

CD953
Gwindinup Groundwater
Management and Monitoring
Native Vegetation Health

Revision 0
September 2009

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**Bemax Resources Ltd
incorporating Cable Sands (WA) Pty Ltd**

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0	September '09	Internal	This document is an amendment of, and supersedes, Version 4a (July '06) of the Strategen Document ' <i>GMMP- Native Vegetation Health</i> ': <ul style="list-style-type: none">• Incorporated document into Bemax Document Control System (General formatting changes).• Amended Monitoring schedule (approved by DEC-Env. Impact Assessment Division, 29/12/09).	3.2.1 Table 1

TABLE OF CONTENTS

1. OVERVIEW	1
1.1 PURPOSE	1
1.2 SCOPE	1
1.3 STRUCTURE AND CONTENT	1
1.4 RELATIONSHIP TO OTHER DOCUMENTS	1
1.5 LEGAL STATUS	2
1.6 MONITORING AND REPORTING	2
2. GROUNDWATER ENVIRONMENT AND HAZARDS TO NATIVE VEGETATION	3
2.1 OVERVIEW	3
2.2 ZONE A: CARTIS VEGETATION	4
2.2.1 VEGETATION DESCRIPTION AND CONDITION	4
2.2.2 RELATIONSHIP TO GROUNDWATER	4
2.2.3 HAZARD ASSESSMENT	4
2.3 ZONE B: WHICHER SLOPE VEGETATION	5
2.3.1 VEGETATION DESCRIPTION AND CONDITION	5
2.3.2 RELATIONSHIP TO GROUNDWATER	5
2.3.3 HAZARD ASSESSMENT	5
2.4 ZONE C: VEGETATION COMMUNITY TYPE 3C	5
2.4.1 VEGETATION DESCRIPTION AND CONDITION	5
2.4.2 RELATIONSHIP TO GROUNDWATER	6

2.4.3	HAZARD ASSESSMENT	6
3.	MANAGEMENT ACTIONS	7
3.1	OVERVIEW	7
3.2	ZONE A: CARTIS VEGETATION	7
3.2.1	MONITORING	7
3.3	ZONE B: WHICHER VEGETATION	7
3.3.1	MONITORING	7
3.4	ZONE C: COMMUNITY TYPE 3C	7
3.4.1	MONITORING	8
4.	ADDITIONAL MEASURES	8
4.1	SOIL MOISTURE AND NEUTRON PROBES	8
4.1.1	DETERMINATION OF BACKGROUND SITE (BASELINE DATA)	9
4.2	TRIGGERS	9
4.2.1	GROUNDWATER LEVELS	9
4.2.2	VEGETATION HEALTH	10
4.3	CONTINGENCY MEASURES	10
5.	REFERENCES	13

LIST OF APPENDICES

1. Procedure for Vegetation Health Assessment
2. Trigger levels for implementing contingency measures

LIST OF REFERRED TABLES

TABLE NO.	DESCRIPTION	LOCATION
Table W01	Register of monitoring bores – Gwindinup	

LIST OF REFERRED FIGURES

FIGURE NO.	DESCRIPTION	LOCATION
Figure W04	Groundwater Monitoring Locations	

1. OVERVIEW

1.1 PURPOSE

The purpose of this Environmental Management Plan (EMP) is to describe management actions to be implemented prior to and during the mining phase, as well as during rehabilitation, necessary to:

- avoid impacts upon native vegetation adjacent to the Gwindinup North mining area

This EMP includes a monitoring program to assess the effectiveness of the management actions and to ensure that changes to the availability and/or quality of local groundwater and vegetation are detected, reported and, if appropriate, acted upon.

1.2 SCOPE

This EMP applies to the Gwindinup North phase of the Gwindinup mining project, during the phases of mine planning, commissioning, operation and rehabilitation.

It specifically addresses management of impacts to the surrounding native vegetation not directly disturbed by the mining project that may be associated with changes to the groundwater table (potentially) associated with mining activities. Monitoring focuses on the shallow water table and vegetation health.

This EMP will be revised prior to the commencement of mining in the Gwindinup South deposit to accommodate risks that might be present in that area. The review will include experiences from the mining of the Gwindinup North deposit and the implementation of the EMP.

