

APPENDIX 7C: GROUNDWATER DEPENDENT ECOSYSTEMS EMP  
(MS1168 CONDITION 10)



YALYALUP MINERAL  
SANDS PROJECT

YALYALUP                      NORTHERN  
EXTENSION                      GDE  
MANAGEMENT PLAN

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# TABLE OF CONTENTS

1.	CONTEXT, SCOPE AND RATIONALE.....	1
1.1.	PROPOSAL .....	1
1.2.	KEY ENVIRONMENTAL FACTORS.....	1
1.3.	RATIONALE AND APPROACH .....	2
2.	MONITORING AND EVALUATION FRAMEWORK.....	3
2.1.	ADAPTIVE MANAGEMENT .....	3
2.2.	INDICATORS.....	3
3.	SURVEY AND STUDY FINDINGS.....	4
3.1.	CLIMATE AND ECOHYDROLOGICAL SETTING.....	4
3.2.	VEGETATION.....	5
3.3.	GROUNDWATER DEPENDENT VEGETATION.....	7
3.4.	GROUNDWATER.....	8
3.4.1.	HYDROGEOLOGY .....	8
3.4.2.	GROUNDWATER LEVELS.....	8
3.5.	ECOHYDROLOGICAL CONCEPTUAL MODEL.....	9
3.5.1.	KEY ELEMENTS OF THE MODEL .....	9
3.5.2.	ECOHYDROLOGICAL FUNCTION.....	9
3.5.3.	ECOHYDROLOGICAL SENSITIVITY.....	9
4.	ENVIRONMENTAL THREATS .....	11
4.1.	THREATENING PROCESSES .....	11
4.1.1.	DRAWDOWN RISK .....	11
4.1.2.	ASSESSMENT OF GROUNDWATER DRAWDOWN .....	11
4.1.3.	GROUNDWATER DRAWDOWNS TO GDE.....	12
4.2.	POTENTIAL IMPACTS .....	19
4.2.1.	MINING RELATED .....	19
4.2.2.	MANAGEMENT RELATED.....	19
5.	ENVIRONMENTAL MANAGEMENT .....	20
5.1.	OBJECTIVES OF MANAGEMENT TECHNIQUES.....	20
5.2.	MANAGEMENT TECHNIQUES – KEY SUCCESS INDICATORS.....	20
5.3.	MANAGEMENT TECHNIQUES .....	21
5.4.	DETAILED DESIGN OF MANAGEMENT TECHNIQUES .....	21

6.	MONITORING PROGRAM .....	22
6.1.	PARAMETERS.....	22
6.2.	GROUNDWATER LEVELS.....	22
6.2.1.	VEGETATION HEALTH MONITORING .....	22
6.2.2.	THREATENED FLORA.....	23
6.3.	MONITORING FREQUENCY.....	23
6.3.1.	GROUNDWATER MONITORING .....	23
6.3.2.	BASELINE / PRE-DEWATERING.....	23
6.3.3.	DURING PERIODS OF DRAWDOWN .....	23
6.3.4.	VEGETATION HEALTH MONITORING FREQUENCY.....	24
7.	PROPOSED MANAGEMENT RESPONSE TRIGGERS AND CONTINGENCY MEASURES .....	25
7.1.	RATIONALE FOR TRIGGERS.....	25
7.2.	HYDROLOGICAL TRIGGERS .....	25
7.3.	VEGETATION TRIGGERS.....	25
7.4.	MANAGEMENT RESPONSE .....	26
7.5.	SUPPLEMENTATION .....	26
8.	STAKEHOLDER ENGAGEMENT.....	27
9.	REFERENCES .....	39
	FIGURE 1: REGIONAL LOCATION .....	i
	FIGURE 2: VEGETATION UNITS.....	ii
	FIGURE 3: TECs.....	iii
	FIGURE 4: AVERAGE SUPERFICIAL WATER TABLE ELEVATIONS .....	iv
	FIGURE 5: GROUNDWATER LEVEL HYDROGRAPHS .....	v
	FIGURE 6: GROUNDWATER GDE MONITORING BORES.....	v

## TABLES

TABLE 1: ANNUAL AVERAGE RAINFALL AND EVAPOTRANSPIRATION

TABLE 2: ECOHYDROLOGICAL SETTING OF THE YALYALUP AREA

TABLE 3. VEGETATION UNITS

TABLE 4. SUMMARY OF TEC BY VEGETATION CONDITION

TABLE 5. SUMMARY OF PREDICTED DRAWDOWN IMPACTS TO GDE'S

TABLE 6. VISUAL HEALTH SCALE USED IN THE YALYALUP MONITORING

TABLE 7. MONITORING FREQUENCY

TABLE 8. GROUNDWATER MONITORING BORES

TABLE 9. STAKEHOLDER ENGAGEMENT

# 1. CONTEXT, SCOPE AND RATIONALE

## 1.1. PROPOSAL

This GDE Environmental Management Plan (GDEMP) has been prepared to address the objectives and commitments in relation to the management of groundwater-dependent vegetation within the Proposal (Figure 1) as outlined in the following document:

- *Yalyalup Mineral Sands Project Northern Extension, Referral Under S.38 of the EP Act (Doral, 2024).*

The EMP identifies management measures, monitoring actions, completion criteria and compliance reporting that are to be implemented to minimise indirect impacts from groundwater drawdowns to the following conservation significant vegetation:

1. SCP01b - Southern *Corymbia calophylla* woodlands on heavy soils (Gibson, et al., 2000)
  - a. Vulnerable (BC Act)
2. SCP10b—Shrublands on southern Swan Coastal Plain Ironstones (Busselton area), including 26 *Verticordia plumosa var. vassensis* individuals.
  - a. Critically Endangered (BC Act)
  - b. Endangered (EPBC Act)
3. SCP09 - Dense shrublands on clay flats
  - a. Vulnerable (BC Act)
  - b. Critically Endangered (EBPC Act)

## 1.2. KEY ENVIRONMENTAL FACTORS

Table 1 summarises the Proposal activities and site-specific environmental values that will affect Flora and vegetation values.

**TABLE 1: KEY PROPOSAL ACTIVITIES AND SITE-SPECIFIC ENVIRONMENTAL VALUES AFFECTING GDE VEGETATION**

KEY PROPOSAL ACTIVITY AFFECTING FLORA AND VEGETATION	SITE-SPECIFIC ENVIRONMENTAL VALUE
<ul style="list-style-type: none"> <li>• Dewatering activities may indirectly affect groundwater-dependent vegetation by lowering local groundwater levels;</li> </ul>	<ul style="list-style-type: none"> <li>• SCP01b - <i>Southern Corymbia calophylla</i> woodlands on heavy soils – TEC with threat status of Vulnerable under BC Act 2016.</li> <li>• SCP09 - <i>Dense shrublands on clay flats</i> – TEC with threat status of Endangered under BC Act and Critically endangered under EPBC Act.</li> <li>• SCP10b - <i>Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)</i>” (Gibson, et al., 2000); (Meissner &amp; English, 2005) – TEC with threat status of Critically Endangered</li> </ul>

KEY PROPOSAL ACTIVITY AFFECTING FLORA AND VEGETATION	SITE-SPECIFIC ENVIRONMENTAL VALUE
	<p>under BC Act and Endangered under the <i>EPBC Act</i>.</p> <ul style="list-style-type: none"> <li>• <i>Verticordia plumosa var. vassensis</i> (Vasse Featherflower) – Threatened (BC Act), Endangered (<i>EPBC Act</i>).</li> <li>• <i>Loxocarya magna</i> - P3 (BC Act)</li> <li>• <i>Grevillea brachystylis</i> subsp. <i>brachystylis</i> – P3 (BC Act)</li> <li>• <i>Calothamnus quadrifidus</i> subsp. <i>Teretifolius</i> - P4 (BC Act).</li> <li>• <i>Acacia flagelliformis</i> – P4 (BC Act).</li> </ul>

### 1.3. RATIONALE AND APPROACH

For the conservation significant GDE vegetation types (as listed above) the EMP details:

- The hydro(geological) setting of the GDEs;
- The vegetation community of the GDEs and their conservation significance;
- Source and extent of change-risk to the GDEs as caused by mining activities;
- The proposed monitoring network to assess changes in the GDEs, including:
  - Vegetation health monitoring;
  - Hydrogeological monitoring.
- Management techniques that be employed to protect the GDEs from potential impact;
- Triggers and thresholds related to the implementation of management techniques;
- The correlation between triggers, thresholds, management intervention and observed vegetation health (during dewatering). This review stage will ensure the plan's efficacy in protecting the GDE.



## 2. MONITORING AND EVALUATION FRAMEWORK

### 2.1. ADAPTIVE MANAGEMENT

Monitoring and evaluating environmental management effectiveness uses the principles of active adaptive management. Active adaptive management is recognised as the most effective contemporary approach for the conservation of natural areas (McCarthy and Possingham, 2006; Hockings et al., 2006). Active adaptive management places an explicit value on learning about the effectiveness of management by monitoring its outcomes. It is highly applicable to environmental management since it assumes that it is impossible to have all knowledge regarding the management unit or ecosystem (McCarthy and Possingham, 2006).

The Monitoring and Evaluation framework includes the following elements:

- Determine the threats to the vegetation (groundwater drawdowns);
- Understand the current state of vegetation that may be affected by modified groundwater levels resulting from mine dewatering and reinjection activities;
- Evaluate and select adaptive management responses to achieve a target vegetation state (i.e. avoiding unacceptable changes to the vegetation that are apparently attributable to the mining process.

### 2.2. INDICATORS

The monitoring framework will comprise the following indicators:

- Groundwater monitoring bores will indicate when groundwater levels recede below the determined range and when to apply water supplementation (management);
- Lagging indicators will allow verification of the success of management interventions and provide redundancy in identifying change risks.

### 3. SURVEY AND STUDY FINDINGS

#### 3.1. CLIMATE AND ECOHYDROLOGICAL SETTING

The Yalyalup Project area has a Mediterranean-type climate, characterised by hot, dry summers and cold, wet winters. The nearest Bureau of Meteorology (BoM) weather station with long-term data averages is Busselton Aero (Station No. 9603) and Busselton Shire (Station No. 9515), approximately 5 and 10km, respectively, to the north-east of the study area.

In the Yalyalup area, the long-term average annual rainfall (1997-2023) is 666.3 mm, with rainfall greatest during the winter months (May to September). Conversely, monthly annual pan evaporation data for Busselton shows that evaporation is lowest during May to August and highest during the dry summer months, with a mean pan evaporation of about 1,220mm.

The following data and calculations to characterise the Site’s ecohydrological setting are provided from the original *Yalyalup Mineral Sands Project GDE Management Plan (AQ2, 2020)*.

Long-term rainfall and pan evaporation data are summarised in Table 1.

**TABLE 1: ANNUAL AVERAGE RAINFALL AND EVAPOTRANSPIRATION**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
<b>Mean Rainfall (1998-2020)</b> <b>Busselton Aero</b>	14.6	4.9	20.5	34.3	100.3	126.8	133.4	108.4	73	31.3	21.5	10.4	679.4
<b>Long-term average Pan Evaporation (Busselton)</b>	189	160	133	78	53	42	47	56	69	99	129	164	1219

Note: All units are in mm/month.

A Budyko model (e.g., Trancoso et al. 2016, Budyko 1974) has been used to characterise the energy/water balance for the Yalyalup area and provide an estimate of catchment-scale actual evapotranspiration (which will control the type of vegetation that can sustainably develop).

Key ecohydrological characteristics are summarised in Table 2.

**TABLE 2: ECOHYDROLOGICAL SETTING OF THE YALYALUP AREA**

RAINFALL PERIOD	RAINFALL	PET	ARIDITY INDEX	CLASSIFICATION	BUDYKO ET
Annual Average	679	1219	0.56	Dry	566

Aridity Index (UN formula) = P/PET

Actual catchment average ET estimated using the Budyko method

Rainfall and ET in mm/year

The Aridity index (ratio of potential evapotranspiration to rainfall) is 0.56, and the area can be classified as dry (sub-humid). The Budyko estimate of ET assesses the actual annual average evapotranspiration across the catchment.

### 3.2. VEGETATION

Six vegetation units comprising native vegetation (A1, B1, B2, C1, C2 and C3) were identified in the Proposal area (Ecoedge, 2023) (Figure 2). Most (93.9%) were in ‘Completely Degraded’ condition due to many years of grazing by livestock. The relatively small percentage (6.1%) that remains in Degraded or better condition (vegetation units A1, B1, B2, C1 and C3) are regarded as occurrences of three Threatened Ecological Communities (TEC) (Ecoedge, 2023). TECs are summarised in Table 4 and shown in Figure 3.

