YALYALUP MINERAL SANDS MINE

GROUNDWATER LICENCE OPERATING STRATEGY

25-MAR-24

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1. INTRODUCTION

The Doral Mineral Sands Yalyalup Project, located approximately 11 km south-east of Busselton, Western Australia (Figure 1). The initial portion of the Project (Yalyalup Mine) was approved by the Department of Environmental Regulation (DWER) on the 17 May 2021 with the issuing of Ministerial Statement 1168 (MS:1168).

Works Approval W6558/2021/1 was granted on the 3rd of October 2021, and EPBC approval for ground-disturbing activities was granted on 12 November 2021.

Construction commenced 15 November 2021, and Time Limited Operations (TLO) commenced 14 April 2022. An amendment to the Works Approval for an extension of TLO was granted on 8 December 2022. TLO ceased on 8 March 2023 with the issue of Operating Licence L9342/2022/1 being granted.

The Yalyalup Mine is located within Mining Lease M70/1400 and Miscellaneous Lease L70/214, which covers an area of approximately 2,290 hectares. It is halfway between Iluka's Tutunup South Mine (closed in 2018) and Tronox's Wonnerup Mine (operating and northern extension).

Doral is proposing a significant amendment of an approved proposal under Section 40AA of the Environmental Protection Act 1986 (EP Act). Specifically, Doral is seeking to expand its current mining operation for the Yalyalup Mineral Sands Project (Figure 2), which operates under Ministerial Statement No.1168, to include an additional 844.92ha of mining area located immediately north of the current operations.

The Proposal includes the expansion of a mineral sands mine, including mine pits with dewatering, to facilitate dry mining techniques. Existing processing facilities, services and support infrastructure will be utilised. Mine voids will be progressively backfilled with sand and clay tailings and rehabilitated to pre-disturbance land use (e.g., pasture).

The expected life of the Yalyalup Project (i.e. Yalyalup Mine and Northern EXtension) is scheduled for 10 -12 years of mining and including the rehabilitation and final closure phase. To enable optimal resource recovery, the mining will occur below the groundwater level, and as a result, dewatering of the open-cut pits will be required to provide dry mining conditions. Superficial aquifer dewatering flows are expected to vary across the project duration, depending on the mining plan and schedule.

Water supplies are required for mineral ore processing and are planned to be sourced from recycled water from hydraulically returned tailings (i.e. sand and clay fines pumped to the mine void and solar evaporation ponds), rainfall-runoff, pit dewatering water and supplemented by pumping from the external production bore in the Yarragadee aquifer (only during periods of water shortfall).

This GLOS has been prepared in accordance with the DWER operational policy 5.08 for reporting associated with operating strategies (DWER, 2020) and the DWER guidelines for the preparation of Operating Strategies for mineral sand mine dewatering licences in the South West Region (DWER, 2015). The GLOS covers groundwater extracted from the Superficial aquifer (during mine dewatering) and the Yarragadee aquifer (for water supply). Additionally, monitoring of surface water monitoring sites is included in this GLOS.

2. ADMINISTRATIVE REQUIREMENTS

2.1. GROUNDWATER LICENCES

Abstractions permitted under the groundwater licences are listed in Table 1 are the subject of this operating strategy.

TABLE 1: PROJECT GROUNDWATER LICENCES

GWL/AGR	GROUNDWATER AREA	WATER RESOURCE	ANNUAL ENTITLEMENT (KL/ANNUM)	LOCATION OF WATER SOURCE	AUTHORISED ACTIVITIES	DATE OF ISSUE	DATE OF EXPIRY
202591(5)	Busselton - Capel	Perth Yarragadee South	394,000	L70/214 Yalyalup M70/1400 Yalyalup	Domestic use Dust suppression for mining purposes Mineral ore processing and other mining purposes Rehabilitation purposes	27 Oct 23	19 Mar 29
208971(1)	Busselton - Capel	Perth Yarragadee South	1,000,000	L70/214 Yalyalup M70/1400 Yalyalup	Dust suppression for mining purposes Mineral ore processing and other mining purposes Rehabilitation purposes	1 Aug 23	31 Dec 27
206603(1)	Busselton - Capel	Perth Superficial Swan	750,000	M70/1400 Yalyalup	Mineral ore processing and other mining purposes	14 Nov 21	30 Dec 30

2.2. STAGED DEVELOPMENT OF WATER LICENCE

Neither groundwater licence applications (for dewatering from the Superficial aquifer and water supply pumping from the Yarragadee aquifer) involve a staged development.

2.3. HYDROGEOLOGICAL AND ENVIRONMENTAL INVESTIGATIONS

Doral has completed a series of investigations covering hydrogeology, modelling, hydrology and environment to assess the dewatering requirements and the potential effects groundwater extraction may have on the aquifer, the environment and the other groundwater users. The most relevant of these are listed below:

- Doral, GDE Management Plan; 2024
- AQ2, Yalyalup Mineral Sands Project, Proposed North Extension, H3 Hydrogeological Assessment, February 2024.
- AQ2, Yalyalup Mineral Sands Project, Site Water Balance, 2023;
- AQ2, Yalyalup Mineral Sands Project, Surface Water Management Plan, Proposed Northern Expansion, September 2023.
- Doral, Acid Sulfate Soil Investigation and Management Plan, 2023.
- AQ2, Yalyalup Mineral Sands Project, Hydrogeological Assessment, May 2020.
- AQ2, Surface Water Assessment for the proposed Yalyalup Heavy Mineral Sands Project, September 2019.
- AQ2, Yalyalup Mineral Sands Operation, Site Water Balance, Project, May 2020.
- AQ2, Doral Yalyalup Operations, Surface Water Discharge Assessment, October 2019.
- AQ2, Yalyalup Mineral Sands Project, GDE Management Plan, October 2020.
- AQ2, Yalyalup Mineral Sand Project, Surface Water Management Plan, May 2021.
- Doral, Acid Sulfate Soil Investigation and Management Plan (DMS17_004_ASSMP_001_EP_V4), August 2021.
- Ecoedge, A Review and Impact Assessment of Potential Water Drawdowns on Groundwater Dependent Ecosystems at the Proposed Yalyalup Mineral Sands Project, November 2019.
- Hydrosolutions, 2017. Initial Hydrogeological Assessment: Proposed Yalyalup Mineral Sands Mine, September 2017.

2.4. WATER RESOURCE MANAGEMENT/ALLOCATION PLAN

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. All these groundwater areas are covered by the Southwest Groundwater Areas Allocation Plan produced by the DWER (DWER, 2009).

The Yalyalup Project is located within the Wonnerup (Busselton Coast) Surface Water Management subarea and is not located within a proclaimed area for surface water management (DWER, 2009). The Project is situated within the Lower Sabina River sub-catchment area. The Lower Sabina River flows from below the Sabina Diversion Weir to the RAMSAR-listed Vasse-Wonnerup Wetlands. The Lower Sabina, Lower Vasse, Abba, and Ludlow rivers drain into the Vasse-Wonnerup Wetlands before discharging through the Wonnerup Inlet into Geographe Bay.

2.5. DURATION OF THE OPERATING STRATEGY

This revised version of the GLOS is intended to apply for the duration of the groundwater licences to March 2029. Amendments to the GLOS may be requested annually as part of the Groundwater Monitoring Summary or Triennial Groundwater Monitoring Report or as necessary to address any changes to the water-supply bore field or monitoring programme or to respond to monitoring data or regulatory changes.

This GLOS requires review at least three months before the expiry date of licences.

2.6. PERSON RESPONSIBLE

Contact details for the person responsible for the implementation of the GLOS are listed in Table 2.

TABLE 2: RESPONSIBLE PERSON/POSITION

Name	Julie Edwards
Position	Environmental Coordinator, Doral Mineral Sands Pty Ltd
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2.7. REPORTING

The annual water year for the Yalyalup Project is from 1 January to 31 December.

The reporting dates of this GLOS will remain in line with the reporting dates required as per the conditions of GWLs and are listed in Table 3.

TABLE 3: REPORTING DATES

ITEM	REPORTING DATES
Water use (metering) data	31 March annually
Annual Groundwater Monitoring Summary (GMS)	31 March annually
Triennial Groundwater Monitoring Review (GMR)	Every three years. Due date of the first report is to be announced.

Annual reports will be submitted to the DWER Bunbury office (and/or via the DWER Water Online Portal) and should follow the reporting structure detailed in DWER Operational policy 5.12: Hydrogeological reporting

associated with a groundwater well licence (2009). An annual GMS report will not be required in the year a triennial review is due.

An annual Groundwater Monitoring Summary (GMS) report will cover monitoring data recorded during the current water year, and it will include:

- a location plan showing relevant bores, discharge sites and active mining cells;
- details of any bores which have been drilled, commissioned or decommissioned;
- current and historical rainfall data to compare long-term averages and variations;
- tabulated meter readings and monthly extraction volumes for each mining cell over the reporting year; water balance estimates;
- graphs of historical monthly and annual extraction data for each mining cell and combined dewatering output;
- tabulated chemistry data for nominated surface water sites and groundwater bores;
- graphs of historical chemistry data including pH, TDS (EC), alkalinity as HCO_3, sulfate:chloride ratio (SO_4:Cl) to clearly identify trends in each monitoring bore and show any indicators of acidification processes;
- tabulated water level data in metres (m) below ground level (bgl) and m AHD for the reporting period;
- graphs of historical water levels;
- an assessment of the effects of the licensee's draw on the groundwater resource and surface water as determined from the monitoring data;
- a comment on the licensee's compliance with the licence and associated monitoring commitments;
- an assessment of the monitoring program and recommendations for any changes to the program;
- provide any information or evidence needed to update information provided in the GLOS.

Every three years, Doral will provide a Groundwater Monitoring Review (GMR) prepared by a qualified hydrogeologist and will provide a complete history of groundwater monitoring over the life of the mine, including a detailed analysis of the aquifer response to groundwater extraction, comparison with modelled predictions and effects on surface water from its use, as monitored in:

- Nominated surface water sites, groundwater production bores and groundwater monitoring bores as reported each year;
- DWER regional monitoring bores.

2.8. GLOS DURATION

This GLOS will be effective for the life of each of the licences (i.e. Superficial and Yarragadee aquifers) for the Yalyalup mine, unless any changes are made by or with the approval of the DWER.

2.9. BREACH OF GLOS

Any reportable breach of this GLOS will be communicated to the DWER as soon as reasonably practicable at the time of the breach and recorded in the annual GMS report.

2.10. GLOS AMENDMENTS AND REVIEW

Any changes to the conditions / commitments of the GLOS that are required during the period of the GLOS must be agreed upon by Doral and DWER, with the signatures of both parties on a GLOS Addendum.

This GLOS requires review at least three months before the expiry date of licences.

3. SCHEME DESCRIPTION AND OPERATING RULES

3.1. MINING AND DEWATERING OPERATIONS

The Yalyalup Project life is approximately 10-12 years, which includes:

- Mining phase: progressive mining via a series of open-cut pits using dry mining techniques. The duration of this phase is expected to be about one hundred and 45 months (i.e., approximately 10 years – May 2035). The total extent of mining and dewatering, including the staged mining zones (i.e., mining quarters), is shown in Figure 3.
- Mine closure phase—Rehabilitation and closure of mining domains will be undertaken in accordance with the Mine Closure Plan. Depending on the success of rehabilitation, this phase is expected to last up to two years. 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.

Mining will be staged in order to minimise the area of disturbance, 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. Each mining zone would be mined over a period of approximately three months. Dewatering of mine pits and associated drawdown of the water table will occur in a staged approach, with mine pits (blocks) being dewatered as per the mining schedule. Should more than one active mine pit be dewatered at any one time, then each dewatering pipeline will be metered separately by a suitable meter before discharge to the Drop Out Dam (DOD) and transferred to the Process Water Dam (PWD).

Doral is planning to extract mineral sands from the Bassendean Sand and Yoganup Formation at the Yalyalup mine. The removed topsoil and overburden will be stockpiled. Ore will be mined in a series of cuts to an approximate maximum depth of 10.5 m. Pits will be mined on a slight incline from the deepest point and then mined moving up-gradient in order to retain pit water within drainage channels to a sump at the deepest point on the pit floor. This form of dewatering is called ‘passive’, as no dewatering apparatus (e.g. spears) is used to actively abstract water and groundwater drawdown below the base of the pit. The groundwater drawdown of any given pit will be related to the pit depth (i.e. up to 10.5 m). Mine pit dewatering is pumped from the sump to the DOD and then to the PWD for reuse.