1.3 STRUCTURE AND CONTENT

This EMP consists of the following sections:

- **Section 2** – identifies vegetation at risk from dewatering impacts based on the investigations conducted to date (a full description is provided in the Overview document) and provides a preliminary assessment of vegetation health.
- Section 3 – lists the specific risks to the vegetation and details the management options (avoid/minimise/mitigate) for the risks. A monitoring, review and reporting program is included for each key risk area.
- **Section 4** – describes appropriate contingency measures, including incident reporting procedures.

A summary table is included to assist in easy identification of management measures and for auditing purposes (Table 1).

1.4 RELATIONSHIP TO OTHER DOCUMENTS

The background setting and investigation of the risks to groundwater supplies that have been used to identify the risks that are manageable under this EMP are described in the CER and its Supplement (Cable Sands Pty Ltd 2000; 2004), as well as the independent hydrological

review conducted by Aquaterra (2005). In addition, results from continuing studies and groundwater monitoring are contained in the “Groundwater Management and Monitoring – Gwindinup. Overview of Groundwater Studies” (the Overview).

Figures and maps cited in this EMP are located in the Addendum to the CER (Cable Sands 2005)

The management and monitoring of potential groundwater-related impacts to local users is described in the “Groundwater Management and Monitoring – Gwindinup. Local Users” EMP.

The restoration of important groundwater features and drainage lines following mining is described in the “Gwindinup Integrated Mining and Rehabilitation Plan”.

1.5 LEGAL STATUS

The EMP is a requirement of Ministerial Statement No. 718, issued by the Minister for the Environment and pursuant to the *Environmental Protection Act 1986*. Once this EMP is in final form and has been prepared to the satisfaction of the Minister for the Environment, changes to this document cannot be made without approval from the Minister.

All measures and actions contained in this EMP must be implemented as prescribed. Implementation of this EMP is auditable under Condition 5 of Statement No. 718. Failure to implement this EMP, as approved, may constitute a breach of the *Environmental Protection Act 1986*.

1.6 MONITORING AND REPORTING

In addition to the monitoring and reporting measures described in this EMP, additional measures will be undertaken at the GN operations as necessary to satisfy the site environmental license and the GN Environmental Management and Monitoring Program (EMMP), which is the over-arching environmental management document for the project. Monitoring requirements are reviewed annually.

Monitoring results and performance and compliance assessments are reported each March to the relevant government agencies and is available to the public.

2. GROUNDWATER ENVIRONMENT AND HAZARDS TO NATIVE VEGETATION

2.1 OVERVIEW

The vegetation of the Gwindinup mining lease area has been extensively surveyed by a number of recognised botanists, the most recent being a survey to identify the floristic community types and values of the Gwindinup North area (BEC 2004a). Descriptions of vegetation classification and condition used in this EMP have been taken from this survey.

The groundwater investigations identified areas of vegetation potentially at risk from anticipated worse-case drawdown from the Gwindinup North mining operations. These areas are shown in Figure 1 and are described in the following sections.

