

**CD952**  
**Gwindinup Groundwater**  
**Management and Monitoring**  
**Local Users**

Revision 0  
September 2009



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

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<b>Rev. #</b>	<b>Issue Date</b>	<b>Reviewer</b>	<b>Description of revision</b>	<b>Sections Amended</b>
0	September '09	Internal	<p>This document is an amendment of, and supersedes, Version 4 (Jan '07) of the Strategen Document '<i>GMMP- Local Users</i>':</p> <ul style="list-style-type: none"> <li>• Incorporated document into Bemax Document Control System (General formatting changes).</li> <li>• Removed commitments relating to landowners of Lot 111 &amp; 114 (approved by DEC- Env. Impact Assessment Division, 28/1/09 &amp; 28/8/09).</li> <li>• Amended Monitoring schedule (approved by DEC- Env. Impact Assessment Division, 29/12/09).</li> </ul>	3.2.1, 3.2.2, 3.2.3, Table 1, Table W01, Appendix 1, Figure 1

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## 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, and during rehabilitation, necessary to:

- avoid, minimise and/or mitigate the effects of mining and related activities on local groundwater supplies to neighbouring users.

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 resources are detected, reported and, if appropriate, acted upon.

### 1.2 SCOPE

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

It specifically addresses management of impacts to the groundwater table that may be directly related to mining (disturbance of the soil profile) and indirectly related, through drawdown associated with abstraction from the Yarragadee Formation. Monitoring focuses on neighbouring groundwater users.

The EMP will be updated prior to the commencement of operations at the future Gwindinup South deposit and will incorporate experiences obtained during the GN operations. Relevant government agencies and other stakeholders will be provided with copies of the updated plan for review, prior to its implementation.

### 1.3 STRUCTURE AND CONTENT

This EMP consists of the following sections:

- **Section 2** – gives a brief description of the groundwater resources and potential hazards presented by the mine (a full description is provided in the Overview document) and identifies surrounding resource users.
- **Section 3** – lists the specific risks to local water users 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 complaint response 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 **Gwindinup Information Folder** (Cable Sands, 2004).

The management and monitoring of potential groundwater-related impacts to native vegetation is described in the “Groundwater Management and Monitoring – Gwindinup. Vegetation Health” 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 monitoring and reporting will be undertaken at the Gwindinup operations as necessary to satisfy the site environmental license and the Gwindinup 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

### 2.1 OVERVIEW

Investigations into the local hydrology and hydrogeology have been underway since 1999, culminating in the modelling of dewatering impacts by Aquaterra (2005). The model indicated that the effects of dewatering would be evident only during the period of mining and that the extent of drawdown of groundwater around the mine would be limited to a distance of approximately 235 m from the pit wall. The widely-used Leederville Formation would not be affected by the mine, as the mine is prohibited from excavating into, or dewatering from, the Leederville.

An important constraint of the Aquaterra model was its lack of capacity to predict the behaviour of both the shallow water table that exists in the sumpland and supported by the Guildford clay and the largely ephemeral water table that exists in the textural boundary between the Yoganup and Bassendean Formations. While this latter resource is not utilised by neighbouring landowners, the sumpland is used for summer watering of stock and is highly valued as a source of green summer feed. The Mining and Rehabilitation Plan has a very strong focus on re-establishing the soil profile, including replacing the different layers responsible for the hydrological behaviour of the landscape, such as the clays and sands that make up the sumpland.

The Overview document describes the environmental investigations that were used for the risk assessment that forms the basis for this EMP.

### 2.2 SUMPLAND ('GYNUDUP BROOK')

The sumpland that is the focus of this EMP is intersected by agricultural drains that are considered locally to be the headwaters of the Gynudup Brook, which continues southwest along a number of parallel drainage channels. The sumpland extends in a southward direction from Lowrie Rd, on Loc. 101 (**Figure W02**). The sumpland originally supported wetland and riparian vegetation types, although these have been predominantly cleared for the establishment of pasture suitable for cattle grazing, where the proximity of the water table and high organic content of the sands support an extended grazing season.

During the wetter parts of the year and when the water table is sufficiently high, flood water from the sumpland is directed via a number of drainage channels to a central drain, where it flows to the south west, under Brilliant Rd and into Lot 114.

#### 2.2.1 Potential hazards

The sumpland overlies much of the Gwindinup North mineral deposit and will be extensively disturbed during the mining process. This disturbance could possibly result in:

- a minor reduction in surface and subsurface flows to the southwest. Due to the low relief of the landscape, water movement to the southwest towards Gynudup Brook is quite slow and is not considered as significant as inflows from the elevated areas to the northwest and east of the sumpland (**Figure W02**).
- a reduction in summer groundwater levels in the sumpland. On occasions and when present, standing water in the lower-lying (excavated) areas of the sumpland has been

observed flowing under Boundary Road 'upgradient' to the northeast. While this is a reflection of the low hydrological gradient of the landscape, excavating across the clay basement could increase this 'reverse flow' and result in localised dewatering of the shallow groundwater table.