3.2. WATER DISTRIBUTION NETWORK

Processing of ore will commence in-pit mining to the feed preparation plant, where the slurry will be pumped to the wet concentration plant for further processing (Figure 2). Waste clay and sand materials from the processing of this ore will be combined and backfilled into the mine voids using co-flocculation (co-disposal system).

The surface water runoff from the ‘beaching’ of the co-disposal and/or the decant water from the solar evaporation ponds is recycled back to the DOD and then to the PWD, prior to being re-entered into the separation process again and then to the mine voids and back as a full circuit water recycling process.

The DOD was constructed adjacent to the PWD. Its purpose is to receive all return water from the site and act as a settling pond to remove suspended solids from the water prior to it entering the PWD.

The PWD provides the main water storage from which all process water demands are sourced, with the main inputs of water into the PWD from:

- Recycled process water (primarily water returned from co-disposed sand tails),
- Groundwater from active mine pits during dewatering operations (pit inflows),
- Runoff from impervious disturbance areas (i.e. roads, buildings/structures and hardstands);
- Direct rainfall that falls over the surface of the PWD;
- Abstraction from production bore screened in the Yarragadee aquifer.

The outputs from the PWD are:

- Use of water in the wet concentration plant process;
- Evaporation;
- Discharges of clean water offsite in the event that onsite storage options are full (during extended rain events).

The DOD and PWD have proposed storage capacities of 20,000 m^3 and 40,000 m^3, respectively.

3.3. PROJECTED WATER BALANCE

The site water balance assessment (AQ2, 2023a) using the GoldSim water balance model was undertaken to estimate the likely groundwater make-up supply volume from the Yarragadee production bore, which may be required to support the operation, as well as the potential discharge volumes of surplus water. Two climatic conditions (dry and wet) have been modelled to incorporate the dry and wet dewatering scenarios.

Within the water balance logic and inputs, the recycling of return water from the hydraulically returned tailings (i.e. sand and clay fines pumped to the mine void) comprises the majority of process water, followed by the use of dewatering (site stormwater and groundwater) as the second priority, with the supply of water from the external Yarragadee production bore only used to supplement these sources during periods of water shortfall. Pumping from the Yarragadee production bore will only occur if the total storage volume in the site storage ponds drop below the equivalent of 2 days of supply (nominally 10,000 m^3).

The water balance model indicates that in the driest conditions modelled, the maximum annual abstraction from the Yarragadee aquifer bore is 1.4GL, which is less than the requested groundwater abstraction licence limit of 1.6GL. The highest groundwater bore demand is predicted to occur in the final three years of mining, while 2031 is predicted to have the lowest annual groundwater bore demand. The groundwater demand is inversely proportional to the average pit footprint and catchment areas over the year, with higher demand during the periods with the smaller average catchment areas. As make-up water requirements are highest during drier periods, the "Dry" dewatering scenario results best represent potential maximum water annual water demands during drought periods.

The water balance assessment indicates that during wet periods, there may not be sufficient water demands or on-site storage capacity to manage all the water collected within the pit from stormwater runoff and dewatering, plus runoff collected within the PWD/DOD. The required period where surplus water would be generated is

generally confined to the period between 2029 and 2031. An annual discharge licence in the order of 100,000m^3 (100ML) would allow the site to discharge from the PWD/DOD during wet conditions without impacting operations. The largest annual discharge volume was predicted to be 135,000m^3 across the 100 model iterations. Some buffer storage capacity within the open pit is assumed within this estimation. Therefore, discharge of surplus water off-site maybe be required via licenced discharge points. A surface water discharge licence in the order of 150,000m^3 is suggested, and the licence covers the risk of a wet period occurring during the winters of 2029-2031. Outside this period, the model does not predict there to be a requirement to discharge surplus water.

A schematic water balance for the Yalyalup project is shown in Figure 4.

3.4. WATER SOURCE DESCRIPTION

3.4.1. GROUNDWATER

The Yalyalup mineral sands deposit is located on the southern part of the Perth Basin, an elongate north-south rift trough with a series of sub-basins, shelves, troughs and ridges. The project area is wholly contained within the Bunbury Trough, a sub-basin containing a Permian-Cretaceous succession up to 11 km thick. The sub-basin is wedged between the Vasse Shelf and the Yilgarn Craton, bounded east by the Darling Fault and west by the Busselton Fault.

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

- Superficial;
- Leederville; and
- Yarragadee.

3.4.2. DEWATERING

Dewatering of mining areas will occur via in-pit sumps, located at the deepest point of the pit, with water pumped from the sump to the DOD (either directly or via an open drain and then gravity fed) and then to the PWD. The extracted water will be sourced from the Superficial aquifer, which comprises the Bassendean Sand, Guildford Formation and Yoganup Formation, with a maximum saturated aquifer thickness of 9 m in the mine area. The Guildford Formation is present between the Bassendean Sand and Yoganup Formation and is of low permeability, owing to its more clayey nature. The permeability of the superficial aquifer is variable and depends on sediment type, with saturated sands having higher permeability than clays. The superficial deposits commonly contain ironstone caprock, colloquially known as Coffee Rock, in the zone of water table fluctuation and at the site, it is generally 2 to 3 m thick and is exposed at the surface in parts of the projects (mainly in the western side). At the project, the Yoganup Formation forms the main portion of the aquifer, while the Bassendean Sand is generally only saturated in the wet season. The Yoganup Formation comprises leached and ferruginous beach coarse grained sand, with localised concentrations of heavy minerals and some sandy silt and clay layers. The thickness of the Superficial Formation is irregular, reaching a maximum of 12 m at the project, but generally being 7-8 m thick.

3.4.3. WATER SUPPLY

Two production bores (YA_PB01 and YA_PB02) have been screened in the Yarragadee aquifer to supply sufficient water for the Yalyalup mining operations (Table 4). Both bores are under the existing Yarragadee aquifer groundwater licence GWL205919(4).

TABLE 4. YARRAGADEE PRODUCTION BORE DETAILS

BORE ID	COORDINATES (MGA, ZONE 50)		GROUND ELEVATION	DEPTH CASED	TOP OF CASING ELEVATION	SCREENED INTERVAL	CASING DIAMETER
	EASTING	NORTHING	mRL	m	mRL	mbgl	mm
YA_PB01	361182	6271638	29.0	361.7	29.39	295.7-355.7	168
YA_PB02	359067	6271714	22.0	402	22.67	298-400	168

4. IDENTIFYING AND MANAGING IMPACTS

A summary of key risks relating to groundwater abstraction, management objectives, monitoring and responses is presented in Table 5. These issues are to be managed if impacts are identified from the monitoring programs (Section 6) and are outlined in the Contingency Plan in Section 7.

TABLE 5. IDENTIFICATION, MEASUREMENT AND MANAGEMENT OF ENVIRONMENTAL RISKS

POTENTIAL ISSUE/RISK	MANAGEMENT OBJECTIVE	MEASUREMENT	MANAGEMENT RESPONSE
DEWATERING OPERATION			
Dewatering	To keep water table in the Superficial aquifer at the base of active pit(s) to prevent flooding	Water levels regularly monitored in the active pit(s) and in the Superficial monitoring bores	Increase abstraction from in-pit sumps. Review mining schedule to reduce extraction rates.
Exceeding Superficial Aquifer GWL allocation	To not exceed the Superficial aquifer annual allocation limit	Totalising meters installed and discharge volumes measured for each active mine pit	Investigate changes to pumping or mining schedules to reduce dewatering rates. If the cumulative abstraction reaches a warning trigger of 80% of the annual allocation limit, an internal review will be undertaken to assess the reason for increased inflows to the pit. If the review indicates the potential for the annual allocation limit to be exceeded, DWER will be contacted to discuss an amendment to the annual allocation limit.
Water levels in Superficial aquifer	To not have excessive drawdowns in the Superficial aquifer due to extraction	Water levels regularly monitored in the Superficial monitoring bores	Assessment of water level trends in the Superficial monitoring bores to further determine impact. Review mining schedule to reduce extraction rates or minimise period of exposure of the area of concern. Consider artificial aquifer recharge to reduce impacted areas.
Water levels in Leederville aquifer	To not have excessive drawdowns in the Leederville aquifer due to extraction from the overlying Superficial aquifer	Water levels regularly monitored in the Leederville monitoring bores	Assessment of water level trends in the Leederville monitoring bores to further determine impact. Review pumping or mining schedule to reduce extraction from the area of concern

POTENTIAL ISSUE/RISK	MANAGEMENT OBJECTIVE	MEASUREMENT	MANAGEMENT RESPONSE
Water quality in Superficial aquifer	To not have excessive long-term increase in salinity or significant change in chemical composition of water due to mining	Measure field pH and electrical conductivity and obtain chemical analyses of water from representative monitoring bores	Assessment of water quality trends in the Superficial monitoring bores to further determine impact. Review reasons for changes in chemistry and propose management options to limit or reverse changes.
Water quality in Leederville aquifer	To not have excessive long-term increase in salinity and significant change in chemical composition of water due to dewatering	Measure field pH and electrical conductivity, and obtain chemical analyses of water from representative monitoring bores	Assessment of water quality trends in the Leederville monitoring bores to further determine impact. Review reasons for changes in chemistry and propose management options to limit or reverse changes.
Off-site discharge of water	To not allow any adverse impacts to water quality within the nearby drains (Princefield Road drain and Woddidup Creek/drain) due to off-site discharge of water during emergency discharge events	Water quality monitoring in the PWD and the off-site discharge points, when required	Provision for sufficient capacity to allow for settling time of surface water. Adequate surface water treatment to maintain water quality parameters (e.g. pH management) to within environmental trigger values. Assessment of water quality in the PWD and if necessary (i.e. triggers exceeded), then treatment of the process water through the addition of a suitable alkaline material to the ore feed and or the tails return water sump, until the water is within the trigger values. Whilst the process water dam quality exceeds the trigger values, discharge of process water off site will cease.
Abnormal surface drainage	To manage any unseasonal increase in surface water flows and water quality	Surface water monitoring	Assessment of surface water flows and water quality to further determine any unseasonal changes
Acid Sulphate Soils	To not allow the oxidation of PASS due to mining operations	Dewatering effluent water quality monitoring, especially pH, Fe and SO_4	Increase monitoring frequency of water quality of the abstracted water from the pit and treat with neutralising agent (e.g. lime), if necessary

POTENTIAL ISSUE/RISK	MANAGEMENT OBJECTIVE	MEASUREMENT	MANAGEMENT RESPONSE
	To not allow off-site impacts to groundwater, due to the release of acid and mobilization of metals	Water quality monitoring in the Superficial aquifer for potential ASS impacts	Any exceedance of chemistry trigger levels in the Superficial aquifer, must be investigated for potential ASS site contamination and, if necessary, implement contingency actions specified in the ASS Management Plan
Groundwater Dependent Ecosystems (GDEs)	To not adversely impact (directly or indirectly) the health of GDE vegetation along the McGibbon Track due to dewatering	Water Level monitoring in the Superficial aquifer in bores directly adjacent to the McGibbon Track, GDE_1, GDE_2, GDE_5, GDE_7 and GDE_8.	Development and implementation of GDE Management Plan Frequent assessment of water levels in the Superficial aquifer via network of monitoring bores and if water levels are below the average low annual measured water level in the bores adjacent to the McGibbon Track and/or at the Yalyalup Northern Extension, increase vegetation monitoring. If any exceedance of water level triggers (i.e. >25 cm below the average low annual measured water level) or vegetation triggers (i.e. Leading and Lagging Indicator triggers) artificially supplement the hydrological regime at McGibbon Track and/or at the Yalyalup Northern Extension (via surface and/or subsurface irrigation using clean Yarragadee groundwater).
Impacts on other adjacent landowners	To not adversely affect the productivity of pasture/horticulture due to mine dewatering	Water level and water quality monitoring in the Superficial monitoring bores nearby the area of concern	Investigate concerns from the local landowners; Assessment of water levels and water quality in the Superficial aquifer to further identify impact and identify measures to reduce impacts.
	To not adversely affect the groundwater availability in the Superficial aquifer to other users, due to mine dewatering	Water level monitoring in the other user's Superficial bores	Assessment of water level trends in the Superficial and Leederville monitoring bores to further determine impact.