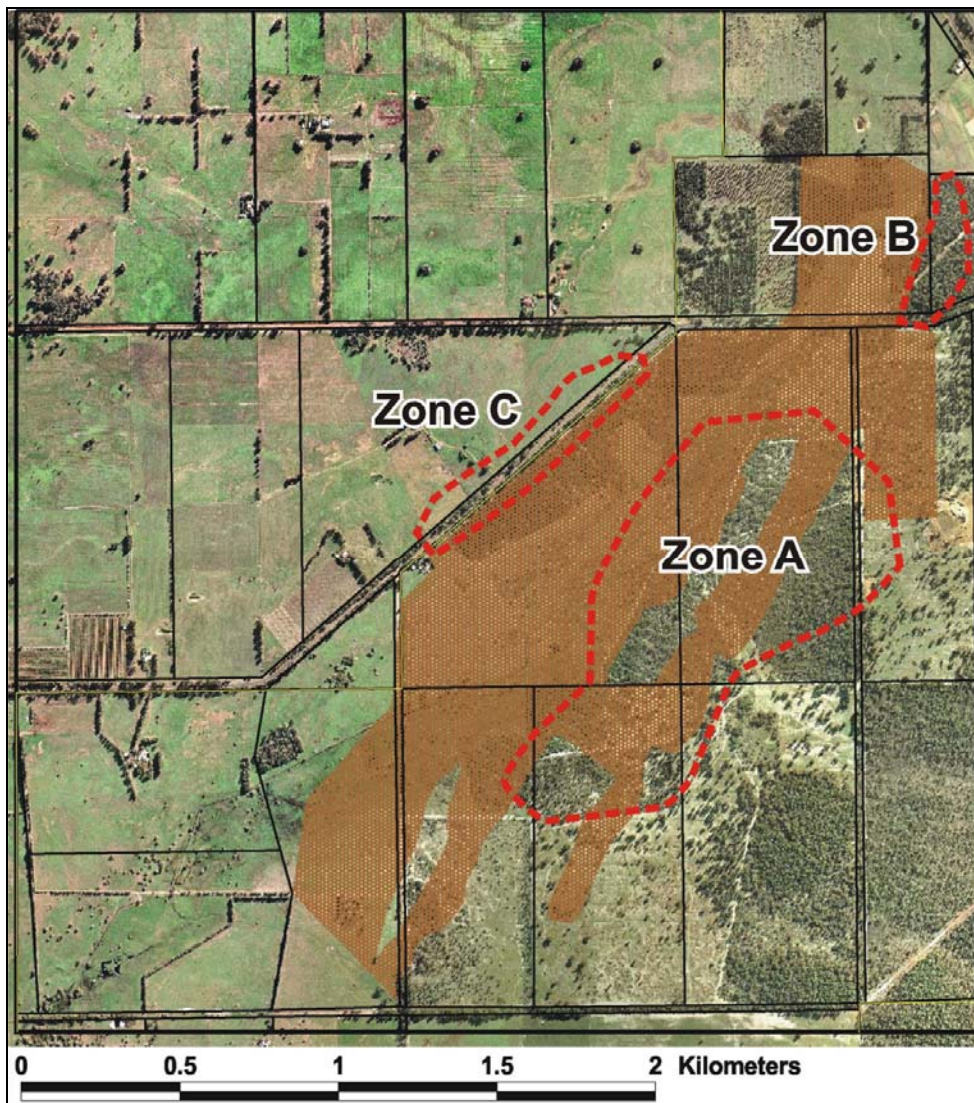


Figure 1 Key risk areas identified for Gwindinup North. The mining footprint is shown in brown.

2.2 ZONE A: CARTIS VEGETATION

Zone A is an area of approximately 15 ha that lies between the eastern and central strands of the Gwindinup North deposit. It includes 12 ha of native vegetation of the Cartis vegetation complex.

2.2.1 Vegetation description and condition

The Cartis vegetation complex (after Heddle *et al* 1980) consists low open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Corymbia haemotoxylon* with some *Banksia attenuata* and *Xylomelum occidentale* on escarpment slopes (CER p40). The soils are predominantly grey Bassendean Sands, occasionally grading to yellow at depth and overlying Guildford Formation clays to the south west of the Gwindinup North deposit and the Yoganup and Leederville Formations to the east and north east. Localised layers of coffee rock are commonplace between the Bassendean Sands and the Yoganup Formation, while lateritic layers predominate where the Bassendean Sands overlie the Leederville Formation.

2.2.2 Relationship to groundwater

Monitoring piezometer **GWMB22** is situated in the midst of the Cartis vegetation, and is screened through the Bassendean Sands to the top of the Yoganup (from 0 – 6 m below ground surface). Monitoring results from the piezometer indicate that there is no seasonal or permanent saturated water table in the Bassendean Sands in this general area. This is consistent with the geological model, which shows that clays only become evident 6 m or more below ground surface.

2.2.3 Hazard assessment

The death of a small area of Cartis vegetation adjacent to the Iluka Resources Limited mining operations at the nearby Yoganup Extended minesite has been investigated and the factors contributing to the death of the vegetation are well understood (refer to the Overview document for a detailed description). The shallow clay layers underlying the vegetation that were found to result in a localised perched water table within the upper 1 – 2 m of the surface do not appear to be widespread in the landscape. Furthermore, extensive investigations that included computer modelling, on-site excavations and the installation of monitoring bores, all give strong support to the conclusion that no similar clay layers exist within the vegetated areas of either of the Gwindinup deposits.

