YALYALUP
Mineral Sands Project

ENVIRONMENTAL REVIEW DOCUMENT- RESPONSE TO SUBMISSIONS, V4

Date: 19 NOVEMBER 2020

EPA ASSESSMENT NO: 2141

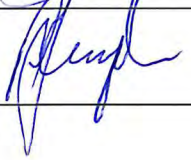
Document Ref: DMS-YAL-ERD-RTS-004-V4

Doral Mineral Sands Pty Ltd ABN 18 096 342 451 ACN 096 342 451 Lot 7 Harris Road, Picton WA 6229
Tel:+61 8 9725 5444 Fax:+61 8 9725 4557 Email: admin@doral.com.au Website: www.doral.com.au

DOCUMENT DETAILS

DOCUMENT ID	REPORT TITLE	VERSION	DATE	PREPARED FOR
DMS-YAL-ERD-RTS-004-V4	Yalyalup Mineral Sands Project, Response to Submissions, V4	Version 4	19/11/20	EPA

PREPARED BY

NAME	TITLE	ROLE	SIGNATURE	DATE
Damon Bourke	ABEC Environmental Consulting Pty Ltd Principal Environmental Scientist	Author		19/11/20
Craig Bovell	Doral Mineral Sands Pty Ltd OHS & E Superintendent	Reviewer		19/11/20
Andrew Templeman	Doral Mineral Sands Pty Ltd General Manager	Approver		19/11/20

Prepared by:

ABEC ENVIRONMENTAL CONSULTING PTY LTD

2/17 Inverness Avenue,
DUNSBOROUGH, WA 6281.
admin@abecenv.com.au

TABLE OF CONTENTS

1. INTRODUCTION

1.1. THE YALYALUP MINERAL SANDS PROJECT

The Proposal is to allow mining of the Yalyalup Mineral Sands Deposit located approximately 11km southeast of Busselton, Western Australia.

The Mine is proposed to operate 24 hours a day, 7 days a week, however during evening and night time periods (7pm-7am) all mining activities at the pits will stop and only the feed prep and wet Concentrator plants will remain in operation.

Ore from the deposit will be mined progressively via a series of open-cut pits using dry mining techniques. Dewatering of groundwater inflows into the pit will be required to enable dry mining to occur. Mining will be staged in order to minimise the area of disturbance (at any one time) with the aim of achieving focused and effective management of the environmental factors at each pit location, prior to moving onto the next pit location.

Processing of ore will commence in-pit and then slurry will be pumped from the feed preparation plant to the wet concentration plant for further processing. Waste clay and sand materials from processing of this ore will be combined and backfilled into the mine voids using co-flocculation (co-disposal system) where possible. Some material will be initially placed in a Tailing Storage Facility, herein referred to as Solar Evaporation Ponds (SEPs), to allow drying of the clay and recycling of water back to the process water dam (PWD) (return water), prior to being co–disposed into mine voids. The mined area will be rehabilitated back to pasture and/or native vegetation, depending on pre-mining conditions, consistent with the post-mine land use requirements.

HMC produced at the wet Concentrator plant will be stockpiled on site prior to transport to Doral's Picton Dry Separation Plant, located ~60km northeast of the mine, for separation using electrostatic processes. The Picton Dry Separation Plant has a licence to process HMC sourced from Doral's Yoongarillup Mine. Processing of HMC into products of zircon, ilmenite, and leucoxene has occurred since the Picton Dry Separation Plant was approved by Ministerial Statement No. 484 in 1998. Once processed, HMC products are hauled by truck to either the Bunbury Port or Fremantle Port for export

1.2. ASSESSMENT PROCESS

The Proposal is being assessed by accredited assessment under Part IV of the *Environmental Protection Act 1986*

An Environmental Review Document (ERD) was prepared which provides an environmental review of the Proposal including a detailed description of the key components, environmental impacts and proposed environmental management measures for the relevant environmental factors identified by the Environmental Scoping Document (ESD) (Doral, 2019).

The public review period for the Proposal commenced on 20 June 2020 for a period of four weeks, ending on 22 July 2020. A total of three submissions from the public were received, as well as submissions from three Government Departments (DBCA, DWER and DAWE).

The key issues raised in the submissions include:

- Groundwater drawdown risk to threatened species, communities and fauna habitat;

- Sensitivity analysis, calibration and level of certainty of predictions of the groundwater model;
- Assessment and management of PASS at the Site;
- Assessment and management of NORMs at the Site;
- Identification of direct offsets and land acquisition.

The purpose of this document is to assist the EPA to assess the Proposal by providing Reponses to issues raised in the submissions and provide additional information relevant to the assessment.

2. FLORA AND VEGETATION

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
Southwest Catchments Council	1. Threatened Flora and Ecological Communities The design of the development to ensure that no Declared Rare Flora or priority flora species are to be cleared is pleasing to see, however the abstraction of significant amounts of ground water are likely to impact on the remaining native vegetation on the site and also potentially offsite. This needs to be closely monitored over the life of the development to identify any potential impacts early on and to address them.	Acknowledged. A GDE Management Plan was prepared by AQ2 (2020c) to document Doral's proposed mitigation measures for potential drawdown impacts on groundwater dependent vegetation and is provided as Appendix 4E of the ERD. The GDE Management Plan has since been revised (October 2020 Version C) in consultation with DAWE and DBCA to remove the point intercept method and increase the frequency of vegetation health quadrat monitoring. The revised version is provided in Attachment 1 of this document.
DBCA	***Recommendation 1:*** *That if the proposal is considered acceptable, a condition of approval is applied that requires the development and implementation (and regular review) of a conservation significant flora and vegetation management plan that specifies the approved limits of impacts, objectives and monitoring protocols to identify and manage conservation significant flora, vegetation, communities and their habitat.* **Discussion:** Threatened flora (and their habitat) and TECs are known to occur within the development envelope and within the area of predicted groundwater drawdown. The ERD (e.g. Tables 4-12, 4-13, and 4-14) and supporting appendices present details on the conservation significant values that are predicted to be directly or indirectly impacted by the proposal. However, there is some uncertainty in: • Verification of the mapped extent of TEC SWAFCT10b 'Shrublands on Southern Swan Coastal Plain Ironstones (Busselton Area)' (ranked critically endangered); TEC SWAFCT02 'Southern wet shrublands, Swan Coastal Plain' (ranked endangered); and TEC SWAFCT01b '*Corymbia calophylla*	Discussion acknowledged. <u>Recommendation 1</u> DIRECT IMPACTS • Doral have prepared a Flora and vegetation Management Plan which includes development and implementation of specific clearing procedures to minimise any inadvertent direct impacts to flora and vegetation, including conservation significant flora and vegetation. This includes demarcation of vegetation/trees to be cleared and authorisation requirements prior to any clearing activity being conducted. Monitoring requirements have also been defined and include rationale of monitoring site selection, baseline monitoring, frequency of monitoring, monitoring methodology and management response triggers and

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	woodlands on heavy soils of the southern Swan Coastal Plain' (ranked vulnerable); as described by Gibson et al. (1994)1. • Confidence in local-scale predictions of indirect impacts to threatened flora, TECs and threatened fauna habitat from mine dewatering and groundwater drawdown. • Identification of occurrences of *Eucalyptus rudis* which have not been made to the subspecies level, so it is unclear if the occurrences of *E. rudis* are the Priority flora subspecies (*E. rudis* subsp. *cratyantha*) or not. • Whether historical occurrences of threatened flora species in the proposal area have been confirmed. DBCA recommends that if, through the Environmental Protection Authority's (EPA) finalisation of this assessment, there remains uncertainty regarding predictions of impacts, a conservative approach to impacts (and their management) is taken for threatened flora and TECs. Should the proposal be considered acceptable, **clarity around the approved limits of acceptable impacts** (e.g. number of plants or hectares of vegetation) will be important to assist DBCA in considering the application of consistent approvals as required for authorising the taking or disturbance of threatened species or modification to a TEC under sections 40 and 45 of the *Biodiversity Conservation Act 2016*, respectively. The ERD provides high-level commitments for the management of flora and vegetation, including the development of a flora and vegetation management plan (Section 4.2. – Mitigation, page 71). Due to the number and significance of threatened species and TECs at risk from the proposal, the development of a flora and vegetation management plan to identify and manage potential impacts on these values and their habitat to within the approved limit of acceptable change is supported by DBCA. It is important such a document provides for robust management and monitoring for individual species and TECs for all phases of the	contingency measures. This Plan has been provided to EPA/DAWE as part of the assessment of the Proposal. • Clearing limits, considered to represent the 'limits of impact' were specified in the ERD (Table 4-13) which are limited to the following (in regards to conservation significant flora and vegetation): i. No clearing of any Threatened or priority flora species; ii. Clearing of 0.17ha of SWAFCT01b. iii. Clearing of 0.63ha of SWAFCT02. Doral have further revised the mine pit/disturbance boundaries as part of Response to Submissions in order to further avoid direct impacts to conservation significant vegetation as far as practicable. This has resulted in the following revised direct impacts: i. <u>No clearing</u> of any Threatened or priority flora species; ii. <u>No clearing</u> of SWAFCT01b. iii. <u>No clearing</u> of SWAFCT02. Figures 1 and 2 show the difference in clearing footprint along Yalyalup Road and McGibbon Track. As such the above revised 'limits of impacts' show no direct impacts to conservation significant flora or vegetation. **INDIRECT IMPACTS** • Doral have provided a GDE Management Plan as Appendix 4E with the ERD, which provides details of the monitoring,

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	project, including pre-development and post-mining. Consideration should be given for the development of outcomes-based provisions within the plan, particularly where environmental components can be objectively measured and reported.	management response triggers and contingency measures that will be implemented to minimise impacts to flora and vegetation values from indirect impacts associated with groundwater drawdowns. The GDE Management Plan has since been revised (October 2020 Version C) in consultation with DAWE and DBCA to remove the point intercept method and increase the frequency of vegetation health quadrat monitoring. The revised version is provided in Attachment 1 of this document. • Predicted areas of indirect impacts have been conservatively provided in Table 4-14 of the ERD based on groundwater modelling, GDE Assessment and assumption that no management or mitigation measures are implemented. These areas are considered to represent the approved limits of impact from indirect groundwater drawdown. These define that indirect impacts have the potential to affect the following TECs: i. Up to 1.81ha of SWAFCT02; ii. Up to 0.34ha of SWAFCT10b; iii. Nine *Banksia squarrosa* subsp. *Argillacea* • Implementation of the GDE Management Plan is expected to minimise the area of indirect impacts to these vegetation communities and Threatened flora from groundwater drawdown. • Doral are proposing an offset for significant residual impacts to SWAFCT10b and the co-located *Banksia*

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		squarrosa subsp. *Argillacea* based on the area provided above.

3. TERRESTRIAL FAUNA

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
Southwest Catchments Council	2. Threatened Fauna Impacts The potential for the abstraction of groundwater to impact on native vegetation on the nearby McGibbon Track and Sabina River needs to be closely monitored. These areas have been identified as important ecological linkages and an important corridor area linking western ringtail possum populations from the coastal plain through to the forested areas on the Darling Scarp. Any impact on these areas needs to be closely monitored over the life of the project and mitigation measures implemented if needed to ensure that these areas are not degraded because of the development. The ponds created as part of the mining process may become used as water sources by black cockatoo species. The use of these ponds by these species should be monitored so that the impact of their removal at the end of the mine's life can be managed in such a way as to avoid any negative impact on these threatened species. If their use becomes significant, consideration should be given to retaining some of the water bodies during the rehabilitation of the site if possible.	Acknowledged A GDE Management Plan has been prepared by AQ2 (2020c) to document Doral's proposed mitigation measures for potential drawdown impacts on groundwater dependent vegetation and is provided as Appendix 4E of the ERD. The GDE Management Plan has since been revised (October 2020 Version C) in consultation with DAWE and DBCA to remove the point intercept method and increase the frequency of vegetation health quadrat monitoring. The revised version is provided in Attachment 1 of this document. Doral has prepared a Fauna Management Plan which includes management and monitoring procedures to mitigate risks to fauna from temporary open water bodies. This Management Plan has been provided to EPA/DAWE for assessment. Doral notes that no evidence to date of usage by fauna (Black Cockatoo) within the production dam or other open water bodies at the Dardanup or Yoongarillup Mine sites has been observed. Several other nearby natural permanent water bodies (Sabina River and Abba River) are in close proximity to the proposal and can continue to be used by Black Cockatoos prior to, during and after implementation of the Proposal.
DWER	The proposal would remove 102 "potential breeding habitat trees" and indirectly impact another 30 (ERD, p. 202). Regarding the direct impacts, the ERD states that "*of these 102, 5 contain hollows considered possibly suitable for use by Black Cockatoo*" (p.162). This understates the impacts of the proposal to black cockatoos, for which breeding habitat is defined as "…. *trees of species*	The ERD has provided an assessment of the direct and indirect impacts to Black Cockatoo potential breeding habitat based on 132 potential breeding trees using the DSEWPaC (2012) criteria (i.e. DBH $\geq$50cm or DBH $\geq$30cm for wandoo). Section 4.3.5 (Table 4-21, pg 95-97) of the ERD correctly states that the proposal will result in a direct impact to 102 isolated scattered paddock

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	known to support breeding within the range of the species which either have a suitable nest hollow OR are of a suitable diameter at breast height to develop a nest hollow" (DSEWPAC, 2012. p.13). The assessment of project impacts should proceed considering all 132 potential breeding habitat trees, not only the five identified with hollows suitable for use by black cockatoos. The ERD proposes the rehabilitation of 4.7 ha of black cockatoo habitat to "...*counterbalance the total clearing of the proposal*" (p. 162). There is a significant time lag – approximately 200 years or more – for the formation of hollows suitable for black cockatoos (DSEWPAC, 2012. p.13). A substantial residual impact to black cockatoo habitat is therefore likely, regardless of rehabilitation. This should be considered during assessment.	trees, mapped as potential breeding habitat (i.e. DBH ≥50cm or DBH ≥30cm for wandoo) as per DSEWPaC, (2012) guidance. This section also states that of these 102 trees, only 5 contain possibly suitable hollows. These 5 trees were subject to an additional assessment by (Harewood, 2020b) (Appendix 6B) to determine suitability and to aid in identifying any signs of current or previous use by Black Cockatoos. None of the hollows showed any conclusive evidence of actual use by nesting Black Cockatoos. Section 4.3.5 of the ERD (pg 98) notes that the fauna habitat likely to be impacted by the projected water drawdowns, will result in a potential residual impact of 1.81ha of WRP habitat (which is an identified GDE), which also contains 32 Black Cockatoo potential breeding habitat trees (i.e. DBH ≥50cm or DBH ≥30cm for wandoo) as per DSEWPaC (2012) guidance. Two of these trees are dead and will not be affected by drawdown and none of the remaining 30 trees contain hollows suitable for a Black Cockatoo to use. These 30 trees have been assessed as being indirectly impacted by the Proposal. As part of Doral's mitigation measures, an area of 4.7ha is proposed to be rehabilitated with local native species, including WRP and Black Cockatoo habitat to counterbalance the total clearing area of the Proposal (revised to 2.72ha of completely degraded vegetation). This rehabilitation is not provided as an offset for the direct and indirect impacts to 132 Black Cockatoo potential breeding habitat trees, which is provided in Section 6 - Offsets in the ERD. Section 6-2 (pg 161-176) of the ERD provides an assessment of significant residual impacts from the Proposal (including direct and indirect impacts to 132 Black Cockatoo potential breeding habitat). Doral has prepared a Draft Offset Strategy for the Proposal which provides proposed offsets using the DAWE calculator for State and Federal matters for the direct impact to 102 Black Cockatoo potential breeding habitat trees,

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		and for 1.81ha to WRP habitat, which includes the 30 Black Cockatoo potential breeding habitat trees, predicted to be indirectly impacted from groundwater drawdown. The Offset Strategy has been provided as a Confidence Attachment to EPA and DAWE.
DWER	The desktop study for SRE invertebrates is inadequate. The ERD states "*… the review of potential conservation significant invertebrates has been limited to those listed by the DBCA and EPBC Act database searches*" (App. 6A, p. 6), and the cited literature does not appear to include surveys specifically for SRE invertebrates (e.g. the ERD states "*where invertebrates have been collected during general fauna surveys at these sites as by catch, none have been identified as being SREs*"; App. 6A, p. 7). A desktop study for SREs should include at a minimum a search of the databases held by the WA Museum and a literature review for published and unpublished SRE invertebrate survey reports. No field surveys for SRE invertebrates have been conducted. The ERD states that "*a targeted SRE survey was not undertaken as it was considered unwarranted*" (App. 6A, p.6), with part of the justification being that "*targeted surveys for SRE's have not been undertaken at any of the nearby mineral sand mines on the southern Swan Coastal Plain in the past*" (App. 6A. p. 6). It should be noted that a lack of SRE invertebrate surveys at adjacent sites does not negate the need for survey of a new proposal area; if anything, it may suggest a heightened need for survey due to a lack of regional consideration of SRE invertebrates. The development envelope largely comprises cleared land and it may well be that implementation of the proposal is unlikely to result in a significant impact to SRE invertebrates. However, it is not possible to	Phoenix Environmental Services (2020) were commissioned by Doral to undertake a desktop review of SREs for the Proposal (see Attachment 1). The purpose of the desktop review was to determine the likelihood of occurrence of SRE taxa within the Development Envelope and undertake a risk assessment in adherence to EPA *Technical Guidance: Sampling of short range endemic invertebrate fauna* (EPA, 2016). The desktop assessment included a search of the WA Museum Archnid, Myriapod, Crustacean and Mollusc databases and a review of the Flora and Vegetation surveys provided with the ERD (Appendix 4A, 4B, 4C of the ERD). Results of the database searches, when restricted to the Swan Coastal Plain (SWA02) IBRA subregion spatial subset, identified a total of 16 taxa which included 14 potential SREs (including *Idiosoma sigillatum* -P3) and two confirmed SREs (both *Antichiropus* millipedes). No SRE tax were recorded within the Development Envelope, however *Bothriembryon irvineanus* is the closest SRE with five records west of the Development Envelope (4.8 – 12.2km). Based on the vegetation mapping for the Development Envelope, only two small areas were identified by Phoenix as having a high likelihood of supporting SREs based solely on the relatively good condition, Vegetation Unit A2 and Vegetation Unit B1, which collectively represent 3.9ha or 0.42% of the 924.8ha Development Envelope. Although a SRE survey has not been conducted for these vegetation units, it is difficult to determine the propensity of these vegetation types to support SREs, however the WAM database searches returned relatively few SREs

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	be confident of this, based on the available information. Current guidance states that an assessment may take a risk-based approach (EPA 2016), which may be appropriate here - but that requires an adequate initial investigation. The above inadequacies in the desktop study should be addressed, with the results used to better support the conclusions in the ERD. If high levels of uncertainty remain then field surveys should be conducted.	from the SWA02 subregion which has been extensively searched to the north. Notwithstanding, Doral have designed the Proposal to avoid clearing vegetation as far as practicable, which has resulted in the avoidance of all vegetation mapped as Unit A2 and Unit B1. Doral will also implement the GDE Management Plan (refer Attachment 1 of this document) to minimise and mitigate impacts to these vegetation types from indirect groundwater drawdowns.
DWER	The document does not explicitly demonstrate that the six Principles in the *WA Environmental Offsets Policy* (2011) have been considered. Not enough information has been provided regarding the proposed land acquisition offset, and therefore an assessment of whether the proposed offset is suitable to counterbalance the impacts of the proposal cannot be undertaken. The proponent should develop an offset strategy plan with the following information: • objectives and intended outcomes • description of actions to be undertaken • specific and measurable success criteria • timelines and milestones • monitoring to assess offset implementation • reporting details and timing • financial arrangements • risks and contingency measures	The ERD has considered the six principles of the WA Offset Policy as summarised below, although not explicitly discussed: 1. *Environmental offsets will only be considered after avoidance and mitigation options have been pursued.* Doral have provided avoidance and mitigation measures throughout the ERD for residual impacts to flora and vegetation and terrestrial fauna/habitat. These are also provided in Doral's Draft Offset Strategy (Confidential Attachment provided to EPA and DAWE). *2. Environmental offsets are not appropriate for all projects.* Doral has undertaken an assessment of significance of residual impacts (section 6-2) and all matters protected by statute affected by the Proposal are considered significant and an offset is proposed. *3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.* Land acquisition is considered to be a cost-effective offset approach and will be provided appropriately to the area/degree of impact, calculated using the DAWE Offset calculator.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	• governance arrangements including responsibilities and legal obligations • proof of consultation with the DBCAregarding offsets. The proponent notes that "*Doral will negotiate with DBCA provisional sum for land acquisition and management and arrange for a transfer of funds*". Please be aware that this is not considered an appropriate offset under Part IV of the EP Act, outside of the Pilbara region. In addition, the proponent appears to consider that land acquisition for an offset can be considered within the post-assessment context. It is the preference that offsets are considered during an assessment, rather than post-assessment. This will provide the EPA with a level of confidence that the proposed offset is appropriate and achievable.	*4. Environmental offsets will be based on sound environmental information and knowledge.* Potential offset sites will be subject to flora and vegetation/ fauna surveys to determine their suitability as an offset, for the matters being impacted. Data from the surveys will then be input into the DAWE Offset calculator to provide a transparent assessment of the offset site's suitability using sound environmental information and knowledge. *5. Environmental offsets will be applied within a framework of adaptive management.* The proposed Offset will be secured and placed under Conservation Covenant by Doral unless the offset land is granted to the State for management by DBCA. *6. Environmental offsets will be focussed on longer term strategic outcomes.* Doral is committed to delivering an offset strategy that addresses the requirements of both the State and Federal Offset Policies with the objective of providing a net benefit to the environment in the long term. Doral proposes to directly offset the significant residual impacts of the Proposal through undertaking a 100% land acquisition offset within the southwest of WA to secure like for like vegetation communities/habitat where possible. The proposed Offset will be secured and placed under Conservation Covenant or granted to the State providing long term security for the Offset site. Doral has prepared a Draft Offset Strategy to provide EPA/DBCA and DAWE with a level of confidence that a suitable offset site(s) can be secured which meets the requirements of the State and Federal Offsets policy's and guidelines. Doral are committed to securing an offset site(s) prior to clearing activities and/or dewatering McGibbon Track (expected to start in Q1, 2023).

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		Doral continues to consult with Regulators in identifying a suitable offset site(s).
DBCA	**Recommendation 2:** That if the proposal is considered acceptable, a condition of approval is applied that requires the development and implementation (and regular review) of a conservation significant fauna management plan that specifies approved limits of impacts, objectives and monitoring protocols to identify and manage conservation significant fauna and fauna habitat for target species. **Discussion:** Threatened fauna (individuals and habitat) are known to occur within the development envelope and within the area of predicted groundwater drawdown. In particular, it is proposed to impact 102 potential breeding trees for the three threatened black cockatoo species (Baudin's, Carnaby's and forest red-tailed black cockatoo) and habitat where threatened western ringtail possums were recorded in both 2017 and 2019 (ERD, page 87). Of highest concern to DBCA is the potential cumulative impacts to these threatened species, which have had substantial contraction in their population size and distribution as a result of changes to available habitat. Should the proposal be considered acceptable, clarity around the approved limits of acceptable impacts (e.g. numbers of habitat trees) will be important to assist DBCA in considering the application of consistent approvals for authorising the taking or disturbance of threatened species under section 40 of the Biodiversity Conservation Act, if required. The ERD provides a high-level summary of potential factors that may impact on threatened fauna, including presence of artificial water bodies and vehicle strikes. The ERD also presents generalised commitments for the management of the proposal for direct impacts on western ringtail possums and black cockatoo species although	Discussion acknowledged. Recommendation 2. DIRECT IMPACTS • Doral have committed to undertaking pre-clearing surveys, where necessary, prior to any vegetation being cleared. Fauna present in the clearing area will be encouraged to move to nearby vegetation, or captured and relocated in adjacent vegetation nearby to the Site (such as Woddidup Creek/drainage line, Lower Sabina River or Abba River). The capture/relocation will be undertaken by a qualified fauna handler with the appropriate licences in place. For Black Cockatoos, a pre-clearing survey using the "Great Cocky Count" methods (Peck, et al., 2018) will be undertaken prior to clearing any Black Cockatoo potential breeding habitat tree containing a possibly suitable hollow. • A Fauna Management Plan has been prepared for the Proposal which includes objectives and monitoring protocols to identify and manage conservation significant fauna and fauna habitat for WRP and Black Cockatoos. The Plan has been provided to EPA/DAWE for review. • Clearing limits, considered to represent the 'limits of impact' were specified in the ERD (Table 4-21 and pgs 98-99). The extent of clearing fauna habitat has been further revised as part of Response to Submissions which are now limited to only: i. Clearing of 102 Black Cockatoo potential breeding habitat trees; The above 'limits of impacts' result in a significant residual impact to fauna habitat and an offset is proposed.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	provides only limited information on the management of indirect impacts during the operation phase of the proposal. For example, the ERD acknowledges that the area of black cockatoo and western ringtail possum habitat will be under moderate to severe dewatering stress, but the only control actions presented are to supplement available water and increase vegetation monitoring within the habitat. As detailed in the conservation advice for the western ringtail possum (Threatened Species Scientific Committee, 2018)2, changes to hydrology can have an impact on the suitability of vegetation as habitat, including changes to nutritional value and vegetation recruitment. The ERD provides high-level commitments for the management of fauna, including the development of a fauna management plan (e.g. Section 4.3.6 – Mitigation, page 101). As threatened fauna are known to use the area and are at risk from the proposal, the development of a fauna management plan to identify and manage potential impacts on these values and their habitat to within the approved limit of acceptable change is supported by DBCA. It is important such a document provides for robust management and monitoring for individual species for all phases of the project, including pre-development and post-mining. Consideration should be given for the development of outcomes-based provisions within the plan, particularly where environmental components can be objectively measured and reported.	INDIRECT IMPACTS • Doral have provided a GDE Management Plan as Appendix 4E with the ERD, which provides details of the monitoring, management response triggers and contingency measures that will be implemented to minimise impacts to flora and vegetation values (and associated fauna habitat) from indirect impacts associated with groundwater drawdowns. The GDE Management Plan has since been revised (October 2020 Version C) in consultation with DAWE and DBCA to remove the point intercept method and increase the frequency of vegetation health quadrat monitoring. The revised version is provided in Attachment 1 of this document. • Predicted areas of indirect impacts were conservatively provided in Section 4.3.5 of the ERD (pg 98-99) based on groundwater modelling, GDE Assessment and assumption that no management or mitigation measures are implemented. These areas are considered to represent the approved limits of impact from indirect groundwater drawdown. The indirect impacts have the potential to impact the following terrestrial fauna habitat: i. 1.81ha of WRP habitat; ii. 30 Black Cockatoo potential breeding trees; • Although implementation of the GDE Management Plan is expected to minimise the area of indirect impacts to these vegetation communities from groundwater drawdown, Doral are proposing an offset.
DAWE	**14. The Department has concerns with the current assessment of potential impacts to listed threatened species and ecological communities and the conclusion there will be no/negligible significant**	Doral is committed to delivering an offset strategy that addresses the requirements of both the State and Commonwealth Offset Policies with the objective of providing a net benefit to the environment in the long term. A Draft Offset Strategy has been provided as a Confidential Attachment to

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	impacts to species such as the Western Ringtail Possum (*Pseudocheirus occidentalis*) (WRP). Should compensatory measures be required, please include details of an offset package proposed to be implemented to compensate for any residual significant impact of the project, as well as an analysis about how the offset meets the requirements of the Department's Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy October 2012 (EPBC Act Offset Policy). This information should include an appropriate reference to the Offset Guide (i.e. offset calculator and justification of figures used in the calculation). Doral has contacted DAWE to discuss concerns with the assessment of MNES. An assessment of impacts to WRP and Black Cockatoos has been provided in Section 4.3.5 (pg 94 to 100) and 7.5 (pg 195 to 201) of the ERD. In addition, an assessment of significance of the impacts to fauna habitat is included in Section 6.2 (pg 161 to 169) and proposed offsets discussed in Section 6.3 to 6.8 (pg 177 to 182). Offsets are proposed for the following significant residual impacts to MNES: • WRP habitat; • Black Cockatoo potential breeding habitat trees (present as isolated scattered paddock trees); • Shrublands on southern Swan Coastal Plain ironstones • *Banksia squarrosa* subsp. *Argillacea* **Partially addressed.**	provide EPA/DAWE and DBCA with a level of confidence that Doral will be able to secure a suitable offset site(s). Doral proposes to directly offset the significant residual impacts of the Proposal through undertaking a 100% land acquisition offset within the southwest of WA to secure like for like vegetation communities/habitat where possible. The proposed Offset will be secured and placed under Conservation Covenant or granted to the State of Western Australia providing long term security for the Offset site. Doral has prepared a Draft Offset Strategy to provide EPA/DBCA and DAWE with a level of confidence that a suitable offset site(s) can be secured which meets the requirements of the State and Federal Offsets policy's and guidelines. Doral are committed to securing an offset site(s) prior to clearing activities and/or dewatering McGibbon Track (expected to start in Q2, 2023). Doral continues to consult with Regulators to assist in identifying a suitable offset site.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	The Department typically requires (that) the proponent secure offset sites prior to approval. The adequacy of the justifications of figures used in the calculation cannot be determined until site specific details are provided. The site details required include the following: • suitability of the location of any proposed offset site for EPBC Act listed species • conservation gain to be achieved by the offset i.e. positive management strategies that improve the site or averting the future loss, degradation or damage of the protected matter • time it will take to achieve the proposed conservation gain • level of certainty that the proposed offset will be successful • current land tenure of any proposed offset and the method of securing and managing the offset for the life of the impact. Please note that, when reviewing Risk of Loss, the Department will take into consideration the *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* (2017). Given the Risk of Loss over twenty years for Busselton is 4.74 percent, please provide further justification as to the 20 percent value used for Risk of Loss without offset in the offsets calculator. Page 181 of the ERD notes the prospective parcels of land are expected to include no more than 3 ha of cleared land for revegetation. The Department notes the time until ecological benefit is 1 year, however revegetation actions may take decades to provide the required improvement in habitat quality (i.e. to develop the same habitat qualities and features that exist at the impact site). The Department recommends further justification is provided.	

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	The Department considers it unlikely that the offset site will deteriorate from a start quality of 6 to a future quality of 3 without further justification. Future quality without offset is the estimate of the habitat quality at a future time based on a business as usual scenario – that is, considering current management practices, use of the site and historic trends for the quality of habitat on the site. The Department notes the difficulty of calculating this accurately without an offset site. In order to achieve an offset which addresses both the Shrublands on southern Swan Coastal Plain ironstones (Endangered) and Whicher Range Dryandra (*Banksia squarrosa subsp. Argillacea* – vulnerable) the Department requires Botanical Surveys which show *Banksia squarrosa subsp. Argillacea* occurs within the community at the offset site.	
DAWE	**18. identify the total amount of habitat for each listed threatened species and/or community within the modelled area of groundwater drawdown.** The ERD notes that a significant impact to the WRP due to groundwater drawdown is unlikely despite the GDE assessment noting potential severe impacts to vegetation along McGibbon Track) the ERD does not provide a proper assessment of light, dust and noise impacts to listed threatened species; please discuss potential impacts and likely severity the ERD does not discuss the potential impacts of groundwater drawdown on the Whicher Range Dryandra (*Banksia squarrosa subsp. Argillacea*) and Vasse Featherflower (*Verticordia plumosa var. vassensis*); both these species have populations within the modelled extent of groundwater drawdown. Noting the above please provide a detailed analysis of the potential indirect impacts on Matters of National Environmental Significance (MNES) including hydrological changes (water drawdown effect on habitat and flow on effects to WRP and Black Cockatoos), increased	Addressed. No response from Doral required.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	predation, habitat (population) fragmentation and isolation, and other indirect impacts (e.g. noise, dust and light). Please provide further justification as to the suitability of the proposed Black Cockatoo Habitat assessment in determining/detecting whether any of the hollows identified within the development envelope has been utilised for Black Cockatoo breeding. Addressed. The Departments concerns were addressed in the proponent's response to DBCA comments on the draft ERD.	

