Water Management Plan

Mulga Downs Iron Ore Mine – Western Australia

Hancock Prospecting Pty Ltd

ABN 69 008 676 417

EPBC Assessment Number: 2022/09255

EPA Assessment Number: 2326

29 August 2025

Revision Register

REV	DATE	DESCRIPTION OF CHANGES
A1	11-Nov-2024	Draft management plan for Client review
A2	22-Nov-2024	Draft management plan incorporating Client comments
A3	25 Nov 2024	Draft management plan incorporating Client comments
A4	12 Dec 2024	Draft management plan incorporating Client comments
A5	19 Dec 2024	Final Management Plan
A6	10 April 2025	Updated for DCCEEW Comments
7	29 August 2025	Revised following public consultation period

[redacted]

Declaration of Accuracy:

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

[redacted]

Organisation (please print) HanRoy
Date 29/08/2025

Executive Summary

Hancock Prospecting Pty Ltd (HPPL, the Proponent) is proposing to construct and operate the Mulga Downs Iron Ore Mine (MDIOM, the Proposal), located approximately 210 kilometres (km) south of Port Hedland and 180 km north-west of Newman in the Pilbara Region of Western Australia.

The purpose of this Water Management Plan (WMP) is to outline the Proponent's approach to management of impacts to water, vegetation and subterranean fauna from the Proposal.

Table E- 1 presents a summary of this WMP, including the key environmental factors and outcomes that must be achieved through the implementation of this WMP.

Table E- 1: Water Management Plan Summary

Proposal name	Mulga Downs Iron Ore Mine (MDIOM, the Proposal)
Proponent name	Hancock Prospecting Pty Ltd (HPPL, the Proponent)
Short Description	The Proposal is for the development of the MDIOM, located 210 km south of Port Hedland and 180 km northwest of Newman in the Pilbara Region of Western Australia. The Proposal includes but is not limited to the following: • The development of a series of above and below water table mine pits; • Dry ore crushing and screening plant(s); • Groundwater abstraction for water supply (for the mine and all associated infrastructure) and for the dewatering to facilitate the recovery of ore below water table in the mine pits; • Surplus water management via managed aquifer recharge (MAR), including aquifer injection and/or in pit infiltration; • Waste rock dumps (WRD); • Infrastructure to manage surface water (diversion of creeks and surface water flows); • Linear infrastructure (haul roads, powerlines, pipelines and conveyor corridors); • Mine associated infrastructure and support facilities (including, but not limited to accommodation camp, energy supply infrastructure, airstrip; wastewater treatment plant; landfill, offices, workshops, laydown areas, etc.); and • Transport of the ore via the Great Northern Highway to Port Hedland or via road to a siding along the existing Roy Hill railway and then via that railway to Port Hedland for export. Future transport options (e.g. rail) will be subject to a separate referral.
Ministerial Statement Number	To be determined *Note: This document has been prepared to support the EPA's assessment of the Proposal* (Part IV EP Act)
EP Act Assessment No.	2326
EPBC Reference Number	2022/09255
Purpose of the EMP	To provide a management framework for groundwater and surface water, vegetation and subterranean fauna to avoid, minimise and mitigate potential adverse impacts associated with the implementation of the Proposal.

Key Environmental factor/s, outcome/s and objectives relevant to this WMP	**Inland Waters**: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values and beneficial use are protected. • The concentration of solutes in runoff and or seepage from WRD's or other mining sources that is potentially released to groundwater and/or surface water shall not exceed baseline default guideline values in Section 3.1.3 **Flora and Vegetation:** To protect flora and vegetation so that biological diversity and ecological integrity are maintained. **Social Surroundings**: • No measurable change, attributable to the Proposal, to groundwater level at Youngaleena and Wirrilimarra community bores for the life of the Proposal. • No measurable change, attributable to the Proposal, to groundwater quality at Youngaleena and Wirrilimarra community bores for the life of the Proposal. • No exceedance of the drinking water guidelines for beef cattle tolerance limit of 5,000 mg/L TDS for the life of the Proposal for groundwater sourced from pastoral groundwater bores within the Salinity Impact Area. **Subterranean Fauna:** • Groundwater quality is managed such that there is no increase in salinity above 5,000 mg/L Total Dissolved Solids (TDS) (equivalent to electrical conductivity (EC) = 7,810 µS/cm) or the pre-disturbance baseline level, whichever is higher, within the Salinity Impact Area for the life of the Proposal and post-closure.
Controlling Provisions - MNES	• Threatened species and communities (s.18 & s.18A) • Migratory Species (s.20 & s.20A)
Condition clauses (if applicable)	Given the Proposal is under assessment (Part IV of EP Act) and is a Controlled Action under EPBC Act, approval conditions are yet to be issued.
Key Components in this WMP	• Minimise potential impacts associated with groundwater abstraction and MAR including water levels and groundwater quality. • Minimise potential impacts to sheet flow dependent and surface water dependent riparian vegetation. • No adverse impact that could result in contamination of groundwater environments associated mining and associated activities. • Undertake appropriate monitoring and report sufficiently to demonstrate compliance with likely approval requirements and enable appropriate and informed water management decisions.
Proposed construction date	Construction of the Proposal is anticipated to commence at the beginning of FY2027 (subject to approvals) and is forecast to take approximately two years.
EMP required pre-construction?	Yes ☒ No☐

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1 Introduction

1.1 Proposal Background

HPPL is proposing to construct and operate the Mulga Downs Iron Ore Mine (MDIOM, the Proposal). The Proposal is a greenfield iron ore mine at Mulga Downs, located in the Fortescue River valley and on the southern flanks of the adjacent Chichester Range. The Proposal is approximately 210 km south of Port Hedland and 180 km north-west of Newman, in the Pilbara Region of Western Australia (Figure 1-1).

Once operational, the Proposal will involve mining of up to 12 million tonnes per annum (Mtpa) of iron ore from above and below the water table using conventional drill and blast, load and haul techniques. Operations will be continuous throughout the year, running 24 hours a day, seven days a week, over an 18 year mine life.

Table 1-1: Proposal Summary

Proposal title	Mulga Downs Iron Ore Mine (Proposal)
Proponent name	Hancock Prospecting Pty Ltd (HPPL)
Short description	The Proposal is for the development of the Mulga Downs Iron Ore Mine (MDIOM) located approximately 210 km south of Port Hedland and 180 km north-west of Newman in the Pilbara Region of Western Australia. The Proposal includes but is not limited to the following: • The development of a series of above and below water table mine pits; • Dry ore crushing and screening plant(s); • Groundwater abstraction for water supply (for the mine and all associated infrastructure) and for the dewatering to facilitate the recovery of ore below water table in the mine pits; • Surplus water management via managed aquifer recharge (MAR) and/or in pit infiltration; • Waste rock dumps (WRD); • Infrastructure to manage surface water (diversion of creeks and surface water flows); • Linear infrastructure (haul roads, powerlines, pipelines and conveyor corridors); • Mine associated infrastructure and support facilities (including, but not limited to accommodation camp, energy supply infrastructure, airstrip; wastewater treatment plant; landfill, offices, workshops, laydown areas, etc.); and • Transport of the ore via the Great Northern Highway to Port Hedland or via road to a siding along the existing Roy Hill railway and then via that railway to Port Hedland for export. Future transport options (e.g. rail) will be subject to a separate referral.

1.2 Purpose and Scope

The purpose of this Water Management Plan (WMP) is to outline the Proponent's approach to managing potential impacts of mining, and changes to ground and surface water regime to the receiving environment and receptors identified for the Proposal, and supports the assessment of the Proposal under both the *Environmental Protection Act 1986* (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This WMP applies to potential direct and indirect impacts resulting from the implementation of the Proposal on hydrogeologic and hydrologic regime; biological diversity and ecological integrity of flora and vegetation, terrestrial fauna, subterranean fauna and social surrounds.

The objective of this WMP is to:

- Identify the key aspects and activities of the Proposal with the potential to directly or indirectly impact hydrological, hydrogeological and ecohydrological environmental features;
- Describe mitigation measures that will be implemented to avoid or minimise the adverse impacts on hydrological, hydrogeological and ecohydrological values of the Proposal;
- Describe the outcomes, consistent with relevant legislation, policies and guidance; and
- Provide the rationale and approach undertaken to enable compliance criteria to be met.

This WMP has been prepared in consideration of, and should be read in conjunction with, the Conservation Significant Fauna Management Plan (CSFMP) and Cultural Heritage Management Plan (CHMP).

The Proposal is subject to separate assessments under the EP Act and the EPBC Act due to a difference in the clearing of native vegetation within the Proposal extent (Development Envelope / Proposed Action Area) under assessment within each jurisdiction. This WMP has therefore been prepared in accordance with:

- '*Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans*' (EPA, 2020), as stated in the ESD, and addresses any specific additional work required for assessment of the Proposal under the EP Act; and
- Information required under the '*Environmental Management Plan Guidelines*' (DoE, 2014) and supports the Public Environmental Report (PER) for the Proposal.

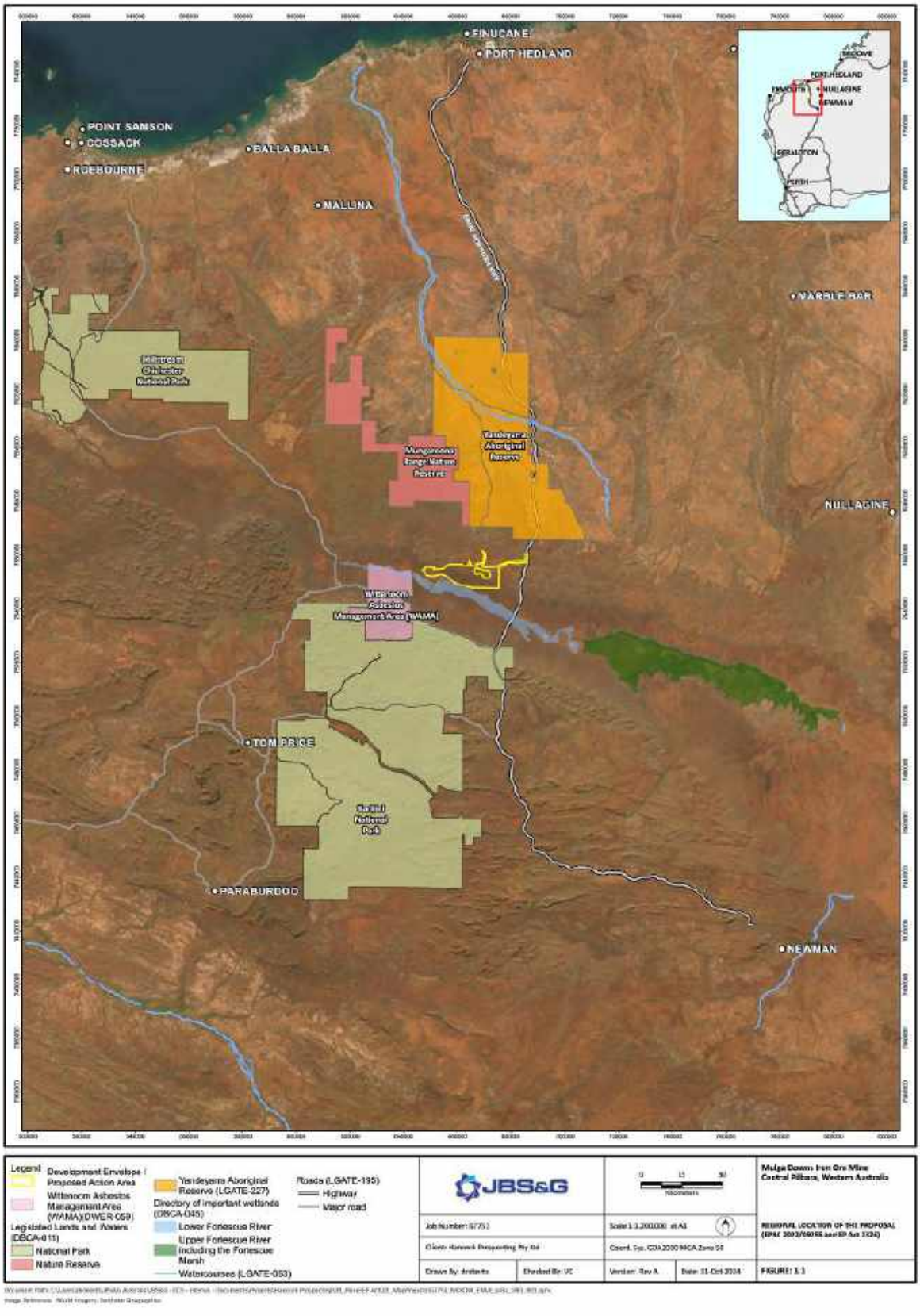

Figure 1-1: Regional location of the Proposed Action Area (2022/09255) and Development Envelope (2326)

1.3 Environmental Impact Assessment

1.3.1 Environmental Protection Act 1986

The Proposal was referred to the WA EPA under Part IV of the EP Act (Assessment No: 2326) in December 2021. The EPA provided notice that the Proposal would be assessed and the level of assessment was set at PER with a 6-week public review period for the Environmental Review Document (ERD).

The Proposal currently under assessment by the EPA under the EP Act will involve the clearing of up to 4,339.16 ha of native vegetation within a Development Envelope of 16,848.83 ha (Figure 1-2).

The key environmental factors relevant to the assessment of the Proposal include:

- Flora and Vegetation;
- Subterranean Fauna;
- Terrestrial Environmental Quality;
- Terrestrial Fauna;
- Inland Waters
- Greenhouse Gas Emissions;
- Social Surroundings; and
- Air Quality.

The key environmental factors subject to this WMP are outlined in Table 1-2. Table 1-3 outlines the Proposal activities and potential impacts to site specific environmental values.

Table 1-2: Key Environmental Factors subject to this WMP

EPA Environmental Factor	Objective
Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so environmental values are protected
Flora and Vegetation	To protect flora and vegetation so biological diversity and ecological integrity are maintained
Social Surroundings	To protect social surroundings from significant harm
Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained

1.3.2 Condition Requirements

Conditional requirements will be added from the Ministerial Statement once issued.

Figure 1-2: Proposal Location, Development Envelope and Indicative Footprint (EP Act: 2326)

1.3.3 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as Matters of National Environmental Significance (MNES).

The Commonwealth is currently assessing the Proposal via a Public Environmental Report under Assessment Number: EPBC 2022/09255. The MDIOM is not being assessed as an accredited assessment under Section 87 of the EPBC Act as the indicative footprints within the Development Envelope/Proposed Action Areas are different. The Proposal being assessed under the EP Act does not include the Murray's Hill Project, which is a component of the Proposal being assessed under the EPBC Act. The Proposal for the purpose of EPBC 2022/09255 is displayed on **Figure 1-3**.

The Proposal being assessed under the EPBC Act will involve the clearing of up to 4,733.66 ha of native vegetation within a Proposed Action Area of 16,848.83 ha (**Figure 1-3**). The Proposal has the potential to impact upon the following MNES:

- Listed Threatened Species and Communities (Sections 18 & 18A); and
- Listed Migratory Species (Sections 20 & 20A).

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) issued Public Environmental Review guidelines to HPPL in October 2022. DCCEEW identified the following MNES as relevant to the assessment of the Proposal:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Vulnerable;
- Ghost Bat (*Macroderma gigas*) – Vulnerable;
- Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable;
- Greater Bilby (*Macrotis lagotis*) – Vulnerable;
- Night Parrot (*Pezoporus occidentalis*) – Endangered;
- Grey Falcon (*Falco hypoleucos*) – Vulnerable; and
- Blind Cave Eel (*Ophisternon candidum*) – Vulnerable.

The following listed migratory species (sections 20 & 20A) were also identified:

- Common Greenshank (*Tringa nebularia*) – Migratory;
- Wood Sandpiper (*Tringa glareola*) – Migratory;
- Red-necked Stint (*Calidris ruficollis*) – Migratory;
- Glossy Ibis (*Plegadis falcinellus*) – Migratory; and
- Fork Tailed Swift (*Apus pacificus*) – Migratory.

1.3.4 Condition Requirements

Conditional requirements will be added from the EPBC Act Approval once issued.

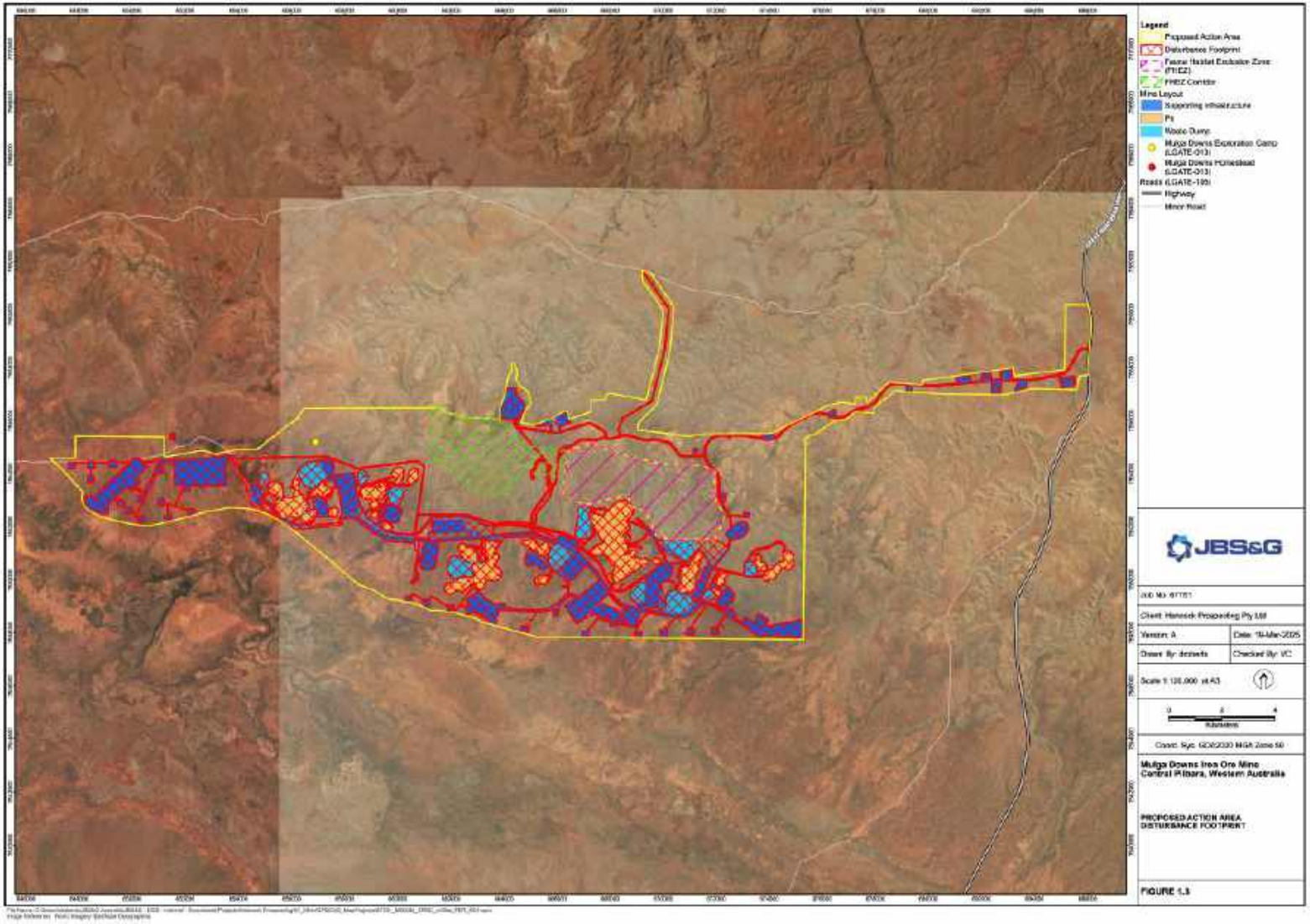

Figure 1-3: Commonwealth Proposed Action Area and Indicative Footprint (EPBC 2022/09255)

1.4 Potential Impacts

Aspects of the MDIOM have the potential to directly and/or indirectly impact key environmental factors and MNES within or near the Proposed Action / Development Envelope during all phases of the Proposed MDIOM. The potential impacts have been identified and presented in Table 1-3.

Table 1-3: Proposal Activities and Impacts to Environmental Factors and MNES

Key Environmental Factor / MNES	Site Specific Value / Receptors	Alteration to Environment	Potential Impacts
EPA Environmental Factor			
Inland Waters	Freshwater Claypans of the Fortescue Marsh, including Gnalka Gnoona Claypan and Koodjeepindarranna Claypan Lower Fortescue River and tributaries Groundwater users (community and pastoral)	Modification of hydrogeologic and hydrologic regimes: - Groundwater drawdown caused by orebody dewatering. - Groundwater mounding caused by MAR - Change in groundwater salinity due to dewatering & MAR - Surface catchment modifications resulting in changed surface water regimes, in particular reduced inflows to portions of the valley environment. - Pollution from leachate infiltration from the WRD	Modification of Existing Hydrogeologic Regimes: - Reduction in groundwater levels from abstraction and mine pit dewatering resulting in reduced groundwater availability at existing bores. - Mounding of groundwater resulting in water logging of root zones and surface expression of saline groundwater - Modification of Groundwater and surface water (Physical and Chemical) Quality - Increased salinity and/or contamination impacting existing groundwater users - Contamination subject to remedial response - Water shadowing and ponding due to changes in the surface water catchments and flow paths.

Flora and Vegetation	Priority 1, 3, 4 flora species Sheet-flow and surface water dependent vegetation Priority 1 Freshwater Claypans of the Fortescue Valley Four plant assemblages of the Wona Land System (Priority 1 to 3)	Modification of hydrogeologic and hydrologic regimes: - Modification of groundwater quality and levels - Modification of surface water quality and quantity Increased dust due to excavation, vehicle movement and clearing activities	Mortality and/or habitat condition reduction from: - Waterlogging or root exposure to saline groundwater, - Increased sediment loads - Decreased surface water quantity due to altered flow direction - Water shadowing Dust has the potential to modify habitat due to degradation of vegetation or topsoil modification. Reduced catchments and altered surface water flow regime that could decrease flood levels. Soil water depletion and drought stress during prolonged interfloods can potentially impact E. victrix communities with denser patches with higher percentage cover. Vegetation types dominated by mulga (*Acacia aneura* complex) are susceptible to increased waterlogging, which could cause a decline in tree health.
Social Surrounds	Mungurrdu lodged DPLH site (ACH-00040484) Koodjeepindarranna and Gnalka Gnoona pools Youngaleena and Wirrilimarra Communities Pastoral bores	Modification of hydrogeologic and hydrologic regimes: - Modification of groundwater quality and levels - Modification of surface water quality and quantity	Disturbance to sites of social and cultural significance and surrounding sensitive receptors. Change to groundwater availability and quality at community bores. Change to groundwater availability and quality at pastoral bores.
Subterranean Fauna	Stygofauna Troglofauna	Modification of hydrogeologic and hydrologic regimes: - Modification of groundwater quality and levels - Modification of surface water quality and quantity - Change in habitat (humidity) from dewatering Direct removal of habitat from mining	Loss/reduction of stygofauna habitat and/or quality from dewatering and MAR, potential leachates from WRDs. Loss/mortality of troglofauna habitat and /or species from MAR and dewatering. Loss/reduction of subterranean fauna habitat from mining

Commonwealth Controlling Provisions			
MNES Listed Threatened Species **MNES Listed Migratory Species**	Grey Falcon MNES Habitat Claypans and Channel Pools Common Greenshank Wood Sandpiper Red-necked Stint Glossy Ibis Fork tailed Swift	Modification of hydrogeologic and hydrologic regimes: - Modification of groundwater quality and levels - Modification of surface water quality and quantity (reduction in hydroperiod)	Mortality and/or habitat condition reduction from: - Waterlogging or root exposure to saline groundwater - Increased sediment loads - Decreased surface water quantity due to altered flow direction - Water shadowing Mortality, reduction, and/or loss of fauna habitat adversely impacting fauna foraging, nesting and migration patterns

1.5 Rationale and Approach

This WMP has been developed to address potential impacts to EPA's key environmental factors (Inland Waters, Flora and Vegetation, Social Surrounds and Subterranean Fauna) and MNES resulting from alterations to naturally occurring surface water and groundwater environments associated with the development of the Proposal. Survey and study findings, risk assessments, and monitoring completed to date and detailed in the ERD and PER, as well as an assessment of assumptions and uncertainties, have been used to define management provisions that will be applied to maintain the environmental objectives associated with the EPA key environmental factors and the Commonwealth MNES subject to this WMP.

HPPL intends to continue monitoring prior to construction and during initial mine development to further enhance existing datasets and support validation and verification of current numeric modelling. As such, it is expected that this WMP will be revised and updated to reflect increased knowledge prior to construction phase of the Proposal, and again following initiation of dewatering and MAR activities. Based on this approach, the trigger levels, threshold criteria, and management provisions as currently detailed in Sections 1.8 and 2 are considered interim.

1.6 Survey and Study Findings

The studies and surveys outlined in Table 1-4 have been performed to inform the surface water, groundwater, ecohydrology, flora and vegetation, and terrestrial fauna summary. Full details of the outcomes from all baseline studies are provided in the State ERD and the Commonwealth PER. A summary of the key environmental aspects relevant to this WMP are provided below.

Table 1-4: Summary of Surveys and Studies

Report Year	Author	Survey / Study Name	Reference
Surface Water, Groundwater and Ecohydrology			
2009	MWH	Murray's Hill Groundwater Investigation – Stage 2	MWH, 2009
2012	MWH	Hydrogeological Assessment of the Fenceline Road Borefield Area	MWH, 2012
2014	MWH	Conceptual Hydrogeology of the Mulga East Deposit	MWH, 2014
2022	PSM	Mulga Downs PFS Geotechnical Assessment and Pit Slope Design	PSM, 2022
2023	GHD	Mulga Downs Water Studies: Groundwater & Surface Water Impact Assessment – Peer Review	GHD, 2023
2023	HydroGeoLogic 2023 / Middlemis 2023	Mulga Downs Groundwater Modelling Independent Peer Review	HydroGeoLogic, 2023
2024	GWC	Mulga Downs Groundwater Modelling	GWC, 2024
2024	AQ2	Mulga Downs Groundwater, Surface Water and Ecohydrological Impact Assessment	AQ2, 2024a
2025	AQ2	Mulga Downs Groundwater, Surface Water & Ecohydrological Studies Baseline Assessment	AQ2, 2025
Flora and Vegetation			
Maia	2022	Mulga Downs Iron Ore Project, Mine and Borefield Study Area Detailed Flora and Vegetation Assessment 2019-2022	Maia, 2022

Report Year	Author	Survey / Study Name	Reference
JBS&G	2023	Memorandum: Mulga Downs Rail and Hub – Flora and Vegetation Surveys – Supplementary memorandum	JBS&G, 2023
Maia	2023	Mulga Downs Iron Ore Mine, Additional Survey Areas, Flora and Vegetation Assessment	Maia, 2023
Spectrum	2024	Memo - Targeted flora and vegetation survey – portion of the Northern Haul Road.	Spectrum, 2024
Spectrum	2025	Report – Mulga Downs Iron Ore Mine – Targeted Hibiscus Survey (report in preparation)	Spectrum, 2025
Subterranean Fauna			
AQ2	2024b	Mulga Downs Iron Ore Mine: Subterranean fauna habitat assessment: Troglofauna and stygofauna habitat assessment.	AQ2 2024b
Bennelongia	2024	Mulga Downs Iron Ore Mine: Subterranean Fauna Survey 2019-2024.	BEC, 2024a
Biologic	2025	Peer review of Salinity tolerance of stygofauna at Mulga Downs Iron Ore Mine. Memo 675	Biologic, 2025a
Biologic	2025	MDIOM Subterranean fauna baseline peer review	Biologic, 2025b
JBS&G	2025	Analysis of stygofaunal associations with groundwater salinity and potential salinity tolerances based on observations, for the Mulga MDIOM (in preparation)	JBS&G, 2025
Biologic	2025	Targeted troglofauna survey 2025	Biologic, 2025c *(in prep.)*
JBS&G	2025	Analysis of stygofaunal associations with groundwater salinity and potential salinity tolerances based on observations, for the MDIOM	JBS&G, 2025b *(in prep.)*

1.6.1 Inland Waters

1.6.1.1 Hydrologic Regime

The Fortescue Valley is split by the Goodiadarrie Hills (a ~5 m barrier that forms a surface water divide) into the (eastern) Fortescue Marsh and the (western) Goodiadarrie Swamp. A second surface water divide exists to the west of the Goodiadarrie Swamp (immediately to the west of Koodjeepindarranna Claypan), separating the Goodiadarrie Swamp from the Lower Fortescue River (Figure 1-5). The Project is located on the northern flanks of the Fortescue Valley and is fully contained within the Goodiadarrie Swamp sub-catchment, with the swamp located on the northern side of the base of the valley and immediately to the south of the Project. The Goodiadarrie Swamp catchment is bounded by the Chichester Range to the north and the Hamersley Range to the south. Runoff from smaller rainfall events is likely to be contained within the Goodiadarrie Swamp area, with discharge into the Lower Fortescue River likely to require large rainfall events.

Claypans and Channel Pools

Two claypans occur outside but in proximity to the Proposal Area: Gnalka Gnoona to the south-east and Koodjeepindarranna to the west. The diversity and abundance of the aquatic biota is dependent on the length of the standing water which influences changes in the community structure in these wetlands. When inundated, these claypans are considered to be of high value for waterfowl and wading species, including MNES. Three migratory wading species (Common Greenshank, Red-necked Stint, and the Wood Sandpiper) were recorded foraging in the surface water present in the Gnalka Gnoona Claypan during the Level 2 survey (ecologia 2021; Biologic 2023).

Small, surface water fed channel pools that hold water for a period of time following runoff events, in the Fortescue Valley, occur south (downstream) of the Development Envelope. These pools are considered to have potential local conservation significance. They are within the Goodiadarrie Swamp and within drainage channels reporting to the valley floor, and persist, following runoff events. Claypans and some of the identified channel pools are shown on Figure 1-4: and Figure 1-5 and described in Table 1-5.

Table 1-5: Claypans and Channel Pools

Feature	Overview
Claypans	• Noted claypans within the Goodiadarrie Swamp catchment are the Koodjeepindarranna Claypan and the Gnalka Gnoona Claypans, immediately south of the Development Envelope. • The Gnalka Gnoona Claypan can form into an extensive waterbody that may persist for extended periods. • Very little transfer of water along the valley floor within the Goodiadarrie Swamp area is thought to occur, with no defined preferred drainage paths along the valley floor and a valley floor slope of -0.01% • Evaporation plays the primary role in removing collected water from the claypans, with only minor seepage to the groundwater system. Residual salts from this evaporative loss are leached into the groundwater system under the claypans by the small component of seepage.
Channel Pools	• Four of the identified surface water fed channel pools which were identified within the Goodiadarrie Swamp area include: – Channel pool within the Koodjeepindarranna Claypan complex. – Channel pool at UTM Zone 50 653300E and 7550400N (vicinity of Gnalka Gnoona Claypan complex) – Channel pool at UTM Zone 50 661600E and 7547770N. – Gidyea pool south east (and upstream) of the Development Envelope (Ebathcalby Claypan complex) • A further channel pool was identified to the north (upstream) of the mining area. • Additional channel pools form across the Goodiadarrie Swamp area following large rainfall events.

Baseline water balance modelling of the Gnalka Gnoona and Koodjeepindarranna Claypans was undertaken to provide baseline predictions of the claypan hydrological regime which were compared to water balance catchment conditions following mine development. Key outcomes are summarised in Table 1-6.