In addition to the localised shallow water table, it is recognised that there was an extended period covering two dry seasons between the excavation of the Yoganup Extended mine void and its backfilling. This scenario will be avoided in sections of the Gwindinup North mine that are adjacent to sensitive vegetation.

Apart from the isolated incident described above, the Yoganup mines of Iluka Resources Limited have not been associated with the death of fringing vegetation, either previously or since, despite mining mineral strands adjacent to Cartis vegetation.

2.3 ZONE B: WHICHER SLOPE VEGETATION

2.3.1 Vegetation description and condition

The Whicher Slope vegetation complex forms an open forest of *Eucalyptus marginata* and *Corymbia calophylla* on the escarpment, with some *Corymbia haematoxylon*, *Banksia attenuata* and *Xylomelum occidentale* (Cable Sands 2000). In the designated area (Zone B), the condition of the vegetation was noted as being better (excellent to very good) in the more elevated areas east of the proposed pit, compared to the lower areas closer to the pit, which consisted largely of *Agonis flexuosa* (BEC 2004a, 2004b).

2.3.2 Relationship to groundwater

The soils associated with this vegetation predominantly consist of shallow grey or yellow sands over deep yellow sands and gravel. Laterite (as continuous layers or heavy gravel) may or may not be present in this layer. Below this, mottled sandy clay is typically present and is associated with the upper zones of the Leederville Formation.

Monitoring piezometer **GWMB08** is located in the area, and records show that there is no saturated water in the upper soils, with the standing groundwater level being in excess of 20 m below the ground surface.

2.3.3 Hazard assessment

Although the vegetation in Zone B is immediately adjacent to the edge of the mine void, which will be approximately 25 m deep, the vegetation does not obviously rely on a saturated water table, but instead satisfies its plant moisture requirements from the deep, unsaturated or semi-saturated soil profile (as indicated by the mottled clays). Therefore, it is not expected that the Gwindinup North mining operations will affect the moisture availability to this vegetation.

2.4 ZONE C: VEGETATION COMMUNITY TYPE 3C

2.4.1 Vegetation description and condition

A threatened ecological community (TEC) of Swan Coastal Plain floristic type 3c has been identified west of the GN deposit, along the eastern margins of the road reserve on Lowrie Road. This community includes the mallee form of *Corymbia calophylla*³ and is located on the heavy clays of the Guilford formation.

The population has been rated as Good to Degraded (4-5) as per the Bush Forever vegetation condition rating, thus indicating that the species composition of the understorey has been significantly to severely altered and is unlikely to regenerate without a significant management effort (BEC 2004b).

³ Type 3c communities are generally located on heavy soils on the eastern side of the Swan Coastal Plain (DEH, 2005).

2.4.2 Relationship to groundwater

The vegetation along the road verge sits in shallow, coarse gray sands that overlie a thick layer of clay (5 – 8 m plus) of the Guildford Formation. The upper layer of the clay is weathered and somewhat friable, while at greater depths, the clay becomes massive and reduced, with no evidence of root penetration (refer to soil profile studies described in the Overview document for more information). The friable clays have good moisture-holding potential and the vegetation accesses moisture from this material. There is no saturated water table present in the area of the vegetation.

2.4.3 Hazard assessment

The *Corymbia calophylla* – *Xanthorrhoea preissii* Woodlands and Shrublands (Swan Coastal Plain Community Type 3c – Gibson et al. 1994) Interim Recovery Plan 2000 – 2003) identifies clearing as the main risk to this community but acknowledges that changes in hydrology may induce changes in species composition.

The TEC is located on the road verge, outside of the mining lease. Although the predicted cone of depression (from dewatering) shows that this area may experience a drop in the groundwater table, the model does not take into account the heavy Guildford clays and, consequently, tends to over estimate drawdown under these soil types (refer to the Overview document for more detailed information on this aspect). It is considered that the vegetation is not at risk from dewatering. Instead, it has been identified that changes in surface water availability in the immediate area is the priority for risk management. These changes could arise from flooding (such as emergency overflows) or from seepage (such as from solar drying dams).