4. INLAND WATERS

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
DBCA	Comment 2: The implications of changed hydrological process and confidence in predictions are important components in considering and assessing the acceptability of the proposal on threatened species and TECs. DBCA seeks confirmation that the hydrogeological model used for impact predictions is adequately sensitive and accurate for predicting impacts to sensitive threatened species and TECs, or habitat. In particular, that: • the hydrogeological and hydrological assessments for the predictions of local-scale impacts from groundwater drawdown on threatened species and communities are suitable; • there is confidence in understanding plant/water relations to inform setting appropriate trigger criteria and thresholds for physical and biological attributes to ensure early detection and mitigation of potential impacts; • commitments and requirements for refinement and revision of regional and local-scale groundwater models are suitable; and • there is confidence in predictions that potential impacts on the nearby Vasse-Wonnerup Ramsar wetland, located about 4.6 km to the north, are unlikely or negligible.	The groundwater model was developed consistent with the site-specific data (i.e. site geological, lithological and assay data, the site geological model, and site hydrogeological data – hydraulic testing and baseline water level and water quality monitoring data) and publicly available data (i.e. geological data, abstraction allocations, long-term water level monitoring data from the DWER database and geological and hydrogeological data from the SWAMS groundwater model) to predict drawdown impacts in the Superficial aquifer on threatened species and communities identified within Doral's Development Envelope. The model has been used to predict groundwater impacts of Doral's proposed development (based on the mine plan provided) and the cumulative impacts of Doral's and Tronox's operations based on an estimated mine footprint and dewatering schedule for Tronox. As the predicted water level drawdown is based on the development of Doral's Yalyalup pit and also includes the dewatering of Tronox's operations downstream of Doral's proposed development, any changes from the currently simulated mine plan, or changes to Tronox's development may result in a different predicted impact. The model predictions show that there will be a drawdown impact at the identified GDE sensitive areas (in terms of magnitude and duration) and groundwater monitoring and management programs for the Proposal have been developed (refer to GWOS, Appendix 7E of ERD). These strategies are designed to monitor water levels to measure and manage any impacts in sensitive areas prior to the exceedance of trigger levels. In addition, a GDE Management Plan (Appendix 4E of ERD and revised Version C as Attachment 1 of this document) has been designed to include a combination of hydrogeological parameters (i.e. groundwater levels) and

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		vegetation, eco-physiological measurements and health assessments. The plant water relations used to develop these are based on independent empirical research published for comparable vegetation communities in the area. A combination of hydrogeological and vegetation triggers is proposed to protect GDE threatened species and communities. GDE groundwater level triggers will be set up based on measured water levels from six monitoring bores (recently constructed along GDE sensitive areas (refer to Figure 9 of GDE Management Plan). Water level triggers and supplementation strategies in the GDE monitoring and management plan are designed such that water levels never fall outside of historical observed ranges. This approach should avoid water stress in sensitive communities. The vegetation monitoring that will be used for verification uses leading indicators (i.e. Leaf Water Potential) and this will allow identification of unforeseen water stress (and intervention management) before vegetation conditions materially deteriorates. It is acknowledged that the model does not include an aquifer stress of the magnitude of the proposed Doral development. To address this key uncertainty, the model performance will be tested against operational data after 6 months and 12 months of development (or a significant aquifer stress). Any changes required to the model set up to achieve model calibration will be made and the model will be used to re-predict the impacts of the remaining mine development (refer to section 12 of Hydrogeological report (Appendix 7A of ERD) and section 5.7 of GWOS).
DAWE	**1a. Groundwater modelling should target a model confidence level classification** Although the model satisfies some of the requirements for a Class 3 confidence level for the Superficial aquifer, the drawdown during the	Over the model calibration period, changes in water levels are associated with seasonal variations. The model is calibrated to replicate these seasonal water level changes. The water level changes included in predictions and associated with dewatering, are much greater than the seasonal variations. As a result, the model is not calibrated to the magnitude of

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	life of mine is not simulated during model calibration. Additionally, there is no data available for model calibration for the Yarragadee aquifer (i.e. the target water supply aquifer). **Partially addressed.** The Department currently has limited confidence in the predicted impacts (e.g. magnitude and extent of groundwater drawdown) for the Yarragadee aquifer due to the poor model calibration to this aquifer (further discussed below in comment 1d).	water level changes or drawdown expected during mine development. This type of data, that includes a significant change or stress on the aquifer, is only available once mining and dewatering commences. As discussed above (DBCA comment 2), validation of the groundwater model will be completed after 6 months and again after 12 months of mining operations to improve the future performance of the groundwater model. Please refer to DAWE comment 1b below in regard to the calibration of the Yarragadee aquifer.
DAWE	**1b. A sensitivity analysis of the model parameters should be undertaken to assess the range of predictions (potential impacts) given a change in the underlying model parameters** 1b. Sensitivity analysis was performed as part of the groundwater calibration process. Model sensitivity was greatest to the specific yield of the Superficial aquifer and the degree of rainfall recharge. **1c. The proponent should comment on the level of certainty of the predictions.** 1c. An alternate model calibration was completed to assess the consequence of uncertainty and non-uniqueness in the model; this alternative calibrated model was used to complete predictions for the Yalyalup Dewatering, Yalyalup Water Supply and No Development Scenarios. The model parameters were adjusted to provide a more conservative case. **Partially addressed.** Model sensitivity analysis was conducted as part of the groundwater model calibration uncertainty analysis, which the proponent has called the 'uncertainty calibration'. This 'uncertainty calibration' used lower vertical and hydraulic conductivities and specific yield parameters	As part of the trial and error model calibration, key model sensitivities were observed as outlined in Section 9.6.6 of the Hydrogeological report (Appendix 7A). For the sensitivity analysis, model parameters were changed and the impact on the model calibration performance was observed. During model calibration, the horizontal and vertical hydraulic conductivity of the Yarragadee aquifer was halved and was not observed to have an impact on the model calibration performance. Similarly, increasing the vertical hydraulic conductivity of the Vasse member of the Leederville aquifer was not observed to have an impact on the model calibration performance. In addition to the sensitivity analysis, model uncertainty was addressed by completing an alternate model calibration, which was then used to complete predictions for wet and dry conditions (in addition to the base case). A detailed review of the available data was undertaken as part of the study. The findings, discussed below are contained within (Attachment 2). The measured aquifer parameter ranges presented in Tables 1, 3, 4 and 5 are derived from published values for the Swan Coastal Plain. Some of these values are derived from studies for the entire Swan Coastal Plain and may not necessarily be representative of the project area, which is only a small

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	(compared to the 'base case' model) for the Bassendean Sand, Guildford Formation and Yoganup Formation (AQ2 2020a, Appendix F, Table F1, p. 4). Groundwater levels and recharge were subsequently modelled for dry and wet scenarios over the life of the mine and closure period and compared to the predictions made from the 'base case' model. The proponent predicts lower cumulative dewatering volumes for the 'uncertainty calibration' compared to the 'base calibration', while predicted water level drawdown and recovery in the Superficial aquifer is similar for both calibrations (AQ2 2020a, Appendix F, p. 7). The Department notes the proponent has conducted sensitivity analysis of a separate model (the 'uncertainty calibration') rather than the post-calibrated model used for predictions. As parameter sensitivity can change during and after model calibration, parameters should be assessed for sensitivity after calibration (i.e. for the 'base case' model). This would verify that parameters considered insensitive (or sensitive) before calibration remained so after calibration. Additionally, the memo provided by AQ2 states that horizontal and vertical hydraulic conductivity of each model layer were assessed for sensitivity as part of the model calibration (AQ2 2020e, p. 2). The proponent also states that specific yield sensitivity was assessed for the Leederville and Yarragadee Formations. However, Table F1 of the hydrological assessment (AQ2 2020a, Appendix F, p. 4) shows no change in these parameters for the Leederville or Yarragadee Formations in the 'base case' and 'uncertainty calibration' models. It is unclear if the proponent has assessed the sensitivity of horizontal and vertical hydraulic conductivity and specific yield of the Leederville Formation and Yarragadee Formation in the 'uncertainty calibration' analysis. As hydraulic conductivities are critical in determining groundwater flows, and as there is potential for upward leakage	area of the entire coastal plain. Table 1 also references the hydraulic testing completed as part of the Yalyalup site specific investigations. Table 2 summarises the estimated hydraulic conductivity values for the Superficial units (Bassendean Sand, Guildford and Yoganup Formations). These were derived from the Saxton Rawls method and site PSD analysis (and were also used to support the development of the Yalyalup GDE Management Plan). Further refinement of aquifer parameters, within measured ranges was completed as part of model calibration. The measured ranges of aquifer parameters assigned to the base case and uncertainty calibration case models are summarised in Tables 1 to 5. The maximum values of aquifer hydraulic conductivity presented in Table 2 are less than the published ranges and the values included in the Base Case. The base case represents the best estimate of aquifer parameters for the study area and as outlined above, adopts aquifer parameters for the Superficial aquifer that are at the higher end of the ranges for the project area (i.e. those parameters are likely to produce the most wide spread drawdown). The uncertainty calibration was developed to simulate an alternate set of aquifer conditions with lower aquifer hydraulic conductivity and specific yield in the superficial aquifers. The uncertainty case parameters were assigned to be at the lower end of the range for the aquifers present in the study area. To achieve model calibration for the uncertainty case, a reduction in the amount of assigned aquifer recharge was required. The uncertainty calibration uses a lower specific yield and associated recharge. As recharge is a key component of the modelled water balance, and the uncertainty model has been re-calibrated for the lower assigned aquifer specific yield numbers, the predictions have been completed to predict the impact under aquifer conditions that are conservative, but still likely to occur in the study environment.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	between the Leederville and Superficial aquifers (AQ2 2020a p. 21), clarification about the model sensitivity to hydraulic conductivities of the Leederville Formation is required. The Department also notes AQ2 (2020a, p. 50) groundwater modelling predicts groundwater levels will recover within the mining pits within approximately 18 months after the cessation of dewatering, with "no long-term (i.e. > 5 years) effects to the groundwater regime expected". However as previously discussed in paragraph 7d, it is unclear what the associated level of uncertainty is for this prediction, and the range of possible recovery times under different model parameters (i.e. sensitivities).	As outlined, sensitivity analysis can be completed to assess the impact on model predictions. However, without re-calibration, as completed for the uncertainty case, the predictions are completed with an uncalibrated model. While predictions with an uncalibrated model may illustrate the model sensitivity to a parameter, the change on its own, does not illustrate the impact using a calibrated model and provides no more confidence in model outcomes. In the case of this model, the use of a calibrated model is particularly important due to the interactions between the aquifer properties and the assigned recharge. With the current model a decrease in any aquifer parameters will require a reduction in the assigned recharge to maintain model calibration. If any predictions were completed with an uncalibrated model, the model would tend to under or over predict impacts (i.e. drawdowns). No changes to aquifer specific yield were made to the Leederville and Yarragadee aquifers as part of the uncertainty analysis as these aquifers remain confined during all simulations and aquifer specific yield is not a key aquifer parameter for these aquifers. For the Leederville aquifer some of the model adopted values do not cover the higher end of the range of horizontal and vertical hydraulic conductivity (Tables 1 and 3). To address this, AQ2 have re-run the model (the "September 2020 Case") with the adjustments shown in Tables 1 and 3 (shaded). The aquifer parameter adjustments were made to the Leederville aquifer only. For the September 2020 Case the calibration data set and the prediction models (assuming dry conditions) have been run to produce the measured drawdown as shown in Figures 1 to 4. No re-calibration of the September 2020 Case model has been completed. Figures 1 and 2 show drawdown for the dewatering cases for the Superficial and the Leederville aquifers for the Base Case and the September 2020

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		Case. The Base Case and September 2020 Case predictions show comparable drawdown (i.e. the changes in aquifer parameters in the Leederville aquifer do not appreciably increase the extent of drawdown). Figures 3 and 4 show the predicted drawdown for the Water Supply Only Case. The predicted drawdown in the Leederville and Yarragadee aquifers for the September 2020 Case at the end of mining are less than those predicted for the Base Case. Similar to the previous predictions, there is no predicted drawdown in the Superficial aquifer due to the proposed water supply pumping and the changes in adopted aquifer parameters. The current model set up is conservative with respect to aquifer parameters assigned to the Yarragadee water supply aquifer however, it is possible that there could be further ranges of aquifers parameters that could be investigated as part of future work. The model set up of this aquifer and potential uncertainties will be further investigated as part as proposed work (as outlined in Section 9.12 of the Hydrogeological report). Fieldwork to drill and construct a Yarragadee production bore and undertake aquifer tests is scheduled after the environmental approvals for the Yalyalup mine site are received from DWER. A nest of four monitoring bores, at a nearby location of the Yarragadee production bore, are proposed to be drilled and constructed separately into the Superficial, shallow Leederville (Mowen), deep Leederville (Vasse) and Yarragadee aquifers, to allow monitoring of water level changes in each aquifer during the test pumping of the Yarragadee production bore and during future mining operations (to determine if there is any short-term and long-term vertical leakage between aquifers). The groundwater flow model will be updated for H3 level reporting to support a DWER 5C groundwater licence application to include the site-specific data for the Leederville (Vasse member) and Yarragadee aquifer (refer to more comments below under DAWE comment 1d).

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
DAWE	**1d. The proponent needs to justify why drawdown of the Yarragadee aquifer is "unlikely to have any adverse impacts on the water supply potentials of the aquifer systems" (ERD, p. 124) given the high degree of model uncertainty and lack of sensitivity analysis.** The Yarragadee production bores will only be used to supplement recycled water from the hydraulically returned tailings and dewatering. Pumping from the production bore in the Yarragadee aquifer will only occur during periods of water shortfall (i.e. during summer). The proponent has predicted a peak make-up water demand of 1.3 GL/year to be required from the Yarragadee production bore (to support peak mine water demand of 1.6 GL/year). Additionally, the proponent suggests that a GWL from the Yarragadee of 1.6 GL/year be applied to cover the full mine water demand as a contingency. Pumping from the Yarragadee aquifer will only occur if the total storage volume of the site storage ponds drops below the equivalent of 2 days of supply (nominally 10,000 m3) (AQ2 2020c, p. 11). **Not addressed.** It is unclear if the Yarragadee aquifer has been calibrated in the groundwater model. For example, the AQ2 memo states that "*there is no data available for model calibration for the Yarragadee aquifer*" (AQ2 2020e, p. 3), yet the Hydrological Assessment states "*locations of monitoring bores screened in the Leederville and Yarragadee aquifers and used for model calibration, are shown in Figure 45*" (AQ2 2020a, Appendix F, p. 1). Figure 45 identifies a single monitoring bore (61000125) screened within the Yarragadee aquifer used for groundwater model calibration. Use of a single bore for calibration is grossly inadequate.	The modelling completed used the available information to define the geometry and assign conservative aquifer parameters to the Yarragadee aquifer. This included data from the SWAMS regional aquifer modelling and published data to define aquifer geometry and parameters (refer to Tables 1 to 5, Attachment 2). The model was calibrated to available water level monitoring for the Yarragadee aquifer (water levels from 61000125) and also simulates water level contours for the Yarragadee aquifer simulated by the SWAMS model (refer to attached Figure 3 showing contours of modelled water levels from the SWAMS model and modelled water levels for the Yarragadee aquifer, which show consistent water level magnitude and flow direction). There are no other data publicly available in the study area, apart from that used for model calibration. There are some Yarragadee monitoring bores located upstream and downstream of the Proposal area that are located close to the model boundaries, however their proximity to model boundaries mean that they were not suitable for model calibration. It is also understood that there is some other regional monitoring available from nearby Yarragadee aquifer users, however this data is not publicly available. The model simulation of available monitoring data is criticised for its match to available data. The Yarragadee monitoring bore that is used for the model calibration (61000125) is screened over 20m of the Yarragadee aquifer (to target Unit 3 only), whereas the groundwater model simulates the Yarragadee aquifer as a single aquifer unit/layer. There are also uncertainties in the actual abstraction rates included in the model calibration (only licenced allocations are available for groundwater use in the modelled catchment). Rather than force model calibration, to limited available data, the model set up was kept consistent with suitably conservative aquifer parameters for the Yarragadee aquifer. This approach was taken to provide conservatism in the model predictions. While there is

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Furthermore, a hydrograph for this bore is provided but is poorly matched to the modelled water levels (AQ2 2020a, p. 37). The measured water responses from this bore are generally between five and six metres below the modelled water levels (AQ2 2020a, Figure 65). The proponent suggests this poor history matching is a result of groundwater pumping that is not reflected in the modelled abstraction rates (AQ2 2020a, p. 37). The Department therefore has limited confidence in the predicted impacts (e.g. magnitude and extent of groundwater drawdown) for this aquifer. Additionally, it is unclear if the proponent has conducted a sensitivity analysis for the Yarragadee aquifer. Table F1 (AQ2 2020a, Appendix F, p. 4) indicates both the base and uncertainty case scenarios have identical parameters, yet the proponent states that Yarragadee aquifer conductivity values (both horizontal and vertical) were reduced by half as part of the model calibration sensitivity analysis which did not significantly impact the model calibration performance (AQ2 2020a, p. 40). The proponent needs to clarify this discrepancy.	still acknowledged uncertainty around the predicted impact of water supply pumping it is unlikely to have any adverse impact on the water supply potential of the Yarragadee aquifer. Moreover, the closest licenced Yarragadee aquifer production bore is located at 4.5km from Doral's proposed Yarragadee production bore. Small drawdowns (between 0.25 and 0.5 m) are predicted at the closest licenced Yarragadee aquifer production bore (provided Doral's proposed production bore is pumped continuously at 1.6 GL/year for the duration of the mine life). The conservative approach, that included the maximum abstraction from Doral's proposed bore was used to predict the "worst case" for impacts on the aquifer water supply potential. Doral plan to abstract from the Yarragadee aquifer bore only when required, which will most likely only be during summer periods when there is a shortfall of water supplied from rainfall runoff and pit dewatering (from the Superficial aquifer). During winter reduced to no pumping from the production bore will occur, and the actual drawdown in the Yarragadee aquifer will be smaller than predicted. Additionally, it should be noted that there is generally 4 to 5 m of the average seasonal water level fluctuation in the Yarragadee aquifer evident at the study area, with a gradual declining trend associated with ongoing pumping activity in the area. As part of the installation of Doral's Yarragadee water supply bore, and submission of an application to DWER to obtain an operational licence for water supply pumping from the Yarragadee, the following work is planned: • The model set up for the Yarragadee aquifer will be refined based on the information obtained from the drilling and testing of Doral's water supply bore. • If required, the Yarragadee aquifer will be simulated by several layers.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		• The model calibration will be updated and model simulations to predict the impact of the Yarragadee pumping will be completed. • Uncertainty analysis will be completed to assess a range of potential impacts from the proposed water supply pumping. As part of the model calibration process, model parameters were changed and the impact on the model calibration performance was observed. During model calibration, the horizontal and vertical hydraulic conductivity of the Yarragadee aquifer was halved and was not observed to have an impact on the model calibration performance. Similarly, increasing the vertical hydraulic conductivity of the Vasse member of the Leederville aquifer was not observed to have an impact on the model calibration performance. For the uncertainty modelling, however, aquifer parameters were changed and the model was re-calibrated to provide the best match to observed water levels. As part of this process, no changes were made to the aquifer parameters for either the Leederville or Yarragadee aquifers. Please refer to DAWE comment 1b above in regard to the additional model run (i.e. September 2020 case, Attachment 2).
DAWE	**2. The proponent needs to justify or explain the selection of the 'wet' and 'dry' rainfall and recharge dataset (July 1997 to December 2000 and July 2003 to December 2006 respectively) used in the water supply predictions.** Based on the rainfall data sets used for model calibration, a set of "wet" and "dry" rainfall and associated recharge conditions was included in model predictions. The "wet" predictions used the measured monthly rainfall from July 1997 to December 2000 (the wettest 3.5 years of the 30 years rainfall data set). The "dry" predictions used measured rainfall from July 2003 to December 2006 (i.e. the driest 3.5 years of the 30 years rainfall data set) (AQ2 2020e, p. 2).	Addressed. No response from Doral required.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Furthermore, by utilizing the synthetic future rainfall data generated from historical records, the proponent predicted more than 50% of the model iterations requiring discharge of surface water from the site during into the lower Sabina River during the winter of 2023 (AQ2 2020c, p. 11). The Department notes the proponent predicts from the site water balance model a maximum annual discharge of approximately 80 ML during project operations for the 'wet' rainfall scenario (AQ2 2020c p. 11). The proponent notes this is an incremental discharge increase of 1.44% to the Lower Sabina River and a 0.28% increase to the Vasse-Wonnerup Ramsar Wetlands (Doral 2020a, p. 131). The Department notes the Surface Water Discharge Assessment (AQ2, 2019b) predicted a 72 hour 1:100 rainfall event would result in discharge of 450 ML from the process water dam and drop out dam. These discharges would reflect an incremental discharge increase of approximately 8% for the Lower Sabina River and 1.5% for the Vasse-Wonnerup Ramsar Wetlands (Doral 2020a, p. 132). **Addressed.**	
DAWE	**3. The Department recommends the proponent provide a draft or final version of the Groundwater Operating Strategy (GWOS) with the final ERD, including a draft contingency action plan.** Groundwater Operating Strategy had been developed and includes a commitment to review the groundwater model as part of the Groundwater Licence (GWL) conditions. It will also provide abstraction operational rules for the Superficial and Yarragadee aquifers. The draft GWOS will be revised and finalised when two separate 5C GWL applications for the Superficial and Yarragadee aquifers are being submitted to the DWER. **Addressed.**	Addressed. No response from Doral required.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	The proponent has provided a draft GWOS (AQ2 2020c) with a contingency plan within the revised ERD.	
DAWE	**4. The proponent should discuss the potential area affected by Potential Acid Sulfate Soils (PASS) should deeper drawdown occur.** **Not addressed.** The proponent has not discussed the possible area affected by PASS should deeper drawdown occur, presumably as the groundwater model predicts the 0.1 m cone of depression to extend only marginally beyond the mining disturbance areas within the Superficial aquifer (AQ2 2020a, p. 49). The proponent should update the groundwater model to reflect the range of possible drawdowns within the Superficial aquifer as part of their sensitivity or uncertainty analysis.	Groundwater drawdowns in the Superficial aquifer and the underlying Leederville aquifer have been predicted in the Groundwater Model by AQ2. These modelled drawdowns are the difference between the water levels predicted at each selected time interval for the *Yalyalup Dewatering Scenario* (i.e. corresponding to the mine pit depth and schedule) and the corresponding *No Yalyalup Development Scenario*. The *No Yalyalup Development Scenario* contains the same conditions as the *Yalyalup Dewatering Scenario,* except the proposed dewatering for the Proposal is excluded. Average seasonal variations of up to 2m are observed in Superficial aquifer monitoring bores (used for model calibration). Predicted drawdowns of between 0.1m and 1m would therefore be within normal seasonal groundwater variation ranges. As such no additional area of PASS would be exposed by groundwater drawdowns. Doral will implement an ASSMP and GWOS to manage ASS at the Site, which have been provided with the ERD.
DAWE	**5. The proponent has given insufficient detail on the management of Acid Sulfate Soil (ASS) affected waste streams (overburden, sand tails and clay fines).** An Acid Sulfate Soil Management Plan (ASSMP) (Doral 2019b) has been provided which details a soil management strategy for the excavation, stockpiling, processing and disposal of overburden, heavy mineral concentrate, clay fines and sand tails.	Doral have prepared an ASSMP for the proposal in consultation with DWER's ASS guidance document (DER, 2015) *Treatment and management of soil and water in acid sulfate soil landscapes* which includes proposed treatment and validation strategies for overburden, clay fines and sand tails (i.e. three waste streams). The Soil Management Strategy detailed in the ASSMP includes an uncorrected neutralisation rate based on the average Net Acidity (NA) values for soils exceeding the DER action criterion of 0.03%S at the Site (0.28%S). The uncorrected neutralisation rate has been calculated using the DER (2015) equation:

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Additionally, a Mine Closure Plan has been provided (Doral 2019a) which outlines the sequence of pit backfill and soil profile construction for the final mine pit landform. **Partially addressed.** The Department notes the proponent has outlined a method of final landform construction whereby mine pit voids are progressively backfilled during mining operations, with a mixture of sand and clay tails to within 1 m of the final rehabilitation surface and capped with dried clay fines, clayey overburden, subsoil and topsoil (Doral 2019a, p. 74). The clay fines and sand tails will be tested for total sulfur concentrations prior to emplacement into voids to ensure that material has been sufficiently neutralised (Doral 2019b, p. 21). However, The Department reiterates our previous advice and recommends that ASS affected waste streams are disposed of into voids based on their PASS risk. Specifically, to minimise potential leaching of ASS, waste streams with lower concentrations of total sulfur should be used to line the voids, with material impacted with higher concentrations of sulfur placed towards the middle of voids. This would be done in conjunction with the neutralisation of PASS in accordance with the liming rates specified in the ASSMP.	**Lime required (kg $CaCO_3/m^3$) = Soil density (t/m^3) x NA (%S x 30.59) x 1.02 x safety factor (1.5) x 100/ENV.** This neutralisation rate, after correction for Effective Neutralisation Value (ENV) (for the specific alkaline material to used) will be used to treat all materials at site that contain NA in excess of >0.03%S. Treated material (i.e. overburden, sand tails and clay fines) will be subject to validation sampling at a rate consistent with (DWER, 2019) guidance in *Landfill Waste Classification and Waste Definitions 1996 (As Amended 2019)*. Samples are to be undertaken to represent 'batches' of treatment. Prior to any material being backfilled a guard layer of alkaline material will initially be added to the base and walls (where practical) of the mine void to limit potential for oxidation. It is also noted that the floors of the mine void are saturated, which will aid in minimising exposure to oxygen of residual soils at the base of the mine voids. All samples (from all waste streams) are to be assessed for pH_F and pH_{FOX}. The accuracy of the field-testing program will be initially 'calibrated' by sending approximately 25% of samples for Total Sulfur analysis. The measurement of Total Sulfur provides a low-cost analytical technique that may be used to estimate the maximum potential environmental risk from acid produced by the oxidation of sulfides (Ahern *et al.,* 2004). For this estimate it is assumed that all sulfur measured is in the form of pyrite or other metal or metalloid disulfides (Ahern *et al.,* 2004), thus providing a more conservative approach to neutralisation. Samples meeting the following criteria (DER, June 2015) will be deemed to be effectively neutralised: 1. Visually, the neutralising material must be well-blended with the soil.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		2. Samples require a pH_F of between 6.0 and 8.5. 3. Samples require a pH_{FOX} of at least 5, to indicate that there is neutralising capacity greater than the existing plus potential acidity of the soil. 4. Total Sulfur concentrations need to be <0.03%S. Based on the neuralisation and validation approach provided in the ASSMP, all material being backfilled into pit voids will be effectively neutralised and validated to ensure they are below the DER NA Action Criterion of 0.03%S. That is, returned material (all waste streams) will have a neutralising capacity greater than the existing plus potential acidity of the soil and should oxidation occur, sufficient buffering capacity will be present in the backfilled materials to neutralise any acidity generated. Notwithstanding, Doral have considered DAWEs recommendations for material replacement based on lowest PASS risk and following the placement of a guard layer of alkaline material in the base of mine voids, sand tails (lowest PASS risk) will be returned hydraulically as a single waste stream and/or co-disposed with clay fines into the base of pit voids. This material will have been maintained in a saturated state, with conditions maintained at pH6.0 throughout the process, significantly reducing the potential for oxidisation. Furthermore, the unused (unreacted) lime sand that was added to the process at commencement of the ore processing sequence (i.e. at the in-pit hopper) will form part of this process stream, resulting in the addition of buffering capacity in the base of mine voids. Remaining neutralised and validated materials (overburden and clay fines) will then be returned to the mine void to achieve the final land form.
DAWE	**6. Metals should be included in the analytical schedule for monthly dam water monitoring to ensure that water quality guidelines are met.**	The monitoring suite and frequency for the process water dam (PWD) and groundwater monitoring bores detailed in the GWOS (AQ2 2020c, Table 11, p. 23) have been developed in consultation with DWER (2015) *Guidelines*

<table>
<tr><th>SUBMITTER</th><th>SUBMISSION AND/OR ISSUE</th><th>RESPONSE TO COMMENT</th></tr>
<tr><td></td><td>
The proponent has outlined the proposed water quality monitoring program in AQ2 2020c, Table 11, p. 23.

Water quality of the process water dam will be monitored three times a week for field measurements including pH, titratable acidity (TTA) and total alkalinity (TAlk). The dam will be monitored quarterly for laboratory analysis for the above parameters plus Total Dissolved Solids (TDS), Na, Cl, dissolved Al and Fe and Mn. If dissolved Al is greater than 1 mg/L, As, Cd, Cr, Cu, Hg, Mg, Ni, Pb, Se, Zn will also be analysed.

Offsite discharge water quality will be monitored for the above parameters on the first day of discharge then monthly during discharge.

Surface water quality at monitoring sites YALSW01 to YALSW15 will be monitored monthly (when flowing) for pH, EC, TDS, TSS, Total acidity and sulfate.

Not addressed.

The Department notes that Al, Fe and Mn are the only metals included within the proposed process water dam and discharge water analytical schedule (contingent on dissolved Al concentrations < 1 mg/L (presumably as a proxy for pH induced metal mobilisation potential)) (AQ2 2020c, Table 11, p. 23).

However, given the material risk of Acid Mine Drainage (AMD), proximity of the downstream Vasse-Wonnerup Ramsar Wetlands and potential for controlled discharges, the proponent should monitor for the suggested analytes listed in Table 11 (AQ2 2020c, p. 23) (As, Cd, Cr, Cu, Hg, Mg, Ni, Pb, Se, Zn) irrespective of the dissolved Al concentration. Additionally, given the risk of Naturally Occurring Radioactive Materials (NORMs), Th and U should also be included in the analytical schedule for dam and discharge water monitoring.
</td><td>
for the preparation of Operating Strategies for mineral sand mining dewatering licences in the south west region.

Specifically, Section C Risk Assessment (Item 3) states the following Required Monitoring to Address Risk:

<table>
<tr><th>Potential Risk</th><th>Required Monitoring to Address Risk</th></tr>
<tr><td>Unacceptable water quality trends in the Superficial aquifer; e.g. saline incursion; mobilisation of saline or acidic water; acid generation from the drying out of Acid Sulphate Soils etc</td><td>
Dewatering Output

Analysis of dewatering output from mining cells. Minimum requirement as follows:

Mon/Wed/Fri field testing: pH and EC (compensated to 25°C)

Monthly laboratory analyses:
o pH, EC (compensated to 25°C), TDS (gravimetric); total acidity, total alkalinity, chloride, sulphate, total Al, dissolved Al, total Fe, dissolved Fe
o Additional metals analysis may be required if dissolved Al > 1mg/L:
</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>SUBMITTER</th><th>SUBMISSION AND/OR ISSUE</th><th>RESPONSE TO COMMENT</th></tr>
<tr><td></td><td>Monitoring of these metals should be conducted without being contingent on a dissolved Al concentration greater than 1 mg/L as redox conditions can dominate pH for the mobility of certain metals e.g. As and U. Relying on dissolved Al concentrations would underestimate this risk.

Furthermore, monthly surface water testing at monitoring sites YALSW01 to YALSW15 should also include the above metals which are currently missing from the proposed water quality monitoring program (AQ2 2020c, Table 11, p. 23), as well as for surface water and groundwater monitoring as part of the proposed closure monitoring program (Doral 2019a, p. 98).</td><td>
<table>
<tr><td></td><td>Zn, Cr, Cu, Mg, Ni, Cd, Se, As, Pb & Hg

Monitoring Bores

Analysis of water from representative monitoring bores. Minimum requirement as follows:

Monthly field testing:

o pH and EC (compensated to 25°C)

Monthly laboratory analyses:

o pH, EC (compensated to 25°C), TDS (gravimetric); total acidity, total alkalinity, chloride, sulphate, dissolved Al, dissolved Fe

o Additional metals analysis may be required if dissolved Al > 1mg/L: Zn, Cr, Cu, Mg, Ni, Cd, Se, As, Pb & Hg.</td></tr>
</table>
Doral’s monitoring program (specifically metals) provided in the GWOS is also consistent with the following DAWE approved Water Management Plans, which are considered relevant given their location is 2.7km closer to the Vasse-Wonnerup Ramsar wetland, and presence of ASS at each Site:</td></tr>
</table>

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		• Water Management Plan (Revision 3) July 2019, Wonnerup Mineral Sands Project (EPBC 2010/5403). • Water Management Plan, April 2020, Wonnerup South Mineral Sands Project (EPBC 2014/7135). • Water Management Plan, August 2018, Wonnerup North Mineral Sands Project (EPBC 2014/7205). Doral will update the Water Quality Monitoring Programme in the GWOS (Table 11, p. 23) to be in alignment with this Monitoring Schedule, specifically: • Increase PWD Monitoring Frequency from Quarterly to Monthly for laboratory analysis. • Include Total Al and Total Fe in Monthly laboratory suite. • Include Mg in the additional metals analysis when required (i.e. diss Al >1mg/L). In addition, Doral will include 6 Monthly laboratory analyses for the PWD and relevant neighbouring monitoring bores for the following: o Metals and Metalloids: Al, As, Cd, Cr, Co, Cu, Fe, Hg, Ni, Se, Tl, U, Zn; o Ra226, Ra228. It is noted that Doral have included additional field-testing measurements (to those listed in DWER, 2015) for both the PWD and groundwater monitoring bores, namely Total Titratable Acidity (TTA), Total Acidity. Based on DAWE advice, Doral will also include Oxidation-Redox Potential (ORP) in the field-testing measurements for the PWD (ORP is already included in groundwater bores). The Groundwater Monitoring Program (post mining) documented in the Mine Closure Plan (Doral, 2019a, pg. 80) will also be updated to include

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		ORP, TTA and Total Alkalinity in the monthly field monitoring parameters and include the additional metals analysis if dissolved Al > 1mg/L (ie. Zn, Cr, Cu, Mg, Ni, Cd, Se, As, Pb & Hg) (as per Table 11 of the GWOS, when updated). Section D of DWER (2015), provides the following Trigger Levels: • *Description of determination method; eg Mean +2SD.* • *Tabulated warning and action trigger values for water levels and chemistry parameters at each location (there will be some defaults; eg pH<4.5, Al>1mg/L, Cl/SO_4<2; total acidity>100mg/L; total alkalinity<10mg/L).* Doral has adopted more stringent Trigger Levels in the GWOS for the PWD (Table 12) and groundwater monitoring bores (Table 13) namely: • pH <5.5 (for PWD) and pH<5 (groundwater monitoring bores). • TTA >40 mg$CaCO_3$/L • Total alkalinity <10mg$CaCO_3$/L. Laboratory analysis of metals concentrations within the PWD for the parameters and at the frequency detailed in Table 11 of the GWOS (once updated) is considered to provide a more accurate assessment of water quality leaving the Site, than to include metals analysis within the surface water monitoring locations (YALSW01-15). This is because modelling has predicted that the required period of surplus water requiring discharge is confined to Q2 2023 (winter), with up to a maximum of 82,000m^3 requiring discharge. This contribution represents only 1.44% of the annual flow to the Lower Sabina River and only 0.28% to the Vasse-Wonnerup Ramsar wetland annual flow. The discharge from the Site is also unlikely to occur when seasonal flows are at their lowest or ceased (i.e. summer), as sufficient storage capacity is available during these times due to the low periods of

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		rainfall. As such a significant proportion of water contributing to the Lower Sabina River and Vasse Wonnerup catchments, at the time of proposed discharge, will be from sources other than the Proposal, predominantly rainfall and surface water runoff within the catchment. Doral has committed to meeting strict water quality criteria, prior to discharge, in accordance with the Sites DWER licence conditions (under Part V of the EP Act).
DAWE	**7. An assessment of the potential for NORMs at the site needs to be provided.** **Not addressed.** The proponent has not provided any information regarding the assessment of NORMs. However, the Department understands the proponent will prepare a radiation management plan for the radiological council of Western Australia.	The Proposal was referred to DAWE (then DoEE) on 1 November 2017 for consideration under the EPBC Act. On 8 February 2018, DAWE determined that the Proposal is a Controlled Action and requires assessment and decision on approval under the EPBC Act for several MNES. Naturally Occurring Radioactive Materials (NORMs) was not identified by DAWE as a Controlled Action (i.e. Nuclear Actions). The assessment of NORMS was therefore not included in the Work Requirements specified in the Environmental Scoping Document (ESD), and thus was not assessed in the ERD. The management of NORMs is regulated by the Radiological Council of WA under the *Radiation Safety Act 1975* and DMIRS (*Mines Safety and Inspection Act 1994* and *Mines Safety and Inspection Regulations, 1995*). The State regulation of radiation includes the Statutory appointment of suitably qualified Radiation Safety Officer and the approval of a Radiation Management Plan and subsequent annual monitoring reports. Notwithstanding Doral provides the following information regarding the potential for NORMs at the site. Mineral sands extraction and separation is a physical process with no chemical treatment applied to the minerals with the exception of flocculent for management of clay fines. At the mine the radionuclide bearing heavy mineral is wet separated by spirals and transferred offsite for secondary dry