Table 1-6: Claypan Hydrological Summary

Feature	Overview
TDS Concentration	• Observed salinity in the claypans is typically below 500 mg/L, with the exception of "first flush" spikes in salinity prior to large inflows of runoff into the claypan. • The low salinity of the ponded water within the claypans and the recorded depth to groundwater below the claypans indicates the water within the claypans is sourced from surface water runoff.
Long Term Water Balance Predictions – Pre Mining	• The largest predicted water level in the claypans: 320 millimetres (mm) of rainfall was simulated over 24 hours. The highest claypan water level predicted: 405.4 mRL. • The longest period of continuous claypan inundation predicted in the order of 300 days (i.e. the maximum claypan hydroperiod), and there are occasions where the hydroperiod of the claypans was predicted to exceed 200 days above 403.2 mRL. • Flooding within the claypans can be driven by both a single rare (very large) rainfall event, or by multiple consecutive large rainfall events. • The claypans are predicted to typically dry-out during the dry season in most years.
Mine Development	• A 10% reduction to the Gnalka Gnoona catchment and 2% reduction to the combined claypan catchment areas was applied to the water balance model to simulate the impact of catchment reduction. The catchment reduction estimated for Koodjeepindarranna due to the Project is insignificant (<0.5%). The impact of the loss of catchment area on claypan water levels is typically less than 0.02 m within the Gnalka Gnoona claypan. • During large runoff events, if additional catchment areas report to the claypan areas (either from the Hamersley Range or from upstream areas of the Fortescue River) then the percentage catchment reduction due to the proposed mine development would reduce (lower impact). • The key characteristics of the claypans which may be impacted by the proposed development are changes to the inundation depths, ponding duration (hydroperiod) and water quality (TDS) of ponded water. The impacts are considered negligible and are summarised as follows: – Reductions in claypan water level were predicted to range between nil to 0.022 m. Note that the water levels in the Koodjeepindarranna Claypan were only impacted if the water level in the Gnalka Gnoona Claypan exceeded the height of the divide between the two claypans (402.9 mRL). – Inundation duration was predicted to decrease in the order of days for large and medium events with negligible change in inundation duration predicted for the small events. – Only a marginal change in TDS is predicted between the model scenarios

Surface Water Data

Baseline surface water monitoring has been undertaken within creek lines, claypans and channel pools at 11 locations (SWML01A, SWML01-09, SWML13). Surface water samples collected for laboratory analysis were collected from SWML01A, SWML01-05, SWML09, and SWM13 with a summary overview of surface water quality results provided in Table 1-7.

Table 1-7: Surface Water Quality Results Summary

Feature	Overview
Surface Water Sample Analytical Parameters	Surface water samples have generally been tested for: • General water quality and general metals suite • Nutrients • TDS/ Total Suspended Solids (TSS)

Feature	Overview
Comparison to ANZECC Freshwater Aquatic Ecosystem Guideline Values	• Samples collected from the creeks and channel pools are classified as being from an 'Upland River' sub-system for comparison to physical stressor trigger values. • Samples collected from the claypans would be classified as being from a 'Fresh Water Lakes' sub- system for comparison to physical stressor trigger values. • The site would be classified as slightly to moderately disturbed due to the historic and continuing cattle farming practices that occur through the catchment. However, the site is considered to have a high conservation value. *Based on the above, sampled results have been compared against ANZECC Tropical Fresh Water trigger levels for physical stressors for Upland River and Freshwater Lakes ecosystems, as well as toxicant default guideline values (DGVs) for both ecosystem types associated with 95% species protection.*
Water Quality Data Analysis	Key data results analysis: • Aluminium, Zinc, Phosphorus, Sulfate concentrations measured are consistently above the DGVs. • The measured TDS concentrations of the samples taken from the claypans (SWML03 and SWML04) are variable (as expected) depending on the timing of the sample collection relative to the date of the inundation event. It is noted that: – When runoff first reports to the claypans, the salinity of the ponded water is typically low (<100 mg/L) – As the water in the claypans evaporates and the salts are left behind, the salinity of the claypans increases – Maximum TDS values from observed data are less than 900 mg/L. • In general, claypan samples have a higher conductivity, TDS and alkalinity.

Flood Modelling

2D flood modelling was undertaken to predict baseline inundation extents resulting from a range of design events. Inflow hydrographs at the model boundary were developed for catchments that extended outside the Digital Elevation Model (DEM) extents within the Chichester and Hamersley Ranges. The intent of the modelling was to provide baseline flood depths and flow velocities in the vicinity of the proposed mine disturbance areas and to provide flood model scenarios which quantified the impacts of the Proposal on the surface water regime. Key outcomes are summarised in Table 1-8.

Table 1-8: Flood Modelling Summary Overview

Overview
• The proposed mine development may represent a loss of surface water catchment of 21 km² (if runoff is contained within the mine disturbance areas). • The reduction in catchments due to the containment of runoff within the mine development areas may cause a reduction in flood levels within some areas of the Fortescue Valley to the south of the Project. In particular, the areas of ponding within the Goodiadarrie Swamp immediately to the south of Anticline South, Fridge West, Fridge Central and Horseshoe South pits are predicted to have a reduction in peak flood levels of up to 0.2 m following a 50% Annual Exceedance Probability (AEP) rainfall event. • Where flow is diverted around the mine development areas, some areas of the Fortescue Valley to the south of the Project are predicted to have increased peak flood levels. • The modelling indicates that the mining development will have a greater effect on infrequent, large flow events than smaller, more frequent flow events. • Key observations from the 1% AEP flood predictions: – Across the alluvial fans, mine infrastructure would be exposed to extensive shallow sheet flow across the floodplain and braided channels branching over the alluvial fans – A number of upstream catchments drain towards the Fortescue valley from the north through the mine as defined water courses. Flood depths in these channels can exceed 1.5 m. The proposed Fridge Central/Horseshoe West mining infrastructure areas appear more susceptible to these flows. – Extensive flooding across the claypans is predicted with areas of widespread ponding occurring.

Overview
• The predicted changes in flood levels following a 63% AEP rainfall event have identified: – A total area of approximately 25 ha subject to increased flood levels (>5 centimetres (cm) increase in maximum flood height). – A total area of approximately 310 ha subject to decreased flood levels (>5 cm decrease in maximum flood height).

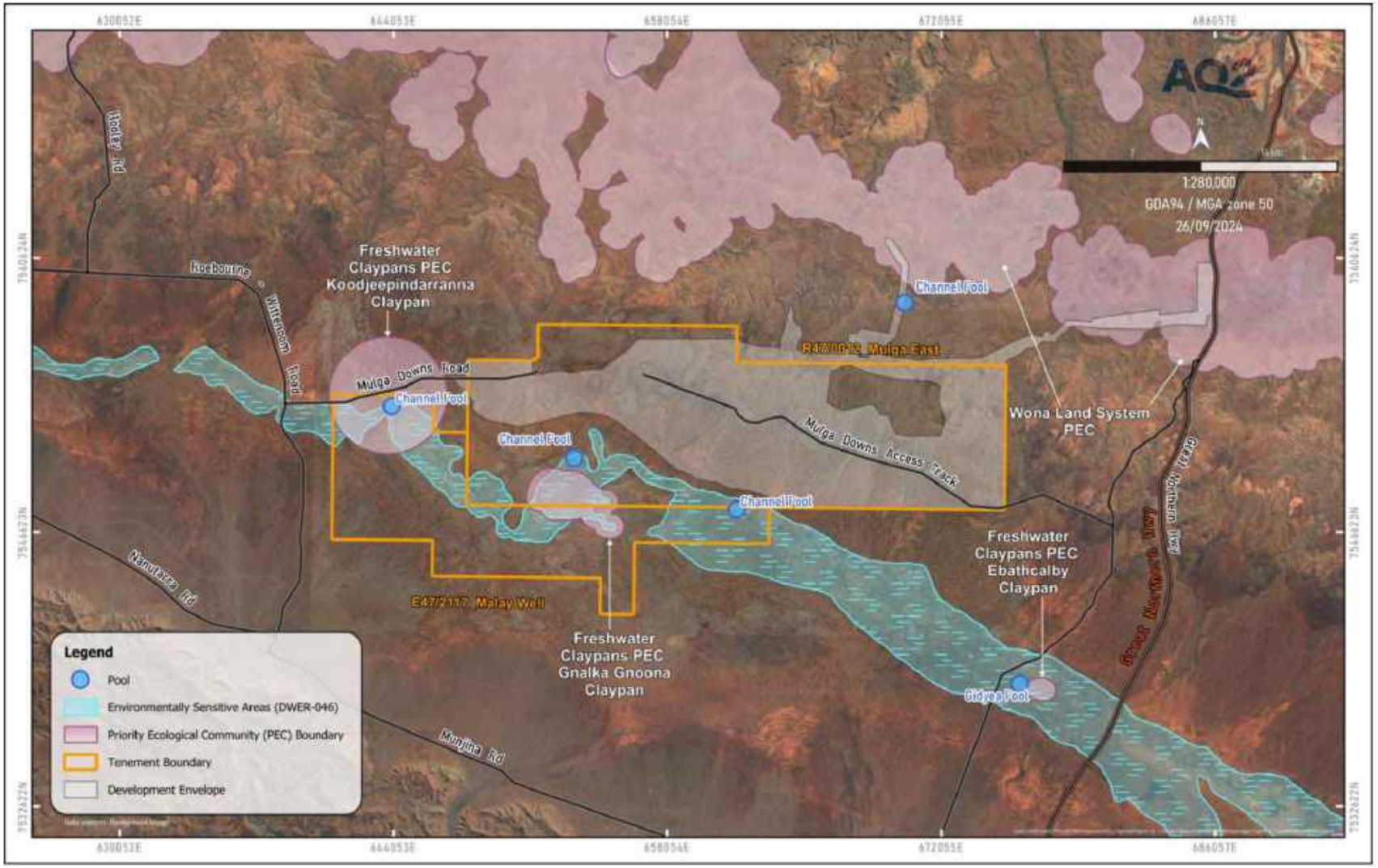

Figure 1-4: Channel pools in relation to the Development Envelope / Proposed Action Area

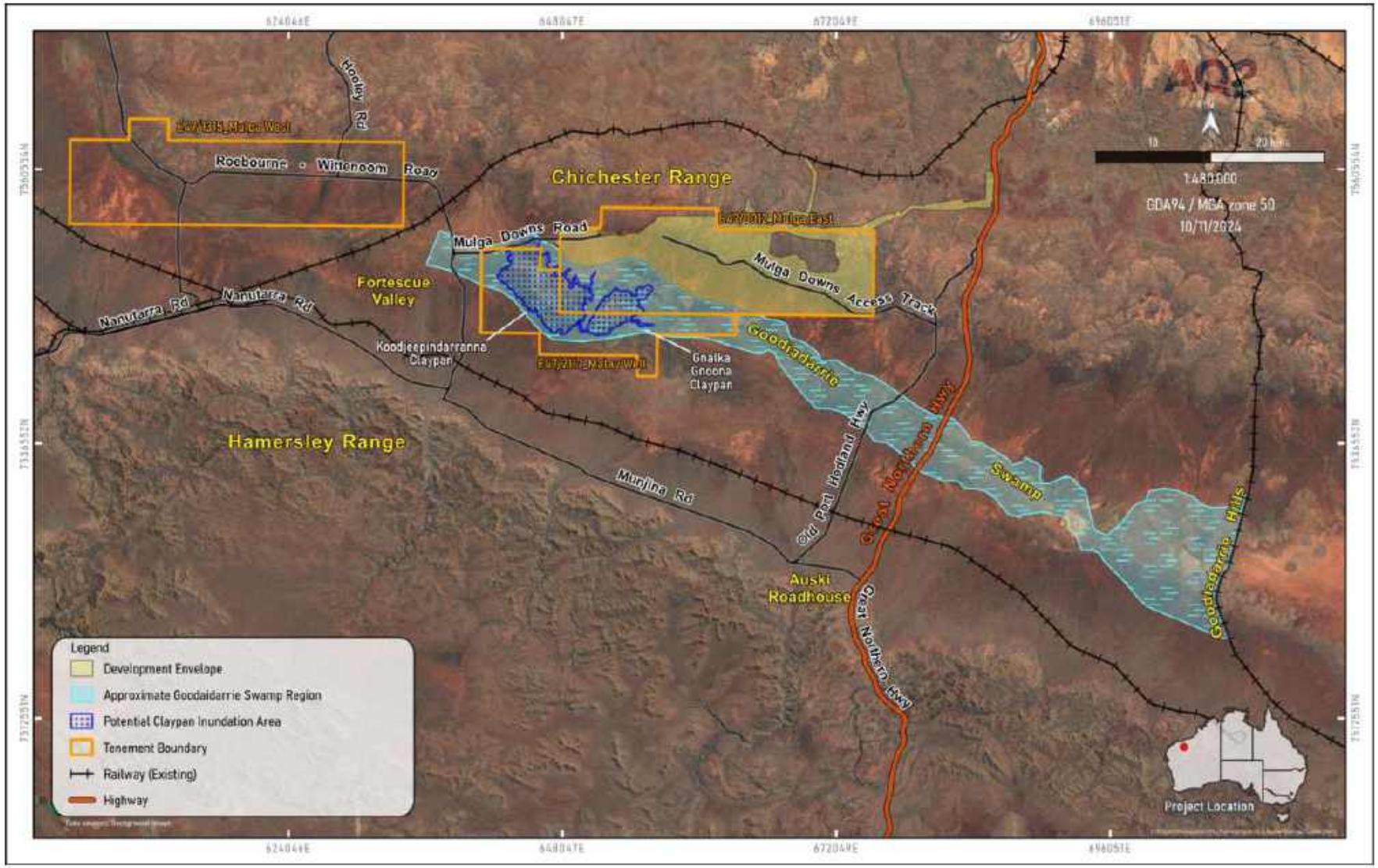

Figure 1-5: Project hydrological setting (AQ2, 2024)

1.6.1.2 Hydrogeologic Regime

Extensive hydrogeological drilling and testing has been undertaken over the Proposal area and surrounds with comprehensive baseline monitoring undertaken since late 2018, in addition to long-term water level records dating back to late 2008.

A summary of the hydrogeologic regime is provided below.

Hydrostratigraphy

Five main hydrogeologic units have been identified as part of the hydrogeologic investigations and are summmarised as follows:

- Tertiary / Quaternary Cover: A thin layer of alluvium covers much of the lower-lying areas and is predominantly unsaturated. The Tertiary overburden forms a highly transmissive and continuous aquifer within the valley. Maximum thicknesses up to approximately 60 metres (m) occur in the middle of the valley, thinning on the valley slopes. The Tertiary overburden comprises the following sub-units: Basal 'Crete', CID/Pisolite, Undifferentiated Tertiary and Upper Calcrete.
- Bedrock Units: Fresh Jeerinah and Marra Mamba Formations: The low permeability Jeerinah Formation and unmineralized Marra Mamba Iron Formation form a basement aquitard with minor local fractured aquifers.
- Altered Marra Mamba Formation and West Angela Member: A highly transmissive and continuous aquifer is hosted in the mineralised, fractured and weathered Marra Mamba Iron Formation which overlies the basement aquitard. Localised (discontinuous) zones of enhanced permeability associated with mineralisation and extreme weathering / alteration have also been identified within the West Angela Member which overlies the Marra Mamba Iron Formation.
- Fresh West Angela Member (Wittenoom Formation): Where fresh, the West Angela Member forms a low to moderately permeable aquifer unit.
- Dolomite (of the Wittenoom Formation): The dolomite of the Wittenoom Formation which overlies the West Angela Member forms a discontinuous fractured rock aquifer in generally low-permeability basement.

Groundwater Levels and Flow Direction

The water table elevation ranges between approximately 385 metres Reduced Level (mRL) and 420 mRL, with groundwater flowing from the topographically higher areas into the valley and then in a north-westerly direction along the valley.

The depth to groundwater is shallow in the lower lying, valley areas at approximately 3 and 5 metres below ground level (mbgl) and increases with elevation, to depths of up to 45 mbgl in the more elevated areas (north of the inferred resource areas)

The derived depth to water for the claypans and channel pools indicate these features are not groundwater related.

Groundwater Quality

Groundwater ranges from fresh [180 milligrams per litre (mg/L) Total Dissolved Solids (TDS)]) in the upper reaches of the groundwater system, to saline (17,000 mg/L TDS) across the valley area. Data indicates the saline water originates from the surface water evaporation in the claypans, with salts mobilising from the unsaturated zone to the groundwater during periods of rainfall. The saline groundwater extends along the valley as well as beneath the southernmost orebodies (refer Figure 1-6).

Laboratory analysis for metals, alkalinity, major and minor anions (chloride, sulfate, boron and fluoride), major and minor cations (potassium, sodium, calcium, magnesium, and strontium) has been completed to establish a baseline dataset. The baseline dataset has been evaluated and through statistical analysis, trigger levels established. The levels and approach are detailed in the CBEC (2024) document provided as **Appendix 1.**

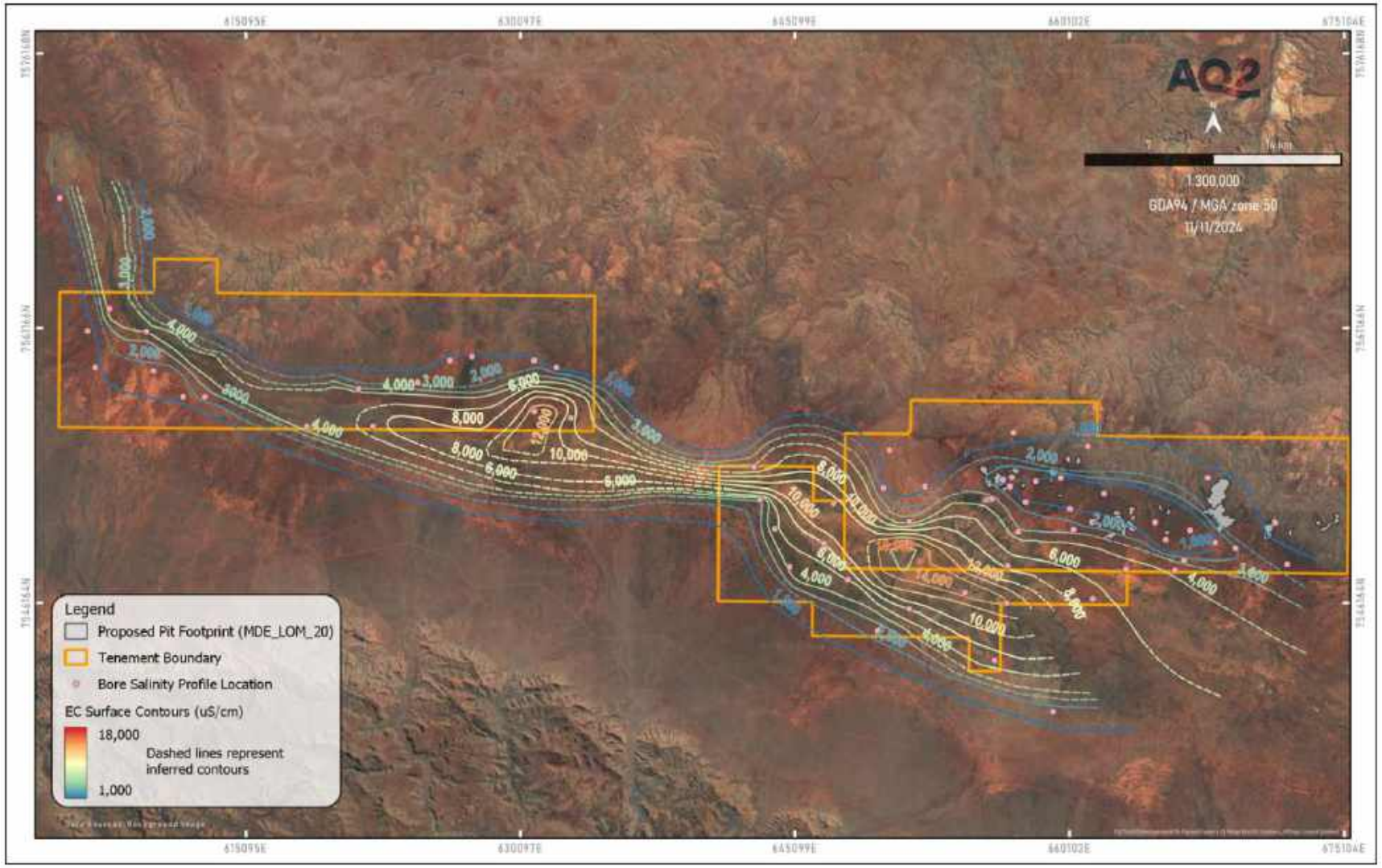

Figure 1-6: EC Contours at Water Table

Dewatering and MAR

Open cut pits are proposed in seven mining areas referred to as Murray's Hill, Anticline Hill, Fridge West, Fridge Central, Fridge Hill, Horseshoe West and Horseshoe Hill. All but 13 of the pits extend (to varying depths) below the groundwater level and will therefore require dewatering. The lowest estimated pit elevation is 388 mRL (i.e., approximately 12 to 16 m below the groundwater level).

Dewatering exceeds water demand and surplus water will be managed via MAR (via re-injection bores, repurposed dewatering bores and/or in-pit infiltration). There are three proposed MAR areas: Murray's West borefield, Fridge/Horseshoe South borefield; and re-injection in the Murray's Hill and Anticline Hill mining areas (post mining of these areas).

Groundwater salinity will change as a result of dewatering and MAR activities. An evaluation of the changes in groundwater salinity was undertaken and summarised as follows:

- The TDS of the combined dewatering discharge for all dewatering bores over Life of Mine (LOM) is predicted to range between 1,700 and 4,200 mg/L, taking into account the uncertainty associated with aquifer porosity.
- Changes in groundwater quality resulting from the proposed dewatering and MAR activities is anticipated to be fairly localised (i.e. approximately 3.6 km in extent, inclusive of uncertainties) and is shown in Figure 1-8.
- The key driver for groundwater salinity change is the proposed dewatering at Murray's Hill. This is predicted to result in increases to the dewatering discharge salinity as more saline water is drawn in from the valley areas. The subsequent re-injection of this more saline dewatering discharge into the Murray's West and Fridge / Horseshoe South MAR Borefields results in localised areas of increased groundwater salinity as well as subsequent increases to the combined dewatering discharge, as the re-injected water in the east is recirculated towards the Fridge West and Fridge Hill mining area.
- Predicted groundwater salinity beneath the claypan areas shows only minor fluctuations (<500 mg/L TDS).

The effects of dewatering and MAR on groundwater levels are summarised in Table 1-9 and illustrated in Figure 1-7.

Table 1-9: Dewatering and MAR – Predicted Groundwater Level Changes

Activity	Regime Alteration
Dewatering	• Maximum drawdowns are predicted in the active mining areas, with maximum drawdown depths of up to 25 m • Drawdown is predicted to extend across the valley, away from the mining areas, however the extent of the drawdown along the strike of the valley is curtailed by MAR in both the east and the west of the Mulga East tenement for various periods through the LOM. • The maximum extent of predicted 2 m drawdown contours are as follows: – Across the valley: ~8 km south-southwest of Fridge West, across the valley. – In the vicinity of the claypans: ~ 7.5 km south-southwest of the Murray's Hill mining area, across the Gnalka Gnoona Claypan area. – Western extent: ~6 km along strike to the west of the Murry's Hill mining area. – Eastern extent: ~-3.5 km to the east of the main Horseshoe West pit
MAR	• Groundwater level rise (mounding) will occur as a result of MAR, with the maximum extent of predicted 1 m mounded contours as follows:

Activity	Regime Alteration
	– Fridge/Horseshoe South Borefields: ~10 km to the south (across the valley) and ~5 km beyond the Mulga East tenement boundary, in a southeasterly direction. – Murray's West MAR Borefield: ~7km to the northwest (along strike) and ~5 to 5.5 km to the south and southwester (across the valley), in the vicinity of the Koodjeepindarranna Claypan. • The threshold groundwater depth above which interaction with vegetation may occur is estimated to be about 2.0 mbgl

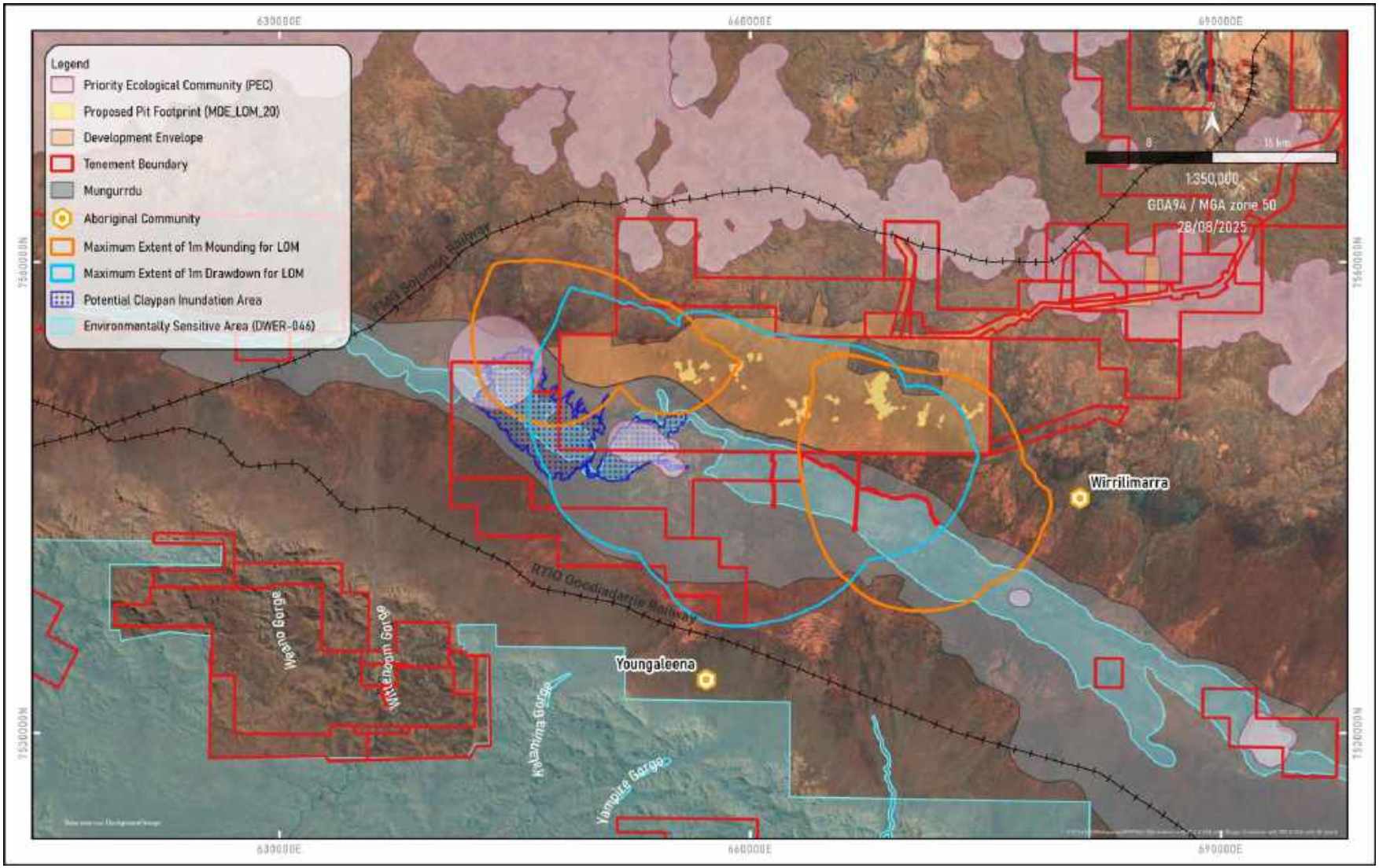

Figure 1-7: Predicted Extent of Drawdown and Mounding with respect to Environmentally Sensitive Areas in the Mulga Area

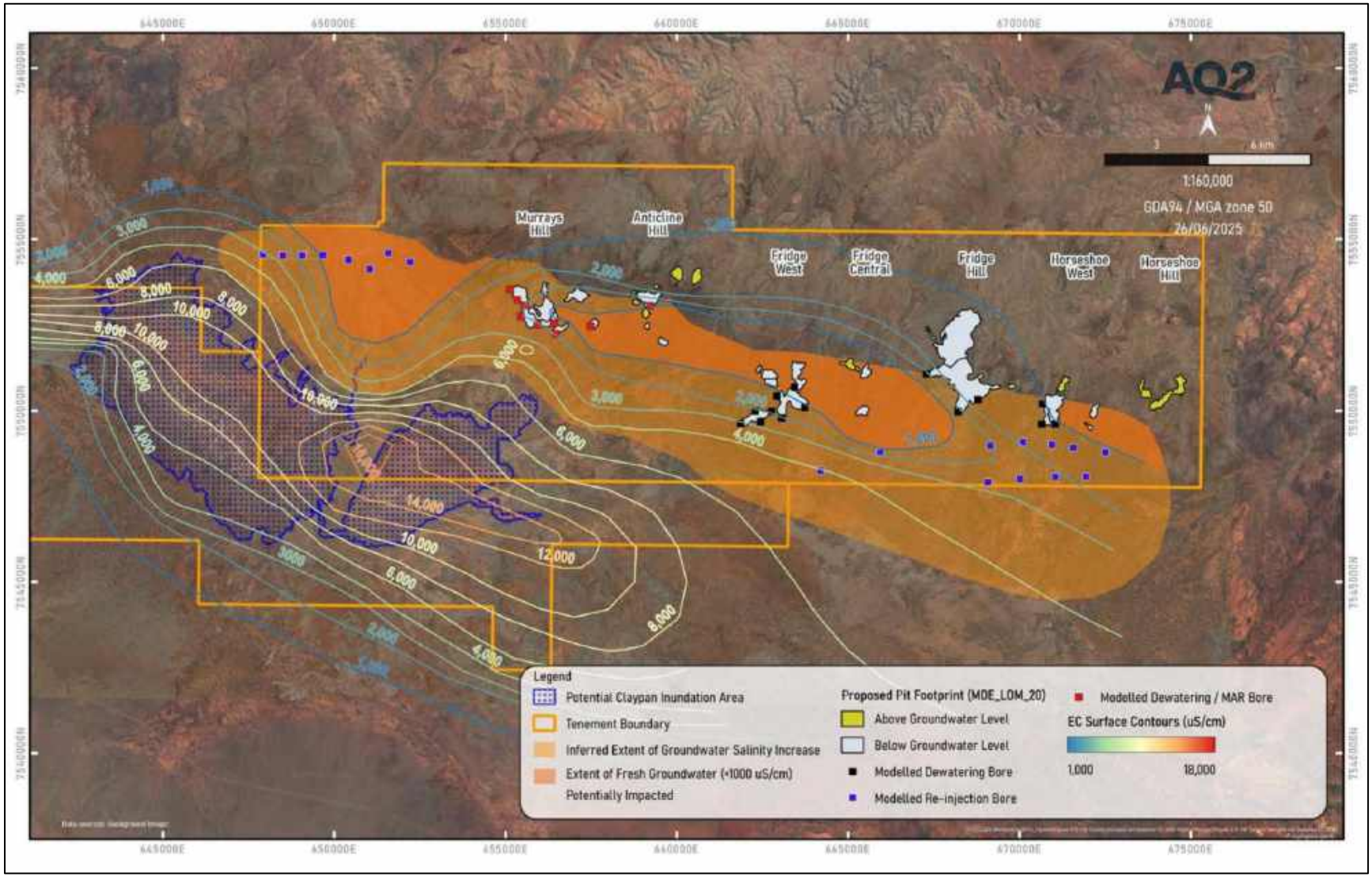

Figure 1-8: Inferred Extent of Groundwater Salinity Increase Based on Model Predictions - Inferred Extent with Baseline EC Contours at Groundwater Level

1.6.2 Flora and Vegetation

Flora and vegetation assessments indicated several relevant species and types that may be subject to impact from altered hydrologic and hydrogeologic regimes result from mine development. These are summarised in Table 1-10.

No Threatened flora species listed under the EPBC Act or the Biodiversity Conservation Act 2016 (BC Act) have been recorded within the Development Envelope.

There are no recorded Threatened Ecological Communities (TECs) listed under the BC Act/EPBC Act within the Development Envelope or within 20 km of the Development Envelope. There is no groundwater dependent vegetation (GDV) recorded in the Development Envelope, and ecohydrological studies concluded that GDVs are not expected to occur. Key rationale is as follows:

- Groundwater underlying the Fortescue Valley environs is generally brackish/saline and therefore does not constitute a favourable water source for the vegetation.
- In most areas, plant roots cannot readily access groundwater as there is calcrete or dense impermeable clay beneath the soil, and above the groundwater table, which plants roots cannot easily penetrate.
- Surface water inputs are sufficient to support the density of trees occurring in the Fortescue Valley *E. victrix* woodland communities. The denser woodland stands are associated with better structured soils with relatively higher plant-available water storage capacity.
- Normalised Difference Vegetation Index (NDVI) imagery assessment, there are no areas of persistently high greenness indicating vegetation is not dependent on groundwater.
- Time-series pre-dawn leaf water potentials, leaf water potential data collected from trees does not indicate groundwater use.

Vegetation potentially dependent on sheet flow (overland/surface water flow) is present within the Development Envelope.

Acacia aneura and closely related co-occurring species are commonly referred to as Mulga vegetation (Mulga) (Page and Grierson, 2010). Mulga has been found to be highly dependent on sheet flow (Winkworth, 1973; Tongway and Hindley, 2004; cited in Maia, 2022); Saco et al., 2010) and sensitive to any changes to sheet flow. The changes can be natural, such as following rainfall events where the natural fluvial channels may be altered from erosional processes.