3. MANAGEMENT ACTIONS

3.1 OVERVIEW

Despite the investigations that have been conducted to date have not identified any sizeable areas of vegetation that will be at significant risk of mine-related hydrological influences, a number of planning and operational measures will be applied as a conservative safeguard.

3.2 ZONE A: CARTIS VEGETATION

By minimising the period in which the Gwindinup North mine area is left unfilled, particularly on both sides of Zone A, it is reasoned that the risks to the remaining Cartis vegetation in the mine area will be minimal and not require further management.

For safety reasons, it may be necessary to remove vegetation for some distance back from the pit wall (max 25 m) to reduce the risk of the sandy pit walls from slumping. The total area of vegetation removed for this purpose will be within the clearing approval.

3.2.1 Monitoring

Piezometers **GWMB22**, **GWMB23** and **GWMB25 (b, d)** will continue to be monitored on a monthly basis for standing water level.

The health of the vegetation population will be assessed immediately prior to mining and also prior to commencing excavations adjacent to the vegetation. Surveys and visual inspections will continue to be conducted according to the procedure documented in **Appendix 1**.

3.3 ZONE B: WHICHER VEGETATION

The Whicher vegetation is not considered to be at risk, and the pit area adjacent will be open only for a very short time. Management will focus on early detection of impacts.

3.3.1 Monitoring

Piezometers **GWMB08** and **DNB1** will continue to be monitored on a monthly basis for standing water level.

The health of the vegetation population will be assessed immediately prior to mining adjacent to it and will continue to be monitored according to the procedure documented in **Appendix 1**.

3.4 ZONE C: COMMUNITY TYPE 3C

To minimise the effects of constructing and operating fines dams within the mining lease to the south east of Lowrie Rd, a 40 m area between the dams and the edge of the lease will be used for stockpiling topsoils from the mine area.

To ensure that the mining activities do not cause excessive flooding or drying of the TEC, any discharges or redirections of drainage into or out of the road reserve will be assessed prior to works commencing.

3.4.1 Monitoring

The health of the TEC will be assessed immediately prior to mining and will continue to be monitored according to the procedure documented in Appendix 1. Existing groundwater piezometers in the area will continue to be monitored on a monthly basis for standing water level.

4. ADDITIONAL MEASURES

4.1 SOIL MOISTURE AND NEUTRON PROBES

The use of soil moisture monitoring for irrigation scheduling is a relatively common practice (DoA 2005). This process employs monitors at specified depths in the soil profile, to determine the moisture content in unsaturated zones. Consequently, the theory of using moisture probes to investigate changes in the unsaturated zone has a firm grounding. Further, soil moisture monitoring has been adopted as part of the Ludlow Mineral Sands Project, with the procedures outlined in the Tuart Preservation Plan (Cable Sands, 2004) forming the basis for the monitoring that will be conducted at Gwindinup.

Bemax Resources NL will undertake monitoring of the soil moisture contents of the unsaturated zone by the neutron attenuation method, using a hydroprobe neutron moisture meter. Sample sites will consist of a sealed PVC pipe drilled to the approximate summer resting water level of the superficial aquifer with the external annulus backfilled in to provide the same soil profile as that which was removed during drilling. The annulus is sealed with a concrete plug to prevent external influence through preferred pathways for surface water infiltration.

Mining and rehabilitation will progress relatively rapidly through the deposit. Selection of appropriate monitoring sites will therefore have to occur on a progressive basis, keeping pace with the advance of mining and providing sufficient baseline data to enable assessment⁴.

- Monitoring of soil moisture will occur every second month
- Prior to each annual topsoil and overburden removal campaign (which will define the area of mining for the coming 12 months), at least 10 sites will be selected within risk areas defined in Figure 1 if mining is to come within 150m of native vegetation within these areas. Sites may be established in transect where vegetation is located close to the mine area.
- Once selected, PVC cases will be installed at each site in preparation for soil moisture monitoring.
- Monitoring will commence as soon as topsoil removal commences. Monitoring will continue until mining has advanced past the point of monitoring and results confirm there is no influence from mining or results have returned to normal levels (as determined by pre-mining data and comparison with control sites).