- an increase in vertical infiltration in the rehabilitated landscape. Removal of the clay horizon by mining activities to access underlying ore reserves would increase downward infiltration through the soil profile. Surface or sub-surface water that was previously directed into the sumpland and then discharged to the south west would instead drain into the underlying formations in a manner similar to local ephemeral streams that flow down from the scarp and then disappear in the grey Bassendean Sands.

Another aspect of mining operations that pose a risk to the downstream environment is the release of surplus water from the operations at a rate that is significantly greater than the drainage system is capable of accommodating, resulting in inundation of grazing areas for a period or at a depth greater than normally experienced.

## 2.3 GRIT STREAMS AND BEDS

Embedded (interbedded) in the clay layers of the Guildford Formation to the east and centre of the Gwindinup deposit are pods and streams of gravel (quartz and/or conglomerate) deposited or formed by fluvial actions. These lenses and/or streams (paleochannels) often act as reservoirs for rainwater or as a preferred pathway for groundwater and many are used by local residences for water supplies. These areas have been identified from aerial photography and from consultation with landowners. The presence of the grit stream and its dimensions and water levels and quality have been confirmed by drilling and the establishment of water monitoring bores.

Directly underneath the massive Guildford Formation clay layer, a thin veneer of coarse sands of unknown extent is evident, both from soil test pits and piezometer logs. The quality of groundwater in this formation is very fresh (120 mg/L TDS) but mildly acidic (pH 5.4). It is thought to overlie the Leederville Formation and be hydrologically connected in some way.

### 2.3.1 Potential hazards

The risks to this water resource relate to interception of the grit stream or palaeochannel by earthmoving equipment, allowing water to drain freely from the formation. The high hydraulic conductivity of the formation would transmit the effects of pressure changes over a very short timeframe, thus any remedial action would require immediate implementation to avoid extended drawdown of the water resource.

Mining is not considered likely to intersect or disturb the most significant of the grit streams identified in **Figure W02**, as the edge of the mining operations are more than 100 m from the channel. However, the reworked geological nature of the landscape may provide scope for feeder streams to be encountered during mining. Soil trenches and modelling of drill results indicate that a number of small and localised grit beds will be disturbed by the mining process. It is very improbable that these isolated features are connected to the main stream.

## 2.4 YOGANUP GROUNDWATER

The Yoganup Formation is made up of a number of Pleistocene or Late Tertiary shoreline deposits generally consisting of sand and lenticular clay beds with a basal conglomerate overlying the Leederville Formation or Bunbury Basalt. The formation is up to 18 m thick against the scarp, becoming thinner as it moves onto the plain. Water quality is variable with TDS in the vicinity of 300 mg/L, but at times may be quite fresh (120 mg/L TDS).

### 2.4.1 Potential hazards

Dewatering and potential drawdown risks are associated with the two Gwindinup deposits, up to an estimated distance of 235 m (Aquaterra 2005). There are only three confirmed groundwater access points within 3 km of the excavation boundary for the two Gwindinup orebodies (**Figure W03**). Most of the groundwater abstraction in the area is from the underlying Leederville Formation.

## 2.5 LEEDERVILLE GROUNDWATER

The Leederville Formation overlies the Bunbury Basalt or Yarragadee Formation and consists mainly of medium to very coarse-grained sand and gravel with thin interbedded clay. The formation wedges out to the west of the Gwindinup project area while thickening to the east. Near the Gwindinup deposit it is approximately 50-100 m thick. East of the Whicher Scarp the unit outcrops and has a deep, weathered lateritic profile.

Groundwater flow within the Leederville Formation in the vicinity of the Gwindinup deposit is north-westerly to the coast. Monitoring wells have been in place since 1999 and show the influences of seasonal changes and a steady downward trend.

### 2.5.1 Potential hazards

The Gwindinup Project does not intersect or abstract from the Leederville Formation<sup>3</sup>, so there is little risk posed by mining. There may be some impact as a result of abstraction from the Yarragadee Formation, which underlies the Leederville and is separated by the Bunbury Basalt. Constant discharge tests by URS in 2000 resulted in a 0.2 m drop in the Leederville at bore BUS8 and a 0.2 m rise in Leederville bore BUS3, so actual impacts are difficult to predict. This impact may become relevant given that a number of neighbouring windmills and shallow bores are located in the upper extent of the Leederville and, as such, could be sensitive to drawdown.

Concerns have been raised over the impacts that mineral sand mining along the base of the scarp may have on the Leederville recharge (CER Responses, 2004). This is associated with mines historically having poor infiltration characteristics. The risk of the Gwindinup deposits affecting Leederville recharge is considered low, as the two deposits, collectively, do not account for a significant proportion of the recharge zone and also that mining practices now focus on improving soil infiltration characteristics to maximise rehabilitation outcomes.

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<sup>3</sup> This aspect is included as an enforceable condition in the Ministerial Statement (Statement No. 718).