POTENTIAL ISSUE/RISK	MANAGEMENT OBJECTIVE	MEASUREMENT	MANAGEMENT RESPONSE
	To not adversely affect the groundwater availability in the underlying Leederville aquifer to other users, due to mine dewatering	Water level monitoring in the other user's Leederville bores	Provide an alternative source of water of similar quality and quantity to meet usage requirements until groundwater levels return to normal.
WATER SUPPLY OPERATION			
Reliable water supply	To supply sufficient water, within the Yarragadee licence allocation limit	Totalising meters installed and discharge volumes measured for production bore.	Investigate additional (alternative) option to supply sufficient water for ore processing; Development of additional production bore, if required. Ongoing innovation in water recycling and reuse across the site
Water levels in Yarragadee aquifer	To not have excessive drawdowns in the Yarragadee aquifer due to abstraction	Water levels regularly monitored in the Yarragadee production and monitoring bores	Assessment of water levels in all Yarragadee bores to further determine impact. Reduce or amend pumping operation of the production bore
Water levels in Leederville aquifer	To not have excessive drawdowns in the deep (Vasse Member) Leederville aquifer due to abstraction from the underlying Yarragadee aquifer	Water levels regularly monitored in the deep Leederville (Vasse Member) monitoring bores	Assessment of water levels in all Leederville (Vasse Member) bores to further determine impact. Reduce or amend pumping operation of the production bore
Water quality in Yarragadee aquifer	To not have excessive long-term increase in salinity and significant change in chemical composition of Yarragadee water due to abstraction	Measure field pH and electrical conductivity, and obtain chemical analyses of water from production bore	Assessment of water quality in the Yarragadee production bore to further determine impact. Reduce or amend pumping operation of the production bore, if appropriate.
Impacts on other users	To not adversely affect the groundwater availability in the underlying Leederville aquifer to other users due to mine dewatering	Water level monitoring in the other user's Leederville bores	Assessment of water level trends in the Leederville and Yarragadee monitoring bores to further determine impact. Provide an alternative source of water of similar quality and quantity to meet usage requirements until groundwater levels return to normal.

4.1. POTENTIAL IMPACTS ON NEIGHBOURING LANDOWNERS

4.1.1. MINE DEWATERING

A numerical groundwater flow model was prepared to assess the dewatering requirements and groundwater drawdown associated with the development of the Yalyalup Project. The modelling indicated that all Superficial aquifer licensed bores are located outside of the predicted 0.1 m drawdown contour and are unlikely to be impacted by the dewatering operations.

Additionally, there are several unlicensed bores across the Northern Extension area, which are screened in the Superficial aquifer that are within the modelled extent of the 0.1 to 0.5 m drawdown contours (generally between 0.1 and 0.25 m). Most of them have either been decommissioned or used by DWER for monitoring purposes. If any of these unlicensed bores that have fallen within the modelled drawdown zone of between 0.1 to 0.5 m due to mining dewatering are still in use – this limited drop in water level is unlikely to influence their supply potential.

The numerical model also indicated that small drawdowns (less than 0.1 m) are predicted in the Leederville aquifer due to dewatering of the overlying Superficial aquifer. However, there are no Leederville aquifer licenced bores located within the drawdown extent of 0.1 m that could be affected by mining related dewatering.

It is therefore unlikely that short-term dewatering for the Yalyalup Project will have any long-term adverse impacts on the water supply potentials of other users in the Superficial and Leederville aquifers.

Regular monitoring of groundwater levels in the Superficial and Leederville bores (as per this GLOS) and the clear communication with the nearby groundwater users during the mining operation, will provide information on the actual induced drawdowns and impacts on the other users. If any of the Superficial and Leederville bores are affected by Doral's mining operations, then Doral will implement mitigation measures to account for any impacts to neighbouring users.

The extent of dewatering impacts for the Yalyalup Project will be monitored according to Table 12 (Section 6.3), with results reviewed on a quarterly basis. If a concern is raised regarding potential impacts to water supplies or vegetation due to dewatering, Doral will undertake an assessment of the monitoring data from nearby monitoring bores, to further determine the cause of impact. Should this assessment and further investigation determine that Doral's operation is having an impact on a neighbour's water supply, Doral will put in place interim remedial measures as soon as practical to effectively 'make good' the water supply and inform the DWER of the interim actions taken and proposed actions for the future.

4.1.2. YARRAGADEE WATER SUPPLY ABSTRACTION

Additionally, the AQ2 numerical groundwater model was used to assess the potential impacts of the planned abstraction from the Yarragadee aquifer on the environment and other groundwater users.

Results of the modelling indicate that the proposed extraction of 1.6 GL/year from the Yarragadee aquifer will be unlikely to have any adverse impacts on the water supply and water quality potentials of the aquifer systems. At the site, the Yarragadee aquifer is a confined aquifer with limited downward leakage from overlying aquifers. This is due to the presence of low permeable confining layers between the aquifers, in particular with the deep Leederville (Vasse Member) aquifer.

There are four known licensed bores under GWL156423, GWL110298, GWL151407 and GWL156776 that abstract water from the Yarragadee aquifer that are located within the modelled extent of the 0.5 m and 1 m drawdown cones developed around the production bore (i.e. within 4.1 km, 4.26 km, 4.7 km and 4.9 km from bore YA_PB02)

The numerical model also indicated that small drawdowns (less than 0.1 m) are predicted in the Leederville aquifer due to pumping from the underlying Yarrgadee aquifer.

The numerical model also indicates that small drawdowns (less than 0.05 m) are predicted in the Leederville aquifer due to pumping from the underlying Yarragadee aquifer, but this is not significant and should not impact any other Leederville aquifer user.

Given the short duration of the abstraction from YA_PB02 and any additional Yarragadee production bore, the impacts to other Yarragadee aquifer users is not expected to be significant. It should be noted that continuously pumping from YA_PB02 has been modelled, whilst it is planned that YA_PB02 and any other production bores will be used only when required, most likely during summer periods when there is a shortfall of water supplied from rainfall runoff and pit dewatering. Therefore, during the winter periods when minimal to no pumping from the Yarragadee aquifer occurs, water levels will recover and the actual drawdowns in the Yarragadee and Leederville aquifers will be smaller than predicted.

Regular monitoring of groundwater levels in the Yarragadee and deep Vasse Member of the Leederville bores (as per GLOS) and clear communication with nearby groundwater users during the mining operation will provide information on the actual induced drawdowns and impacts on the other users.

The extent of abstraction impacts will be monitored according to Table 12 (Section 6.3), with results reviewed on a quarterly basis. If a concern is raised from another local landowner regarding potential impacts to water supplies due to abstraction from the Yarragadee production bore, Doral will undertake an assessment of the monitoring data from nearby monitoring bores to further determine the cause of impact. Should this assessment and further investigation determine that Doral's operation is having an impact on a neighbour's water supply, Doral will put in place interim remedial measures to allow the water level to recover as soon as practical and inform the DWER of the interim actions taken and proposed actions for the future.

5. OPERATING RULES

5.1. RECOMMENDED OPERATING SCHEMES

Seasonally the site transitions from a water surplus in winter months, to a water deficit during summer months. During winter months water intercepted on the mining footprint via mining activities is retained onsite. Captured water is treated for sediment removal prior to reuse. If dam storages exceed, discharge to the environment after treatment may occur. Occasionally, during periods of sustained high rainfall, small volumes of water are discharged downstream at monitored licenced `emergency discharge' sites.

5.1.1. WATER SOURCES

The site receives/obtains water from a number of sources:

- Incidental rainfall;
- Intercepted shallow groundwater and local runoff (winter/spring);
- In pit dewatering sump(s) in the Superficial aquifer (winter/spring);
- Yarragadee production bores (summer/autumn); and
- Recovery of water from tailings.

5.1.2. DEWATERING OPERATION

During the operational period for the Yalyalup Project, Doral is committed to the following:

- Doral will not exceed the maximum water draw (i.e. annual water allocation) of 750,000 kL/year (i.e. 0.75 GL/year) from the Superficial aquifer;
- The volume of water taken from the individual pits dewatered under the Superficial GWL, will be metered using suitable type flow meters, that will be installed in accordance with the provisions of the document "Guidelines for water meter installation" (DWER, 2009). The installed meters accuracy will be maintained within plus or minus 5% of the volume metered, in field conditions;
- Should more than one active mining pit be dewatered at any one time, then the pipeline from each pit will be metered separately by a suitable meter, before discharge to the DOD;
- Pits will be dewatered as required, so no constraints have been set on dewatering pumping rates from the mine pits to the DOD. The pumping rate into the DOD from the in-pit sumps will vary depending on the pit inflows at each active pit (with monthly groundwater inflows in the range of 0 kL/d to 4,000 kL/d, generally less than 2,000 kL/d throughout the mine life), and dependent on additional external inflows e.g. tails return water, stormwater catchment;
- Maintain a record of flow meters for the dewatering program and submit to the DWER, via DWER Water Online Portal.

5.1.3. AQUIFER DEWATERING VOLUMES

Measurement of the actual volume of groundwater abstracted during mine dewatering is complicated by the inflow of surface water, direct rainfall into the open pits and the return water from the sand tails and the SEPs to the sumps. The resulting total volume of water pumped from the in-pit sumps is therefore much greater than the volume of pure groundwater removed from the aquifer.

All water recorded as having been drawn from the active mining pits via in-pit sumps is to be used for compliance against the GWL annual allocation, but will require to be reduced as best as can be reasonably calculated by the:

- Volume of stormwater (i.e. direct rainfall) entering the active pit dewatering sump;
- Volume of stormwater from catchments directed to the active pit dewatering sump;
- Volume of return sand tails water flowing to the active pit sump;
- Volume of SEP decant water flowing to the active pit sump.

A simple water balance approach will be employed to allow all volumes of indirect water directly collected in the pit throughout the year to be deducted from the total volume of water abstracted during dewatering. Daily rainfall data collected at the nearest Bureau of Meteorology (BoM) weather station; Busselton Aero (Station No. 9603) will be used to calculate the volume of rainfall entering the active pit. As the mine progresses, the surface area of the active dewatering pit(s) will be surveyed and therefore allow for the water catchment to be calculated using GIS software and mine survey data.

The total volume of groundwater abstracted during mine dewatering will be compared with the annual water allocation to determine compliance with the Superficial GWL condition.

5.1.4. WATER SUPPLY OPERATION

During the operational period for the Yalyalup Project Doral commits that:

- The mine will not exceed the maximum water draw of 1,394,000 kL/year (i.e. 1.394 GL/year) from the Yarragadee aquifer;
- The volume of water taken under the Yarragadee GWL will be metered using suitable type flow meters, that will be installed in accordance with the provisions of the document “Guidelines for water meter installation” (DWER, 2009). The installed meters accuracy will be maintained within plus or minus 5% of the volume metered, in field conditions;
- Any Yarragadee production bore will be equipped with an electric submersible pump with suitable operational protection (e.g. low-flow and high-temperature cut-off switches);
- Any Yarragadee production bore will be operated according to water demand, with no set schedule, and a manually set timer to ensure the bore does not run to waste.

5.2. WATER RE-USE

Passive recharge back to the Superficial aquifer will occur through the progressive backfill of co-disposed sand tails slurry to the mine void and any water from this operation will be recycled back to the DOD/PWD for re-use. It is anticipated that all water collected on-site, including groundwater pumped from the active mine pits during dewatering, surface water inflow into open pits, rainfall into the open pits, SEPs and sand tails return and surface runoff collected from the mine site (that did not enter the open pits), will be fully utilised during the wet concentration plant process.

Water required for dust suppression activities may be sourced from water storage sources such as the DOD and/or PWD and the return water sumps.

The Yalyalup Project will operate in a water efficient manner, thus surplus water generation is only likely to be as a direct result of rainfall. Therefore, the possibility of providing an off-site water supply to a third party is limited;

however, upon arrangement with Doral and the local authorities (e.g. DFES, Rural fire brigade), there is a possibility of water being provided to assist with a reasonable request such as bush fire management or other significant situations. Doral will consider any request in line with their clear commitment to the safety and well-being of the adjacent community.

5.3. OFF-SITE DISCHARGE WATER

In the event of all water storages (i.e. mine voids, PWD, DOD, SEPs and drains) being at their full capacities and prolonged heavy rainfall occurs within the pit catchment area, then excess water will have to be discharged off-site site via the proposed controlled "Licensed Discharge Point" (located at the eastern end of Lot 1293/3752 on Princefield Road), as shown on Figure 2. The excess water could include a mixture of groundwater, surface inflow, direct rainfall, SEP returns, sand tails returns and surface runoff collected from the mine site. Excess water flows that will exit the PWD will be measured at the proposed "Licensed Discharge Point". Once discharged from the PWD, water will move through the on-site drainage network into the Princefield Road drain flowing west into Woddidup Creek/drain before reaching the Lower Sabina River northwest of the mine, where it will ultimately discharge into the Vasse-Wonnerup Ramsar wetlands.