**TABLE 3. VEGETATION UNITS**

VEGETATION UNIT	DESCRIPTION	COMMENTS	QUALIFY AS TEC
A1	Woodland/open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> , with scattered <i>Agonis flexuosa</i> , <i>B. grandis</i> , <i>Melaleuca preissiana</i> , <i>Nuytsia floribunda</i> , <i>Persoonia longifolia</i> or <i>Xylomelum occidentale</i> over <i>Xanthorrhoea preissii</i> over weeds on grey-brown or grey loamy sand or sand (on farmland usually only <i>C. calophylla</i> and <i>E. marginata</i> are present)	When in degraded or better condition, it is considered to represent an occurrence of SCP01b - Southern <i>Corymbia calophylla</i> woodlands on heavy soils’	Yes  (when in degraded or better condition)
B1	Tall shrubland of <i>Acacia saligna</i> , <i>Calothamnus quadrifidus</i> subsp. <i>teretifolius</i> , <i>Melaleuca incana</i> and <i>Kunzea micrantha</i> (with scattered emergent <i>Eucalyptus rudis</i> ) over scattered native herbs, including <i>Drosera glanduligera</i> and <i>Sowerbaea laxiflora</i> , the sedge <i>Loxocarya magna</i> , and weeds on shallow red sandy clay on massive ironstone	When in degraded or better condition, it is considered to represent an occurrence of SCP10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)’.	Yes  (when in degraded or better condition)
B2	Open woodland of <i>Melaleuca preissiana</i> over weeds (rarely with <i>Hyalosperma cotula</i> ) on seasonally wet brown clay loam over massive laterite.	When in degraded or better condition, it is considered to represent an occurrence of SCP10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)’.	Yes  (when in degraded or better condition)

VEGETATION UNIT	DESCRIPTION	COMMENTS	QUALIFY AS TEC
C1	Open forest of <i>Eucalyptus rudis</i> and/or <i>Corymbia calophylla</i> over scattered <i>Agonis flexuosa</i> and <i>Melaleuca rhapsiophylla</i> occasionally over <i>Acacia saligna</i> , <i>A. extensa</i> , <i>Astartea scoparia</i> , <i>Xanthorrhoea preissii</i> scattered shrubs over weeds on grey-brown clayey loams in drainage lines and on damp flats.	When in degraded or better condition, it is considered to represent an occurrence of SCP01b - Southern <i>Corymbia calophylla</i> woodlands on heavy soils'	Yes (when in degraded or better condition)
C2	Open woodland of <i>Melaleuca preissiana</i> over weeds on seasonally wet brown clay loam.	All are in completely degraded condition	No
C3	Tall Open Shrubland that may include <i>Acacia saligna</i> , <i>Jacksonia furcellata</i> , <i>Kingia australis</i> , <i>Melaleuca osullivanii</i> , <i>M. preissiana</i> , <i>M. viminea</i> and <i>Xanthorrhoea preissii</i> on seasonally wet grey-brown sandy loam	When in degraded or better condition, it is considered to represent an occurrence of SCP09 – Dense shrublands on clay flats	Yes (when in degraded or better condition)
Cleared Pasture	Cleared pasture		No
Planted species	Amenity Plantings of <i>Eucalyptus sp.</i> Or <i>Melaleuca sp.</i>		No

TABLE 4. SUMMARY OF TEC BY VEGETATION CONDITION

FCT AND VEGETATION UNIT	CONDITION	AREA (HA)
SCP01b - Southern <i>Corymbia calophylla</i> woodlands on heavy soils' Units A1 and C1	Good	0.21
	Degraded	1.96
	<b>Subtotal</b>	<b>2.17</b>
SCP10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) Units B1 and B2	Very Good	0.21
	Good	0.39
	Degraded	0.20
	<b>Subtotal</b>	<b>0.80</b>
SCP09 – Dense shrublands on clay flats Unit C3	Good	0.07
	<b>Subtotal</b>	<b>0.07</b>
<b>Total TEC</b>		<b>3.04</b>

### 3.3. GROUNDWATER DEPENDENT VEGETATION

Almost all of the survey area is classified as ‘Multiple Use’ palusplain wetland and all of the vegetation units identified by Ecoedge (2023) have some species that are either fully or partially phreatophytic, or ground-water dependant, e.g., *Eucalyptus rudis*, *Melaleuca incana*, *M. preissiana*, *M. raphiophylla*, *Acacia saligna* and *Kunzea micrantha* (Canham et al. 2009). It is likely, therefore, that, to a greater or lesser extent, all vegetation units within the survey area are GDEs.

Twelve GDE areas were identified within the Proposal area (Figure 4).

**TABLE 5: SUMMARY OF NORTHERN EXTENSION GDES**

GDE #	VEGETATION TYPE <sup>1</sup>	VEGETATION CONDITION	THREATENED ECOLOGICAL COMMUNITY (TECS)	CRITICAL HABITAT SCP10B SOUTHERN IRONSTONE
GDE_1	A1	Degraded	Yes – TEC (FCT01b)	No
GDE_2	B1	Very Good	Yes – TEC (FCT10b)	Yes (SCP10b)
GDE_3	A1	Degraded	Yes – TEC (FCT01b)	No
GDE_4	A1	Degraded to Good	Yes – TEC (FCT01b)	No
GDE_5	B1	Good	Yes – TEC (FCT10b)	Yes (SCP10b)
GDE_6	C1	Degraded	Yes – TECs (FCT01b)	No
GDE_7	C1	Degraded	Yes – TEC (FCT01b)	No
GDE_8	C1 C3	Good Degraded/Good	Yes – TEC (FCT01b) Yes – TEC (FCT09)	No
GDE_10	C1	Degraded	Yes – TECs (FCT01b)	No
GDE_11	B2	Completely Degraded / Good	Yes – TECs (FCT10b)	Yes (SCP10b)
GDE_12	B2	Completely Degraded	No	Yes (SCP10b)

\*GDE\_3, GDE\_4 and GDE\_6 will be cleared and not subject to indirect impacts from drawdown. GDE\_7 will be partially cleared.

## 3.4. GROUNDWATER

### 3.4.1. HYDROGEOLOGY

The hydrogeology of the Proposal area has been detailed in the Hydrogeological Assessment report (AQ2, 2024). The Proposal is located within the Busselton-Capel Groundwater Area for the Superficial and Leederville aquifers and within the Busselton-Yarragadee Groundwater Area for the Yarragadee aquifer.

Three major aquifers have been identified within the Proposal area (ordered from shallow to deep), namely:

- Superficial;
- Leederville;
- Yarragadee.

The Bassendean Sand, Guildford Formation and Yoganup Formation form an unconfined Superficial aquifer with a maximum saturated thickness of ~9m. The permeability of the superficial aquifer is variable and depends on sediment type, with saturated sands having higher permeability than clays. At the Site, the Yoganup Formation forms the main portion of the aquifer, while the Bassendean Sand is generally saturated when water levels rise in the wet season. The Guildford Formation is of lower permeability owing to its more clayey nature. The high sand content in all the superficial units at the site means they are in hydraulic connection and behave as a single aquifer unit. There is no evidence of any perched aquifer at the site.

It should be noted that the Leederville and Yarragadee aquifers are not discussed in this GDE Management Plan.

### 3.4.2. GROUNDWATER LEVELS

The water table elevation slopes gently from the Whicher Scarp (i.e. ~40m AHD) to the coast (i.e. 0m AHD) and closely parallels the topography in a north-western direction under a low hydraulic gradient. Groundwater levels, as measured in the Superficial monitoring bores (both Doral's monitoring bores, other private users and DWER monitoring bores), are close to the surface, at depths of between 0 to 5m bgl (i.e. 15 and 35m AHD). At the Site, low-lying areas are often waterlogged during winter (i.e., with the water table rising to the ground surface). The seasonal water table fluctuation is less than 0.4m close to the coast, approximately 1 to 2m across the central part of the Swan Coastal Plain (including the mine site) and up to 2 to 4m close to the Whicher Scarp. Hydrographs for superficial deposits on the Coastal Plain show that variations in water level are usually correlated with variations in rainfall. Peaks in the groundwater hydrographs generally occur 1 to 3 months after peaks in rainfall, and the length of the time lag increases with increasing depth in the water table. The average water table elevation contours in the Superficial aquifer across the modelled area are shown in Figure 5. Although annual rainfall indicates a drying climate, rainfall and subsequent aquifer recharge experienced in recent years are still sufficient to fill the Superficial aquifer and a long-term trend of decline in water levels due to changes in climate is therefore not observed in the Project area.

The modelled predicted groundwater level hydrographs for the monitoring bores close to GDEs (AQ2, 2024) indicate the following:

- Highest water level elevations were recorded in August or September and lowest in May or June;
- Seasonal cycles of water table variations associated with the winter-dominated rainfall recharge to the aquifer are evident;

- Variations in depth to water can be generally correlated with variations in rainfall, with the minimum depth to water fluctuating considerably compared to the maximum depth to water.

### 3.5. ECOHYDROLOGICAL CONCEPTUAL MODEL

#### 3.5.1. KEY ELEMENTS OF THE MODEL

The area is characterised by overstorey vegetation comprising *Corymbia calophylla*, *Eucalyptus marginata*, *Melaleuca raphiophylla*, *Eucalyptus rudis*, *Melaleuca preissiana* and *Banksia littoralis*. Mid-storey vegetation (within GDE\_2) also includes *Verticordia plumosa* subsp. *Vassensis*. The vegetation occurs in obligate phreatophytic communities with the species mix depending on the degree of water logging and substrate characteristics; “A1-type communities” are associated with shallow groundwater and heavy soils, while “B1-type communities” are associated with shallow groundwater and ironstone in the substrate.

The root zone has been estimated by comparing the groundwater hydrographs and the hydraulic properties of the soil (AQ2, 2020). The root systems will not tolerate permanent saturation (as oxygen stress and root die-back occur) and thus are likely to occur in the saturated zone for only a few months a year. The root system is also likely to develop where the connection is retained with the capillary fringe (as the communities comprise obligate phreatophytes); this would mean they will remain within less than 0.5m of the water table (i.e. <0.5 m from the average seasonal low groundwater levels). The root systems are also likely to exhibit some degree of plasticity on a seasonal basis. On balance, this means the rooting depth is likely to be in the range 1 m to 1.3 mbgl (based on the measured hydrograph from monitoring bore YA\_MB08S); there will be local variations based on local hydrologic setting.

#### 3.5.2. ECOHYDROLOGICAL FUNCTION

The relatively shallow rooting depth, high evapotranspiration demand and poor moisture retention properties of the sandy soil will make the communities sensitive to changes in groundwater levels. By way of a corollary, in a study of vegetation change on the Gnaragarra Mound, Sommer and Froend (2014) classified species into four hydrotypes based on the hydrological habitat preference of a species. These hydrotypes were defined as:

- Hydrophytes, which are species tolerant of excessive wetness;
- Mesophytes, species that grow optimally on moist sites but are intolerant of extremes in moisture conditions;
- Xerophytes, which are species with a wide tolerance of hydrological conditions but with maximum development on dry sites; and
- Generalists: species without particular hydrological habitat preferences.

Sommer and Froend (2014) calculated a theoretical overlap between hydrophyte and xerophyte dominated-vegetation types at around 2.4m depth to groundwater (DGW), with mesophyte abundance highest between 2.5 and 5m. This is consistent with the observed distribution in the GDE Vegetation Units A1, B1, C1 and C3, which are dominated by hydrophytes, in habitats where the DGW varies from approximately 1.3m in winter to 2.2m in summer.

#### 3.5.3. ECOHYDROLOGICAL SENSITIVITY

Vegetation dominated by hydrophytes and mesophytes may be less resilient to environmental perturbations (Sommer & Froend, 2014). For example, stands containing *Banksia littoralis* may be sensitive to rapid or

large increases in DGW (Groom, Froend, Mattiske, & Gurner, 2001) as they are more vulnerable to xylem cavitation than congeneric species (Canham, Froend, & Stock, 2008). Stands with *Melaleuca raphiophylla* and/or *Eucalyptus rudis* may withstand periods of waterlogging but be sensitive to falls in the water table. Although *Melaleuca preissiana* is an obligate phreatophyte, it is likely sensitive to permanent decreases in DGW.

The vegetation units within the Northern Extension GDEs are likely to be sensitive to significant or rapid changes in DGW. Vegetation Units A1, C1 and C3 contain trees of *Melaleuca preissiana*; therefore, they may be sensitive to decreases and increases in DGW. Vegetation Unit B1 overlies the shallow ironstones and contains *Eucalyptus rudis*, *Calothamnus quadrifidus* subsp. *teretifolius*, and *Loxocarya magna*. Unit C3 A significant increase in DGW may result in a decline in vegetation condition or the health of plants, including the loss of individuals.

Interim Recovery Plans have been developed for SCP10b (Vegetation Unit B1; GDE\_2 and GDE\_5) (DEC, 2004; 2005). The key regional threats to SCP10b include dieback, clearing, frequent fire, weed invasion and potential salinisation and waterlogging.



## 4. ENVIRONMENTAL THREATS

### 4.1. THREATENING PROCESSES

#### 4.1.1. DRAWDOWN RISK

Based on the literature outlined previously, key thresholds in relation to changes in groundwater level appear to be:

- Total groundwater level drawdown of more than 0.25m;
- Rate of groundwater level drawdown (outside of the natural range).

#### 4.1.2. ASSESSMENT OF GROUNDWATER DRAWDOWN

To provide a clear indication of predicted drawdowns across the project area in relation to the proposed temporal and spatial progress of mining, several model outputs have been prepared by AQ2 as part of the Hydrogeological Assessment (AQ2, 2024). A groundwater model was prepared, and predictions were run for a set of wet and dry climatic conditions based on the “wet” and “dry” real rainfall data sets. This way, the dewatering rates and drawdowns were predicted over various climatic conditions (i.e. extended periods of below and above-average rainfall). Regarding the “worst case” impacts on the GDEs, the dry climatic scenario (late autumn) predicted drawdowns have been used.