⁴ The Bemax Resources Work Instruction 'Procedure for Calibration of Neutron Hydroprobe' indicates that up to one season may be required to enable calibration of the probes.

- PVC sleeves to allow soil moisture testing will be retained for at least 12 months after the completion of mining to allow sites to be revisited at a later time.
- Two background sites remote from the mineral deposit will also be established to allow comparison with those in the vicinity of mining. These sites will be established in areas with comparable hydrology and vegetation types to those established within the mining lease.

4.1.1 Limitations of background sites

The results achieved through the use of neutron probe meters are affected by differing soil characteristics such as moisture, clay and organic content (Baldock, K 2005). On this basis, each site requires calibration to enable compensation for those influences other than moisture. Consequently, the use of background sites as a comparison is unlikely to provide sufficient accuracy to determine mining impacts and the setting of specific trigger levels is inappropriate. However, Bemax Resources will review information received from each site to determine potential reductions in the moisture content within the soil profile and monitor sample sites outside the predicted cone of depression to provide some indication of soil drying through mining activities.

4.2 TRIGGERS

4.2.1 Groundwater levels

Studies conducted on the Gngangara Mound, found that roots of native trees common to the Swan Coastal Plain can grow at a maximum rate of 0.2 m per year to remain in contact with a declining water table (Oracle, 2003). Consequently, a decrease in the superficial (Bassendean) watertable of 0.2 metres over 12 months or a decrease of more than 1.5 m over any period, has been determined as appropriate to initiate contingency action,.

To enable application of a trigger value, baseline data is required to form a comparison. However, as superficial aquifers are influenced by a number of factors outside the mining operation, a comparison of current monitoring data with historic results is considered to be ineffective at identifying impacts related to mining operations. To determine potential mining related impacts, trigger levels will be compared to monitoring data from a background bore influenced by similar factors, but divorced from potential mining impacts.

Determination of background bore (baseline data)

A background bore is required to be located in the same aquifer, with similar geophysical characteristics as the target bore, and outside the predicted cone of depression. Modelling of predicted drawdown impacts from the mine pit indicate that impacts are likely to extend approximately 235 metres from the pit.

The background bore will be determined through comparison of standing water levels in the potential background and target bores, with the strength of the statistical relationship the determining factor in determination of the background bore. Regression analysis will be undertaken on the datasets for the background and target bores to determine a modelling

equation⁵. A close linear relationship between the water levels at the background bore and target bore provides a high degree of accuracy in predicting impacts due to mining. Worked examples of the modelling method used to determine baseline data are provided the Overview document.

Suitable background bores will be identified and matched to key monitoring bores in the risk areas prior to the commencement of mining.

4.2.2 Vegetation health

Following the procedure for monitoring of vegetation health (Appendix 1) any areas recording a condition rating of 2 or more (above baseline) would instigate an investigation into plant deaths to species level and increase of monitoring frequency from quarterly to monthly.

Any areas recording a condition rating of 3 or more would require implementation of appropriate contingencies.

4.3 CONTINGENCY MEASURES

In the event that the health of the vegetation is found to be deteriorating unacceptably as a result of the mining operations, the possibility of hastening backfilling operations will be examined, coupled with an assessment of the suitability and likely success of watering and/or recharge mechanisms. Where possible, recharge of the affected watertable will be undertaken through the use of small spears or recharge basins up-gradient of the affected vegetation, in an attempt to reduce the possible mounding of the watertable.

In the event that vegetation health appears to be declining as a result of the mining activities, a recovery plan will be prepared and implemented that may include measures such as directing flows away from, or into the area of the TEC.

⁵ This method of using regression analysis to model background data was used to predict the flow of the Augustus River. In this situation, observed flows in the neighbouring Hamilton River were used to determine predicted flows in the Augustus River, with these flows used in the determination of the Ecological Water Requirements for the Augustus River (Wetland Research and Management, 2005).