Across the Pilbara, sheetflow vegetation typically comprises banded Mulga and non-banded Mulga that is most commonly associated with the Jamindie land system.

Vegetation types listed in Table 1-10 and shown in Figure 1-9 may represent sheetflow dependent vegetation types have been mapped within and surrounding the Development Envelope. They are identified as potential sheetflow vegetation solely due to the dominant presence of Mulga species, such as *Acacia aneura*, within these vegetation types (Maia 2022). Soil type and gradient has not been considered in the identification of these potential sheetflow dependent communities.

Table 1-10: Relevant Flora and Vegetation Overview

Feature	Description
Flora	
Priority	Ten confirmed 'Priority' flora species have been identified in the Development Envelope • **Priority 1**: *Dipteracanthus chichesterensis* , *Hibiscus sp.* Mulga Downs (S. Hitchcock SH 638), *Triodia veniciae* • **Priority 3**: *Aristida jerichoensis* var. *subspinulifera* , *Dolichocarpa sp. Hamersley Station* (A.A. Mitchell PRP 1479), *Euphorbia australis var. glabra, Rostellularia adscendens* var. *latifolia, Themeda sp.* Hamersley Station (M.E. Trudgen 11431) • **Priority 4**: *Rhynchosia bungarensis* and *Bulbostylis burbidgeae*.
Hibiscus sp. Mulga Downs (S. Hitchcock SH 638)	*Hibiscus sp.* Mulga Downs (S. Hitchcock SH 638) (Priority 1) has shown a possible habitat preference to sheetflow dependent vegetation (Figure 1-9).
Potential Grey Falcon Nesting Trees	*Eucalyptus victrix* were mapped within the Drainage Line/Floodplains habitat in various surveys. These trees were identified as suitable nesting trees for the Grey Falcon and were mapped if already constructed nests were visible (Spectrum 2023b). A total of 46 nests were recorded across 27 locations (sites) and assessed as being suitable for use by the Grey Falcon for nesting. However, no Grey Falcons were observed during the survey, there was no evidence of these nests in use by Grey Falcons, including secondary evidence of this species
Vegetation	
Priority Ecological Communities (PECs)	**Freshwater Claypans of the Fortescue Valley (Priority 1)** • The Freshwater claypans of the Fortescue Valley PEC (Priority 1) comprise of claypans in the Fortescue Valley, including the Gnalka Gnoona Claypan and the Koodjeepindarranna Claypans. • The Development Envelope does not intersect the Department of Biodiversity, Conservations and Attractions (DBCA) designated buffer of the 'Freshwater Claypans of the Fortescue Valley' Priority 1 PEC. **Four plant assemblages of the Wona Land System (Priority 1-Priority 3)** • Vegetation type MTGW has been mapped in the Development Envelope and described as Mixed Tussock Grasslands of *Eragrostis xerophila, Aristida latifolia* and *Astrebla pectinate*, with patches of Triodia spp. and sparse mixed shrublands. • Vegetation type ASL(2) shares similar species to MTGW and may also be associated with the PEC so has been conservatively considered. • Vegetation types MTGW & ASL (2) are mapped as the 'Four plant assemblages of the Wona Land System'
Surface Water Dependent Riparian Vegetation	Surface water dependent riparian vegetation have been identified as: • *Eucalyptus victrix* • *Melaleuca glomerata* • *Ficus braccypoda* • *Atalaya hemiglauca* • *Hakea lorea.* One mapped riparian vegetation of local significance (restricted to the Fortescue River and associated habitats) within the Development Envelope is AdEvWL. AdEvWL supports species that only occur in seasonally inundated habitats.
Sheetflow Dependant Vegetation	Vegetation potentially dependent on sheet flow (overland/surface water flow) is present within the Development Envelope. This have been recorded as: • AaAxSL - tall sparse shrubland of *Acacia aneura* (alliance) • ASL (1) - *Acacia* tall shrubland • ASL (2) - *Acacia* tall shrubland • AWL (1) - *Acacia* low woodland or tall shrubland • AWL (2) - *Acacia* low woodland or tall shrubland • AWL (3) - *Acacia* low woodland or tall shrubland • AxAsSL - *Acacia* tall sparse shrubland

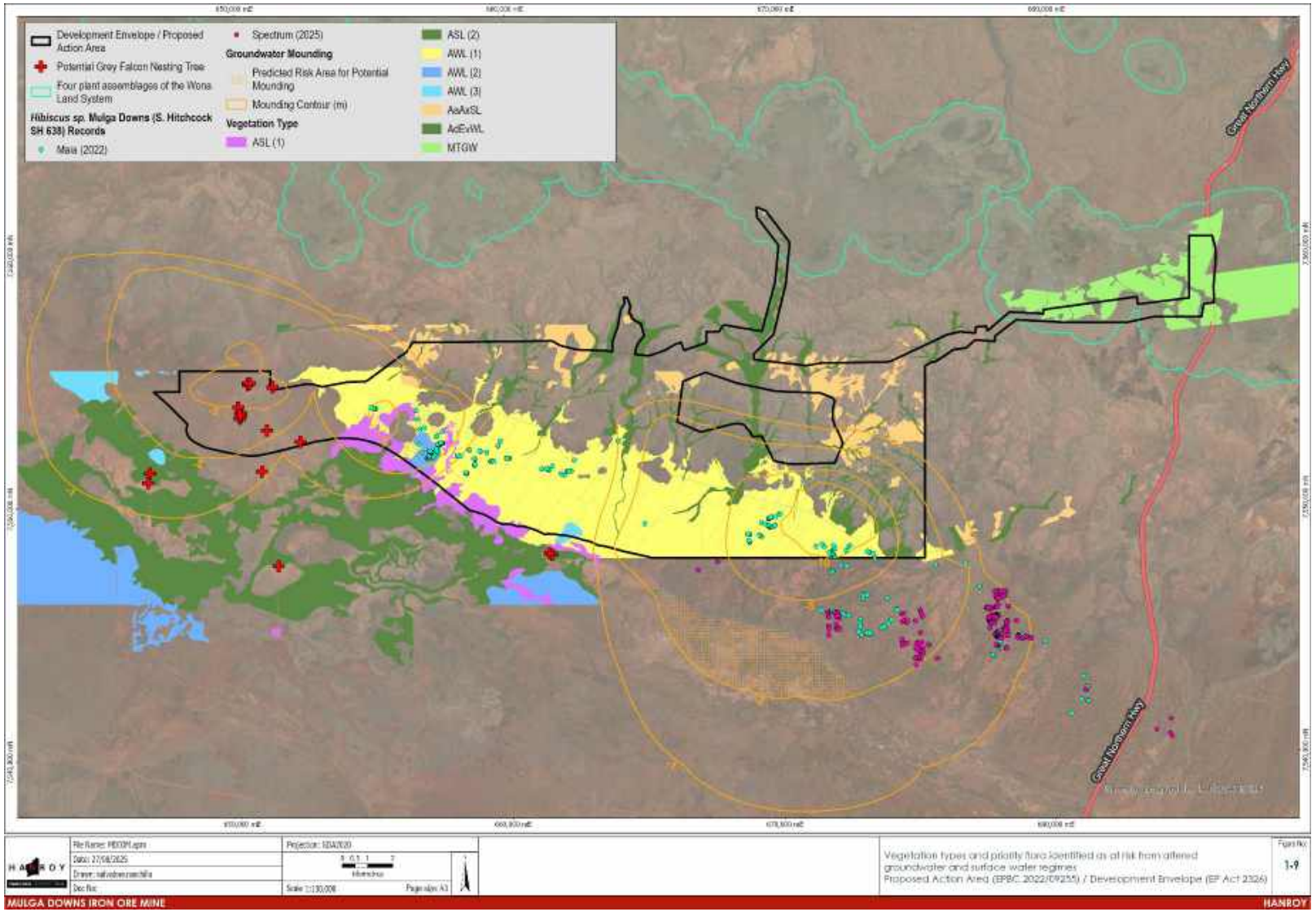

Figure 1-9 Vegetation types identified as at risk from altered groundwater and surface water regimes

Given that the vegetation is disconnected from the groundwater system under baseline conditions, a reduction in groundwater levels is not predicted to impact the terrestrial environment. A lowered water table would increase the thickness of unsaturated sediments, which may slightly reduce the responsiveness of the aquifer to recharge events. However, these sediments are not considered to be accessible to plant root systems (AQ2, 2024).

A schematic description of the effect of lowered groundwater levels on the Fortescue Valley *E. victrix* woodlands and adjacent claypans is shown in Figure 1-10.

Groundwater mounding will also not impact the terrestrial environment if there is no interaction between the water table and the overlying soil profile occupied by tree roots, either by direct intersection or via capillary rise. Based on the ecohydrological conceptual model and measured baseline conditions, the threshold groundwater depth above which interaction with vegetation may occur is estimated to be about 2.0 mbgl (AQ2, 2024).

A schematic description of the effect of lifted groundwater levels on the Fortescue Valley *E. victrix* woodlands and adjacent claypans is shown in Figure 1-11.

The model simulations of MAR achieve the required volume and minimum water level below ground level objectives. Additional capacity exists in areas allowing flexibility to manage minimum water level below ground level.

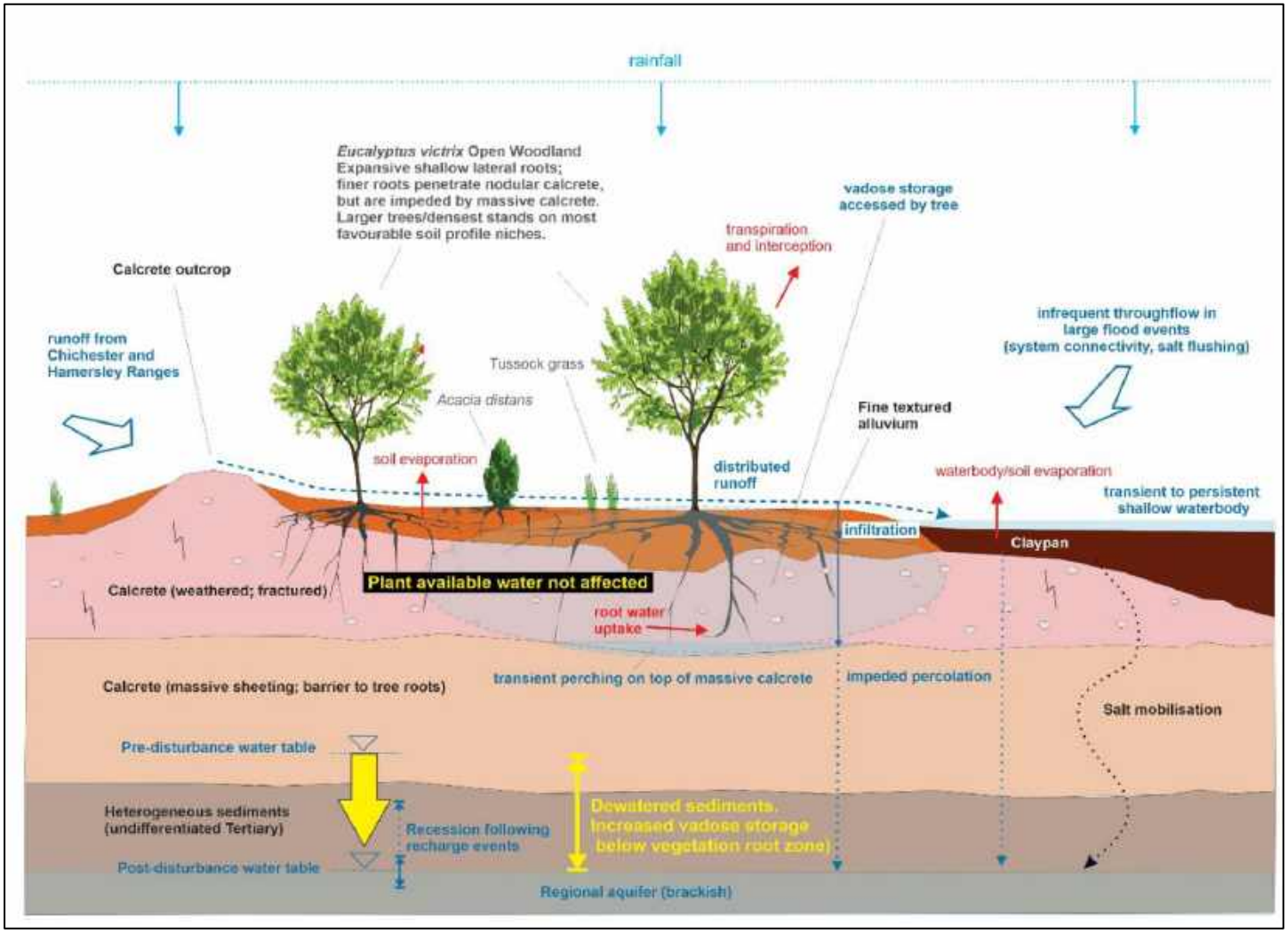

Figure 1-10: Predicted system response to lowered water tables in the Fortescue Valley environs (NB:"post-disturbance water table" refers to the operational phase of the Proposal) (AQ2, 2024)

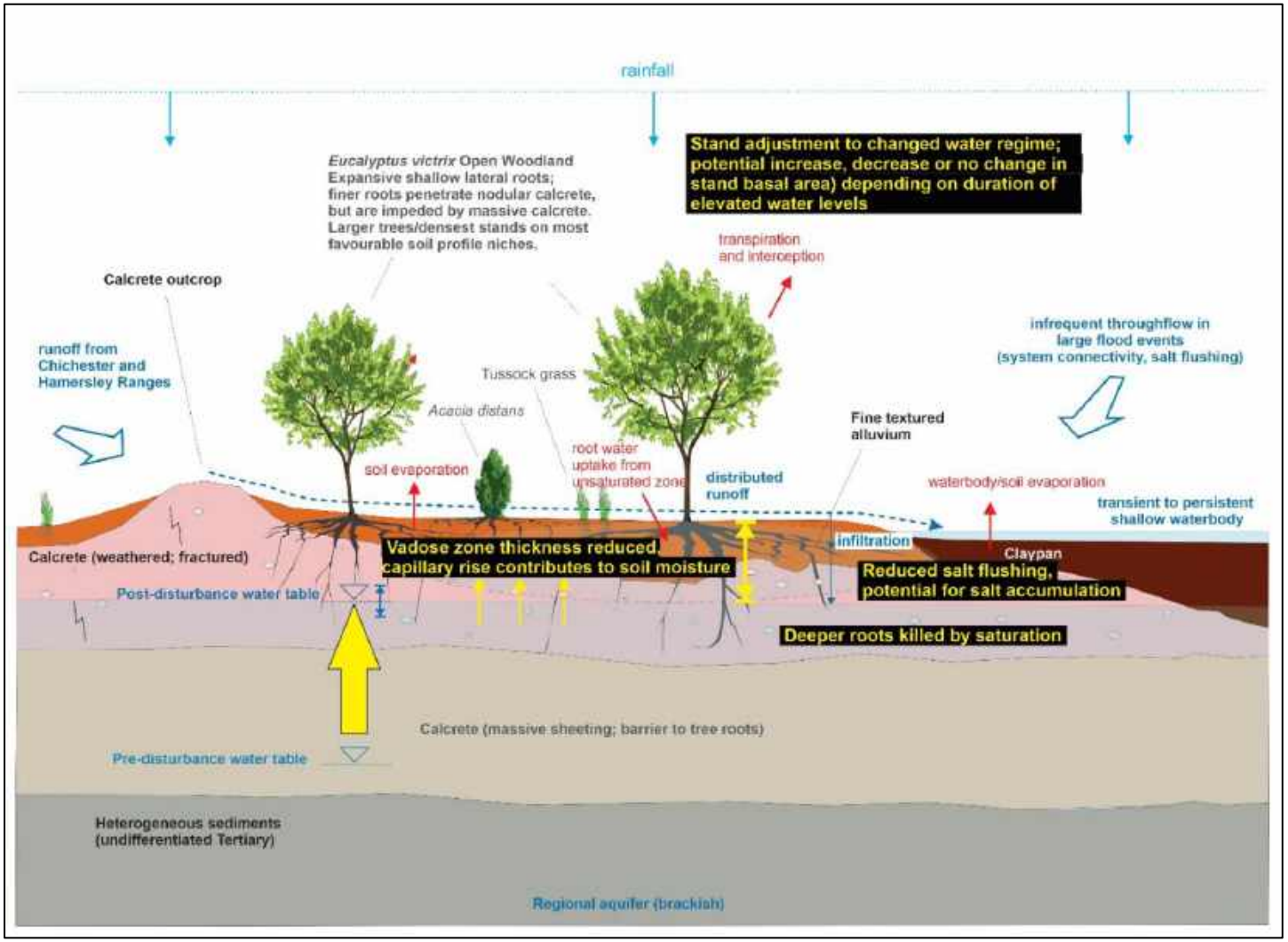

Figure 1-11: Predicted system response to lifted water tables in the Fortescue Valley environs (NB: "post-disturbance water table" refers to the operational phase of the Proposal) (AQ2, 2024)

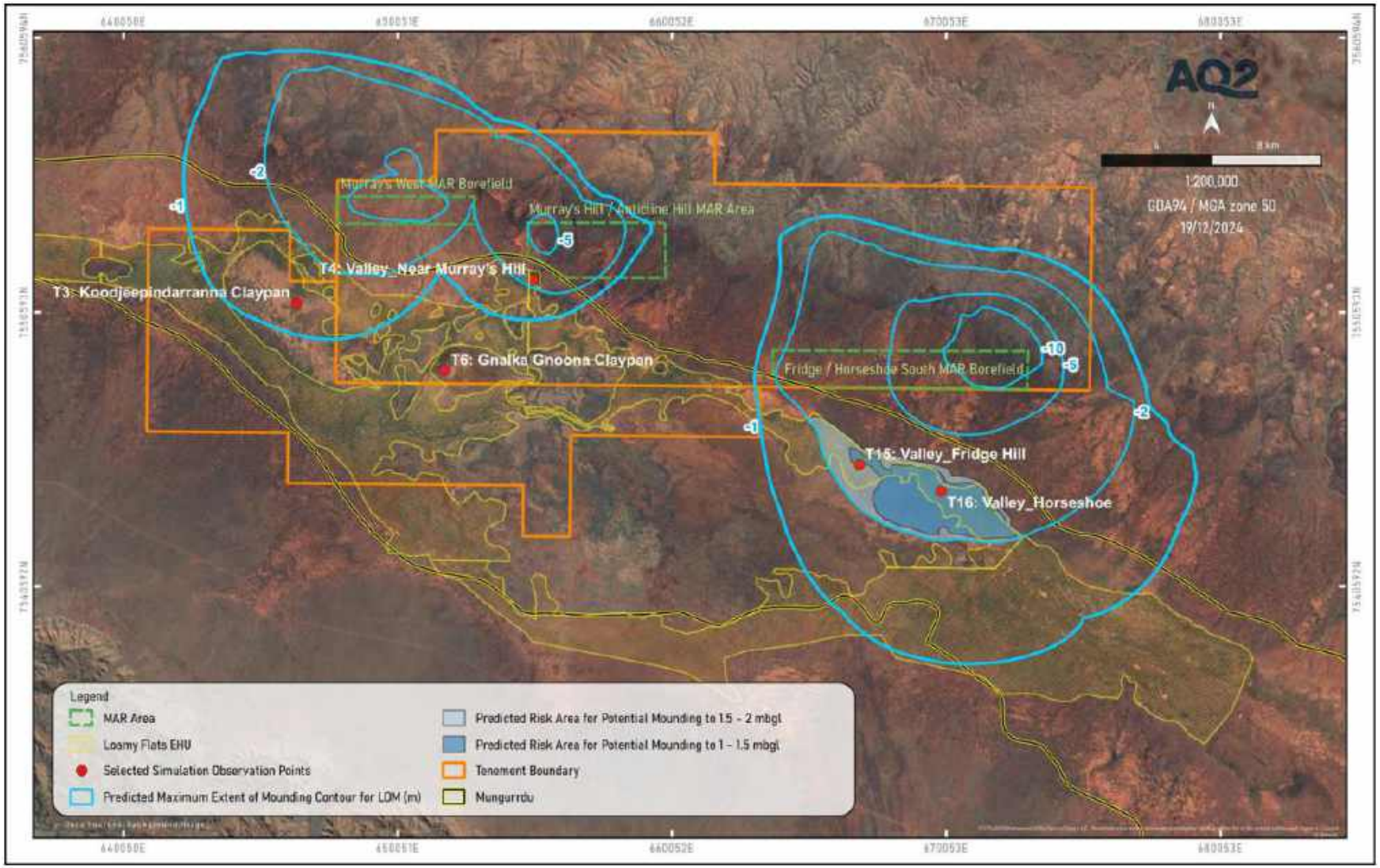

Figure 1-12 Predicted Areas where Maximum Groundwater Mounding is within 2 m of the Ground Surface over the Life of the Project (AQ2 2024)

1.6.3 Subterranean Fauna

The Proposal area supports a rich subterranean fauna community consisting of troglofauna and stygofauna which includes cosmopolitan species, those which are widespread in the catchment and potentially taxa with limited ranges due to either poor dispersal capabilities or as a result of unresolved taxonomy (that is they are poorly delineated) and can be categorised as short range endemic fauna (SREs). Detailed and targeted surveys have been competed for the Proposal from 2019-2025 (as summarised in Bennelongia 2024a) with a reconciled dataset in Biologic 2025b) and further troglofauna targeted surveys in 2025 (Biologic 2025c). The information from the earlier surveys (pre 2019) were provided in the EIA for context for the subterranean fauna community.

1.6.3.1 Subterranean Fauna Assemblages

Stygofauna

The combined results of all surveys, as presented in the updated dataset, yielded at least 173 stygofauna operational taxonomic units (OTUs). The most recent surveys (2019-2024) yielded 146 stygofauna OTUs within the Proposal and in the adjacent landscape (Bennelongia, 2024a; Biologic 2025b). Groups represented include ostracods, harpacticoid and cyclopoid copepods, amphipods and isopods, annelid worms, syncarids species), rotifers, mites, flatworms, polychaete worms, a spelaeogriphacid species and nematode worms. The nematodes, flatworms or rotifers are not routinely included in environmental impacts involving subterranean fauna and they are not included in the EIA.

Based on the sampling results a number of the stygofauna OTUs were found only in the area considered as the extent of groundwater drawdown predicted to be ≥2 m. An assessment of the stygofauna which were found in limited locations concluded that based on their dispersal capabilities and the location of other OTUs within the same functional groups (high level groups such as Class or Order, where possible genera) none of the OTUs were considered restricted *sensu lato*. Several OTUs were mapped as located only within the extent of the Salinity Impact Area which is defined as the extent of the predicted groundwater salinity changes from MAR. As recognised in this field, the area of occupancy of a number of taxa (that is known linear ranges) has limitations because of the poor delineation of the taxa and therefore may be an artefact of sampling rather than true short-range endemism. Typically, stygofauna will have small distributions due to poor dispersal ability and the discontinuous nature of their habitats (EPA 2012).

Troglofauna

High diversity was also displayed with the troglofauna (Bennelongia 2024; Biologic 2025b). The combined result of surveys 2009 to 2024 identified 109 troglofauna OTUs. The total number of specimens during the 2019-2024 survey yielded 69 different troglofauna taxa (OTUs). This data was compiled from the recent updated dataset (Biologic 2025b). The 2025 targeted troglofauna yielded additional potential troglofauna, however until the laboratory analyses (including molecular work) is complete, the troglomorphsim of some of these specimens has not been assessed.

The groups represented in the troglofauna surveys include diplurans, isopods, beetles, pauropods, pseudoscorpions, silverfish, true bugs, schizomids, centipedes, palpigrads, cockroaches, spiders, symphylans, millipedes and flies.

Based on the sampling results several of the troglofauna OTUs were found to only occur within the proposed mine pits. These are primarily singletons. Following assessment of the data, two OTUs were considered to potentially be restricted to habitat which was not continuous.

The relationship between hydrogeology and groundwater stygofauna ecology has been established (EPA, 2012). The same relationship has been displayed with troglofauna, however understanding the movement of troglofauna is also with its limitations. Subterranean ecosystems are thought to have reduced habitat diversity compared to terrestrial ecosystems, primarily due to the absence of vegetation, however geology and hydrology drive habitat heterogeneity (Gilbert et al, 1994). Generally, more groundwater transmissive geologies tend to support more substantial assemblages of subterranean fauna, both in terms of abundance and diversity.

1.6.3.2 Subterranean Fauna Habitat Assessment

A troglofauna and stygofauna habitat assessment model was developed by AQ2 using the Leapfrog Geo (3D) modelling software (Seequent 2022) (AQ2 2024b, **Error! Reference source not found.**). A summary of the habitats defined by AQ2 is present in Table 1-11. Vertical habitat for the stygofauna was considered in terms of changes in groundwater salinities (potential haloclines – defined as a distinct layer of water where there is a rapid increase in salinity at depth).

HanRoy have been able to quantify the potential impact from mining and groundwater mounding from MAR and the potential impact from mining and groundwater drawdown from pit dewatering (AQ2, 2024b).

Stygofauna

Habitat for stygofauna in and around the MDIOM is extensive and was modelled as occurring across a greater landscape. The main habitats within the Tertiary Aquifer were found to be extensive and contiguous, extending beyond the areas of predicted impact. In terms of vertical habitat for stygofauna, no variation in groundwater salinity was found within the Tertiary (Detrital) aquifer at depths up to 40 mbgl. The depth to 30 mbgl was selected as this depth is recognised as the likely extent of occupancy of stygofauna (EPA 2021). Output from the block model showed that baseline groundwater salinity to 30 m was homogenous; the surface of the groundwater displaying lower salinities which is consistent with all other studies for stygofauna.

Troglofauna

Habitat considered suitable for troglofauna was modelled throughout the MDIOM and the broader landscape (AQ2 2024b). Many of the troglofauna collected from the surveys were found in lithologies which were contiguous. The sequence of the habitat is shown in Table 1-11. The Unmineralised Marra Mamba habitat is not contiguous across the landscape and occurs in areas where the overlying lithologies were contiguous. It was therefore considered highly likely that the troglofauna occurred in these lithologies closer to the surface.

Table 1-11 Lithological Groupings with respect to Potential Subterranean Fauna Habitats (from AQ2 2024b,c)

Habitat Stratigraphy	Lithology / Member	Stratigraphy	Habitat Probability		Reasoning
			Stygofauna	Troglofauna	
Alluvium	Alluvium	Recent Alluvium / Colluvium	Unlikely	Unlikely	This unit typically has a clay dominant matrix with low potential for porosity. Where drill data is available it predominantly occurs above the water table
Calcrete	Upper Calcrete	Tertiary Detritals	**Likely**	**Likely**	This unit typically has a high primary porosity.
Undifferentiated Sediments/Tertiary	Undifferentiated Sediments		Possible	Possible	Areas of lower clay content have the potential for high porosity.
CID / Pisolite	CID / Pisolites		**Likely**	**Likely**	CID unit is often vuggy, while pisolitic units typically have high primary porosity.
Basal Crete	Basal Crete (Calcrete / Silcrete)		Possible	None	Unit always encountered below water table within project area.
Jeerinah	Jeerinah Shale	Jeerinah Formation	None	None	Unit is dominated by shales with a low primary porosity.
Mineralised Marra Mamba	Mineralised / Hydrated BIF	Marra Mamba Formation	**Likely**	**Likely**	Units likely to have enhanced secondary porosity due to weathering/mineralisation processes.
Shaley / Unmineralised Marra Mamba	Undifferentiated	Marra Mamba Formation	Unlikely	Unlikely	Vugs/voids possible down to base of oxidation but unlikely due to shale content and more localised zones enhanced porosity.
	Nammuldi Member				
	MacLeod Member				
	Mt Newman Member				
West Angela Member	West Angela Member	Wittenoom Formation	Unlikely	Unlikely	Vugs/voids possible down to base of oxidation.
-	Paraburdoo Member		None	None	Units dominated by dolomite and dolomitic shales- low porosity even after weathering. Unit is not impacted by drawdown.

1.6.3.3 Disturbance of Habitat from Mining

There will be direct loss of habitat from excavation of a series of open cut mine pits, which extend below the water table. Volume (m^3) of habitat has been inferred in the troglofaunal and stygofauna habitat assessments (AQ2, 2024b) and are outlined in Table 1-12 and Table 1-13 respectively.

Table 1-12: Troglofauna habitat predicted volume impacted by mining (AQ2, 2024b)

Troglofauna Habitat	Habitat Likelihood	Predicted Volume (m^3) Impacted (Excavation)
Upper Calcrete	Likely	374,740
CID / Pisolite		12,275,000
Mineralised Marra Mamba		54,082,000
Undifferentiated Tertiary	Possible	25,833,000
Alluvium	Unlikely	11,922,000
Shaley / Unaltered Marra Mamba		7,895,500
Total		**112,382,240**

Table 1-13: Stygofauna habitat predicted volume impacted by mining (AQ2, 2024b)

Stygofauna Habitat	Habitat Likelihood	Predicted Volume Impacted by Mining (m^3)
Upper Calcrete	Likely	0
CID / Pisolite		3,273,500
Mineralised Marra Mamba		550,280
Undifferentiated Tertiary /Sediment	Possible	1,415,200
Basal Crete		0
Alluvium	Unlikely	0
West Angela Member		11,438
Shaley / Unaltered Marra Mamba		13,937,000
Total		**19,187,418**

1.6.4 Matters of National Environmental Significance (MNES)

1.6.4.1 MNES Threatened Species

The Grey Falcon (*Falco hypoleucos*) is listed as Vulnerable under the EPBC Act. Breeding for this species occurs from June to November, with eggs laid in the old nests of other birds, particularly those of other raptors or corvids. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but falcons also nest in telecommunication towers (Marchant & Higgins 1993).

Suitable nesting habitat within the Proposed Action Area is the Drainage Lines/Floodplains. The banks of some Drainage Line/Floodplains support *Eucalyptus victrix* (*E. vicitrix*) trees that have the potential to be used for nesting, if they possess previously built nest. The Mixed Eucalypt/Mulga Floodplain habitat type associated with

the Fortescue Marsh Environmentally Sensitive Area supports trees (*E. victrix*) of a suitable size for nesting if they possess previously built nests. This habitat type occurs outside of the Disturbance Footprint.

Potential Grey Falcon trees are discussed in Section 1.6.2.

1.6.4.2 MNES Migratory Species

The migratory bird species which are considered of particular relevance to the Proposed Action are the Common Greenshank (*Tringia nebularia*), Wood Sandpiper (*T. glareola*), Red-necked Stint (*Calidris ruficollis*), Glossy Ibis (*Plegadis falcinellus*) and the Fork Tailed Swift (*Apus pacificus*). All are listed as Migratory under EPBC Act.

An assessment of habitat for these migratory species indicates:

- Common Greenshank, Wood Sandpiper, Red-necked Stint, and Glossy Ibis are likely to be infrequent visitor to the Claypans and/or Drainage Lines within the Proposed Action Area when inundated after rainfall.
- The Fork-tailed Swift is almost exclusively aerial and likely to only overfly the Proposed Action Area.

An overview of the claypan hydrology can be found in Section 1.6.1.

1.6.5 Social Surroundings

The Proposal is located entirely within Banjima native title determination area. The Banjima Traditional Owners hold native title rights and interests over approximately 10,185 km^2 as determined by the Federal Court in WAD6096/1998. The Banjima Traditional Owners are represented by the Banjima Native Title Aboriginal Corporation RNTBC (BNTAC). HPPL has undertaken consultation with Traditional Owners, including engagement to undertake ethnobiological surveys, to understand areas of importance and key concerns associated with the Proposal. Ongoing consultation will continue throughout the life of the Proposal through the implementation of the proposed Project Agreement.

1.6.5.1 Communities

Two remote Aboriginal Communities are located within the vicinity of the Proposal. The Youngaleena Community is located approximately 15 km south of the Development Envelope, and the Wirrilimarra Community is located approximately 7 km east of the Development Envelope (Figure 1-13).

Water supply bores to the Youngaleena and Wirrilimarra Communities are outside of the modelled area of influence and not at risk from changes to groundwater level or quality from the Project.

1.6.5.2 Water

Water was identified as a key focal area for Banjima Traditional Owners during consultation. Both groundwater and surface water were raised, as well as responsible use of water and concern about the location and extent of MAR required for the Proposal.

Potential indirect impacts to the DPLH lodged Mungurrdu heritage (40484) site through altered hydrological and hydrogeological processes were also raised.