## 2.6 YARRAGADEE GROUNDWATER

The Yarragadee Formation forms a multi-layered confined aquifer predominantly (70%) comprised of weakly consolidated sandstone, with siltstone and shale interbeds. The formation thickness varies from 600m to 1,200 m. The depth to the Yarragadee Formation ranges from 360m to 215m in the Boyanup area.

Regional groundwater flow is northward and northwestward from the Blackwood Plateau. There is also a significant vertical downward hydraulic gradient from the upper aquifer layers to the lower layers. The groundwater flow reflects both topographic and recharge influences. Recharge occurs in areas on the Blackwood Plateau. It is also evident that there are vertical head gradients and potential for leakage from the overlying Leederville Formation, particularly in the areas east of the Whicher Scarp. Along the Whicher Scarp, the Yarragadee Formation is locally unconformably overlain by the Bunbury Basalt.

Groundwater quality within the Yarragadee Formation is generally fresh. A salinity of 360mg/L Total Dissolved Solids has been reported for the Sunnywest bore at Boyanup.

### 2.6.1 Potential hazards

Bemax Resources has applied for a license to abstract 1 500 ML per year from the Yarragadee Formation, using its production bore GWPB01. This equates to an average daily abstraction rate of 4100 m<sup>3</sup> per day. A Dames and Moore report (2000), adequately covers the anticipated impacts related to abstraction of a demand varying between 4000 - 8000 m<sup>3</sup>/day. Based on the lower abstraction rate, Dames and Moore predicted drawdowns of 1.3 m in the confined Yarragadee aquifer at the Abattoir bore (4 kms from the production bore) and 0.6 m in the Bunbury area. This drawdown was based on abstraction for 7 years, two years at the higher rate of 8000 m<sup>3</sup>/day and was determined by analytical calculations, rather than modelling. Note that abstraction requirements will now average 4100 m<sup>3</sup>/day.

A review of the Dames and Moore report by Aquaterra (2005) advised that the predicted drawdown was highly conservative, because it did not consider recharge from overlying aquifers, confining layers between the different aquifers and could not allow for the large screen interval (260 m) of the production bore.

Some areas have been identified where limited confining layers exist between the Yarragadee, Leederville and the superficial aquifers, where drawdown effects in the Leederville and superficial aquifer could potentially occur. Monitoring bores have been installed in these areas as part of the groundwater monitoring programme to be undertaken in accordance with the WRC Groundwater Well Licence.

## 3. MANAGEMENT ACTIONS

### 3.1 OVERVIEW

Groundwater users within the predicted zone of depression and sufficiently close to it have been identified and alternative measures that have been determined in consultation with the affected party, will/have been implemented. Impacts to these users are reasonably expected to be short-term only, if at all. However, because the sumpland that forms part of the Gwindinup North deposit is a feature of the landscape that will be interrupted by mining,

disturbances to neighbouring users of the sumpland could be much longer in duration unless the feature is reconstructed and the hydrology of the area reinstated.

### 3.2 SUMPLAND GROUNDWATER RESOURCES

#### 3.2.1 Prior to mining

To preserve drainage requirements, the current channel that traverses the sumpland will be diverted around mine operations adjacent to Lowrie Rd. In the first two years of mine development the diversion drain will then link into the main sumpland feature at locations ahead of mining. In the latter stages of the mining project the diversion will continue along Lowrie Rd and Brilliant Rd, where flows will rejoin the main agricultural drain that flows under Brilliant Rd. Flows in the diversion drain will include controlled discharges from the mine site<sup>4</sup>. This will further assist in recharging the shallow water table in the sumpland to the west of Brilliant Rd.

#### 3.2.2 During mining

The seasonal flows into Lot 114 that existed prior to mining will be maintained during mining and rehabilitation. This may require supplementation from other mine water sources.

To prevent unseasonable or excessive inundation of downstream pastures, peak discharges will be diverted into an existing drain to the north west of the mine site if required (**Figure W02**).

#### 3.2.3 Monitoring and reporting

A flow meter at the south west boundary of the GN mine site will continuously record the volume of water that flows into the drain on Lot 114 (**GWSW07**). Soil moisture measurements will be assessed in accordance with a specific monitoring program for Lot 114.

Four piezometers installed within the boundary of Lot 114, adjacent to mining operations will be monitored monthly for standing water level (**GWMB 26A,27A,28A & 29A**).

### 3.3 GRIT STREAMS AND BEDS

#### 3.3.1 On-site management

In the event that a grit stream or similar feature is intercepted during mining, its position, dimensions and discharge rate will be recorded. Based on these variables, one of the following actions will be adopted.

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<sup>4</sup> Surplus water from the mine water circuit, which is used to separate the mineral component from the ore in a slurry, is clarified to remove silts and sediments prior to discharge. All discharges are monitored and must meet water quality criteria specified by the Department of Environment and Conservation.

### *Monitor*

The simplest course of action is to monitor the rate and volume of discharge from the grit stream or gravel bed to identify to some level the extent of the water resource and hence the off-site risk. However, this approach should be conducted in a structured and coordinated fashion to ensure that the appropriate management action is adopted and that the management objectives of the program can be met.