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		plant processing whilst the quartz sand tails and clay fines are directly returned to the mine void (and neutralised for ASS with alkaline material at the rates specified in the ASSMP, where required). At the Dry Plant the heavy mineral is (dry) separated by magnetic and electrostatic separation into the various mineral types for export. The mineral types produced by the Doral Picton Dry Plant presently utilises all heavy mineral arising from the plant feed thus any dry plant tailing material is less than 1Bq/g. Should any returned dry plant tailing material be in excess of 1Bq/g Th and U, then as per the Doral Radiation Management Plan, it shall be dispersed with outgoing wet concentrator (quartz) tails and thus diluted further to ensure Th and U concentrations are conservatively below 1Bq/g. In further support to this, the limit as set by the Department of Mine, Industry Resources and Safety is a maximum range of 140-180ppm Th and U. As such any returned dry plant tailings will not be NORM enriched and shall be managed such that it does not constitute a radioactive material (<1Bq/g). Doral has routinely monitored Ra226 and Ra228 within it's operations and near surrounding bores for many years (including Recent Yoongarillup Operations) without any evidence of impact or trends of radionuclide mobilisation shown. As outlined in response to DAWE Comment 6 above, Doral will revise the proposed GWOS to include 6 monthly sampling and analysis of Ra226, Ra228 and Uranium to be reported in the Annual Groundwater Review Report.
DAWE	**8. The magnitude and extent of ASS and mobilisation of NORMs is unclear. The impacts that these processes may have on biota are also unclear.**	Refer to DAWE Response 4 for ASS. With reference to *The Fundamentals for Protection against Ionising Radiation (2014)*, ARPANSA Radiation Protection Series F-1, second

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Not addressed. Refer to comment 4. The Department notes that some level of radioactivity via radionuclides entering the groundwater system is possible as groundwater levels in the mine pit are likely to recover and because of the lack of lined pit voids (Doral 2019b, p. 18). This is because the pit will be backfilled with material (sand tails and clay fines) with varying contaminant concentrations and the Superficial aquifer (which the mine pit intercepts) is likely to have a relatively high hydraulic conductivity meaning groundwater will move through the pit, dissolving contaminants (including radionuclides) contained in the backfilled material over time and transport these into the aquifer. Therefore, impacts and management of radionuclide mobilisation (as well as potential ASS and ASS induced metal mobilisation) on downstream biota, including the Vasse-Wonnerup Ramsar Wetlands should be discussed as part of the groundwater numerical model, ecohydrological conceptual model and GWOS.	paragraph from the bottom on page 16, states: *"In some situations, the exposure, or the amount or concentration of radioactivity being dealt with is low, and the activity may be inherently safe (i.e. no accident scenario or radiological concern can be foreseen. The responsible person or organisation may under such circumstances carry out the activities without any consideration to its radiological properties. This is referred to as being exempt from control".* Further guidance on what is considered to be 'inherently' safe' is provided in: • *ARPANSA Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)* RPS-9 on mining (2005), as stated at the bottom of page 20: "Ores or mineral concentrates with head-of-chain uranium or thorium activity concentrations less than 1 Bq/g would generally be considered inherently safe." • *ARPANSA National Directory for Radiation Protection (NDRP)* June 2017, RPS-6, National Directory for Radiation Protection, has those exemption limits in Schedule 4, with both Th-nat and U-nat being 1 Bq/g. The mineral types produced by the Doral Picton Dry Plant presently utilises all heavy mineral arising from the plant feed thus any dry plant tailing material is less than 1Bq/g. However, should any returned dry plant tailing material be in excess of 1Bq/g Th and U, then as per the Doral Radiation Management Plan, and in accordance with the *Mines Safety And Inspection Regulations 1995* (e.g. Reg 16.34 "discharges of radioactive waste at the mine are in accordance with the radiation management plan" and Reg 16.35 "so far as is practicable, radioactive waste is diluted with other mined material before it is finally disposed of in order to ensure that in the long term the use of the disposal site is not restricted"), it shall be dispersed with

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		outgoing wet concentrator (quartz) tails and thus diluted further to ensure Th and U concentrations are conservatively below 1Bq/g. As such any returned dry plant tailings will not be NORM enriched and shall be managed such that it does not constitute a radioactive material (<1Bq/g). In addition to this, particle tracking calculations were conducted to predict the flow paths from the infilled mine area after the completion of mining for a period of 32 years assuming the recharge and discharge conditions included in the calibrated hydrology model (Attachment 3). It was determined that the flow paths in the Bassendean Sand would be short as a result of the recharge and evaporative fluxes from this aquifer. The underlying Guildford has a low permeability and also predicts short flow paths away from the mine area (~100m). If any material from the infilled mine path were to migrate to the underlying Yoganup, this would provide the potential flow pathway toward the Vasse- Wonnerup wetland. Particle tracks were predicted assuming particles originated under the infilled mine in the Yoganup (layer 4 of the model). Over the 32-year prediction period, particles are predicted to travel a distance less than 1 km (700m) and therefore, given the distance to the Vasse-Wonnerup Wetlands from the project area is approximately 4.6km, the time to reach the wetlands is conservatively 210 years. With respect to the theoretical potential for the Thorium bearing NORM (monazite) radionuclides to mobilise Ra228 from the project area, given the half live of Ra228 being 5.8 years, then the practicality of any detectible Ra228 emanating from the project area would decay to the point of being undetectable 4.6 km away. The release of radionuclides from naturally occurring mineral sands minerals into groundwater in the natural environment is considered to be unlikely. However, Doral taking the conservative approach, shall revise the

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		GWOS to include six monthly sampling and analysis for Uranium, Ra226 and Ra228 in the neighbouring monitoring bores. The neighbouring monitoring bores are within a range of less than 1km from the mining void and therefore any risk of mobilised metals and radionuclides will be detected within the first instance and therefore shall allow for early investigation and action well before any detrimental environmental impacts to the Vasse-Wonnerup Wetlands are possible. With respect to the Uranium contained in monazite, which is comparably much lower than Thorium (10:1), it is considered that if anything was detectible it would initially be from the Thorium decay chain as both Ra 226 and Ra228 are expected to behave similarly within the same environment.
DAWE	**9. Analysis of the potential impacts of ASS mobilisation on on-site species should be included in the final ERD.** **Not addressed.** The Department considers ASS poses a risk to foraging and habitat trees for Black Cockatoos and the Western Ringtail Possum, and *Banksia squarrosa* subsp. *Argillacea* found on-site. The Department notes that the ASSMP provided by the proponent has not been updated since the previous advice provided by the Department and does not provide an analysis of the potential impacts of ASS to on-site vegetation and associated species. The Department recommends that analysis of the potential impacts of ASS mobilisation on on-site species be conducted.	The GDE Assessment (Ecoedge, 2020c) (Appendix 4D) was conducted to assist with identification of Type 3 GDE's within the area predicted to be impacted by dewatering for the Proposal. This included a detailed review of soil information, depths to groundwater, proposed dewatering extents and specific water dependency of flora species/ecosystems. Vegetation units within the Development Envelope were described by (Ecoedge, 2020a) and provided in Table 4-5 and shown on Figure 4-1a of the ERD. Three of these vegetation units are considered to be GDEs (Unit A2, Unit B1, and Unit C3). Two of the GDEs (A2, SWAFCT02 and B1, SWAFCT10b) are listed as TECs under the BC Act, whilst Unit B1 (SWAFCT10b), is also listed as Threatened under the EPBC Act. Unit B1 also contains nine *Banksia squarrosa* subsp. *Argillacea* listed as Threatened under the EPBC Act. The occurrence of the unit C3 is considered to be too small and badly degraded to be inferred as an example of the TEC, SWAFCT09 (Ecoedge, 2020a). Groundwater drawdown of the GDE's mapped within the Development Envelope (Ecoedge, 2020c) has the potential to indirectly reduce the quality

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		of fauna habitat. Specifically, Vegetation Unit A2 (SWAFCT02 - Wet Shrublands), is known to contain conservation significant WRP habitat and Black Cockatoo potential breeding habitat trees (i.e. DBH ≥50cm or DBH ≥30cm for wandoo). The fauna habitat likely to be impacted by the projected water drawdowns, will result in a potential residual impact of 1.70ha of WRP habitat, also containing 30 Black Cockatoo potential breeding habitat trees. All other scattered isolated paddock trees, mapped as Black Cockatoo potential breeding habitat trees are not groundwater dependent (i.e. not within a mapped GDE). In addition, drawdown impacts are also predicted to impact up to 0.34ha of Vegetation Unit B1 - SWAFCT10b, including nine *Banksia squarrosa* subsp. *Argillacea.* Results of Doral's ASS investigation indicates that potential unoxidised sulfidic acidity is present in Site soils throughout the soil profile. If exposed to the atmosphere, the sulfide minerals will oxidise and generate sulfidic acidity. Oxidation of sulfide minerals may potentially occur during extraction of soils containing potential ASS and/or as a result of dewatering activities. It is noted that the majority of excavations for mine pits are located down hydraulic gradient of the GDEs (containing WRP habitat, Black Cockatoo potential breeding trees and nine *Banksia squarrosa* subsp. *Argillacea*), however given the extent of drawdowns in proximity to the GDEs, potential impacts from ASS are possible to groundwater-dependent MNES, without the application of mitigation and management measures. To mitigate the potential for ASS to effect on-site GDE's, Doral have prepared an ASSMP for the proposal in consultation with DWER's ASS guidance document (DER, June 2015) *Treatment and management of soil and water in acid sulfate soil landscapes* which includes proposed treatment and validation strategies for overburden, clay fines and sand tails (i.e. three

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		waste streams). Implementation of the ASSMP is considered adequate to mitigate the risks to on-site GDEs from acid sulfate soils. An assessment of Significant Residual Impacts from the Proposal using the Residual Impact Significance Model was provided in Table 6-3 of the ERD which includes potential indirect impacts from groundwater drawdowns. The outcome of this assessment was that a significant residual impact (from groundwater drawdown) will occur to: • 1.70ha of WRP and co-located 30 Black Cockatoo potential breeding trees (present within the identified GDE); • 0.34ha of SWAFCT10b - *Shrublands on southern Swan Coastal Plain Ironstones (Busselton area),* including nine *Banksia squarrosa* subsp. *Argillacea.* As such, Doral is committed to providing a suitable offset (land acquisition) to secure a positive environmental outcome for the Proposal on a 'like for like' principle (or as near to as practical) based on the significant impacts to these MNES. Given the potential impacts from groundwater drawdown and ASS would affect the same areas and species of MNES, the provision of the Offset is considered suitable to counterbalance any impacts from groundwater drawdowns and/or ASS.
DAWE	**10. Analysis of the potential impacts of ASS affected groundwater on the Vasse-Wonnerup Ramsar wetland be included in the final ERD.** **Not addressed.** The local groundwater hydraulic gradient indicates that the Vasse-Wonnerup Wetlands may be a destination for groundwater, or a potential groundwater plume derived from the tailings of the proposed development (Doral 2019b, Figures 4 - 5). The proponent should discuss the likelihood and potential impact of ASS impacted groundwater to	Doral have prepared an ASSMP for the Proposal in consultation with DWER's ASS guidance document (DER, June 2015) *Treatment and management of soil and water in acid sulfate soil landscapes* which includes proposed treatment and validation strategies for overburden, clay fines and sand tails (i.e. three waste streams). The Soil Management Strategy detailed in the ASSMP includes an uncorrected neutralisation rate based on the average Net Acidity (NA) values for soils exceeding the DER Net Acidity (NA) action criterion of

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	diffuse or leak down-gradient from the pits and/or tailings towards the Vasse-Wonnerup Ramsar wetland via the Superficial aquifer. This should be included within the groundwater modelling and groundwater modelling sensitivity analysis.	0.03%S at the Site (0.28%S). The uncorrected neutralisation rate has been calculated using the DER (2015) equation: Lime required (kg CaCO3/m3) = Soil density (t/m3) x NA (%S x 30.59) x 1.02 x safety factor (1.5) x 100/ENV. This neutralisation rate, after correction for Effective Neutralising Value (ENV) (based on specific alkaline material to used) will be used to treat all materials at site that contain NA in excess of >0.03%S. As documented in DER (2015) (and reproduced as follows) the ENV of a neutralising material is the ability of a unit mass of neutralising material to change soil pH. The higher the ENV, the more effective the neutralising material will be at increasing pH. ENV takes into account: • Neutralising value (NV) – amount of calcium or magnesium as oxides or carbonates, expressed as percentage; • Particle size distribution (percentage by weight) – i.e. the fineness of the neutralising material. The finer the product the greater the surface area for the neutralising chemical reactions to occur; • Solubility of the neutralising material. As recommended by DWER (DER, 2015), Doral will utilise fine ag-lime, (crushed limestone which passes through a <1mm sieve) as the neutralising material for the Proposal. This is because: • It has a relatively high neutralising value (NV) of 85-95%. • It has a pH in the range of 8.5 to 9.0, making it safe from occupational health and safety perspective and reduces the risk from environmental harm from excess alkalinity (i.e. pH overshoot); • It has a low solubility in water so it can provide acid buffering capacity over a sustained period of time.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		Following neutralisation, samples at the rate specified in DWER (2019) Landfill waste Classification (from all waste streams) are to be assessed for pHF and pHFOX. The accuracy of the field testing program will be initially 'calibrated' by sending approximately 25% of samples for Total Sulfur analysis. The measurement of Total Sulfur provides a low-cost analytical technique that may be used to estimate the maximum potential environmental risk from acid produced by the oxidation of sulfides (Ahern et al., 2004). For this estimate it is assumed that all sulfur measured is in the form of pyrite or other metal or metalloid disulfides (Ahern et al., 2004), thus providing a more conservative approach to neutralisation. Samples meeting the following criteria (DER, June 2015) will be deemed to be effectively neutralised: 1. Visually, the neutralising material must be well-blended with the soil. 2. Samples require a pHF of between 6.0 and 8.5. 3. Samples require a pHFOX of at least 5, to indicate that there is neutralising capacity greater than the existing plus potential acidity of the soil. 4. Total Sulfur concentrations need to be <0.03%S. Doral are also proposing to install a series of downgradient groundwater monitoring bores which will allow early identification of adverse changes in water quality. These bores will be monitored in accordance with the GWOS. Given the distance of the Proposal to the Vasse-Wonnerup Ramsar wetlands, this would allow sufficient time to implement further contingency measures such as additional neutralisation of groundwater and/or soils. With the implementation of the ASSMP, the likelihood and potential impact of ASS impacted groundwater to diffuse or leak down-gradient from the pits

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		and/or tailings towards the Vasse-Wonnerup Ramsar wetland via the Superficial aquifer id considered low. To assist with assessing potential impacts from potential ASS and ASS induced metal mobilisation on downstream biota, including the Vasse-Wonnerup Ramsar Wetlands, particle tracking has been completed to predict flow paths from the infilled mine area after the completion of mining for a period of 32 years (Attachment 3). Particles were released after recovery was complete (in 2034) assuming the recharge and discharge conditions included in the calibrated model. To add further conservatism to the prediction, it was also assumed that there was no further dewatering from Tronox's operations located 2.7km downstream of Doral's proposed development (i.e. particles could travel past Tronox's operations towards the Vasse – Wonnerup wetland). Preliminary particle tracking suggested that flow paths in the Bassendean Sand would be short as a result of the recharge and evaporative fluxes from this aquifer. The underlying Guildford has a low permeability and also predicts short flow paths away from the mine area (~100m). If any material from the infilled mine path were to migrate to the underlying Yoganup, this would provide the potential flow pathway toward the Vasse- Wonnerup wetland. Particle tracks were predicted assuming particles originated under the infilled mine in the Yoganup (layer 4 of the model) and are shown in Attachment 3. Over the 32year prediction period, particles are predicted to travel a distance less than 1 km (700m)'. Discussion with DWER indicated that plume modelling of groundwater impacts (from ASS) to the Vasse-Wonnerup wetlands would be extremely difficult to conduct, due to the complex nature of the various mass flux components that contribute to the Vasse-Wonnerup wetland. In order to provide an accurate plume model to predict impacts from the Proposal and

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		enable an accurate assessment, the following mass fluxes would need to be quantified: • Seawater derived sulfate; • Tronox's Mines' water inputs and outputs to the aquifer systems; • Surface water runoff quality and quantity from catchments that contribute to the Vasse-Wonnerup wetlands; • Regional acidification issues that are occurring as a result of naturally declining water tables, due to drying climate. Given the significant difficulties in preparing an accurate plume model to allow an accurate assessment to be conducted, Doral has used the particle tracking analysis to assist in demonstrating that any ASS affected groundwater would unlikely reach the Vasse-Wonnerup wetland. Furthermore if ASS affected groundwater resulting from the Proposal was identified offset (downgradient), the Site would be reported and managed under the WA *Contaminated Sites Act 2003* as a Contaminated Site (source site).
DAWE	**11. The Department recommends the proponent seek expertise on the impacts of NORMs e.g. on receiving environments such as the Vasse-Wonneup Wetlands. Discussion of potential impacts should be included in the final ERD and should consider the assessment of the potential for NORMS including the hydrology of the final landform and the stability of tailings storage.** **Not addressed.** Refer to comment 8 and comment 10. Although the proponent has provided a Mine Closure Plan (Doral 2019a) wherein post-mining landforms are outlined, the assessment of the	Refer to DAWE responses 8 and 10 above. Doral have prepared a Mine Closure Plan as required by the Western Australian Mining Act 1978 describing Doral's strategies for decommissioning mining infrastructure, rehabilitating land disturbed by mining activities and releasing the area for future use. The MCP was prepared to support the submission of the ERD, specifically to address Work Items 9 and 22 of the Environmental Scoping Document (ESD) (Doral, 2019). The MCP was structured and prepared to meet the requirements of Guidelines for Preparing Mine Closure Plans (DMP and EPA, 2015) (the Guidelines) and was based upon existing information available from applicable site studies and investigations, legislative and policy needs.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	geotechnical stability of the final landform is presented at a high level. For example, Doral (2019a, p. 61) states "[previous] pits backfilled with sand tails or co-disposed sand and clay mixtures have not shown subsidence and maintain their constructed soil levels", however no corresponding geotechnical documentation to support this is presented. The proponent needs to assess the geotechnical stability of the final landform, particularly as the risk of subsidence may impact both the surface and groundwater hydrology. The Department notes the proponent will undertake pre-mining and post-mining ground-level gamma radiation surveys to ensure that post-mining landforms are returned to acceptable pre-mining gamma radiation levels (Doral 2019a, p. 61).	In accordance with the Completion Criteria committed to in the Mine Closure Plan (Table 6-1, pg 27-30), final landforms will be returned to topography similar to pre-mining levels and meet landowner specifications. Final landforms will be constructed to ensure they can support the designated post-mining agreed land use, specifically: • Agriculture - To return the land to a condition capable of supporting dairy and/or beef production with pasture production rates equivalent to or better than pre-mining production rates. • Conservation - To rehabilitate areas of environmental significance such that their environmental values are restored. • Road Reserve - To retain or re-establish roads/road reserves to engineering and construction standards acceptable to the City of Busselton. Doral recognises the risks associated with subsistence and undertake regular subsidence monitoring of backfilled mine pits, utilising both surveyed ground surface markers and visual inspection. The surveyed method is considered accurate to within 10mm. Historic monitoring at previous Doral operational sites (Dardanup and Burekup West) has identified that deep pits (approximately 10 metres) backfilled with clay overburden are subject to 100-200mm of subsidence in the first year of rehabilitation. Pits backfilled with sand tails or co-disposed sand and clay mixtures have not shown subsidence and maintain their constructed soil levels (i.e. at Doral's other sites). Post-mining soil profile reconstruction is modelled on the pre-mining landform with adjustments made on the basis of practical (the limitations of the materials available) and economic constraints, while also exploiting

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		the opportunities present to remove soil landscape constraints to improve agricultural productivity where possible. Within road reserves/road crossings, reconstruction of roads (if required) is conducted under the technical direction and to the standards of the City of Busselton. This will include City of Busselton acceptance that Geotechnical and Engineering standards have been met. Doral will conduct post-mining final land surface elevation surveys. These are used to check that final surface topography is as designed and to identify maintenance work (if required as a result of subsidence). In addition, the following Completion Criteria have been committed to in relation to surface water and groundwater: • Groundwater levels in monitored bores are stable within the range of variation of surrounding monitoring bores and show the same seasonal patterns as surrounding monitored bores. • Groundwater quality is within the range monitored within the surrounding areas. • Surface water quality is within the range monitored within the surrounding areas. • Drainage lines flow in similar directions and to the same catchments as they did pre-mining. Following the completion of the closure activities described in the Mine Closure Plan, Doral intend to relinquish the mining tenements that the Yalyalup Mine operates on, and return property to landowners. The proposed process to achieve this outcome is: • Implement rehabilitation, deconstruction and infrastructure reinstatement;

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		• Document fulfilment of completion criteria; • Obtain written acceptance from landowners that property meets the landowner's requirements, that Doral has fulfilled its obligations to rehabilitate the property and the landowner is willing to resume control of the property; Request relinquishment of the mining leases from DMIRS and receive release of any financial environmental securities.
ANON-M9EV-PTTD-W	Main concern is relating to Doral's treatment of tailings post operation. Given this proposal is in the catchment of the internationally recognised Ramsar site I believe that the proponents plan poses significant risk to this fragile and already compromised site. Under the Ramsar convention Australia has agreed to conserve the high ecological value of these wetlands however the proposal I believe underestimates the risks associated with the proposed treatment of tailings and as such warrants further examination. Doral has not considered how NORM enriched tailings will be managed post mining operations. NORMs pose a material risk to the ecologically fragile Vasse Wonnerup Ramsar Wetlands, particularly as the hydraulic gradient within the Superficial aquifer flows downstream from the proposed mine towards the Wetlands. Presumably, Doral believes applying lime to the tailings will reduce this risk via neutralisation of potential acid sulfate soils. However, NORMs, such as Uranium, can be mobilised under neutral/alkaline conditions given sufficient redox potentials. Furthermore, lime application is a heterogeneous process, meaning complete neutralisation of acid sulfate soils is only theoretically possible. No consideration of these processes have been acknowledged	The management of NORMs is regulated by the Radiological Council of WA under the Radiation Safety Act 1975 and DMIRS (Mines Safety and Inspection Act 1994 and Mines Safety and Inspection Regulations, 1995). The State regulation of radiation includes the Statutory appointment of suitably qualified Radiation Safety Officer and the approval of a Radiation Management Plan and subsequent annual monitoring reports. Notwithstanding Doral provides the following information regarding the potential for NORMs at the site. Mineral sands extraction and separation is a physical process with no chemical treatment applied to the minerals with the exception of flocculent for management of clay fines. At the mine the radionuclide bearing heavy mineral is wet separated by spirals and transferred offsite for secondary dry plant processing whilst the quartz sand tails and clay fines are directly returned to the mine void (and neutralised for ASS with alkaline material at the rates specified in the ASSMP, where required). At the Dry Plant the heavy mineral is (dry) separated by magnetic and electrostatic separation into the various mineral types for export. The mineral types produced by the Doral Picton Dry Plant presently utilises all heavy mineral arising from the plant feed thus any dry plant tailing material is less than 1Bq/g.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	by Doral. Additionally, Doral has not provided any contaminant transport modelling which could quantity the rate, distribution and magnitude of post-mining NORM mobilisation. Given these non-trivial uncertainties, it is unclear how Doral can claim the risk of the proposed action to the Vasse Wonnerup Ramsar Wetlands is low.	Should any returned dry plant tailing material be in excess of 1Bq/g Th and U, then as per the Doral Radiation Management Plan, it shall be dispersed with outgoing wet concentrator (quartz) tails and thus diluted further to ensure Th and U concentrations are conservatively below 1Bq/g. In further support to this, the limit as set by the Department of Mine, Industry Resources and Safety is a maximum range of 140-180ppm Th and U. As such any returned dry plant tailings will not be NORM enriched and shall be managed such that it does not constitute a radioactive material (<1Bq/g). Doral has routinely monitored Ra226 and Ra228 within it's operations and near surrounding bores for many years (including Recent Yoongarillup Operations) without any evidence of impact or trends of radionuclide mobilisation shown. Doral have prepared an ASSMP for the proposal in consultation with DWER's ASS guidance document (DER, June 2015) Treatment and management of soil and water in acid sulfate soil landscapes which includes proposed treatment and validation strategies for overburden, clay fines and sand tails (i.e. three waste streams). The Soil Management Strategy detailed in the ASSMP includes an uncorrected neutralisation rate based on the average Net Acidity (NA) values for soils exceeding the DER Net Acidity (NA) action criterion of 0.03%S at the Site (0.28%S). The uncorrected neutralisation rate has been calculated using the DER (2015) equation: Lime required (kg CaCO3/m3) = Soil density (t/m3) x NA (%S x 30.59) x 1.02 x safety factor (1.5) x 100/ENV. This neutralisation rate, after correction for Effective Neutralising Value (ENV) (based on specific alkaline material to used) will be used to treat all materials at site that contain NA in excess of >0.03%S.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		As documented in DER (2015) (and reproduced as follows) the ENV of a neutralising material is the ability of a unit mass of neutralising material to change soil pH. The higher the ENV, the more effective the neutralising material will be at increasing pH. ENV takes into account: • Neutralising value (NV) – amount of calcium or magnesium as oxides or carbonates, expressed as percentage; • Particle size distribution (percentage by weight) – i.e. the fineness of the neutralising material. The finer the product the greater the surface area for the neutralising chemical reactions to occur; • Solubility of the neutralising material. As recommended by DWER (DER, 2015), Doral will utilise fine ag-lime, (crushed limestone which passes through a <1mm sieve) as the neutralising material for the Proposal. This is because: • It has a relatively high neutralising value (NV) of 85-95%. • It has a pH in the range of 8.5 to 9.0, making it safe from occupational health and safety perspective and reduces the risk from environmental harm from excess alkalinity (i.e. pH overshoot); • It has a low solubility in water so it can provide acid buffering capacity over a sustained period of time. Following neutralisation, samples at the rate specified in DWER (2019) Landfill waste Classification (from all waste streams) are to be assessed for pHF and pHFOX. The accuracy of the field-testing program will be initially 'calibrated' by sending approximately 25% of samples for Total Sulfur analysis. The measurement of Total Sulfur provides a low-cost analytical technique that may be used to estimate the maximum potential environmental risk from acid produced by the oxidation of sulfides (Ahern et al., 2004). For this estimate it is assumed that all sulfur measured is in the

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		form of pyrite or other metal or metalloid disulfides (Ahern et al., 2004), thus providing a more conservative approach to neutralisation. Samples meeting the following criteria (DER, June 2015) will be deemed to be effectively neutralised: 1. Visually, the neutralising material must be well-blended with the soil. 2. Samples require a pHF of between 6.0 and 8.5. 3. Samples require a pHFOX of at least 5, to indicate that there is neutralising capacity greater than the existing plus potential acidity of the soil. 4. Total Sulfur concentrations need to be <0.03%S. To assist with assessing potential impacts from radionuclide mobilisation (as well as potential ASS and ASS induced metal mobilisation) on downstream biota, including the Vasse-Wonnerup Ramsar Wetlands, particle tracking has been completed to predict flow paths from the infilled mine area after the completion of mining for a period of 32 years (Attachment 3). Particles were released after recovery was complete (in 2034) assuming the recharge and discharge conditions included in the calibrated model. To add further conservatism to the prediction, it was also assumed that there was no further dewatering from Tronox's operations located 2.7km downstream of Doral's proposed development (i.e. particles could travel past Tronox's operations towards the Vasse – Wonnerup wetland). Preliminary particle tracking suggested that flow paths in the Bassendean Sand would be short as a result of the recharge and evaporative fluxes from this aquifer. The underlying Guildford has a low permeability and also predicts short flow paths away from the mine area (~100m). If any material from the infilled mine path were to migrate to the underlying Yoganup, this would provide the potential flow pathway toward the Vasse- Wonnerup

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		wetland. Particle tracks were predicted assuming particles originated under the infilled mine in the Yoganup (layer 4 of the model) and are shown in Attachment 3. Over the 32-year prediction period, particles are predicted to travel a distance less than 1 km (700m)'.

5. SOCIAL SURROUNDINGS

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
ANON-M9EV-PTTX-H	Comments in relation to Noise Sensitive Receptor R2 and surrounding premises north of R2 (our ref NR2). Task No. 42 & 43 noise sensitivity Appendix 8 Figure 4-32 page 35. The main concern being potential transport noise, dust issues & visual amenity impacts. Figure 4-32 locates transport route approximately 200m north of NR2 and 500m north of R2. The close proximity of the proposed transport route is very close to both houses raising concerns of continued truck transport noise & development noise. Also noise of truck movements entering and exiting the transport route at the proposed Ludlow Hithergreen Road entry point. R2 has been specifically positioned with living areas to the north to reduce road noise. R2 does not have any windows facing Ludlow Hithergreen Road other than a very small fixed pane window to assist in noise reduction. R2 has also been setback from Ludlow Hithergreen Road to for this purpose. NR2 is located very close to the proposed transport route and is expected to be unreasonably effected by noise during development of the transport route and continuous noise from truck movements along this route as well as noise caused by trucks entering and exiting from Ludlow-Hithergreen Road. Figure 1-3 page 3 shows the Disturbance Area including the transport route, however Figure 4-32 that show the expected noise levels does not have any noise modelling of the transport route. This information should have been included in the proposal.	Noise modelling has been conducted for several mining scenarios and included within the ERD (section 4.5 and Appendix 8). It is noted that the mine access route was not included and subsequent haulage truck monitoring and modelling has been conducted specifically for the mine access road following discussion with neighbouring residents. Noise modelling concluded that full compliance is achieved at both residences with and without a 3m noise bund to the south of the access road (refer to Attachment 4). Doral is committed to providing a 3m (topsoil) noise bund on the south of the access road extending from Ludlow-Hithergreen Rd to the Abba River crossing. The predicted noise levels including a 5dB penalty for tonality as per the EP Noise Regulations 1997 is 38.3dB(A) for the location 'NR2' and 33.9dB(A) for the location R2. The travel of haul trucks along the mine access road will be restricted to day time hours (7am to 7pm) and the speed will be limited to 40km/h. The 3m bunding would also provide a visual screen for vehicles along the Access road and will be vegetated with grass and with or without PVA dust sealant as required for dust management. Regular consultation shall be maintained with neighbouring residents to evaluate the performance of the site with regards to potential noise concerns.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	We are very concerned that potential noise issues as mentioned above will significantly reduce our current, peaceful enjoyment of our property and effect the ability to continue to rent NR2 due to these potential impacts. Although the noise modelling shows minimal effect on R2 and NR2, this will also be unknown until the HMC is fully operational.	
ANON-M9EV-PTTX-H	Visual Amenity As previously mentioned R2 has been specifically designed and positioned with the main aspect facing north reducing the visibility of Ludlow Hithergreen Road and capturing the natural landscape. The truck movements along the proposed transport route will significantly impact our visual outlook. NR2 will also be effected with visibility from the outside living areas having direct view of the proposed operations. These operations are expected to continue for a lengthy period of time and may have a negative impact on the value of our property due to all of the reasons mentioned above. Heavy Mineral Concentrator Figure 1-2 page 2 We are concerned of the potential visual amenitie impacts that the HMC may have on our property including both R2 and NR2. This will be unknown until the HMC is in operation, notably the impacts during night time operations.	As mentioned above, noise bunding constructed of topsoil will be constructed and vegetated with grass and thus visual screen of 3m will be installed on the south side of the mine access road. This will be effective as a visual screen to obscure traffic movements from general view to the residences to the south. Lights at night will be directed towards construction and operation activities and will be in accordance with *AS4282-1997 Control of the obtrusive effects of outdoor lighting* to ensure that lighting associated with the plant buildings, structures and extraction operations are designed and implemented to limit light spill into neighbouring land and/or road reserves. Angled-directional, or downlighting will be considered to achieve this. Regular consultation shall be maintained with neighbouring residents to evaluate the performance of the site with regards to potential lighting concerns.
ANON-M9EV-PTTX-H	Also of major concern is any future development or operations in closer proximity to our property.	Regular community engagement will continue throughout the life of the mine and any potential future developments will be through consultation and in accordance with regulatory processes.