There are two culturally significant pools (claypans) located 3 to 4 km south of the Development Envelope, Koodjeepindarranna (also referred to as Koodjeepindarrnna) and Gnalka Gnoona (also referred to as Ngarlganoona). These sites have been identified through heritage surveys as significant sites for the Banjima People. The Koodjeepindarrnna and Ngarlganoona claypans are not located within the Development Envelope; however, they may be considered proximal (Figure 1-13).

The Ngarlganoona Claypan can form into an extensive (> 1,000 ha) waterbody which may persist for extended periods. There are records of these claypans being inundated for several years following continuous favourable climate sequences.

An overview of the claypan hydrology can be found in Section 1.6.1.1.

1.6.5.3 Fortescue Valley

HPPL understands through consultation with Banjima Traditional Owners that the Fortescue Valley, including the surface water and groundwater resources that feed into and support this landscape feature, are culturally significant.

HPPL has undertaken comprehensive site investigations for groundwater, surface water and ecology to understand baseline conditions, eco-hydrological relationships, and impact pathways associated with the Proposal. A key objective in developing water management strategies for the Proposal is minimisation of change to baseline conditions. Surface water and groundwater modelling have been developed to simulate surface water and groundwater management strategies and quantify changes.

1.6.5.4 Land Use

The Development Envelope is located entirely within the boundaries of the Mulga Downs Pastoral Station (Figure 1-13). The land is mainly used for pastoral activities and is also used by Traditional Owners for hunting and other culturally significant purposes.

1.6.5.5 Groundwater Users

Existing groundwater users in the Project area and surrounds include:

- The local and nearby stations (Mulga Downs, Hooley and Mt Florance Stations), unlicenced bores for stock watering.
- Fortescue's White Knight exploration area, licenced bores for drilling and potable water supplies.
- Wirrilimarra and Youngaleena Communities for potable supplies.
- Licensed water supply bores associated with the previous construction and on-going maintenance of the existing Fortescue (Solomon) railway and RTIO (Goodiadarrie) railway.

Figure 1-14 and Table 1-14 present the currently licensed draw points (bores) and groundwater well licence (GWL) details under the Rights in Water and Irrigation Act 1914. It should be noted that the status of these licenced bores is uncertain. In particular, there is no evidence of any bore or access track for the Fortescue draw points plotted in the Mungurrdu (valley) area.

Table 1-14: Groundwater Well Licence Details

GWL Number	Issue Date	Expiry Date	Annual Allocation (KL)	Licence Holder	Aquifer
158473	17/06/2024	16/06/2034	45,000	Pilbara Iron Company (Services) Pty Ltd	Hamersley - Fortescue
171847	15/09/2017	15/09/2027	45,000	Pilbara Iron Company (Services) Pty Ltd	Wittenoom - Wittenoom
174412	18/02/2025	17/02/2035	100,000	Fortescue Ltd	Hamersley - Fortescue
174541	17/10/2014	16/10/2024	100,000	Fortescue Ltd	Hamersley - Fractured Rock
202550	19/11/2020	18/11/2030	2,000,000	Pilbara Iron Pty Ltd	Hamersley - Fortescue
203599	14/11/2019	13/11/2029	40,000	Main Roads	Hamersley - Fortescue
207984	1/11/2022	31/10/2032	99,000	Fortescue Ltd	Hamersley - Fortescue
207985	1/11/2022	31/10/2032	99,000	Fortescue Ltd	Hamersley - Fortescue

Within the predicted areas of influence, water supplies maybe impacted by either drawdown or changes to water quality. This will predominantly affect pastoralist bores which may dry out or become more saline. Drinking water guidelines for beef cattle indicate a tolerance limit of 5,000 mg/L TDS (ANZECC/ARMCANZ, 2000; ANZG, 2018).

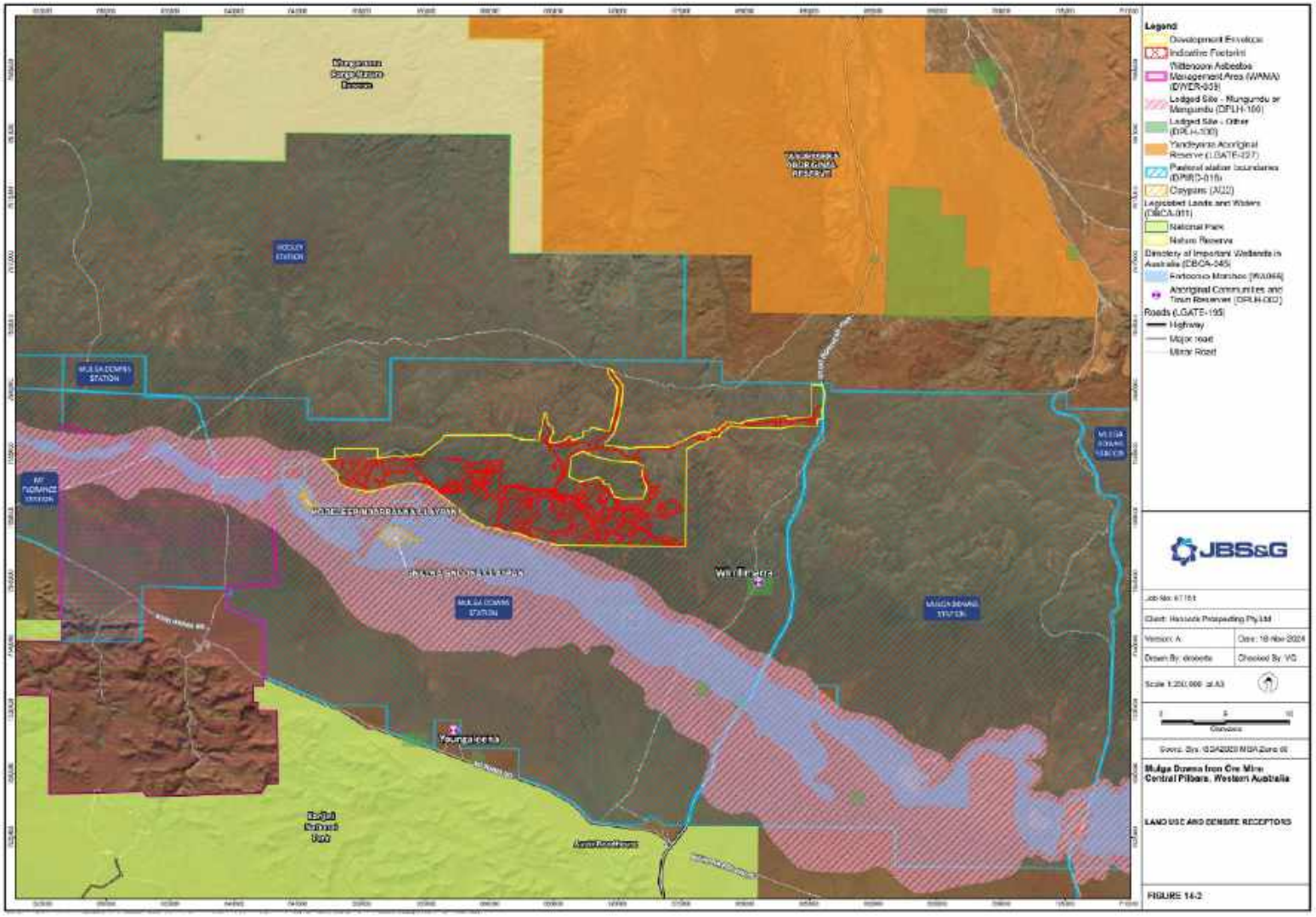

Figure 1-13: Land use and Sensitive Receptors

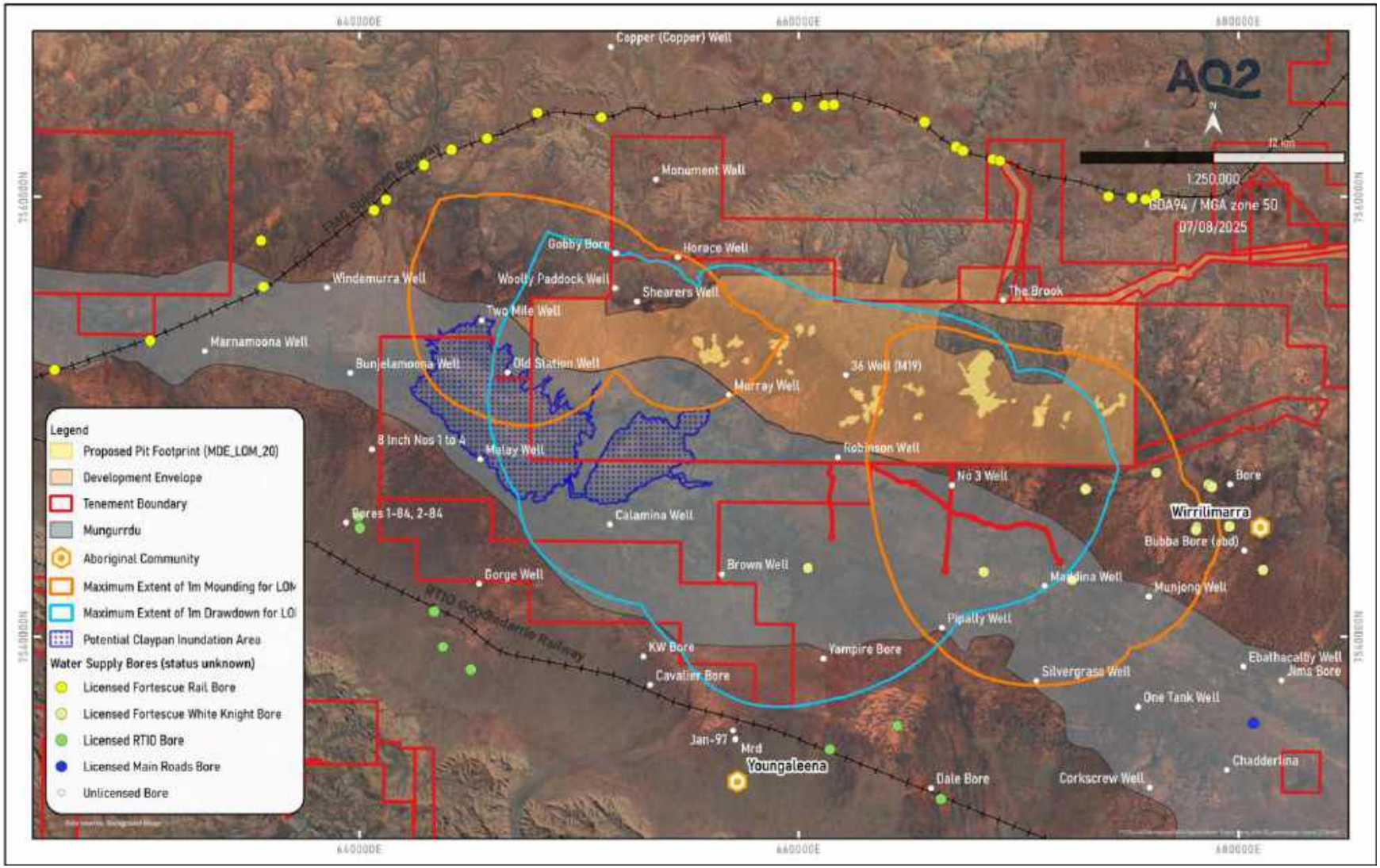

Figure 1-14: Water Supply Bores within the Predicted Area of Groundwater Level Change

1.7 Key Assumptions and Uncertainties

The WMP relies on the accuracy of field surveys and baseline investigation information (Table 1-4). The field surveys and baseline investigations have been completed in compliance with EPA and DCCEEW requirements. Where requirements for both agency requirements do not align, the compliance with the agency, to which the impact is greater has been used. This WMP has been prepared based on the assumptions below.

Key assumptions and uncertainties adopted for the development of this WMP are:

- This WMP has been developed based on the outcome of studies and completed for the Proposal. As requirements change and knowledge increases over time, this WMP may be subject to updates. Consideration and investigation of new technologies and management practices will inform updates to monitoring parameters, monitoring sites, and management measures.
- Regular review and update of the monitoring program will be based on changes to mine planning, diversion designs, timings of construction and operations of these diversion structures, operations, hydrological and surface water flood models, and monitoring data.
- Groundwater in the region is used for potable supplies at the Wirrilimarra and Youngaleena Communities. Consultation between HPPL and these communities is ongoing to support agreed outcomes on alternative provisions of potable water.
- The existing and proposed use, and viability of, pastoral (stock) bores within and externally adjacent to predicated drawdown contours are pending further field evaluation and consultation with pastoral tenement holders. Included in these stakeholder consultations will be agreements on supply of alternate water sources and duration. Based on this assumption, interim management measures for the continued provision of pastoral stock water will be addressed through agreements made between HPPL and pastoral tenement holders.
- In some cases, triggers proposed in this WMP are based on change from baseline conditions or the prediction of groundwater change, for example triggers related to the predicted 1 m drawdown extent. The baseline or predicted change does not necessarily represent a threat to receptors however it is a divergence from the current conditions or the forecast and mean that future water levels/quality if continuing to diverge from the baseline or forecast may become a threat to receptors. Responses to trigger exceedances are focused on understanding why there is a divergence from the baseline or forecast for water levels and quality, revising the forecast for water levels or quality, evaluating specific receptor risk to the revised forecast, establishing specific receptor related threshold values and developing specific receptor response plans.
- With respect to stygofauna, salinity is measured as electrical conductivity (EC) in µS/cm. The conversion factor for this management plan is 1 mg/L of TDS is equivalent to 1.562 µS/cm.
- The location of the stygofauna is based on the presence of stygofauna at the time of collection. The stygofauna were collected by lowering the phreatic net to the base of the sampling hole and hauling through the water column. The depth of the sampling may not truly represent habitat (microniche) for each of the stygofauna. Given the baseline groundwater modelling to 30 mbgl does not indicate stratification, it is assumed that the stygofauna will occur throughout the water column.

- Stygofauna are presented as operational taxonomic units (OTUs). The majority of the stygofauna and troglofauna taxonomy remains unresolved and true linear ranges cannot be determined. The OTUs which were only found within the Salinity Impact Area and the extent of the 2 m drawdown were singletons, their SRE status primarily an artifact of sampling and the state of knowledge of the subterranean fauna. As such, the distribution of the stygofauna and their baseline salinity ranges (inferred tolerances) up to 30 mbgl have been grouped based on their functional groups (refer to Appendix 5 – Analysis of stygofaunal associations with groundwater salinity and potential salinity tolerances based on observations, for the MDIOM).
- Releases of chemical constituents of concern associated with storage, handling and transport of explosives, hydrocarbons and chemicals, and hazardous materials will be assessed in line with guidelines endorsed by Department of Water and Environmental Regulation (DWER) under the *Contaminated Sites Act 2003* including the National Environment Protection (Assessment of Site Contamination) Measure 1999 (the ASC NEPM) guideline.

Key uncertainties include:

- The proposed dewatering and MAR borefields, and associated monitoring infrastructure, have not yet been constructed due to the stage of the Proposal. As the Proposal develops and infrastructure is installed and operated (i.e., dewatering and MAR borefields), this WMP will be updated to incorporate new knowledge and understanding.
- Limitations on the true linear ranges of the subterranean fauna include artifacts of sampling (high number of singletons) and state of knowledge of subterranean fauna (majority have unresolved taxonomy).
- The WMP is pending approval under the EPBC Act and EP Act, and will be updated upon receipt of approval conditions, as required.

1.8 Phase of the Proposal

The environmental provisions set out in Section 2 may apply to different phases of the Proposal or contain requirements that change depending on the current phase of the Proposal. Terms used are defined in Table 1-15 and illustrated in relation to Proposal activities in Table 1-15.

Table 1-15: Proposal Phases and Key Definitions

Construction	The period during which construction activities are occurring.
Operations	The period during which operational activities are occurring. Generally, this includes mining (development of open pits and extraction of ore), processing (crushing of ore) and product transport (haulage).
Post-mining	The period commencing at the conclusion of mining activities.
Post-closure	The period commencing at the conclusion of initial major mine closure works. Minor/remedial closure works may still occur post-closure.
Abstraction	Process of removing ground water via bores to support construction and operation requirements.
Dewatering	The process by which groundwater is removed via groundwater bores, or in-pit sumps, with the primary intent to provide access to below natural water table ore bodies.

Manager Aquifer Recharge (MAR)	The practice of recharging groundwater systems for the purpose of environmental management or storage and potential future reuse, methods of MAR can include Aquifer Injection via bores and Pit/sump Infiltration.
Groundwater Rebound	The period following cessation of dewatering and MAR where groundwater will return back to a natural state.
Excess water	Mine dewater that is not required for operational, construction or consumption requirements.
Aquifer Injection	The process by which excess dewatering is returned to the groundwater system via bores that intersect the aquifer, to replenish and maintain water levels.
Pit Infiltration	The process by which excess dewatering is returned back to the groundwater system via mine pits that intersect the aquifer, to replenish and maintain water levels.

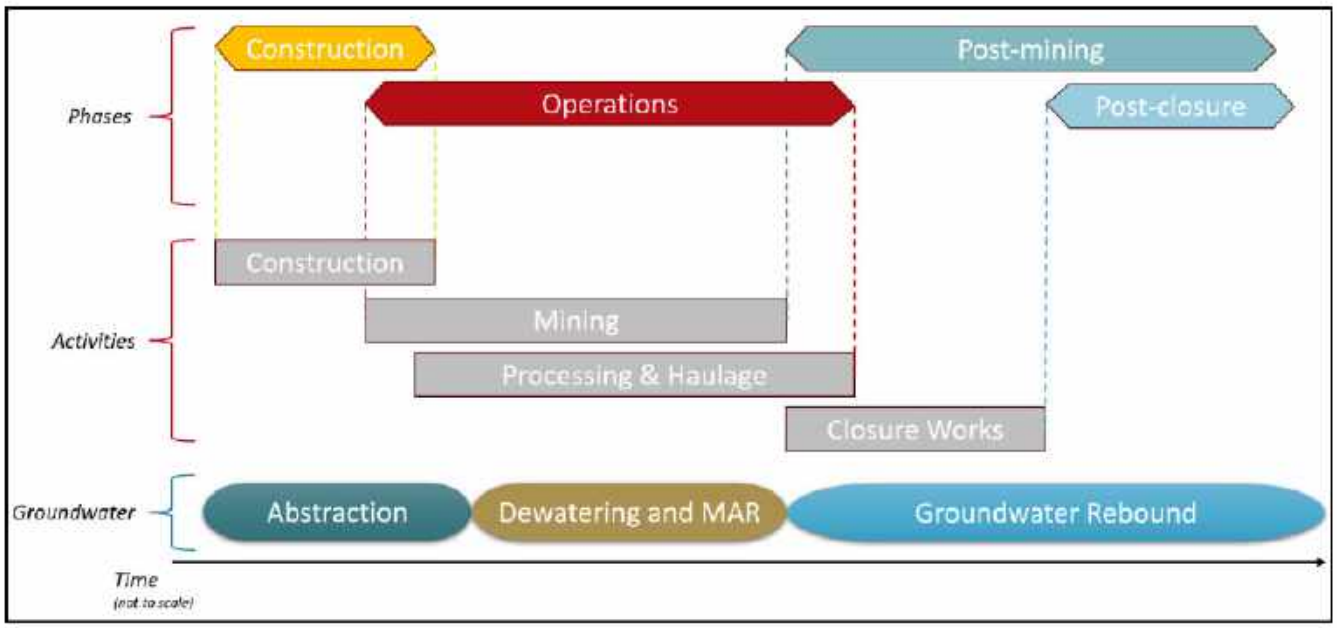

Figure 1-15: Proposal Phases and Activities Schematic

1.9 Management Approach

HPPL's Environmental Management System (EMS) Framework provides a basis for achieving the key environmental management objectives during the construction and operational phases of the Proposal. The framework is illustrated in Figure 1-16. Implementation of the EMS Framework ensures environmental performance is achieved through environmental management practices consistent with HPPL's Environmental Policy and objectives.

Figure 1-16: Environmental Management System Framework

1.10 Risk Assessment

Construction will be completed over approximately two years, and the Proposal will operate for a further 18 years.

Management and mitigation measures will apply for the duration of construction, operation and closure. Management targets and associated actions have been developed through risk-based assessment (provided in Appendix 2) and have included the application of the mitigation hierarchy, to ensure impacts to key environmental factors have been avoided or reduced to as low as reasonably practicable (ALARP). Management actions have been identified and prioritised based on the risk assessment, which was based on survey outcomes and potential Proposal impacts during construction, operation and closure.

The risk assessment process adopted a systematic approach, aligned with standard risk assessment and management methodologies outlined in:

- AS/NZS ISO 31000:2018: Risk management - Guidelines
- Statutory Guidelines for Mining Proposals (DEMIRS, 2023).

Results of additional risk assessments will be used to scope further investigations, as required, and to inform amendments to monitoring programs, enabling validation or refinement of trigger levels and contingency measures for future mining operations

1.11 Rationale for Choice of Indicators and Management Actions

Survey and study findings, risk assessments, and assessment of assumptions and uncertainties have been used to support the identification of indicators and management measures.

1.11.1 Indicators

Nominated indicators and associated rationale is summarised in Table 1-16.

Table 1-16: Nominated Indicators and Associated Rationale

Indicator	Rationale
Groundwater Quality	Release of potential contaminants from WRDs result in contamination of groundwater subject to remediation. Groundwater salinity will change as a result of dewatering and MAR activities. Changes in salinity may impact: - Local users of groundwater (stock). - Vegetation health if roots are exposed to shallow saline groundwater for extended periods of time. - Stygofauna (subterranean fauna) habitat, impacting life stages and biodiversity.
Groundwater Levels	Groundwater drawdown from dewatering is predicted to extend across the valley, away from mining areas. Surplus water from dewatering is to be managed via MAR (re-injection bores, repurposed dewatering bores and /or in pit infiltration). MAR is predicted to result in mounding of groundwater. Changes in groundwater levels above certain thresholds may impact: - Vegetation health of species supported by surface water infiltration and not exposed to groundwater under pre-development conditions. Waterlogging of root systems or exposure to surface expression of saline groundwater for extended periods of time may impact ecosystem health. - Subterranean fauna habitat – reducing mount of available habitat impacting dispersal, life stages and biodiversity.
Surface Water Quality	Mining activities can impact surface water quality through various mechanisms, including sediment and erosion, and altered hydrological regimes.
Surface Water Quantity	Mine development may alter the hydrologic regime. Alterations will reduce catchment areas and may alter flow directions and runoff quantities. Altered surface water regime may impact the existing water balance that supports the hydrological function of the freshwater claypans and the health of riparian vegetation and sheet flow dependent vegetation.
Vegetation Health	Maintaining vegetation health is critical to support MNES and terrestrial flora and vegetation and fauna habitats. Key habitats subject to potential impact are sheet flow dependent vegetation (sensitive to surface water flow and soil erosion) and surface water dependent riparian vegetation which support biodiversity and ecosystem health. Noted terrestrial fauna and MNES identified as reliant on vegetation health are the Grey Falcon and migratory birds.

1.11.2 Management Measures

Management measures comprised both outcome-based and objective-based management provisions as detailed in Table 1-17.

Table 1-17: Outcome -Based and Objective-Based Management Measures

Management Measure	Rationale	Applied Indicator	Management Objective
Outcome-Based Management Provisions	Outcome-based provisions are performance-based and may be used where the part of the environment is capable of objective measurement and reporting Outcome-based provisions have been developed where the level of impact is known and quantifiable, with the establishment of trigger and threshold criteria and appropriate exceedance responses	Groundwater Quality Groundwater Levels Vegetation Health Subterranean Fauna	Minimise change to current beneficial use of groundwater Minimise the impact on other groundwater users including minimising the extent of groundwater level change Manage groundwater levels such that there is no surface expression of groundwater or water logging of vegetation that could impact vegetation health Manage groundwater levels to retain adequate suitable subterranean fauna habitat (based on percentage of habitat removed) Manage groundwater salinities within Salinity Impact Area to retain adequate salinity ranges, to retain suitable subterranean habitat (based on baseline groundwater salinities modelled for the first 30 m)
Objective Based Provisions	Objective-based management actions are applied when the level of impact is unknown or unable to be quantified. Objective-based management is used where specific trigger or threshold criteria may not be appropriate for the circumstances. This includes where insufficient information is known about the environmental system or where all or part of the environment is not capable of being measured against trigger or threshold criteria.	Surface Water Quality Surface Water Quantity Subterranean Fauna	Maintain the existing hydrological regime as much as is practicable Mitigate impacts on surface water regime within the Goodiadarrie Swamp and its catchment, in terms of both quality and quantity of water, to maintain vegetation health Mitigate impacts on surface water quality from erosion, sedimentation and pollution associated with construction and operations by containing contact water and impacted water, and treating impacted water on-site prior to release to the downstream environment Reduce the risk of surface water having a significant impact on mining operations Mitigate impacts on groundwater salinity from reinjection of mine dewater associated with operations.

2 WMP Provisions

The WMP includes both **outcome-based** and **objective-based** management frameworks, which are described below:

- **Outcome-based**: elements that are performance based. Focused on monitoring and evaluating specific measurable outcomes, usually driven by trigger and threshold criteria.
    - Trigger criteria, threshold criteria, response actions, monitoring, timing/frequency of monitoring, and reporting.
- **Objective-based**: elements relate to monitoring and management actions that are required to achieve an objective.
    - Management actions, management targets, monitoring, and reporting.

Outcome-based and objective-based management actions will be implemented to manage direct impacts, for example removal of subterranean fauna habitat from mining, and changes to groundwater quality from leachate. The management actions focus on all key Proposal activities identified as potentially having a medium or higher risk. The provisions within this WMP have been informed by the results of baseline surveys as detailed in **Section 1.6**, the characteristics of the Proposal and EPA and DCCEEW guidelines (EPA, 2020; DoE, 2014).

Overall, the controls are considered in line with similar proposals approved in the region, and consistent with industry practices. This WMP provides for:

- Early response indicators and criteria (**Section 1.11**);
- Expected changes in the intensity, duration, magnitude or geographic footprint of the impact;
- Expected changes and rate of changes in the environment;
- Possible effects of issues external to the Proposal (e.g. rainfall, land use, other users); and
- Expected timeframe for mitigation to take effect.

2.1 Outcomes Based Provisions

Outcome-based provisions are performance-based and are used where a potential impact on the environment is suited to objective measurement and reporting. For the WMP these include:

- Protection of regional aquifer for groundwater users (pastoral, communities and stygofauna). No. 1a & 1b
- Limit to the extent and magnitude of groundwater mounding from MAR. No. 2
- No indirect impact to vegetation health and terrestrial fauna habitat from groundwater mounding from the Project. No. 3
- The concentration of solutes in runoff and or seepage from WRD's or other mining sources that is potentially released to groundwater and/or surface water shall not exceed baseline default guideline values in Section 3.1.3. No. 4
- Limits on removal of likely stygofauna and troglofaunal habitat from mining. No. 5

The outcome-based environmental criteria have been identified in Table 2-1, **Error! Reference source not found.**, Table 2-3, and Table 2-4. For each of the criteria trigger and threshold indicators, response actions and corresponding monitoring and reporting requirements are outlined.

Table 2-1: Outcomes-based Provisions: Protection of regional aquifer for groundwater users (pastoral, communities and stygofauna)

EPA Factors and Objectives	**Inland Waters:** To maintain the hydrological regimes and quality of groundwater and surface water so environmental values are protected. **Social Surrounds:** To protect social surroundings from significant harm **Subterranean fauna**: To protect subterranean fauna so biological diversity and ecological integrity are maintained.
Outcomes	Provisions 1a and 1b will result in the following environmental outcomes: • No measurable change, attributable to the Proposal, to groundwater level at Youngaleena and Wirrilimarra community bores for the life of the Proposal. • No measurable change, attributable to the Proposal, to groundwater quality at Youngaleena and Wirrilimarra community bores for the life of the Proposal. • No exceedance of the drinking water guidelines for beef cattle tolerance limit of 5,000 mg/L TDS for the life of the Proposal for groundwater sourced from pastoral groundwater bores within the Salinity Impact Area. • Groundwater quality is managed such that there is no increase in salinity above 7,810 µS/cm (EC) (equivalent of 5,000 mg/L (TDS)) or the pre-disturbance baseline level, whichever is higher, within the Salinity Impact Area for the life of the Proposal and post-closure.
Key Environmental Values	Beneficial use, Pastoral station livestock, Lower Fortescue River valley, Stygofauna Habitat
Key impacts and risks:	Reduced groundwater availability and/or and impacted groundwater quality from salinity.

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger Level Actions • Threshold Contingency Actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
1a	**Trigger Levels - Groundwater Salinity** Groundwater monitoring in salinity bores identifies an exceedance in salinity > 4,500 mg/L TDS. **Threshold Citeria - Groundwater Salinity** Groundwater monitoring in salinity bores identifies an exceedance in salinity > 5,000 mg/L TDS. OR Groundwater monitoring in salinity bores identifies a change to extent of groundwater salinity resulting from MAR that may impact groundwater quality at the Youngaleena and /or Wirrilimarra Communities. *Note: Trigger and threshold values are void if the pre-disturbance baseline value at a salinity monitoring bore is higher than the trigger and threshold value.*	**Trigger Level Actions**: In the event of a trigger exceedance the following will be undertaken: • Investigate to establish causal factors such as equipment error, sampling error, climatic influences, individual bore characteristics i.e., infrastructure capacity. • Undertake modelling to reforecast groundwater quality change. • Review predicted groundwater quality change and re-assess impact to receptors and, if no change to significance of impact revise WMP triggers/thresholds accordingly. • Identify specific groundwater users at risk from salinity change. AND/OR • Undertake actions where required to reduce groundwater salinity below trigger limits. If infrastructure capacity is identified as an issue the potential for additional bores to spread the injection load of a borefield(s) within the approved limits will be assessed. **Threshold Contingency Actions:** In the event the threshold level is exceeded, the following will be undertaken: • Investigate to establish causal factors such as equipment error, sampling error, climatic influences, individual bore characteristics i.e., infrastructure capacity. • Redirect, reduce or cease MAR until the water level in the affected area reduces below the threshold level. Redirection of MAR may require installation of	The proposed groundwater salinity monitoring bore network is shown in **Appendix 3.**	**Operations:** • Groundwater salinity monitoring at the salinity monitoring bores quarterly when MAR is being undertaken in the vicinity. Frequency may be reduced if the injected water is fresher than the MAR location. • Monitoring to be conducted quarterly. **Post-mining:** • Annually for two years.	Annual Groundwater Monitoring Assessment Report. Exceedance of threshold criteria – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented b) The effectiveness of the threshold response actions implemented against the threshold criteria c) The findings of the investigations d) Assessment of any impact(s) to groundwater users; e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding,

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger Level Actions • Threshold Contingency Actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
		additional injection bores and water conveyance infrastructure OR Consultation between HPPL and communities / pastoralists is ongoing to support agreed outcomes on alternative provisions of potable/stock water. If infrastructure capacity is identified as an issue the potential for additional bores to spread the injection load of a borefield(s) within the approved limits will be assessed.			
1b	**Trigger Level - Groundwater Level** Nominated drawdown extent monitoring bores indicates that the extent of groundwater level drawdown resulting from dewatering exceeds numerical model predictions and has the potential to impact other groundwater users exceeding 1 m relative to baseline groundwater levels in regional monitoring bores. *Note - Availability of groundwater in pastoral bores will be impacted within the area of predicted groundwater drawdown. This impact will be most significant in bores proximal to the operation. HPPL will liaise with the Pastoral station regarding management of impacted bores on a case-by-case basis.* **Threshold Criteria - Groundwater Level** Nominated drawdown extent monitoring bores indicates that the extent of groundwater level drawdown resulting from dewatering may reduce groundwater availability at the Youngaleena and /or Wirrilimarra Communities.	**Trigger Level Actions:** In the event of a trigger exceedance the following will be undertaken: • Investigate to establish causal factors such as equipment error, sampling error, climatic influences, individual bore characteristics i.e., infrastructure capacity. • Undertake modelling to reforecast groundwater level change. • Identify specific groundwater users at risk from groundwater level change and determine whether alternate water supply options are required i.e. pastoral water supply. AND/OR • Undertake actions where required to reduce groundwater level below trigger limits. If infrastructure capacity is identified as an issue the potential for additional bores to spread the injection load of a borefield(s) within the approved limits will be assessed. **Threshold Contingency Actions:** In the event the threshold level is exceeded the following will be undertaken: • Assess significance of difference between the groundwater drawdown models. • Review mine pit dewatering monitoring network. • Investigate to establish causal factors such as modelling constraints, sampling or equipment error, climatic influences and review against dewatering activities. • Continue gathering groundwater level and dewatering data. And where practicable: Reduce dewatering rates where safe to do so.	The proposed drawdown monitoring bore network is presented in **Appendix 3.**	**Operations:** • Continuous monitoring via logger when dewatering is operational. • Results will be assessed on a quarterly basis. • Ongoing numerical modelling will be performed and reviewed utilising all available data. **Post-mining:** • Annually for two years.	Annual Groundwater Monitoring Assessment Report. Exceedance of threshold criteria – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented b) The effectiveness of the threshold response actions implemented against the threshold criteria c) The findings of the investigations d) Assessment of any impact(s) to groundwater users; e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding.