Overall, dewatering due to mining at the Proposal is likely to result in negligible regional-scale groundwater drawdowns in the Superficial aquifer. Drawdowns in the Superficial aquifer are predicted to be localised in the immediate area of the active mining (pits), temporary in duration and relatively small. A maximum drawdown of 11m is predicted at the end of mining in August 2030. The cone of depression of 0.1m generally lies within the proposed mining disturbance envelope and only marginally extends past this area (up to 550 m for the dry scenario).

Additionally, some small drawdowns (less than 0.1 m) are predicted in the Leederville aquifer due to the dewatering of the overlying Superficial aquifer. The Mowen Member of the Leederville Formation is generally considered an aquitard; however, at the Yalyalup site, the Mowen Member is thin, resulting in small indirect upward leakage of water from the Leederville aquifer from below the pit floor. Based on groundwater modelling results, the drawdowns in the Leederville aquifer are predicted to be local and likely to extend laterally but not vertically (owing to clayey layers within the sand). The extent of 0.1 m drawdown is generally limited to areas immediately outside the planned mining areas.

Therefore, it is unlikely that short-term dewatering for the Proposal will adversely impact the water supply potentials of the Superficial and Leederville aquifer systems. The Superficial aquifer is resilient and will cope with the proposed changes due to mining.

Long-term post-mining effects on water levels are expected to be minimal. The recovery of water levels will commence immediately once mining of each active mine pit is completed, owing to backfilling of mined-out pits. Water level gradients between the mine voids and the surrounding areas drive groundwater inflows to the mined-out pits. It should be noted that during the mining phase, water recovery in mined-out areas may be interfered with by dewatering of subsequent mining areas. Thus, the rate of water level recovery can be slow. Once all mining areas are completed, dewatering will cease, and water levels will continue to rise until a steady state or equilibrium water level is resumed. The numerical model shows that water levels are predicted to return to pre-mining levels within 12 months of mine closure (i.e. by December 2037).

### 4.1.3. GROUNDWATER DRAWDOWNS TO GDE

AQ2 (2024) model predictions suggest that there will be drawdowns in areas of potential GDEs across the Proposal area over the life of the mine. These drawdowns have the potential to impact groundwater-dependent vegetation close to mining areas. It should be noted that the magnitude of change in groundwater level (i.e. drawdowns of more than 0.25m) thresholds have been used by AQ2 (2024) to assist in providing an assessment of risk.

Details of the predicted maximum drawdowns at the GDE locations due to dewatering for the Proposal are shown in Table 6.

**TABLE 6: PREDICTED MAXIMUM DRAWDOWNS AT SELECTED GDE LOCATIONS DUE TO NORTHERN EXTENSION DEWATERING**

GDE	PREDICTED MAX DRAWDOWN (m)	MONTH OF PREDICTAED MAX DRAWDOWN	PERIOD OF PREDICTED DRAWDOWN (>0.25m)	PREDICTED MAX DRAWDOWN BELOW LOWEST SEASONAL GW LEVEL (m)
GDE_1	1.50	April 2036	February to November 2027	1.46
GDE_2 / YA_MB37_GDE	2.20	June 2027	September 2026 to November 2028	1.92
<b>*GDE_3</b>	<b>0.34</b>	<b>September 2028</b>	<b>August to September 2028</b>	<b>0.25</b>
<b>*GDE_4</b>	<b>1.62</b>	<b>August 2028</b>	<b>June 2027 to June 2030</b>	<b>1.28</b>
GDE_5	2.57	February 2029	May 2027 to October 2030	2.45
<b>*GDE_6</b>	<b>4.73</b>	<b>February 2029</b>	<b>October 2027 to November 2030</b>	<b>4.68</b>
GDE_7	2.71	August 2029	September 2028 to October 2032	2.43
GDE_8	1.60	June 2030	April 2029 to October 2032	1.20
GDE_10	0.24	July 2032	NA	0.01
GDE_11	0.07	October 2034	NA	0
GDE_12	0.10	October 2034	NA	0

**\*GDE\_3, GDE\_4 and GDE\_6 will be cleared and not subject to indirect impacts from drawdown. GDE\_7 will be partially cleared.**

The GDEs with the highest maximum modelled drawdowns (i.e. relative water level changes) assuming dry climate conditions (i.e., the most conservative case) are shown below in Charts 1 and 2. The maximum drawdowns at each of these GDEs are also shown in Charts 3 and 4, reproduced from (AQ2, 2024). Figures showing the drawdowns for all GDEs are provided in Figures 10-2 to 10-13 of Appendix 10B (AQ2, 2024).

CHART 1: PREDICTED WATER LEVELS AT GDEs (GDE\_1, GDE\_2, GDE\_5)

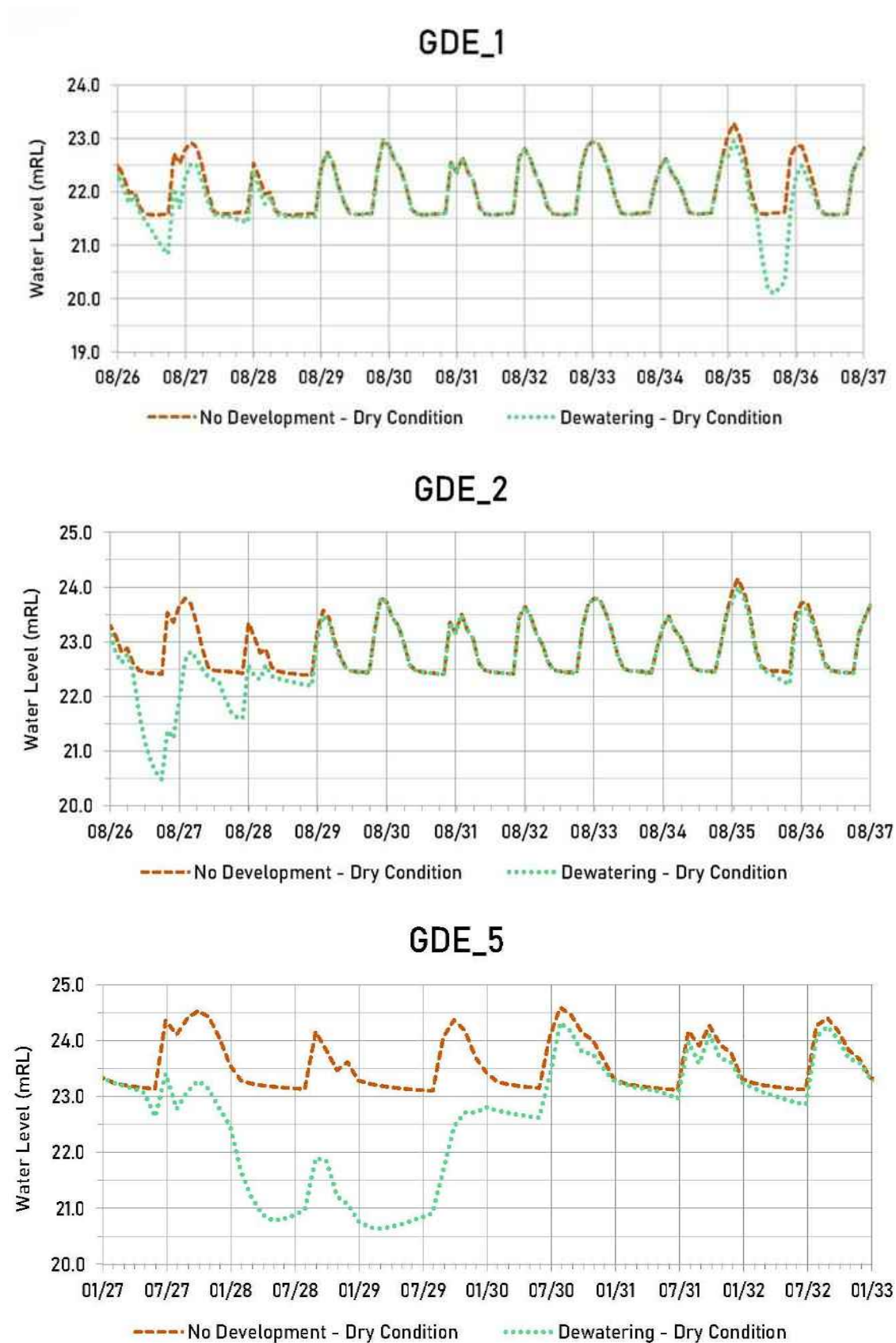
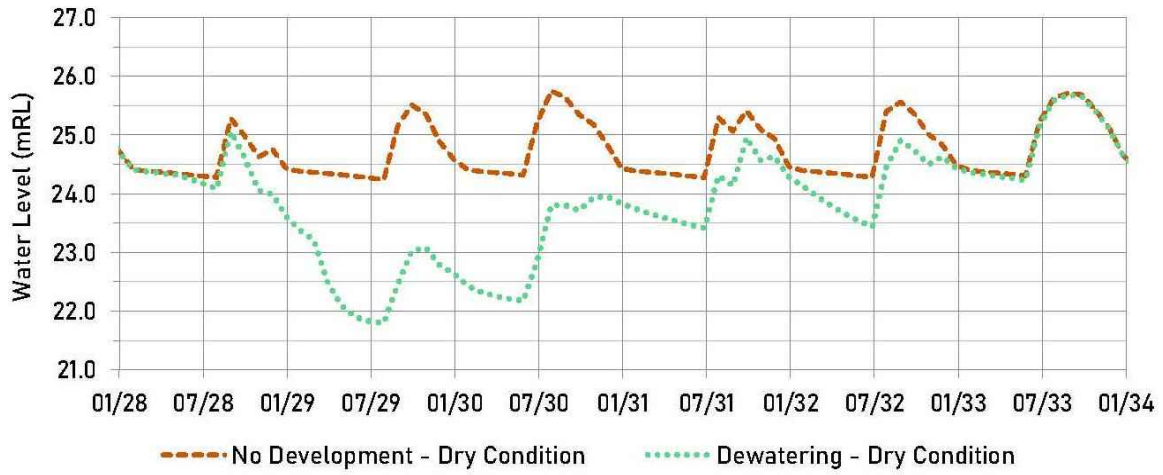


CHART 2: PREDICTED WATER LEVELS AT GDEs (GDE\_7, GDE\_8)

### GDE\_7



### GDE\_8

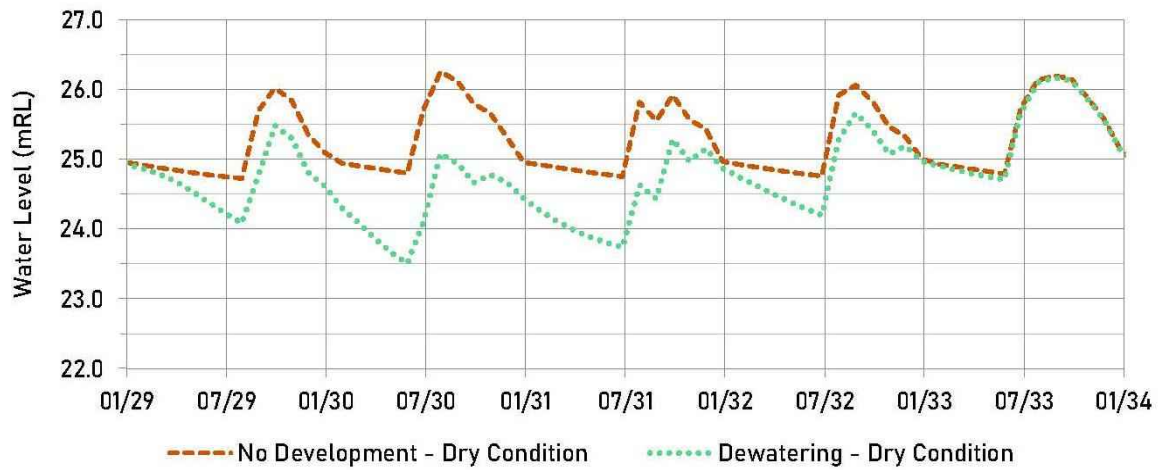


CHART 3: PREDICTED GDE DRAWDOWNS (GDE\_1, GDE\_2, GDE\_5)