6. OTHER

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
DBCA	Comment 1: The key aspect of this proposal that is of significance to the Department of Biodiversity, Conservation and Attractions (DBCA) is the potential for significant impacts from groundwater drawdown on threatened species and threatened ecological communities (TECs), or their habitat. This includes, but is not limited to the following: • TEC SWAFCT10b 'Shrublands on Southern Swan Coastal Plain Ironstones (Busselton Area)' (ranked critically endangered); • TEC SWAFCT02 'Southern wet shrublands, Swan Coastal Plain' (ranked endangered); • TEC SWAFCT01b 'Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain' (ranked vulnerable); • threatened flora Verticordia plumosa var. vassensis (ranked endangered); • threatened flora Banksia squarrosa subsp.argillacea (ranked vulnerable); • threatened fauna western ringtail possum (Pseudocheirus occidentalis) (ranked critically endangered); • threatened black cockatoos including Carnaby's cockatoo (Calyptorhynchus latirostris) (ranked endangered), Baudin's cockatoo (Calyptorhynchus baudinii) (ranked endangered) and forest red-tailed black cockatoo (Calyptorhynchus banksii naso) (ranked vulnerable); and	Comment acknowledged. Doral have applied the mitigation hierarchy to avoid, mitigate and rehabilitate potential impacts to flora and vegetation, and terrestrial fauna values. This included designing the Proposal to avoid clearing of any Threatened flora species and maximise usage of existing cleared areas, which has resulting in all but <1% of the disturbance area being located on cleared pasture. Mitigation measures include preparation of a flora and vegetation management plan, fauna management plan, ASS management plan, groundwater operating strategy, fire management plan, dust management plan and a GDE Management Plan. Doral have proposed to rehabilitate an area of 4.7ha to counter balance the clearing impacts for the Proposal. Following the application of the mitigation hierarchy, an assessment of significance of the Proposal for the residual impacts to flora, vegetation communities and fauna/fauna habitat, against applicable matters listed in Section 5 of *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018b) was provided to assist in determining significance of the impacts. The outcome of the assessment is that impacts to several TECS and fauna habitat protected under statute will occur or potentially occur and as such they are considered significant residual impacts requiring an offset. Potential offset parameters have been quantified for both State and Federal significant residual impacts, as per the *How to Use the*

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	• other conservation significant species considered disjunct from their typical range or restricted to ironstone surfaces, particularly those associated with TECs.	*Offsets Assessment Guide* and the associated *EPBC Act Environmental Offsets Policy (DSEWPaC, 2012a).* This is intended to meet the requirements of the *EPBC Act Environmental Offsets Policy (DSEWPaC, 2012a)* for the MNES, as well as providing a conservative estimate for quantifying an appropriate offset for State matters, given there are no published annual probability of extinction figures at State level. Doral has prepared a Draft Offset Strategy to provide EPA/DBCA and DAWE with a level of confidence that a suitable offset site(s) can be secured which meets the requirements of the State and Federal Offsets policy's and guidelines. Doral are committed to securing an offset site(s) prior to clearing activities and/or dewatering McGibbon Track (expected to start in Q1, 2023). Doral continues to consult with Regulators in identifying a suitable offset site(s).
DBCA	**Comment 3:** The proponent has populated the Federal Department of Agriculture, Water and the Environment offset calculator and has determined the quantum of potential offsets required to counter the significant residual impacts to several threatened species and TECs (refer to Section 6.3.2 page 177 and Appendix 11). The proponent has proposed strategies for direct offsets, including land purchase and a funding arrangement if direct offsets are not achievable. Section 6.3.4 of the ERD notes that the proponent has been unable to identify prospective land parcels that may contain all values that are being sought in the offsets. **Comment 4:** It is noted that several sections of the ERD (e.g. Section 6.3.1, Section 6.3.3, and Section 6.3.6) suggest that DBCA plays a key role in the identification and purchase of land parcel(s) to fulfil the proposed offset package. Unless formal arrangements are made with DBCA, it is the responsibility for the proponent (in agreement with the State and/or Federal	Comment 3 and 4 noted. Doral are fully aware that the responsibility of identifying and facilitating a suitable offset site is the responsibility of Doral, not DBCA or DAWE. Doral will continue to search for an appropriate direct Offset site via land acquisition, to offset the significant residual impacts of the Proposal that remain after the application of the mitigation hierarchy. Doral will continue to consult with both DBCA and DAWE to ensure the suitability of potential Sites. Doral has prepared a Draft Offset Strategy to provide EPA/DBCA and DAWE with a level of confidence that a suitable offset site(s) can be secured which meets the requirements of the State and Federal Offsets policy's and guidelines. Doral are committed to securing an offset site(s) prior to clearing activities and/or dewatering

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	regulators) to identify and facilitate appropriate offsets for the proposal if and where required.	McGibbon Track (expected to start in Q1, 2023). Doral continues to consult with Regulators in identifying a suitable offset site(s).
DBCA	**Comment 5:** Several matters of detail are provided to assist the Department of Water and Environmental Regulation, and the EPA in this assessment: • The ERD states that the threatened flora *V. plumosa* var.*vassensis* is known from 97 records in the DBCA database (page 187 and Table 7-3). DBCA has further interrogated the records and understands that this species is known from 56 WA Herbarium collections (WA Herbarium 1998-), of which a number have "?" identifications and many are from the same location. This species is only known from 13 locations and many of these populations have few individual plants, and/or are in poor condition, with some having been lost altogether. • Biodiversity Conservation Act listings (e.g. page 84) and rankings should be assigned as critically endangered, endangered, or vulnerable. The ERD uses schedule numbers from the *Government Gazette* publication. The correct conservation rankings are: o Carnaby's black cockatoo *Calyptorhynchus latirostris* (endangered). o Baudin's cockatoo *Calyptorhynchus baudinii* (endangered). o Forest red-tailed black cockatoo *Calyptorhynchus banksii naso* (vulnerable). o Western ringtail possum *Pseudocheirus occidentalis* (critically endangered). o Peregrine falcon *Falco peregrinus* (specially protected).	Comment 5 noted. Doral has designed the proposal as far as practicable to avoid the need for clearing vegetation. As such, no impacts to the Threatened flora *Verticordia plumose* var. *vassensis* will occur as a result of implementing the Proposal. Doral has relied upon the results of the Fauna Survey to provide the rankings for fauna species, however it is noted that these should be as per the *Biodiversity Conservation Act 2016* listings. Notwithstanding, the assessment of impacts to Terrestrial fauna for the Proposal remains unchanged when applying the correct conservation rankings.
DAWE	**12.The Department of the Environment and Energy is now called the Department of Agriculture, Water and Environment. Please amend accordingly.**	Addressed. No response required.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Draft V2 of the ERD was resubmitted to the EPA on 23 January 2020, prior to the change in Commonwealth Department name. Version V3 of the ERD has been updated to the new Department name throughout the document. Addressed. The proponent has amended the name of the Department.	
DAWE	13. Given the variation under Section 43A of the *Environment Protection Act*, the Department requires a variation under Section 156A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) noting the development envelope has increased. Addressed. A request for a formal variation was submitted on 15 May 2020 and the delegate of the Minister accepted the variation to the proposal in accordance with section 156B of the EPBC Act on 29 May 2020. The Department recommends a statement is included the Environmental Review Document noting the EPBC variation.	Addressed. No response required.
DAWE	15. The Department requires further information on the social and economic costs and/or benefits of undertaking the proposed action, including: • projected economic costs and benefits of the project, including the basis for their estimation through cost/benefit analysis or similar studies • assessment of potential societal costs and/or benefits Economic and social impacts should be considered at the local, regional and national levels. Not addressed.	A Confidential Attachment providing a summary of the economic and social benefits of the Project has been provided to EPA and DAWE with Response to Submissions.

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	The Department notes the proponent has not included further information on the social and economic costs and/or benefits of undertaking the proposed action. The Department requires this information to undertake the assessment.	
DAWE	**16. Please discuss how all Policy and Guidance documents (i.e. Recovery Plans, Threat Abatement Plans and Conservation Advices) have been considered.** **Not addressed**. Please discuss how all Policy and Guidance documents (i.e. Recovery Plans, Threat Abatement Plans and Conservation Advice) have been considered. That is, having regard to, and providing a discussion on, the objectives of these documents. In addition, please discuss further how the proposed avoidance, mitigation/management and offsetting measures have been drafted in accordance/consideration of these documents. For example, the *Conservation Advice Pseudocheirus occidentalis Western Ringtail possum* states 'Vegetation stress due to groundwater decline is likely to impact WRP's due to a decline in nutritional quality and quantity of food causing nutritional stress, threatening recruitment and survival'. Please discuss how the ERD has regard to this.	During the preparation and assessment of the Environmental Scoping Document (ESD), Doral provided a detailed list of relevant policy and guidance documents that would be considered during the preparation of the ERD. Doral has relied upon these documents to prepare the ERD, which has been prepared in accordance with *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (EPA, 2016a) and the *Instructions and Template: Environmental Review Document* (EPA, 2018a). The ERD is also considered to satisfy the requirements for an accredited assessment under the EPBC Act. Although a discussion on the objectives of each Policy and Guidance document has not been explicitly included in the ERD, a summary of the EPBC status and distribution, habitat preferences, key threats, results of Site-specific surveys, maps and a list of references for each species was included in the existing environment section for MNES (Section 7.3 of the ERD) and throughout the other relevant sections of the ERD. The Policy and Guidance documents were also reviewed by Doral to assist with determining what threatening processes for each MNES was relevant to the Proposal (i.e. habitat loss via dewatering of TECs and WRP habitat), providing an assessment of the relevant direct and indirect impacts to MNES and then applying the mitigation hierarchy (i.e. avoidance, mitigation and rehabilitation), before assessing the significance of the residual impacts, and proposing an

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		Offset, where required in accordance with the EPBC Environmental Offsets Policy. It is noted that this Comment (DAWE Comment 16) with the example reference to Conservation Advice for *Pseudocheirus occidentalis Western Ringtail possum* was likely provided by DAWE during an earlier review of the ERD, of which indirect impacts to WRP habitat from dewatering were not considered a significant residual impact, given the habitat present is outside of the WRP core habitat, primary corridors and supporting habitat as documented in *Significant Impact Guidelines for the Vulnerable Western Ringtail Possum in the Southern Swan Coastal Plain, Western Australia* (DEWHA, 2009). The ERD however was updated in response to DAWE comments, which now considers there is a significant residual impact to WRP habitat due to indirect impacts from groundwater drawdowns. To mitigate this risk Doral will implement the GDE Management Plan and provide an Offset.
DAWE	**17. The Department notes the proponent's commitment to undertake mitigation measures (Section 4.3.6 Mitigation) including the development and implementation of several different management plans including a Flora and Vegetation Management Plan, Fauna Management Plan, Fire Management Plan and Dust Management Plan. Given these plans have not been made available to the Department, it is difficult for the suitability of the proposed measures and their effectiveness in fully mitigating the impacts of the proposed action to be appropriately assessed.** **Not addressed.** The Department notes the proponent has not included any draft management plans.	The Proposed Action was determined to be a Controlled Action by DAWE, requiring assessment by accredited assessment under Part IV of the Western Australian *Environmental Protection Act 1986*. The purpose of the accredited assessment process is to remove duplication between the States and Commonwealth during assessment As provided in Section 6 of the ERD, Doral provided an assessment of significance of the residual impacts to flora and vegetation and terrestrial fauna (including relevant MNES) resulting from the implementation of the Proposal. The assessment identified the following significant residual impacts to MNES:

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
	Any proposed management plan should note the potential impacts outlined and if required, provide sufficient mitigation (such as buffer zones) to reduce significant residual impacts on EPBC Act listed species and communities and their habitat. Please note that, when reviewing Environment Management Plans/Action Plans, the Department will take into consideration the Department's *Environmental Management Plan Guidelines* (2014) (Guidelines) available at http://www.environment.gov.au/epbc/publications/environmental-management-plan-guidelines which provides general guidance to stakeholders preparing environmental management plans for environmental impact assessments and approvals under Chapter 4 of the EPBC Act. Please ensure that any management plan(s) are consistent with the Guidelines. Please ensure mitigation measures referenced are measurable, auditable and timely. Additionally, when committing to management actions, the proponent should refrain from using terminology of 'where possible/practical', 'it is anticipated', 'as required', 'should' or 'may' and use terms "will" and "must".	DIRECT IMPACTS • Clearing of 0.11ha of WRP habitat; • Clearing 102 Black Cockatoo potential breeding habitat trees (i.e. DBH ≥50cm and DBH ≥30cm for wandoo). INDIRECT IMPACTS • Groundwater drawdown to 0.34ha of SWAFCT10b and nine *Banksia squarrosa* subsp. *Argillacea.* • Groundwater drawdown to 1.70ha of WRP habitat (including 30 co-located Black Cockatoo potential breeding habitat trees). As uncertainty exists around the actual extent of indirect impacts from groundwater drawdown to flora and vegetation and terrestrial fauna habitat (including MNES identified above), Doral has provided a GDE Management Plan (Appendix 4E of the ERD and revised Version C as Attachment 1 of this document) and GWOS (Appendix 7E) to EPA for assessment, to demonstrate that the impacts to flora and vegetation/terrestrial fauna habitat (including MNES) are expected to be minimised with the implementation of these Plans. In addition, Doral are proposing a suitable offset via land acquisition to offset the direct and indirect impacts to MNES. Doral have committed to preparing additional Management Plans to minimise impacts from the Proposal, however given the significant residual impacts to MNES result primarily from indirect groundwater drawdown, assessment of the additional Management Plans by DAWE is not considered necessary as these Management Plans will be assessed under the accredited

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		assessment by relevant State Departments (EPA, DWER, DBCA) as appropriate, prior to the implementation of the Proposal.
DAWE	**19. Comment on ERD** The Department notes the following documents should be included in the EPBC guidance (page 184 of the ERD): Department of the Environment and Energy (2018). *Threat abatement plan for disease in natural ecosystems caused by* Phytophthora cinnamomi. Canberra: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-disease-natural-ecosystems-caused-phytophthora-cinnamomi-2018. Department of the Environment (2015). *Threat abatement plan for predation by feral cats*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). *Threat abatement plan for predation by the European red fox*. DEWHA, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox.	Noted. These references are included in the ERD (Section 4.2.2 – Flora and Vegetation, Section 4.3.2 – Terrestrial Fauna), although were inadvertently missed in Section 7 of the ERD (MNES). Notwithstanding these documents have been relied upon in preparation of the ERD.
DAWE	**20. Comment on ERD** The ERD should include a discussion of how the proposed action meets the principles of ecologically sustainable development, as defined in s. 3A of the EPBC Act.	**Principles of ecologically sustainable development** **(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;**

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		The Proposal will provide economic and social benefits to the Western Australia community and economy, including within regional Western Australia. Employing approximately 100 staff and contractors, Doral's business is a source of employment locally and provides business for suppliers, distributors and local services (e.g. mechanics, contractors, consultants). Doral contributes financial support to local schools, sporting groups, various volunteer groups, and annual local festivals and is considered a valuable member of the local community. Mining operations at Doral's Yoongarillup Mine are anticipated to be completed in 2020. An alternative ore source is therefore required to continue to meet global demand and to ensure the continued employment of Doral's employees and contractors. Commencement of construction activities at the Yalyalup Mineral Sands Project in Q3 2021 and mining in Q1 2022 will enable Doral to continue operating in the southwest of Western Australia and ensure employees and contractors are retained in the southwest and local support to communities continues. The following design optimisations have been incorporated into the design and layout of the Proposal to minimise environmental impacts: • Areas containing native vegetation have been avoided where possible (McGibbon Track) to minimise the need to clear vegetation; • Utilising mine voids where possible for ponds and location of mine infrastructure to reduce the total area disturbed;

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		• Location of processing equipment in-pit (e.g. hopper) to minimise noise emissions to sensitive receptors; • Incorporation of noise bunds to minimise potential noise impacts under certain wind conditions on nearby residences; Doral have also committed to implementing a range of mitigation measures to minimise impacts to the environment. These are summarised in Table ES-3 of the ERD for each of the Key Environmental Factors, which take into consideration the relevant MNES. **(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;** Doral have used existing environmental data and commissioned site-specific investigations and assessments to assess risk to relevant environmental values during the design of the Proposal. Environmental management plans and closure plans have been prepared to avoid or minimise impacts on identified environmental values. Doral have maintained engagement with relevant government agencies (see Table 3-3) to minimise any uncertainty surrounding the environmental impact of the Proposal. **(c) the principle of inter-generational equity--that the present generation should ensure that the health, diversity and productivity of the environment maintained or enhanced for the benefit of future generations;**

SUBMITTER	SUBMISSION AND/OR ISSUE	RESPONSE TO COMMENT
		Doral recognises the importance of intergenerational equity and throughout the management measures sections of this ERD, measures to appropriately manage potential impacts to ensure health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations are presented. **(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;** Doral recognises the values of native vegetation present within the Development Envelope and have designed the Proposal to avoid clearing vegetation as far as practicable. **(e) improved valuation, pricing and incentive mechanisms should be promoted.** Doral have factored in the costs of implementing environmental management measures into annual budgets for the Proposal. Costs of rehabilitation and decommissioning will be further considered and included in the Mine Closure Plan.

7. REFERENCES

Acoustic Engineering Solutions (2020), *Noise Modelling for Yalyalup Haul Road. Unpublished report prepared for Doral Mineral Sands. July 2020. REF: AES-890059-L01-A-03072020.*

Phoenix Environmental Sciences (2020), *Short-range endemic review for the Yalyalup Mineral Sands Deposit. Prepared for Doral Mineral Sands Pty Ltd. August 2020.*

DER, (2015), *Treatment and management of soil and water in acid sulfate soil landscapes.*

Doral, 2019, *Environmental Scoping Document, Yalyalup Mineral Sands Project, Final V2. 29 May 2019.*

DWER (2019), *Waste Classification and Waste Definitions 1996 (as amended 2019).*

FIGURE 1: REVISED CLEARING AREA – YALYALUP RD

357250 357500 357750 358000

6270250 6270000 6269750

N

0 12.5 25 50 75

Meters

Legend

- Yalyalup Development Envelope
- Intial Cleared Areas
- Revised Cleared Areas
- Initial Disturbance Boundary
- Revised Disturbance Boundary

Conservation Significant Vegetation

Vegetation Unit

- A1 - FCT01b
- A2 - FCT02
- B1 - FCT10b

A1

A1

YALYALUP RD

Doral

Yalyalup Mineral Sands Project

Conservation Significant Vegetation and Flora
Intial and Revised Clearing Area Comparison Yalyalup Rd

Scale 1:2,500	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 1		28/08/2020

FIGURE 2: REVISED CLEARING AREA – MCGIBBON TRACK

358250 358500 358750 359000 359250 359500 359750 360000

6271500 6271250 6271000 6270750 6270500

N

0 25 50 100 150
Meters

Legend

- Yalyalup Development Envelope
- Intial Cleared Areas
- Revised Cleared Areas
- Initial Disturbance Boundary

Conservation Significant Vegetation

Vegetation Unit

- A1 - FCT01b
- A2 - FCT02
- B1 - FCT10b

A2

B1

A2

A1

MCGIBBON TK

Doral

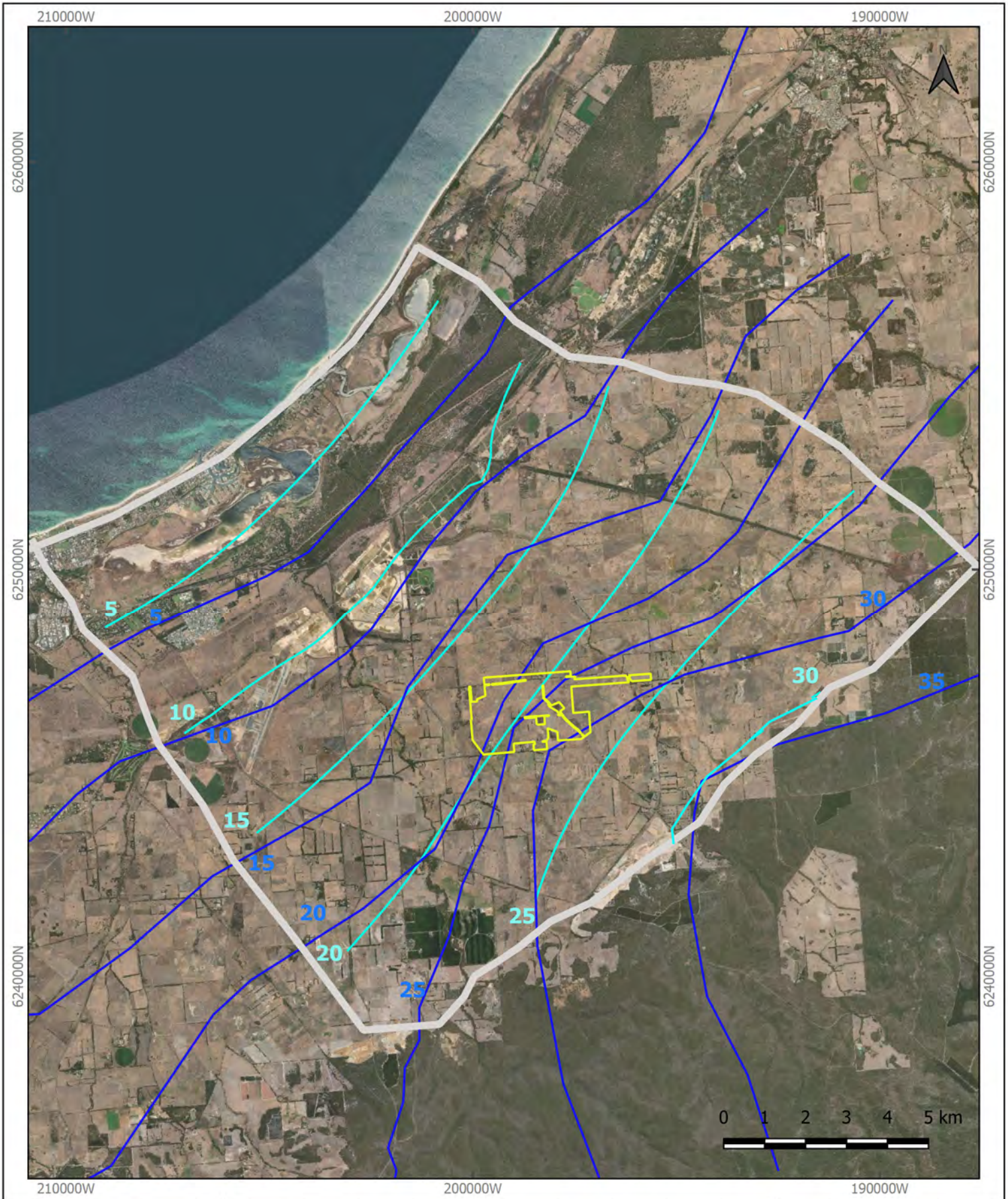
Yalyalup Mineral Sands Project

Conservation Significant Vegetation and Flora
Intial and Revised Clearing Area Comparison McGibbon Tk

Scale	Datum: GDA94	Sheet Size A3
1:5,000	Projection: MGA Zone 50	
Figure: 2		16/11/2020

358250 358500 358750 359000 359250 359500 359750 360000

FIGURE 3: YARRAGADEE AQUIFER MODELLED WATER LEVELS



Legend

- Groundwater Model Boundary
- Yalyalup Disturbance Envelop
- Modelled Averaged Water Level (mRL) from SWAMS Model in 5m Intervals
- Modelled Average Water Level (mRL) in 5m Intervals

AUTHOR: BDK	REPORT NO:	Notes and Data Sources:
DRAWN: BDK	JOB No: 136D	Aerial Imagery sourced from ESRI (2020)
DATE: 12/8/2020	Coordinates: MGA Zone 50	

AQ2

Figure 1

Contours of Modelled Water Levels from SWAMS Model and Modelled Water Levels for the Yarragadee Aquifer

ATTACHMENT 1: GDE MANAGEMENT PLAN

YALYALUP MINERAL SANDS PROJECT

GDE MANAGEMENT PLAN

Prepared for

DORAL MINERAL SANDS

October 2020

Version c

AQ2 Pty Ltd
Level 4, 56 William Street
Perth 6000

T: 08 9322 9733
www.aq2.com.au

Document Status

Version	Purpose of Document	Author	Reviewed By	Review Date
a	Draft for review	DGS	SC	12 May 2020
b	Revised version	DGS	BDK/CB	14 May 2020
C	Revised Monitoring Program	CB	CB	23 Oct 2020

TABLE OF CONTENTS

Tables

Figures

1 INTRODUCTION

1.1 Background

Doral Mineral Sands Pty Ltd (Doral) proposes to develop the Yalyalup mineral sands mine, located approximately 11 km south-east of Busselton, Western Australia (Figure 1). The Yalyalup mineral sands deposit is located within Retention Licence R70/0052, which covers an area of approximately 2,290 hectares, halfway between Iluka's Tutunup South Mine (closed in 2018) and Cristal's (Tronox) Wonnerup Mine (operating and northern extension).

The expected Yalyalup mine life is six years, comprising three and a half years of mining and the remainder being startup and closure. Some mining will occur below the groundwater level and at times, dewatering of the open-cut pits will be required to provide dry mining conditions.

A draft Environmental Review Document (ERD) was submitted to the Department of Water and Environmental Regulation (DWER) on 6th December 2019. The DWER and other relevant government agencies have recently reviewed Doral's draft ERD and have requested further information regarding the proposed mining and potential impact management strategies on Groundwater Dependent Ecosystems (GDE) occurring within the Proposal Area (Ecoedge, 2019). GDEs at the northern end of McGibbon Track have been identified as being potentially impacted by the proposed mining (Figure 2).

This document describes a Groundwater Dependent Ecosystem Management Plan (GDEMP) for the Yalyalup project, that will support the ERD assessment, in light of the potential predicted impacts and adequacy of the proposed management measures.

1.2 Requirements for the Management Plan

The GDE along McGibbon Track comprise a narrow strip of native vegetation within the City of Busselton road reserve that contains occurrences of three threatened ecological communities and several conservation significant flora species. The threatened ecological communities along McGibbon Track identified by Ecoedge to represent GDEs include:

1. SWAFCT02 Southern Wet shrublands
2. SWAFCT10b Shrublands on southern ironstones

Additionally, the threatened ecological communities SWAFCT01b (Southern *Corymbia calophylla* woodlands on heavy soils), identified along McGibbon Track, is not considered a GDE. However, it does support riparian tree species.

Ecoedge has also identified the threatened ecological communities SWAFCT09 (Dense shrublands on clay flats), located at the western end of Princefield Road to represent GDEs.

All of these communities are listed as threatened ecological communities (TEC) under the Western Australian *Biodiversity Conservation Act 2016* and SWAFCT09 and SWAFCT10b are also listed as threatened under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In addition to recognising the conservation status of the vegetation communities, the GDEMP also addresses specific requirements arising from review of the Environmental Scoping Document (ESD):

- ESD Requirement 2: to provide information on the hydro(geo)logical setting of the GDE and potential changes related to dewatering
- ESD Requirement 4: where possible, to provide information on the conservation status of the GDE vegetation along McGibbon Track
- ESD Requirement 4: to provide information on potential management techniques employed to protect the GDE

1.3 Objectives and Scope of this Plan

The objectives of this plan are to define:

- the hydro(geological) setting of the GDE along McGibbon Track.
- the vegetation community of the GDE along McGibbon Track and its conservation significance.
- source and extent of change-risk to the GDE as caused by mining activities
- the proposed monitoring network to assess changes in the GDE, including:
    - vegetation monitoring
    - hydro(geo)logical monitoring
- management techniques that be employed to protect the GDEs from potential impact
- triggers and thresholds that related to the implementation of management techniques
- further assessments required during the early stages of implementing this GDEMP prior to the predicted drawdown impacts of mining.

1.4 Implementation and Review

1.4.1 Implementation

It is recommended that monitoring of the parameters identified in this plan commence as soon as practicable to confirm baseline conditions and support on going refinement of the GDEMP.

This initial revision of the GDEMP identifies the principles that underpin management techniques and the objectives of those management techniques. However, further study is required in the detailed design of these management techniques; this should occur as part of the initial implementation of the GDEMP.

1.4.2 Review

It is recommended that this GDEMP is subject to annual review covering:

- The correlation between monitored parameters and observed vegetation health (prior to impact dewatering). This stage of review will ensure the monitored parameters reflect baseline conditions in the GDE.
- The correlation between triggers, thresholds and management intervention and observed vegetation health (during dewatering). This stage of review will ensure the efficacy of the plan in protecting the GDE.

1.4.3 Duration

It is recommended that this management plan is implemented and reviewed until mining is complete and the groundwater levels have returned to a natural range of variation.

2 MONITORING & EVALUATION FRAMEWORK

2.1 Adaptive Management

Monitoring and evaluation for 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 and 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 pressures or threats to the vegetation (pressure or change-risk);
- Understand the current state of vegetation that may be affected by modified groundwater levels resulting from mine dewatering and reinjection activities (State);
- 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, and that are not apparent in the reference area(s)), as described in Section 8.1 (Response).

These elements collectively comprise the Pressure-State-Response model used when applying an adaptive management approach for protecting environmental values in natural areas. This provides a framework for planning and implementing environmental management actions.

2.2 Leading and Lagging indicators

The monitoring framework will comprise leading and lagging indicators:

- Leading indicators will identify changes to the hydrological conditions that may ultimately manifest as vegetation stress. The leading indicators will allow pre-emptive intervention.
- Lagging indicators will allow verification of the success of management interventions and provide redundancy in the identification of change-risks.

3 EXISTING ENVIRONMENT

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 10 km, respectively to the north-east of the study area.

In the Yalyalup area, the long-term average annual rainfall (1998-2020) is 680 mm, with rainfall being greatest during the winter months (May to September). Conversely, monthly annual pan evaporation data for Busselton shows that evaporation is lowest during the months of May to August and highest during the dry summer months, with a mean pan evaporation of about 1,220 mm.

Long-term rainfall and pan evaporation data are shown in Figure 3 and summarised in Table 3.1.

Table 3.1: Annual Average Rainfall and Evapotranspiration

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Rainfall (1998-2020) Busselton Aero	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
Long-term average Pan Evaporation (Busselton)	189	160	133	78	53	42	47	56	69	99	129	164	1219

All units 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 to 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 **Error! Reference source not found.**.

Table 3.2: 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 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 provides an assessment of the actual annual average evapotranspiration across the catchment.

3.2 Vegetation

Ecoedge (2020) have identified three groundwater dependent ecosystems (GDEs) as occurring within the Yalyalup Development Envelope (YDE). Vegetation Unit A2 is a woodland of *Corymbia calophylla* (sometimes with *Eucalyptus marginata* or *E. rudis*) with scattered *Melaleuca preissiana* or *Banksia littoralis* over an open shrubland. The occurrence of Vegetation Unit A2 along McGibbon Track is inferred to be part of SWAFCT02 (Southern wet shrublands) and is listed as an 'Endangered' Threatened Ecological Community (TEC) by DBCA.

Vegetation Unit B1 is a tall shrubland of *Acacia saligna*, *Banksia squarrosa* subsp. *argillacea*, *Calothamnus quadrifidus* subsp. *teretifolius* and *Kunzea micrantha* (with scattered emergent *Eucalyptus rudis*) over scattered native herbs. It occurs in stands adjacent to vegetation unit A2 on McGibbon Track and on Princefield Rd just outside the YDE, and is inferred to be a part of SWAFCT10b (Shrublands on southern Swan Coastal Plain Ironstones (Busselton Area)). SWAFCT10b is listed as a 'Critically Endangered' TEC by DBCA and as 'Endangered' under the EPBC Act.

Vegetation Unit C3 is a tall open shrubland that may include *Acacia saligna*, *Jacksonia furcellata*, *Kingia australis*, *Melaleuca osullivanii*, *M. preissiana*, *M. viminea* and *Xanthorrhoea preissii* on seasonally wet grey-brown sandy loams. A degraded stand occurs along Princefield Rd and is likely part of SWAFCT09 (Dense shrublands on clay flats), listed as 'Vulnerable' by DBCA and 'Critically Endangered' under the EPBC Act. However, the condition of this stand is too degraded to be confidently inferred as an example of this TEC.

The occurrence of Vegetation Unit A1 on McGibbon Track is inferred to be part of SWAFCT01b (Southern *Corymbia calophylla* woodlands on heavy soils) and is not considered a GDE. However, it does support phreatophytic tree species. Four obligate phreatophytic tree species and four significant phreatophytic shrubs or herb species have been recorded within or near to the YDE:

- *Melaleuca rhaphiophylla* (Swamp paperbark) is an obligate phreatophyte that occupies habitats between low and high watermarks along rivers and streams, and fringes of wetlands. It can tolerate flooding or waterlogging for extended periods throughout the year. This species has only been recorded in completely degraded stands and paddocks within the YDE.
- *Eucalyptus rudis* (Flooded gum) occupies habitats similar to *Melaleuca rhaphiophylla*, but will tolerate flooding for shorter periods and avoids permanent waterlogged sites. It occurs in Vegetation Units A2 and B1.
- *Melaleuca preissiana* (Modong) occupies sites above high watermark in riparian vegetation and in winter-wet habitats. It does not tolerate soils that are waterlogged for extended periods and was recorded in Vegetation Units A1 and A2.
- *Banksia littoralis* (Swamp banksia) occurs in habitats with perennially high water availability. Within the YDE, it was recorded in Vegetation Unit A2.
- *Banksia squarrosa subsp. argillacea* (Whicher Range Dryandra) occurs in Vegetation Unit B1. It is listed as 'Vulnerable' by DBCA and 'Endangered' under the EPBC Act. Nine plants have recorded by Ecoedge (2020), which is a decline from the 14 plants recorded in the Interim Recovery Plan for the species (DBCA 2004).
- *Verticordia plumosa* subsp. *vassensis* (Vasse Featherflower) occurs in the Princefield Rd reserve in an occurrence of Vegetation Unit B1. It is listed as 'Endangered' by both the DBCA and under the EPBC Act. The population was estimated by Ecoedge to be around 30 plants, compared to the estimated 200 plants in 1996 and 100+ plants in 2006 (Ecoedge (2020).
- *Calothamnus quadrifidus* subsp. *teretifolius* (P4) occurs in Vegetation Unit B1 along McGibbon Track, where 70 plants have been recorded. It has also been recorded outside the YDE.
- *Loxocarya magna* (P3) also occurs in Vegetation Unit B1, where 32 plants were recorded by Ecoedge (2020).

3.3 Vadose Zone

3.3.1 Physical Characteristics of the Alluvium

The particle-size distribution (PSD) of the alluvium is the principal control on its hydraulic properties. In particular, the PSD controls the matric-pressure / moisture-retention relationship that affects tree-water use from the vadose zone. The PSD was analysed from 1090 bores across the project area. Soil samples were collected at each bore at 1 m increments and the analysis was undertaken for the top 3 m of soil (i.e. the material that forms the bulk of the vadose zone and shallowest aquifer). Six material types have been identified in the geological logging:

- Clay
- Sandy Clay
- Clayey Sand
- Silty Sand
- Sand
- Ironstone / Laterite

The PSD of samples that are predominantly ironstone (laterite) are not summarised in the table nor are they included for further analysis because the PSD of a disturbed sample is not representative of the in-situ characteristics of this material. Details of the granular materials are provided in Table 3.3.

Table 3.3: Summary of Particle Size Distribution

Sample / Site	% Passing				Total Fines
	Clay	*Silt*	*Sand*	*Gravel*	
Clay	26%	6%	51%	17%	83%
Sand	2%	11%	81%	6%	94%
Sandy Clay	19%	8%	60%	13%	87%
Clayey Sand	12%	8%	74%	6%	94%
Silty Sand	4%	15%	75%	6%	94%

Total fines = proportion of total sample mass that is clay, silt and sand

The samples are poorly sorted (i.e. comprise a range in particle sizes). All samples have a significant sand component ranging between 50% for the finest graded samples to 81% for the coarsest graded samples. Thus, regardless of the distinction made in the geological logging between clay and sand units (which was undertaken from a mineral perspective), all samples can be considered sandy and have hydraulic properties that are influenced by this substantial sand component.

3.3.2 Unsaturated Zone Hydraulic Properties

Unsaturated hydraulic properties of the alluvium have been estimated from the PSD analysis using a methodology developed by the USDA (Saxton and Rawls, 2006). The results are summarised in Table 3.4.

The specific yield of the alluvium ranges between 24% and 36% with an average value of 29%. The porosity of the sands has an average value of 38%. As the sand becomes unsaturated, some moisture is retained in the pore-space where it is held under a negative pressure (or tension). At –33 kPa, the pressure at which gravity drainage ceases, and the field capacity (i.e. the specific

moisture content at this pressure) is estimated to be around 8%. It is estimated that when matric pressure is -2,500 kPa and close to the point at which the trees lose turgor (i.e. the pressure at which hydraulic failure in the tree may occur), the moisture content will be less than 1%.

In summary, this means:

- Infiltrating rainwater will start to move through the profile when the moisture content exceeds 8% (i.e. a relatively low moisture content that means water will move through the profile readily).
- After a rainfall event, when gravity drainage of the soil profile stops, there will only be 8% moisture content within the vadose zone as plant available water.
- The moisture release curve for the sands is likely to be rapid with very little moisture (i.e. plant available water) remaining as the vadose zone dries and the matric pressure becomes significantly negative.

It is unlikely the transpiration flux associated with the observed vegetation communities would be supported by the moisture available in the vadose-zone alone (i.e. without groundwater use).

The saturated horizontal hydraulic conductivity ranges between 1 and 5 m/d. Percolation through the vadose zone will decline very quickly once the alluvium starts to dry and moisture content and matric pressure decrease; at -30 kPa (the matric pressure at which gravity drainage will stop), the hydraulic conductivity is 1×10^{-5} m/d; this reflects the relatively low moisture content at field capacity.

The estimated capillary fringe is small and ranges between 0 cm and 20 cm. This means there will be very little capillary rise and tree roots will be very close and sensitive to groundwater levels (where the trees rely on groundwater as a component water-source).