Table 2-2: Outcomes-Based: Management of groundwater mounding and indirect impacts on vegetation and fauna habitat

EPA Factors and Objectives	**Inland Waters:** To maintain the hydrological regimes and quality of groundwater and surface water so environmental values are protected **Social Surrounds:** To protect social surroundings from significant harm **Flora and Vegetation:** To protect flora and vegetation so biological diversity and ecological integrity are maintained. **Terrestrial Fauna:** To protect terrestrial fauna so biological diversity and ecological integrity are maintained. **Subterranean fauna:** To protect subterranean fauna so biological diversity and ecological integrity are maintained.
Outcome/s	Provisions 2 and 3 will result in the following environmental outcomes: • Limit to the extent and magnitude of groundwater mounding from MAR. • No indirect impacts to vegetation health, and therefore terrestrial fauna habitat, from the Proposal.
Key Environmental Values:	Freshwater Claypans of the Fortescue Valley (Priority 1) - Gnalka Gnoona Claypan and the Koodjeepindarranna Claypans, Fortescue Valley *E. Victrix* woodlands, Lower Fortescue River valley, Conservation Significant Fauna Habitat, Troglofauna Habitat.
Key impacts and risks:	Waterlogging of root systems and exposure to surface expression of saline groundwater for extended periods of time may impact ecosystem health or sites of cultural significance.

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger level actions • Threshold contingency actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
Outcome: Limit to the extent and magnitude of groundwater mounding from MAR.					
2	**Trigger Level:** Groundwater monitoring identifies an exceedance of provisional trigger levels for existing and proposed mounding monitoring bores as presented in **Appendix 3.** **Threshold Citeria:** Groundwater monitoring identifies an exceedance of provisional threshold levels for existing and proposed mounding monitoring bores as presented in **Appendix 3.**	**Trigger Level Actions:** In the event of a trigger exceedance the following will be undertaken: • Investigate to establish causal factors such as equipment error, sampling error, climatic influences, individual bore characteristics i.e., infrastructure capacity. • Undertake modelling to reforecast groundwater level change. • Identify areas at risk from mounding. • Undertake actions where required to reduce groundwater level below trigger limits. If infrastructure capacity is identified as an issue the potential for additional bores to spread the injection load of a borefield(s) within the approved limits will be assessed. **Threshold Contingency Actions:** In the event the threshold level is exceedance the following will be undertaken: • Investigate to establish causal factors such as equipment error, sampling error, climatic influences, individual bore characteristics i.e., infrastructure capacity. • Redirect, reduce or cease MAR until the water level in the affected area reduces below the threshold level. Redirection of MAR may require installation of additional injection bores and water conveyance infrastructure	Proposed mounding monitoring bores detailed in **Appendix 3.**	**Operations:** • Groundwater levels monitoring will be continuous via loggers and assessed regularly when MAR is operational in the vicinity. • Monitoring results will be assessed on a quarterly basis. • Ongoing numerical modelling will be performed and reviewed utilising all available data **Post-mining:** • Annually for two years.	Annual Groundwater Monitoring Assessment Report. Exceedance of threshold criteria – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented. b) The effectiveness of the threshold response actions implemented against the threshold criteria. c) The findings of the investigations d) Assessment of any impact(s) to groundwater users. e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding.
Outcome: No indirect impacts to vegetation health and terrestrial fauna habitat from the Project					
3	**Trigger Criteria:** For vegetation at risk from groundwater mounding and/or changes to surface water flows: • Decline at potential impact sites of more than two standard deviations from the baseline mean and decline is significantly	**Trigger Level Actions** In the event the Trigger Criteria is exceeded at a vegetation monitoring site, the following will be undertaken: Investigate to establish causal factors such as: 1. climatic influences;	Vegetation health monitoring method and locations referenced in **Section 3.3**.	**Before Operations:** Site verification and baseline monitoring event. **Operations:**	Annual Vegetation Health Monitoring Report Compliance against the Vegetation Management Plan will be included in the annual Compliance Assessment Report that

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger level actions • Threshold contingency actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
	greater than the reference sites, in one or more quantitative on-ground health and condition variables for vegetation. OR • The mean value of an appropriate remote sensing vegetation condition index for tree canopies identified at baseline falls below the 5th percentile of the baseline value for the zone AND The percentage reduction is greater than for a valid reference area by 10%; examples of preferred indices include the NDVI, Modified Soil Adjusted Vegetation Index (MSAVI) or similar. OR • the mean value of an appropriate remote sensing vegetation condition index for tree canopies identified at baseline falls below the 10th percentile of the baseline value for the receptor; AND The percentage reduction is greater than for a valid reference area by 5%.	2. confirm the validity of the data, including compliance against sampling protocols, collection methods, data recording, equipment calibration and documentation; 3. where possible adjacent third-party mining activities; 4. groundwater levels and water quality trigger and threshold criteria; 5. the rate of change; 6. investigate the function of surface water infrastructure located upstream of the declining vegetation community, i.e. culverts, diversion drains, flood ways and levees; and 7. potential mining activities that could be the cause of the exceedance e.g., dewatering or changes in surface water flow. Where the investigation confirms an exceedance of a trigger criteria is attributed to Project impacts to groundwater or surface water, HPPL will implement the management actions identified in the groundwater and surface water provisions of this Plan.		Conducted annually at the end of the dry season in accordance with **Section 3.3.3** of this Plan. **Post-mining:** Annually for two years.	will be submitted to the CEO of DWER and the Commonwealth DCCEEW. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented. b) The effectiveness of the threshold response actions implemented against the threshold criteria. c) The findings of the investigations d) Assessment of any impact(s) to groundwater users. e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding.
	Threshold Criteria: For vegetation at risk from groundwater mounding and/or changes to surface water flows: • Decline at potential impact sites of more than two standard deviations from the baseline mean and decline is significantly greater than the reference sites, in two or more quantitative on-ground health and condition variables for vegetation AND reduction in value for the variables is more than 25% below both the baseline and the reference area values. *Note: 'decline' in health and condition variables is defined as a negative change in a quantitative health and condition variable present at a potential impact site and the change is statistically different ($P < 0.05$) from reference sites. The relevant period is from baseline to latest monitoring date.*	**Threshold Response** In the event the threshold is exceeded at a vegetation monitoring site and impacts is attributed to groundwater mounding, the following will be undertaken: • Redirect, reduce or cease MAR until the water level in the affected area reduces below the threshold level. Redirection of MAR may require installation of additional injection bores and water conveyance infrastructure In the event the threshold is exceeded at a vegetation monitoring site and impacts is attributed to change to surface water flows, the following will be undertaken: • Assess the significance of change to surface water flows and develop appropriate mitigation strategies. These include, no-action, re-instatement of surface water flows, additional culverts to prevent inundation, burial of pipeline at drainage lines/ creek crossings to prevent disruption to flows, raise pipelines at regular intervals to allow surface water to move past. Then: • Report the threshold exceedance to the CEO of DWER and DCCEEW within seven (7) days of the exceedance being identified. • Investigate to establish causal factors such as equipment error, climatic influences, individual bore characteristics. The same causal factors defined in Trigger Level Actions will be investigated. • Determine if any potential environmental harm or alteration of the environment occurred due to the threshold criteria being exceeded.			

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger level actions • Threshold contingency actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
		• Continue cessation of aquifer injection at the individual injection bore until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met and implementation of the threshold contingency actions is no longer required. • Provide a report to the CEO of DWER and DCCEEW within 21 days as per 'Reporting' In addition to the management actions identified in the groundwater and surface water provisions of this Plan, additional actions may be considered where reasonably practicable: • Additional vegetation surveys to locate additional priority species; and • Initiate rehabilitation of impacted area(s)* within 6 months of detecting and confirming a threshold exceedance, taking into account seasonal requirements for optimal vegetation rehabilitation. • If the impacted area can't be rehabilitated, HPPL will resolve via the Impact Reconciliation Plan (IRP) where appropriate. **Note: this may not be reasonably practicable where salinisation has occurred in a large area* ***Note: diversion of excess water can only be undertaken once adjacent injection borefields are constructed and operational. Furthermore, re-diversion may only be conducted if the borefield(s) are able to receive the water based on other conditional constraints.*			

Table 2-3: Outcomes-Based: The concentration of solutes in runoff and or seepage from WRD's or other mining sources that is potentially released to groundwater and/or surface water shall not exceed baseline default guideline values in Section 3.1.3

EPA Factors and Objectives	**Inland Waters:** To maintain the hydrological regimes and quality of groundwater and surface water so environmental values are protected **Social Surrounds:** To protect social surroundings from significant harm **Flora and Vegetation:** To protect flora and vegetation so biological diversity and ecological integrity are maintained. **Subterranean fauna:** To protect subterranean fauna so biological diversity and ecological integrity are maintained.
Outcome	Provision 4 will result in the following environmental outcome: • No release of WRD leachate or contaminants from mining to groundwater and/or surface water
Key Environmental Values:	Freshwater Claypans of the Fortescue Valley (Priority 1) - Gnalka Gnoona Claypan and the Koodjeepindarranna Claypans, Fortescue Valley *E. Victrix* woodlands, Lower Fortescue River valley, Conservation Significant Fauna Habitat, Subterranean Fauna Habitat
Key impacts and risks:	Adverse impact to groundwater and surface water quality that may affect environmental values.

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger level actions • Threshold contingency actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
Outcome: No release of WRD leachate or contaminants from mining to groundwater and/or surface water					
4	**Trigger Level:** Groundwater monitoring in downstream mine infrastructure and landform bores identify two consecutive exceedances of the 80th % DGVs as defined in Table 3-2: Provisional Groundwater Water Quality Trigger Values OR Surface water monitoring at downstream mine infrastructure identifies two consecutive exceedance of the 80th % DGVs as defined in Table 3-5: Provisional Surface Water Quality Trigger Levels. **Threshold Criteria** To be determined from trigger level action assessment. Groundwater water monitoring identifies three exceedances of the 90th % DGV as defined in Table 3-2: Provisional Groundwater Water Quality Trigger Values OR Surface water monitoring identifies three exceedances of the 90th % DGV as defined in Table 3-5: Provisional Surface Water Quality Trigger Levels.	**Trigger Level Actions:** In the event the trigger criteria are exceeded at infrastructure and landform bores, the following will be undertaken: • Investigate to establish causal factors such as sampling or laboratory error, climatic influences, individual bore characteristics and potential sources of increased analyte(s). • One or more of the following may also be undertaken to improve the investigation findings and potential source identification: - Inspect upstream infrastructure and landforms. - Undertake a source-receptor-exposure pathway analysis to assess impacts to receptors and set **threshold criteria.** **Threshold Contingency Actions** In the event the threshold trigger is exceeded at infrastructure and landform bores, the following will be undertaken: • Implement Trigger Level Actions • Report the threshold exceedance to the CEO of DWER within seven (7) days of the exceedance being identified. • If the source of adverse impact is suspected to be due to MDIOM, determine if any potential environmental harm or alteration of the environment occurred due to the threshold criteria being exceeded. This may include review of results by a specialist to determine risk to the environment and define mitigation measures to prevent significant environmental impacts.	Groundwater sampling to be conducted manually in specified mine infrastructure and landform groundwater monitoring bores (sites to be established).	**Operations:** • Groundwater quality sampling is to be conducted quarterly (laboratory analysis) and monthly (field parameter monitoring). **Post-mining:** • Annually for two years.	Annual Groundwater Monitoring Assessment delivered annually. Exceedance of threshold criteria – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented. b) The effectiveness of the threshold response actions implemented against the threshold criteria. c) The findings of the investigations d) Assessment of any impact(s) to groundwater users. e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding.

Table 2-4: Outcome Based: Limits on removal of likely stygofauna and troglofaunal habitat from mining.

EPA Factors and Objectives	**Subterranean Fauna:** To protect subterranean fauna so biological diversity and ecological integrity are maintained.
Outcome	Provision 5 will result in the following environmental outcome: • Limits on direct removal of likely stygofauna and troglofaunal habitat from mining.
Key Environmental Values:	Stygofauna and Troglofaunal Habitat, potentially restricted species.
Key Impacts and risks:	Removal of habitat from mining impact to subterranean fauna assemblages.

No.	Indicators: • Trigger Levels: • Threshold Criteria:	Response Actions: • Trigger level actions • Threshold contingency actions	Monitoring Indicator, Methods and Locations	Timing / Frequency of Monitoring	Reporting
Outcome: Limits on direct removal of likely stygofauna and troglofaunal habitat from mining.					
5	**Likely Troglofauna Habitat* (m²) trigger and threshold:** **Likely Stygofauna habitat** (m²) trigger and threshold:** *Habitat volume will be refined over the life of the project as more detailed resolution of lithologies are mapped through drilling and geological interpretations.* **Troglofauna habitat is considered as the volume of Upper Calcrete, CID/Pisolite and Mineralised Marra Mamba that occur above the pre-disturbance/baseline groundwater level.* ***Stygofauna habitat is considered as the volume of Upper Calcrete, CID/Pisolite and Mineralised Marra Mamba that occur below the pre-disturbance/baseline groundwater level.*	**Trigger Level Actions:** In the event the trigger criteria are exceeded the following will be undertaken: • No further mining to be authorised if the mine plan indicates threshold criteria will exceed. • Confirm extent of existing approved mined volume against assessment of volume yet to be mined. • Mining only to proceed once confirmation the mine plan will not exceed the threshold criteria. **Threshold Contingency Actions:** In the event the threshold trigger is exceeded the following will be undertaken: • Immediate cease of mining excavation activities. • Schedule audit on current mined volumes. • Investigation into threshold breach.	**Indicator:** • Mine Plan Block Model. • As mined survey data. **Methods:** • Monitoring will be inline with HanRoy Environmental Compliance Standard (ECS). • Internal mine plan approval process, to ensure compliance with State approval limits. **Locations:** • Within the Proposal Development Envelope.	**Operations:** Prior to commencement of a revised mine plan. In line period reporting requirements.	Annual Compliance Assessment Report. Exceedance of threshold criteria – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days. A report shall be provided to the CEO and DCCEEW within 21 days of the threshold criteria exceedance reported. The report shall include: a) Details of threshold response actions implemented. b) The effectiveness of the threshold response actions implemented against the threshold criteria. c) The findings of the investigations d) Assessment of any impact(s) to groundwater users. e) Measures to prevent the threshold criteria being exceeded in the future; f) Measures to prevent, control or abate impacts which may have occurred; and justification of the threshold criteria remaining, or being adjusted based on better understanding.

Subterranean Fauna Habitat	90% Trigger Value (m²)	Threshold Stygofauna Habitat (m²)
Upper Calcrete	337,266	374,740
CID / Pisolite	11,047,500	12,275,000
Mineralised Marra Mamba	48,673,800	54,082,000

Subterranean Fauna Habitat	90% Trigger Value (m²)	Threshold Stygofauna Habitat (m²)
CID / Pisolite	2,946,150	3,273,500
Mineralised Marra Mamba	495,252	550,280

2.2 Objectives Based Provisions

Objective-based provisions related to management actions are used when the environment is not suited to objective measurement and reporting.

Table 2-5 outlines the management objectives that have been identified for the Proposal. All objectives and outcomes of potential impacts cover both State and Commonwealth assessments. Management actions, monitoring and reporting requirements are outlined for each of the management objectives.

Objective based management targets are for the surface water diversions and surface water quality and include:

- No degradation of surface water quality reporting to downstream environments due to mining and associated activities. No. 1
- No significant modification to the hydrological function of the claypans and other ponding areas in the Fortescue Valley due to mining activities. In particular, the hydroperiod of the claypans should not be significantly impacted. No. 2
- Minimal impact on vegetation and fauna habitat quality immediately downstream of mine disturbance areas due to interrupted runoff regime and altered sediment transport. No. 3

Table 2-5: Objectives-Based: Management of Surface Water Diversions and Surface Water Quality

EPA Factors and Objectives	**Inland Waters:** To maintain the hydrological regimes and quality of groundwater and surface water so environmental values are protected **Social Surrounds:** To protect social surroundings from significant harm **Flora and Vegetation:** To protect flora and vegetation so biological diversity and ecological integrity are maintained. **Terrestrial Fauna:** To protect terrestrial fauna so biological diversity and ecological integrity are maintained. **Subterranean fauna:** To protect subterranean fauna so biological diversity and ecological integrity are maintained.
Key environmental values	Freshwater Claypans of the Fortescue Valley (Priority 1) - Gnalka Gnoona Claypan and the Koodjeepindarranna Claypans, Fortescue Valley *E. Victrix* woodlands, Lower Fortescue River valley, Conservation Significant Fauna Habitat and Mungurrdu lodged DPLH site (ACH-00040484), subterranean fauna habitat.
Key impacts and risks:	Altered hydrological regimes, reduction in water quantity and quality reporting to the Fortescue Valley and claypans, impacts to local vegetation and fauna habitat quality immediately downstream of mine disturbance areas.

No.	Management targets	Management actions	Monitoring / Assessments	Timing / frequency of actions	Reporting
1	No degradation of surface water quality reporting to downstream environments due to mining and associated activities.	• Ongoing development of baseline water quality data set for surface water runoff and ponded water. During operations, monitoring network to include upstream control sites for comparison. • Divert undisturbed catchments around disturbance areas to avoid contamination of "clean" water. • Contain runoff from disturbance areas where sediment loads are likely to be high (waste dumps, stockpiles, pits and ROM pads) and divert runoff through sediment treatment facilities prior to release to the environment. Sediment control facilities (such as basins and containment bunding) to be designed to reduce sediment loads to the environment. • Local runoff management practices deployed within plant and mining areas as outlined in the EMS/Environmental Compliance Standard (HNR-00000-EN-STD-0001), including: - Storage, handling and disposal of hazardous substances in accordance with internal procedures. - Containment of runoff and waste water at washdowns, workshops etc. and passed through an oily water separator with re-use of runoff water within the process prioritised. - Clean up local oil spills and leaks immediately when they occur. - Procedures for applying dust suppression to roads will prevent over-watering of roads. - Design and operation of dewatering and MAR system to prevent pipeline bursts	**Indicator:** Water Quality Erosion and deposition **Methods** Where safe, surface water samples are to be collected immediately following rainfall event >35 mm over 24-hr period (nominally). Surface water stations to be visited, and samples collected if water available. Samples from creek stations to be collected within 24-hrs of rainfall event where access is possible. Surface water samples to be collected from claypans and other ponding areas following large runoff events. Samples to be collected at locations where the ponding is accessible, which may not be the same exact location each time. Surface water monitoring stations are equipped with data loggers that record EC at sub-hourly time increments. Surface water quality monitoring suite shown in Appendix 3. Annual inspection of site aerial photography for evidence of sediment transport around WRDs and pit stormwater discharge points. Event-based inspections of sediment basins and containment infrastructure to ensure hydraulic integrity and erosion control effectiveness. **Locations** Surface water quality monitoring as per the monitoring network discussed in Section 3.2. Water quality monitoring includes sites upstream and downstream of disturbance areas Sediment basins and containment infrastructure	**Construction/Operations:** On a continuous basis during construction and mine operation until the mine is decommissioned. Surface water samples to be collected immediately following rainfall event >35 mm over 24-hr period (nominally). Event based inspection once access allows following 24-hr rainfall event exceeding 100 mm.	Annual Surface Water Monitoring Assessment Reporting on the review and revision of management actions – annually in the EP Act CAR and the EPBC Act Annual Compliance Report. Exceedance of management target – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days
2	No significant modification to the hydrological function of the claypans and other ponding areas in the Fortescue Valley due to mining activities. In particular, the hydroperiod of the claypans should not be significantly impacted.	• Culverts to allow flow of runoff past roads and other linear infrastructure. • Diversion of catchments around mine disturbance areas to minimise the reduction in surface water runoff to the downstream environment. • Burial of pipeline at drainage lines/ creek crossings to prevent disruption to flows • Raise pipelines at regular intervals to allow surface water to move past	**Indicator:** Water Quality Water Level (hydroperiod) Claypan Water Balance **Method:** Surface water samples to be collected from claypans and other ponding areas following large runoff events. Samples to be collected at locations where the ponding is	**Operations:** Event based inspection once access allows following 24-hr rainfall event exceeding 100 mm Annual flood modelling assessment. Claypan water balance assessment if the mine plan changes.	Annual Surface Water Monitoring Assessment Reporting on the review and revision of management actions – annually in the EP Act CAR and the EPBC Act Annual Compliance Report. Exceedance of management target – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and

No.	Management targets	Management actions	Monitoring / Assessments	Timing / frequency of actions	Reporting
			accessible, which may not be the same exact location each time. Within the surface water monitoring locations pressure transducers will provide ongoing measurements of water depths which will be used to review the hydroperiod of claypan flooding events. The transducers will also provide ongoing measurements for salinity levels (EC). Remodel claypan water balances if changes to the mine plan result in increased catchment reductions due to the Proposal. Re-run 2D flood model predictions on an annual basis with the upcoming 12-month mine plan to allow management and vegetation health monitoring to focus on areas at risk in the next 12-months. Significant runoff events over the period would be used to recalibrate the models. Annual LIDAR survey of the site to underpin the above surface water modelling and allow current site conditions to be modelled. **Locations:** Channel Pools, Gnalka Gnoona and Koodjeepindarranna claypans. Catchment modelled extent		provide a written report within 21 days.
3	Minimal impact on vegetation and fauna habitat quality immediately downstream of mine disturbance areas due to interrupted runoff regime and altered sediment transport.	• Culverts to allow flow of runoff past roads and other linear infrastructure. • Diversion of catchments around mine disturbance areas to minimise the reduction in surface water runoff to the downstream environment. • Ongoing development of baseline water quality data set for surface water runoff and ponded water. During operations, monitoring network to include upstream control sites for comparison. • Divert undisturbed catchments around disturbance areas to avoid contamination of "clean" water. • Contain runoff from disturbance areas where sediment loads are likely to be high (waste dumps, stockpiles, pits and ROM pads) and divert runoff through sediment control facilities prior to release to the environment. Sediment control facilities (such as basins and containment bunding) to be designed to reduce sediment loads to the environment. • Design and operation of a controlled release strategy for water held in sediment dams	**Indicator:** Vegetation health **Method:** Annual inspection of condition culverts and other surface water management infrastructure (including sediment basins and diversion drains/bunds). Maintenance of this infrastructure as required. Event-based inspection of surface water management infrastructure to ensure hydraulic integrity is maintained. Maintenance of this infrastructure as required. Surface water samples to be collected from claypans and other ponding areas following large runoff events. Samples to be collected at locations where the ponding is accessible, which may not be the same exact location each time. Annual inspection of site aerial photography for evidence of sediment transport around WRDs and pit stormwater discharge points. Inspection of aerial photography is to focus on identifying the presence of potential erosion gullies and sedimentation build up. **Locations:** Vegetation health monitoring sites (see Section 3.3). Claypan monitoring sites (see Section 3.2) Culverts and other surface water management infrastructure (including sediment basins and diversion drains/bunds).	**Operations and Post Closure (vegetation health):** Annual vegetation health monitoring at the end of the dry season around October/November when vegetation is normally subject to the highest degree of drought stress. Annual inspection surface water infrastructure (nominally before August to provide sufficient time to complete maintenance works). Event based inspection once access allows following 24-hr rainfall event exceeding 100 mm.	Annual Surface Water Monitoring Assessment Annual Vegetation Health Assessment Reporting on the review and revision of management actions – annually in the EP Act CAR and the EPBC Act Annual Compliance Report. Exceedance of management target – notify regulatory authorities (DWER and DCCEEW) within 7 days of exceedance being identified and provide a written report within 21 days.

3 Monitoring

Due to cultural sensitivities, access to baseline monitoring locations or proposed construction/operational monitoring sites may be restricted. The Proponent will work with the Banjima people to implement the monitoring program outlined in this section. The specific locations and number of sites proposed may change as a result of those discussions. The WMP will be updated accordingly.

3.1 Groundwater Monitoring

The purpose of groundwater monitoring is to inform, through environmental criteria, if environmental objectives are being achieved. In addition, monitoring will inform when trigger level actions or threshold contingency actions are to be implemented or if the objectives are being achieved through the defined management tasks.

Monitoring will be undertaken to monitor for the following groundwater stressors from the Project:

- Groundwater drawdown from mine dewatering;
- Groundwater mounding from MAR;
- Groundwater quality change from dewatering / MAR (salinity);
- Leachate from WRD/contamination from mining;

Where possible (pre-implementation), monitoring sites have been identified relevant to the predicted stressor and receptor. Additional sites will be established in line with land access constraints and development of the Project i.e. installation of impact monitoring bores down gradient of WRDs to monitor for potential leachate.

3.1.1 Groundwater Monitoring for MAR and Dewatering

Proposed groundwater monitoring bores are illustrated in Figure 3-1 and Figure 3-2 tabulated in Table 3-1. Groundwater sample analytical results will be compared against provisional groundwater quality results identified in Table 3-2.

Table 3-1: Proposed Ground Monitoring Bore Information

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status
MDE_MON_1	645718	7556531	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed
			MAR	Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDE_MON_2	654703	7551910	MAR	Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	Proposed
MDE_MON_4	665185	7546959	MAR	Water Level - Mounding	Mounding at break of slope	Proposed
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDE_MON_5	667964	7545368	MAR	Water Level - Mounding	Mounding at break of slope	Proposed
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDE_MON_6	669255	7543432	MAR	Water Level - Mounding	Mounding on valley floor	Proposed
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDE_MON_7	671873	7543379	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed
			MAR	Water Level - Mounding	Mounding at break of slope	
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDE_MON_8	666653	7542993	MAR	Water Level - Mounding	Mounding on valley floor	Proposed
MDE_MON_9	675125	7547815	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed
			MAR	Water Quality - Salinity	Other GW Users - Wirrilimarra	
MDE_MON_10	676395	7546188	MAR	Water Quality - Salinity	Other GW Users - Wirrilimarra	Proposed
MDE_MON_11	669636	7547030	MAR	Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	Proposed
MDE_MON_12	671595	7545400	MAR	Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	Proposed
MDE_MON_13	658610	7537800	Dewatering	Water Level - Drawdown Extent	Other GW Users - Youngaleena	Proposed
			Dewatering / MAR	Water Quality - Salinity		
MDPZ7449A,B,C	655657	7551787	MAR	Water Level - Mounding	Mounding at break of slope	Existing
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status
MDPZ7450A, B, C	652219	7552541	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing
MDPZ7451A, B, C	651347	7550579	MAR	Water Level - Mounding	Mounding near Claypans	Existing
MDPZ7456A, B,C	665851	7547907	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing
MDPZ7456C	665851	7547907	MAR	Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	Existing
MDPZ7460A, B, C	663202	7547987	MAR	Water Level - Mounding	Mounding at break of slope	Existing
MDPZ7461	656010	7542996	Dewatering	Water Level - Drawdown Extent	Other GW Users - Youngaleena	Existing
MDPZ7462A, B, C	644800	7548089	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing
MDPZ7463	642867	7553588	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing
MDPZ7464	649944	7552428	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDPZ7465, MDPZ0757	670005	7547881	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDPZ7468A, B, C	647191	7551524	MAR	Water Level - Mounding	Koodjeepindarranna Claypan	Existing
MDPZ7469A, B, C	657312	7550011	MAR	Water Level - Mounding	Mounding at break of slope	Existing
				Water Quality - Salinity	Shallow Fresher GW - Stygo / Other Users	
MDPZ7470A, B, C	661399	7546377	MAR	Water Level - Mounding	Mounding on valley floor	Existing
MDPZ7471A, B, C	646686	7549394	MAR	Water Level - Mounding	Koodjeepindarranna Claypan	Existing
MDPZ7472	670921	7555275	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing
MDWB0011	660244	7557808	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing
MDWB0013	665270	7556265	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing
MDWB0034	652853	7555585	MAR	Water Quality - Salinity	Other GW Users	Existing

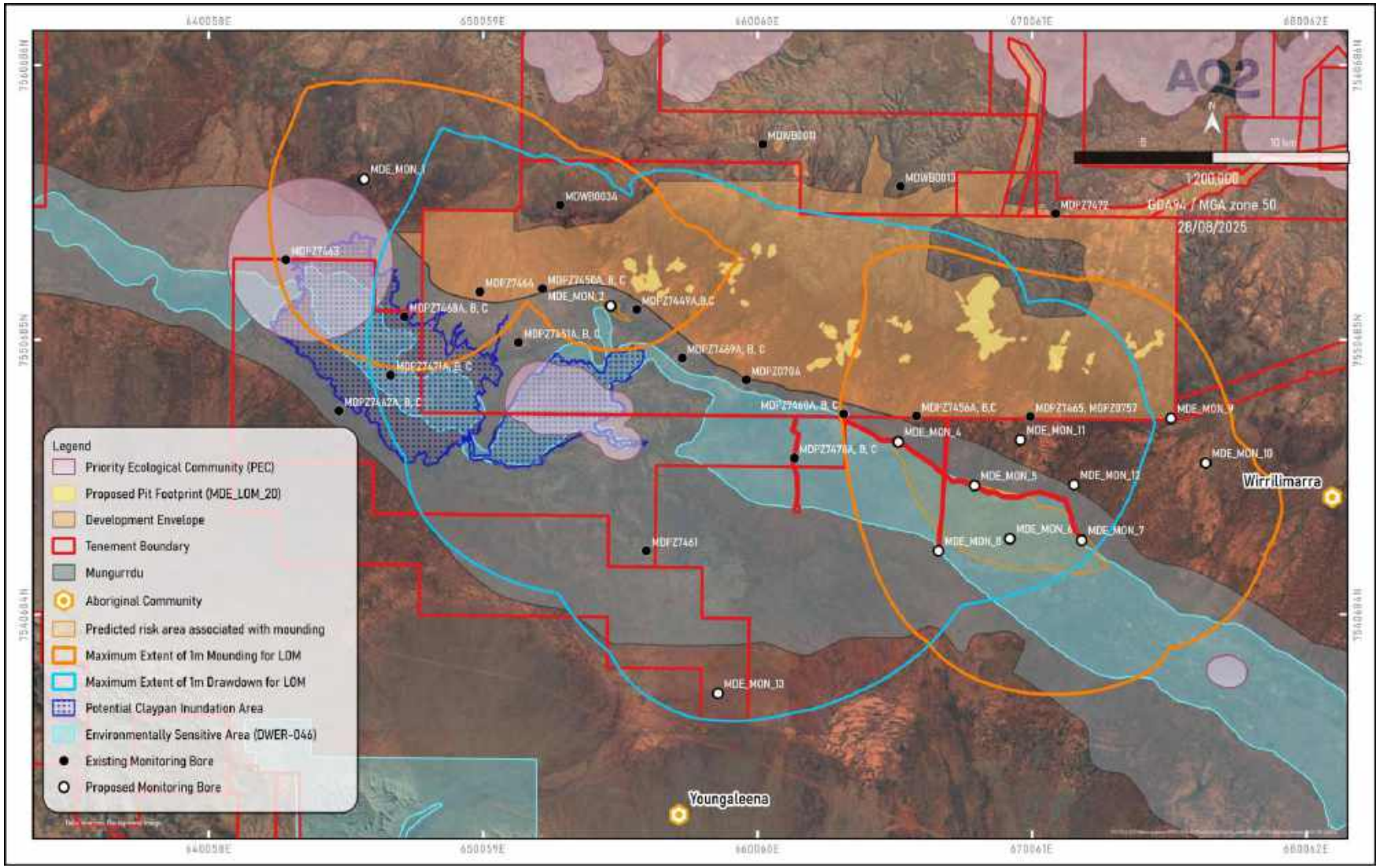

Figure 3-1: Proposed Groundwater Monitoring Network

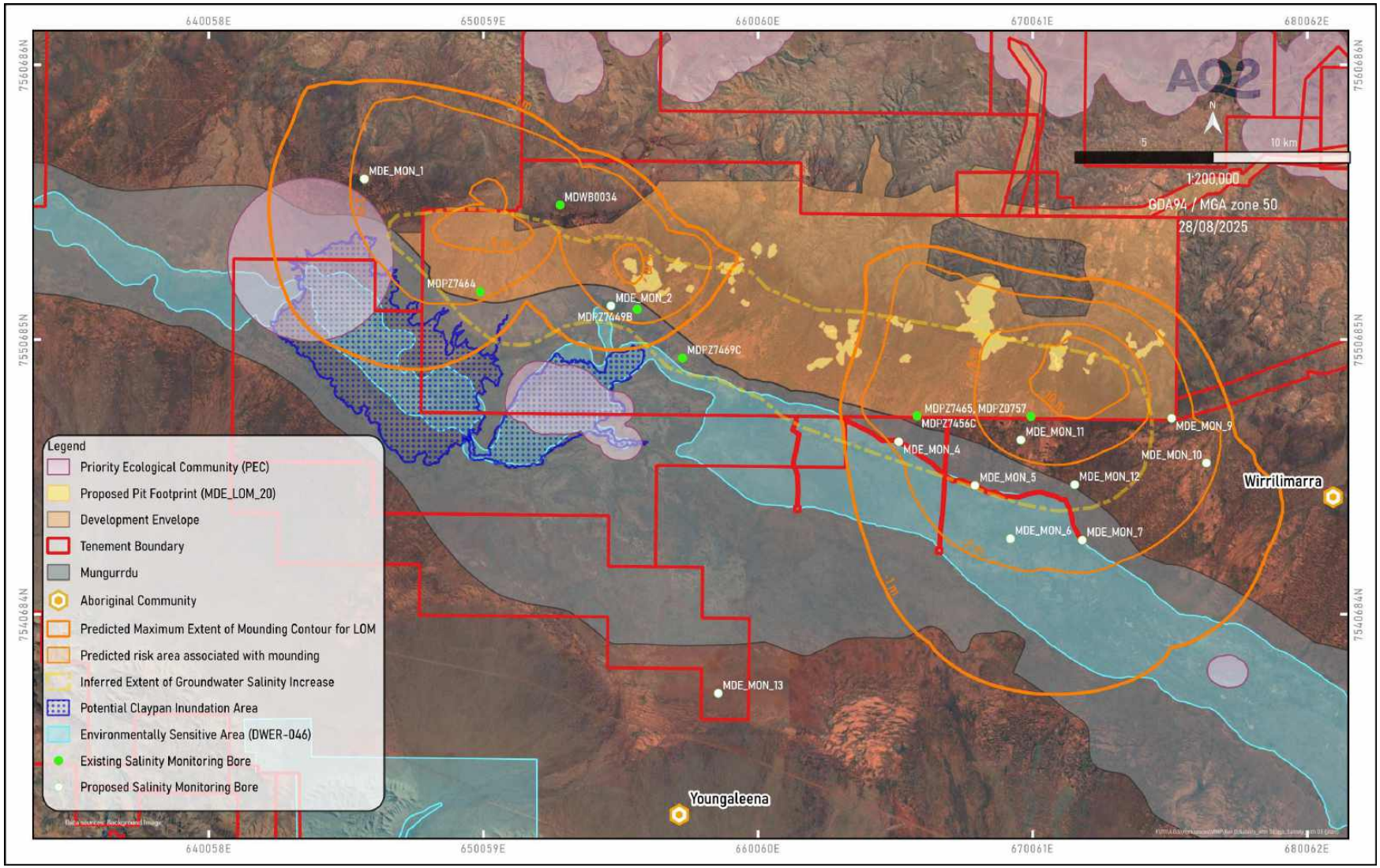

Figure 3-2: Groundwater Salinity Monitoring Network in relation to Development Envelope and Communities

3.1.2 Groundwater Monitoring for MAR Change to Salinity

Groundwater salinity profiling will be undertaken at the salinity monitoring bores quarterly when MAR is being undertaken in the vicinity. The frequency may be reduced if the injected water is fresher than the MAR location. Water samples will be collected and field parameters measured at the time of salinity profiling.