During extreme rainfall events, excess water is proposed to be able to be discharged off the mine site via the proposed "Emergency Discharge Points", located in the northwestern corner of the Yalyalup mine, , and at several locations for the Yalyalup Northern Extension (Figure 2). The Licenced discharge point for the Yalyalup Project will remain connected to the existing roadside drain along the Princefield Road.

A V-notch flow metering gauge will be installed at the proposed Licenced Discharge point. The Emergency Discharge location is proposed to be actively enacted by the pump to ensure it is a last resort only and upon which the pump flow curves will enable flow measurement.

Doral will ensure that the DWER will be notified of any alterations or additions made concerning off-site discharge water locations.

It should be noted that all runoff from catchment areas upstream of the mine envelope will be diverted around mining operations and discharged to a downstream water course. Bunding and drainage shall be installed to ensure that up-gradient stormwater does not flow into the mining area and potentially impede the region's natural surface water flows. To minimise the potential impacts on local surface water features, a Surface Water Management Plan (SWMP) for the Yalyalup mine has been prepared (AQ2, 2023a) and will be implemented by Doral.

5.4. SURFACE WATER

A network of surface water monitoring sites (SWMS) for the existing Yalyalup Mine (YALSW01 to YALSW15) and Northern Extension (YALSW16 to YALSW23) have been selected to monitor water quality chemistry. SWMS are shown in Figure 5 and are summarised in Table 6. Monitoring of surface water levels and quality at these locations allows for recording any unseasonal increases in water levels, seasonal fluctuations and any changes in basic water chemistry, pre-mining and during the period of the mine operations.

Doral will ensure that the DWER will be notified of any alterations or additions that are made in relation to surface water monitoring locations.

TABLE 6. SURFACE WATER MONITORING SITES

SITE NAME	APPROX. LOCATION (MGA50)		LOCATION DESCRIPTION	COMMENT
	EASTING	NORTHING		
EXISTING SWMS				
YALSW01	355307	6269882	Original Sabina River channel.	Limited area surface flows ~1km Downstream from Sabina Diversion weir.
YALSW02	356614	6269990	Artificial drainage flows from paddocks within Lot 421	Artificial drainage flows from paddocks within Lot 421
YALSW03	357034	6270001	Woddidup Creek flows, semi regional, ~3.0km x 2.0km catchment	Woddidup Creek flows, semi regional, ~3.0km x 2.0km catchment
YALSW04	357848	6270038	Ag dam Lot 758.	Seepage from Bassendean Sands in close proximity to proposed mining
YALSW05	359214	6270070	Un-named Creek, catchment estimated 2.0km x 2.0km	Un-named Creek, catchment estimated 2.0km x 2.0km
YALSW06	356099	6270231		Optional, alternate site if YALSW02 access is poor
YALSW07	356887	6270304	Farm dam	Farm dam
YALSW08	356081	6270852		Optional, alternate site if YALSW02+06 access is poor
YALSW09	357805	6270840		Un-named Creek/Artificial drains in centre of project
YALSW10	355520	6271611		Downslope sampling site for western margins of project.
YALSW11	356540	6271665	Existing	Important for Woddidup Creek monitoring. Will be used for extension area SWMS as well.
YALSW14	358604	6271766	Existing	Important for potential Abba River Flooding. Will be used for extension area SWMS as well.
YALSW15	359297	6271785	Existing	Important till current licenced discharge point is removed. Will be used for extension area SWMS as well.

SITE NAME	APPROX. LOCATION (MGA50)		LOCATION DESCRIPTION	COMMENT
	EASTING	NORTHING		
ADDITIONAL EXTENSION AREA SWMS				
YALSW16	360766	6271588	Upstream (US) Abba River & downstream (DS) Abba River Drain intersection point	Note, Abba River at Ludlow-Hithergreen Road is seasonally dry.
YALSW17	361262	6271591	US Abba River Drain near Ludlow-Hithergreen Rd	
YALSW18	359860	6273060	Abba River & DS (Water Corporation) WCORP Drain intersection point. Just DS of Extension Area B Emergency Discharge (ED).	Try to place in a location that best captures both: - The combined flow of the Abba River and WCORP Drain (ideally at intersection). - Steady state flow when Extension Area B ED is operating (potentially further DS of intersection).
YALSW19	361287	6272653	US WCORP Drain near Ludlow-Hithergreen Road	
YALSW20	359252	6274217	DS Abba River & Extension Area C	
YALSW21	357105	6273073	DS of Area Extension D	Ideally this is to be as close to Extension Area D as possible, but investigations suggest this part of the channel is often dry. Place where there is reliable flow (location provided is indicative). Note, pre-mine monitoring will be particularly important as other catchments will contribute to the recordings measured. Abba River likely contributes to channel/floodplain in larger events.
YALSW22	355464	6272875	DS Woddidup Creek near Wonnerup S Rd (less preferable)	Not essential if monitoring sites collate reliable data in the 2 contributing tributaries upstream.
YALSW23	356371	6272550	DS Extension Area E ED (preferred)	Preferred over Wonnerup S Rd location. Try place in a location that best captures steady state flow when Extension Area E ED is operating.

6. MONITORING AND REPORTING

The reporting dates for dewatering and water supply activities are outlined in Table 3.

6.1. PURPOSES OF THE GROUNDWATER MONITORING PROGRAM

Doral implements a monitoring program to achieve the following objectives:

- Measure abstraction volumes (and water levels) in the production bores to assess whether the bores operate within their pumping capacities and that the total annual abstraction is within the licence limit;
- Measure abstraction volumes of the in-pit sump(s) to inform assessments of total abstraction /recharge and evaluation against licence limits;
- Measure water levels in the production and monitoring bores to allow for assessment of impacts on the Superficial and Leederville aquifers, the environment, and other groundwater users;
- Measure water quality data in the production and monitoring bores to allow for an assessment of the influence of abstraction on groundwater quality;
- Describe water quality variations in salinity, major ions and pH over time; and
- Measure water levels and assess condition of conservation significant vegetation.

The program has been revised based on the results of the first three years of intensive monitoring and in accord with recommendations stemming from a Triennial Aquifer Review (Groundwater Resource Management, 2018).

6.2. WATER USE MONITORING

A totalising (cumulative) flow meter will be installed at each active in-pit and Yarragadee water abstraction source, V-notch flow gauge will be installed at the proposed "Licensed Discharge Point" and proposed "Emergency Discharge Point" will be measured by flow rates (Figure 2). The proposed extraction monitoring program is provided in Table 7.

TABLE 7: PROPOSED ABSTRACTION MONITORING PROGRAM

MONITORING PURPOSE	DRAW POINT ID	DESCRIPTION OF METER INSTALLED (MAKE, SERIAL NO., INSTALLATION DATE)	METER MAINTENANCE/ CALIBRATION SCHEDULE	FREQUENCY OF RECORDING METER DATA
Pit dewatering volume	Pit Dewatering	Make: Aquamaster, serial no. 3K220000101352, installed 14/03/2022. Make: Aquamaster, serial no. 3K220000543162, installed 20/07/2022.	Maintenance – Annually Calibration – As required	Weekly

MONITORING PURPOSE	DRAW POINT ID	DESCRIPTION OF METER INSTALLED (MAKE, SERIAL NO., INSTALLATION DATE)	METER MAINTENANCE/ CALIBRATION SCHEDULE	FREQUENCY OF RECORDING METER DATA
		Make: Aquamaster, serial no. 3K220000535787, installed 8/11/2022. Make: Siemens, serial no. 299921D152, installed 12/09/2023.		
Yarragadee abstraction volume	Production Bores YA_PB01 and YA_PB02	YA_PB01 – Make: Triangle, serial no. 21900473, installed 06/12/2021. YA_PB02 – Make: Zenner, serial no. 21904076, installed 24/11/2022.		Monthly
Off-site Licenced Discharge Volume	Proposed Licensed Discharge Point	V-notch	Not applicable	Daily (when in use)
Off-site Emergency Discharge volume	Proposed Emergency Discharge Point	Yalyalup Emergency Discharge Point – Make: Siemens, serial no. 332621D262, installed 02/08/2023. Northern Extension Emergency Discharge Point TBC		Daily (when in use)

The water meters will be inspected regularly for faults, maintenance will be undertaken as required and calibration will be carried out according to the manufacturer's specifications. Details of any significant meter maintenance and replacement will be collated throughout the water year and incorporated into the annual monitoring summary.

6.3. WATER LEVEL MONITORING

Twelve superficial monitoring bores (YA_MB01S to YA_MB012S) were installed across the Yalyalup Mine site to the base of the Superficial Formation (i.e. Yoganup Formation). Additionally, five GDE monitoring bores (YA_MB33_GDE to YA_MB37_GDE) were installed into the Superficial aquifer in May 2020 to allow monitoring of water level changes within groundwater dependent vegetation on McGibbon Track. In 2023, seven additional superficial monitoring bores (YA_MB38 to YA_MB44) were installed to the base of the Superficial aquifer to allow monitoring of water level changes of the proposed Northern Extension. Five additional GDE monitoring bores

(YA_MB45_GDE and YA_MB48_GDE) are proposed to be installed in the Superficial aquifer in April 2024 to allow monitoring of water levels in groundwater dependent vegetation along Princefield Rd within the Northern Extension area. Water level monitoring will be conducted to establish a pre-disturbance baseline and pre-dewatering and then more frequently during active dewatering activities adjacent to this area. Locations of the groundwater monitoring bore network are shown in Figure 6. Details of monitoring bores are provided in Table 8.

An additional 22 existing DWER and private bores have been monitored to obtain the baseline groundwater monitoring data from the Superficial and Leederville aquifers (i.e., 10 Superficial and 12 Leederville monitoring bores). Their details are presented in Table 9, and their locations are shown in Figure 7.

TABLE 8. YALYALUP - MONITORING BORE DETAILS

BORE ID	COORDINATES (MGA, ZONE 50)		GROUND ELEVATION #	CURRENT CASED TOTAL DEPTH#	TOP OF CASING (TOC)	TOC ELEVATION	PVC CASING DIAMETER	SCREENED/ SLOTTED INTERVALS	AQUIFER	STATUS
	Easting (m)	Northing (m)	(mAHD)	(mbgl)	(mAHD)	(mbgl)	(mm)	(mbgl)		
EXISTING MONITORING BORE DETAILS										
YA_MB01S	357253	6270021	23.46	5.01	24.18	0.72	50	1-7	Superficial	Current
YA_MB02S	356760	6270882	20.23	7.16	21.17	0.94	50	3-9	Superficial	Current
YA_MB03S	356989	6271678	18.76	8.66	19.22	0.46	100	1.8-7.8	Superficial	Current
YA_MB04S	357789	6270637	22.86	7.56	23.57	0.71	50	3-9	Superficial	Current
YA_MB05S	357787	6270960	21.80	7.64	22.28	0.48	100	1.5-7.5	Superficial	Current
YA_MB06S	357960	6271720	20.52	7.43	20.95	0.43	100	1.3-7.3	Superficial	Current
YA_MB07S	358606	6270858	25.04	7.26	25.83	0.79	50	2-8	Superficial	Current
YA_MB08S	358589	6271310	23.24	9.42	23.65	0.41	100	3.3-9.3	Superficial	Current
YA_MB09S	359401	6270501	30.58	7.65	31.2	0.62	50	2-8	Superficial	Current
YA_MB10S	359305	6270896	28.51	4.65	29.26	0.75	50	1-7	Superficial	Current
YA_MB11S	359295	6271545	24.69	8.22	25.14	0.45	100	1.8-7.8	Superficial	Current
YA_MB12S	359159	6271808	22.79	8.51	23.24	0.45	100	2.5-8.5	Superficial	Current