Table 3.4: Hydraulic Properties of the Sandy Vadose Zone at Yalyalup

Sample	Moisture Content			Water Yields and Availablity			Water Movement			
	Porosity (0 kPa) (%)	Field Capacity (-30 kPa) (%)	M. raph. limit (-2500 kPa) (%)	Specific Yield (%)	Vadose Yield (to -2500 kPa) (%)	Total Tree-Available Water (%)	Capillary Fringe (cm)	Hydraulic Conductivity (m/d) - Saturated	Hydraulic Conductivity (m/d) - Unsaturated @ -30 kPa	Hydraulic Conductivity (m/d) - Unsaturated @ -200 kPa
Clay	34.1	10.0	0.7	24.1	9.3	33.4	22.7	1.8	7.3E-04	7.0E-07
Sand	39.8	5.1	0.1	34.8	5.0	39.7	0.5	5.2	1.1E-04	2.2E-08
Sandy Clay	41.3	5.4	0.3	35.9	5.1	41.0	0.5	4.3	2.4E-05	1.6E-08
Clayey Sand	37.2	12.4	6.4	24.8	6.0	30.9	7.2	0.9	2.2E-08	2.6E-10
Silty Sand	38.5	7.7	1.5	30.7	6.2	37.0	4.2	2.2	3.8E-06	1.3E-08
Geometric Mean	**38.0**	**7.6**	**0.6**	**29.4**	**6.1**	**36.0**	**2.5**	**2.5**	1.4E-05	**1.6E-08**

Moisture content % vol/vol
Tree Water Availablility = water release between fully-saturated conditions to turgor loss (~-2500 kPa), % vol/vol
Parameters derived from PSD analysis using Saxton Rawls (2006) methodology

3.4 Groundwater

3.4.1 Hydrogeology

The hydrogeology of the Yalyalup project area has been documented in detail in the Hydrogeological Assessment report (AQ2, 2019). The Yalyalup project is wholly 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 Yalyalup project (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 9 m in the study area. The permeability of the superficial aquifer is variable and depends on sediment type, with saturated sands having higher permeability than clays. At the project, 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 mean 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 levels in the superficial aquifer across the site slope in a north-westerly direction under a low hydraulic gradient, which closely reflects the site topography. The groundwater flow direction is generally towards the coast.

The pre-mining water table elevations, as measured in the Superficial monitoring bores (both Doral's monitoring bores, other private users and DWER monitoring bores) across the site, are close to surface in a range of between 15.6 and 34.8 mAHD (i.e. depths to water of between 0 and 4.7 mbgl). In the project area, low-lying areas are often waterlogged during winter (i.e. the water table rises to ground surface). Although very long term annual rainfall indicates a drying climate, rainfall and subsequently aquifer recharge experienced in recent years is still sufficient to fill the Superficial aquifer and a long-term trend of decline in water levels due to change in climate is not observed in the project area.

The groundwater level hydrograph (Figure 4) for selected monitoring bores close to the McGibbon Track, indicates the following:

- Pre-mining depth to water in the Superficial aquifer in McGibbon Track area ranged between 0 to 3.45 mbgl (generally, between 0 and 2.5 mbgl along the McGibbon Track);
- 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;
- The seasonal water level variations were between 1.4 and 2.6 m, with general seasonal variations of 1.2 to 1.9 m along the McGibbon Track;
- The depth to water in summer ranges between 1.5 to 2.1 mbgl, while in winter ranges between 0 to 0.7 mbgl;
- Variations in depth to water can be generally correlated with variations in rainfall, with the minimum depth to water fluctuating greatly 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 *Melaleuca rhaphiophylla*, *Eucalyptus rudis*, *Melaleuca preissiana* and *Banksia littoralis.* Mid-storey vegetation also includes *Banksia squarrosa subsp. Argillacea* and *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; "A2-type communities" are associated with shallow groundwater and sandy soil 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. The root systems will not tolerate permanent saturation (as oxygen-stress and root die-back occurs) and thus are likely to occur in the zone that is saturated for only a few months a year. The root system is also likely to develop where connection is retained with the capillary fringe (as the communities comprise obligate phreatophytes); this would mean they will remain within less than 0.5 m 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 Gnangara 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 2.4 m depth to groundwater (DGW), with mesophyte abundance highest between 2.5 and 5 m. This is consistent with the observed distribution in the YDE of Vegetation Units A2 and B1, which are dominated by hydrophytes, in habitats where the DGW varies from approximately 1.3 m in winter to 2.2 m 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 *et al*. 2001) as it has a higher vulnerability to xylem cavitation than congeneric species (Canham *et al.* 2008). Stands with *Melaleuca rhaphiophylla* and/or *Eucalyptus rudis* may be able to withstand periods of waterlogging but be sensitive to falls in the water table. Although *Melaleuca preissiana* is an obligate phreatophyte, it is likely to be sensitive to permanent decreases in DGW.

The vegetation units within the YDE are likely to be sensitive to significant or rapid changes in DGW. Vegetation Unit A1 contains trees of *Melaleuca preissiana* and Vegetation Unit A2 contains *Melaleuca preissiana*, *Banksia littoralis* as well as *Hakea ceratophylla.* Both vegetation types therefore may be sensitive to decreases as well as increases in DGW. Vegetation Unit B1 overlies the shallow ironstones and contains *Eucalyptus rudis, Banksia squarrosa* subsp. *argillacea*, *Calothamnus quadrifidus* subsp. *teretifolius* and *Loxocarya magna.* A significant increase in DGW may result in a decline in vegetation condition or a decline in the health of plants, including the loss of individuals.

Interim Recovery Plans have been developed for both SWAFCT10b (Vegetation Unit B1) and *Banksia squarrosa* subsp. *argillacea* (DEC 2004, 2005). The key regional threats to SWAFCT10b include dieback, clearing, frequent fire, weed invasion and potentially salinisation and waterlogging. The major regional threats to *Banksia squarrosa* subsp. *argillacea* include clearing, dieback, track maintenance, inappropriate fire regimes, weed invasion and hydrological changes.

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 0.25 m;
- Rate of groundwater level drawdown (outside of the natural range) at more than 0.1 m per year.

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 at Yalyalup, several model outputs have been prepared by AQ2 as part of the Hydrogeological Assessment (refer to figures 75 to 103 in AQ2, 2019). 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. In this way the dewatering rates and drawdowns were predicted over a range of climatic conditions (i.e. extended periods of below and above average rainfall). In terms of 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 Yalyalup 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 10.5 m predicted after mining Q2 of 2023, with the 0.1 m drawdown contour falling only marginally outside of the proposed mining disturbance envelop. 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. 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 18 months of mine closure for both dry and wet climatic scenarios.

4.1.3 Predicted Maximum Water Level Drawdowns along the McGibbon Track

The drawdowns at McGibbon Track are predicted to be evident from Q1 of 2023 (i.e. 18 months since the planned mining commences), and continued to occur until the mining ceases in Q4 of 2024. The magnitude of drawdowns along McGibbon Track vary depending on the proximity of the active mining quarter and the total depth mined to the track are summarized in Table 4.1.

Table 4.1: Summary of Predicted Drawdowns Along McGibbon Track Over the Mine Life

Mining Quarter (Q)	Predicted Drawdown (m) McGibbon Track – Northern Part (vegetation communities A2)	Predicted Drawdown (m) McGibbon Track – Central Part (vegetation communities B1)
Q1_2023	<0.3	0
Q2_2023	<0.25	0
Q3_2023	0.5-5	0.1-0.3
Q4_2023	0.5-3	0.1-0.5
Q1_2024	0.5-2	0.1-0.5
Q2_2024	0.5-1	0.15-0.5
Q3_2024	1-4	0.25-1.5
Q4_2024	0.75-1.5	0.25-1.5

Additionally, four notional monitoring points have been set along McGibbon Track (Figure 5) to obtain the information on the changes of the predicted water level drawdowns during the life of mine operation and during closure. The predicted drawdowns over time along McGibbon Track is presented in Figure 6.

At the northern part of the McGibbon Track, where the vegetation communities A2 has been identified, the maximum water level drawdowns are predicted after mining Q3 of 2023 and are 4 to 5 m (Figure 7). The predicted drawdowns at the central part of the track, where the vegetation communities B1 has been identified are 0.3 m or less.

At the central part of McGibbon Track (the vegetation communities B1), the maximum water level drawdowns are predicted after mining Q3 of 2024 and are between 0.25 and 1.5 m (Figure 8). During mining this quarter, the predicted drawdowns at the northern part of the track (vegetation communities A2) are between 1 and 4 m.

The key points are:

- First water level changes at McGibbon Track are predicted to occur after 18 months since mining commences.
- Areas of >0.25 m water level change are predicted to affect approximately 60% of McGibbon Track GDE.
- Areas of >0.25 m water level change are predicted to affect vegetation communities A2 and B1, with the communities A2 north of McGibbon Track being the most effected and the longest.
- Hydrograph shows rapid rate of water level change of up to 1.5 m/month during mining.

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 to the vegetation. In the absence of management intervention, the following impacts may occur:

- Complete or partial loss of phreatophytic 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). The water regime is defined by both total plant-available-water and plant water sources. Typically, GDE's obtain a significant portion of total plant available water from the vadose zone and root systems are configured to exploit water from both 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 is occurring, 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 not active). The systems may use more water from the vadose zone.
- During summer when the vadose zone is drier and groundwater levels recede, the deepest parts of the root system will be in close proximity 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 that is close enough to natural conditions so as not to result in reconfiguration or truncation of the root systems.

5.2 Management Techniques – Key Success Indicators

Given the identified threats to the vegetation units and conservation-coded species within the YDE, it is the overall objective of the management plan 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 respective Interim Recovery Plans (IRPs) for *Banksia squarrosa* subsp. *argillacea* and Southern Swan Coastal Plain Ironstone Association (Busselton Area) (DBCA 2004, 2005, respectively).

For *Banksia squarrosa* subsp. *argillacea,* the objective of the IRP is to maintain or enhance *in situ* populations. A loss of ten percent of individuals within any population or the number of populations would be considered a failure of the plan. Therefore, the aim of this management plan with regard to *Banksia squarrosa* subsp. *argillacea* is no net loss of individuals within Vegetation Unit B1.

Verticordia plumosa subsp. vassensis does not have an IRP in place for the taxon and so the same aims will be adopted for the population in the Princefield Rd reserve.

For the Southern Swan Coastal Plain Ironstone Association (Busselton Area), 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 criteria of failure 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 the Southern Swan Coastal Plain Ironstone Association (Busselton Area) 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 within the YDE 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 be an indication of 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 supplementation of water to offset groundwater level drawdown beneath the GDEs will be the key management technique. The following are relevant to the supplementation technique:

- The vadose zone moisture cycle is related to rainfall recharge and should be unaffected by changes in groundwater level.
- Management will focus on preservation of groundwater availability within the root zone of the GDE community.

Techniques for sub-surface supplementation will be based on supplementing water to the aquifer with materially affecting the vadose zone. Techniques will include an optimal combination of:

- Infiltration from trenches excavated parallel to and in proximity (i.e. either side) of McGibbon Track.
- Infiltration from subsurface field drains laid in trenches excavated parallel to and in proximity (i.e. either side) of McGibbon Track. This option may be beneficial over trenches in avoiding ground stability and trafficability issues.
- Lines of shallow spearpoints parallel to and in proximity of McGibbon Track.

It is envisaged that surface irrigation would be used either only periodically or in the event urgent intervention is required.

5.4 Detailed Design of Management Techniques

The existing groundwater model should be used to estimate infiltration volumes that are required to offset drawdown in areas of the GDE that are predicted to suffer a groundwater level decline of more than 0.25 m below normal autumn level or at a rate that exceeds 0.1 m/yr.

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

Once the volume of water required has been determined, the most efficient method of delivering this water to the subsurface 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 outline above to deliver the required volumes of water to the subsurface.

6 MONITORING PROGRAM

6.1 Parameters

Monitoring will comprise a combination of hydrological parameters and quantitative and qualitative vegetation measurements, ecophysiological measurements and health assessments using qualitative criteria. The monitoring programme is summarised in Table 6.1 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; the bore locations are summarised in Table 6.2 and shown in Figure 9.

6.3 Vegetation Monitoring

To meet the objectives for botanical values within the YDE outlined in Section 5.2, monitoring will be undertaken of the status of the Threatened Flora populations, the use of groundwater by phreatophytic species within the respective GDEs on McGibbon Track, and the condition and diversity of the vegetation units along McGibbon Track.

Leaf Water Potential (LWP) monitoring

The species to be targeted for Leaf Water Potential (LWP) have been selected because they are common and representative of the canopy and mid-storey structural layers of the GDEs potentially at risk. It was considered that measurement and observation of the water status in these species would be representative of the overall communities' response to water deficit as a result of dewatering.

Monitored species within Vegetation Unit A2 will be:

1. *Acacia saligna*;
2. *Hakea ceratophylla*;
3. *Banksia littoralis* (tree)

Monitored species within Vegetation Unit B1 will be:

1. *Acacia saligna*;
2. *Calothamnus quadrifidus subsp. teretifolius*; and
3. *Eucalyptus rudis* (tree)

Vegetation Health Monitoring

The species selected for (Vegetation Units A2, B1) LWP monitoring will also be assessed for health monitoring using visual inspection and assessed using a scale based on that used by Lay and Meissner (1985) (Table 6.3). Photographs will also be taken of all the monitored trees and shrubs every three months, starting in Spring 2020.

Quarterly vegetation health monitoring of identified and tagged native tree and shrub species along McGibbon Track within monitoring plots (10mx10m) spaced at 100m within A2 (SWAFCT02), 50m within B1(SWAFCT10b) and 150m within A1 (SWAFCT01b), a total of 14, as shown in Figure 9 using

visual inspection and assessed against a scale based on Lay and Meissner (1985). Weed coverage of each quadrat to also be assessed quarterly as a % of cover.

Threatened Flora

Monitoring of Threatened taxa populations (*Banksia squarrosa* subsp. *argillacea* and *Verticordia plumosa* subsp. *vassensis*) will be undertaken using the health scores described in Table 6.2 as this approach will be non-invasive.

All (9) individuals of *Banksia squarrosa* subsp. *argillacea* will be tagged and monitored every three months.

Up to 10 individuals of *Verticordia plumosa* subsp. *vassensis* will be tagged and monitored every three months. It is noted that 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 ingress of weeds, only plants that can be assessed without degrading the vegetation stand be monitored.

Table 6.1: Monitoring Frequency

Monitoring Parameter	Period					Objectives / Remarks
	Baseline		Active Dewatering			
	Freq	Trigger	Freq	Trigger	Response	
Hydrological						
Groundwater Level	Monthly	n/a	Weekly	< Avg lowest level	Increased veg monitoring	Increased risk when GWLs fall below natural range
Rate of change			Weekly	> 1.5cm/wk	Supplementation	Managing rate of GWL change
Absolute change			Weekly	> 25cm	Supplementation	Managing absolute GWL change
Leaf Water Potential (LWP)						
Pre-dawn	Quarterly	n/a	Quarterly	< lowest baseline meas (~0.5Mpa)	Supplementation	Monitoring GDE Connection with GWL
Pre-dawn after GW level trigger (during dewatering)			Fortnightly	< lowest baseline meas (~0.5Mpa)	Supplementation	Targeted species of GDE wetland (A2 community) and Ironstone Species (B1 community)
Midday	Quarterly	n/a	Quarterly			
Midday after GW level trigger (during dewatering)			Fortnightly			Use in calculation of rehydration index
Rehydration Index	Quarterly	n/a	Quarterly	<0.4	Supplementation	Monitor tree water stress (RI = (MD – PD) / MD)
Rehydration Index after GW level trigger (during dewatering)			Fortnightly	<0.4	Supplementation	
Vegetation Health						
Targeted GDE and LWP species in Veg Units A2, B1	Quarterly	n/a	Quarterly	>2 place reduction in health score	Mgt review Supplementation	Verification of successful mgt
Targeted and tagged native species in quadrats	Quarterly	n/a	Quarterly	>2 place reduction in health score	Mgt review Supplementation	Verification of successful mgt
Weed coverage % in quadrats	Quarterly	n/a	Quarterly	>10% increase		

Table 6.2: GDE Monitoring Bore Locations

Bore ID	Easting (m)	Northing (m)	Depth to Base of Superficial Formation (mbgl)	Predicted Minimum Depth to Water (mbgl)	Predicted Maximum Depth to Water (mbgl)	Predicted Maximum Drawdown Q3_2023 (m)	Predicted Maximum Drawdown Q3_2024 (m)	Predicted Maximum Depth to Water During Mining (mbgl)	Status (Oct 2020)
GDE_A	358888	6271018	4.0	0.25-0.75	2.4	0.2	0.5	2.9	operational
GDE_B	358724	6271157	6.4	0.2-0.7	2.4	1.3	3.0	5.4	operational
GDE_C	358599	6271569	6.0	0.1-0.6	1.75	3.0	0.9	4.75	operational
GDE_D	359075	6270792	5.5	0.2-0.4	2.4	0.0	0.0	2.4	operational
GDE_E	359474	6271785	5.0	0.2	1.5	0.0	0.3	1.8	operational
YA_MB08S	358589	6271310	9.7	0.2-0.75	2.1	6.0	1.5	8.1	operational

Table 6.3: Visual Health Scale used in the Yalyalup Monitoring (After Lay & Meissner, 1985)

Score	Description
0	Dead shrub.
1	Shrub/Tree with <20% of 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)[1].
3	Shrub/Tree with 41-60% of the original canopy present; some smaller dead branches evident (21-40% canopy); moderate amount of leaf yellowing (21-40% 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.

6.4 Monitoring Frequency

The monitoring frequency is summarised in Table 6.1. Monitoring frequencies fall into two broad categories: baseline / pre-dewatering and during active dewatering.

6.4.1 Baseline / Pre-Dewatering

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

Vegetation health monitoring will occur quarterly. Baseline flora and vegetation monitoring will be conducted prior to the commencement of mining.

Baseline monitoring includes:

- Qualitative vegetation health assessments of trees (*Eucalyptus rudis*, *Melaleuca preissiana*, *Banksia littoralis*) along McGibbon Track following an adapted method from Souter *et al*. (2009) and Backstrom *et al*. (2010);
- Quantitative weed cover and qualitative native species cover/abundance assessments along McGibbon Track;
- Quantitative water status assessments using pre-dawn and midday leaf water potential measurements for selected species along McGibbon Track;
- Quantitative depth to groundwater measurements in GDEs.

6.4.2 During Periods of Drawdown

Groundwater levels will be monitored and reviewed at least weekly during periods of active dewatering in the vicinity of the McGibbon track.

Vegetation health monitoring will continue with quarterly monitoring until groundwater level triggers are exceeded. 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).

[1] Depending on the time of year, yellowing leaves may or may not be present. In summer and early autumn, almost all dead leaves may fall or be blown off the plant.

7 PROPOSED MANAGEMENT RESPONSE TRIGGERS & CONTINGENCY MEASURES

7.1 Rationale for Triggers

This management plan has been designed to include the following:

- Leading indicators of risk such that management intervention can pre-empt the development of vegetation water stress:
    - Hydrological triggers provide warning of the onset of a water regime that may cause water tress to develop.
    - Ecophysiological triggers within the vegetation community provide a direct measure of current water status.
- Lagging indicators designed to provide redundancy in risk identification and allow verification of success of management interventions.

Triggers have been designed around parameters that may be affected by mining-induced changes to the water regime (i.e. groundwater levels and associated plant hydration status). Soil moisture is not included as a monitoring parameter because it is influenced by infiltrating rainfall and this 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 commencement of dewatering in the vicinity of McGibbon Track 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 hydrological regime. This will trigger increased monitoring frequency of vegetation. With respect to groundwater levels:
    - If total groundwater level decline subsequently reaches 0.25 m below the average low annual measured water level (i.e. below the typical autumn groundwater level), then supplementation will be triggered.
    - If the rate of decline continues at more than 1.5 cm per week, then supplementation will be triggered.

7.3 Vegetation Triggers

7.3.1 Leading Indicator Triggers

Leaf water potential is the key parameter to quantify instantaneous tree water status. Leaf water potential measurements should include:

- Pre-dawn leaf water potential (which provides a proxy for water availability in the root zone and hydraulic connection with the water table). If the pre-dawn becomes more negative than the lowest level measured during the baseline monitoring period (and there is active dewatering and associated drawdown), then water supplementation will be required. The

actual pre-dawn threshold will be confirmed during the baseline period; it is likely to be -0.5 MPa or higher.

- Midday leaf water potential will be measured to provide an indication of transpiration water demand. The midday and pre-dawn leaf water potentials will be used in combination to determine rehydration. If the rehydration index falls below 0.4 (and there is active dewatering and associated drawdown), then water supplementation will be required.

The management response when leaf water potential triggers are exceeded will be water supplementation.

7.3.2 Lagging Indicator 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 change risk has not been identified by the monitoring network.

The vegetation health trigger will be:

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

For all trigger-exceedances, the management response will be that water supplementation is required.

7.4 Management Response

The management response comprises two tiers:

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

7.5 Supplementation

Exceedance of absolute or rate-of-change triggers in groundwater levels will require water supplementation.

Exceedance of vegetation health parameters or vegetation water status (as measured by pre-dawn LWP or rehydration index) will require supplementation to return groundwater levels to within the natural range within the area of the GDE.

Final design for the supplementation scheme will be completed during implementation of this GDEMP. Supplementation will be based on a combination of:

- Surface irrigation.
- Subsurface irrigation in proximity to the groundwater table through either trenches or shallow spear-points.

The supplementation scheme will have the following design criteria:

- To supply enough water to offset declines in groundwater levels (i.e. to maintain levels within the natural range under the GDEs along McGibbon Track. This will be determined using the existing groundwater model.
- To prevent sustained periods of excessive inundation of the vadose zone that may result in water logging or reconfiguration of the root systems within the GDEs. This will be achieved by the use of sub-surface supplementation.
- To be operationally effective and not subject to excessive clogging that may limit infiltration capacity. This will be assessed during engineering design of the scheme based on aquifer parameters derived during previous groundwater investigations.
- To incorporate a monitoring programme that can be used to confirm the efficacy of the supplementation system. This will be achieved by the monitoring programme outlined in this plan.
- To utilise water of sufficient quality so as not to result in acidification or dieback within the GDEs along McGibbon Track. In this regard, supplementation water will be sourced from the Yarragadee aquifer.

8 REFERENCES

AQ2 (2019). *Yalyalup Mineral Sands Project, Hydrogeological Assessment*, November 2019.

Backstrom, A., Jolly, K., and Bennetts, K. (2010). *The Living Murray Tree Condition Survey: Gunbower-Koondrook-Perricoota Forests: Final report*, July 2010. Australian Ecosystems Pty Ltd.

Canham, C.A., Froend, R.H. & Stock, W.D. (2008) *Water stress vulnerability of four Banksia species in contrasting ecohydrological habitats on the Gnangara Mound, Western Australia,* Plant, Cell & Environment, 32:64-72

Department of Conservation and Land Management (2004) *Whicher Range Dryandra (Dryandra squarrosa subsp. argillacea),* Interim Recovery Plan No. 177, Western Australian Threatened Species and Communities Unit, Wanneroo

Department of Conservation and Land Management (2005) *Shrubland Association on Southern Swan Coastal Plain Ironstone (Busselton Area) (Southern Ironstone Association) Recovery Plan*, Interim Recovery Plan No. 215, Western Australian Threatened Species And Communities Unit, Wanneroo

Ecoedge (2020) *Water Potential and Visual Health Monitoring at McGibbon Track in the Proposed Yalyalup Mineral Sands Mining Area: Preliminary Report,* Unpublished report for Doral Mineral Sands

Groom PK, Froend R, Mattiske EM, Gurner R (2001) *Long-term changes in vigour and distribution of Banksia and Melaleuca overstorey species on the Swan Coastal Plain*. Journal of the Royal Society of Western Australia 84, 63–69.

Lay, B.G. and Meissner, A.P. (1985). An objective method of assessing the performance of amenity plantings. J. Adelaide Botanical Garden. & (2): 159-166.

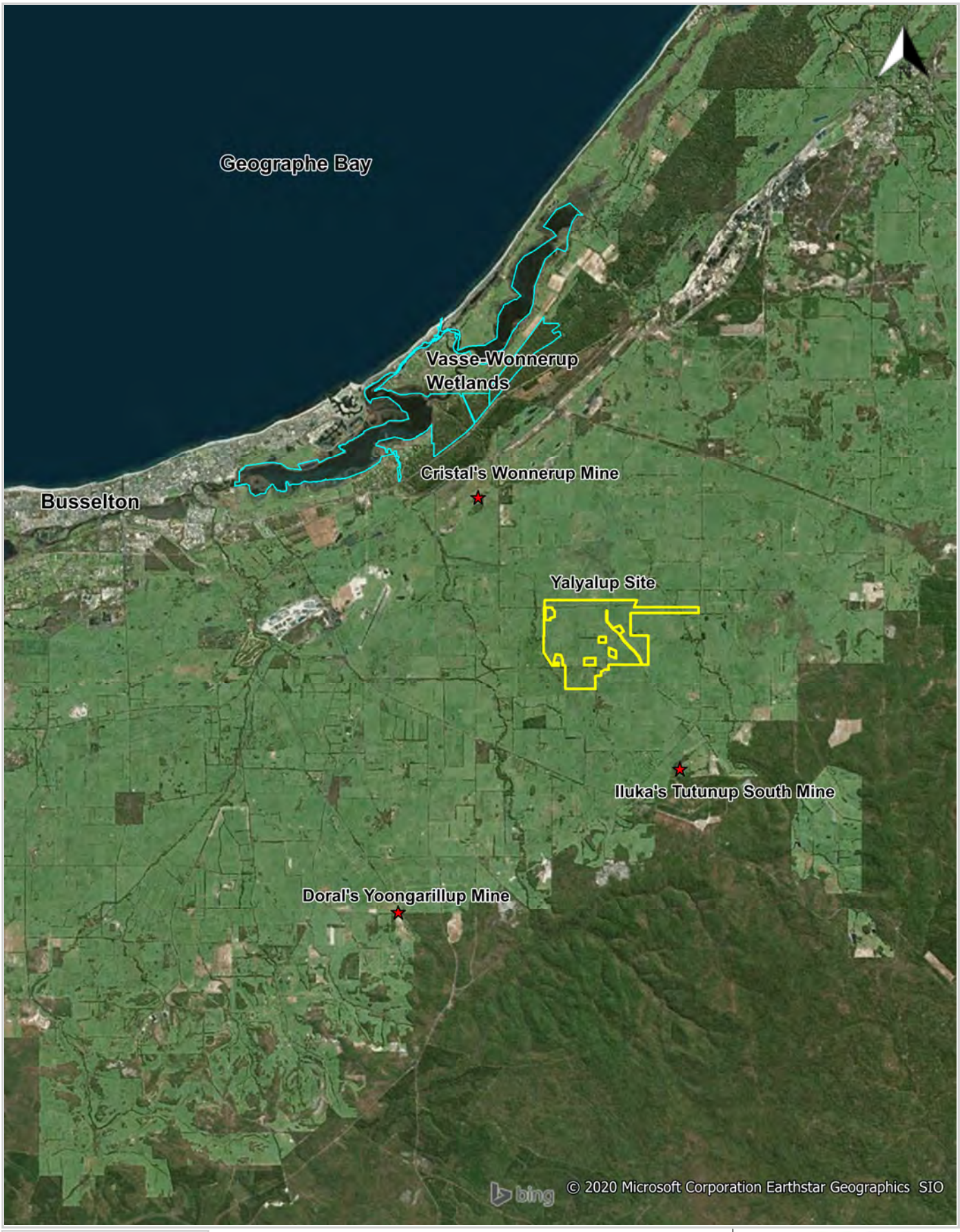
Loomes, R. , Wilson, J. & Froend, R. (2008) *2007 Vegetation Monitoring – Swan Coastal Plain (Bunbury, Busselton-Capel Groundwater Areas): A report to the DoW,* CEM report no. 2007-15, Centre for Ecosystem Management ECU Joondalup

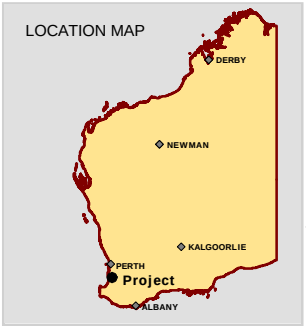
Sommer, B. & Froend, R. (2014) *Phreatophytic vegetation responses to groundwater depth in drying mediterranean-type landscape*, Journal of Vegetation Science, 25:1045-1055

Souter, N.J., Watts, R.A., White, M.G., George, A.K., McNicol, K.J. (2009). *Method manual for the visual assessment of lower River Murray floodplain trees. River Red Gum (Eucalyptus camaldulensis)*, DWLBC Report 2009/25, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

AQ2

FIGURES





Location: F:\136\4.GIS\Workspaces\

Legend

Proposed Yalyalup Distrubance Boundary

Scale

0 5

kilometres

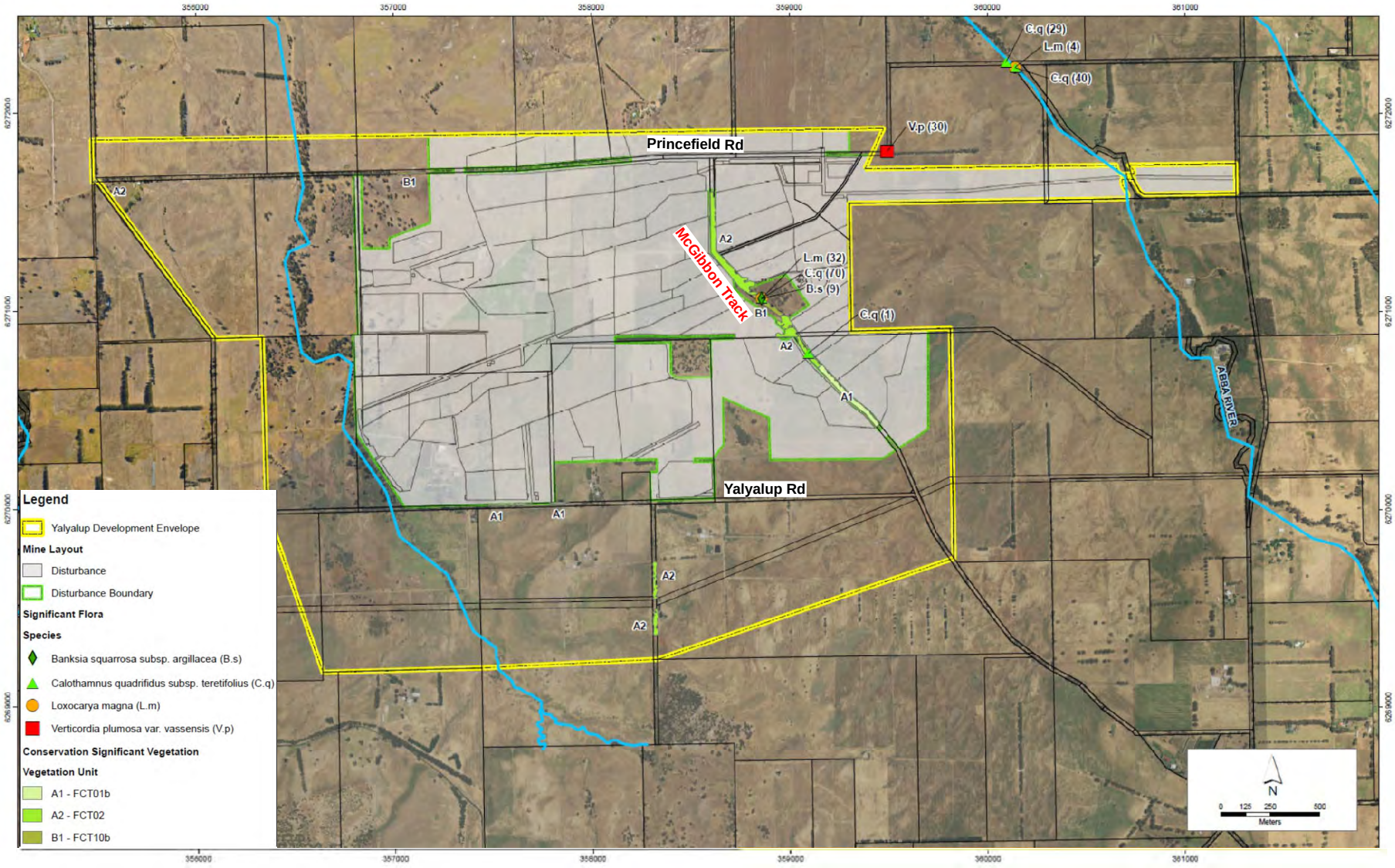
Scale 1:150,000

AUTHOR:	GC	REPORT NO:	022	**NOTES & DATA SOURCES:** Mine outlline provided by Doral
DRAWN:	GC	REVISION:	A	
DATE:	04/05/20	JOB NO:	136H	

AQ2

FIGURE 1

REGIONAL LOCATION OF THE YALYALUP MINERAL SANDS PROJECT



LOCATION MAP

AUTHOR: BK
DRAWN: BK
DATE: 12/5/20

REPORT NO: 022
REVISION: A
JOB NO: 136H

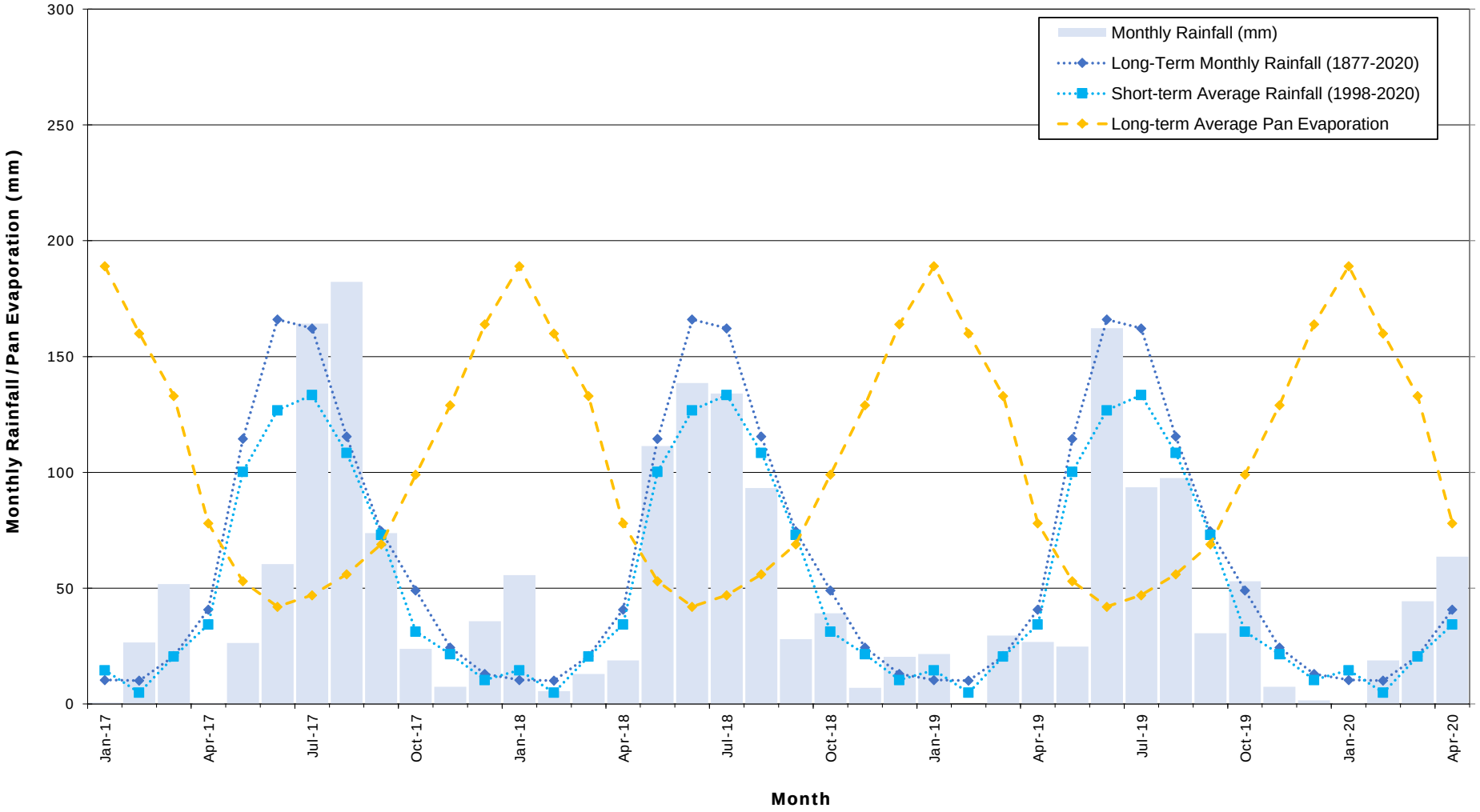
NOTES & DATA SOURCES:
Figure taken from Figure 4-3
Doral ERD, 2020