As field measurements (inclusive of salinity profiling) are in EC, conversions to TDS will be based on TDS / EC results from laboratory analyses for each site.

In addition to absolute values, trends in salinity change, both over time and with depth, will be assessed against previous baseline and operational monitoring data.

It should be noted that thresholds and triggers are related to salinity changes relating to MAR. Changes related to dewatering (i.e., the drawing in of more saline water from the valley / claypan area) are not restricted by trigger / threshold values.

3.1.3 Groundwater Quality Trigger Levels – Leachate and Contamination from Mining

Trigger levels have been defined for water quality and groundwater levels. Provisional water quality trigger levels, provided in Table 3-2, have been developed based on statistical analysis of baseline data and in line with Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000; ANZG, 2018). The methodology applied and rationale, as well as response actions, are detailed in the CBEC (2024) assessment document, provided as **Appendix 1**.

Additionally, predicted water quality change, specifically salinity (as total dissolved solids), due to dewatering and MAR has been considered in setting water quality triggers. The prediction of salinity change has been undertaken in conjunction with the simulation of dewatering and MAR and prediction of water level change. It should be noted however that the triggers for elemental concentrations (Table 3-2) are not based on predictions of change or amended to reflect change in line with predicted salinity change. Future assessment of change to elemental concentrations will require consideration of predicted salinity change.

Provisional trigger levels for groundwater levels and groundwater salinity have been developed bespoke to mine development progression and modelled hydrogeologic regime responses to dewatering and MAR. Bore-specific triggers and monitoring bore locations are presented in **Appendix 3.**

Table 3-2: Provisional Groundwater Water Quality Trigger Values

Parameter (mg/L)	ANZG Default Guideline Value (DGV) 95% of Species Limit of Protection	Low Risk Trigger Value (LRTV) 80th percentile	Investigation Trigger Value (ITV) 90th percentile
pH	6.5 – 8.5	7.1-8.0	7.0-8.0
Alkalinity as $CaCO_3$	-	400	440
*Ag	0.00005	(0.002)*	(0.0025)*
Al	0.055	0.050	0.050
As	0.013	0.0025	0.0070
B	0.37	2.4	3.1
Ba	-	0.055	0.13

Parameter (mg/L)	ANZG Default Guideline Value (DGV) 95% of Species Limit of Protection	Low Risk Trigger Value (LRTV) 80th percentile	Investigation Trigger Value (ITV) 90th percentile
Be	0.00013§	(0.001)*	(0.0025)*
Bi	0.0007§	(0.0025)*	(0.0025)*
Ca	-	240	300
*Cd	0.0002	(0.0001)*	(0.00025)*
Cl	-	2,000	4,000
Co	0.0028	0.0010	0.0025
Cr	0.001	0.0080	0.0092
*Cu	0.0014	(0.002)*	(0.0025)*
F	-	2.0	3.3
Fe	0.3§	0.013	0.030
HCO_3	-	440	480
Hg	0.0006	0.0005	0.0005
K	-	270	320
Mg	-	350	480
Mn	1.9	0.15	0.92
Mo	0.034§	0.0030	0.0060
N (as NO_3)	-	21	26
Na	-	1,200	2,500
Ni	0.011	0.0014	0.0060
P	-	0.11	0.14
Pb	0.0034	0.0010	0.0025
SO_4	-	2,200	2,600
Sb	0.009§	0.0025	0.0025
Se	0.011	0.0094	0.011
Si	-	80	90
Sn	0.003§	0.0010	0.0025
Sr	-	2.8	3.8
Ti	-	0.0010	0.0025
Tl	0.00003§	(0.0010)*	(0.0025)*
U	0.0005§	0.0050	0.0068
V	0.006§	0.018	0.029
Zn	0.008	0.020	0.033

§ANZG Low Reliability Trigger Value

*Metals that require lower detection limits for establishment of trigger value

All groundwater samples will be analysed at a National Association of Testing Authorities (NATA)-certified laboratories. As part of the revised groundwater monitoring program, preparation and sampling laboratory

methods and appropriate levels of reporting (LOR), as well as additional hydrogeochemical analytical parameters, will be defined an included in this WMP. Groundwater field parameters are shown in Table 3-3.

Table 3-3: Proposed Groundwater Field Parameter Monitoring

Parameter	Unit of Measurement	Comment
Depth to Water	Metres below ground level (mbgl)	-
pH	-	To be collected where field water quality monitoring is specified
Electrical Conductivity (EC)	Microsiemens per centimetre (µS/cm)	
Total dissolved solids	Milligrams per litre (mg/L)	
Temperature	Degrees Celsius (°C)	
Dissolved Oxygen (DO)	Percentage (%)	To be collected where water chemistry sampling is specified
Redox Potential	Millivolts (mV)	

3.1.4 Method

Water sample collection from the nominated monitoring bores is undertaken using a passive sampler (i.e., HydraSleeve), installed within the screened interval of the bore.

Salinity profiles are undertaken by lowering a water level / EC / temperature probe or data logger (i.e., AquaTroll logger) slowly through the screened interval of the nominated bores.

Pressure transducers / data loggers are installed in the nominated monitoring bores for recording groundwater levels, with manual water level (dip) readings undertaken when loggers are routinely downloaded. Water level / EC / temperature data loggers are installed where continuous salinity readings are required.

3.1.5 Reporting

A standalone report at the conclusion of each monitoring period will be prepared documenting the groundwater levels and quality monitored by this procedure. This report will include the following sections: methods, results, discussion and recommendations, as well as any instances of species of conservation significance that may be observed during the monitoring or elsewhere within the Development Envelope.

3.2 Surface Water Monitoring

3.2.1 Monitoring Sites

As part of the baseline hydrological study, eight surface water monitoring locations (SWML) have been established, with six sited on claypan tributaries and two in the claypans themselves (one in each of the Gnalka Gnoona and Koodjeepindarranna Claypans). The six selected tributaries are all located on the northern (Chichester Range) side of the claypans as the HPPL tenements do not cover defined tributaries coming from the south (Hamersley Range) side of the claypans. Additional baseline monitoring sites are proposed to be installed, with most of the additional sites located within the Goodiadarrie Swamp. The locations of the existing and proposed baseline monitoring locations are detailed in Table 3-4.

Water quality samples have been collected from persistent ponding in channel pools across the site (when ponding is present). The approximate coordinates of the "grab sample" locations are shown in Table 3-4 and these represent locations where on-going water quality samples will be collected.

To ensure that the monitoring program is consistent with, and builds on data previously collected during baseline surveys, on-going monitoring during mine operations will continue to utilise surface water monitoring sites established during baseline surveys where possible, with additional monitoring for mine operations proposed to be positioned downstream of drainage lines which are proposed to be diverted around the mine footprint. These monitoring locations are available for viewing in Figure 3-3, detailed in Table 3-4.

Table 3-4: Surface Water Monitoring Locations

Monitoring Location Type	Location ID	Installation Date	Feature Type	Coordinates (UTM Zone 50)
Logger/Passive Sample	SWML01	28/07/20	Creek reporting to Koodjeepindarranna Claypan	651075 E, 7555241 S
Logger/Passive Sample	SWML02	12/10/18	Creek reporting to Fortescue Valley immediately upstream of Gnalka Gnoona Claypan	667963 E, 7550632 S
Logger	SWML03	11/10/18	Koodjeepindarranna Claypan	646369 E, 7550913 S
Logger	SWML04	11/10/18	Gnalka Gnoona Claypan	651771 E, 7548466 S
Logger/Passive Sample	SWML05	06/05/20	Creek reporting to Gnalka Gnoona Claypan	656713 E, 7555960 S
Logger/Passive Sample	SWML06	09/05/23	Creek reporting to Fortescue Valley upstream of Gnalka Gnoona Claypan	664587 E, 7553273 S
Logger/Passive Sample	SWML07	16/11/23	Creek reporting to Fortescue Valley upstream of Gnalka Gnoona Claypan	668999 E, 7554721 S
Logger/Passive Sample	SWML08	16/11/23	Creek reporting to Fortescue Valley upstream of Gnalka Gnoona Claypan	671812 E, 7551062 S
Grab sample	SWML09	n/a (no logger at this location)	Channel pool to the northwest of Koodjeepindarranna Claypan	643979 E, 7553027 S
Logger	SWML10	n/a (proposed logger location)	Backup monitoring location for claypan water levels in the event of a logger failure	647223 E, 7548879 S
Grab sample	SWML11	n/a (no logger at this location)	Channel connecting the claypans.	649958 E, 7546490 S
Logger/Passive Sample	SWML12	n/a (proposed logger location)	Backup monitoring location for claypan water levels in the event of a logger failure	652194 E, 7548841 S
Grab sample	SWML13	n/a (no logger at this location)	Channel Pool	653291 E 7550386 S

Monitoring Location Type	Location ID	Installation Date	Feature Type	Coordinates (UTM Zone 50)
Logger/Passive Sample	SWML14	n/a (proposed logger location)	Channel Pool	661607 E, 7547771 S
Grab sample	SWML15	n/a (no logger at this location)	Channel pool on the valley floor upstream of the claypans to which runoff from the eastern mining area reports	665149 E, 7546389 S
Logger	SWML16	n/a (proposed logger location)	Creek reporting to Koodjeepindarranna Claypan	650917 E, 7551505 S

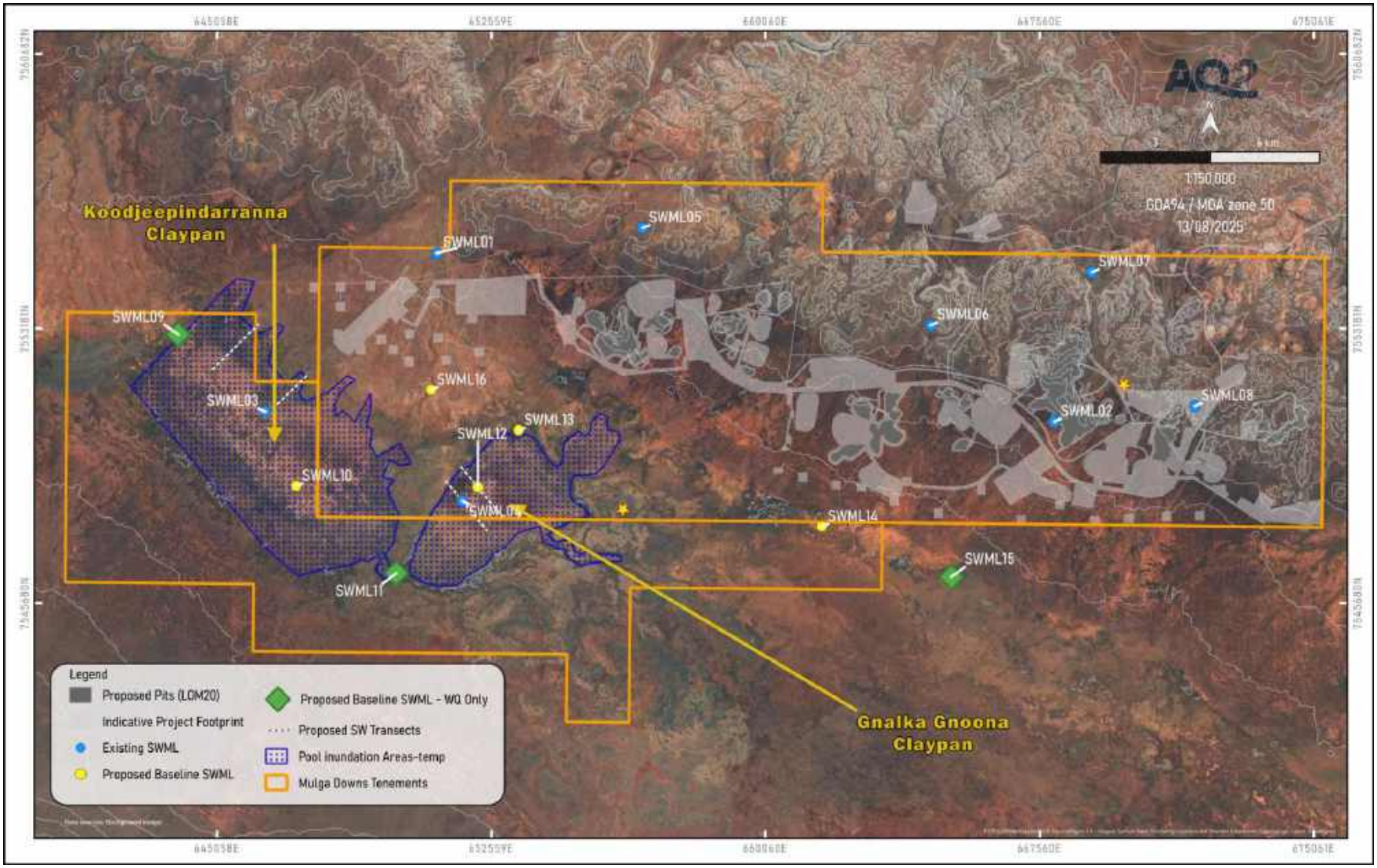

Figure 3-3: Proposed Full Baseline Surface Water Monitoring Network

3.2.2 Surface Water Quality Trigger Levels

Provisional surface water quality trigger levels have been developed by CBEC (2024), along with rationale (**Appendix 1**). The trigger levels are provided in Table 3-5 below.

Table 3-5: Provisional Surface Water Quality Trigger Levels

Parameter (mg/L)	ANZG DGV 95% of Species Limit of Protection	80th percentile
pH	6.5 – 8.5	7.1-8.0
EC (us/cm)	-	290
TDS	-	4,180
Alkalinity as $CaCO_3$	-	88
Ag	0.00005	-
Al	0.055	1.68
As	0.013	-
B	0.37	-
Ba	-	-
Be	0.0001	-
Bi	0.0007	-
Ca	-	16
Cd	0.0002	-
Cl	-	558
Co	0.0028	-
Cr	0.001	-
Cu	0.0014	-
Fe	-	1.6
HCO_3	-	76
Hg	0.0006	-
K	-	24
Mg	-	5
Mn	1.9	0.34
Mo	0.034	-
N (as NO_3)	-	2.3
Na	-	404
Ni	0.011	-
p	-	0.67
Pb	0.0034	-
SO_4	-	94
Sb	0.009	-
Se	0.011	0.0005

Parameter (mg/L)	ANZG DGV 95% of Species Limit of Protection	80th percentile
Si	-	23
Sn	0.003	-
Sr	-	-
Ti	-	-
Tl	0.00003	-
TL	0.0005	-
V	0.006	-
Zn	0.008	0.034

Where specified, surface samples will be analysed at a National Association of Testing Authorities (NATA)-certified laboratories. Surface water field parameters are shown in Table 3-6.

Table 3-6: Proposed Surface Water Field Parameter Monitoring

Parameter	Unit of Measurement	Comment
Water depth	Metres (m)	-
pH	-	To be collected where field water quality monitoring is specified
Electrical Conductivity (EC)	MicroSiemens per centimetre (µS/cm)	
Total dissolved solids	Milligrams per litre (mg/L)	
Temperature	Degrees Celsius (°C)	
Dissolved Oxygen (DO)	Percentage (%)	To be collected where water quality sampling is specified
Redox Potential	Millivolts (mV)	

3.2.3 Method

Water quality sample collection from the claypans is proposed to be taken from along transects across the claypan, as the exact location for sample collection will be dependent on the level of inundation within the claypan at the time of sampling. A single water sample is proposed to be taken from the transect during each monitoring event.

Water quality samples will be collected opportunistically after a substantial rainfall event. Other than the claypans and other ponding locations, the SWMLs contain a passive water quality sampling unit installed in the drainage line which will collect a water quality sample when water levels reach a set flow/inundation depth (to avoid collecting first flush samples).

Installed pressure transducers record water levels in the drainage lines and claypans. The recordings in the claypans can be used to assess the recession rate of claypan water levels (and therefore the claypan hydroperiods). The observed recession rates will be compared to past observations and water balance predictions of recession rates to identify if water levels are receding at a significantly faster or slower rate to baseline observations (which may indicate groundwater conditions impacting the claypan hydroperiod).

3.2.4 Reporting

A standalone report at the conclusion of each monitoring period will be prepared documenting the surface water quality monitored by this procedure. This report will include the following sections: methods, results, discussion and recommendations, as well as any instances of species of conservation significance that may be observed during the monitoring or elsewhere within the Development Envelope.

3.3 Vegetation Health Monitoring

The purpose of vegetation health monitoring is to inform, through the environmental criteria, if the environmental outcomes are being achieved and, if required, when trigger level or threshold levels are exceeded. The exceedance of trigger or threshold criteria then informs which contingency management measures need to be implemented. The vegetation health monitoring program will employ a combination of field-based and remote sensing techniques to assess the impact of mining activities on vegetation.

A statistical approach based on a BACI (before – after - control – impact) design will be used to provide objectivity and rigour to thresholds and triggers. The BACI approach is to sample Before and After an impact activity has commenced, to determine how the mine activities will change the condition of a site from its historical condition, whilst Control and Impact sampling will enable the effects of mining activities to be discerned from natural variation and other events. BACI designs are useful where there are large potential changes after impact and where changes may be permanent after impact. This approach is consistent with rigorous monitoring programs and for monitoring programs undertaken elsewhere in the Pilbara.

3.3.1 Site Locations

Locations of on-ground sites have been informed by a risk to receptor framework. The monitoring program will focus on claypans, vegetation at risk in groundwater mounding areas, surface water dependent riparian vegetation, channel pools, and sheetflow dependent vegetation (Table 3-7). Although not subject to any specific risk from the Project, two additional sites have been added to the monitoring program for nesting trees identified as potential breeding habitat for Grey Falcon (*Falco hypoleucos*). The specific locations and methods may be adjusted based on ongoing monitoring, stakeholder input, and regulatory requirements. Site locations are currently indicative, further site verification and baseline monitoring is planned to occur in H1 2026, prior to the construction phase of the Proposal.

Table 3-7: Number and purpose of on-ground monitoring sites

Receptor	Potential Impact	Impact Monitoring Sites	Reference Sites
Vegetation at risk from groundwater mounding	Groundwater mounding	2	2
Claypans and channel pools	Groundwater mounding and/or changes to surface water flow diversion	2	1
General vegetation management		4	4
Potential Grey Falcon nesting trees		2	0
Surface water dependant riparian vegetation	Changes to surface water flow diversion	1	1
Sheetflow dependent vegetation		4	2

The number of monitoring sites is considered sufficient to statistically differentiate impacts to plant condition as a result of mining activities from background natural variation.

3.3.2 Method

Vegetation health monitoring will be undertaken using the methodology outlined in Table 3-8. Multiple quantitative and qualitative variables are used to assess vegetation health and condition at each site. Variables selected are standard indicators of health and condition used in vegetation monitoring programs and are assessed using robust scientific methods. Some variables are measured across the entire Mine area and adjacent areas through remote sensing, while others are measured on-ground at permanent monitoring sites.

Where possible, vegetation monitoring sites are located near suitable groundwater monitoring bores.

Table 3-8: Monitoring Methodology

Variable	Method
1. Plant mortality	Count of the number of live/dead permanent sample plants. If dead, includes distinction between recently dead (within 1 year) and long dead.
2. Plant crown cover	For woody plants: visual estimate of crown density and foliage transparency of permanent sample plants using United States Department of Agriculture method (Schomaker et al. 2007). For spinifex hummock grasses: measurement of hummock length, width and height of permanent sample plants to nearest 5 cm using a measuring tape
3. Plant condition	For woody plants: visual assessment of plant health and condition of permanent sample plants using appropriate rating system for Australian trees (e.g., Grimes 1978) and noting other obvious signs of health decline if present. For spinifex hummock grasses: rating system for estimating percentage of green (live) foliage of permanent sample plants.
4. Plant physiological health	Measurement of chlorophyll fluorescence on a sub-sample of permanent sample plants (e.g., at least one tree and one shrub species per site) using a hand-held chlorophyll fluorimeter.
5. Community composition and cover	Survey of all plants along a 20 m transect using a line intercept method (e.g., Caratti, 2006), including identification of all intercepting plants to species level to determine species richness, and length of crown intercepts to determine cover. Species composition described using appropriate statistical methods (e.g., Permutation Multivariate Analysis of Variance).

Variable	Method
	An alternative method is applied for some historic legacy sites, comprised of species inventory and visual estimates of Projected Foliage Cover by species within 50 x 50 m quadrats. General presence/absence of riparian species and Mulga vegetation species within a site is noted within a broad radius of at least 50 m.
6. General site condition	Vegetation condition rated using Trudgen (1988) scale. Site condition variables rated using simple abundance scale (variables include regeneration, weeds, recent fire, grazing, surface water, understorey dieback, soil surface condition, dust and erosion).
7. Soil salinity	Non-invasive measurement of subsurface apparent soil electrical conductivity (EC) along two 20 m transects at each site using a hand-held electromagnetic induction meter (e.g., Geonics Ltd. EM38 meter).
8. Spectral index of vegetation condition	Satellite or airborne digital multispectral imagery (DMSI) is used to derive indices for assessing the condition status of vegetation at multiple scales, from individual plants and vegetation communities to landscapes and management zones. Examples of suitable indices include the NDVI and the Modified Soil Adjusted Vegetation Index (MSAVI) derived from near infrared and visible bands. Higher resolution imagery (2 m or less) is captured annually (e.g., Worldview 3), while lower resolution imagery (10 to 30 m) is acquired at shorter intervals (e.g., Sentinel) or from previous years (e.g., LandSat) to evaluate shorter- or longer-term trends in vegetation cover and condition as required. All imagery is radiometrically corrected and orthorectified prior to analysis. Ground truthing of remote sensing data is undertaken as necessary. Hancock Iron Ore is also in collaboration with FrontierSI and Curtin University to develop a near-real time vegetation monitoring platform using Sentinel imagery. This may be formalised as part of the monitoring schedule in the future.
9. Vegetation cover	Cover is determined using remote sensing data as described above. Index thresholding, training data and machine learning algorithms are applied to classify image pixels by vegetation or species group, and models are applied to delineate plant canopies, with outputs used to determine percentage vegetation cover. Where possible, cover is determined by vegetation type (riparian and groundwater dependent vegetation, Mulga vegetation) or species. Cover is determined at site and management zone scales.
10. Climate, weather and hydrology	Data captured from on-site and regional weather stations including daily rainfall, temperature and relative humidity. Historic climate data is sourced from the Bureau of Meteorology. Weather and climate data are used to aid interpretation of vegetation monitoring data. Where available, trends in groundwater depth and salinity from suitable nearby monitoring bores is assessed in the context of vegetation monitoring data.

3.3.3 Frequency

All monitoring will be undertaken annually at the end of the dry season around October/November when vegetation is normally subject to the highest degree of drought stress.

The end of dry season timing is also suitable for remote sensing because it coincides with a period when artefacts in vegetation condition variables, due to the occurrence of (seasonal) understorey vegetation, are minimised.

3.3.4 Reporting

A standalone report at the conclusion of each monitoring period will be prepared documenting the vegetation health monitored by this procedure. This report will include the following sections: methods, results, discussion and recommendations, as well as any instances of species of conservation significance that may be observed during the monitoring or elsewhere within the Development Envelope.

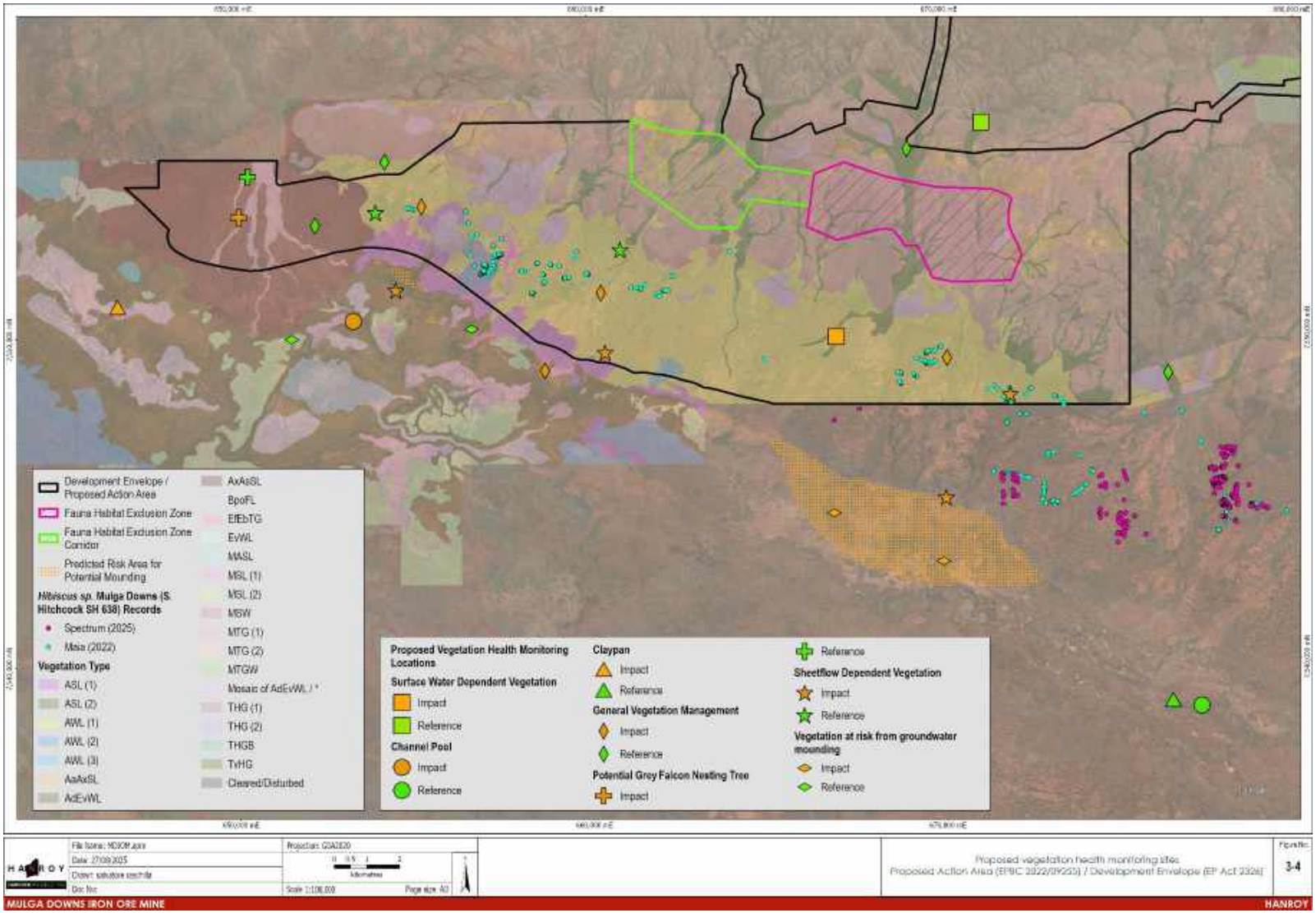

Figure 3-4: Proposed vegetation health monitoring locations

3.4 Subterranean Fauna Monitoring

Monitoring for impacts to subterranean fauna from mining will be through the mine planning process. For each iteration of the mine plan, HPPL will review the mine block model (ore and waste) and pit shell in relation to the subterranean fauna habitat units to assess compliance with the triggers and thresholds for impacts to habitat prior to the commencement of mining in that area.

3.4.1 Method

To confirm compliance with the triggers and thresholds, the volume of actual (mined) vs proposed (mine plan) habitat impact will be validated against the 'as mined' survey data.

This is an administrative control (similar to the Ground Disturbance Permit Process for managing impacts to vegetation and fauna habitat from clearing) which will ensure the impacts to Likely subterranean fauna habitat do not exceed the volume of habitat removed from Mining for which the impact assessment was based on.