### *Seal*

In the event that the resource is identified as significant and may result in offsite impacts or a flooding risk to the mine, the grit stream can be sealed across its course to prevent the continued discharge of water. This can be achieved by excavating a trench across the feature adjacent to the pit and backfilling with low-permeability material, such as clay.

### *Drain*

If the feature is not significant and flows are minor, it may be of little benefit to attempt to seal the feature. If the decision is made to leave the feature to drain, the rate and volume of groundwater needs to be periodically assessed to ensure that this course of action is still appropriate (re-assess if flows do not decline).

## 3.3.2 Off-site management

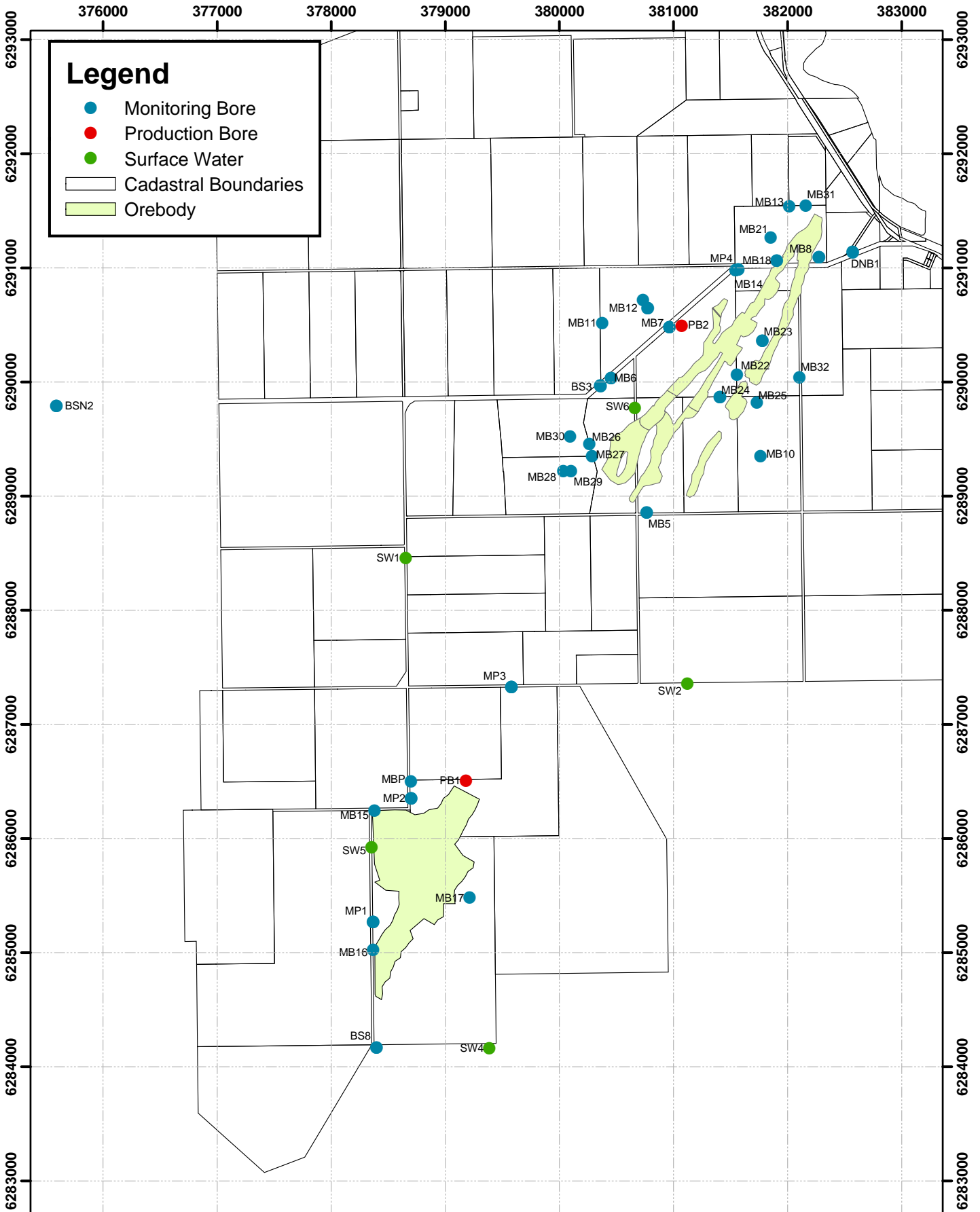
In the event that local users of the shallow water resource experience significant loss of water availability as a result of mine operations, then Bemax Resources will either recharge the local feature with potable water or make available an acceptable alternate supply, in accordance with the procedures described in Section 4.3.

## 3.3.3 Monitoring and reporting

A piezometer installed into the "Depression" feature adjacent to the dam on Loc 576 will be monitored monthly for standing water level (**GWMB31A**). Monitoring results will be reported to the land owner each month.