AQ2

FIGURE 2

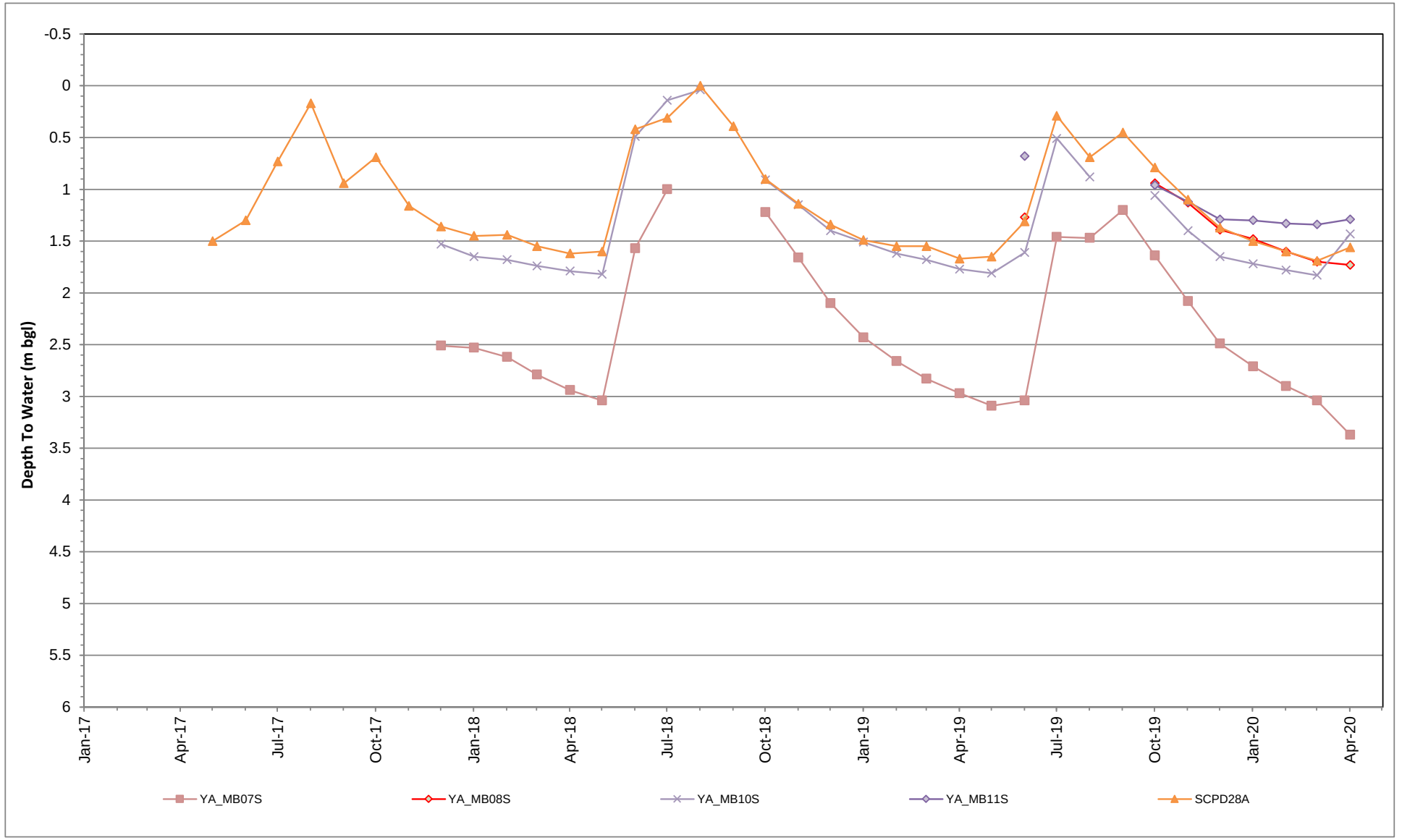
YALYALUP MINERAL SAND PROJECT

LOCATIONS OF GDES



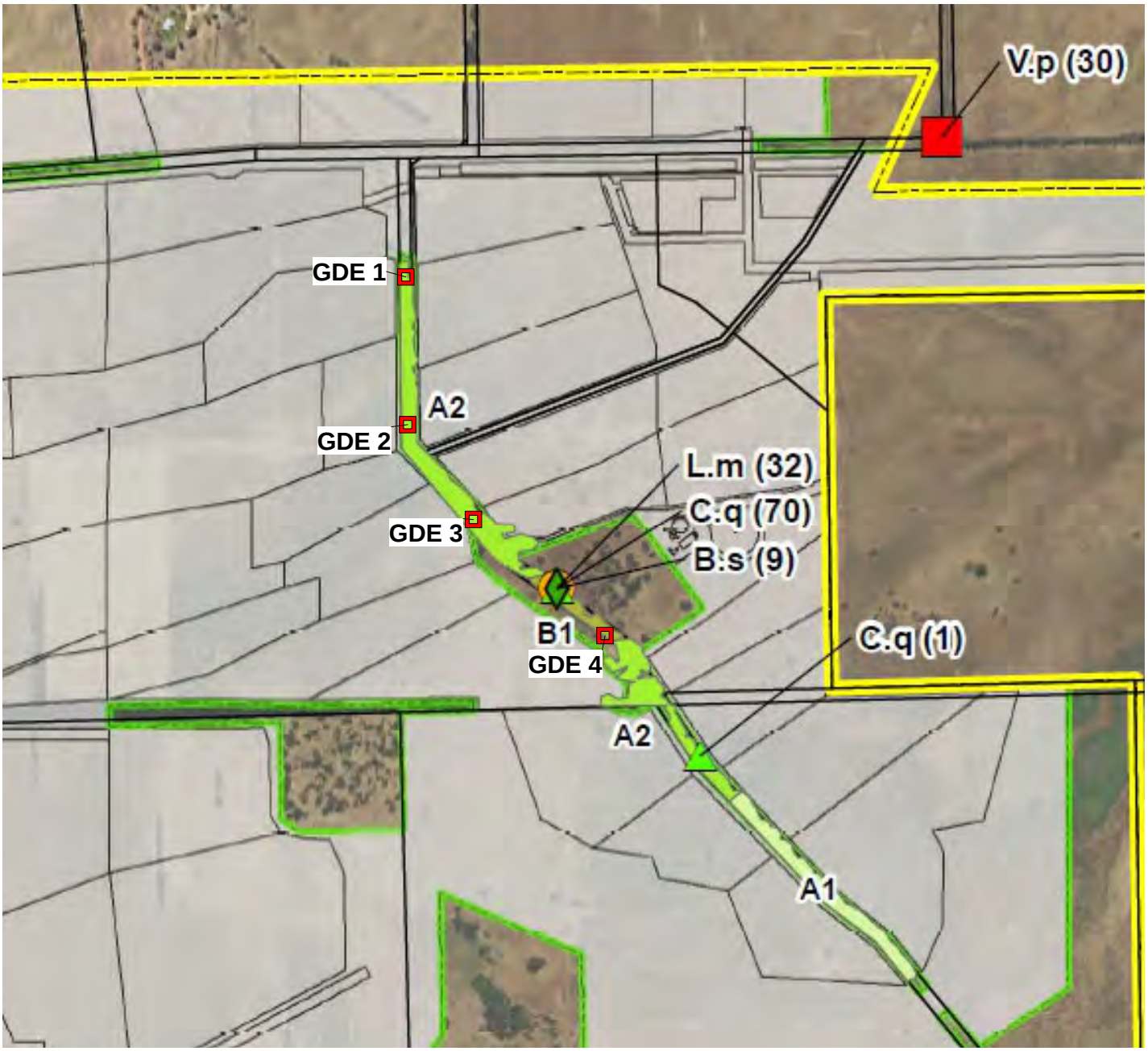
AQ2

BUSSELTON RAINFALL AND PAN EVAPORATION DATA - Figure 3



AQ2

Depth to Water (m bgl) in Superficial Aquifer in Selected Bores Adjacent to McGibbon Track FIGURE 4



LEGEND

- Monitoring Bore Location
- Notational GDE Monitoring Points
- Vegetation Unit A1
- Vegetation Unit A2
- Vegetation Unit B1

LOCATION MAP

0 500 1000 1500 2000

AUTHOR: BK
DRAWN: BK
DATE: 8/05/20

REPORT NO: 022
REVISION: A
JOB NO: 136H

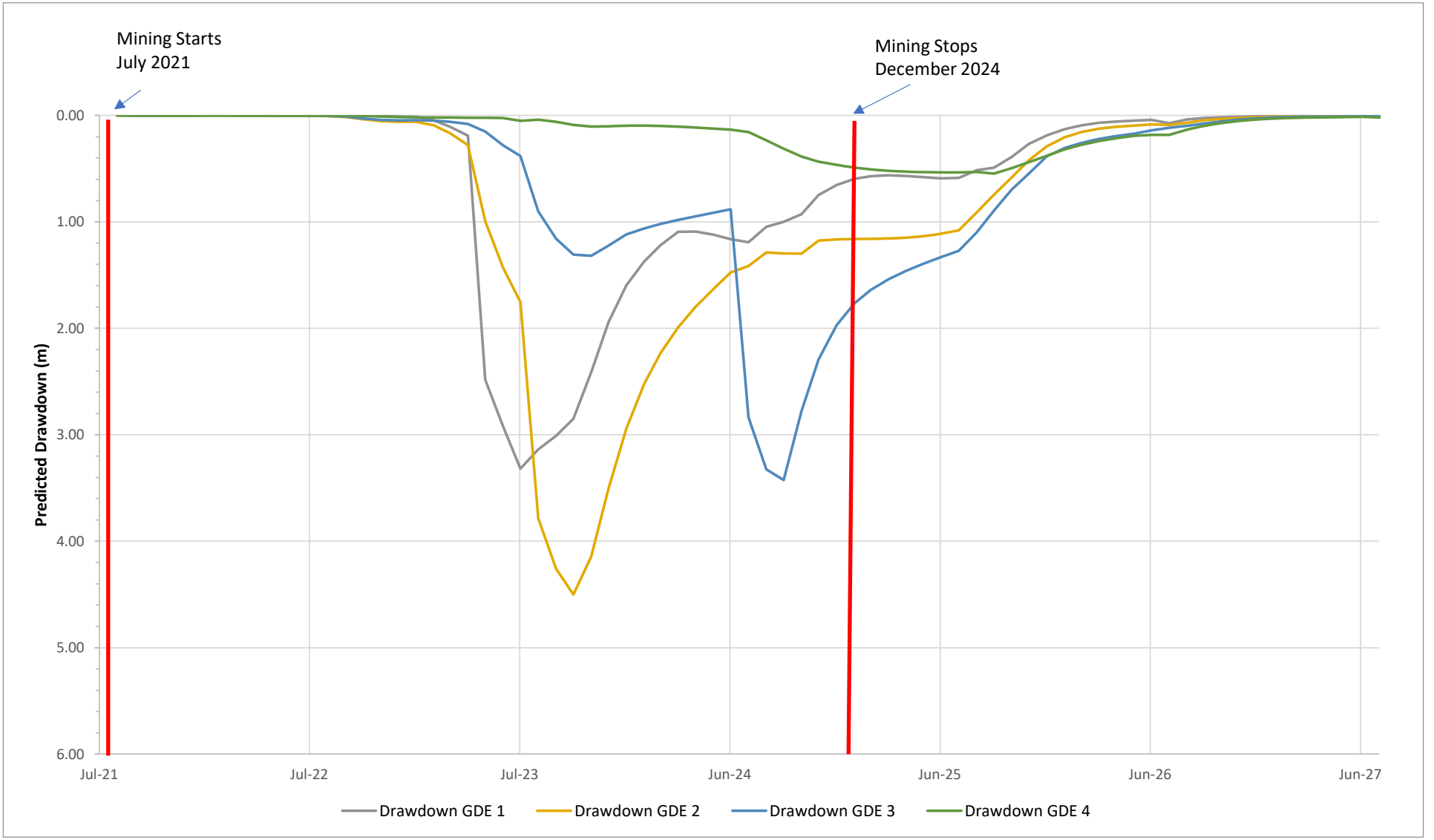
NOTES & DATA SOURCES:

AQ2

FIGURE 5

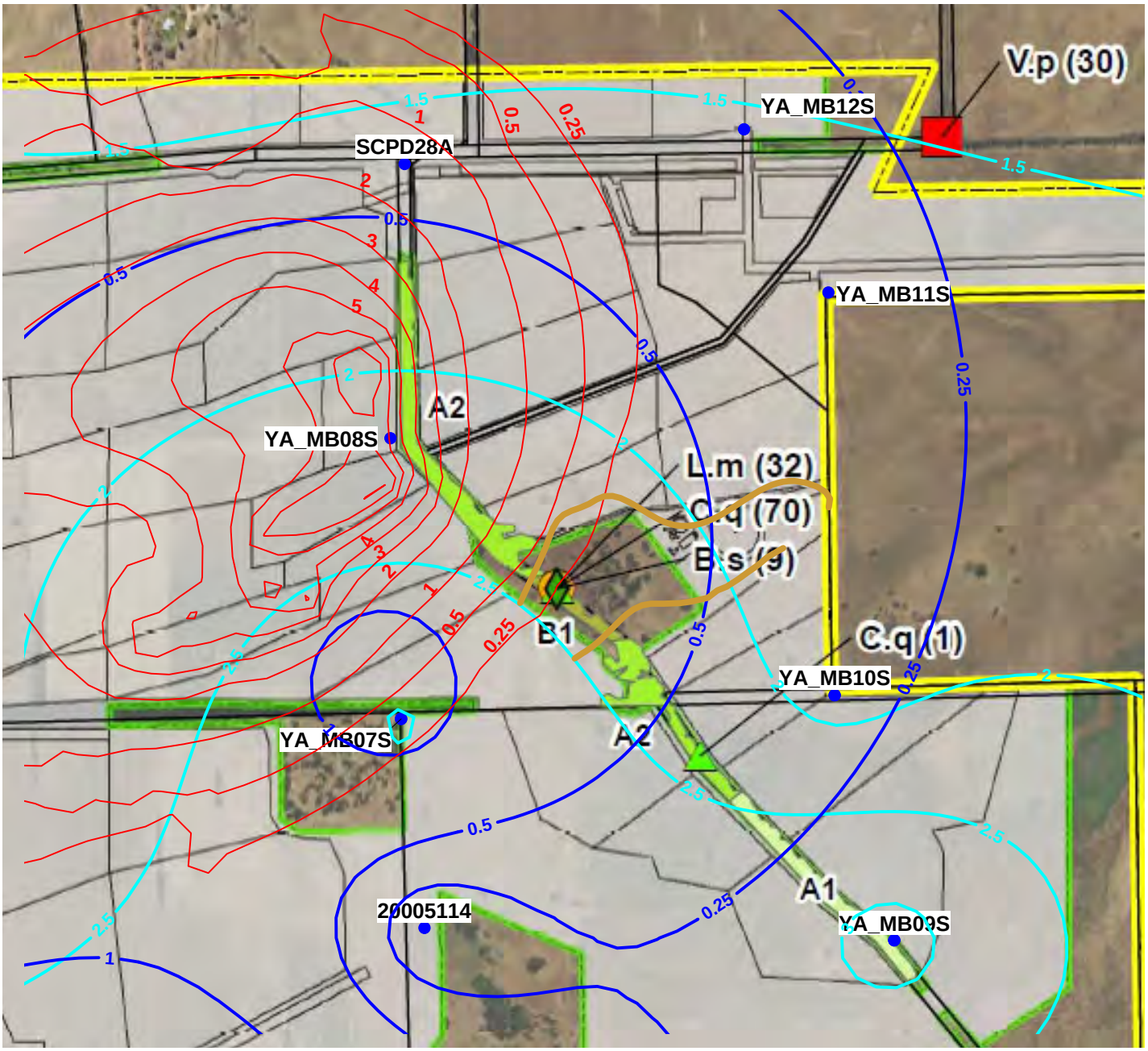
YALYALUP MINERAL SAND PROJECT

LOCATIONS OF NOTATIONAL MONITORING POINTS ALONG MCGIBBON TRACK



AQ2

Predicted Drawdown (m) in the Notational GDE Monitoring Points FIGURE 6



LEGEND

●	Monitoring Bore Location		Ironstone/Laterite Outcrop Extent
0.5	Minimum Depth to Water (mbgl)		Vegetation Unit A1
0.5	Maximum Depth to Water (mbgl)		Vegetation Unit A2
0.5	Drawdown Contours (m) (Q3_2023)		Vegetation Unit B1

LOCATION MAP

0 500 1000 1500 2000

AUTHOR: BK
DRAWN: BK
DATE: 8/05/20

REPORT NO: 022
REVISION: A
JOB NO: 136H

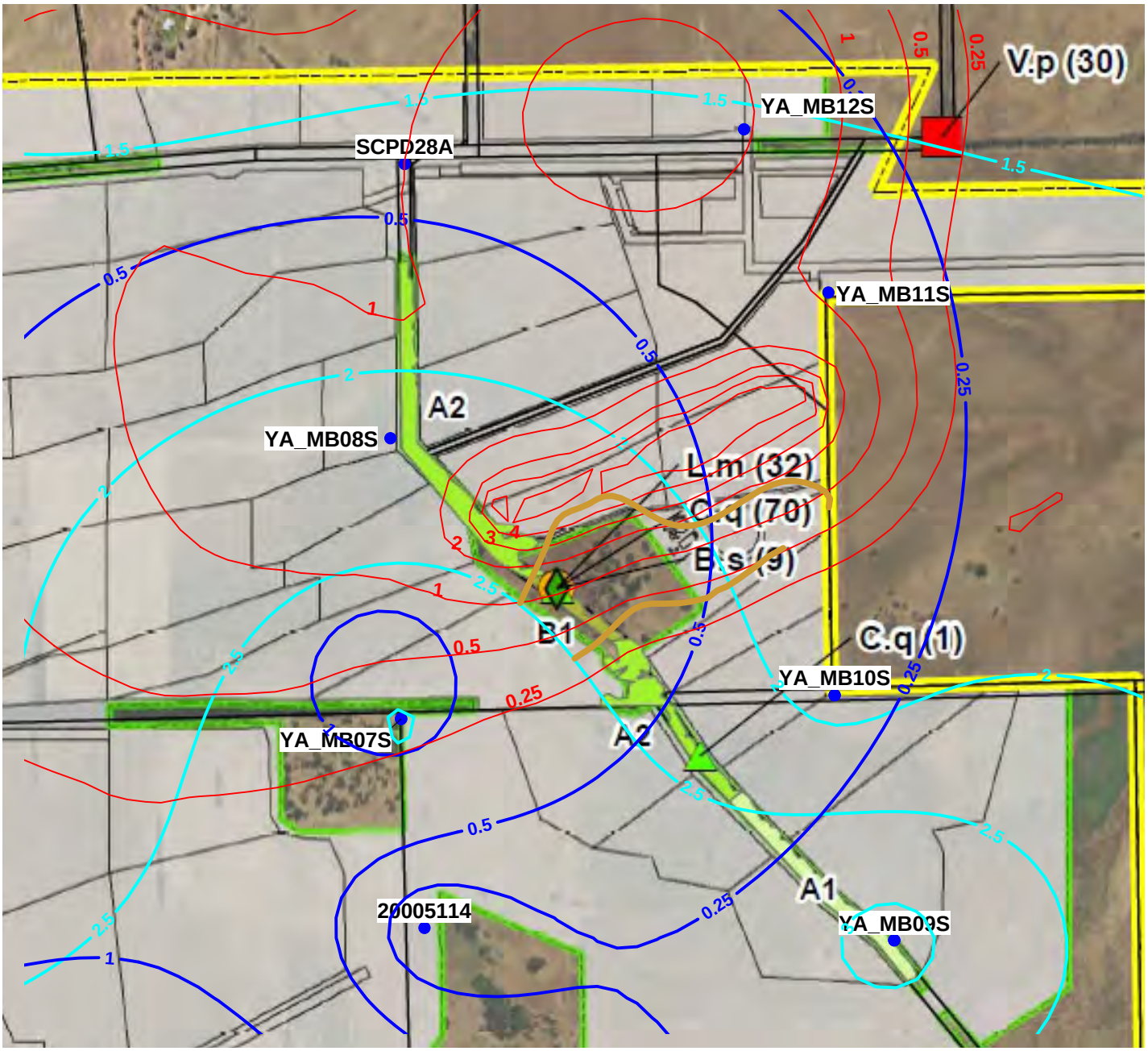
NOTES & DATA SOURCES:

AQ2

FIGURE 7

YALYALUP MINERAL SAND PROJECT

ECOHYDROGEOLOGICAL CONCEPTUAL MODEL WITH MAXIMUM PREDICTED DRAWDOWN FOR VEGETATION UNIT A2



LEGEND

- Monitoring Bore Location
- 0.5 — Minimum Depth to Water (mbgl)
- 0.5 — Maximum Depth to Water (mbgl)
- 0.5 — Drawdown Contours (m) (Q3_2024)
- Ironstone/Laterite Outcrop Extent
- Vegetation Unit A1
- Vegetation Unit A2
- Vegetation Unit B1

LOCATION MAP

0 500 1000 1500 2000

AUTHOR: BK
DRAWN: BK
DATE: 8/05/20

REPORT NO: 022
REVISION: A
JOB NO: 136H

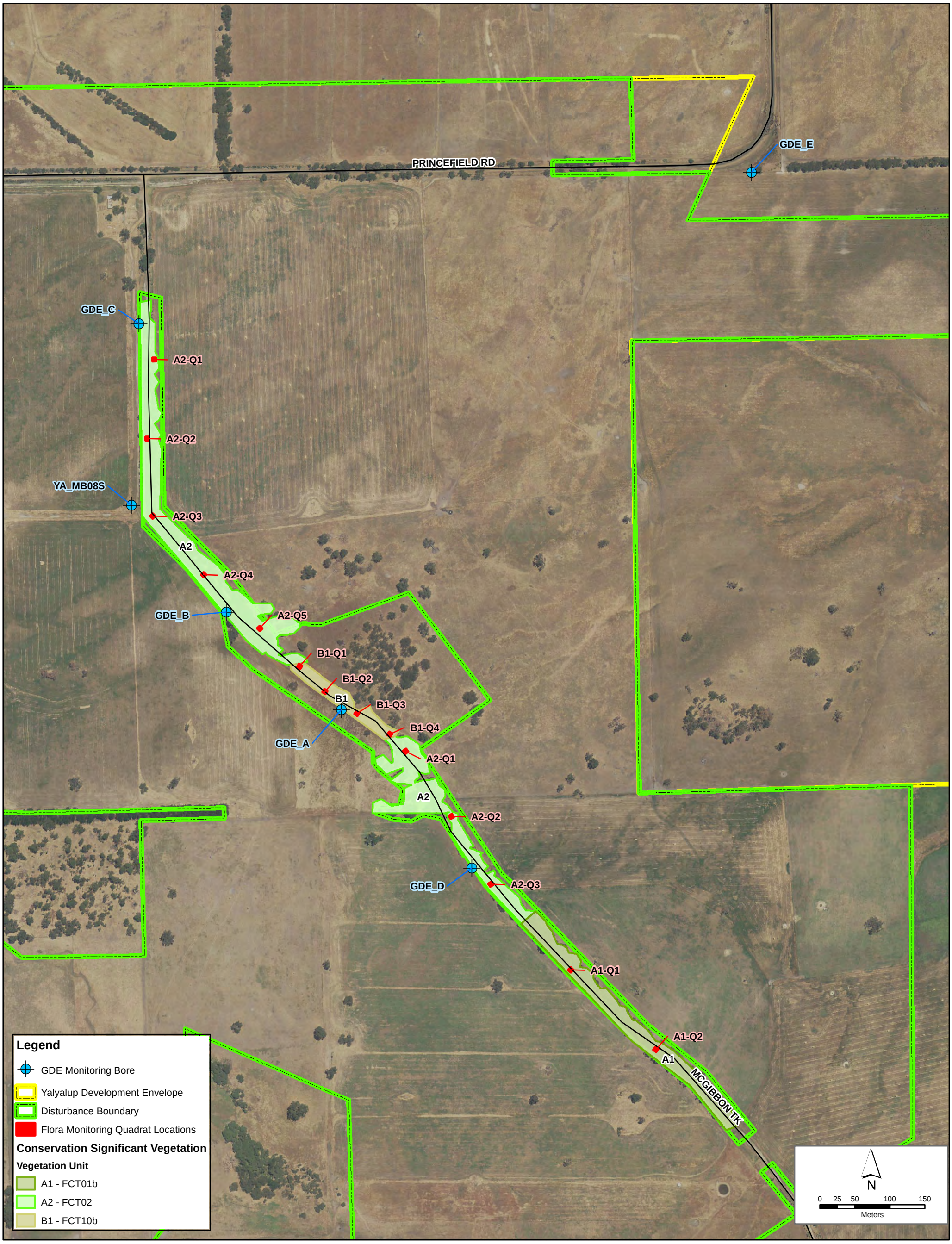
NOTES & DATA SOURCES:

AQ2

FIGURE 8

YALYALUP MINERAL SAND PROJECT

ECOHYDROGEOLOGICAL CONCEPTUAL MODEL WITH MAXIMUM PREDICTED DRAWDOWN FOR VEGETATION UNIT B1



Doral

Yalyalup Mineral Sands Project

Flora and Vegetation Management Plan
Monitoring Locations

Scale	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
1:5,000		
Figure: 8		Date: 14/10/2020

ATTACHMENT 2: SRE DESKTOP ASSESSMENT

PHOENIX
ENVIRONMENTAL SCIENCES

Short-range endemic desktop review for the Yalyalup Mineral Sands Deposit

Prepared for Doral Mineral Sands Pty Ltd

August 2020

Final

Short-range endemic desktop review for the Yalyalup Mineral Sands Deposit Project

Prepared for Doral Mineral Sands Pty Ltd

Version history

Author/s	Reviewer/s	Version	Version number	Date submitted	Submitted to
J.Clark	A.Jacks	Draft for client comments	0.1	12-Aug-20	J.Edwards
J.Clark	J.Edwards and D.Bourke	Final, client comments addressed	1.0	17-Aug-20	J.Edwards

Phoenix Environmental Sciences Pty Ltd

2/3 King Edward Road OSBORNE PARK WA 6017

P: 08 6323 5410

E: admin@phoenixenv.com.au

Project code: 1349-YAL-DOR-TIN

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

Doral Mineral Sands Pty Ltd (Doral) is seeking to mine the Yalyalup Mineral Sands Deposit (the Project), located 11 km southeast of the town of Busselton, Western Australia (WA; Figure 1-1).

The Proposal is to develop, mine, rehabilitate and decommission the Yalyalup Mineral Sands Mine. The Proposal includes the development of mine pits and associated infrastructure, wet concentration processing plant, solar evaporation ponds, groundwater abstraction, water management infrastructure and process water dam. The life of mine is expected to be 4 to 5 years.

The Proposal was referred to the Environmental Protection Authority (EPA) under section 38 of the Environmental Protection (EP) Act on 26 October 2017. On 3 January 2018 the EPA published its decision to formally assess the Proposal (Assessment No. 2141) under Part IV of the EP Act as a Public Environmental Review, with a four-week public review period for the ERD.

The Key Environmental Factors identified for the Proposal in the Environmental Scoping Document (ESD) were:

- Flora and Vegetation
- Terrestrial Fauna
- Hydrological Processes
- Inland Waters Environmental Quality
- Social Surroundings.

Surveys for short-range endemic fauna were not required according the Required Work items specified in the ESD.

Following submission of the ERD and receipt of comments, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Doral to undertake a short-range endemic desktop review for the Project.

The purpose of the review was to determine the likelihood of occurrence of SRE taxa within the development envelope and undertake a risk assessment in adherence to EPA guidelines (EPA 2016b); This is despite SREs not being considered a key environmental factor within the ESD approved by the EPA.

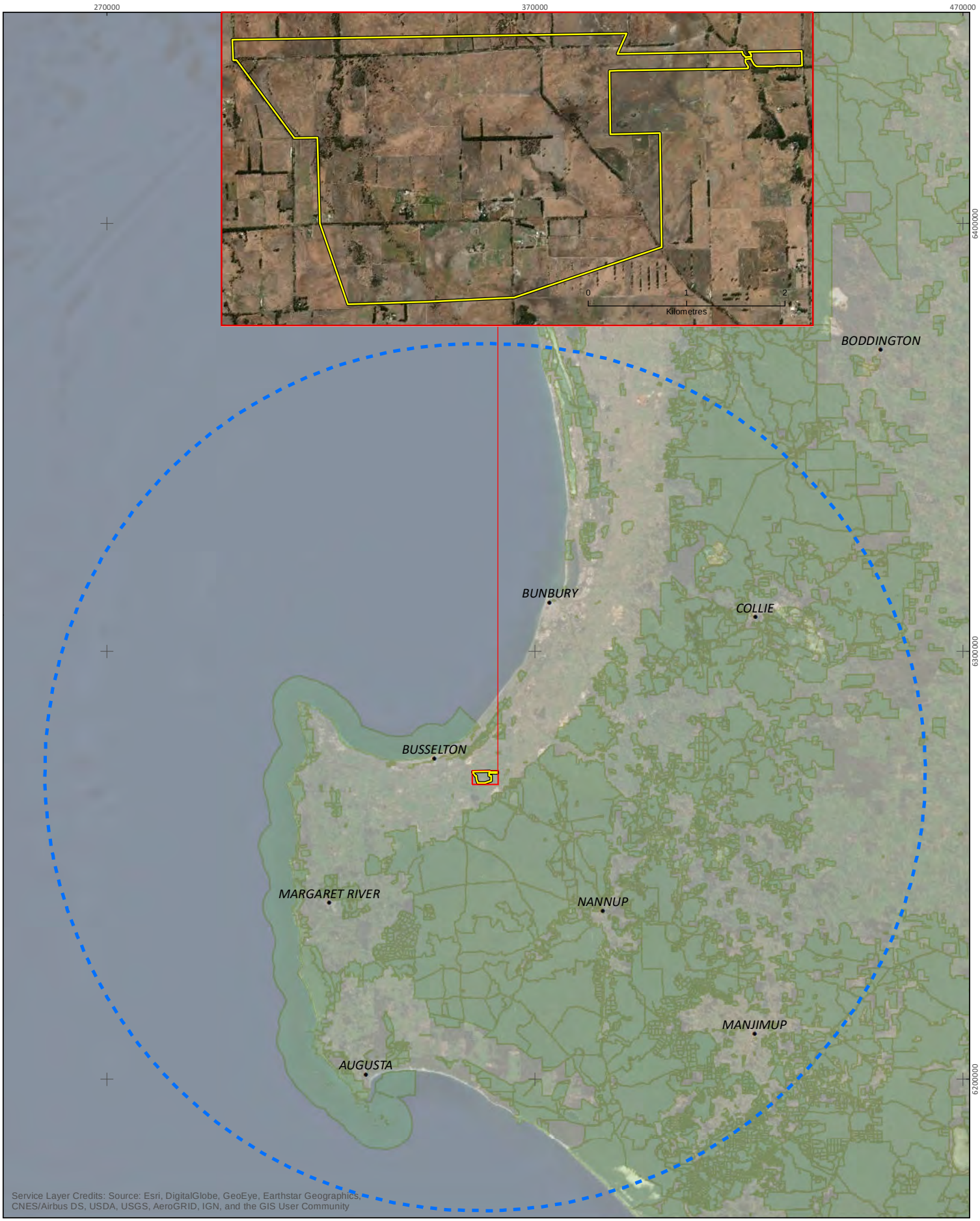
1.1 SCOPE OF WORK

The scope of work for the short-range endemic desktop review was as follows:

- Compile a list of potential SRE taxa based on the relevant WA Museum databases (WAM 2020)
- Review the compiled list and assess whether any of the resultant taxa may occur within the study area
- Undertake an SRE risk assessment based on vegetation/habitats present, in accordance with EPA guidelines (EPA 2016b)list.

1.2 STUDY AREA

The study area is he Project Development Envelope (DE) and is 924.8 ha in area and contains approximately 38 ha of remnant native vegetation in largely degraded condition (Ecoedge 2020a) (Figure 1-1).



South 32 Ltd
Future Mining Areas fauna desktop review

Project No	1349
Date	12-Aug-20
Drawn by	AJ
Map author	AJ

0 20 40
Kilometres

1:1,150,000(at A4) GDA 1994 MGA Zone 50

- Study area
- Study area 100 km buffer
- DBCA managed land

Figure 1-1

Project location and study area

PHOENIX ENVIRONMENTAL SCIENCES

1.3 SHORT-RANGE ENDEMIC INVERTEBRATES

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey 2002). EPA (2016a) identifies species with restricted distributions as being significant fauna in the context of environmental impact assessments (EIA). SRE fauna need to be considered in EIA as localised, small populations of species that are generally at greater risk of changes in conservation status due to environmental change than other, more widely distributed taxa.