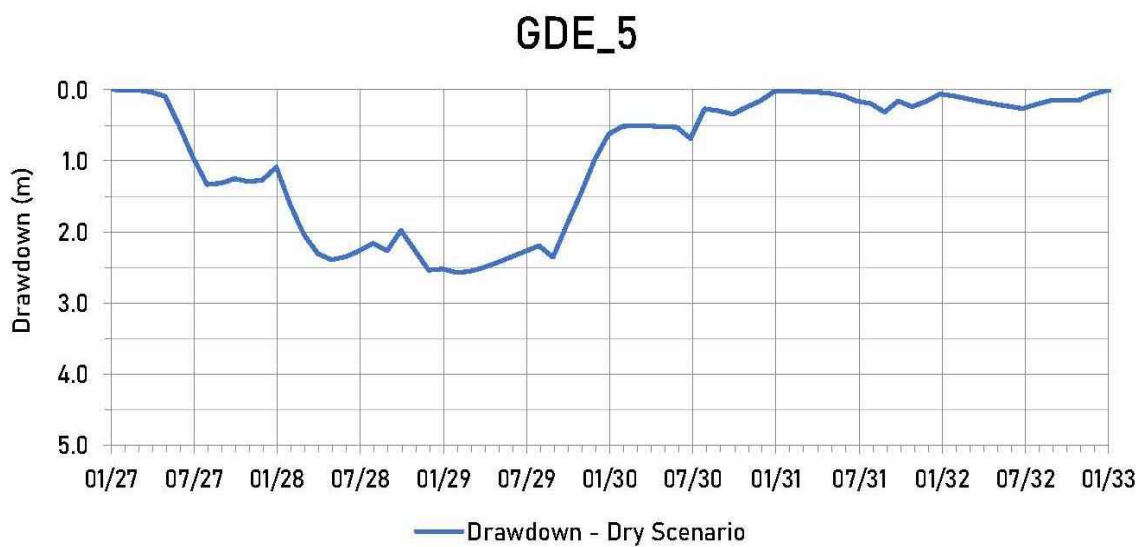
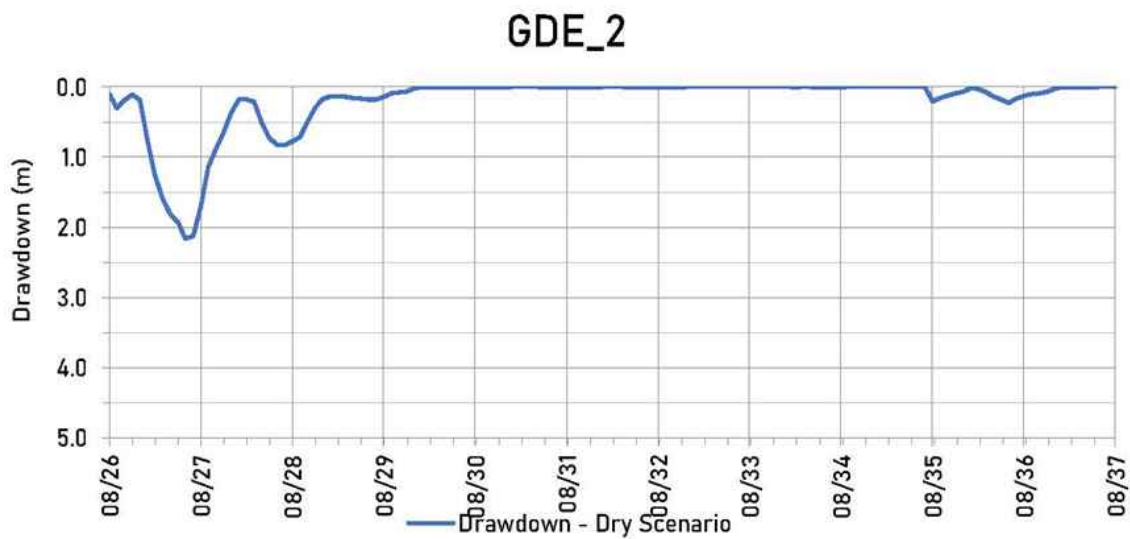
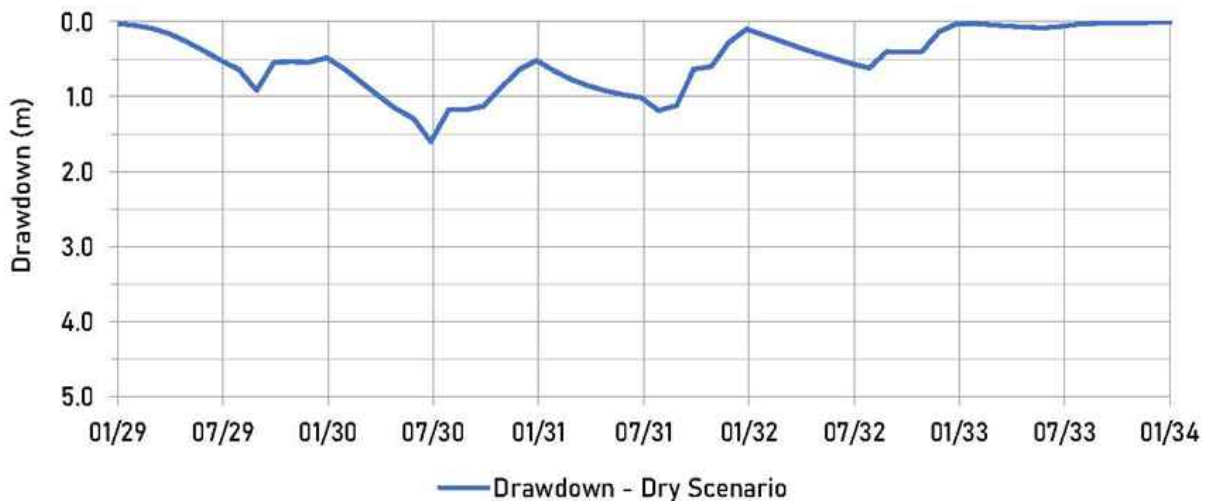


CHART 4: PREDICTED GDE DRAWDOWNS (GDE\_7, GDE\_8)

### GDE\_7



### GDE\_8



The salient points in relation to groundwater drawdowns to GDEs are as follows:

- The magnitude of drawdowns along the GDE areas varies depending upon the proximity of the Northern Extension active mining pits. However, all drawdowns will be localised and temporary.
- The highest maximum drawdowns are predicted to be at GDE\_1, GDE\_2, GDE\_5, GDE\_7 and GDE\_8 (i.e. 1.5 to 2.72 m). However, these GDEs, except for GDE\_2 and GDE\_5 are in heavily degraded condition;
- GDE\_7 has the longest predicted drawdown period of more than 0.25m (i.e. ~4 years). As stated above, part of GDE\_7 is heavily degraded and in poor condition and will be partially cleared for mining;
- Drawdowns at GDE\_10, GDE\_11 and GDE12 are less than 0.25m and drawdowns at GDE\_3 are short-term (2 months), thus having a low risk of being impacted due to dewatering.
- There are minor drawdowns (less than 0.4m) that extend into the McGibbon Track area in the approved Yalyalup Mine due to mining at the Northern Extension. However, these drawdowns are localised and temporary and much smaller than the original drawdowns predicted due to the dewatering of the approved Yalyalup Mine. Implementation of the existing GDE Management Plan as required by MS1168—Condition 10 will continue to apply to these areas.

In conclusion, groundwater modelling predicts that the dewatering operations for the Proposal will temporarily cause groundwater levels to decline and fall outside the seasonally observed range. The magnitude of the change in groundwater levels (i.e. drawdowns of more than 0.25m) exceeds thresholds that could potentially result in impacts to 0.66ha of vegetation in GDE\_1, GDE\_2, GDE\_5, GDE\_7 and GDE\_8 as follows:

- GDE\_1 – 0.09ha mapped as SCP01b - Southern *Corymbia calophylla* woodlands on heavy soils'
- GDE\_2 – 0.16ha mapped as SCP10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area), includes 26 *Verticordia plumosa* var. *vassensis*.
- GDE\_5 – 0.21ha mapped as SCP10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)
- GDE\_7– 0.15ha mapped as SCP01b - Southern *Corymbia calophylla* woodlands on heavy soils'
- GDE\_8 – 0.05ha mapped as SCP09 and 0.02ha mapped as as SCP01b - Southern *Corymbia calophylla* woodlands on heavy soils'



## 4.2. POTENTIAL IMPACTS

### 4.2.1. MINING RELATED

Groundwater modelling predicts the mining operation will temporarily cause groundwater levels to decline and fall outside the seasonally observed range. The magnitude and rate of change exceed thresholds that have been shown in other studies to result in impacts on the vegetation. In the absence of management intervention, the following impacts may occur:

- Complete or partial loss of phreatophyte species due to water stress and hydraulic failure;
- Vegetation health decline, including leaf or limb shedding and the introduction of disease;
- Community invasion by weed species.

### 4.2.2. MANAGEMENT RELATED

Management intervention may involve the artificial supplementation of plant-available water (e.g. through irrigation). Both total plant-available water and plant-water sources define the water regime. Typically, GDEs obtain a significant portion of total plant available water from the vadose zone, and root systems are configured to exploit water from both the vadose zone and groundwater zone. The relative contribution from each water source may vary on a seasonal basis. For example:

- During the winter, when recharge occurs, the vadose zone will be wetter as rainfall infiltrates. The rise in groundwater levels could result in a portion of the deeper root zone being below the water table (i.e. in fully saturated anoxic conditions where the roots are inactive). The systems may use more water from the vadose zone.
- During summer, when the vadose zone is drier, and groundwater levels recede, the root system's deepest parts will be close to the groundwater table and the capillary fringe. The systems may use more water from deeper sources and groundwater.

The root zone may reconfigure, and root truncation may occur if the zone of consistently high moisture content or permanent saturation is materially changed during management intervention. This may result in a loss of resilience within the system and an inability to survive the natural range in groundwater levels.

## 5. ENVIRONMENTAL MANAGEMENT

### 5.1. OBJECTIVES OF MANAGEMENT TECHNIQUES

Management intervention will have two key objectives:

- Preserve groundwater levels within a range that will maintain system health and robustness;
- Maintain a soil moisture regime close enough to natural conditions to prevent root reconfiguration or truncation.

### 5.2. MANAGEMENT TECHNIQUES – KEY SUCCESS INDICATORS

Given the potential impacts from groundwater drawdowns to conservation significant vegetation and flora species within the GDEs, the management plan's overall objective is to maintain the botanical values within the site. It is unlikely that no change would be observed during the mining phase, even under natural conditions, and it is expected that some degree of change may be tolerated to a level that would be recoverable post-mining. Any change in botanical values will also be consistent with the goals set out in the Interim Recovery Plans (IRPs) for SCP10b - Southern Swan Coastal Plain Ironstone Association (Busselton Area) (DBCA 2004, 2005, respectively).

*Verticordia plumosa* subsp. *vassensis* does not have an IRP in place for the taxon. However, a loss of 10% of individuals within any population or the number of populations would be considered a plan failure. Therefore, the aim of this management plan with regard to *Verticordia plumosa* subsp. *vassensis* is no net loss of individuals within GDE\_2 (SCP10b).

For SCP10b, the objective of the IRP is to improve or maintain the overall condition of the community with a view of reclassifying it from Critically Endangered to Endangered. Failure of the plan is considered to be a decline in 10% or more of the area covered by the community or a reduction in the number of occurrences. Other failure criteria include a decline of 10% or more of native plant taxa within any occurrence, an increase in exotic species cover of 10% or more and the level and quality of groundwater falling outside natural parameters. Therefore, the aims of this management plan with regard to SCP10b are restricting any increase of weed cover to less than 10% of that pre-mining; any change in number of native plant taxa present to be less than a 10% decline and groundwater levels and quality will be maintained within an acceptable range of natural levels.

The success of the management plan for the GDEs to be potentially impacted by drawdowns (GDE\_1, GDE\_2, GDE\_5, GDE\_7 and GDE\_8) will be assessed against criteria for each of the following parameters:

- Species functional type composition
  - No measurable change in functional type composition. The composition of native taxa within a GDE shall remain predominantly hydrophytic. An increase in mesophytes or xerophytes may indicate an alteration in hydrology.
- Species mortality
  - Mortality of individuals will remain below 15% for dominant species. No net mortality of Threatened taxa.
- Species richness
  - <10% decline in native species richness

- Vegetation density/cover and abundance
  - Reduction in cover of native taxa to be less than 10%
- Vegetation height and diameter
  - Reduction in height or cover of Threatened taxa to be kept below 10%

### 5.3. MANAGEMENT TECHNIQUES

The key management technique will supplement water to offset groundwater level drawdown beneath the affected GDEs. Management will focus on preserving groundwater availability within the root zone of the GDE community.

Techniques for surface supplementation will be based on experience gained at the McGibbon track irrigation for the existing Yalyalup Mine, which involves surface delivery of clean Yarragadee water as required via a network of perforated irrigation pipes to ensure adequate volumes are delivered without sustained surface flooding.

### 5.4. DETAILED DESIGN OF MANAGEMENT TECHNIQUES

The existing groundwater model should be used to estimate the infiltration volumes required to offset drawdown in areas of the GDE predicted to suffer a groundwater level decline of more than 0.25m below the seasonal low groundwater levels.

It should be noted that preserving the groundwater level in the GDE area (otherwise affected by dewatering) may result in increased dewatering rates.

Once the required volume of water has been determined, the most efficient method of delivering this water can be determined, and the overall scheme can be designed. This determination will involve the engineering assessment of the capacity and efficacy of the options outlined above to deliver the required volumes of water.

## 6. MONITORING PROGRAM

### 6.1. PARAMETERS

Monitoring will comprise a combination of hydrological parameters and visual vegetation health assessments using qualitative criteria. The monitoring program is summarised in Table 7, and the detailed methodology for each component is described below.

### 6.2. GROUNDWATER LEVELS

Groundwater levels will be monitored in a network of 6 bores located at each of the affected GDEs; the bore locations are summarised in Table 7 and shown in Figure 4. Levels will be monitored with a remote data logger.