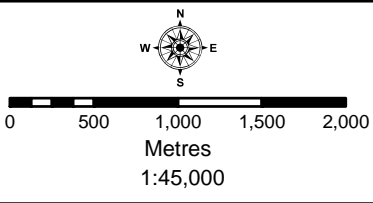
Piezometers installed in the grit stream on Loc 64 will be monitored monthly for standing water level (**GWMB11**; **GWMB12A**). Monitoring results will be provided to the landowner when requested.

Piezometers installed to the north and west of the GN deposit will be monitored monthly for standing water level and quarterly for water quality (see **Table W01** and **Figure W04** for location and description of piezometers).




### Legend

- Monitoring Bore
- Production Bore
- Surface Water
- ▭ Cadastral Boundaries
- ▭ Orebody



<b>W04 Gwindinup North Water Monitoring Locations</b>	
Drawn : Amy Robinson	Originator : B Edwards
Date : September 2009	Version : 3



File Name :

Datum : GDA Zone 50

### 3.4 YOGANUP GROUNDWATER RESOURCES

Potential impacts to landowners that access groundwater from the Yoganup Formation and that are at risk from the mining operations are managed through the agreements described in **Appendix 1**.

#### 3.4.1 Monitoring and reporting

Piezometers installed in the Yoganup Formation will be monitored monthly for standing water level and quarterly for water quality (see **Table W01** and **Figure W04** for location and description of piezometers).

### 3.5 LEEDERVILLE GROUNDWATER RESOURCES

Management will focus on the operation of the Yarragadee bores to minimise the risk of drawdown as a result of abstraction from the Yarragadee (Section 3.6).

Management of post-mining infiltration characteristics are addressed in the Mining and Rehabilitation Plan.

#### 3.5.1 Monitoring

Piezometers installed in the Leederville Formation will be monitored monthly for standing water level and quarterly for water quality (see **Table W01** and **Figure W04** for location and description of piezometers).

### 3.6 YARRAGADEFEE GROUNDWATER RESOURCES

Average daily production will be capped at 3973 m<sup>3</sup>/day, consistent with the production bore license.

#### 3.6.1 Monitoring and reporting

Abstraction volumes will be monitored on a daily basis and will be reported annually.

Piezometers installed in the Yarragadee Formation will be monitored monthly for standing water level and quarterly for water quality (see **Table W01** and **Figure W04** for location and description of piezometers).

## 4. AGREEMENTS AND DISPUTES

### 4.1 AGREEMENTS WITH SPECIFIC LANDOWNERS

Bemax Resources, through direct consultation with each of the listed landowners, has made specific commitments to minimise the impact of mining operations on their use of the neighbourhood's groundwater resources. These commitments are presented in **Appendix 1**, according to the land title(s).

Typically, these commitments cover:

- establishment of an alternative groundwater resource, such as a deep(er) bore into the Leederville Formation, fitted with the specified pump, prior to the commencement of mining operations
- provision of contingent water supplies if mining operations, once commenced, have an impact on existing supplies
- construction and monitoring of groundwater piezometers
- where applicable, pasture productivity is monitored, with scope for the provision of feed or pasture if impacts from the mine on pasture productivity are recorded.

These commitments form part of this EMP and are to be implemented as described.

#### 4.2 OTHER LANDOWNERS OR ISSUES

Bemax Resources has previously committed to 'making good' interruptions to, or significant reductions in available groundwater resources, if those resources were being accessed for a reasonable period of time prior to the mining operations commencing and that the impact can be attributed to the mining operations.

#### 4.3 COMPLAINT PROCEDURES AND DISPUTE RESOLUTION

Consistent with its Environmental Policy, Bemax Resources maintains internal procedures for recording and addressing the complaints and express concerns of neighbours and other members of the community in regards to the impacts of its operations on the environment and amenity (SP13). Compliance with these procedures is regularly reviewed by internal and external auditors.

It is the preferred option of Bemax Resources to address reported instances of unacceptable impacts on the groundwater resources by its mining operations through these procedures. However, if the issue cannot be satisfactorily resolved using these procedures, a more formal mechanism exists.

The mechanism to resolve disputes or differences between users of local groundwater supplies and Bemax Resources regarding impacts from the development and operation of the Gwindinup mines on local groundwater resources is described in Statement No. 718 (Schedule 2, Commitment 5). In accordance with the Statement, the process includes the following key elements:

- If a dispute or difference between users of the local water supplies and Bemax Resources arises, any party may give the other written notice of the dispute or difference, adequately identifying and providing details.
- The parties will then confer to resolve the dispute or difference, or agree on methods of doing so.
- If the dispute or difference is not resolved, the parties will agree to settle the dispute or difference by expert determination administered by the Australian Commercial Disputes Centre Limited.
- The expert determination will be final and binding on the parties involved.

- Bemax Resources will meet reasonable costs as determined by the “expert”.

Compliance with the Ministerial Statement is a legal requirement through the *Environmental Protection Act 1986*.