Short-range endemism in terrestrial invertebrates is believed to have evolved through two primary processes (Harvey 2002):

1. Relictual – where the drying climate reduced the area of suitable habitat available to a species, forcing a range contraction. Such habitats typically maintain historic mesic conditions (e.g. south-facing rock faces or slopes of mountains or gullies)
2. Habitat speciality – where species settled in particular isolated habitat types (e.g. rocky outcrops) by means of dispersal and evolved in isolation into distinct species.

However, SRE invertebrates have also been reported in more widespread habitats such as spinifex plains or woodlands, mainly in groups with low dispersal capabilities, for example mygalomorph spiders and millipedes (see for example Car & Harvey 2014; Rix et al. 2018).

There can be uncertainty in categorising a specimen as an SRE due to several factors including poor regional survey density, lack of taxonomic research and problems of identification, i.e. specimens that may represent SREs cannot be identified to species level based on the life stage at hand. For example, in contrast to mature males, juvenile and female millipedes, mygalomorph spiders and scorpions cannot be identified to species level. Molecular techniques such as 'barcoding' (Hebert *et al.* 2003a; Hebert *et al.* 2003b) are routinely employed to overcome taxonomic or identification problems.

Currently, there is no accepted system to determine the likelihood that a species is an SRE. The WA Museum applies four categories which were adopted in this assessment: confirmed, potential, uncertain and not SRE. Confirmed SREs are taxa for which the distribution is known to be less than 10,000 km^2, the taxonomy is well known and the group is well represented in collections and/ or via comprehensive sampling (WAM 2013). Potential SREs include those taxa for which there is incomplete knowledge of the geographic distribution of the group and its taxonomy, and the group is not well represented in collections.

2 METHODS

A search of the WA Museum Arachnid, Myriapod, Crustacean and Mollusc databases (WAM 2020) was undertaken as the most contemporary and accurate SRE data source for the Project. The search was approximately 100km^2 in size and based on the centre point of the Development Envelope (Figure 1-1). The dataset was spatially constrained to within the Perth (SWA02) subregion of the Swan Coast Plain IBRA region.

Three flora and vegetation reports written specifically for the Proposal were also reviewed in order to assess the local and regional importance and condition of vegetation within the study area:

- Report of a Level 1 Flora and Vegetation survey at the Yalyalup Proposed Mine Area (Ecoedge 2020a).
- Supplementary Reconnaissance and Targeted Flora and Vegetation survey Yalyalup Proposed Mine Area (Ecoedge 2020b).
- Report of a supplementary Level 1 Flora and Vegetation survey over part of the Yalyalup Proposed Mine Area (Ecoedge 2017).

3 RESULTS

3.1 SRE TAXA

The desktop review identified records of 74 Confirmed, Potential and Likely SREs from within the 100 km^2 search area. When the data was restricted to the Swan Coast Plain (SWA02) IBRA subregion as the most relevant spatial subset, a total of 16 taxa were returned, including two confirmed SREs (both *Antichiropus* millipedes*)* and 14 potential SREs, including *Idiosoma sigillatum* (P3) (Table 3-1). No SRE taxa have been recorded in the study area; *Bothriembryon irvineanus* is the closest SRE with five records west of the development envelope (4.8 km – 12.2 km) (Figure 3-1).

Table 3-1 SRE taxa identified in the desktop review

Higher taxon, species	SRE category/ Conservation status	Proximity to study area (km)	Habitat records
Harvestmen			
Nunciella `sp. 5`	Potential	14.8	Not recorded
Millipedes			
Antichiropus `DIP045`	Confirmed	37.6	Leaf litter
Antichiropus nanus	Confirmed	31.2	Leaf litter
Mollusca (Gastropoda)			
Bothriembryon cf. irvineanus	Potential	4.8	Marri swamp
Bothriembryon irvineanus	Potential	10.1	Jarrah/ banksia woodland; On sand, under 1-2inch damp Euc. leaf litter; Recently burnt; 7m from large Marri; Dark grey sandy soil; On sand; among 2cm litter; under fallen damp Marri branch; recently burnt; Dark grey sandy soil
Mygalomorphae			
Aname `MYG161`	Potential	52.5	Bushland with industrial core
Aname `MYG184`	Potential	7.3	open woodland
Idiosoma `sp. indet.`	Potential	121	On upper edge of pit trap, after fire
Idiosoma sigillatum	Potential/P3	22.3	*Banksia attenuata*, *B.menziesii* woodland; Coastal plain woodland; *Melaleuca pressiana*, *M. rhaphiophylla* open woodland
Kwonkan `gelorup`	Potential	35.6	Not recorded
Proshermacha `MYG449`	Potential	173.9	Bushland with industrial core; Wetland with Melaleuca & marri

Proshermacha `MYG488`	Potential	10.7	Not recorded
Proshermacha `MYG659`	Potential	29.6	Not recorded
Pseudoscorpions			
Austrochthonius strigosus	Potential	10.4	Borehole
Scorpions			
Lychas `majeri`	Potential	36.1	Not recorded
Slaters			
Buddelundia nigripes	Potential	177.7	Not recorded

3.2 VEGETATION

Ecoedge (2020a) report six native vegetation types being present within the Development Envelope (Table 3-2; Figure 3-2). However, the DE is largely cleared for agriculture and includes landcover mapped as cleared and planted (887 ha; 96%). Five of the native vegetation types represent either a small isolated example of numerous Threatened Ecological Communities (TEC's) or due to degradation, vegetation that could have once been considered a TEC.

This does not mean however that such vegetation types are automatically likely to support SREs, i.e. the vegetation was not necessarily historically rare. Typically, TECs are listed because they occur on land desirable for agriculture or other developments and thus have been heavily cleared or degraded throughout their range; often they were once widespread, but today the remaining representative remnants are rare and thus important.

In this case, the majority of the condition of the remnant vegetation within the DE has been determined to be Completely degraded to Degraded (920.1ha; 99.5%) and was rarely rated above Degraded/Good condition (2.31 ha; 0.25%); where it is in Good condition it has largely been determined to be important floristically (Ecoedge 2020a).

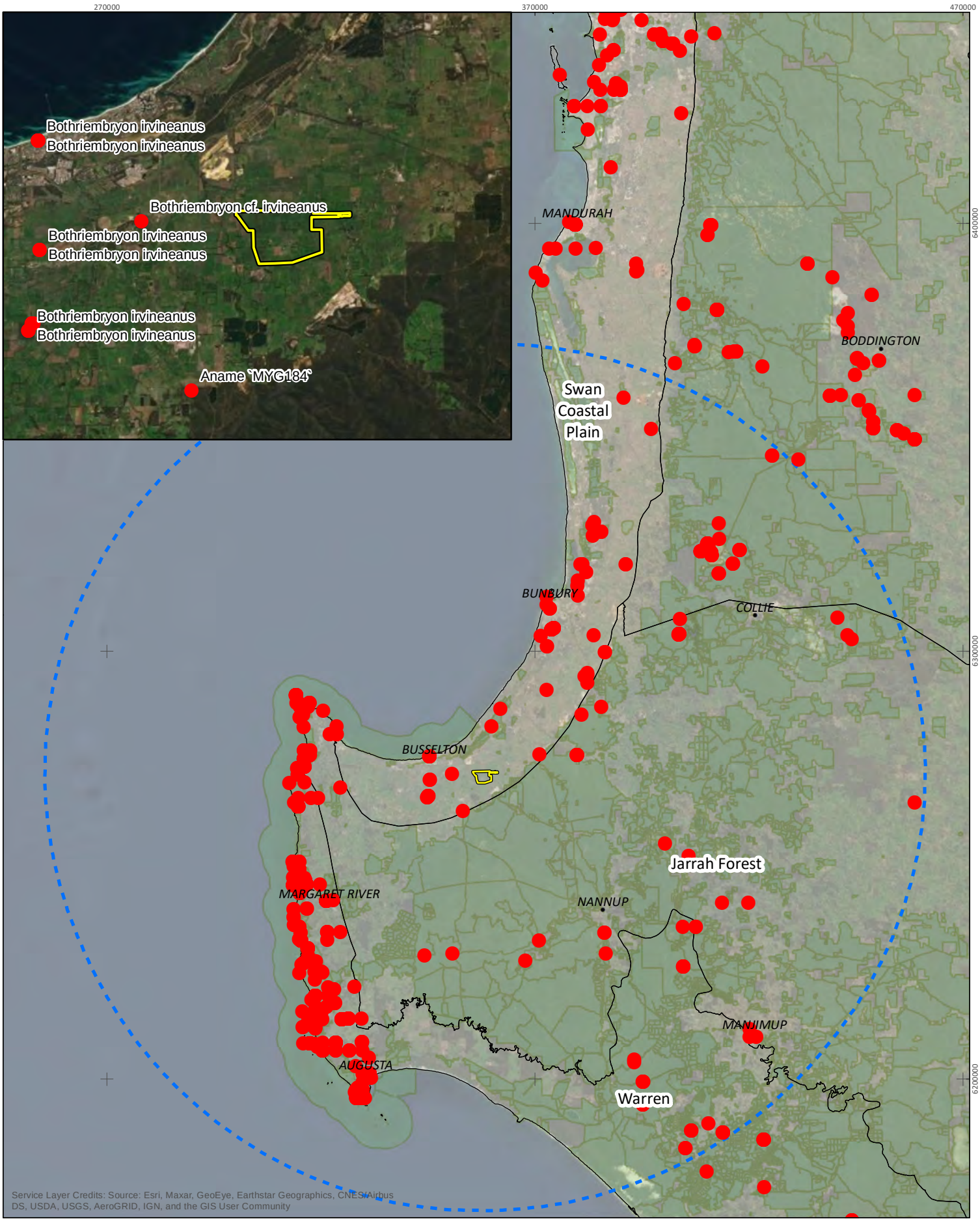
While the WA Museum desktop search returned many Potential and Confirmed SRE records, there are actually very few records in close proximity to the study area (Figure 3-1), this is likely a result of a lack of sampling due to the widespread clearing for agriculture that has taken place on the southern Swan Coastal Plain.

Given the above it is straight forward to determine the likelihood of each vegetation type supporting SRE taxa in the DE as all the vegetation is now rare; Habitat for SREs can simply be rated according to condition. Thus 3.42 ha of A2 and 0.45 ha of B1 are considered to have a High likelihood of supporting SREs. The remainder is considered Low or to have no potential, as it has been previously cleared (Figure 3-2).

Table 3-2 Summary of native vegetation occurring within the study area (Ecoedge 2020a) and potential to support SREs

Vegetation Unit	Description	Comments	Area (ha)	Pct (%)	Potential to support SREs
A1	Woodland of *Corymbia calophylla* and *Eucalyptus marginata*, with scattered *Agonis flexuosa*, *Banksia attenuata*, *B. grandis*, *Melaleuca preissiana*, *Nuytsia floribunda*, *Persoonia longifolia* or *Xylomelum occidentale* over *Xanthorrhoea preissii* over weeds on grey-brown or grey loamy sand or sand (on farmland usually only *C. calophylla* and *E. marginata* are present).	"SWAFCT01b – Southern *Corymbia calophylla* woodlands on heavy soils" (TEC). Mostly in Degraded or Completely Degraded Condition.	9.68	1.05%	Low
			1.18	0.13%	High (TEC FCT01b)
A2	Woodland of *Corymbia calophylla* (sometimes with *Eucalyptus marginata* or *E. rudis*) with scattered *Melaleuca preissiana* or *Banksia littoralis* over open shrubland that may include *Acacia extensa*, *A. saligna*, *Hakea ceratophylla*, *H.lissocarpha*, *H. prostrata*, *H. varia*, *Kingia australis*, *Melaleuca viminea* and *Xanthorrhoea preissii* over weeds on seasonally wet grey loamy sand.	Similar to "SWAFCT02 - Southern wet shrublands". (TEC), which may have an overstorey of *C. calophylla*, *M.preissiana* or *B. littoralis*. At the northern end of McGibbon Track this unit is in Good condition.	3.42	0.37%	Low
			0.61	0.07%	High (TEC FCT01b)
B1	Tall shrubland of *Acacia saligna*, *Banksia squarrosa* subsp. *argillacea*, *Calothamnus quadrifidus* subsp. *teretifolius*, *Hakea oldfieldii* and *Kunzea micrantha* (with scattered emergent *Eucalyptus rudis*) over scattered native herbs including *Drosera glanduligera* and *Sowerbaea laxiflora*, the sedge *Loxocarya magna*, and weeds on shallow red sandy clay on massive ironstone.	"SWAFCT10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)". Except on McGibbon Track where it is classed as Good condition the small fragments of this unit are Degraded/Good or Degraded condition.	0.05	0.01%	Low
			0.45	0.05%	High (TEC FCT01b)
B2	Woodland of *Eucalyptus rudis* and (in some areas) *Melaleuca rhaphiophylla* over weeds on massive ironstone.	"SWAFCT10b - Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)". Completely Degraded areas of B1 with only the overstorey remaining.	2.79	0.30%	Low
C1	Woodland of *Eucalyptus rudis* (and sometimes *Corymbia calophylla*) over scattered *Agonis flexuosa* and *Melaleuca rhaphiophylla* over weeds on grey-brown clayey loams in drainage lines.	Riverine Jindong Plant Communities (Webb *et al*., 2008). All in Completely Degraded condition.	19.08	2.06%	Low

Vegetation Unit	Description	Comments	Area (ha)	Pct (%)	Potential to support SREs
C3	Tall Open Shrubland that may include *Acacia saligna*, *Jacksonia furcellata*, *Kingia australis*, *Melaleuca osullivanii*, *M. preissiana*, *M. viminea* and *Xanthorrhoea preissii* on seasonally wet grey-brown sandy loam.	"SWAFCT09 - Dense shrublands on clay flats". (TEC). A small area in Degraded/Good or Good condition on the verge of Princefield Road.	0.55	0.06%	Low
P	Planted	Planted vegetation	6.87	0.74%	None
CL	Cleared	Cleared for agriculture and other uses	880.17	95.17%	None
		Total	**924.84**	**100.00%**	**NA**



Doral Mineral Sands Pty Ltd
Yalyalup Mineral Sands Project

Project No	1349-YAL-DOR-TIN
Date	13/08/2020
Drawn by	J.Clark
Map author	J.Clark

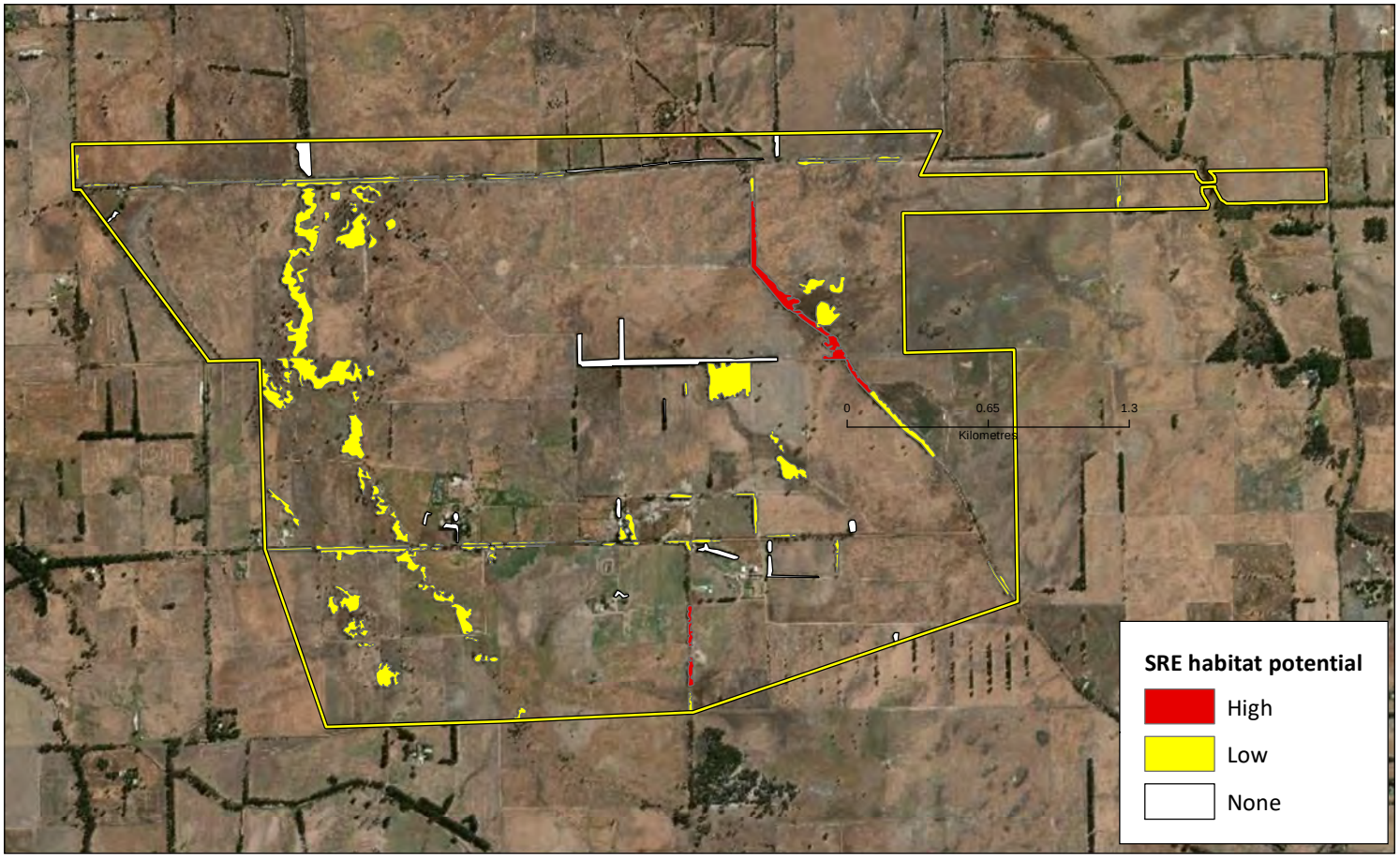
0 20 40
Kilometres

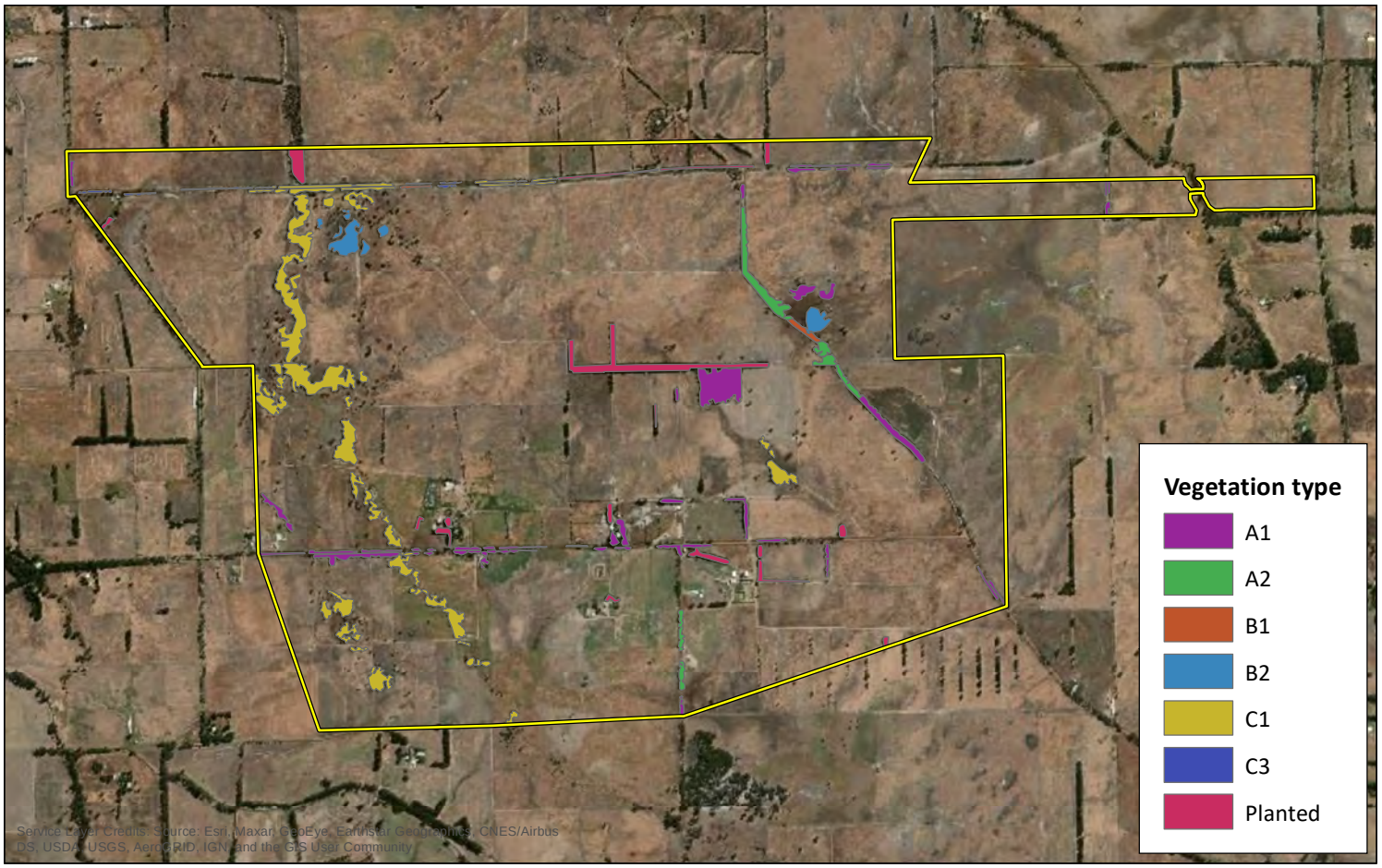
1:1,150,000(at A4) GDA 1994 MGA Zone 50

- WAM desktop SRE records
- Study area
- Study area 100 km buffer
- IBRA regions
- DBCA managed land

Figure 3-1
Desktop records of SRE terrestrial invertebrates

PHOENIX ENVIRONMENTAL SCIENCES





Doral Mineral Sands Pty Ltd
Yalyalup Mineral Sands Project

Project No	1349-YAL-DOR-TIN
Date	13/08/2020
Drawn by	JC
Map author	AJ

0 1
Kilometres

1:32,384 (at A4) GDA 1994 MGA Zone 50

Study area

Figure 3-2
Vegetation type and SRE habitat potential

PHOENIX ENVIRONMENTAL SCIENCES

4 DISCUSSION

The Yalyalup Mineral Sands Project is located in an area that has been extensively cleared for agriculture, few large parcels of native vegetation remain and typically, remnants are restricted to streamlines and road reserves where they are linear in orientation and degraded due to the edge effects. This is largely the case with the remaining vegetation within the DE.

While over 2000 individual records were returned by the WA Museum database search (WAM 2020) it is evident from the results that few targeted SRE surveys have been conducted in the vicinity of the Project and indeed few are known from the Swan Coastal Plain generally (16 in total returned).

Ecoedge (2020a) report six native vegetation types being present within the DE (Table 3-2) of which the vast majority are highly degraded forms of vegetation that, had it not been degraded by agricultural activities, would probably be considered one of the various regional TECs today. Almost 88% of the vegetation present is considered to be in Completely degraded to Degraded condition Ecoedge (2020a).

Two small areas within the DE were found to have a high likelihood of supporting SREs based solely on the relatively good condition, A2 and B1, which collectively represent 3.9 ha or 0.42% of the 924.8 ha DE. No surveys have been conducted in these vegetation types within the DE or from what we can find, elsewhere. And therefore, it is difficult to determine the natural propensity of these vegetation types to support SREs. Notwithstanding the fact that the WAM database returned relatively few SREs from the SWA02 subregion which has been extensively surveyed to the north, compared with the surrounding regions where many more SERs are known (Jarrah Forest, 43; Warren, 32).

EPA (2016b) provides for a risk-based approach to assessing Project risks to SREs where targeted surveys have been conducted and SREs have been found to occur within vegetation/habitats that are to be impacted and where additional surveys appear unlikely to yield results in a timely manner. The approach allows for the use of habitat surrogates for inferring distributional boundaries. The distribution patterns and ecology of other related taxa can also be used to infer risk.

The problem therefore is that targeted SRE surveys have not been conducted in this case and little to no data exists regarding the remnant vegetation outside the DE. EPA (2016b) does not allow for the use of surrogates in the risk assessment process were surveys have not been undertaken; but conversely, SREs were not considered a factor in the ESD, thus the following statement within EPA (2016b) is not applicable:

> "The EPA will expect the requirements of this Guidance to be met when SRE fauna is a relevant factor for proposals,"

Regardless of the above survey and biological limitations the Proponent has developed a Groundwater Dependent Ecosystem Management Plan (GDEMP; AQ2 2020) that aims to protect the High prospectivity SRE habitat by:

- Monitoring of groundwater levels at six bores
- Enhancing water infiltration to the vadose zone
- Monitoring of Leaf Water Potential (LWP)
- Monitoring of vegetation health and condition
- Responding to adverse monitoring outcomes in various ways, such as the cessation of abstraction.

Given that the most prospective SRE habitat/vegetation is to be retained and stringently monitored, the risk to SREs within the DE would appear to be low and as such targeted SRE surveys are not

considered warranted, particularly given that the GDEMP actions aim to ensure the Project is able to meet numerous EPA objectives with respective to SREs and terrestrial fauna generally:

- ensure the protection of key habitats for SRE species (EPA 2016b)
- maintain the distribution, abundance and productivity of populations of SRE taxa (EPA 2016b)
- ensure that the conservation status of SRE taxa is not adversely changed as a result of development proposals(EPA 2016b)
- To protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA 2016a).

5 REFERENCES

AQ2. 2020. *Yayalup Mineral Sands Project GDE Management Plan*. Report prepared for Doral Minersal Sands Pty Ltd.

Car, C. A. & Harvey, M. S. 2014. The millipede genus *Antichiropus* (Diplopoda: Polydesmida: Paradoxosomatidae), part 2: species of the Great Western Woodlands region of Western Australia. *Records of the Western Australian Museum* **29**: 20–77.

Ecoedge. 2017. *Report of a supplementary Level 1 Flora and Vegetation survey over part of the Yalyalup Proposed Mine Area*. Ecoedge, Bunbury, WA. Report prepared for Doral Mineral Sands Pty Ltd.

Ecoedge. 2020a. *Report of a Level 1 Flora and Vegetation survey at the Yalyalup Proposed Mine Area*. Ecoedge, Picton, WA. Prepared for Doral Mineral Sands Pty Ltd.

Ecoedge. 2020b. *Supplementary Reconnaissance and Targeted Flora and Vegetation survey Yalyalup Proposed Mine Area 2019*. Picton, WA. Prepared for Doral Mineral Sands Pty Ltd.

EPA. 2016a. *Environmental Factor Guideline: Terrestrial fauna*. Environmental Protection Authority, Perth, WA. Available at: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Terrestrial-Fauna-131216_3.pdf

EPA. 2016b. *Technical Guidance: Sampling of short range endemic invertebrate fauna*. Environmental Protection Authority, Perth, WA. Available at: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Sampling-SREs-Dec-2016.pdf

Harvey, M. S. 2002. Short-range endemism among the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**: 555–570.

Hebert, P. D. N., A., C., Ball, S. L. & de Waard, J. R. 2003a. Biological identifications through DNA barcodes. *Proceedings of the Royal Society London B* **270**: 313–321.

Hebert, P. D. N., Ratnasingham, S. & de Waard, J. R. 2003b. Barcoding animal life: Cytochrome c oxidase subunit 1 divergences among closely related species. *Proceedings of the Royal Society London B, Supplement* **270**: 96–99.

Rix, M. G., Huey, J. A., Cooper, S. J. B., Austin, A. D. & Harvey, M. S. 2018. Conservation systematics of the shield-backed trapdoor spiders of the *nigrum*-group (Mygalomorphae, Idiopidae, *Idiosoma*): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. *Zookeys* **756**: 1–121 http://dx.doi.org/10.3897/zookeys.756.24397.

WAM. 2013. *WAM short-range endemic categories and sub-categories*. Western Australian Museum, Welshpool.

WAM. 2020. *WA Museum Arachnology/Myriapodology, Crustacea and Mollusca database*, Welshpool, WA.

ATTACHMENT 3: ADDITIONAL HYDROGEOLOGY INFORMATION

Table 1 Summary of Horizontal Hydraulic Conductivity Values

Aquifer	Base Case Model Kh (m/d)	Uncertainty Calibration Model Kh ((m/d)	September 2020 Case Model Kh (m/d)	Measured Range Kh (m/d)
Alluvium, Estuarine Deposits, & Sand derived from Tamala Limestone	5	5	5	Very fine to very coarse sand – 1 to 50m/d Fine to medium sand – 8-15m/d Clayey sand – 1m/d Slightly silty/clayey sand – 5 m/d Clay – 0.01 m/d Slightly sandy clay – 0.5m/d
Alluvium and Estuarine Mud	0.01	0.01	0.01	
Safety Bay Sand	15	15	15	average 15m/d
Tamala Limestone	50	25	50	20-100m/d (average 50 m/d). In Busselton area lower value due to sandy & clayey layers within limestone
Bassendean Sand*[#]	10	5	10	10 to 50m/d (depending on clay content); South West region more silty. See table below for site specific ranges
Guildford Formation*[#]	0.3	0.15	0.3	average 0.1 m/d, range 0.01 to 1 m/d, (depending on sand content). See table below for site specific ranges
Yoganup Formation*[#]	5	2.5	5	Average 8 m/d, range 5 – 8 m/d (depending on clay content). See table below for site specific ranges
Leederville Formation Mowen Member	0.01	0.01	0.01	Average 0.01m/d With more sandy layers 0.1m/d
Leederville Formation Vasse Member North	1	1	5	Bulk horizontal hydraulic conductivity 1 to 5m/d, Busselton area ~1 m/d
Leederville Formation Vasse Member South	1	1	5	
Yarragadee Formation	7	7	7	Bulk horizontal hydraulic conductivity in Busselton area 2-10 m/d, average 7m/d

*Superficial aquifer in Busselton Area estimated hydraulic conductivity 0.5 to 5m/d

[#] Range of measured hydraulic conductivity values from hydraulic testing 0.1 to 10 m/d (AQ2, 2020)

Table 2 Estimated Hydraulic Conductivity Values Saxton Rawls Method, AQ2 2020.