**TABLE 7: GDE MONITORING BORES**

BORE ID	COORDINATES (MGA, ZONE 50)		DEPTH TO BASE OF AQUIFER	MAX DEPTH TO WATER	PROPOSED DEPTH	AQUIFER
	EASTING (m)	NORTHING (m)	(m)	(mbgl)	(mbgl)	
MB_GDE_1	359247	6271808	8.5	2.0	4.5	Superficial
<i>*YA_MB37_GDE (MB_GDE_2)</i>	<i>359470</i>	<i>6271780</i>	<i>8.0</i>	<i>1.8</i>	<i>5.0</i>	<i>Superficial</i>
MB_GDE_5A	360270	6272136	10	3.0	6.5	Superficial
MB_GDE_5B	360191	6272238	9.5	2.5	6.5	Superficial
MB_GDE_7	360748	6272281	7.0	1.8	6.0	Superficial
MB_GDE_8	360975	6272282	7.0	2.0	4.0	Superficial

*\*Existing groundwater well*

#### 6.2.1. VEGETATION HEALTH MONITORING

The vegetation within the affected GDEs (i.e., GDE\_1, GDE\_2, GDE\_5, GDE7 and GDE8) will be assessed for health monitoring using visual inspection and assessed using a scale based on Lay and Meissner's use (1985) (Table 8). Photographs will also be taken of all the monitored trees and shrubs.

**TABLE 8. VISUAL HEALTH SCALE** (Lay & Meissner, 1985)

SCORE	DESCRIPTION
0	Dead shrub.
1	Shrub/tree with <20% of the original canopy; most main branches dead; remaining leaves mostly dying off.
2	Shrub/tree with 21-40% of original canopy present; some main branches dead (50-80% canopy); abundant leaf yellowing (>41% canopy)

SCORE	DESCRIPTION
3	Shrub/tree with 41-60% of the original canopy present; some smaller dead branches evident (21-40% canopy); a moderate amount of leaf yellowing (21-40% of canopy)
4	Shrub/ tree with 61-80% of the original canopy present; occasional dead branches (<20% of canopy); small patches of leaf yellowing (<20% of canopy).
5	Shrub/tree with >81% of the original canopy present; healthy overall; little or no leaf yellowing.

### 6.2.2. THREATENED FLORA

Monitoring of Threatened taxa (*Verticordia plumosa* subsp. *vassensis*) will be undertaken using the health scores described in Table 6, as this approach will be non-invasive.

Up to 6 individuals of *Verticordia plumosa* subsp. *vassensis* will be tagged and monitored every three months. The density of vegetation prevents access to all individuals in this occurrence of this taxon. To prevent trampling and opening of the vegetation that may allow weeds to ingress, only plants that can be assessed without degrading the vegetation stand will be monitored.

## 6.3. MONITORING FREQUENCY

### 6.3.1. GROUNDWATER MONITORING

Table 7 summarises the groundwater monitoring frequency for the GDE bores. Monitoring frequencies fall into two categories: baseline/pre-dewatering and during active dewatering.

**TABLE 7. MONITORING FREQUENCY**

MONITORING PARAMETER	PERIOD					OBJECTIVES / REMARKS
	BASELINE		ACTIVE DEWATERING			
HYDROLOGICAL	FREQ	TRIGGER	FREQ	TRIGGER	RESPONSE	
Groundwater Level	Monthly	N/A	Weekly	< Avg lowest level	Increased vegetation monitoring	Increased risk when GWLs fall below the natural range
Absolute Change			Weekly	>0.25cm	Supplementation	Managing absolute GWL change

### 6.3.2. BASELINE / PRE-DEWATERING

Groundwater levels will be monitored and reviewed monthly to confirm seasonal sequences.

### 6.3.3. DURING PERIODS OF DRAWDOWN

Groundwater levels will be monitored and reviewed at least weekly during periods of active dewatering.

#### 6.3.4. VEGETATION HEALTH MONITORING FREQUENCY

Vegetation health monitoring will occur 6-8 times per year (unless monitoring bores are triggered to increase frequency), generally from October to May. Winter monitoring (June, July, August and September) is not considered to be required.

Before the commencement of mining, baseline flora and vegetation monitoring will be conducted.

The key trigger for increased vegetation monitoring will be when groundwater levels fall lower than the average “low” water level (i.e. the average water level recorded during autumn).

## 7. PROPOSED MANAGEMENT RESPONSE TRIGGERS AND CONTINGENCY MEASURES

### 7.1. RATIONALE FOR TRIGGERS

This GDEMP has been designed to include the following:

- Hydrological triggers warn of the onset of a water regime that may cause water stress to develop.
- Lagging indicators designed to provide redundancy in risk identification and allow verification of the success of management interventions.

Triggers have been designed around parameters that mining-induced changes to the water regime (i.e., groundwater levels) may be affected. Soil moisture is not included as a monitoring parameter because it is influenced by infiltrating rainfall, which will not be affected by mining.

### 7.2. HYDROLOGICAL TRIGGERS

Groundwater level is the key hydrological parameter. The following trigger-response mechanism will be used:

- The observation of dewatering impacts to adjacent bores will trigger increased groundwater monitoring frequency.
- If groundwater levels fall below the average low annual measured water level (i.e. below the typical autumn groundwater level), then there is a risk water levels will fall below the root zone, and water stress and/or hydraulic failure may occur from the inability of root systems to respond to changing the hydrological regime. This will trigger an increased frequency of vegetation monitoring. With respect to groundwater levels:
  - If the total groundwater level declines subsequently to 0.25m below the average low annual measured water level (i.e. below the typical autumn groundwater level), supplementation will be triggered.

### 7.3. VEGETATION TRIGGERS

Vegetation health will be a lagging indicator. Sustained health scores will be used to verify the success of management intervention. A decline in vegetation health during active dewatering will be used as a fail-safe mechanism to identify areas where management intervention has not worked or where the monitoring network has not identified the change risk.

The vegetation health trigger will be:

- Visible declines in health score during the period of dewatering - decline in health score of 2 categories;
- Greater than 15% reduction in the abundance of dominant species (during active dewatering);
- Weed increased as a community component by 10%.

The management response will be that water supplementation is required for all trigger-exceedances.

## 7.4. MANAGEMENT RESPONSE

The management response comprises two tiers:

- Increased monitoring - Observing operational dewatering impacts on adjacent bores or the exceedance of some hydrological triggers will require more frequent monitoring
- Water supplementation - Indications of water stress or exceedance of some hydrological parameters will require water supplementation.

## 7.5. SUPPLEMENTATION

Exceedance of triggers in groundwater levels will require water supplementation.

Exceedance of vegetation health condition triggers will require supplementation with the purpose to return groundwater levels to within the natural range within the area of the GDE.

The final design for the supplementation scheme will be completed during the implementation of this GDMP. Supplementation will be based on:

- Surface irrigation.

The supplementation scheme will have the following design criteria:

- To supply enough water to offset declines in groundwater levels (i.e., maintain levels within the natural range under the GDEs). This will be determined using the existing groundwater model;
- To be operationally effective. This will be assessed during the engineering design of the scheme based on aquifer parameters derived during previous groundwater investigations;
- To incorporate a monitoring program that can confirm the supplementation system's efficacy. The monitoring program outlined in this plan will achieve this.

Supplementation water will be sourced from the Yarragadee aquifer to ensure sufficient water quality within the GDEs without risk of impacts due to acidification or dieback.



## 8. STAKEHOLDER ENGAGEMENT

Doral has consulted with several stakeholders in relation to the management of groundwater-dependent vegetation for the Proposal. A summary of the consultation is provided in Table 9.

**TABLE 9. STAKEHOLDER CONSULTATION**

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
DWER (OEPA)	19/10/17 26/10/17 03/01/18 07/04/18 29/08/18 05/03/19 21/03/19 29/05/19 30/05/19 04/10/19	Pre-referral meeting; R Sutherland, R Hughes. All relevant environmental factors discussed. Referral Document received. Referral Document accepted and nominated as PER. Draft ESD submitted to EPA. Yalyalup Site Visit – R Hughes and M Spence. ESD Submitted to EPA. Presentation of Yalyalup Project to EPA Board. Submission of Revised version of ESD to EPA. ESD acceptable by EPA services and published on website. Submission to EPA of S43A amendment to Proposal for the amendment of Development Envelope and disturbance areas to include creation of internal access road.	No significant issues noted at this stage
DMIRS	14/02/18	Pre-referral meeting to discuss project; R Hepworth, L Copeland. All relevant environmental factors discussed.	No issues noted
DBCA	24/05/19	A Webb - Post referral meeting to discuss project, flora studies to date and proposed GDE survey scope. Reference to historic mineral sands dewatering incident at Gwinninup mine and likelihood of direct offsets due to dewatering risks of McGibbon Track. Likely offsets requirement due to dewatering risk of McGibbon Track. Several sites	Acknowledged

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
	03/12/19	mentioned as possible Ironstone community for investigation by Doral.  Email to DBCA; A Webb of completed Yalyalup GDE report for discussion.	Proposed meeting to discuss in new year (2020).
DWER- Licencing	01/12/17	Pre-referral meeting - D Hartnup to inform of proposal and relevant environmental factors.	No issues noted.
DWER - DoW	22/11/17	Pre referral meeting to discuss project; A De Chanee, R Gibbs. Potential for cumulative effects of dewatering with Avocado farm and Wonnerup North Mine.	Acknowledged.
DWER - Contaminated Sites Branch	13/11/17	Pre-referral meeting S Appleyard, S Jenkinson to discuss potential acid sulphate soils risk and intended management actions.	Acknowledged.
City of Busselton	09/08/19  09/12/19  2023  8/9/23  8/2/24  20/2/24	Email correspondence regarding construction for intersection and road reserve crossings.  Meeting with City of Busselton Executive and CEO to discuss Yalyalup Proposal.  Quarterly update and newsletter mailed.  Meeting with CoB CEO and Director of planning to discuss Northern Extension proposal.  Meeting with Director of Community planning and Infrastructure/Environment provide northern extension proposal overview, timeline, boundary, approvals process.  Meeting with Shire council members and Executive to brief on Northern Extension proposal.	Committed to ongoing engagement.
SWALSC	06/08/19	Consultation; P Nettleton and M Benson to review Heritage agreement contract and request nomination of consultants for Ethnographic studies.	Agreed.
DAWE (previously DoEE)	01/11/17  09/11/17	Submission of referral of Project.  Request for information; D Rothenfluh regarding Naturally Occurring Radioactive Materials.	Information supplied, not a nuclear action.

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
	12/02/18	DAWE (then DoEE) decision a declared action. Assessment by EPA under bilateral agreement.	Acknowledged.
Water Corporation	12/12/19	Construction of crossing over Abba River identified as a drain under the <i>Water Services Act 2012</i> and will require approval by the Water Corporation.	The proposed construction of the bridge to cross the Abba River (drain) will not impede upon the waterway. Doral will provide suitable engineering drawings of the “bridge” design to the Water Corporation to satisfy Water Corporation Policy requirements.
<b>LANDOWNERS (require approvals and/or agreements)</b>			
Tonkin S & N Lot 2	2020/22  3/11/22 16/5/23 1/6/23 8/8/23 18/10/23 30/11/23 15/12/23	Regular consultation Yalyalup project overview, timeline, new developments and follow up on any concerns.  Regular engagement on Northern extension proposal overview, timeline/boundary distance and environmental approvals/assessments.  Noise, dust, visual amenity concerns  Quarterly update and newsletter mailed.  Community update letter Northern Extension proposal overview.  Discussion on referral timeline.	Committed to ongoing engagement.  Potential impacts assessed in modelling. Mitigation measures presented in management plans (refer social surroundings)      Commenced mining lease discussions.
Tonkins G & A Lot 1	2020/22  2022/23 15/2/23  24/11/23	Consultation on Yalyalup project overview, timeline, boundary and exploration drilling.  Quarterly update and newsletter mailed.  Meeting on exploration drilling and northern extension proposal.  Concerns water quality/quantity of bore.  Meeting Northern extension proposal overview, timeline/boundary distance. Environmental approvals/assessments  No concerns raised.	Investigation of historical bore monitoring results. No impact  Potential impacts assessed in ERD and will be incorporated into water management plans (refer Hydrological Processes)      Committed to ongoing engagement.
Cowcills Lot 102	2021-2023  18/10/23	Regular consultation on Yalyalup project overview, timeline, new developments and follow up concerns.  Quarterly update letter/newsletter mailed.	Potential visual amenity impacts assessed. Tree planting provision.  Potential impacts assessed in ERD and incorporated into noise and dust

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
	5/12/23	Community update overview of northern extension proposal. Meeting on Northern Extension progress, boundary, timeline and approvals process. Concerns with visual amenity and dust.	management plans (refer Social Surroundings). <b>Committed to ongoing engagement.</b>
Stone Lot 1833	7/2/23 2022/23 18/10/23	Consultation on exploration drilling and northern extension overview. Quarterly update and newsletter mailed. Community update letter. Northern Extension proposal overview and invitation to meet. Ongoing discussion on suitable meeting date.	<b>No concerns raised</b>
Bills/Waters Lot 3196	18/10/22 13/11/23 29/2/24	Community update letter. Northern Extension proposal overview and invitation to meet. Meeting on project proposal, timeline, boundary, environmental approvals process. Concerns on impact on Surface dam water.	Potential impacts on water supply assessed in the groundwater modelling studies and ERD (refer Hydrological Processes).
Don Lot 1832	18/10/22 1/12/23	Community update letter. Northern Extension proposal overview and invitation to meet. Project proposal, timeline, boundary, environmental approvals process. Dust concerns.	Potential impacts assessed in ERD and incorporated into dust management plans (refer Social Surroundings).
Whiteland Lot 4	2019-2023 18/10/22	Regular consultation on Yalyalup project overview, timeline, new developments. Quarterly update letters/newsletter mailed. Regular consultation on exploration drilling and project extension. Community update letter Northern Extension proposal and offer to meet.	Continue to send quarterly Community update and newsletter. <b>No concerns raised.</b>