BORE ID	COORDINATES (MGA, ZONE 50)		GROUND ELEVATION #	CURRENT CASED TOTAL DEPTH#	TOP OF CASING (TOC)	TOC ELEVATION	PVC CASING DIAMETER	SCREENED/ SLOTTED INTERVALS	AQUIFER	STATUS
	Easting (m)	Northing (m)	(mAHD)	(mbgl)	(mAHD)	(mbgl)	(mm)	(mbgl)		
YA_MB33_GDE	358889	6271018	25.78	3.97	26.43	0.65	50	0.5-4.0	Superficial	Current
YA_MB34_GDE	358725	6271158	24.61	6.26	25.22	0.61	50	0.4-6.4	Superficial	Current
YA_MB35_GDE	358599	6271570	21.98	6.0	22.54	0.56	50	0.5-6.0	Superficial	Current
YA_MB36_GDE	359075	6270792	27.95	5.41	28.56	0.61	50	0.5-5.5	Superficial	Current
YA_MB37_GDE	359475	6271786	24.47	4.92	25.01	0.54	50	0.5-5.0	Superficial	Current
NORTHERN EXTENSION BORES										
YA_MB38S	358680	6272790	19.0	8.59	19.66	0.66	50	6.0-9.0	Superficial	Current
YA_MB39S	359720	6272500	23.3	8.82	24.00	0.70	50	6.0-9.0	Superficial	Current
YA_MB40S	360300	6271960	26.7	8.70	27.45	0.75	50	5.0-9.0	Superficial	Current
YA_MB41S	360760	6273755	21.8	8.53	22.43	0.63	50	5.0-9.0	Superficial	Current
YA_MB42S	361220	6273035	25.0	9.08	25.68	0.68	50	7.0-9.0	Superficial	Current
YA_MB43S	361220	6272515	26.3	5.85	26.96	0.66	50	4.0-6.0	Superficial	Current
YA_MB44S	357160	6272735	17.0	6.73	17.52	0.52	50	3.0-7.0	Superficial	Current
YA_MB45_GDE	359247	6271808	TBA	TBA	TBA	TBA	TBA	TBA	Superficial	Current
YA_MB46_GDE	360270	6272136	TBA	TBA	TBA	TBA	TBA	TBA	Superficial	Current

BORE ID	COORDINATES (MGA, ZONE 50)		GROUND ELEVATION #	CURRENT CASED TOTAL DEPTH#	TOP OF CASING (TOC)	TOC ELEVATION	PVC CASING DIAMETER	SCREENED/ SLOTTED INTERVALS	AQUIFER	STATUS
	Easting (m)	Northing (m)	(mAHD)	(mbgl)	(mAHD)	(mbgl)	(mm)	(mbgl)		
YA_MB47_GDE	360191	6272238	TBA	TBA	TBA	TBA	TBA	TBA	Superficial	Current
YA_MB48_GDE	360748	6272281	TBA	TBA	TBA	TBA	TBA	TBA	Superficial	Current
YA_MB49_GDE	360975	6272282	TBA	TBA	TBA	TBA	TBA	TBA	Superficial	Current

TABLE 9. YALYALUP - EXISTING OTHER USER'S BORE (REGIONAL AND LOCAL) DETAILS

BORE ID	COORDINATES		GROUND ELEVATION #	SCREENED DEPTH	TOP OF CASING (TOC)	AQUIFER	STATUS
	Easting (m)	Northing (m)	(mAHD)	(mbgl)	(mAHD)		
EXISTING OTHER USER'S BORE (REGIONAL AND LOCAL) DETAILS							
YA_MB14_W	358052	6272283	20.5	3.6	0.40	Superficial	Current windmill, suitable for water levels monitoring only
YA_MB15_W	358644	6270521	25	5.5	0.50	Superficial	Current bore, suitable for water levels monitoring only
YA_MB16_W	357995	6269748	28	8.54	0.25	Superficial	Current bore, suitable for water levels monitoring only
YA_MB17_W	357282	6270170	23.5	3.7	0.01	Superficial	Current bore, suitable for water levels monitoring only
YA_MB18_W	357402	6269919	23.8	4.3	0.00	Superficial	Current bore, suitable for water levels and quality monitoring
YA_MB19_W	356737	6271639	18.1	3.8	0.10	Superficial	Current windmill, suitable for water levels monitoring only
YA_MB20_W	359000	6269832	30.5	3.4	0.10	Superficial	Current bore, suitable for water levels monitoring only
SCPD28A	358612	6271752	21.2	9	0.00	Superficial	DWER bore, suitable for water levels and quality monitoring
SCPD29A	359916	6269605	34.8	9.5	0.00	Superficial	DWER bore, suitable for water levels and quality monitoring
TS012M	358329	6270015	29.24	9	0.48	Superficial	Current bore, suitable for water levels and quality monitoring
YA_MB21_W	359572	6270576	30	17	0.25	Leederville	Bore removed by landowner September 2023
YA_MB22_L	357207	6270142	23.5	16.5	0.05	Leederville	Defunct bore, suitable for water levels and quality monitoring
YA_MB23_L	358326	6272028	20.5	42	0.10	Leederville	Current bore, suitable for water levels and quality monitoring
YA_MB24_W	357928	6271837	19.8	48	0.45	Leederville	Bore installed at top of casing March 2023, unable to measure level.
YA_MB30_W	357993	6269748	28	69	0.10	Leederville	Current bore, suitable for water levels monitoring only
YA_MB25_L	356347	6270064	22.25	70	0.10	Leederville	Current bore, suitable for water quality monitoring (pump in bore)
YA_MB26_W	356712	6271194	19.2	16	0.15	Leederville	Windmill removed by landowner, bore collapsed December 2021
YA_MB27_L	357323	6269971	25	48	030	Leederville	Current bore, suitable for water quality monitoring (pump in bore)
YA_MB28_W	356220	6269870	23	70	0.00	Leederville	Current bore, suitable for water quality monitoring (pump in bore)
YA_MB29_W	358311	6269190	29	11	0.35	Leederville	Current bore, suitable for water quality monitoring (pump in bore)
YA_MB31_L	357996	6269745	28	25.3	0.25	Leederville	Current bore, suitable for water levels and quality monitoring
YA_MB32_L	358002	6270118	25.5	30	0.10	Leederville	Current bore, suitable for water quality monitoring (pump in bore)

It should also be noted that during the construction of the first Yarragadee production bore YA_PB01 mid-2021, a nest of four monitoring bores (YA_MB13S, YA_MB13M, YA_MB13V and YA_MB13Y) were constructed separately into the Superficial, shallow Leederville (Mowen Member), deep Leederville (Vase Member) and Yarragadee (Unit 3) aquifers, to allow monitoring of water level changes in each aquifer during mining operations (Figure 8). In 2022, Doral drilled, constructed and test-pumped a second Yarragadee production bore (YA_PB02) at the Yalyalup mine, providing the required abstraction rate of 50 L/s needed for mine water supply purposes. Additionally, a nest of three monitoring bores (YA_MB12M, YA_MB12V and YA_MB12Y) between 10 to 30 m west of YA_PB02 have been installed separately into the shallow Leederville, deep Leederville and Yarragadee aquifers (Figure 8). Furthermore, two existing private bores have been added to monitor water level changes on a regional scale. Construction details for these monitoring bores are summarised in Table 10.

TABLE 10. DETAILS OF EXISTING NEST OF YARAGADEE MONITORING BORES

BORE ID	COORDINATES (MGA, ZONE 50)		GROUND ELEVATION #	CURRENT CASED TOTAL DEPTH#	TOP OF CASING (TOC)	TOC ELEVATION	PVC CASING DIAMETER	SCREENED/ SLOTTED INTERVALS
	Easting (m)	Northing (m)	(mAHD)	(mbgl)	(mAHD)	(mbgl)	(mm)	(mbgl)
YA_MB12M	359098	6271720	26	100	306-402	23.03	Mowen Member (Leederville)	Nest of bores located approx. 10-30m west of YA_PB02
YA_MB12V	359088	6271718	60	100	54-60	22.94	Vasse Member (Leederville)	
YA_MB12Y	359078	6271716	402	100	20-26	22.93	Yarragadee (Unit 3)	
YA_MB13S	361158	6271638	5.5	100	1-5.5	29.58	Superficial	Nest of bores located approx. 10-25m west of YA_PB01
YA_MB13M	361162	6271638	17.5	100	11.5-17.5	29.56	Mowen Member (Leederville)	
YA_MB13V	361168	6271638	89	100	83-89	29.55	Vasse Member (Leederville)	
YA_MB13Y	361173	6271638	349	100	289-349	29.52	Yarragadee (Unit 3)	
YA_MB30_W	357993	6269748	54	100	39-54	28.10	Vasse Member (Leederville)	Regional bore
61000125 (also known as BN20Y)	358660	6273620	352	65	344-350	18.27	Yarragadee (Unit 3)	Regional bore

The proposed water-level monitoring program is listed in Table 11.

Water level notes:

- Water levels will be measured from a standard measuring point, for example - the top of the casing. Any change in the position of the reference point will be recorded, and previous measurements adjusted accordingly;
- Water levels will be reported as metres below the standard reference point (mbtoc), below ground level (mbgl) and (if surveyed) metres above the Australian Height Datum (mAHD);
- Water levels will be recorded to the nearest centimetre;
- A note will be made as to whether the Yarragadee production bore is pumping or not at the time of the manual measurement;
- The Yarragadee monitoring bore YA_MB13Y and the Leederville (Vasse Member) monitoring bore YA_MB13V will have data loggers installed to monitor water level changes in the Yarragadee and Leederville (Vasse Member) aquifers.

TABLE 11: WATER LEVEL MONITORING PROGRAM

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY
DEWATERING OPERATION			
Superficial aquifer water level	Doral monitoring bores	YA_MB01S to YA_MB12S and YA_MB38 to YA_MB44	Monthly
		GDE monitoring bores (YA_MB33_GDE to YA_MB37_GDE) and YA_MB45_GDE_YA_MB49_GDE)	Monthly (during baseline and pre-dewatering) and Weekly (during active adjacent dewatering)
	Existing other user's bores (local)	SCPD28A, SCPD29A, TS012M, YA_MB14_W, YA_MB15_W, YA_MB16_W, YA_MB17_W YA_MB18_W, YA_MB19_W, YA_MB20_W, YA_MB30_W	Monthly
Leederville aquifer water level	Existing other user's bores (local)	YA_MB21_W, YA_MB22_L, YA_MB23_L, YA_MB24_W, YA_MB26_W, YA_MB31_L	Monthly
WATER SUPPLY			
Yarragadee aquifer water level	Doral production bores	YA_PB01 and YA_PB02	Monthly
	Monitoring bores (local)	Nested monitoring bores: YA_MB12M, YA_MB12V*, YA_MB12Y YA_MB13S, YA_MB13M, YA_MB13V*, YA_MB13Y *	
	Existing other user's bores (regional)	61000125 (providing DWER allow access to the bores)	Monthly
Leederville (Vasse Member) aquifer water level	Existing monitoring bores (regional)	YA_MB30_W	Monthly

6.4. WATER QUALITY MONITORING

The proposed water quality monitoring program is given in Table 12.

Water chemistry notes:

- All methods and equipment used in water quality sampling should be undertaken in accordance with the Australian Standard AS/NZS 5667 (1998) and wherever possible, a NATA registered laboratory should undertake the analyses, using NATA accredited analysis methods;
- The method (e.g. EC correction factor; gravimetric) used for the determination of TDS must be specified.
- Field test analysis methods shall be conducted in accordance with the equipment manufacturer's instructions. In particular, the calibration of field pH/EC meter shall be conducted prior to sampling, in accordance with manufacturer's instructions and field test kits (total acidity and total alkalinity) will be used in accordance with manufacturer's instructions.