Table 1 Summary of risk management and monitoring actions

Aspect	Hazard	Management	Monitoring	Trigger	Contingency
Cartis Vegetation (Zone A in Figure 1).	Cartis vegetation will be left standing in between the central and eastern strands and upslope of the eastern strand. Cartis vegetation is sensitive to mining operations where perched water table is present. No such feature identified under remaining vegetation. Risk is LOW – MODERATE.	Management will be to prioritise backfilling of at least one of the two strands after mining. Mine eastern strand in winter months, if possible.	Monitor piezometers 22, 23 and 25 (b,d) monthly for SWL. Routinely monitor vegetation health (both survey and visual).	A greater than 20 cm decline (corrected) in the superficial (Bassendean) water table over any 12 month period and a maximum decline of 1.5 m over any period A determinable decline in vegetation health.	Further identify risk (ie groundwater dependency) using exposed pit wall. Examine potentials to further hasten backfill. If warranted, commence detailed investigation into effective implementation of recharge.
Whicher Slope Vegetation (Zone B in Figure 1).	In the north of the GN project, the pit will come close to an area of Whicher Slope vegetation. Studies show no saturated water table to the depth of the Whicher soils (10-12 m). Risk is NEGLIGIBLE.	Management will prioritise backfilling of the pit area closest to the vegetation. No other management is considered necessary at this time.	Monitor piezometers 8 and DNB1 monthly for SWL. Routinely monitor vegetation health (both survey and visual).	A determinable decline in vegetation health.	If warranted, commence detailed investigation into effective implementation of recharge.
Vegetation Community 3c (Zone C in Figure 1)	A Threatened Ecological Community of Swan Coastal Plain Community Type 3C is located along Lowrie Rd, in the road reserve outside of the mining lease. Changes to the soil moisture availability, such as increased water levels in nearby drains, could potentially impact on the composition of the vegetation community. Risk is LOW - MODERATE.	Solar drying dams will not be constructed within 40 m of the road reserve. A review will be conducted prior to establishing or altering drainage that may pass along or close to the road reserve.	Routinely monitor vegetation health. Visually assess and record drainage status when assessing vegetation.	A determinable decline in vegetation health. Obvious excessive surface ponding.	If warranted, amend drainage layout or discharge practices as necessary to alleviate risk.

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Appendix 1 Procedure for Vegetation Health Assessment

PROCEDURE FOR VEGETATION HEALTH ASSESSMENT – PRE, DURING AND POST OPERATIONS

To ensure adequate replication and hence statistical validity of data, a minimum of 5 randomly placed belt transects will be established within each broad vegetation complex at the Gwindinup North mine site. Transects will be situated adjacent to proposed mine activities to maximise the likelihood of recording vegetation decline at the site.

Each assessment transect will comprise 20 contiguous 1 m² quadrats (20m by 1m). The corners of each transect will be permanently marked by four star pickets. Within individual 1m² quadrats, plant frequency, % ground cover and maximum plant height will be recorded for each plant species present. Transects will be sampled in early spring prior to mine excavation commencing, and will continue on an annual basis until 12 months following the completion of backfilling of the mining excavation. Data will be summarised for each 20m transect to provide mean plant density, mean % ground cover, and mean maximum plant height for each species. Annual data will be compared using one way analysis of variance testing ($\alpha=0.05$) to elucidate statistically significant differences.

In addition, a quarterly assessment of vegetation condition will be made along each of the 20 x 1m transects. Transects will be photographed from the north side, and a vegetation condition rating assigned based on the scale outlined in Table A1.1. Data will be summarised for each 20m transect to provide a mean condition rating. Quarterly data will be compared using one way analysis of variance testing ($\alpha=0.05$) to elucidate statistically significant differences.

Table A1.1 Vegetation condition rating scale.

Score	Observation
0	No evidence of stress
1	Odd plant showing signs of stress
2	One or two stressed plants usually under severe stress, near death
3	Scattered stressed and dead plants around plot
4	Susceptible plants dead or dying
5	Graveyard death, most plants dead

Appendix 2
Trigger levels for
implementing
contingency measures

TRIGGER LEVELS FOR IMPLEMENTING CONTINGENCY MEASURES

GROUNDWATER LEVELS

Method 1 – Default method

Studies conducted on the Gngangara Mound found that roots of native trees common to the Swan Coastal Plain can grow at a maximum rate of 0.2 m per year to remain in contact with a declining water table (Oracle, 2003). Consequently, a seasonally-corrected decrease in the superficial (Bassendean) watertable of 0.2 metres over any 12 month period will be used as a trigger level to initiate contingency action. An additional trigger of more than 1.5 m decline over any period will also be used.