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Waters Haddon Lot 1761	2019-2023  18/10/22  15/12/24	Regular consultation providing Yalyalup project overview, timeline, new developments, receive feedback, follow up on any concerns.  Quarterly update letters/newsletter mailed.  Community update letter Northern Extension proposal and offer to meet.  Northern extension proposal, timeline, boundary, environmental approvals process.	No concerns raised.  <b>Committed to ongoing engagement.</b>
Hodgson Lot 1830	18/10/22  6/3/24	Community update letter. Northern Extension proposal overview and invitation to meet.  Meeting Northern Extension overview, timeline, boundary and approvals process.  Dust concerns.	Continue to send Quarterly update and newsletter.  Potential impacts assessed in modelling. Mitigation measures presented in management plans (refer social surroundings)  <b>Committed to engagement.</b>
Chapman Lot 1762 Lot 1764 Rentals	2021-2023 7/2/23 18/10/22 9/1/24 7/2/24  5/3/24	Quarterly updates, newsletter mailed.  Bore Water quality issue.  Quarterly update letter Northern extension overview and offer to meet.  Phone/email to provide Northern extension update.  Meeting to discuss the Northern Extension, timeline, boundary and approvals process.  <b>No issues raised</b>	Investigations of historical data identified no impact.  Potential impacts on water supply assessed in the groundwater modelling studies and ERD (refer Hydrological Processes).  Continue quarterly updates to landowner and tenants.  <b>Committed to ongoing engagement.</b>
Denny Lot 1 Lot 107 Rentals	2022/23  18/10/22  10/1/24	Regular consultation on Yalyalup project update, timeline, new developments, follow up on any concerns.  Quarterly update letter mailed. Northern Extension overview and offer to meet.  Consultation northern extension progress, timeline, boundary, approvals process.  Dust concerns.	Dust monitoring and assessment conducted.  Dust mitigation strategies adopted.  Potential impacts assessed in ERD and incorporated into dust management plans (refer Social Surroundings).

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Avery Lot 1270	2020-2023  18/10/22  14/2/24	Regular consultation providing Yalyalup project overview, timeline, new developments, follow up on concerns.  Quarterly update letter/newsletter mailed.  Northern Extension overview and offer to meet.  Discussion on extension proposal, timeline, boundary, approvals process.  Dust, water, vermin control concerns.	Potential impacts assessed in ERD and incorporated into noise and dust management plans (refer Social Surroundings).  <b>Committed to ongoing engagement</b>
Hodge 309	2019-2022  2022/23 18/10/23  8/1/24  14/02/24	Consultation providing Yalyalup project overview, timeline, new developments, receive feedback, follow up on any concerns.  Quarterly update letter/newsletter mailed.  Community update letter. Northern Extension proposal overview and invitation to meet.  Phone discussion on northern extension.  Concerns on summer weather conditions impacting on dust/noise.  Follow up to offer to meet to discuss Northern extension proposal, timeline, boundary, and approvals process.  No response	Potential impacts assessed in ERD and incorporated into dust and noise management plans (refer Social Surroundings).  <b>Committed to ongoing engagement</b>
Plank Lot 15	2022/23  2022/23 18/10/23  18/12/23 4/1/24 9/1/24	Quarterly update letter/newsletter mailed. Consultation on Yalyalup minesite and noise concerns.  Quarterly community update/newsletter mailed.  Community update letter, Northern Extension proposal overview.  Phone and email invitation to meet to discuss extension proposal in early 2024.  Exploration drilling on adjacent property and invitation to meet.  No response.	Potential impacts assessed in ERD and incorporated into noise management plans (refer Social Surroundings).

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Teal Lot 1831	18/10/23  29/1/24	Community update letter mailed on Northern extension proposal and invitation to meet.  Phone call to discuss extension. Concern on distance and potential impacts.	Continue to send community update sand newsletter.  Potential impacts assessed in ERD and incorporated into management plans (refer Social Surroundings).
Harbeck Lot 61  Lot 1757 Rental	2022-2023  18/10/23  26/02/24	Quarterly update letter mailed.  Regular consultation exploration drilling.  Community update letter. Northern Extension proposal overview and invitation to meet.  Meeting on Northern extension overview, timeline, boundary, and approvals process.	<b>No concerns raised</b>
Radford Lot 82	2021-2023 18/10/23  9/1/24	Quarterly update letter/newsletter mailed.  Community update letter. Northern Extension proposal overview and invitation to meet.  Phone discussion on extension timeline and boundary.  Public road condition a concern.	
Buchan Lot 81	2020-2023  18/10/23  9/1/24 5/2/24	Consultation via email.  Quarterly update letter emailed to postal address.  Community update letter. Northern Extension proposal overview and invitation to meet.  Phone and Email offer to meet to discuss extension plans.	<b>No Concerns raised.</b>
Van Kleef Lot 651	2019-2022  2022/23 18/10/23  30/11/23 30/1/24 21/02/24	Phone discussion providing project overview. Interested in site plan/ layout and proximity to residence including road haulage options.  Quarterly update letter mailed to postal address. Northern extension overview and offer to meet.  Phone call and email on extension proposal. Offer to meet to update on intent, boundary, timeline, approvals process.	No concerns raised.  Follow up meeting in 2024.  Committed to ongoing engagement

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Ealing Lot 1759	2022-2023  8/6/23 18/10/23  9/1/24 11/1/24	Quarterly update letter/newsletter emailed.  Exploration drilling program  Community update letter mailed on northern extension overview and offer to meet.  Emailed purpose of meeting, northern extension referral, timeline, boundary, approvals process.  Not interested in meeting.  Amenity concerns.	Committed to quarterly community update letters and newsletters.  Potential impacts assessed in ERD and will be incorporated into noise and dust management plans (refer Social Surroundings).
P & A Macleay Lot 843 Lot 748	2017 – 2022	Regular consultation providing project overview, timeline and any new developments, receive feedback, follow up on any concerns.  Quarterly update letter mailed to postal address.	<b>Property sold 2022.</b>
K & J Hester Lot 103 Lot 104	2017 – 2019	Ongoing engagement regarding project proposal, timeline and environmental approvals process.	<b>Property sold 2020</b>
Mark Conrau Lot 4551 Land only	2019-2023  18/10/24  21/2/23	Consultation and quarterly updates on Project overview, approvals process, timeline, new developments.  Quarterly update letter mailed on northern extension and offer to meet.  Meeting to discuss Northern Extension proposal overview, timeline and approvals process.	No concerns raised.
A & K Bashford Lot 1426 Lot 552	2017 – 2022   31/10/22 2022 /2023  18/10/22	Regular consultation providing project overview, timeline, new developments, receive feedback.  Quarterly update letter mailed to postal address.  Quarterly update letter mailed to postal address.  Community update Northern Extension proposal overview and invitation to meet.	Committed to ongoing engagement.  <b>Mining agreement commenced October 2022.</b>



YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Boardman Lot 3773	2017 – 2023  18/10/24	Ongoing engagement providing project progress, timeline, new developments, follow up on any concerns.  Quarterly update Northern Extension overview and invitation to meet.	Mining agreement discussion commenced.  No concerns raised.  Committed to ongoing engagement.
Slade Lot 668 Lot 421	2017- 2024  2022/23 18/10/23	Ongoing consultation on project progress, timelines, new developments, follow up concerns raised. Dust management, noise, water concerns.  Quarterly update letter mailed.  Community update letter. Northern Extension proposal overview and invitation to meet.	Undertake dust sampling pre-mining and radiation survey. Incorporate in Dust Management Plan.  Potential noise impacts incorporated in MP. Soil and water testing incorporated in mine closure plan.
Gronya Swift Lot 200	2017-2019  5/06/19	Project overview and next phase of work were discussed.  Preliminary mine plan and approvals process discussed.	Potential impacts on water supply assessed in the groundwater modelling studies and ERD (refer Hydrological Processes).  <b>Property sold in 2020</b>
Jane Gilham Lot 200	2020-2023  18/10/24  24/11/23	New owners contacted and informed of Yalyalup project. Regular engagement on project timeline and progress.  Quarterly update letter mailed Northern Extension overview and invitation to meet.  Northern Extension proposal discussion northern extension proposal, timeline and approvals process.  Concern on impacts water supply from natural creek line.	Committed to ongoing engagement.  No concerns raised.  Committed to ongoing engagement.  Potential impacts assessed in ERD and will be incorporated into water management plans (refer Hydrological Processes)
Mitchell & Anstey Lot 292	2019-2024  18/10/222	Regular engagement on project progress, timeline and follow up concerns.  Quarterly update letter mailed Northern Extension overview and invitation to meet.  Meeting Northern Extension proposal overview, timeline and approvals process.	Potential impacts assessed in ERD and will be incorporated into noise, dust and water management plans (refer Hydrological Processes and Social Surroundings).  Committed to ongoing engagement.
McClean Lot 10	2017 – 2022	Regular consultation on Yalyalup project, timeline, new developments and any concerns or feedback.	No concerns raised.

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
	18/10/22  20/02/24	Quarterly update letter mailed. Northern Extension proposal overview and invitation to meet.  Discussion on Northern Extension proposal. Arrange time to meet.	
<b>NEAR NEIGHBOURS (residents)</b>			
Jamie Oates Lot 652	2017 – 2024  18/10/22  16/11/23	Regular consultation on Yalyalup project, timeline, new developments and follow up any concerns.  Concern raised at increased traffic on Ludlow Hithergreen Road and visual amenity.  Quarterly update letter mailed. Northern Extension proposal overview and invitation to meet.  Meeting to discuss Northern Extension proposal overview, timeline, approvals process.	Advised of the proposed road access and haulage route as per mine plan.  Potential visual amenity impacts assessed. Tree planting along haulage route. Follow up meeting to advise on mitigation measures (refer social surroundings)  No concerns raised
Treanor Lot 60 Rental	2020-2021  2022/23  8/10/23	Overview of project, timeline and approvals process. Concerned at increase in traffic in general and air quality.  Quarterly update letter mailed to postal address.  Northern Extension proposal overview and invitation to meet.	Advised of the proposed road access and haulage route as per mine plan.  Potential impacts assessed in modelling. Mitigation measures presented in management plans (refer social surroundings)  Committed to ongoing engagement with landowner and tenant.
Clifford Lot 52	2020-2023  18/10/23	Meeting to discuss project plan, timeline and update.  Concern noise, truck movements  Quarterly update letters emailed and mailed to postal address.  Northern Extension proposal overview and invitation to meet.	Potential impacts assessed in ERD and incorporated into noise and dust management plans (refer Social Surroundings).
Taylor's Lot 102	2020/ 2021	Project overview, timeline and rehabilitation. Quarterly update letter mailed to postal address.	<b>Property sold 2021</b>
Phillips Lot 229	2017	Consulted on Yalyalup project overview, mine plan and approvals process.	Committed to ongoing engagement via tenant.  Continue community update letters.

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
Rental	2020/21  18/10/23  6/2/24	Quarterly update letter mailed to landowner and tenant.  Northern Extension proposal overview and invitation to meet.  Phone call to discuss Northern Extension.  No concerns raised.	
Scott, Spragg, Hartnett  Lot 1461	2019-2022	Overview Yalyalup project, timeline, and approvals process.  Quarterly update letter mailed.	<b>Property sold 2022</b>
Peter Oates  Lot 1370, Lot 3382, 1976	2019-2023  18/10/23  15/1/24  5/3/24	Regular consultation of Yalyalup project, mine plan and timeframe. Concerns at McGibbon track access and closure.  Quarterly update letter mailed.  Community update letter northern extension proposal and offer to meet.  Meeting discuss Northern Extension proposal, boundary, timeline and approvals process.	Potential impacts assessed in the Groundwater Dependent Ecosystems Study and the ERD (refer Flora and Vegetation and Hydrological Processes factors).  No concerns raised
Copeland  Lot 221	2019-2023  18/10/23  15/12/23	Consultation Yalyalup project, mine plan, approvals process and timeframe. Quarterly update letter/newsletter emailed and mailed.  Community update letter northern extension proposal and offer to meet.  Meeting discuss Northern Extension proposal, boundary, timeline and approvals process.	No concerns raised.
A Franklin  Lot 52	2019-2022  18/10/23  8/2/24	Phone discussion on Yalyalup project overview, current work, and timeframe.  Quarterly update letter mailed to postal address.  Community update letter northern extension proposal and offer to meet.  Meeting extension overview, timeline, boundary, approvals process.	No concerns raised.
Wright  Lot 1758	2022/23	Regular consultation on Yalyalup project, new developments, timeline.	No Concerns raised