Table 1 Summary of risk management and monitoring actions

Aspect	Hazard	Management	Monitoring	Contingency
Sumpland/sump	Mining could disrupt local shallow groundwater and surface water flows along the sumpland, reducing availability to adjacent downstream users.	Direct surface drainage flows around GN mining operations to 'reconnect' to sumpland at progressive locations ahead of mining.	Monitor shallow water table at Lot 111/114. Monitor appropriate control/background site. Continuously monitor flow volume in agricultural drain at south west boundary.	Supplement as required to maintain seasonal flows and recharge local water table.
	Mine water discharge may cause flooding.	Emergency peak overflows will be directed along Clark Rd and not onto paddocks.		
Grit streams and beds	Mining may intersect paleochannels and beds used as a local groundwater resource	Implement agreed actions, where specified. Where unspecified, implement appropriate restitution/restoration of supply in accordance with policy.	Monitor designated water access/storage features and piezometers. Monitor water levels and quality of bores in grit stream.	Implement dispute resolution procedure.
	Mining may intersect paleochannels and beds <u>not</u> used as a local groundwater resource	Assess inflows and size of feature. Seal using clay bund if appropriate.	Visual inspection of inflows.	Review necessity to seal paleochannel.
Yoganup Formation groundwater users	Mining will lower the water table in the Yoganup Formation to a 400 m aerial extent	Implement agreed actions, where specified. Where unspecified, implement appropriate restitution/restoration of supply in accordance with policy.	Monitor water level and quality in piezometers screened in Yoganup.	Implement dispute resolution procedure.
Leederville Formation groundwater resources	Users with shallow Leederville bores may be influenced by a number of factors	Implement agreed actions, where specified. Where unspecified, implement appropriate restitution/restoration of supply in accordance with policy.	Monitor water level and quality in piezometers screened in Leederville.	Implement dispute resolution procedure.
	Users may be affected by drawdown from the Yarragadee	Implement appropriate restitution/restoration of supply in accordance with policy.		Review operation of production bore.
Yarragadee abstraction	Yarragadee users may be affected by drawdown	Implement appropriate restitution/restoration of supply in accordance with policy.	Monitor water level and quality in piezometers screened in Yarragadee.	Review operation of production bore.

Note: Water quality parameters: pH, EC, Major cations (Ca, Fe, Mg, Na), Major anions (Cl, SO<sub>4</sub>, HCO<sub>3</sub>)



## 5. REFERENCES

Aquaterra 2005, *Gwindinup Project – Independent Hydrological Review*, Aquaterra, Como, Western Australia, 25<sup>th</sup> February 2005.

Cable Sands, 2000. *Gwindinup Mineral Sands Mine*, Consultative Environmental Review.

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Strategen, 2004, *Gwindinup Supplement, Gwindinup Groundwater Monitoring Network*, Cable Sands, Report CD771, Perth

**Table W01 – Register of Monitoring Bores - Gwindinup**

PIEZO ID	EASTING	NORTHING	LAND TITLE	GROUND_RL	TOC_RL	SCREEN_DEPTH (M)	FORMATION	DATE INSTALLED	Comments
GWNMP1A	378366.680	6285266.300	4485	0.000	50.900	2 - 5m	Guildford	May-99	Quarterly monitoring of SWL until the commencement of Gwindinup South project.
GWNMP1B	378366.680	6285266.300	4485	0.000	50.900	16 - 22m	Yoganup	May-99	
GWNMP1C	378366.670	6285266.300	4485	0.000	51.000	27 - 33m	Leederville	May-99	
GWNMP2A	378700.210	6286352.900	3829	0.000	43.400	2 - 5m	Superficial - Laterite	May-99	
GWNMP2B	378700.190	6286352.900	3829	0.000	43.400	15 - 21m	Yoganup	May-99	
GWNMP2C	378700.180	6286352.900	3829	0.000	43.500	25 - 31m	Leederville	May-99	
GWNMP3A	379579.400	6287324.300	3829	0.000	40.500	3 - 6m	Superficial - Sand	May-99	
GWNMP3B	379579.410	6287324.300	3829	0.000	40.500	8 - 14m	Yoganup	May-99	
GWNMP3C	379579.420	6287324.300	3829	0.000	0.500	27 - 33m	Leederville	May-99	
GWNMP4A	381567.090	6290983.100	101	0.000	41.000	5 - 10m	Superficial - Upr Clay	May-99	
GWNMP4B	381567.080	6290983.100	101	0.000	41.000	12 - 15m	Yoganup	May-99	
GWMB5a	380765.400	6288858.500	109	49.420	50.310	0 - 3.7m	Superficial	Jun-04	
GWMB5b	380763.500	6288858.500	109	49.420	50.340	14 - 21m	Yoganup	Jun-04	
GWMB6a	380452.000	6290034.500	284	36.850	37.630	6 - 9m	Yoganup	Jun-04	
GWMB6b	380452.300	6290034.500	284	36.850	37.630	14 - 18m	Leederville	Jun-04	