Method 2 – Regression analysis with control bores

The following method is under development and will be implemented for those key sites where control bores are available and the monitoring records are sufficient.

To enable application of a trigger value, baseline data is required to form a comparison. However, as superficial aquifers are influenced by a number of factors outside the mining operation, a comparison of current monitoring data with historic results is unlikely to identify mining impacts. To determine potential mining related impacts, trigger levels will be compared to monitoring data from a background bore influenced by similar factors, but sufficiently free from potential mining impacts.

To determine an appropriate background bore, the bore is required to be located in the same aquifer, with similar geophysical characteristics as the target bore, and outside the predicted cone of depression. Modelling of predicted drawdown impacts from the mine pit indicate that impacts are likely to extend approximately 235 metres from the pit.

The background bore will be determined through comparison of standing water levels in the potential background and target bores, with the strength of the statistical relationship the determining factor in determination of the background bore.

Regression analysis will be undertaken on the datasets for the background and target bores to determine a modelling equation. A close linear relationship between the water levels at the background bore and target bore provides a high degree of accuracy in predicting impacts due to mining.

VEGETATION HEALTH

Method 1 – Survey (as per Appendix 1)

Monitoring results will be statistically analysed after each monitoring event following the baseline survey. A statistically recorded reduction in health will trigger further detailed investigation for potential mine impacts.

Method 2 – Photo-point monitoring

Bemax Resources NL will regularly inspect the vegetation in the general area adjacent to the ore body with observations and changes in vegetation recorded. A photographic record will be maintained for each transect, with this monitoring used to determine baseline levels and potential impacts. Photo-points will be established in specified areas, with photographic monitoring from these points undertaken on a monthly basis.

This photographic monitoring will provide baseline data on vegetation health, so that appropriate management action can be taken should vegetation exhibit stress or changes, relative to mining impacts. Factors such as fire, soil and climatic changes mean that the use of alternate sites as baseline data is difficult. Consequently, at least six months monitoring data will be used as baseline data for each site.

Due to the difficulty in determining if visible impacts are mining related, monitoring will be used as a pre-cursor to undertake further investigation for potential mining related impacts. Photographic records will form baseline monitoring for vegetation sites and include areas of significance, such as the *Eucalyptus decipiens* population.

A baseline spring survey was conducted in October 2005, during which photographic points were determined and baseline data collected. The information gathered from this will be used in the development of the Environmental Management Plan for the site.

Method 3 - Soil moisture monitoring

The use of soil moisture monitoring for irrigation scheduling is a relatively common practice (DoA 2005). This process employs monitors at specified depths in the soil profile, to determine the moisture content in unsaturated zones. Consequently, the theory of using moisture probes to investigate changes in the unsaturated zone has a firm grounding. Further, soil moisture monitoring has been adopted as part of the Ludlow Mineral Sands Project, with the procedures outlined in the Tuart Preservation Plan (Cable Sands, 2004) forming the basis for the monitoring that will be conducted at Gwindinup.

Bemax Resources NL will undertake monitoring of the soil moisture contents of the unsaturated zone by the neutron attenuation method, using a hydroprobe neutron moisture meter.

The results achieved through the use of neutron probe meters are affected by differing soil characteristics such as moisture, clay and organic content (Baldock, K 2005). On this basis, each site requires calibration to enable compensation for those influences other than moisture. Consequently, the use of background sites is unlikely to provide sufficient accuracy to determine mining impacts.

Due to the inability to determine background sites and external influences on soil moisture (climate and rainfall) the setting of specific trigger levels is inappropriate. However, Bemax Resources will review information received from each site to determine potential reductions in the moisture content within the soil profile and monitor sample sites outside the predicted cone of depression to provide some indication of soil drying through mining activities.