YALYALUP NORTHERN EXTENSION GDE MANAGEMENT PLAN

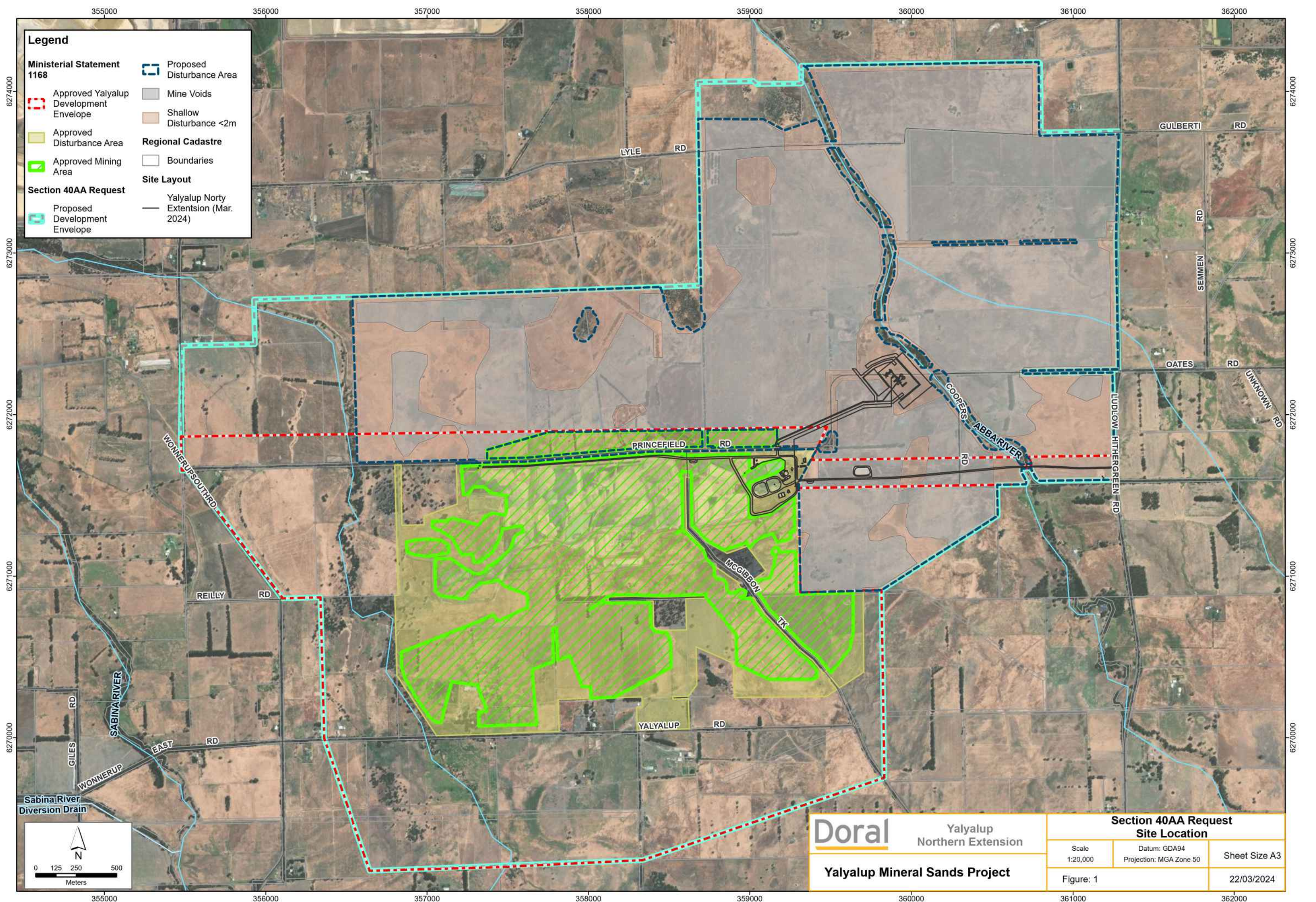
STAKEHOLDER	DATE	ISSUES/TOPICS RAISED	PROPONENT RESPONSE/OUTCOME
	17/2/223  18/10/23	Drilling, northern extension preliminary discussions.  Community update letter and phone conversation on extension proposal, timeline, boundary, approvals process.	
Jones	20/02/24	Preliminary discussion on northern extension. Meeting end of March  Water supply concerns.	Potential impacts assessed in ERD and will be incorporated into water management plans (refer Hydrological Processes).

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## FIGURE 1: REGIONAL LOCATION





**Legend**

**Ministerial Statement 1168**

- Approved Yalyalup Development Envelope
- Approved Disturbance Area
- Approved Mining Area

**Section 40AA Request**

- Proposed Development Envelope

**Proposed Disturbance Area**

- Proposed Disturbance Area

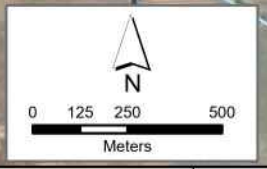
**Mine Voids**

- Mine Voids
- Shallow Disturbance <2m

**Regional Cadastre**

- Boundaries
- Yalyalup Norty Extension (Mar. 2024)

**Site Layout**



**Doral** Yalyalup Northern Extension

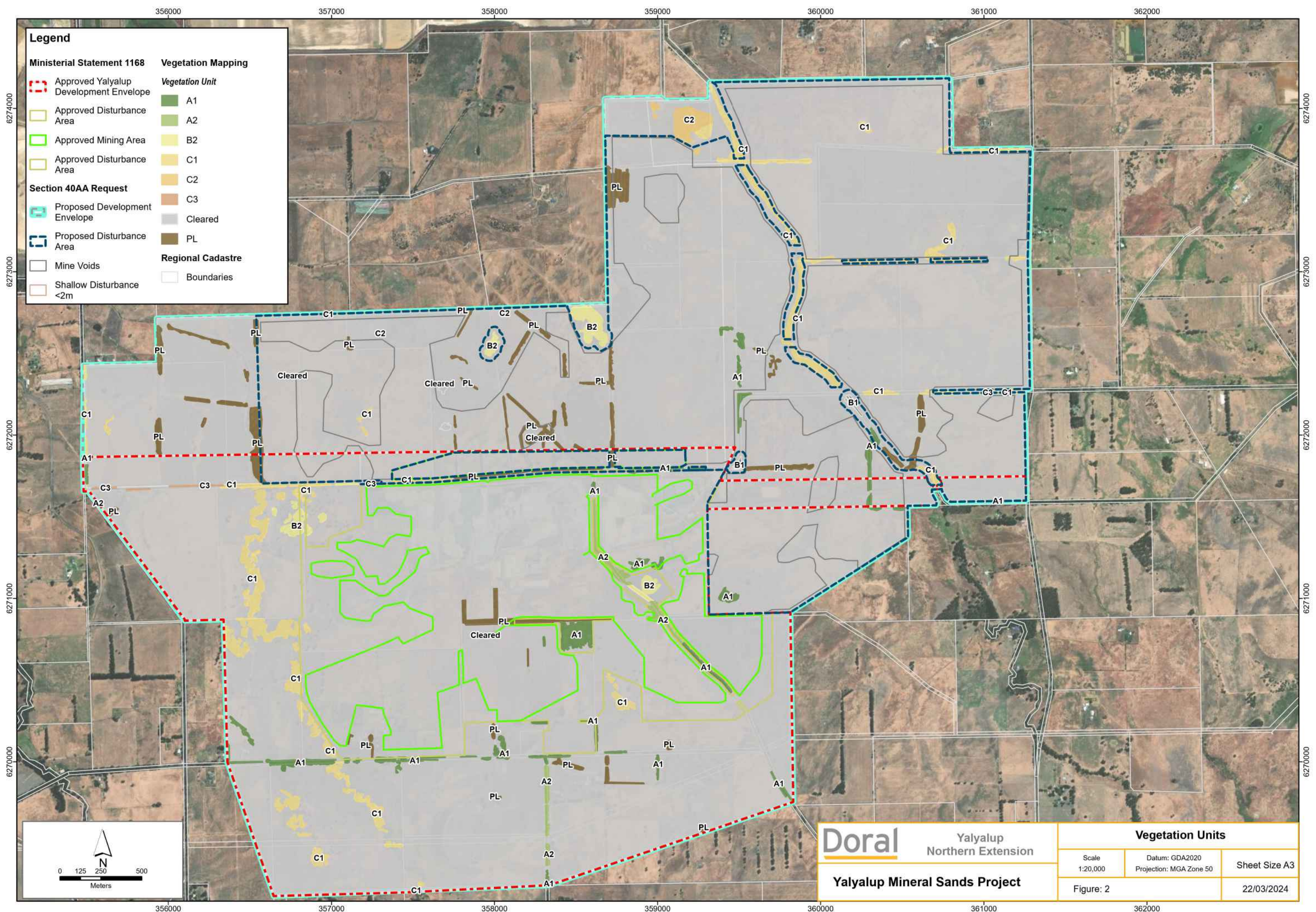
**Yalyalup Mineral Sands Project**

Section 40AA Request Site Location		
Scale 1:20,000	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 1	22/03/2024	



## FIGURE 2: VEGETATION UNITS





**Legend**

**Ministerial Statement 1168**

- Approved Yalyalup Development Envelope
- Approved Disturbance Area
- Approved Mining Area
- Approved Disturbance Area

**Section 40AA Request**

- Proposed Development Envelope
- Proposed Disturbance Area
- Mine Voids
- Shallow Disturbance <2m

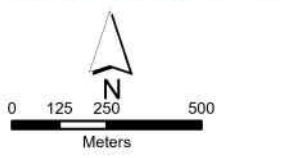
**Vegetation Mapping**

**Vegetation Unit**

- A1
- A2
- B1
- B2
- C1
- C2
- C3
- Cleared
- PL

**Regional Cadastre**

- Boundaries



**Doral** Yalyalup Northern Extension

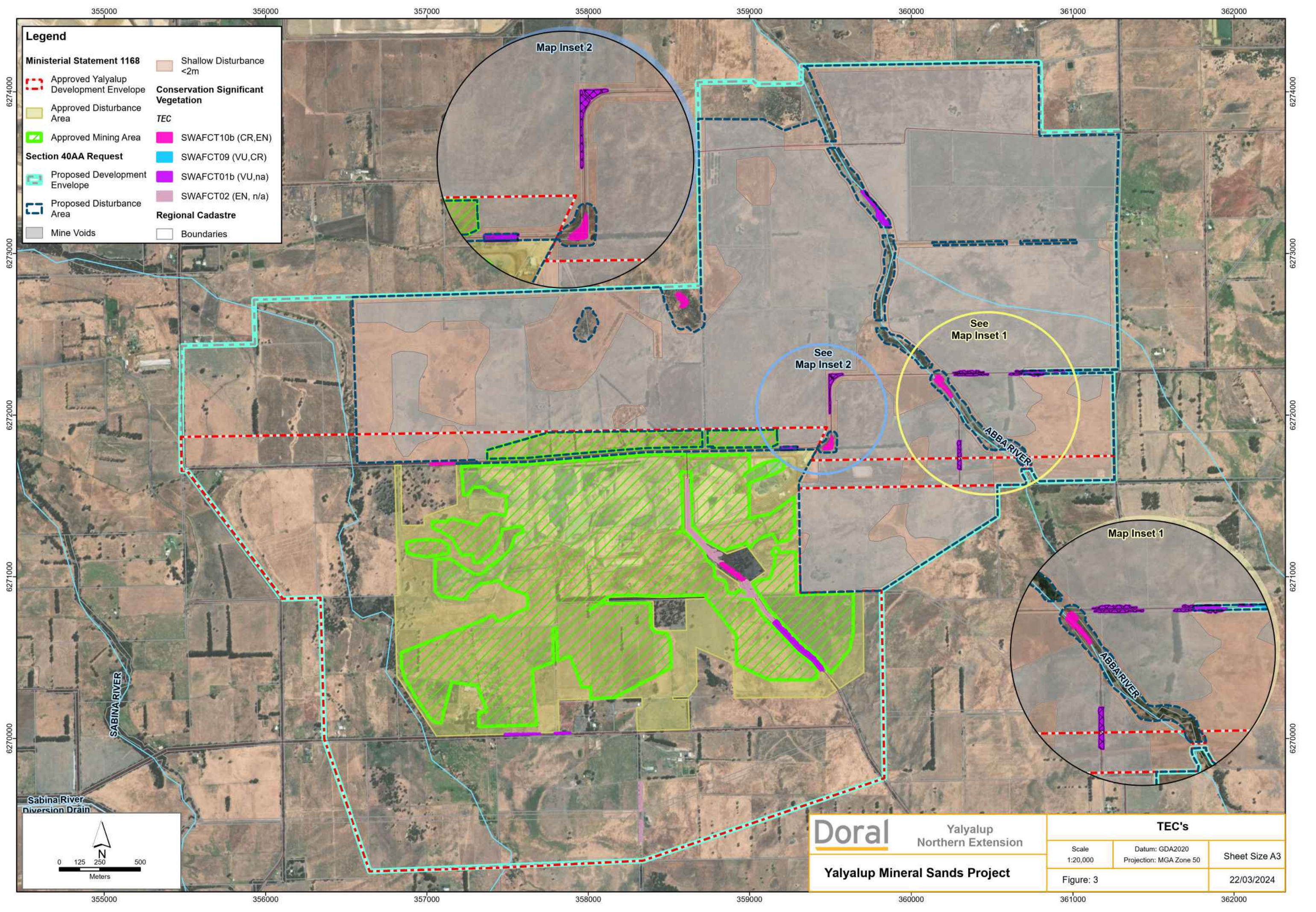
**Yalyalup Mineral Sands Project**

Vegetation Units		
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Figure: 2	22/03/2024	