Bemax Resources Incorporating Cable Sands  
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PIEZO ID	EASTING	NORTHING	LAND TITLE	GROUND_RL	TOC_RL	SCREEN_DEPTH (M)	FORMATION	DATE INSTALLED	Comments
GWMB7a	380963.300	6290481.000	63	39.180	40.040	8 - 11m	Superficial	Jun-04	
GWMB7b	380963.600	6290481.000	63	39.180	40.040	19 - 22m	Leederville	Jun-04	
GWMB8a	382274.900	6291095.500	3287	52.590	53.460	0 - 4.4m	Superficial	Jun-04	
GWMB8b	382273.900	6291095.000	3287	52.590	53.410	16 - 22m	Leederville	Jun-04	
GWNMB8C	382273.193	6291091.576	3287	52.457	53.129	5 - 11m	Superficial	FEB 06	
GWMB11a	380374.000	6290517.000	64	38.360	39.240	0 - 6m	Superficial - Grit Stream	Jun-04	
GWMB12a	380732.700	6290717.000	64	39.620	40.510	0 - 6m	Superficial - Grit Stream	Jun-04	
GWMB12b	380772.400	6290648.000	64	39.200	40.130	8 - 11m	Superficial	Jun-04	
GWMB12c	380775.300	6290647.000	64	39.200	39.850	18 - 24m	Leederville	Jun-04	
GWMB13	382013.300	6291540.500	3287	42.530	43.420	15.7 - 21.7m	Yoganup	Jun-04	
GWMB14a	381545.600	6290978.000	101	39.800	40.580	15 - 17.5m	Yoganup	Jun-04	
GWMB14b	381544.300	6290979.500	101	39.800	40.580	20 - 22m	Leederville	Jun-04	
GWMB15	378377.900	6286247.000	4485	37.300	38.500	0 - 4m	Superficial	Mar-05	Quarterly monitoring of SWL until the commencement of Gwindinup South project.
GWMB16	378368.000	6285021.500	4485	53.800	55.000	0 - 6m	Superficial	Mar-05	
GWMB17	379212.000	6285481.500	4485	61.400	62.600	0 - 4m	Superficial	Mar-05	
GWMB18a	381905.500	6291064.000	3287	41.240	42.410	0 - 3m	Superficial	Mar-05	
GWMB18b	381905.000	6291064.000	3287	41.240	42.410	14 - 17m	Yoganup	Mar-05	

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PIEZO ID	EASTING	NORTHING	LAND TITLE	GROUND_RL	TOC_RL	SCREEN_DEPTH (M)	FORMATION	DATE INSTALLED	Comments
GWMB21	381851.000	6291264.500	3287	41.720	42.860	0 - 3m	Superficial	Mar-05	
GWMB22	381554.400	6290067.000	101	46.100	47.300	0 - 6m	Superficial	Mar-05	
GWMB23A	381779.213	6290361.611	101	44.434	43.829	1 - 4m	Superficial	FEB 06	
GWMB23B	381778.573	6290361.052	101	44.351	43.826	6 - 12m	Yoganup?	FEB 06	
GWMB24B	381405.561	6289867.306	110	45.041	45.634	3 - 6m	Superficial	FEB 06	
GWMB24C	381407.968	6289867.030	110	45.041	45.730	9 - 15	Yoganup	FEB 06	Quarterly monitoring of SWL until the commencement of Gwindinup South project.
GWMB24D	381406.958	6289867.221	110	45.768	45.026	3.3 - 9.3		FEB 06	
GWMB25C	381730.849	6289817.189	105	57.818	58.509	11 - 17m	Yoganup	FEB 06	
GWMB26A	380261.376	6289457.399	114	35.539	36.185	0.2 - 2.2m	Superficial	FEB 06	
GWMB27A	380284.118	6289348.681	111	36.516	37.262	0.2 - 2.2m	Superficial	FEB 06	
GWMB28A	380032.806	6289216.999	111	35.475	36.242	0.2 - 2.2m	Superficial	FEB 06	
GWMB29	380100.023	6289216.535	111	36.124	36.843	0.2 - 2.2m	Superficial	FEB 06	
GWMB30A	380092.761	6289524.969	114	34.984	35.610	12 - 18m	Leederville	FEB 06	
GWMB31A	382156.997	6291545.096	3287	41.195	41.959	2 - 5m	Superficial - Grit Stream	Feb 06	
GWNB32	382114	6290153	105			31.2- 37.2m	Leederville	Nov 06	
GWNB33	381747.09	6289308.28	105				Leederville	Pending construction	

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PIEZO ID	EASTING	NORTHING	LAND TITLE	GROUND_RL	TOC_RL	SCREEN_DEPTH (M)	FORMATION	DATE INSTALLED	Comments
GWNPB1	379181.060	6286508.700	3829						
GWNMBP s	378698.360	6286498.200	3829		41.1	82.6 to 102.0	Leederville		Quarterly monitoring of SWL until the commencement of Gwindinup South project.
GWNMBP i	378698.360	6286498.200	3829		41.1	155.0 to 200.5	Yarragadee		
GWNMBP d	378698.360	6286498.200	3829		41.1	253.0 to 350.0	Yarragadee		