Superficial Formation Units	Saxton Rawls Hydraulic Conductivity (m/d) Minimum	Saxton Rawls Hydraulic Conductivity (m/d) Maximum	No. of Doral PSD samples tested	Hydraulic Conductivity used in Base Case Model (m/d)	Hydraulic Conductivity used in Alternative Case Model (m/d)
Bassendean Sand	3.5	7.5	1894	10	5
Guildford Formation	0.03	0.1	2137	0.3	0.15
Yoganup Formation	1.6	3.4	2246	5	2.5

Values derived from PSD analysis and used to estimate hydraulic conductivity for GDE Management Plan

Table 3 Summary of Vertical Hydraulic Conductivity Values

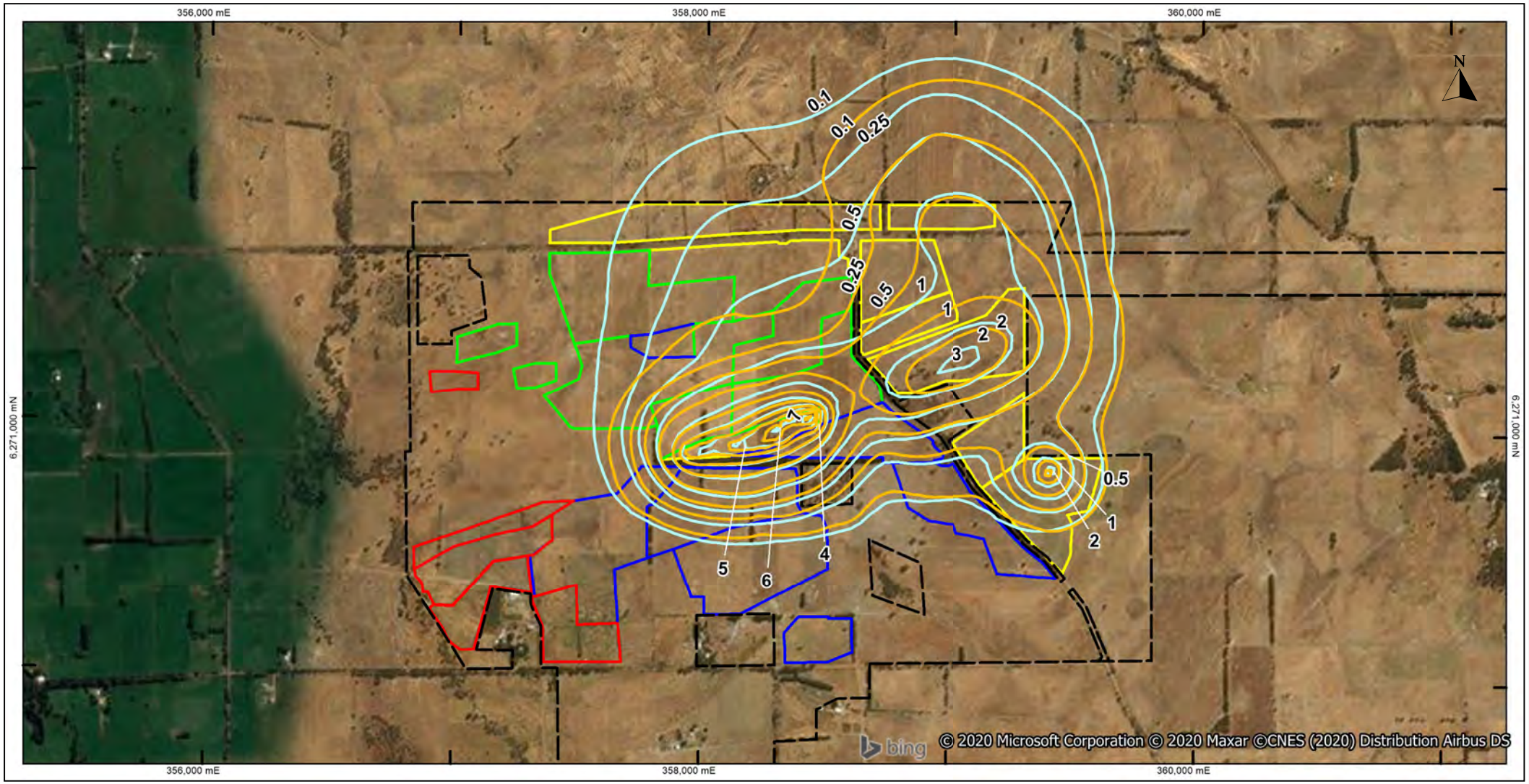
Aquifer	**Base Case Model Kv (m/d)**	**Uncertainty Calibration Model Kv (m/d)**	**September 2020 Case Model Kv (m/d)**	**Measured Range Kv (m/d)**
Alluvium, Estuarine Deposits, & Sand derived from Tamala Limestone	0.5	0.5	0.5	At a minimum, 1 order of magnitude less than horizontal hydraulic conductivity Except for "estuarine mud" due to the presence of substantial clay layers restricting vertical flow
Alluvium and Estuarine Mud	0.0001	0.0001	0.0001	
Safety Bay Sand	0.15	0.15	0.15	
Bassendean Sand	1	0.5	1	
Tamala Limestone	5	2.5	5	
Guildford Formation	0.03	0.015	0.03	
Yoganup Formation	0.5	0.25	0.5	
Leederville Formation Mowen Member	0.0001	0.0001	0.0001	Range 0.0005 – 0.000015, with higher permeabilities observed where shale units within the aquitard are thin
Leederville Formation Vasse Member North	0.0001	0.0001	0.01	Range 0.01-0.0001, depending on clay beds and interconnectivity of sand layers
Leederville Formation Vasse Member South	0.001	0.001	0.01	
Yarragadee Formation	0.07	0.07	0.07	Range 0.1-0.001, depending on clay beds and interconnectivity of sand layers

Table 4 Summary of Confined Storage Values

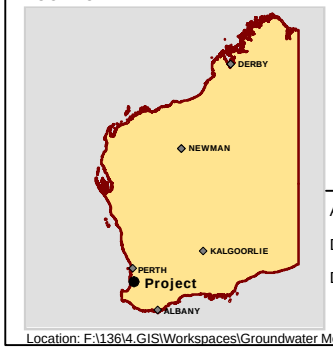
Aquifer	Base Case Model S	Uncertainty Calibration Model S	September 2020 Model S	Measured Range S
Alluvium, Estuarine Deposits, & Sand derived from Tamala Limestone	-	-	-	-
Alluvium and Estuarine Mud	-	-	-	-
Safety Bay Sand	-	-	-	-
Bassendean Sand	-	-	-	-
Tamala Limestone	0.0001	0.0001	0.0001	-
Guildford Formation	0.0001	0.0001	0.0001	-
Yoganup Formation	0.0001	0.0001	0.0001	-
Leederville Formation Mowen Member	0.0001	0.0001	0.0001	0.0001 – 0.00027
Leederville Formation Vasse Member North	0.0001	0.0001	0.0001	
Leederville Formation Vasse Member South	0.0001	0.0001	0.0001	
Yarragadee Formation	0.0001	0.0001	0.0001	0.0001 – 0.00021

Table 5 Summary of Specific Yield Values

Aquifer	Base Case Model Sy (%)	Uncertainty Calibration Model Sy (%)	September 2020 Model Sy (%)	Measured Range Sy 9%)
Alluvium, Estuarine Deposits, & Sand derived from Tamala Limestone	10	5	10	Range – 5 to 20% 5-10% clayey, 10-20% sandy
Alluvium and Estuarine Mud	10	5	10	
Safety Bay Sand	20	10	20	
Bassendean Sand	20	10	20	
Tamala Limestone	20	10	20	
Guildford Formation	10	5	10	
Yoganup Formation	20	10	20	
Leederville Formation Mowen Member	5	5	5	10% for Leederville aquifer
Leederville Formation Vasse Member North	10	10	10	
Leederville Formation Vasse Member South	10	10	10	
Yarragadee Formation	10	10	10	10% for Yarragadee aquifer



LOCATION MAP



LEGEND

- Potential Disturbance Envelope
- Mining outline for year 2021
- Mining outline for year 2022
- Mining outline for year 2023
- Mining outline for year 2024
- "Base Case" Drawdown in metres at 0.1, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9
- "September 2020 Case" Drawdown in metres at 0.1, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9

0 1
kilometres

AUTHOR: GC
DRAWN: LDS
DATE: 22/09/2020

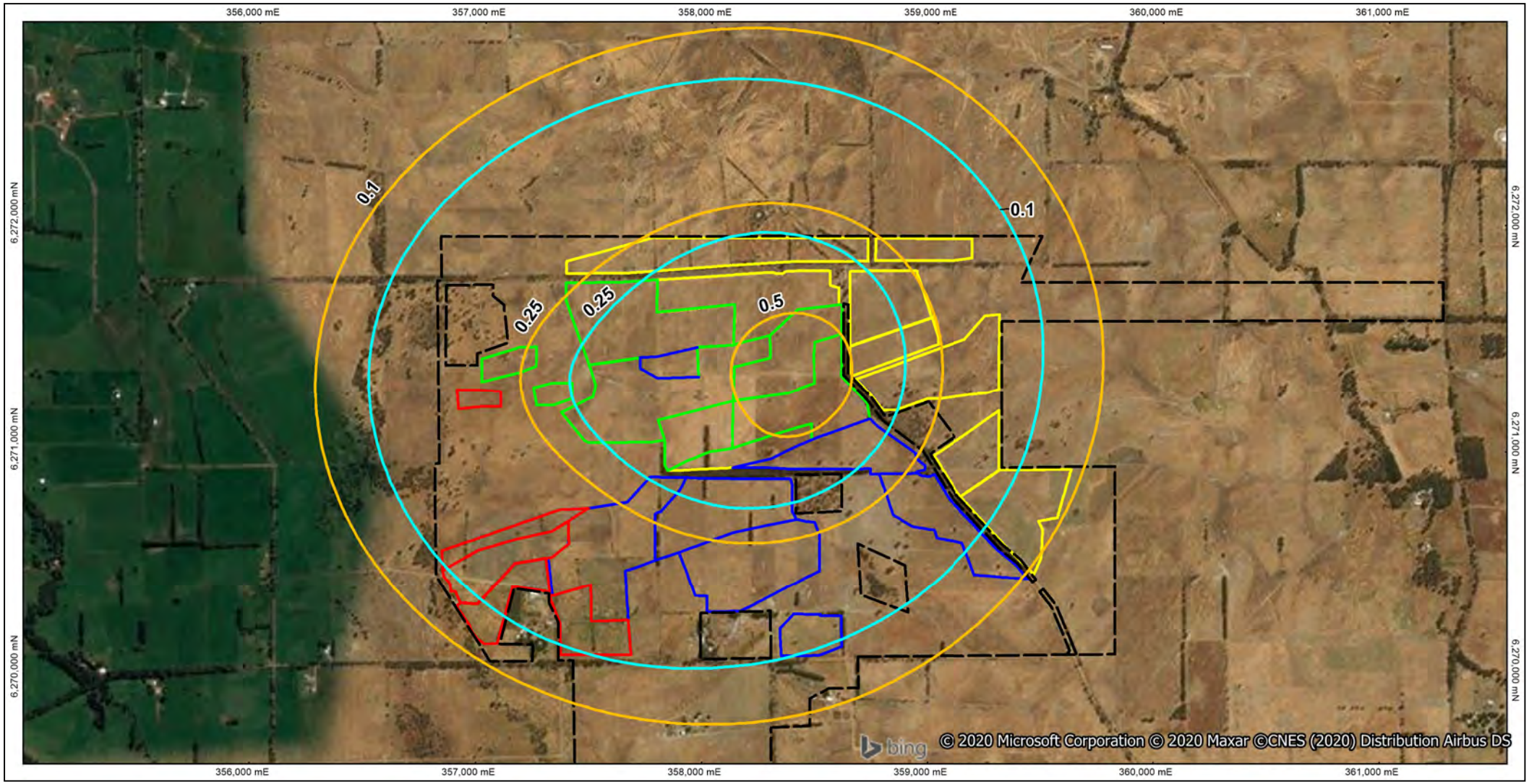
REPORT NO: 007
REVISION: a
JOB NO: 136

NOTES & DATA SOURCES:
Mine outlines provide by Doral

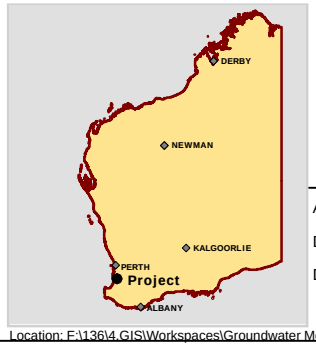
FIGURE 1

Q4 – 2024 (END OF MINING) CONTOURS OF PREDICTED DRAWDOWN IN SUPERFICIAL AQUIFER DRY CONDITIONS "BASE CASE" AND "SEPTEMBER 2020 CASE" YALYALUP DEWATERING PREDICTIONS

Location: F:\136\4.GIS\Workspaces\Groundwater Model



LOCATION MAP



LEGEND

- Potential Disturbance Envelope
- Mining outline for year 2021
- Mining outline for year 2022
- Mining outline for year 2023
- Mining outline for year 2024
- "Base Case" Drawdown in metres at 0.1, 0.25
- "September 2020 Case" Drawdown in metres at 0.1, 0.25, 0.5

N

0 1

kilometres

AUTHOR: GC

DRAWN: LDS

DATE: 22/09/2020

REPORT NO: 007

REVISION: a

JOB NO: 136

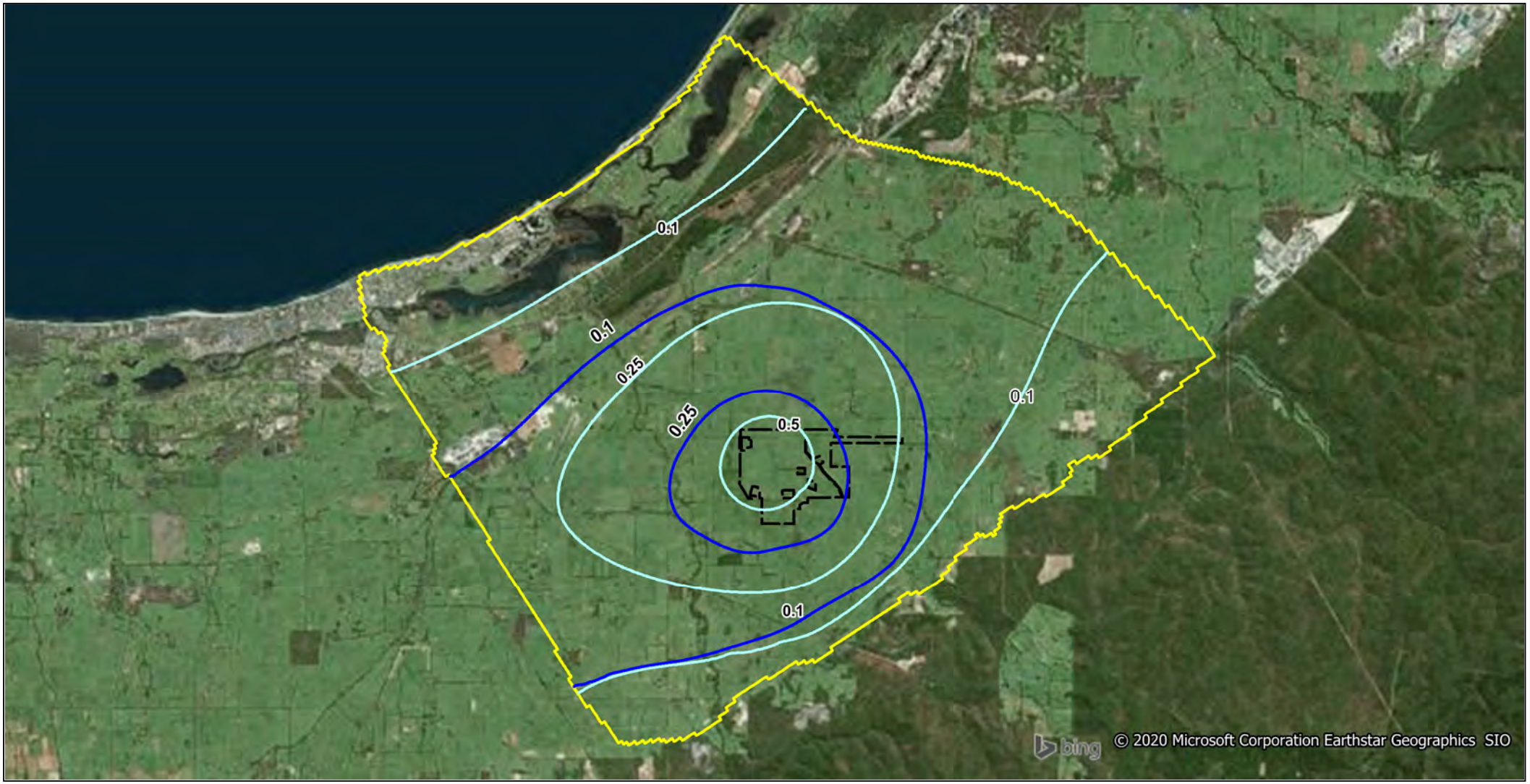
NOTES & DATA SOURCES:
Mine outlines provide by Doral

AQ2

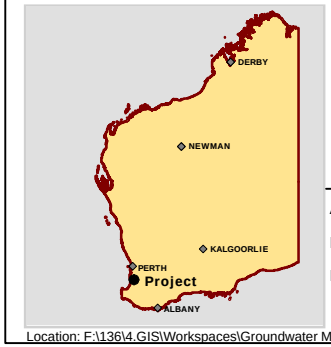
FIGURE 2

Q3 -2023
CONTOURS OF PREDICTED DRAWDOWN IN LEEDERVILLE AQUIFER DRY CONDITIONS "BASE CASE" AND "SEPTEMBER 2020 CASE" YALYALUP DEWATERING PREDICTIONS

Location: F:\136\4.GIS\Workspaces\Groundwater Model



LOCATION MAP



LEGEND

- Groundwater model boundary
- "Base Case" Drawdown in metres at 0.1, 0.25, 0.5
- "September 2020 Case" Drawdown in metres at 0.1, 0.25, 0.5
- Potential Disturbance Envelope

N

0 5

kilometres

AUTHOR: GC

DRAWN: LDS

DATE: 22/09/2020

REPORT NO: 007

REVISION: a

JOB NO: 136

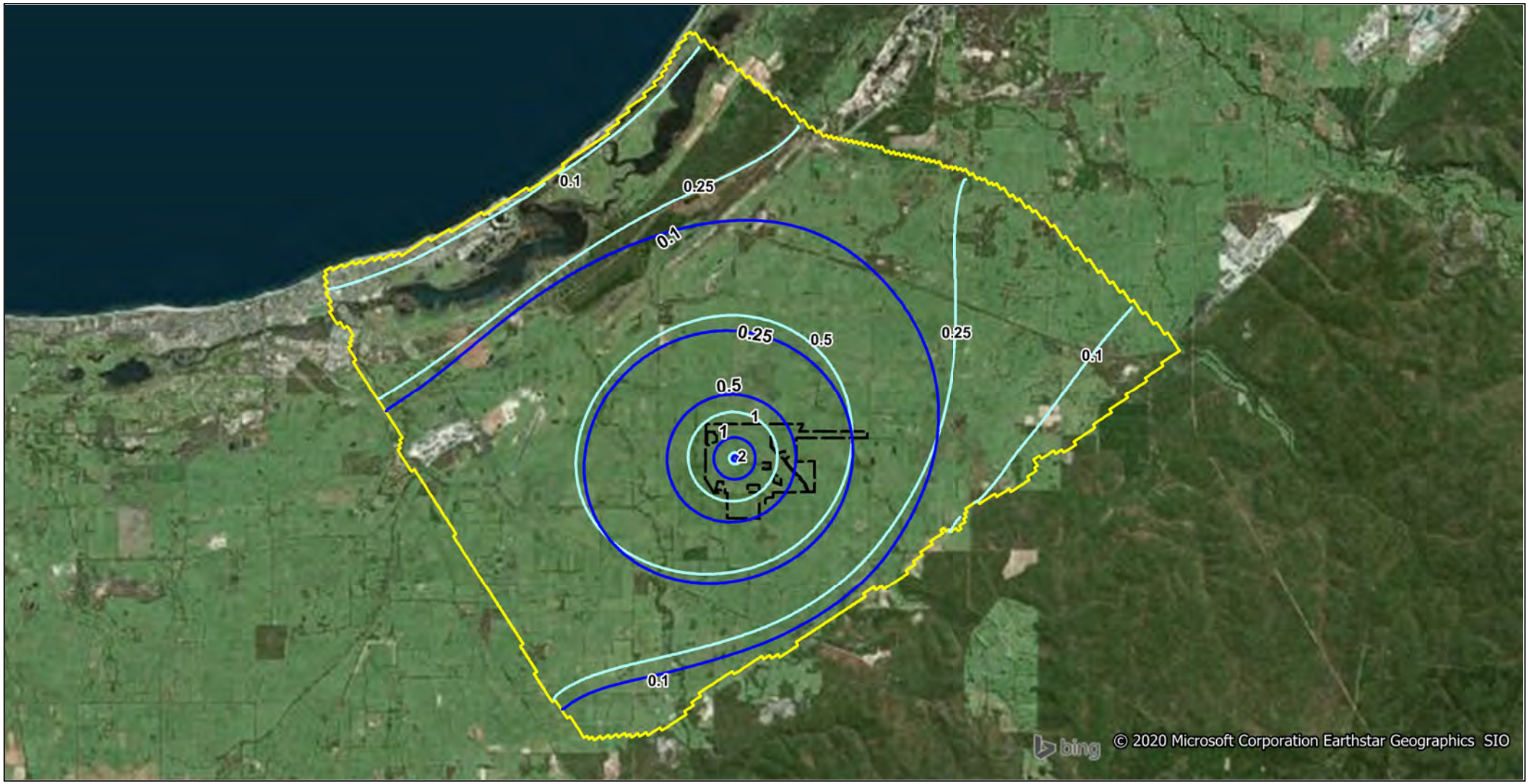
NOTES & DATA SOURCES:

Mine outlines provide by Doral

FIGURE 3

PREDICTED CONTOURS OF DRAWDOWN IN LEEDERVILLE AQUIFER AT END OF MINING FOR DRY CONDITIONS IN WATER SUPPLY ONLY "BASE CASE" AND "SEPTEMBER 2020 CASE"

Location: F:\136\4.GIS\Workspaces\Groundwater Model



LOCATION MAP

Location: F:\136\4.GIS\Workspaces\Groundwater Model

LEGEND

- Groundwater model boundary
- "Base Case" Drawdown in metres at 0.1, 0.25, 0.5, 1, 2, 3
- "September 2020" Drawdown in metres at 0.1, 0.25, 0.5, 1,
- Potential Disturbance Envelope

N

0 5

kilometres

AUTHOR: GC

DRAWN: LDS

DATE: 22/09/2020

REPORT NO: 007

REVISION: a

JOB NO: 136

NOTES & DATA SOURCES:
Mine outlines provide by Doral

FIGURE 4

PREDICTED CONTOURS OF DRAWDOWN IN YARRAGADEE AQUIFER AT END OF MINING FOR DRY CONDITIONS IN WATER SUPPLY ONLY "BASE CASE" AND "SEPTEMBER 2020 CASE"

ATTACHMENT 4: PARTICLE TRACKING ANALYSIS

\\dc02\Jobs\136\4.GIS\Workspaces\Partical Figure\Figure 1 - Particle tracing.qgz

Legend

- Planned Mining Area
- Predicted Flow Path
- Particle Start Location
- Vasse-Wonnerup Wetland System

AUTHOR: KR	REPORT NO:	Notes and Data Sources:
DRAWN: GC	JOB No: 136E	
DATE: 13/08/2020	Coordinates: MGA Zone 50	

AQ2

Attachment 3

Predicted Flow Paths from 2034 to 2066

ATTACHMENT 5: MINE ACCESS ROAD NOISE MODELLING ASSESSMENT

NOISE MODELLING

FOR

YALYALUP HAUL ROAD

3 July 2020

AES-890059-L01-A-03072020

Acoustic Engineering Solutions
www.acousticengsolutions.com.au

1.0 INTRODUCTION

Acoustic Engineering Solutions (AES) has been commissioned by Doral Mineral Sands Pty Ltd (Doral) to assess the noise emission from double-trailer Qube trucks on Yalyalup haul road.

Figure 1 shows the haul road and the closest residences R1 and R2. The Qube trucks enter the Yalyalup minesite from Ludlow-Hithergreen Road to load products at the HMC pad, and then exit to Ludlow-Hithergreen Road. The speed limit on the haul road is 40km/h. The haul road is about 2500m between Ludlow-Hithergreen Road and the HMC pad. It will take about 3.7 minutes for a truck to travel on the haul road at 40km/h.

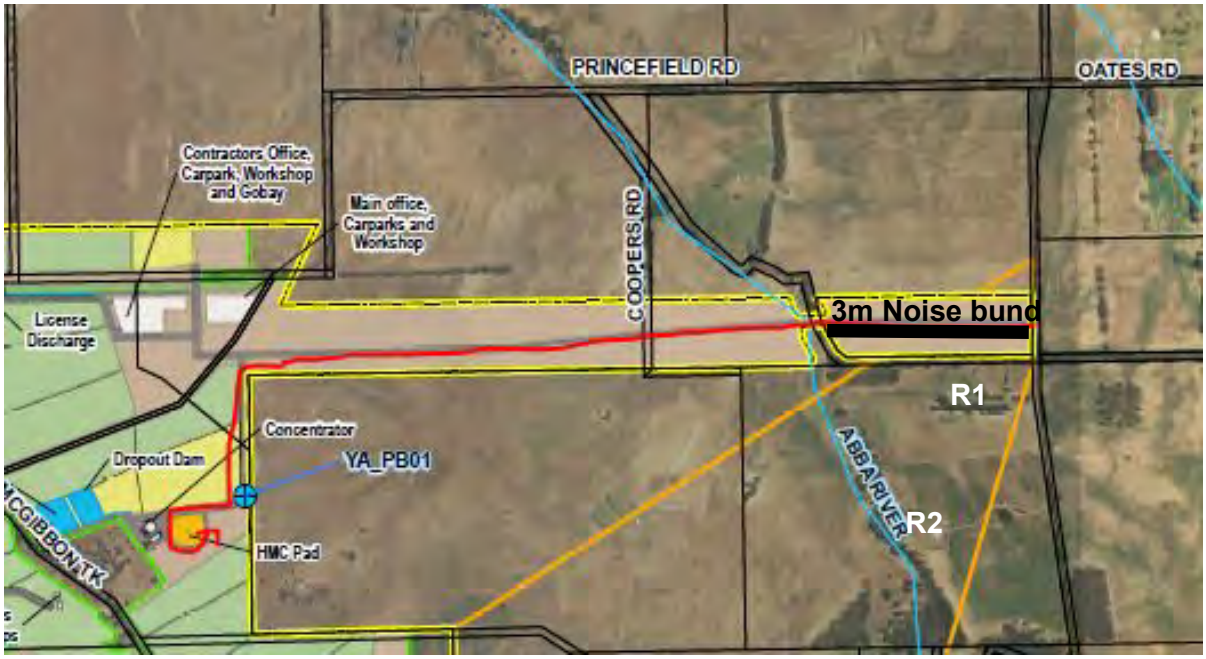


Figure 1: Site Layout.

Doral advised that Qube trucks transport products from the Yalyalup mine site for approximate 10 trips per day (7 days a week) during day time only. No more than one Qube trucks drive inside the Yalyalup mine site at the same time. This means that the total time for Qube trucks driving on the haul road is 74 minutes per day.

2.0 MEASURED SOUND POWER LEVEL

Onsite sound power measurements of double-trailer Qube trucks were undertaken at the Doral Keysbrook mine site in the morning of Thursday 2 July 2020, when it was a calm sunny day with a maximum temperature of 16^0C.

Table 1 presents the measured sound power levels of two double-trailer Qube trucks driving on a haul road at a speed of 40km/hour. One truck was empty and another was with full loading of products in its two trailers. The empty truck has higher sound power level than the loading truck.

Table 1: Measured sound power levels

Loading Conditions	Octave Frequency Band Sound Power Levels in dB(lin)								Overall
	63	125	250	500	1k	2k	4k	8k	dB(A)
Empty	104.9	104.8	105.7	103.7	100.2	96.3	90.8	85.8	**105.4**
Full Loading	105.8	101.5	99.2	100.9	98.9	94.8	88.0	80.8	**103.0**

3.0 MODELLING RESULTS

A driving truck is a moving source. SoundPlan cannot model a moving source. A driving truck is represented by a line source. The predicted noise levels and noise contours are the average of noise received during the whole period (3.7 minutes) of a truck driving on the haul road between the HMC pad and Ludlow-Hithergreen Road.

Doral advised that a 3m high noise bound is proposed on the south of the haul road between the Creek and Ludlow-Hithergreen Road, as shown as a black line in Figure 1.

Two following scenarios are modelled:

Scenario 1: A double-trailer Qube truck drives on the haul road.

Scenario 2: Scenario 1 plus a 3m noise bound on the south of the haul road between the Creek and Ludlow-Hithergreen Road.

For both scenarios, the Qube truck is assumed to have the highest sound power level of 105.4 dB(A).

3.1 PREDICTED NOISE LEVELS

Table 2 presents the predicted noise levels in dB(A) at the two closest residential locations. The predicted noise levels are the averaged noise levels over 3.7 minutes when a truck drives on the haul road. It is shown that the 3m noise bund reduces the noise level by 6.5 dB at R1 and 3 dB at R2.

Table 2: Predicted worst-case noise levels in dB(A)

Closest Residences	Predicted Noise Levels in dB(A)	
	Scenario 1	Scenario 2
R1	39.8	33.3
R2	31.9	28.9

3.2 NOISE CONTOURS

Figure 2 and Figure 3 in the back of this report present the predicted noise contours at 1.5m above the ground. These noise contours represent the worst-case noise propagation envelopes, i.e., worst-case propagation in all directions simultaneously.

4.0 COMPLIANCE ASSESSMENT

4.1 ASSIGNED NOISE LEVELS

R1 and R2 are located at more than 450m away from the Yalyalup mine site. No influencing factors apply. The day-time assigned noise level L_{A10} is 45 dB(A) for both R1 and R2.

4.2 ADJUSTED NOISE LEVELS

Noise from driving trucks exhibit tonality. According to Regulations, the predicted noise levels shown in Table 2 should be adjusted by adding 5 dB.

Table 3 presents the adjusted noise levels in dB(A).

Table 3: Adjusted noise levels

Closest Residences	Predicted Noise Levels in dB(A)	
	Scenario 1	Scenario 2
R1	44.8	38.3
R2	36.9	33.9

4.3 COMPLIANCE ASSESSMENT

Table 4 presents a compliance assessment. It is shown that all adjusted noise levels are below the assigned noise level. Full compliance is achieved for each of two scenarios.

Table 4: Compliance assessment

Closest Residences	Day-time Assigned Noise Levels in dB(A)	Adjusted Noise Levels in dB(A)	
		Scenario 1	Scenario 2
R1	45	44.8	38.3
R2	45	36.9	33.9

5.0 SUMMARY AND DISCUSSIONS

AES has been commissioned by Doral to undertake noise modelling for double-trailer Qube trucks driving on the Yalyalup haul road. Site noise measurements were undertaken in the morning of Tuesday 2 July 2020.

Two scenarios are modelled. The modelling results show that the averaged noise levels are below 40 dB(A) at the two closest residences for both scenarios.

The compliance assessment concludes that full compliance is achieved for Qube trucks driving on the Yalyalup haul roads with and without a 3m noise bund.

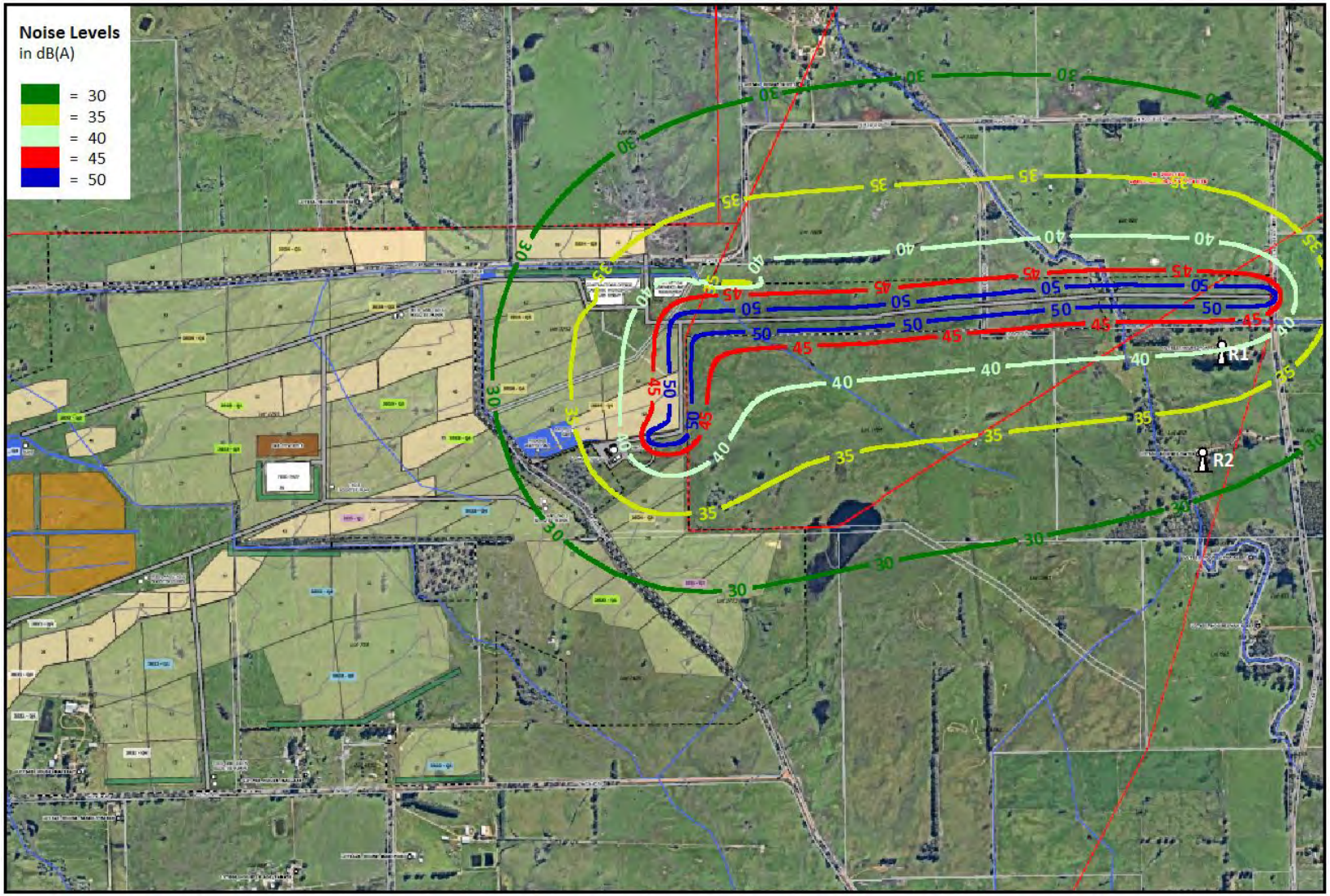


Figure 2: Worst-case noise contours for scenario 1.

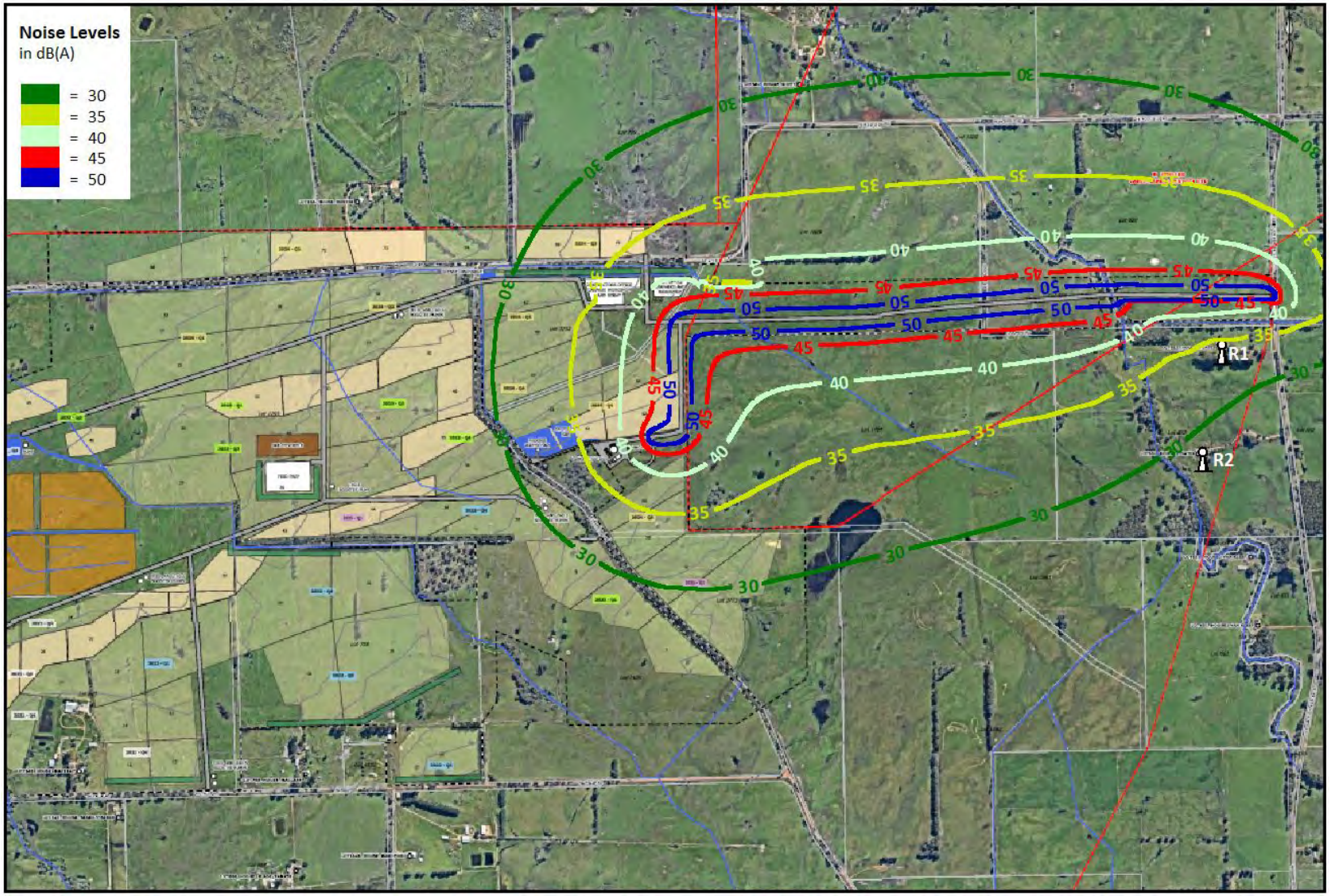


Figure 3: Worst-case noise contours for scenario 2.

ABEC ENVIRONMENTAL CONSULTING PTY LTD
2/17 Inverness Avenue, Dunsborough WA 6281
admin@abecenv.com.au
www.abecenvironmental.com.au

ABEC ENVIRONMENTAL CONSULTING PTY LTD
2/17 Inverness Avenue, Dunsborough WA 6281
admin@abecenv.com.au
www.abecenvironmental.com.au