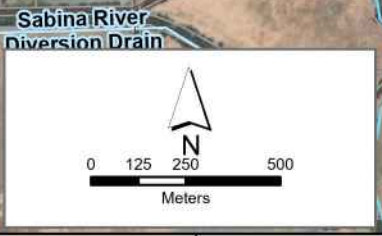
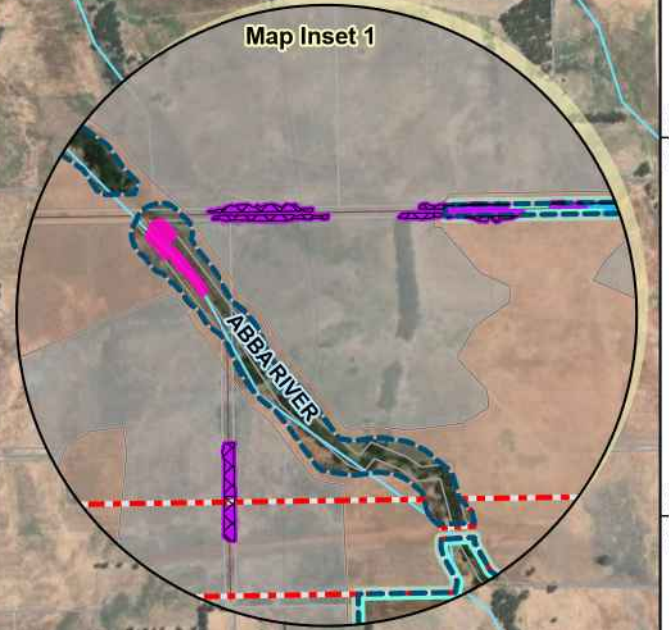
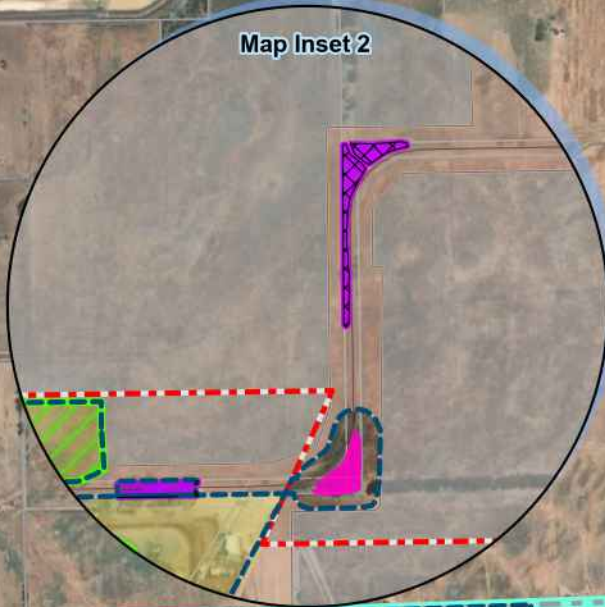


## FIGURE 3: TECS





Legend	
<b>Ministerial Statement 1168</b>	
Approved Yalyalup Development Envelope	Shallow Disturbance <2m
Approved Disturbance Area	<b>Conservation Significant Vegetation</b>
Approved Mining Area	<b>TEC</b>
<b>Section 40AA Request</b>	
Proposed Development Envelope	SWAFCT10b (CR,EN)
Proposed Disturbance Area	SWAFCT09 (VU,CR)
Mine Voids	SWAFCT01b (VU,na)
	SWAFCT02 (EN, n/a)
	<b>Regional Cadastre</b>
	Boundaries



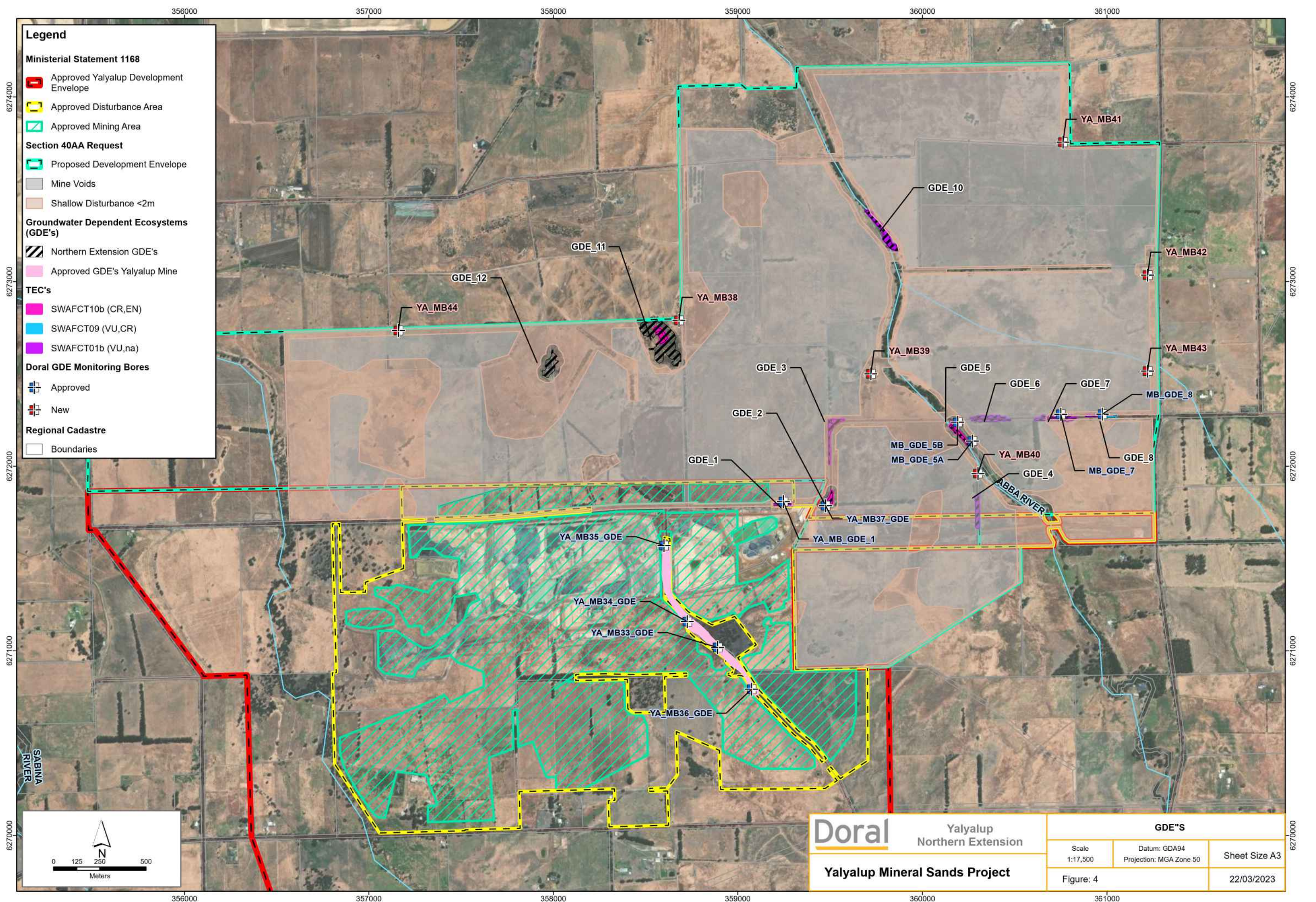
**Doral** Yalyalup Northern Extension  
**Yalyalup Mineral Sands Project**

TEC's		
Scale 1:20,000	Datum: GDA2020 Projection: MGA Zone 50	Sheet Size A3
Figure: 3	22/03/2024	



## FIGURE 4: GROUNDWATER DEPENDENT VEGETATION AND MONITORING BORES





**Legend**

**Ministerial Statement 1168**

- Approved Yalyalup Development Envelope
- Approved Disturbance Area
- Approved Mining Area

**Section 40AA Request**

- Proposed Development Envelope
- Mine Voids
- Shallow Disturbance <2m

**Groundwater Dependent Ecosystems (GDE's)**

- Northern Extension GDE's
- Approved GDE's Yalyalup Mine

**TEC's**

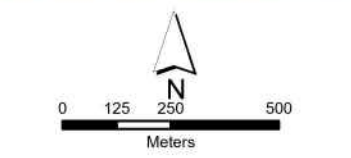
- SWAFCT10b (CR,EN)
- SWAFCT09 (VU,CR)
- SWAFCT01b (VU,na)

**Doral GDE Monitoring Bores**

- Approved
- New

**Regional Cadastre**

- Boundaries



**Doral** Yalyalup Northern Extension

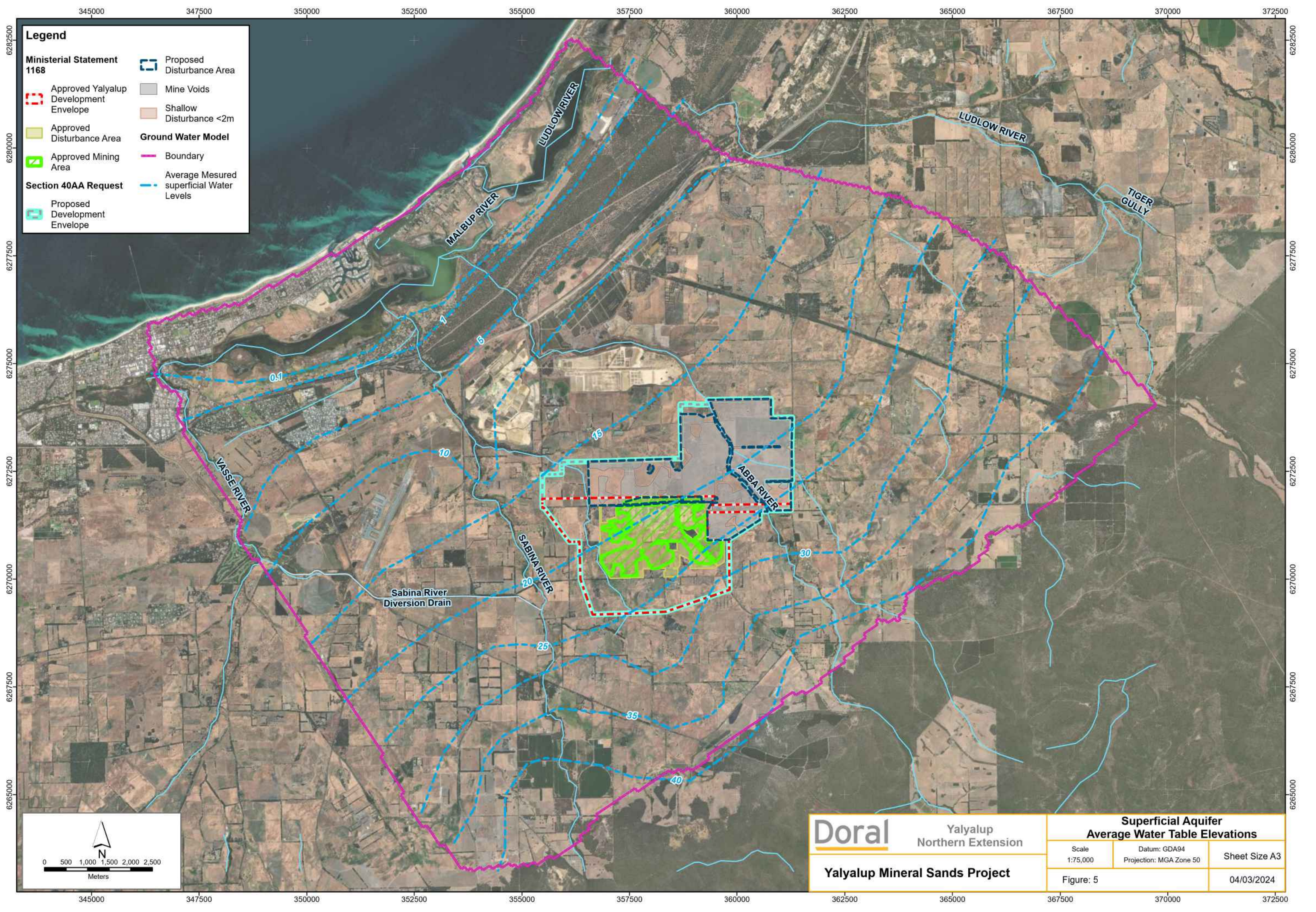
**Yalyalup Mineral Sands Project**

GDE'S		
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Figure: 4	22/03/2023	



## FIGURE 5: AVERAGE WATER TABLE ELEVATIONS





**Legend**

**Ministerial Statement 1168**

- Approved Yalyalup Development Envelope
- Approved Disturbance Area
- Approved Mining Area

**Section 40AA Request**

- Proposed Development Envelope

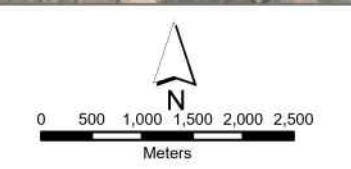
Proposed Disturbance Area

Mine Voids

Shallow Disturbance <2m

**Ground Water Model**

- Boundary
- Average Measured superficial Water Levels



<b>Doral</b> Yalyalup Northern Extension <b>Yalyalup Mineral Sands Project</b>	<b>Superficial Aquifer Average Water Table Elevations</b>	
	Scale: 1:75,000	Datum: GDA94 Projection: MGA Zone 50
	Figure: 5	Sheet Size A3 04/03/2024



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