TABLE 12: WATER QUALITY MONITORING SCHEDULE

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY	PARAMETERS	
DEWATERING OPERATION					
Pit dewatering quality	Pit dewatering discharge point	Pit dewatering discharge point	3 times a week (M, W, F) (field)	Field: • pH • Eh • EC • Temperature	• Total Titratable Acidity (TTA) • Total Alkalinity
			Monthly (lab) (or weekly if daily pH_F <4)	Laboratory: • pH • EC • TDS • Total acidity	• Total alkalinity • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
Superficial aquifer water quality	Superficial monitoring bores	Local: YA_MB01S to YA_MB12S, YA_MB38 to YA_MB44 TS012M, SCPD28A, SCPD29A	Monthly (field)	Field: • pH • Eh • EC	• Temp • TTA • Total Alkalinity
			Monthly (lab) (or weekly if pH $_F$<4)	Laboratory: • pH • EC • TDS • Total acidity • Total alkalinity	• Sodium • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
		Local	Six-monthly (lab)	• Total Al	• Total Hg

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY	PARAMETERS	
		YA_MB08S, YA_MB11S, YA_MB12S, SCPD28A, YA_MB39, YA_MB42, YA_MB43		• Total As • Total Cd • Total Cr • Total Co • Total Cu • Total Fe	• Total Ni • Total Se • Total Tl • Total U • Total Zn • Ra226 • Ra228
		Regional: YA_MB18_W	Quarterly (field) (Sept/Dec/March/ June)	Field: • pH • EC	• Temp • TTA
			Quarterly (lab) (or weekly if pH_F <4)	Laboratory: • pH • EC • TDS • Total acidity • Total alkalinity	• Sodium • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
Leederville water quality	Leederville monitoring bores	YA_MB21_W, YA_MB22_L, YA_MB23_L, YA_MB25_L, YA_MB27_L, YA_MB28_W, YA_MB29_W, YA_MB31_L, YA_MB32_L	Quarterly (field) (Sept/Dec/March/ June)	Field: • pH • Eh • EC	• Temp • TTA • Total Alkalinity
			Quarterly (lab) (or weekly if daily pH_F <4)	Laboratory: • pH • EC • TDS • Total acidity	• Sodium • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved)

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY	PARAMETERS	
				• **Total alkalinity**	• Mn (dissolved)
Process Water Dam water quality	Surface water sampling location	PWD sampling point	3 times a week (M, W, F) (field)	<u>Field:</u> • pH • **EC**	• TTA • Total Alkalinity
			Monthly (lab)	<u>Laboratory</u>: • pH • EC • TDS • Total acidity • Total alkalinity • **Sodium**	• Chloride • Sulphate • Total Al • Total Fe • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
			Quarterly (lab) (or weekly if daily pH_F <4)	<u>Laboratory</u>: • pH • EC • TDS • Total acidity • **Total alkalinity**	• Sodium • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
			Six-monthly (lab)	• Total Al • Total As • Total Cd • Total Cr • Total Co • Total Cu • **Total Fe**	• Total Hg • Total Ni • Total Se • Total Tl • Total U • Total Zn • Ra226 • Ra228

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY	PARAMETERS	
Off-site Discharge water quality	Surface water sampling location	Proposed "Licenced Discharge Point" and "Proposed Emergency Discharge Point"	On the first day of discharge then three times per week during discharge	Field: • pH • **EC**	• TTA
			On the first day of discharge then monthly during discharge	Laboratory: • pH • EC • TSS • TDS • Total acidity • **Total alkalinity**	• Sodium • Chloride • Sulphate • Al (dissolved)* • Fe (dissolved) • Mn (dissolved)
Surface water quality	Surface water sampling location	YALSW01 to YALSW23	Monthly when flowing	Field: • pH • **EC**	NA
				Laboratory: • pH • EC • TDS • **TSS**	• Total acidity • Sulphate
WATER SUPPLY OPERATION					
Yarragadee aquifer water quality	Production Bores	Yarragadee Production Bores YA_PB01 and YA_PB02	Monthly (field)	Field: • **pH**	• EC
			Six-monthly (lab)	Laboratory:	• Chloride

MONITORING PURPOSE	MONITORING SITE TYPE	MONITORING SITE ID	MONITORING FREQUENCY	PARAMETERS	
				• pH • EC • TDS • Total acidity • Total alkalinity • Total hardness • Calcium • Sodium • Magnesium • Potassium	• Sulphate • Ammonia • Phosphate • Carbonate • Bicarbonate • Nitrate • Silica • Aluminium • Iron • Manganese

Water samples will be collected from the monitoring sites at the frequency and analysed for the parameters listed in Table 12. Samples collected for the laboratory will be submitted to a NATA-registered laboratory for analysis. A chain of custody form will be used for the collection, transport and delivery of all water samples.

6.5. TRIGGER LEVELS

6.5.1. DEWATERING ABSTRACTION TRIGGER LEVELS

To prevent the exceedance of the Superficial aquifer annual allocation limit, a warning trigger level has been set when the cumulative abstraction reaches 80% of the annual allocation limit.

On any exceedance of a warning dewatering abstraction trigger value, Doral will conduct an internal review to determine the cause of the warning trigger breach.

6.5.2. WATER LEVEL TRIGGER VALUES

In accordance with the GDE Management Plan's (AQ2, 2020c, Doral,2024), the following trigger-response mechanism will be used for the GDE Monitoring bores (Yalyalup: YA_MB33_GDE to YA_MB37_GDE and Nth Ext: YA_MB45_GDE to YA_MB49_GDE):

- The commencement of dewatering adjacent to the identified GDE area will trigger increased groundwater monitoring frequency (from monthly to weekly);
- 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 0.25m below the average low annual measured water level (i.e. below the typical autumn groundwater level), then supplementation will be triggered.

No water level trigger values have been set at the other monitoring bores outside the McGibbon Track area. However, the extent of dewatering impacts will be regularly monitored (as per Table 11), with results reviewed monthly to assess when water supplementation should be applied.

6.6. WATER CHEMISTRY TRIGGER VALUES

6.6.1. PIT DEWATERING

Pit dewatering water (i.e. dewatering effluent) default trigger values have been defined by the DER (2015) and are provided in Table 13.

TABLE 13. PIT DEWATERING WATER CHEMISTRY DEFAULT TRIGGER VALUES

PIT DEWATERING WATER PARAMETER	TRIGGER CRITERIA
pH*	<5.5
Chloride: Sulphate ratio, or Sulphate: Chloride ratio#	<2, or >0.5
TTA	>40 $mgCaCO_3/L$
Total alkalinity	<30 $mgCaCO_3/L$
Dissolved Aluminium#	>1 mg/L

* values were taken from the DER ASS guideline (DER, 2015);

values as advised by Regional DWER

Should any of these criteria be triggered, dewatering effluent will be treated via the addition of a suitable neutralising agent prior to re-infiltration (i.e. hydraulic return of sand tails and/or clay fines into mine void). The DWER will be notified within 14 days of a sustained specified trigger exceedance along with the short-term actions taken and proposed long-term management actions.

If dissolved Al concentration exceeds 1 mg/L for any laboratory test, then the sample must be analysed further for As, Cd, Cr, Cu, Pb, Hg, Ni, Se and Zn.

If total $alkalinity_{FIELD}$ (as $CaCO_3$) <30mg/L, Doral will review the data available to determine whether there is a Downward trend in total alkalinity and pH or a corresponding upward trend in filtered Al, Fe, Mn and SO_4.

6.6.2. PWD WATER

PWD water default trigger values have been defined by ABEC Environmental (2019) and are provided in Table 14.

TABLE 14: PWD WATER CHEMISTRY DEFAULT TRIGGER VALUES

PWD WATER PARAMETER	TRIGGER CRITERIA
pH	<5.5
TTA	>40 $mgCaCO_3/L$
Total alkalinity	<30 $mgCaCO_3/L$
Dissolved Aluminium#	>1 mg/L

In the event that the water within the process water dam exceeds the trigger values, contingency actions specified in Section 7 will be affected.

If dissolved Al concentration exceeds 1 mg/L for any laboratory test, then the sample must be analysed further for As, Cd, Cr, Cu, Pb, Hg, Ni, Se and Zn.

6.6.3. GROUNDWATER

Groundwater water quality default trigger values have been advised by Regional DWER Office and are provided in Appendix 1.

Groundwater chemistry site-specific trigger values have been developed for each of the Superficial aquifer groundwater monitoring bores, by comparing baseline data to DWER guideline values as advised by regional DWER office. The bore specific chemical triggers have been determined using background data and were based on the mean +/- 2x standard deviations of the background set and are provided in Appendix 1.

If any trigger level is exceeded, contingency actions specified in Section 6 will be actioned and the DWER will be notified within 14 days of a sustained trigger exceedance, along with the short-term actions taken and long-term actions proposed to manage the breach.

If dissolved Al concentration exceeds one mg/L for any laboratory test, the sample must be analysed further for As, Cd, Cr, Cu, Pb, Hg, Ni, Se and Zn.

6.6.4. OFF-SITE DISCHARGE WATER

Trigger values for the discharge water sent off-site are set in accordance with the DWER discharge licence conditions:

- pH - 5.5 –8.5 mg/L
- TSS – 80 mg/L
- TDS – 1,500 mg/L
- TTA – 65 mg/L.

6.7. OTHER MONITORING

Monitoring of the GDE vegetation health condition will be undertaken separately as per the GDE Management Plan (Doral, 2024) and will not normally form part of the annual aquifer review, unless adverse impacts to the GDE vegetation as a result of dewatering, are detected.

6.8. NATIVE VEGETATION CONDITION MONITORING

In the event that any of the hydrological triggers (i.e. absolute or rate-of-change triggers in groundwater levels) or vegetation triggers (i.e. vegetation health parameters) have been exceeded, Doral will implement the management response adopted in the GDE Management Plan.

The management response will comprise two tiers:

- Increased monitoring - The start of operational dewatering or the exceedance of some hydrological triggers will require more frequent monitoring of ecophysiological parameters;
- Water supplementation - Indications of water stress or exceedance of some hydrological parameters will require water supplementation.

The final design for the supplementation scheme will be completed during the implementation of this GDE Management Plan. Supplementation will be based on a combination of:

- Surface irrigation.
- Subsurface irrigation near the groundwater table through trenches, slotted pipes or shallow spear points.

At all times great care would need to be taken to prevent overland flow of water, and to minimise wetting of the vegetation itself as a hygiene measure. The supplementation water (i.e. water of sufficient quality) will be sourced from Doral's Yarragadee aquifer production bore only, with no anticipated impact on the Yarragadee licence allocation. Any PWD water or pit dewatering groundwater will not be used during the supplementation scheme process. The volume of water used for the supplementation will be accounted for by the totalising flow meter installed at the production bore prior to being piped to the location for irrigation.

7. CONTINGENCY MEASURES

The contingency plan has been identified to mitigate potential impacts caused by the Yalyalup Project.

Doral will notify the DWER South West Region within 7 days of becoming aware that the events listed below have occurred and advise the DWER of the action undertaken, or the proposed course of action. The events include:

- a meter malfunction;
- monthly extraction volumes indicate there is potential for the GWL annual allocation to be exceeded;
- a sustained chemistry or water level action trigger level is reached;
- a justified concern regarding unacceptable impacts is received from a neighbour or the general public.

The course of action will address the event to the satisfaction of the DWER and may include, but is not limited to, those actions outlined below.

7.1. OPERATING SCHEME

Doral will maintain all meters in working order by checking their operation on a minimum monthly basis. In the event of the malfunction of a water meter, Doral will ensure that a spare meter is available for replacement.

Doral will conduct ongoing water efficiency assessments, to investigate methods of reducing water demand.

Contingency plans related to the pumping operations are primarily directed towards the prevention and containment of the spillage or leakage of water from the Yalyalup mine and include the following:

- Any minor pipeline leaks will be controlled by temporary bunding and the pipeline will be repaired as soon as possible;
- If a major leak occurs, the abstraction and transfer pumps will be shut down, until repairs are completed;
- If a failure occurs, the pipeline system will be shut down until changes are made to ensure that the risk of a further failure is minimised.

7.2. DEWATERING

In the event that dewatering extraction is likely to exceed 80% of the annual Superficial aquifer licence entitlement, Doral will, in first instance, investigate changes to pumping or mining schedules to reduce dewatering rates. An internal review to determine the cause of the breach of the warning level will be undertaken. If the review indicates the potential for the annual allocation limit to be exceeded, DWER will be notified, along with the short-term actions taken and discussions held to amend the annual allocation limit to be increased.

7.2.1. PIT DEWATER EFFLUENT

In the event that water quality monitoring of the dewatering effluent reaches any ASS trigger values (as a warning of any oxidation of sulphidic material on site) listed in Table 13, Doral will undertake the following mitigation measures;

- Increase the monitoring listed in Table 12 to daily field testing and weekly laboratory testing of the affected areas.
- Commence neutralization treatment (liming) of the pit dewater. This is achieved by directly adding lime to the dewater sumps and/or the more effective method of adding lime sand to the plant feed. Adding lime to the ore feed effectively neutralises the water circuit through the plant and returns neutralising lime sand in the sand tails, and neutralised tails return water to the recirculating pit dewatering sumps.

Following a review of the mine schedule, additional contingencies that may be implemented include:

- Mining activities will be scheduled to be undertaken on a campaign basis, with a portion of the ore body being mined and processed in a discrete period to assist in minimising the area of groundwater drawdown at any one time;
- Topsoil/subsoil will be stripped to a depth of ~100 mm, stockpiled for rehabilitation and neutralised if pH is <4.0.
- Mitigate the effect of dewatering activities by accelerating the backfill of the pit in the affected area to reduce the amount of time PASS horizons are exposed.

7.2.2. PWD WATER

In the event that water quality monitoring of the PWD water reaches any ASS trigger values (as per Table 14), the initial contingency measure will be to treat the process water through the addition of a suitable alkaline material to the ore feed and/or the tails return water sump until the water is above the trigger values. Whilst the PWD is above the trigger values, the discharge of process water off-site will cease.

