed if monitoring indicates that completion criteria for the rehabilitation areas have not been met or are unlikely to be met (Table 14). The Bemax Rehabilitation Advisor is responsible for implementing contingency actions where required whilst the proposal area remains under Bemax's care.

Table 14 Contingency actions for rehabilitation

Trigger	Action
Insufficient provenance seed volumes or plants collected and propagated from current seed collection areas	1. Extend seed collection area. 2. Determine if additional seed and plants can be obtained from other seed collectors and native nurseries. Discuss with the DEC the potential to use non-provenance seed and plants. 3. Prioritise areas for planting and/or direct seeding.
Inappropriate flora species used within vegetation communities on revegetation areas	1. Identify cause. 2. Remove inappropriate species and replace with appropriate species. 3. Ensure inappropriate species are not used in future.
Inadequate native flora species richness and/or cover	1. Identify cause. 2. Implement approach to remedy cause, which could include: · collecting additional provenance seed for direct seeding or plant propagation to compensate for the insufficient native plant species richness and/or cover · application of fertilisers or wetting agents etc. to improve soil fertility 3. Monitor success of additional direct seeding and plant installation.
Changes to native flora species diversity, richness and/or cover between monitoring years	1. Identify cause, could include: · favoured species is potentially invasive or a pioneer species · spatial and seasonal variation is attributing to succession within plant communities · limiting factors restricting the development of species (e.g. infiltration rates, groundwater level, soil surface features, diseases). 2. Implement approach to remedy cause, which could include: · application of fertilisers or wetting agents etc. to improve soil fertility · removing potentially invasive species · dieback treatment. 3. Monitor success of remedy.
Unacceptable weed infestations	1. Identify cause. 2. Identify the weeds, their location and coverage and obtain quotations from contractors to control them. 3. Employ a contractor to control the weeds. 4. Monitor success of control.

Erosion occurring	1. Identify cause. 2. Consult expert to determine appropriate remedy. 3. Implement remedy. 4. Monitor success of remedy.
Introduction of diseases, e.g. dieback	1. Confirm presence. 2. Identify cause. 3. Undertake sampling to determine extent. 4. Erect signage warning of infested area. 5. Consult expert to determine requirement for treatment (i.e. phosphite spraying or stem injection). 6. Undertake treatment, if required. 7. Monitor movements of infestation annually.

5.5 REPORTING

A report describing the performance of the IMRP in working towards its objectives, based on monitoring results and the extent to which it has been complied with, will be submitted to the DEC each 12 months on 31 March each year. The report will be provided to documented stakeholders and will be otherwise publicly available on request.

Upon completion of the rehabilitation project, it is envisaged that a rehabilitation case study will be compiled for dissemination of information regarding the efficacy of various rehabilitation strategies employed at this site. This will then be converted to an appropriate format and submitted for publication in an appropriate peer-reviewed journal.

5.6 STAKEHOLDER CONSULTATION

Bemax has developed a comprehensive consultation program that will be implemented throughout the feasibility, planning, commissioning, operational and rehabilitation phases of a project. The proponent has considerable experience in conducting large-scale consultation programs for past and current projects in the southwest and has established a working relationship with many of the stakeholders likely to be involved in the Happy Valley proposal. The proponent has prepared a consultation database, containing the names and contact details of important stakeholders. Since June 2007, Bemax has posted seven project updates to all stakeholders identified on the stakeholders database.

In May 2007, Bemax held the first meeting of the formal Working Party that it had established to actively involve the community in the environmental impact assessment process. The Working Party consisted of people and groups in the local area that had made submissions to the Environmental Scoping Document, including:

- Capel LCDC
- Capel Shire
- DEC
- SW Environment Centre and Busselton-Dunsborough Environment Centre
- Owners of Lot 215 to the north of the proposal
- Owners of Lot 1 to the west of the proposal.

As part of providing the general public with as many avenues as possible to access the required information in order to make an informed decision on the merits of the mining proposal, Bemax commissioned a web-space specifically for the Happy Valley project in May 2008.

Company contact details are always listed in documents provided to stakeholders to encourage the wider community to seek further information and provide feedback on the project. Bemax will continue to consult with relevant stakeholders throughout the duration of the proposal to ensure that the environmental aspects of the proposal are adequately managed.

5.7 DOCUMENT REVIEW

Bemax will review and revise as necessary the management plan on a two yearly basis or more frequently if required.