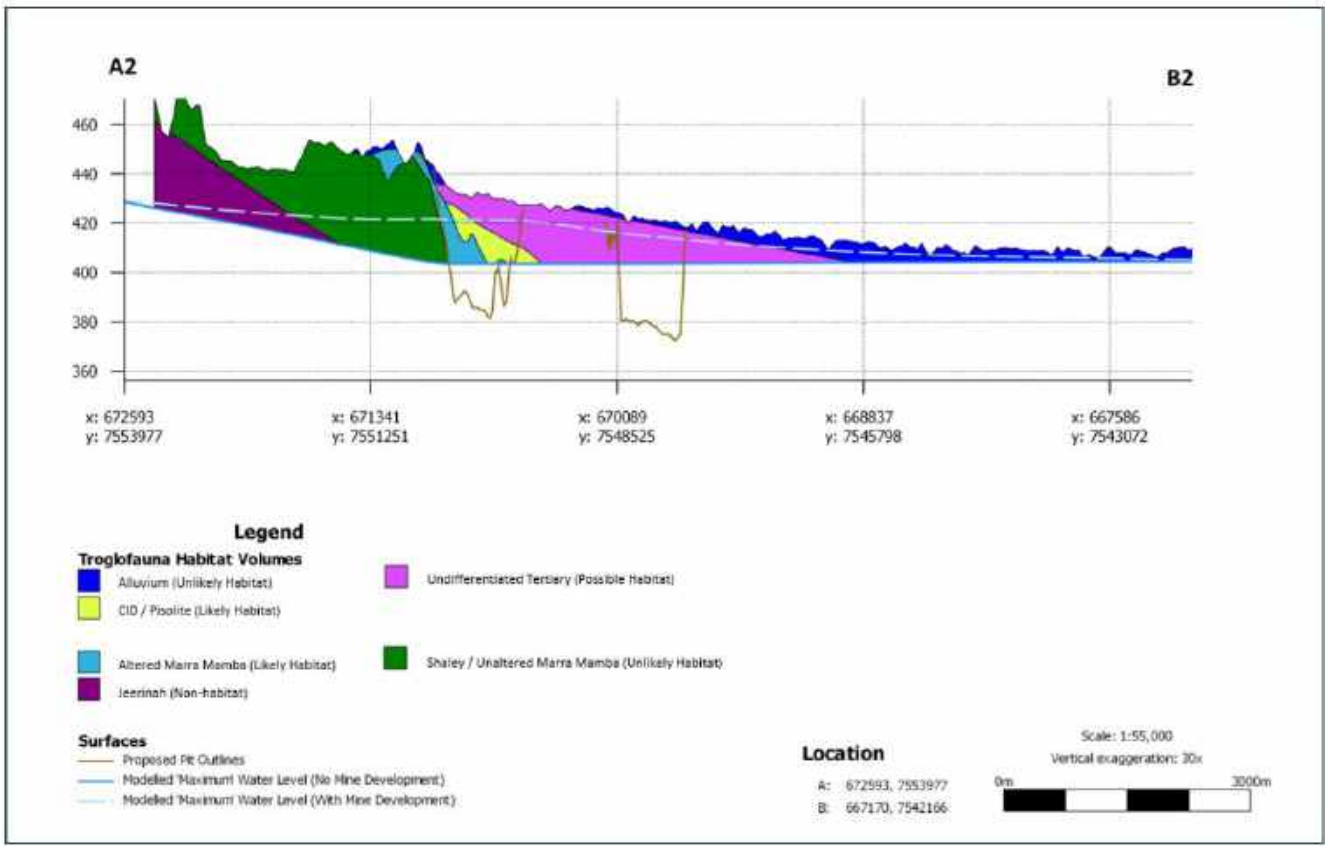

Figure 3-5: Screenshot of 3D Habitat Assessment of impacts from mining (Troglofauna Cross Section, AQ2 2024)

3.4.2 Reporting

A standalone report at the conclusion of each monitoring period will be prepared documenting the volume of habitat minded vs proposed and tracking against triggers and thresholds for impacts.

3.5 Monitoring Overview

A summary of monitoring actions is provided in Table 3-9.

Table 3-9: Monitoring Action Summary

Monitoring Event	Monitoring Action	Frequency	Responsibility
Groundwater	MAR groundwater quality chemistry • Reinjection bores • Nomination salinity bores	Quarterly	Site Environmental Advisor
	MAR groundwater quality field readings • Reinjection bores • Nomination salinity bores	Monthly	Site Environmental Advisor
	MAR groundwater levels	Continuous groundwater level monitoring and monthly manual measurements	Site Environmental Advisor
	Mine groundwater drawdown	Monthly	Site Environmental Advisor
	Mine groundwater quality chemistry – upstream and downstream of WRDs	Quarterly	Site Environmental Advisor
Surface Water	Surface water quality	Following significant rainfall event	Site Environmental Advisor
Vegetation	Field based surveys	Annual during the dry season	Site Environmental Advisor
	Remote sensing	In addition to field based surveys	Site Environmental Advisor
	Multivariate modelling	In addition to field based surveys	Site Environmental Advisor
Subterranean Fauna Habitat	Mine block model (ore and waste) of the volume of actual (mined) vs proposed (mine plan) likely habitat against triggers and thresholds.	Whenever there is a change to the Mine Plan	Mine Planning

4 Adaptive Management and Review

HPPL will employ adaptive management through the LOM to incorporate knowledge from the implementation of mitigation measures, monitoring, and evaluation of data against trigger and threshold criteria to more effectively meet regulatory conditions and objectives outlined in this WMP. The following approach will be followed:

- Monitoring data will be systematically evaluated and compared to baseline data and predictions on an annual basis to verify whether groundwater responses to operational activities are the same or similar to predictions
- Re-evaluate the risk assessments annually after monitoring is completed
- Incorporate additional knowledge including higher resolution digital elevation to improve topographic representation as it comes to hand to address assumptions and uncertainties to gain increased understanding of vegetation and aquifer response
- Periodically incorporate additional data, acquired through detailed design and monitoring, into groundwater and surface water models to increase certainty around predicted changes to groundwater regimes and water quality
- Review the mine planning program, GWOS, and input changes into risk assessments to refine or modify the monitoring program
- Undertake revision(s) when WMP provisions are not as effective as predicted, or trigger levels do not have the outcome anticipated or required
- Incorporate alternative techniques, technologies, and methodologies to enhance and improve the program
- Revise the WMP periodically to include additional and updated trigger and threshold levels based on developed baseline data
- Revise the WMP periodically to include additional Proposal areas (if required), monitoring locations, parameters and site-specific trigger and threshold levels
- Develop other monitoring programs as required to respond to additional operational activities
- Incorporate and modify the program to include any external changes during the life of the Proposal (e.g., changes to the sensitivity of the vegetation, climate change, implementation of other activities in the area, etc.).

All amendments to this WMP must be submitted to and approved by the CEO of DWER and DCCEEW. The Management Plans shall also be reviewed, and amendments submitted as and when directed by the CEO in addition to every five years from approval with outcomes of the five-yearly review submitted to the CEO.

The WMP will be reviewed on a biennial basis, or following:

- The grant of, or modification to, relevant approvals
- Major changes to the scope or operation of the mine

- Relevant findings or actions identified through monitoring, audits and incident reporting.

5 Roles and Responsibilities

All employees and contractors are required to comply with the requirements of this WMP. An outline of roles and responsibilities for all personnel is provided in Table 5-1.

Table 5-1: Roles and Responsibilities for Implementation of this Plan

Role	Responsibility
All personnel	Comply with all legal requirements and the requirements of this plan.
Environment Manager (or equivalent)	• Maintain the WMP, and review the WMP as required • Provide advice, including procedures and requirements, to all key parties to ensure compliance with legal requirements, achievement of environmental objectives and improving environmental performance • Provide support to all personnel as required to ensure the WMP is implemented.
Site Environmental Advisor (or equivalent)	• Report on the implementation of the plan. • Provide advice, including procedures and requirements, to all key parties to ensure compliance with legal requirements, achievement of environmental outcomes and objectives
Mine Planning Engineer	• Monitor mine plan for impacts to subterranean fauna habitat.

6 Abbreviations, Definitions & Acronyms

Abbreviation	Definition
AEP	Annual Exceedance Probability
AER	Annual Environmental Report
AIC	Akaike Information Criterion (multivariate analysis)
AMD	Acid and/or Metalliferous Drainage
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australia and New Zealand Guidelines
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999
BC Act	*Biodiversity Conservation Act 2016*
BIC	Bayesian Information Criteria (multivariate analysis)
BNTAC	Banjima Native Title Aboriginal Corporation
CEO	The Director General of the Western Australian Department of Water and Environmental Regulation, or his/her delegate
cm	Centimetres
CSFMP	Conservation Significant Fauna Management Plan
DBCA	Department of Biodiversity, Conservations and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEM	Digital Elevation Model
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DJTSI	Department of Jobs, Trade, Science and Innovation
DPLH	Department of Planning, Lands and Heritage
DGV	Default Guideline Value
DWER	Department of Water and Environmental Regulation
EC	Electrical Conductivity
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
ESD	Environmental Scoping Document
ERD	Environmental Referral Document
FY	Financial Year
GDV	Groundwater Dependent Vegetation
GWOS	Groundwater Operating Strategy
ha	Hectare
HPPL	Hancock Prospecting Pty Ltd
ITV	Investigation Trigger Value
km	Kilometre
km^2	Square kilometre
LAI	Leaf Area Index
LOM	Life of Mine

Abbreviation	Definition
LRTV	Low Risk Trigger Value
L/s	Litre per second
m	Metre
mm	millimetres
MAR	Managed Aquifer Recharge via reinjection
mbgl	Metres below ground level
MDIOM	Mulga Downs Iron Ore Mine
m^2/ha	Square metre per hectare
mg/L	Milligrams per litre
ML/d	Megalitre per day
mm/yr	Millimetres per year
MNES	Matters of National Environmental Significance
mRL	metres Reduced Level
MRWA	Main Roads Western Australia
Mtpa	Million tonnes per annum
NAF	Non-Acid Forming
NATA	National Association of Testing Authorities
NDVI	Normalised Difference Vegetation Index
NDWI	Normalised Difference Wetness Index
NMD	Neutral Mine Drainage
OSA	Overburden Storage Area
PAF	Potentially Acid Forming
PAW	Plant Available Water
PEC	Priority Ecological Community
PER	Public Environmental Report
RIWI Act	Rights in Water and Irrigation Act 1914
SFMMP	Subterranean Fauna Monitoring and Management Plan
SRE	Short-range Endemism
SD	Saline Drainage
TDS	Total Dissolved Solids
TEC	Threatened Ecological Communities
TSS	Total Suspended Solids
WMP	Water Management Plan
WRD	Waste Rock Dump
µS/cm	MicroSiemens per centimetre

7 References

Table 7-1: References

Author, year published	Title
ANZECC/ARMCANZ, 2000	National Water Quality Management Strategy Guidelines
ANZG, 2018	Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Default Guideline Values
Attexo, 2023	Consolidated Terrestrial Fauna Report
AQ2, 2024a	Mulga Downs Groundwater, Surface Water and Ecohydrological Impact Assessment
AQ2, 2024b	Mulga Downs Iron Ore Mine: Subterrean fauna habitat assessment: Troglofauna habitat assessment and stygofauna habitat assessment.
AQ2, 2025	Mulga Downs Groundwater, Surface Water & Ecohydrological Studies – Baseline Assessment
AS/NZS ISO 31000:2009	Risk management – Principles and Guidelines
BEC, 2024a	Mulga Downs Iron Ore Mine: Subterranean Fauna Survey 2019-2024.
BEC, 2024b	Memo 675: Salinity tolerance of stygofauna at Mulga Downs Iron Ore Mine
Biologic, 2022a	Mulga Downs Iron Ore Project: Transport Corridor to Great Northern Hwy Terrestrial Fauna Survey
Biologic 2022b	Mulga Downs Iron Ore Mine: Mulga West Borefield and Mulga East Southern Corridor Terrestrial Fauna Survey. Report
Biologic 2023	Mulga Downs Iron Ore Mine: Freshwater Claypans Desktop Assessment.
Biologic, 2025a	Peer review of Salinity tolerance of stygofauna at Mulga Downs Iron Ore Mine. Memo 675
Biologic, 2025b	MDIOM Subterranean fauna baseline peer review
Biologic, 2025c *(in prep.)*	Targeted troglofauna survey
Caratti, JF 2006	Line Intercept (LI) Sampling Method, USDA Forest General Technical Report RMRS-GTR-164-CD.
CBEC, 2024	Mulga Downs Project-Provisional Water Quality Trigger Values
DCCEEW 2024	*Environmental Management Plan Guidelines.*
DEMIRS, 2023	Statutory Guidelines for Mining Proposals
ecologia, 2020	Baseline Terrestrial Invertebrate Fauna (SRE) Level 2 Assessment
ecologia, 2021a	Mulga East Baseline Terrestrial Vertebrate Fauna Assessment
ecologia, 2021b	Letter: Targeted Pilbara Leaf-nosed Bat Gap Analysis
EPA, 2012	EPA (2012) A review of subterranean fauna assessment in Western Australia. Discussion Paper.
EPA, 2020	EPA Guideline: Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans.
EPA, 2021	EPA (2021) Technical Guidance – Subterranean Fauna Surveys for Environmental Impact Assessment; Environmental protection Authority, Western Australia.
GHD, 2023	Mulga Downs Water Studies: Groundwater & Surface Water Impact Assessment – Peer Review
GWC, 2024	Mulga Downs Groundwater Modelling
HydroGeoLogic, 2023	Mulga Downs groundwater Modelling Independent Peer Review
JBS&G, 2023	Memorandum: Mulga Downs Rail and Hub – Flora and Vegetation Surveys – Supplementary memorandum
JBS&G, 2025b *(in prep.)*	Analysis of stygofaunal associations with groundwater salinity and potential salinity tolerances based on observations, for the MDIOM

Author, year published	Title
Maia 2021a	Mulga East Iron Ore Project, Mine Study Area Detailed Flora and Vegetation Assessment 2019-2020
Maia, 2022	Mulga Downs Iron Ore Project, Mine and Borefield Study Area Detailed Flora and Vegetation Assessment 2019-2022
Maia, 2023	Mulga Downs Iron Ore Mine, Additional Survey Areas, Flora and Vegetation Assessment
MWH, 2009	Murray's Hill Groundwater Investigation – Stage 2
MWH, 2012	Hydrogeological Assessment of the Fenceline Road Borefield Area
MWH, 2014	Conceptual Hydrogeology of the Mulga East Deposit
PSM, 2022	Mulga Downs PFS Geotechnical Assessment and Pit Slope Design
Spectrum, 2024	Memo - Targeted flora and vegetation survey – portion of the Northern Haul Road.
Spectrum, 2025	Report – Mulga Downs Iron Ore Mine – Targeted Hibiscus Survey (report in preparation)
Schomaker et al. 2007	Crown-Condition Classification: A Guide to Data Collection and Analysis, United States Department of Agriculture (USDA) Forest Service, Southern Research Station, General Technical Report SRS-102.
Strategen-JBS&G, 2021	Subterranean Fauna – Preliminary Impact Assessment
Trudgen, ME 1988	A Report of the Flora and Vegetation of the Port Kennedy Area, unpublished report to Bowman Bishaw and Associates.

8 Appendices

Appendix 1 Provisional Water Quality Trigger Report (CBEC, 2024)

Memorandum

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Date: 1 October 2024

[redacted]

Re: Mulga Downs Project_Provisional Water Quality Trigger Values _Rev4

The Provisional Water Quality Trigger Values have been revised to reflect the change in the mine plan and changes in source and pathway assessments.

1. Introduction

In order to measure the effect of mining disturbance on the environment, it is necessary to establish the baseline hydrogeochemistry regime of the potential pathways prior to disturbance. Any changes then resulting from mining activities on chemical parameters can then be compared to this baseline. This memo details the provisional groundwater and surface water trigger values and the results for the greenfields Mulga Downs area. The procedure for establishing suitable trigger values follows that detailed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018; ANZECC & ARMCANZ, 2000b).

1.1 Relevant guidelines

In order to evaluate analytical data, elemental concentrations are required to be compared to standards. Commonly in the absence of site-specific reference values, water quality data can be compared to the ANZ Toxicant Default Guideline Values for Fresh and Marine Water Quality at the 95% of Species Protection (SP) for a Slightly to Moderately Disturbed System (ANZG, 2018; ANZECC & ARMCANZ, 2000b).

Where applicable, the 95% Species Protection Toxicant Default Guidelines Values (DGVs) will be modified for the relative hardness of the water (ANZG, 2018; ANZECC & ARMCANZ, 2000b).

Contaminated land guidelines refer specifically to disturbed growth medium (DER, 2014), or surface soils that may have been contaminated by materials that are not present naturally. Similarly, Health-based Soil and Groundwater Investigation Levels (DHAC, 2001) and the NEPM Guideline on Investigation Levels for Soil and Groundwater: Ecological investigation levels (NEPC, 2010) do not apply to natural rock or soil material unless this material has come into contact with contaminating substances.

1.2 Background

The DGVs provide a guide for the specific toxicity of water parameters on the most sensitive aquatic ecosystems by compiling studies from around the world and applying a factor of safety to the lowest concentrations. They are, as a result, protective of communities that may be resident in the highest quality natural waters. The principle behind site specific trigger values (SSTVs) is the assumption that aquatic ecosystems have ecological tolerances that allow them to persist, and that as long as their habitat ranges

(upper tolerance limits), such as high natural salinity in the Pilbara or high concentrations of any particular element, are not exceeded, the local ecosystems dependant on surface water or groundwater will not be adversely affected. Thus, even if a particular element concentration exceeds the ANZ Toxicant Default Guideline Values, local species will be tolerant of such concentrations. It is especially important to establish site-specific conditions in the Pilbara, as a result of the highly salinity and hardness (representative of concentrations of divalent cations calcium and magnesium) naturally present in the groundwater environment, where often, undisturbed ecosystems will far exceed ANZ DGVs.

The goal of a geochemistry characterisation programme is to assess what the likely leachate from mining waste will be and compare those concentrations to the local surface and groundwater regime to predict drainage quality and any changes to the environment. If leachate concentrations are predicted to exceed local conditions, then metalliferous drainage may be a concern and management options can be implemented. Conversely, if leachate concentrations are lower than the local groundwater conditions it is assumed they will not pose a risk and management is not required. Elements that exhibit a tendency to bioaccumulate in the environment such as mercury, selenium or thallium require special consideration.

Mining in the Pilbara could potentially affect several different downgradient systems, across different groundwater regimes resulting in the need for different baselines for each system. Groundwater is first assessed to determine if different types are present across the site.

2. Method

Natural groundwater quality typically varies vertically with aquifer and rock units and temporally/seasonally at individual points and catchments, as a result of system conditions. While a minimum of one upgradient monitoring point is required to determine background water quality, in complex situations or large operations more than one upgradient point may be needed to characterise spatial variability accurately. Water quality is influenced by depth, thickness and lithology of units, as well as the hydraulic conductivity, permeability, rainfall, climate and topography.

Groundwater quality data should be collected and compared to the ANZG 95% Species Protection (SP) for freshwater systems DGVs to determine the relevance of these limits (DoW, 2013). Frequently, groundwater in the Pilbara is saline to hypersaline quality, and may not meet the 95% SP DGVs, even after concentrations have been modified for high (>30 mg $CaCO_3$/L) water hardness (ANZG, 2018; ANZECC & ARMCANZ, 2000b). If the undisturbed/upgradient water quality exceeds the 95% SP, then a SSTV should be established.

The ANZECC & ARMCANZ (2000b) guidelines state that a baseline data set should be established with a "minimum of two years of contiguous monthly data at the reference site before a valid trigger value can be generated". Until this minimum data requirement has been established, comparison of the median value of the dataset should be made with reference to the 95% SP DGVs.

The ANZECC & ARMCANZ (2000b) guideline stipulates a monthly sampling frequency for two years, such that trigger values may be established from 24 data points. However, this high frequency is only applicable for surface water quality, in permanent river systems, which are dynamic. For baseline determination of groundwater quality and ephemeral inland waters the number of collected data points should be similar: 18

(DEHP, 2009) to 24 samples, but may be collected seasonally over a longer period of time, such as quarterly, and may still be considered to be "contiguous".

ANZ Guidelines for the Management of Water Quality in Temporary Waters (Smith, et al., 2020) recommend that the Low-Risk Trigger Value (LRTV) for ephemeral surface water is generated from the 80th percentile of the data set, as a rolling value updated for each new analysis. If the 80th percentile value is exceeded by an analysis, then further investigation may be required.

An additional higher risk investigative trigger value (ITV) can be established to represent a value above which an impact may be occurring. This limit could be set at the 90th or 95th percentiles, and if exceeded an investigation action may be triggered.

Goudey (1999) indicates that in order to calculate 80th and 90th percentile values to assess water quality objectives at a 95% confidence interval, sample sizes of 14 and 29, respectively, are required. The water sample volumes required for 95% confidence of various percentile rankings is demonstrated in Figure 1. It is accepted that baseline groundwater quality data can continue to be collected from upgradient monitoring bore(s) or reference site(s) and in cross-gradient bores throughout the life of mine operations. If groundwater modelling predicts these areas are affected by operations, such as dewatering or groundwater reinjection, then groundwater monitoring results should be compared to baseline to assess the magnitude of the impact of operations. Downgradient bores can also be used as reference sites for all data collected before mining operations are likely to have caused an effect on the groundwater quality at that reference site.

At Mulga Downs groundwater samples have been collected from shallow (<20 metres below ground level) medium (25-55 mbgl) and deep (60-115 mbgl) bores across the proposed Mine Development Envelope. The volume of data over the

from March 2019 to October 2022 at Mulga Downs has provided 472 analyses from 102 positions. While no single bore has a more than 29 analyses, samples from different bores may be grouped if they are hydrogeochemically the same to a give statistically robust data set.

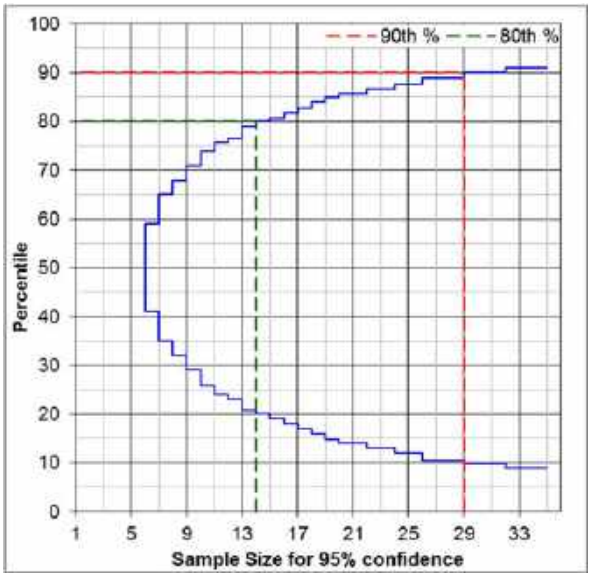

Figure 1: Sample size required to derive 95% confidence interval for a population

2.1 Groundwater differences

In order to determine whether groundwater quality varied significantly by depth or area the groundwater type was assessed. The groundwater quality statistics were then compared in these groupings to determine whether these factors would affect element concentrations.

Following this exercise, the minimums, maximums, 25th and 75th percentiles and mean values were calculated. In addition to these statistics the outliers, strong outliers and 99th percentile values were determined for the database. Outliers were calculated based on the interquartile range (IQR) = Q3 – Q1 (75th percentile – 25th percentile) where:

$$\text{Upper Outliers} = Q3 + (1.5 \times IQR)$$

$$\text{Strong Upper Outliers} = Q3 + (3 \times IQR)$$

The analyses of several bores were excluded from the baseline determination. Two bores contained low pH values and extremely high metal concentrations as they had been installed into pyritic Jeerinah Formation. In addition, 5 bores on the southwest edge of the marsh exhibited high salinity (>10,000 mg/L) and were excluded from the assessment. Additionally, two bores exhibited acidic water and were excluded from the assessment

3. Results

Figure 2 shows a map of all bores at the Mulga Downs site relative to planned pits. This includes production bores and monitoring piezometers. Bores with labels in red indicate points separated from the statistical analyses as being outliers.

Two bores were installed into Jeerinah Formation and as a result have acidic water, and several bores to the south west of the mining area are highly saline.

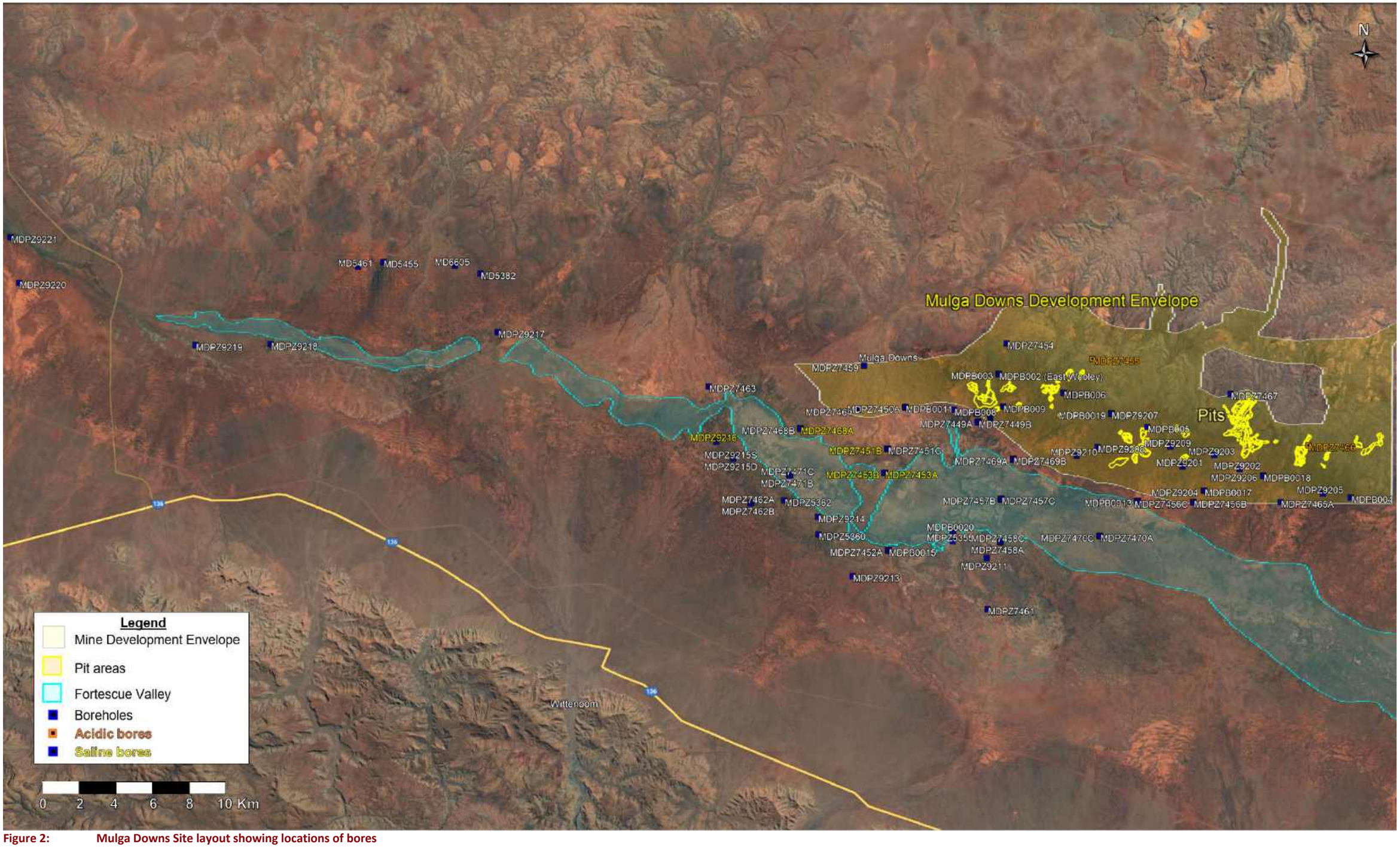

Figure 2: Mulga Downs Site layout showing locations of bores

Figure 3 shows the groundwater salinity as a function of depth. Water analyses with a salinity greater than 12,000 mg/L were excluded from the baseline determination as outliers. Highly saline waters are required to have separate baseline values for major ions. However, there is generally no correlation between the depth of the sample from surface and the salinity of the sample. Similarly, there is no correlation between salinity and elevation, or latitude or longitude, or relative distance from the Fortescue Valley.

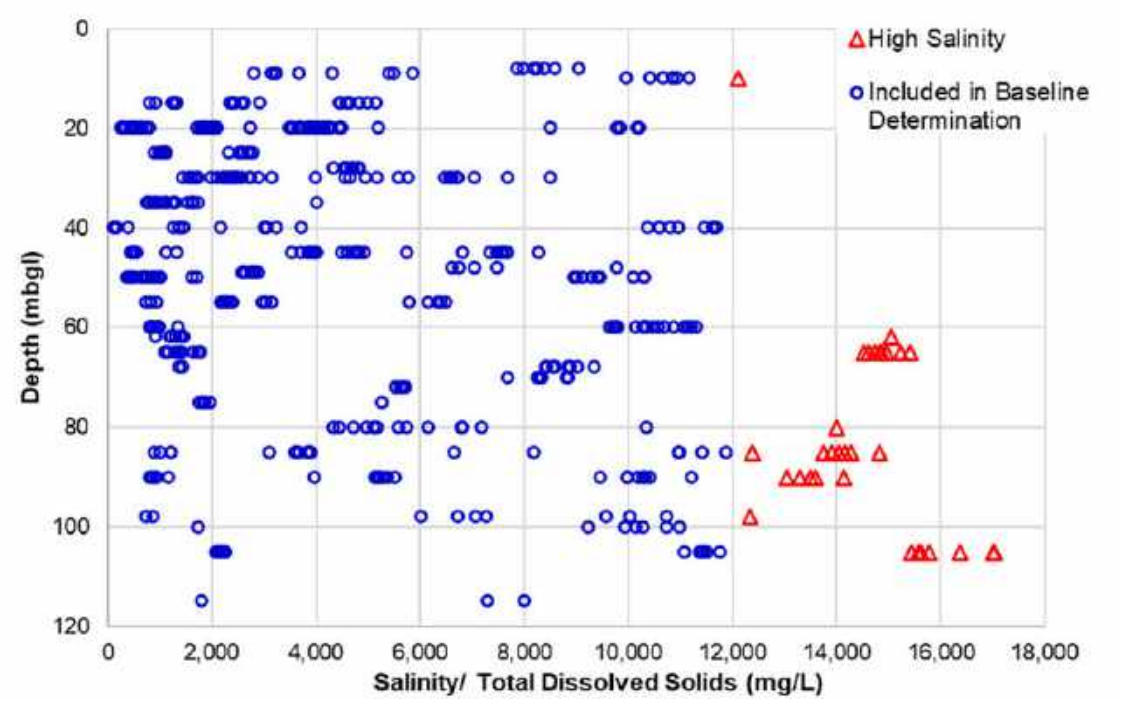

Figure 3: Groundwater salinity as a function of sample depth.

Figure 4 shows the water type for all bores separated by depth. The majority of bores are of a sodium-chloride type with one bore being a magnesium carbonate type, and some samples being calcium chloride or mixed types. As indicated, by the salinity there is no significant influence by depth on the water type. As a result of this water analyses were grouped by water type as shown in Figure 5. Water types different from the sodium chloride type were separated out of the dataset.

Statistics were calculated from the following sets of data:

- Population of all analyses (maximum n=539 – not all analytes have been analysed in every sample). It is convention when a concentration is reported in text, as being below the limit of reporting, that the concentration is converted numerically to half the limit of reporting (e.g. if concentrations was "<0.005" then the value "0.0025" was used for statistical calculation);
- Population of analyses excluding those with low (<5.5) pH (n=19) and high (>12,000 mg/L) salinity (n=488);
- Population of only high salinity (>10,000 mg/L) analyses (n=32);
- Populations of analyses of shallow samples (n=125), medium depth samples (n=170) and deep samples (n=181);
- Population of analyses of the main sodium-chloride water type (n=392) (production bores where the sample depth was not known were included); and
- Population of analyses of all other water types (n=126), excluding the dominant Na-Cl type.