7.2.3. GROUNDWATER

In the event that the sustained trend of the chemical trigger values listed in Table 13 and Table 14 have been exceeded in any of the groundwater monitoring bores, an investigation shall be undertaken, in particular with regard to the potential for ASS site contamination. If necessary, the following contingency measures will be implemented.

The initial response to the exceedance of any trigger values will be:

- Establish the context of the exceedance and determine whether the result requires re-sampling/analysis, immediate action, or no response at all. A key measure for the context of an exceedance is to consider whether multiple triggers are exceeded.
- Review exceedance in relation to any site wide changes or trends in key ASS risk parameter (pH, TTA);
- Review sample collection, handling and analysis methods and procedures, to ensure appropriate methods were used;

- Review groundwater level data, dewatering effluent quality data and current mining operations, to consider possible causal factors;
- If necessary, re-sample affected locations as soon as practical (i.e. within 2-weeks) to confirm whether or not the groundwater quality parameter(s) exceed the trigger value.
- Increase on-going water quality monitoring frequency of the affected bore or bores.

Secondary responses will be developed based upon situation specific outcomes from the initial responses, but will include the following immediate further action responses:

- If it is confirmed that the pH and TTA exceed trigger criteria in successive sampling events, the sampling frequency for field parameters will be increased to fortnightly; and/or
- When it is confirmed that any other groundwater quality parameters have deteriorated to levels outside of the background-based trigger levels; then
    - Inform the DWER that contingency monitoring is being undertaken; and
    - Prepare a contingency action plan suited to the level of risk that confirmed adverse groundwater quality poses to potential receiving environments, such as Down gradient groundwater users or environmental receptors.

7.3. OTHER USERS

If a concern is raised from another local landowner regarding potential impacts to water supplies or vegetation due to mining activities, Doral will undertake an assessment of the monitoring data from nearby monitoring bores to further determine the cause of impact and if deemed to be mine related, the DWER will be advised on the outcome of the review and proposed course of action as soon as is reasonably available or otherwise within 7 days of the trigger level being reached.

If other aquifer users experience a reduction in their water supply or the productivity of pasture/horticulture due to mine dewatering, contingency actions may include ‘making good’ supplies to neighbours (e.g. providing access to an alternative source of water of similar quality and quantity to meet usage requirements, dam supplementation; reticulation; hay supplies, etc.).

Should the investigation into a reported reduction in supply determine that Doral’s operation is impacting a neighbour’s water supply, Doral will implement interim measures as soon as practical and inform the DWER of the interim actions taken and proposed actions for the future.

7.4. WATER SUPPLY

In the event of the identified malfunction of a water meter on either of the production bores YA_PB01 or YA_PB02, pumping from the Yarragadee production bore in question will be suspended until the meter is either repaired or replaced.

The abstraction from the Yarragadee aquifer is not expected to impact on the environment. However, if the abstraction is shown to have a detrimental effect on the environment, pumping will be reduced from the Yarragadee aquifer until a solution is found.

If a bore or pump fails for the Yarragadee production bore, an investigation will be undertaken to identify an additional (alternative) option to supply sufficient water for ore processing (e.g., development of an additional Yarragadee production bore, if required).

7.5. OFFSITE WATER DISCHARGE

In the event that the mine's excess water does not meet the water quality criteria (as per DWER licence conditions), off-site water discharging during the emergency discharge events will cease as far as is practicable until measures are implemented to improve the water quality.

8. WATER USE EFFICIENCY

Doral will make every effort to maximise water recycling and minimise water use. In the first instance, process water will be sourced from recycled water and dewatering of the pits. Additional process water sourced from the Yarragadee aquifer bore will only be used after other resources have been fully utilised (i.e. PWD /DOD water storage falls below nominal 10,000 m^3, approximately 17% of the total capacity of PWD/DOD). Water will not intentionally be discharged offsite when it cannot be used for other purposes.

The delivery system for groundwater pumped will be designed using best practice methods to minimise the likelihood of uncontrolled water loss.

Water application for dust suppression will be carefully controlled to prevent runoff or over-spray.

Doral will continually attempt to improve water use efficiency as part of the ongoing water management programme (e.g. conducting water efficiency assessments to investigate methods of reducing water demand).

9. SUMMARY OF COMMITMENTS

The monitoring and other commitments proposed in this GLOS are summarised in Table 15.

TABLE 15. SUMMARY LIST OF COMMITMENTS

RELEVANT SECTION	NO.	COMMITMENT
Administrative Requirements	1	The Groundwater Licence Operating Strategy (GLOS) will apply for the life of the groundwater well licences and the life of any licence renewals
	2	Any changes to the conditions / commitments of the GLOS that are required during the period of the GLOS must be agreed by the licensee and DWER with the signatures of both parties on an GLOS Addendum.
	3	Any reportable breach of this GLOS will be reported to the DWER as soon as reasonably practicable from the time of the identification of the breach and recorded in the annual report.
	4	A Groundwater Monitoring Summary (GMS) report will be prepared each year, covering monitoring data recorded during the water year from 1 January to 31 December, and submitted to the DWER Bunbury office within three months of the close of the water year, i.e. by 31 March each year
	5	A qualified hydrogeologist will prepare a Groundwater Monitoring Review (GMR) report every three years in accordance with guidelines in DWER Operational Policy 5.12 Hydrogeological reporting associated with a Groundwater Well Licence. The review will provide a complete history of groundwater monitoring over the life of the mine, including a detailed analysis of the aquifer response to groundwater abstraction, comparison with modelled predictions and effects on surface water from its use. The GMR will be submitted to the DWER Bunbury office by 31 March of the year it is due
Operating Rules	6	Doral will ensure that the schedule of production bore use and a table of monitoring bore details will be kept up to date
	7	The DWER will be notified of any bore alterations or additions.
	8	The abstraction from the Superficial aquifer shall not exceed 750,000 kL/year
	9	The abstraction from the Yarragadee aquifer shall not exceed 1,600,000 kL/year
	10	The volume of water taken under the Superficial and Yarragadee licences will be metered using suitable flow meters to meet licence requirements, with meters installed per the document “Guidelines for water meter installation” (DWER, 2009). The accuracy of the installed meters will be maintained within plus or minus 5% of the volume metered in field conditions
	11	Should more than one active mine pit be dewatered at any one time, then each pit’s dewatering pipeline will be metered separately by a suitable meter before discharge to the drop-out pond

RELEVANT SECTION	NO.	COMMITMENT
	12	The Yarragadee production bore will have an electric submersible pump with suitable operational protection (e.g. low-flow and high-temperature cut-off switches). The bore will be operated according to water demand, with no set abstraction schedule
	13	A totalising flow meter will be installed at the Yarragadee production bore to measure abstraction volumes, with the monthly recording of volumes.
	14	The recommended pumping rate for the Yarragadee production bore, as set after the aquifer testing, shall not be exceeded
	15	Maintenance staff will check The Yarragadee production bore regularly to ensure the bore and flow meter are operating satisfactorily.
	16	Regular inspection for pipeline water leaks will be carried out by maintenance staff, and when required, repairs will be carried out immediately.
	17	The irrigation of the native vegetation (if required) will be sourced from Doral's Yarragadee production bore only. PWD water or pit dewatering groundwater will not be used during the native vegetation irrigation.
	18	The volume of water used for the irrigation will be recorded from the totalising meter installed at the Yarragadee production bore
	19	Surplus water may be made available for emergency services or other special third-party use only under an arrangement with Doral in circumstances of need. However, it is possible that this supply can only be made available when surplus water is generated during winter rainfall events.
	20	In the event of all water storages being at their full capacities and prolonged heavy rainfall occurs within the pit catchment area, any excess water will have to be discharged offsite via the proposed controlled "Licenced Discharge Point."
	21	In extreme cases, a "Proposed Emergency Discharge Point" can be used to discharge water off the mine site
	22	A v-notch flow gauge will be installed at the proposed Licensed Discharge Point, and the proposed Emergency Discharge Point will be activated manually by a pump with flow curves to measure volumes of off-site discharge.
	23	Doral will ensure that the DWER will be notified of any alterations or additions made concerning off-site discharge locations.
	24	Doral will ensure that the DWER will be notified of any alterations or additions related to surface water monitoring locations.
Identifying and Managing Impacts	25	If Doral identify a breach of management objectives, due to the groundwater abstraction, they will establish a water management response.

RELEVANT SECTION	NO.	COMMITMENT
Abstraction Monitoring	26	Doral will undertake and report to DWER on the abstraction monitoring as scheduled in Table 7 of this document.
	27	The water meters will be inspected regularly for faults and maintenance will be undertaken as required. Calibration will be carried out according to the manufacturer's specifications. Details of any significant meter maintenance and replacement will be collated throughout the water year and incorporated into the annual monitoring summary
Water Level Monitoring	28	Doral will undertake and report to DWER on the water level monitoring programme as listed in Table 11 of this document
Water Quality Monitoring	29	Doral will undertake and report to DWER on the water quality monitoring programme as listed in Table 12 of this document
Contingency Plan	31	Doral will notify the DWER South West Region within 14 days of becoming aware that the events listed below have occurred and advise the DWER of the proposed course of action. The events include: • a meter malfunction; • monthly extraction volumes indicate there is potential for the Annual Water Entitlement to be exceeded; • a sustained chemistry or water level action trigger level is reached; • a justified concern regarding unacceptable water impacts is received from a neighbour or the general public. The course of action will address the event and may include, but is not limited to, those actions outlined in Section 6 of this report.
Water Use Efficiency	32	Doral will continue to focus on water use efficiency as part of its water management programme.
	33	Doral will make every effort to maximise water recycling and minimise water use.
	34	Water application for dust suppression will be carefully controlled to prevent runoff or over-spray.
	35	The delivery system for groundwater pumps will be designed using best practice methods to minimise the likelihood of uncontrolled water loss.

FIGURE 1: REGIONAL LOCATION

345000 347500 350000 352500 355000 357500 360000 362500 365000 367500 370000

6280000 6277500 6275000 6272500 6270000 6267500 6265000 6262500

Geographe Bay
LUDLOW RIVER
MALBUP RIVER
WONNERUP SIDING
Vasse-Wonnerup System
SABINA RIVER
VASSE RIVER
BUSSELTON
BUSSELL HIGHWAY
WONNERUP NORTH TRONOX
ABBA RIVER
RUABON
WONNERUP TRONOX
WONNERUP SOUTH TRONOX
Vasse River Diversion Drain
BUSSELTON BYPASS
BUSSELTON
TUTUNUP
YOGANUP
CARTIS
TIGER GULLY
SCARP
YALYALUP
HAPPY VALLEY
Sabina River Diversion Drain
AMBERGATE
YOONGARILLUP
SUES ROAD
WHICHER
TUTUNUP SOUTH ILUKA
VASSE HIGHWAY
WALSALL
YOONGARILLUP DORAL
ACTON PARK
Map Location

N
0 0.5 1 2 3
Kilometers

Legend

Section 40AA Request
- Proposed Development Envelope

Ministerial Statement 1168
- Approved Yalyalup Development Envelope
- Approved Disturbance Area

Other
- Operational Minesite

Ramsar Sites (DPAW)
- Vasse-Wonnerup System

Doral

Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy Regional Location

Scale 1:75,000	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 1		Date: 08/01/2024

FIGURE 2: SITE LOCATION AND INFRASTRUCTURE

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Mine Layout Yalyalup

- Infrastructure
- Disturbance Envelope
- Water Dams / Drainage
- HMC Pad
- Ore Stockpile
- Orebody
- Orebody Deep Strand
- Other Supporting Infrastructure
- Pipeline
- Roads
- SEP/Tails Storage Dams
- Topsoil Stockpile

Section 40AA Request

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

Regional Cadastre

- Boundaries

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Emergency Discharge

Name

- Emergency Discharge
- Licence Discharge

LYLE RD
GULBERTI RD
SEMMEN RD
OATES RD
UNKNOWN RD
COOPERS ABBA RIVER RD
LUDLOW HITHERGREEN RD
PRINCEFIELD RD
MCGIBBON TK
YALYALUP RD
REILLY RD
WONNERUP SOUTH RD
SABINA RIVER
GILES RD
EAST WONNERUP RD
Sabina River Diversion Drain

N

0 125 250 500
Meters

Doral
Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy Disturbance Areas

Scale	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
1:20,134		
Figure: 2		5/04/2024