**Appendix 1  
Water Supply  
Contingencies –  
Adjoining Landowners -  
Gwindinup**



## **APPENDIX 1: PROPOSED WATER SUPPLY CONTINGENCIES – ADJOINING LANDOWNERS - GWINDINUP**

### **Lot 2 on Diagram 82050 & Lot 64 on Deposited Plan 232802**

1. Bemax Resources Limited will contract a licensed drilling contractor to install a new bore on the property at the location specified by the owner to a depth of approximately 40 metres (exact depth determined by water availability).
2. Bemax Resources Limited will purchase and install a 2hp submersible pump for the above well. The pump would become the property of the owner after installed. The owner will be responsible for future maintenance of this pump.
3. Bemax Resources Limited will pay for a licensed contractor to conduct a pump test on the main bore and shallow well closest to the house and if possible installing a flow meter on the main bore during the summer.

### **Lot 49 & 50 on Deposited Plan 232802**

1. Bemax Resources Limited will contracting a licensed drilling contractor to install a new bore at the location specified by the owner to a depth of approximately 30-40 metres (exact depth determined by water availability). This is intended to supply cattle troughs currently fed by a shallow well in “the Depression” feature.
2. Bemax Resources Limited will purchase and install a 2hp submersible pump for the above well. The pump would become the property of the owner after installed. The owner will be responsible for future maintenance of this pump.
3. Bemax Resources Limited will pay for a licensed contractor to conduct a pump test on the bore near the shed and shallow bore closest to the house and if possible install a flow meter on the shed bore prior to summer.
4. If mining effects the water supply to the house Bemax Resources Limited will provide potable water of similar quality to the tank near the house until the situation can be rectified.

### **Portion of Wellington Location 467 & 576**

1. Bemax Resources Limited will contribute \$4000 towards purchase of a large storage tank to the owners specifications in proximity to their home.
2. In the event mining operations impact temporarily on the domestic water supply, Bemax Resources Limited will pay for the delivery of potable water (currently sourced from a 4m well) to the new tank as required.

3. Bemax Resources Limited will install a monitoring piezometer into the "Depression" feature adjacent to the 6m deep dam and monitor water levels on a monthly basis. Results to be supplied to the owner each month.
4. In the event mining operations impact on the water supply from the dam, Bemax Resources Limited will recharge water levels in the dam via a 10,000-litre mine water transporter until the situation can be rectified.
5. Bemax Resources Limited will pay for a licensed contractor to airlift the 21m deep bore located at the rear of the house.
6. Bemax Resources Limited will pay for a licensed contractor to conduct a pump test on each water source and if possible install a flow meter on the dam outlet and house well prior to summer.

#### **Boyanup Agricultural Area Lot 214**

1. Bemax Resources Limited will contract a licensed drilling contractor to install a new bore on the property at the location specified by the owner to a depth of approximately 50 metres (exact depth determined by good water availability).
2. Bemax Resources Limited will purchase and install a 2hp submersible pump for the above well. The pump will become the owners property after installed. The owner will be responsible for future maintenance of this pump.
3. Bemax Resources Limited will pay for a licensed drilling contractor to redrill a new hole to a maximum depth of 18mtrs adjacent to the current well. The owner will be responsible for casing, commissioning and equipping this well.
4. Bemax Resources Limited will pay for a licensed contractor to conduct a pump test on the existing bore and if possible install a flow meter on this source prior to summer.
5. Bemax Resources Limited will make available suitable quantities of clay material for the owner to collect at the minesite to allow the dam on the property to be better lined.

#### **Lot 106 on Deposited Plan 156157**

1. Bemax Resources Limited will purchase a 1.5 hp submersible pump and a 5.9 KVA petrol generator to power the pump to extract water from the bore at the northern end of the property. The pump and generator would become the owners property after it is installed. The owner would be responsible for future maintenance of this equipment.
2. Bemax Resources Limited will pay for a licensed contractor to airlift the 2 bores on the property.
3. Bemax Resources Limited will pay for a licensed contractor to conduct a pump test on each bore and if possible install a flow meter on these sources prior to summer.
4. If required by the owners, Bemax Resources Limited will pay for an independent agronomist to monitor pasture productivity on the property during the spring growing season (Sept – Nov). The monitoring program to be designed by the agronomist in consultation with the owner and Bemax Resources Limited. Baseline conditions to be assessed by spring 2006 if the monitoring program is to proceed.

5. Bemax Resources Limited will negotiate an agreeable level of feed substitute eg additional grazeable land or dry feed (hay) (Should pasture productivity results indicate to the agronomist that mine activities have had a noticeable impact on pasture productivity).
6. Bemax Resources Limited will purchase and install a concrete drinking trough in proximity to the dam and connect this trough by polyline to the existing water supply line from the well if mining is shown to effect normal water levels or yield.
7. Bemax Resources Limited will connect the water supply line from the windmill to the supply line from the well to ensure flexibility of supply options if mining is shown to effect normal water levels or yield.