FIGURE 3: PROPOSED MINE SCHEDULE

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Mining Area

- Area A
- Area B
- Area C
- Area D
- Area E

LYLE RD
GULBERTI RD
SEMMEN RD
OATES RD
UNKNOWN RD
COOPERS ABBA RIVER RD
LUDLOW HITHERGREEN RD
PRINCEFIELD RD
WONNERUPSOUTHRD
REILLY RD
MCGIBBON TK
YALYALUP RD
SABINA RIVER RD
EAST RD
GILES
WONNERUP

Area A
Area B
Area C
Area D
Area E

N
0 125 250 500
Meters

Doral
Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy Mining Stages

Scale 1:20,000	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 3		5/04/2024

FIGURE 4: WATER BALANCE MODEL SCHEMATIC

Legend

- Dirty Water
- Clean Water
- Pumped Flow

Return Sand Tails Water flowing into pit

Stormwater Catchment

Direct rainfall

Evaporation

SEP Decant Water Flowing into the Pit

Active mining pit

Groundwater inflow

Direct rainfall

Evaporation

Direct rainfall

Evaporation

Direct rainfall

Process Water Dam (PWD)

Drop Out Dam (DOD)

Dirty runoff from impervious & process areas

Yarragadee Bore water (groundwater) pumped as required

Wet plant processing water – Nett demand up to 4.38 ML/day (1.6 GL/year)

Licenced &Emergency Discharge

Direct rainfall

Clean upstream runoff diverted around site

Downstream catchment

Doral — Yalyalup Northern Extension	Groundwater Licence Operating Strategy Schematic Water Balance	
	Scale: N/A; Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Yalyalup Mineral Sands Project	Figure: 4	5/04/2024

FIGURE 5: SURFACE WATER MONITORING LOCATIONS

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Regional Cadastre

- Boundaries

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Monitoring Site

- Surface Water

YALSW20 YALSW21 YALSW22 YALSW23 YALSW18 YALSW19 YALSW14 YALSW15 YALSW11 YALSW10 YALSW16 YALSW17 YALSW08 YALSW09 YALSW07 YALSW06 YALSW02 YALSW03 YALSW04 YALSW05 YALSW01

LYLE RD
GULBERTI RD
SEMMEN RD
OATES RD
UNKNOWN RD
COOPERS RD
LUDLOW HITHERGREEN RD
PRINCEFIELD RD
RD
WONNERUP SOUTH RD
REILLY RD
SABINA RIVER
ABBA RIVER
McGIBBON TK
YALYALUP RD
GILES RD
WONNERUP EAST RD
Sabina River Diversion Drain

N

0 125 250 500
Meters

Doral

Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy Surface Water Monitoring Sites

Scale 1:20,000	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 5		5/04/2024

FIGURE 6: GROUNDWATER MONITORING BORE NETWORK

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Regional Cadastre

- Boundaries

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Groundwater Monitoring Bores

- Superficial Monitoring Bore
- GDE Monitoring Bore

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

YA_MB41S
YA_MB42S
YA_MB43S
YA_MB44S
YA_MB38S
YA_MB39S
YA_MB47_GDE
YA_MB48_GDE
YA_MB49_GDE
YA_MB46_GDE
YA_MB12S
YA_MB37_GDE
YA_MB06S
YA_MB03S
YA_MB35_GDE
YA_MB11S
YA_MB45_GDE
YA_MB08S
YA_MB34_GDE
YA_MB05S
YA_MB02S
YA_MB33_GDE
YA_MB36_GDE
YA_MB10S
YA_MB04S
YA_MB07S
YA_MB09S
YA_MB01S

LYLE RD
GULBERTI RD
SEMMEN RD
OATES RD
UNKNOWN RD
COOPERS RD
LUDLOW HITHERGREEN RD
PRINCEFIELD RD
WONNERUP SOUTH RD
REILLY RD
MCGIBBON TK
ABBA RIVER
SABINA RIVER
GILES RD
EAST WONNERUP RD
YALYALUP RD
Sabina River Diversion Drain

N
0 125 250 500
Meters

Doral
Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy
Groundwater Monitoring Bores

Scale	Datum: GDA94	Sheet Size A3
1:19,604	Projection: MGA Zone 50	
Figure: 1-2		5/04/2024

FIGURE 7: OTHER MONITORING BORES

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Regional Cadastre

- Boundaries

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Monitoring Bores

- Other

LYLE RD
GULBERTI RD
SEMMEN RD
OATES RD
UNKNOWN RD
COOPERS RD
LUDLOW-HITHERGREEN RD
PRINCEFIELD RD
WONNERUPSOUTHRD
REILLY RD
MCGIBBON TK
YALYALUP RD
EAST WONNERUP RD
GILES RD
ABBA RIVER
SABINA RIVER
Sabina River Diversion Drain

YA_MB14_W
YA_MB23_L
YA_MB24_W
YA_MB19_W
SCPD28A
YA_MB26_W
YA_MB21_W
YA_MB15_W
YA_MB17_W
YA_MB22_L
YA_MB32_L
YA_MB25_L
YA_MB27_L
YA_MB28_W
YA_MB18_W
TS012M
YA_MB20_W
YA_MB31_L
YA_MB16_W
YA_MB30_W
SCPD29A
YA_MB29_W

N
0 125 250 500
Meters

Doral
Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy
Other Monitoring Bores

Scale 1:20,000	Datum: GDA94 Projection: MGA Zone 50	Sheet Size A3
Figure: 7		5/04/2024

FIGURE 8: EXISTING OTHER USER'S BORE (REGIONAL AND LOCAL)

353000 354000 355000 356000 357000 358000 359000 360000 361000 362000

6276000 6275000 6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Regional Cadastre

- Boundaries

Leerderville Aquifer Users

- Licenced

Leederville Bores

- Licenced
- Unlicenced

ABBA RIVER

SABINA RIVER

N

0 125 250 500

Meters

Doral

Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Leederville Aquifer Groundwater Users

Scale	Datum: GDA94	Sheet Size A3
1:25,000	Projection: MGA Zone 50	
Figure: 7.5		4/04/2024

FIGURE 9: LOCATIONS OF YARRAGADEE PRODUCTION BORES AND NESTED MONITORING BORES

355000 356000 357000 358000 359000 360000 361000 362000

6274000 6273000 6272000 6271000 6270000

Legend

Ministerial Statement 1168

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

Section 40AA Request

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

Regional Cadastre

- Boundaries

Site Layout

- Yalyalup North Extentsion (Mar. 2024)

Doral Production Bore

- Yarragadee

Monitoring Bore

- Yarragadee

61000125 (also known as BN20Y)

LYLE RD

GULBERTI RD

SEMMEN RD

OATES RD

UNKNOWN RD

COOPERS RD

YA_MB12M

PRINCEFIELD RD

YA_MB12Y

YA_MB12V

YA_MB13S

YA_MB13Y

YA_MB13V

YA_MB13M

WONNERUPSOUTHRD

MCGIBBON TK

ABBA RIVER

LUDLOW HITHERGREEN RD

REILLY RD

SABINA RIVER

YALYALUP RD

YA_MB30_W

GILES RD

EAST WONNERUP RD

Sabina River Diversion Drain

N

0 125 250 500

Meters

Doral

Yalyalup Northern Extension

Yalyalup Mineral Sands Project

Groundwater Licence Operating Strategy
Yarragadee Production and Monitoring Bores

Scale	Datum: GDA94	Sheet Size A3
1:20,000	Projection: MGA Zone 50	
Figure: 8		5/04/2024

APPENDIX 1: GROUNDWATER WATER QUALITY DEFAULT TRIGGER VALUE

Appendix 1 Table 1: Groundwater Chemistry Bore Specific Trigger Values

Bore ID	SWL (mbtoc)	Parameter											
		Field pH	Field Total alkalinity (mg/L)	Sulphate: Chloride ratio	Chloride: Sulphate ratio	Dissolved Aluminum (mg/L)	Field Total acidity (mg/L)	Field Electrical Conductivity (uS/cm)	Total Dissolved Solids (mg/L TDS)	Sulphate (mg/L)	Chloride (mg/L)	Dissolved Iron (mg/L)	Dissolved Manganese (mg/L)
DWER Default Triggers	> Any baseline value	<5	<10	>0.5	<2	>1	> Any baseline value PLUS Cl: SO_4 Ratio OR All Trigger						
YA_MB01S	>4.16	<5	<35.11	>0.5	<0.84	>1	>150.43	>2,306.20	>1,184	>157.20	>576.88	>11.43	>0.32
YA_MB02S	>3.18	<5	<24.95	>0.5	<2	>1	>221.17	>2,161.99	>1,092.40	>120.06	>569.68	>25.62	>067
YA_MB03S	>2.35	<5	<39.50	>0.5	<2	>1	>210.95	>2,236.96	>1,086.26	>96.42	>602.45	>29.87	>0.90
YA_MB04S	>2.80	<5	<25.39	>0.5	<2	>1	>174.79	>1,699.30	>851.70	>44.77	>435.48	>13.04	>0.25
YA_MB05S	>1.81	<5	<15.06	>0.5	<2	>1	>87.52	>1,096.73	>528.29	>45.42	>248.37	>1.89	>0.06
YA_MB06S	>2.65	<5	<55.07	>0.5	<2	>1	>69.65	>11,940.73	>7,553.63	>634.46	>3,940.53	>3.64	>0.40
YA_MB07S	>4.37	<5	<7.78	>0.53	<1.54	>1	>63.22	>521.24	>252.54	>30.27	>95.38	>0.27	>0.02
YA_MB08S	>2.32	<5	<15.37	>0.5	<2	>1	>56.45	>671.40	>291.03	>39.22	>130.28	>0.47	>0.02
YA_MB09S	>4.47	<5	<32.72	>0.5	<1.34	>1	>114.71	>3,259.95	>1,638.33	>190.83	>858.47	>1.62	>0.03
YA_MB10S	>2.93	<5	<23.27	>0.5	<1.22	>1	>99.68	>1,932.48	>1,034.23	>159.93	>598.76	>4.62	>0.03
YA_MB11S	>2.04	<5	<46.48	>0.5	<2	>1	>129.59	>3,943.12	>2,013.80	>172.19	>1,177.81	>11.11	>0.66
YA_MB12S	>0.56	<5	<53.64	>0.5	<2	>1	>262.48	>1,994.23	>1,021.12	>58.34	>529.35	>33.94	>1.08
SCPD28A	>1.92	<5	<42.48	>0.5	<2	>1	>137.34	>4,205.06	>4,078.27	>1,258.72	>1,258.72	>3.18	>0.28
SCPD29A	>1.48	<5	<26.19	>0.5	<2	>1	>250.90	>1,143.21	>535.07	>30.30	>274.71	>7.93	>0.15
TS012M	>4.28	<5	<41.66	>0.64	<0.75	>1	>268.64	>2,375.82	>1,310.69	>259.19	>597.36	>22.43	>0.06
YA_MB18_W	>3.34	<5	<6.99	>0.84	ND[#]	>1	>133.75	>1,655.55	>896.76	>181.79	>357.70	>0.28	>0.40

ND – not determined due to high variability in the dataset (i.e. values are far from the mean)

Appendix Table 2: Groundwater Chemistry Trigger Criteria

Groundwater Parameter	Trigger Criteria
Field pH	<5.0
Field Total alkalinity	<10 mg$CaCO_3$/L
Dissolved Aluminum#	>1 mg/L PLUS Cl: SO_4 Ratio <2 OR Baseline condition trigger (EC, Total acidity, TDS, SO_4, Cl, Fe or Mn)
Chloride: Sulphate Ratio	<2 PLUS Dissolved Aluminum >1 mg/L OR Baseline condition trigger (EC, Total acidity, TDS, SO_4, Cl, Fe or Mn)
Field Total Acidity	> Any baseline value (as per Table 15) PLUS Cl: SO_4 Ratio OR All Trigger
Field Electrical Conductivity	
Total Dissolved Solids	
Sulphate	
Chloride	
Dissolved Iron	
Dissolved Manganese	

"Management Trigger R**esponse"**:

If EC, TDS, Chloride, Sulfate, Total acidity Fe and Mn are in excess of the corresponding baseline triggers in conjunction of at least one other trigger. The initial response to the exceedance will be:

- Then samples are re-tested for metals,
- An internal review is undertaken,
- DWER is notified within 14 days of the trigger event results becoming known,
- The frequency of the groundwater monitoring in the triggering bore (s) is to be increased to fortnightly until the analytes return to non-triggering levels or advice is received by DWER that monitoring can return to monthly.