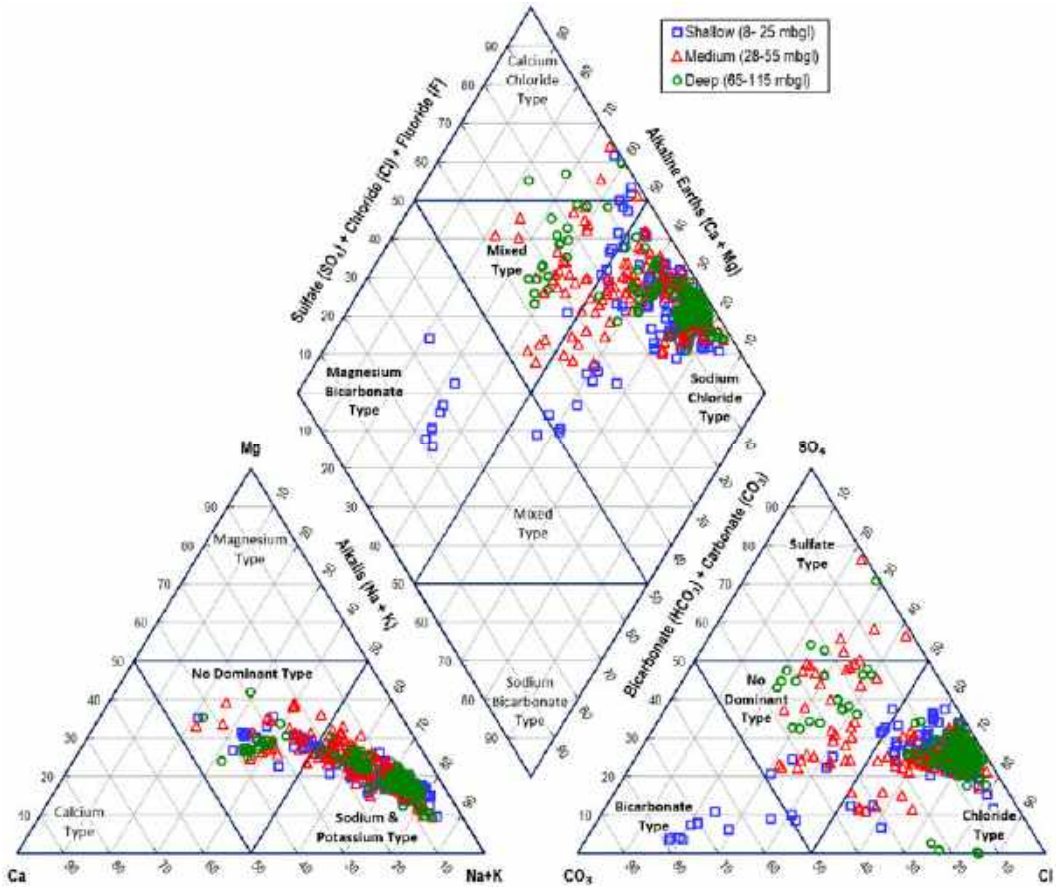

Figure 4: Piper plot of water quality for all water samples from different depths.

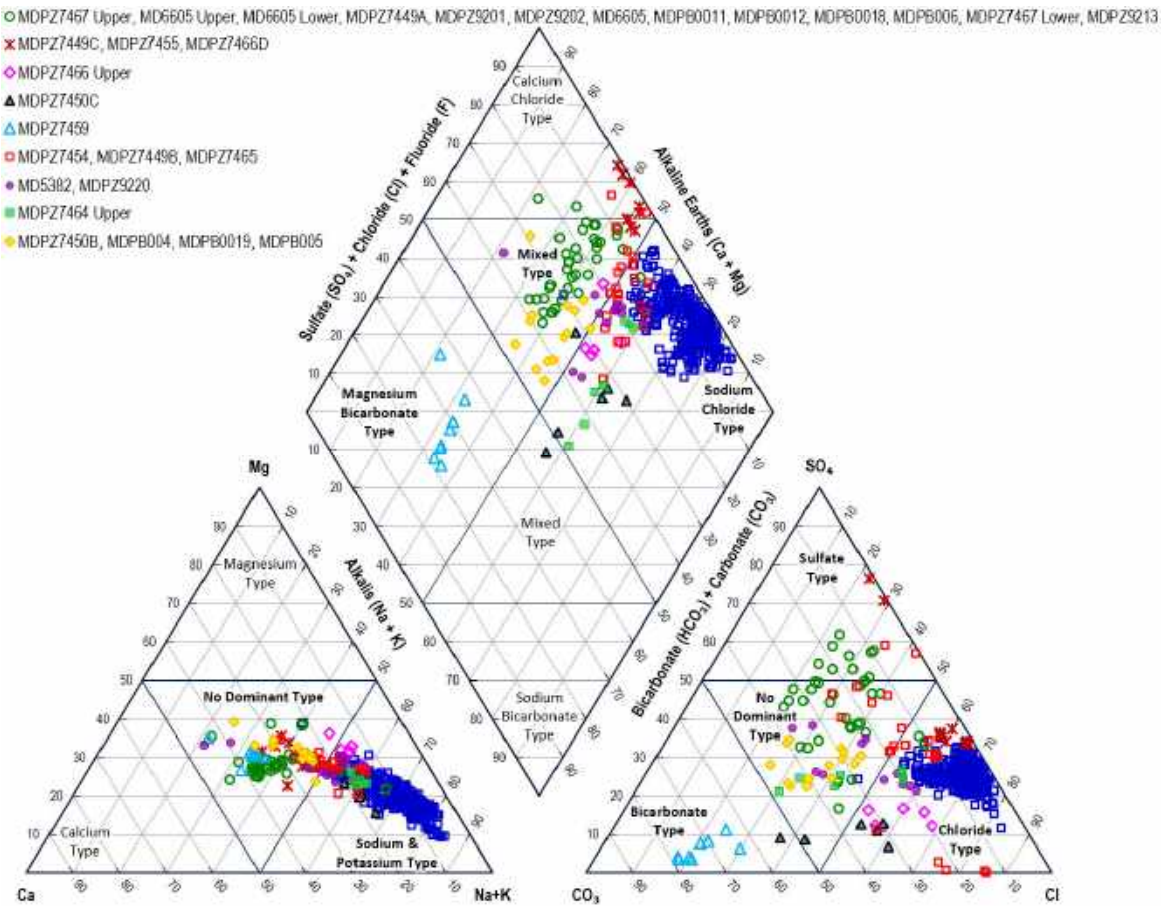

Figure 5: Piper plot of all water samples of same type grouped with other types separated.

4. Summary

A summary of the groundwater data analysis results is given in Appendix A and detailed as follows:

- The majority of water samples are of a sodium-chloride type. The Mulga Downs Water Studies Groundwater & Surface Water Impact Assessment (AQ2, 2023) provides a more in-depth assessment of groundwater water quality types and spatial distribution in the landscape.
- Major cations: potassium, sodium, calcium and magnesium, and minor cation strontium, show some variability between water at different depths but are mostly highly influenced by salinity, sodium being significantly less in the Shallow Bores and highest in the Saline Bores.
- Major anions: chloride and sulfate and minor anions: boron and fluoride, are highly influenced by salinity with shallow and medium depth water having significantly lower 80th and/or 90th percentiles. However, bicarbonate shows only minor variation with depth and salinity and has a narrow consistent range over water types. Other minor anions: nitrate and phosphate are influenced by biological activity and are thus highest in shallow surface waters and lower in saline waters.
- Minor elements were compared for the different water types, and were found to be broadly similar, with most being linearly affected by salinity.
  - Parameters where the 80th and/or 90th percentile values were highest in the Saline Bore population are: silver, cadmium, cobalt, iron, manganese, molybdenum, titanium and uranium. Even though the Saline Bore population has the highest 80th and/or 90th percentiles in the data population for these metals, they are not the water receptor, and will not be used to derive trigger values.
  - It is worth noting that Shallow Bore data population had the highest 80th and/or 90th percentile values for alkalinity, chromium, fluoride, nitrate, phosphate, antimony, selenium and vanadium relative to the other data populations. The values have been set as the most appropriate Low Risk and Investigative trigger values.
  - The population of bores with Different Water types had the highest 80th and/or 90th percentiles for arsenic, barium, nickel and zinc.
- The data analysis indicates that one set of trigger values can be established for the mining area. High salinity waters are too far away from the mining area to impact dewatering operations.
- For the majority of metals the ambient groundwater at Mulga Downs meets the 95% of Species Limit of Protection, where the groundwater is different the Shallow Bore population has been set as the most relevant trigger.

Therefore, for the following parameters the toxicant Default Guideline Values may be considered the trigger value: pH, aluminium, arsenic, beryllium, bismuth, cadmium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, antimony, selenium and tin.

- For some parameters the majority of analyses are below the limit of reporting, however that limit (or half that limit) is above the DGV and more samples at a lower reporting limit must be collected. Therefore, the following parameters are considered to have **provisional trigger values**: **silver, beryllium, bismuth, copper, and thallium**. For silver, beryllium and thallium, it is unlikely the required limit of reporting will ever be achieved by a commercial laboratory.

- For some metals the natural groundwater concentrations are naturally elevated above the DGVs and **require site specific trigger values: chromium, uranium, vanadium and zinc.**

Table 1 gives the final trigger value concentrations for the Mulga Downs site. Where the salinity of the water has had an impact on a parameter's concentrations the TV calculated has excluded saline waters. Where the water type has had an impact on a parameter, the TV calculated has been the data set excluding different water types. Some notable results are as follows:

Table 1: Final combined groundwater baseline concentrations

Parameter (mg/L)	ANZG DV 95% of Species Limit of Protection	Low Risk Trigger Value 80th percentile	Investigative Trigger Value 90th percentile
pH	6.5 – 8.5	7.1-8.0	7.0-8.0
EC (µS/cm)	-	8,000	15,000
Alkalinity as $CaCO_3$	-	400	440
*Ag	0.00005	(0.002)*	(0.0025)*
Al	0.055	0.050	0.050
As	0.013	0.0022	0.0070
B	0.37	2.4	3.1
Ba	-	0.055	0.13
Be	0.00013§	(0.001)*	(0.0025)*
Bi	0.0007§	(0.0025)*	(0.0025)*
Ca	-	240	300
*Cd	0.0002	(0.0001)*	(0.00025)*
Cl	-	2,000	4,000
Co	0.0028	0.0010	0.0025
Cr	0.001	0.0080	0.0092
*Cu	0.0014	(0.002)*	(0.0025)*
F	-	2.0	3.3
Fe	0.3§	0.013	0.030
HCO_3	-	440	480
Hg	0.0006	0.0005	0.0005
K	-	270	320
Mg	-	350	480
Mn	1.9	0.15	0.92
Mo	0.034§	0.0030	0.0060
N (as NO_3)	-	21	26
Na	-	1,200	2,500
Ni	0.011	0.0014	0.0060
P	-	0.11	0.14
Pb	0.0034	0.0010	0.0025
SO_4	-	2,200	2,600
Sb	0.009§	0.0025	0.0025
Se	0.011	0.0094	0.011
Si	-	80	90
Sn	0.003§	0.0010	0.0025
Sr	-	2.8	3.8
Ti	-	0.0010	0.0025
Tl	0.00003§	(0.0010)*	(0.0025)*
U	0.0005§	0.0050	0.0068
V	0.006§	0.018	0.029
Zn	0.008	0.020	0.033
TDS	-	10,000	12,000

*Metals that require lower detection limits for establishment of trigger value
§ ANZG low reliability trigger value

The establishment of provisional surface water trigger values has been conducted as per Step 4 of Assessing and Managing Water Quality in Temporary Waters (Smith, et al., 2020). Sufficient analyses have been collected to determine the 80th percentile for surface water to a 95% confidence interval for major parameters. However, only one sample has been analysed for minor metals and a baseline for metals cannot yet be established (Table 2).

Table 2: Provisional surface water baseline concentrations

Parameter (mg/L)	ANZ DGVs 95% of Species Limit of Protection (95% SLP)	80th percentile
pH	6.5 – 8.5	6.4-7.8
EC (µS/cm)	-	290
Alkalinity as $CaCO_3$	-	88
Ag	0.00005	-
Al	0.055	1.68
As	0.013	-
B	0.37	-
Ba	-	-
Be	0.00013[5]	-
Bi	0.0007[5]	-
Ca	-	16
Cd	0.0002	-
Cl	-	558
Co	0.0028	-
Cr	0.001	-
Cu	0.0014	-
F	-	-
Fe	0.3[5]	1.6
HCO_3	-	76
Hg	0.0006	-
K	-	24
Mg	-	5
Mn	1.9	0.34
Mo	0.034[5]	-
N (as NO_3)	-	2.3
Na	-	404
Ni	0.011	-
P	-	0.67
Pb	0.0034	-
SO_4	-	94
Sb	0.009[5]	-
Se	0.011	0.0005
Si	-	23
Sn	0.003[5]	-
Sr	-	-
Ti	-	-
Tl	0.00003[5]	-
U	0.0005[5]	-
V	0.006[5]	-
Zn	0.008	0.034
TDS	-	4,180

5. Trigger value exceedance procedure

The purpose of establishing trigger values based on water quality monitoring baseline concentrations is to measure *changes* to the water environment that may be occurring as a result of disturbance by mining activities. A change in conditions does not necessarily result in negative impact and exceedance of an established Trigger does not indicate that contamination is occurring. As the Trigger Values are statistically established, 10-20% of samples ***will*** exceed the Triggers. The goal of establishing Triggers is to make the

process of water monitoring an active management process that can respond to issues arising during operations rather than a passive snapshot of conditions.

Exceedance of a Trigger is a prompt that an action should be taken according to a procedure.

A Risk of Contamination is only indicated if the Source-Pathway-Receptor model predicts that unacceptably high concentrations of a hydrogeochemical parameters will have a significant negative impact on a sensitive Receptor, that cannot be mitigated or prevented by remediation actions.

The Trigger Value Exceedance Procedure in **Figure 6** is detailed as follows. The trigger values and procedure to follow must be established with consideration of the Source-Pathway-Receptor model and definition of nearby sensitive Receptors. If likely Receptors do not comprise of Fresh water or Marine Environments, but are solely comprised of human drinking water, stock watering or other water uses then triggers may be higher, more lenient, or have reference to other publications not discussed here. Trigger Values must be tailored for the protection of the most relevant, specific, most sensitive Receptor.

5.1 Low Risk Trigger Value (LRTV) Exceeded

The Low Risk Trigger Value is usually set at the 80th percentile of baseline monitoring data and is indicated to be an early sign of potential increases. *Numerically, 20% of all data points will exceed this trigger.*

5.2 Monitor next 3 analyses for increases

Following on from an exceedance of a LRTV, attention should be paid to the next three monitoring results of that sampling point to see if the exceedance was statistically normal or is increasing.

5.3 ANZ Toxicant Default Guideline Values (DGVs)

(https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants#metals-and-metalloids)

The ANZ Guidelines for the Fresh and Marine Water Quality online resource contains all information regarding Default Toxicant values and their derivation. As well as how to establish a baseline, site specific triggers, how to conduct investigations into a source and implementation of monitoring programmes and should be heavily consulted.

For the majority of trace metals or metalloids, their low solubility in water, under oxidising conditions and circumneutral pH values, is an indication of toxicity and likely concentrations, even in saline environments i.e. a toxic element like silver is toxic precisely because it has low solubility and biota have not evolved to tolerate it.

Most major ions will increase with increased salinity and will require site specific triggers, while many trace elements will not be detectable or only at low concentrations (under normal water conditions), so that often the 90th percentile concentration of the baseline monitoring database meets or is below the ANZ DGV. In these instances, the ANZ toxicant DGV is the default Investigative Trigger Value. The DGV level of protection applicable to the quality and sensitivity of nearby receptors must be predetermined according to Undisturbed = 99% of Species Limit of Protection (SLP), Moderately Disturbed = 95% SLP, and Disturbed = 80% SLP, and in consultation with regulators and Traditional Owners.

Trigger Value Exceedance Procedure

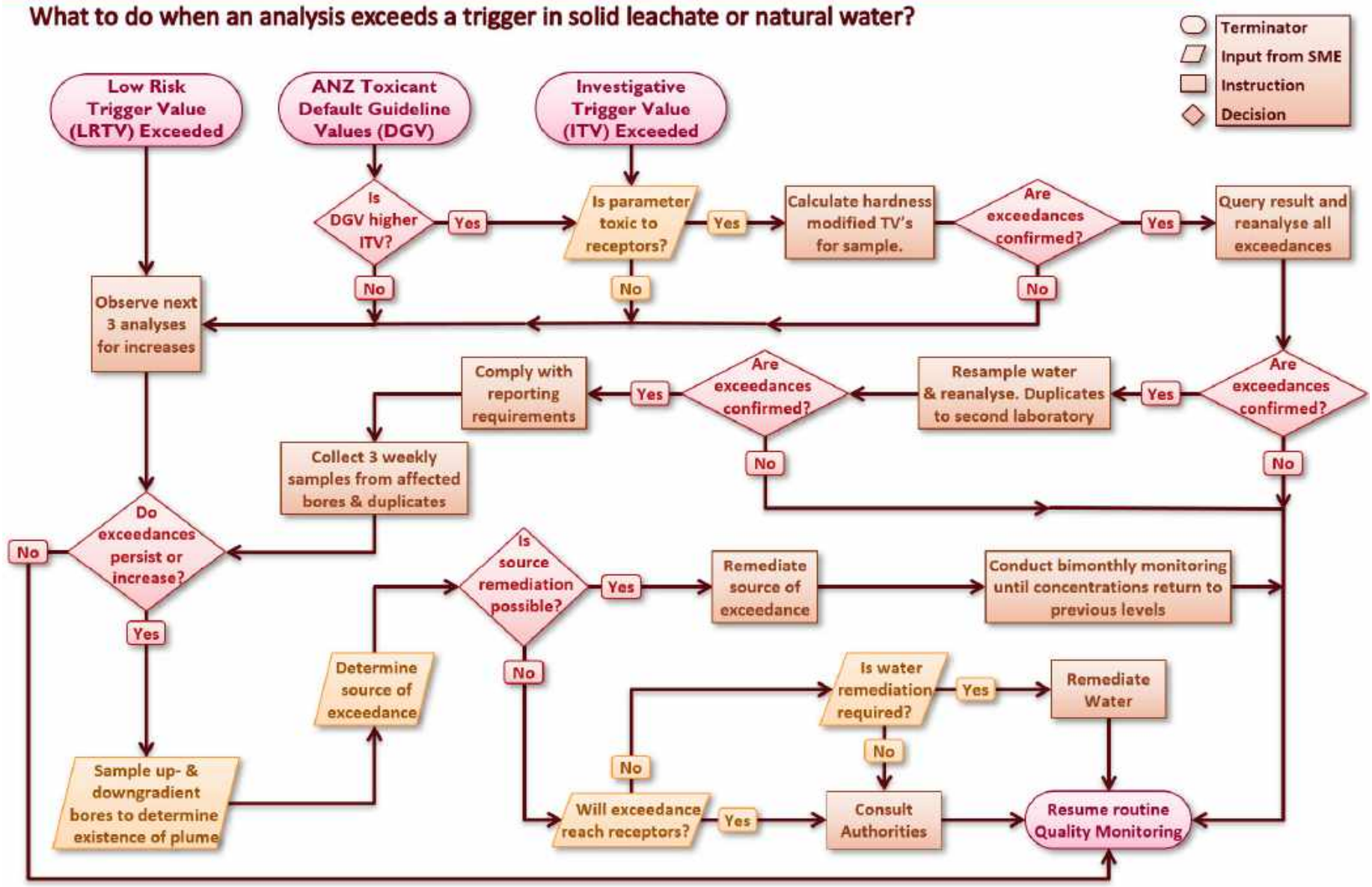

Figure 6:

5.4 Investigative Trigger Value (ITV) Exceeded

The action of exceeding this trigger indicates that a more in depth look at the exceedance must be performed: i.e. an Investigation but *numerically, 10% of all data points **will** exceed this trigger.*

The ITV is usually established at the 90th percentile of a baseline database of significant size and samples over several years and seasons. Baseline data may continue to be collected up until the water environment is disturbed, either until dewatering mining or begins. Therefore, triggers are termed as "Preliminary" while baseline data collection is still underway, and may increase or change with additional data, shifting of the statistical 90th percentile or additional studies or monitoring. If the local environment has unusual geology, some trace elements not usually soluble, may be seen at concentrations higher than the ANZ DTGs and the ITV becomes a Site-Specific Trigger as the local biota can tolerate high concentrations. Evaluation of the baseline monitoring database must also take different aquifers/ catchments, depths, water types, anomalies, outliers and etc. into account and different areas of a site may require different Trigger Values.

5.5 Is DTG higher ITV?

Where a Default Toxicity Guideline does not exist for some ions or metals, or where the ITVs are higher the exceedance may be treated as Low Risk. The ITV should be the default triggers, but ANZ guidelines may be incorporated for reference.

5.6 Is parameter toxic to receptors?

This input is to account for some low toxicity metals or ions that may be occurring at elevated concentrations but are of less concern as a result of their high solubility and low toxicity, e.g. calcium or manganese. An exceedance in such parameters may indicate a change occurring and other elements may become elevated.

5.7 Calculate hardness modified TV's for sample.

For metals such as cadmium, copper, chromium, lead, and zinc, the toxicity is greatly dependant and reduced in hard water (high calcium and magnesium). The ANZ guidelines specify a calculation that may be applied to adjust the DTG value higher to account for this. If exceedance is below the HMTV then it is no longer considered to be of concern.

5.8 Query result and reanalyse all exceedances

Aside from routine numerical exceedances, the most common cause of spikes or elevated concentrations is analytical error or sampling error. Often querying or repeating the analysis resolves the exceedance and a correction is issued. Other "non-field" investigation can be performed at this stage, such as querying the sampling protocols to see if other errors may have occurred e.g. incorrect labelling, accidentally mixing up deep and shallow bore samples, or equipment issues etc.

5.9 Resample water & reanalyse. Duplicates to second laboratory

If the laboratory query indicates an analysis within allowable error tolerance then it is recommended the sample be repeated as soon as possible and a duplicate sample collected and be sent to a second laboratory for further confirmation.

5.10 Comply with reporting requirements

Once there is no doubt as to the veracity of the exceedance, the result may be included in the whatever mandated reporting is required e.g. Annual Environmental Reporting or exceedance reporting.

5.11 Collect 3 weekly samples from affected bores & duplicates

To determine whether the exceedance was random or natural additional samples should be collected. At least 3, non-routine samples, but more may be collected or for a longer time-span for certainty.

5.12 Do exceedances persist or increase?

If the original exceedance and the next 3 analyses indicate the persistence of higher concentrations or an increasing trend then this is of statistical significance and a change to the water regime may have occurred and requires investigation.

5.13 Sample up & downgradient bores to determine existence of plume

The spread or movement of elevated concentrations should be confirmed to determine the existence of a plume.

5.14 Determine source of exceedance

Depending on the chemical parameter or the proximity of the sampling point to potential sources, the source may be obvious e.g. petroleum hydrocarbon from above ground storage tanks, or adjacent to a tailings storage facility. However, occasionally the source of the exceedance may be a bore that has too much sediment (i.e. incompletely airlifted when installed, or requires repair), or a bore that has been installed into acid-generating rock and is required to be redrilled. The source of the increasing concentrations should be thoroughly investigated for possible reasons.

5.15 Is source remediation possible?

If the source is a spillage at storage facility, then it is usually fairly simple to remove the majority of the issue. If the source is a large waste rock dump then removal or remediation may be less possible depending on the stage of construction. If the source is a result of incorrect mineral, or putrescible/ organic waste management practices, then a review of operations is required and possibly a change in management of waste may be required. The careful monitoring of exceedances can prevent further incorrect practices.

5.16 Remove/ or remediate source of exceedance

Excavation of a spillage, or placement of potentially-acid forming material may be possible if volumes are relatively low. If not possible other remediation options such as compaction or cover may be sufficient to prevent ingress of air and water and the generation of leachate. There are several possible solutions depending on the source, for example the exposure of PAF material on a pit wall may require a cutback and then correct placement in the waste landform.

5.17 Conduct bimonthly monitoring until concentrations return to previous levels

Following remediation activities routine monitoring must occur on an increased schedule until elevated concentrations have resolved.

5.18 Will exceedance reach receptors?

Geochemical and groundwater modelling should be conducted to determine the likely path of any elevated concentrations and the speed at which it will move through the pathway. Dilution, adsorption and reaction in the aquifer or along the streambed may result in natural attenuation without further action being necessary.

5.19 Is water remediation required?

If modelling indicates that unacceptably high concentrations will negatively impact a downgradient receptor then active ongoing remediation may be required. This may mean extraction and treatment of water, or divergence and dilution, or provision of uncontaminated water.

5.20 Consult Authorities

Once the Source-Pathway-Receptor model linkages have been established and the risk of contamination determined, the mitigation and remediation actions should be presented to the regulators for consultation and approval.

5.21 Remediate water

Once approved the appropriate water remediation actions should be implemented until Closure outcomes are met or exceedances resolved.

5.22 Resume Normal Quality Monitoring

When inputs, instructions and decisions are resolved, monitoring may return to routine levels

6. References

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Appendix A: Summary statistics for groundwater populations

Parameter	ANZ DGV for 95% of SLP	All bores		High salinity & low pH excluded		All Outliers Excluded		Saline Bores		Shallow depth		Medium Depth		Deep Bores		Same Water Type		Different Water Type	
		80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile	80th percentile	90th percentile
pH	6.5-9.0	6.9	8.0	7.0	8.0	7.0	8.0	6.9	7.7	7.1	8.0	6.9	7.9	7.0	7.9	7.1	8.0	6.7	8.0
EC	-	13,085	16,000	12,000	15,000	12,000	15,000	**22,000**	**23,000**	**8,000**	**14,500**	9,720	12,000	16,000	20,100	15,000	17,000	1,900	2,500
Tot Alk	-	390	410	390	410	390	410	390	410	**400**	**440**	390	400	400	410	400	420	330	370
Ag	0.00005	**0.0025**	0.0025	0.0025	0.0025	0.0025	0.0025	**0.0052**	**0.0066**	0.0020	0.0025	0.0025	0.0025	0.0025	**0.0053**	0.0025	0.0025	0.0005	0.0005
Al	**0.055**	0.050	0.050	0.050	0.050	0.050	0.050	0.018	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
As	**0.013**	0.0025	0.0064	0.0025	0.0060	0.0025	0.0025	0.0025	0.0025	0.0022	**0.0070**	0.0025	0.0025	0.0025	0.0033	0.0025	0.0025	**0.0040**	**0.010**
B	0.37	2.7	3.4	2.4	3.1	2.4	3.17	**4.6**	**4.8**	**2.4**	**3.1**	1.7	2.4	**3.5**	4.2	3.1	3.6	0.51	0.64
Ba	-	0.045	0.061	0.046	0.066	0.045	0.056	0.027	0.035	**0.055**	**0.13**	0.040	0.056	0.039	0.051	0.038	0.048	**0.080**	**0.16**
Be	**0.00013**	**0.0025**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0010	0.0025	0.0010	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
Bi	**0.00070**	**0.0025**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Ca	-	200	280	200	240	200	240	**350**	**390**	140	250	170	200	270	300	**240**	**300**	130	160
Cd	**0.00020**	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	**0.00025**	**0.00076**	0.00010	0.00025	0.00010	0.00025	0.00025	0.00025	0.00025	0.00025	0.00010	0.00020
Cl	-	3,800	4,400	3,400	4,100	3,400	4,100	**6,200**	**6,500**	**2,000**	**4,000**	2,620	3,520	4,700	5,700	4,100	4,700	340	500
Co	**0.0028**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	**0.0030**	**0.0080**	0.0010	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.00090	0.0020
Cr	0.0010	0.0050	0.0080	0.0056	0.0080	0.0050	0.0070	0.0030	0.0050	**0.0080**	**0.0092**	0.0050	0.0080	0.0046	0.0060	0.0060	0.0088	0.0040	0.0040
Cu	**0.0014**	**0.0025**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0010	0.0025	0.001	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0020
F	-	2.2	2.7	2.1	2.4	2.0	2.4	**3.0**	**3.3**	**2.0**	**3.3**	1.6	2.3	2.6	2.9	2.4	2.9	1	1.2
Fe	**0.30**	0.013	0.040	0.013	0.03	0.013	0.020	0.016	0.21	0.0050	0.013	0.010	0.030	0.028	0.14	0.013	0.030	0.026	0.099
HCO_3	-	410	470	410	470	410	470	**440**	**480**	**430**	480	390	470	**440**	**480**	**440**	**480**	300	390
Hg	**0.0006**	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
K	-	230	290	200	270	200	270	**460**	**540**	130	250	170	220	300	400	**270**	**320**	36	52
Mg	-	300	410	260	350	260	350	**590**	**620**	180	330	220	280	400	510	**350**	**480**	70	90
Mn	**1.9**	0.22	0.94	0.12	0.48	0.020	0.050	**2.2**	**2.5**	0.0050	0.0050	0.021	0.14	0.92	1.6	0.15	0.92	0.21	0.63
Mo	**0.034**	0.0025	0.0050	0.0025	0.0040	0.0025	0.0030	**0.0078**	**0.020**	0.0030	0.0052	0.0025	0.0025	0.0025	0.0053	0.0025	0.0058	0.0010	0.0020
NO_3-N	-	16	23	17.6	24	17.6	24	1.66	4.91	**21**	**26**	18	23.7	6.1	12	17	23	14	**26**
Na	-	2,400	2,800	2,100	2,600	2,100	2,600	**4,200**	**4,480**	1,220	2,500	1,600	2,220	2,900	3,700	**2,600**	**2,900**	180	275
Ni	**0.011**	0.0025	0.0060	0.0025	0.0050	0.0025	0.0025	0.0030	0.0092	0.0014	0.0025	0.0025	0.0030	0.0030	0.0060	0.0025	0.0025	**0.0060**	**0.013**
PO_4	-	0.080	0.11	0.080	0.11	0.070	0.099	0.090	0.11	**0.11**	**0.14**	0.080	0.10	0.060	0.090	0.090	0.12	0.060	0.070
Pb	**0.0034**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0010	0.0025	0.001	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
SO_4	-	1,800	2,400	1,600	2,200	1,600	2,200	**3,500**	**3,600**	1,000	1,700	1,300	1,800	2,400	3,200	**2,200**	**2,600**	340	450
Sb	**0.0090**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Se	0.011	0.0060	0.0094	0.0060	0.0097	0.0060	0.0097	0.0070	0.0090	**0.0094**	**0.011**	0.0060	0.0094	0.0070	0.0087	0.0070	0.010	0.0020	0.0030
Si-React	-	70	80	70	80	70	80	50	60	**80**	**90**	70	80	50	60	70	80	60	70
Sn	**0.0030**	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0040	0.0010	0.0025	0.0010	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
Sr	-	2.4	3.38	2.1	2.67	2.1	2.7	**4.4**	**4.5**	1.7	2.5	1.7	2.2	3.3	4.1	**2.8**	**3.8**	0.43	0.46
Ti	-	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	**0.0030**	**0.0050**	**0.0010**	**0.0025**	0.0010	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
Tl	0.00003	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	**0.0010**	**0.0025**	0.001	0.0025	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
U	0.0005	0.0038	0.0054	0.0030	0.0050	0.0030	0.0050	**0.0082**	**0.011**	0.0042	0.0069	0.0030	0.0042	0.0050	0.0060	**0.0050**	**0.0068**	0.0020	0.0020
V	0.0060	0.0060	0.011	0.0060	0.011	0.0050	0.0070	0.0060	0.011	**0.018**	**0.029**	0.0058	0.0070	0.0030	0.0070	0.0060	0.013	0.0050	0.0079
Zn	0.0080	0.026	0.063	0.026	0.056	0.020	0.033	0.025	0.026	0.014	0.022	0.020	0.029	0.024	0.032	**0.019**	**0.033**	**0.067**	**0.10**
TDS	-	9,000	11,000	8,100	10,000	8,100	10,000	**16,000**	**16,000**	4,900	8,900	5,400	8,000	11,000	14,000	10,000	12,000	1,200	1,500

Yellow highlight bold text = assigned trigger Bold red text = highest 80th & 90th percentile of a population in dataset

Appendix 2 – Groundwater and Surface Water Risk Assessment

Table A2-1: Likelihood Criteria

Rating	Likelihood Factor	Descriptor	Description	Frequency	Probability
5	30	Almost Certain	The event is expected to occur in most circumstances	May occur multiple times within 12 months	>91% chance of occurrence
4	20	Likely	The event will probably occur in many circumstances	May occur once per year	61-90% chance of occurrence
3	12	Possible	The event is expected to occur at some time	May occur once in 5 years	41-60% chance of occurrence
2	7.5	Unlikely	The event could credibly occur at some future time	May occur once in 10 years	10-40% chance of occurrence
1	5	Rare	The event may occur only in special circumstances	May occur once during life of mine	<10% chance of occurrence

Table A2-2: Consequence Criteria

Environmental Factor	Slight	Minor	Moderate	Major	Severe
Biodiversity	Direct impact to fauna (does not include conservation significant, priority or threatened fauna species).	Localised impact (<24 hours recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Medium term impact (<3 months recovery time) to land or water providing habitat for flora and fauna that can be remediated within 3 months	Long term impact (>5 years recovery time) to land or water that provides habitat for flora and fauna OR Medium term impact (<3 months recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Direct impact to individual flora/fauna of threatened species	Permanent or irreversible widespread impact to land or water that provides habitat for flora and fauna OR Long term impact (>5 years recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Irreversible impact to scheduled, listed or declared rare and/or threatened species of flora or fauna (>5 individuals)	Permanent or irreversible widespread impact to land or water providing habitat for threatened flora or fauna species or a mangrove community
Water Resources	Local impact to water that can be remediated within 24 hours.	Localised impact (<24 hours recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Medium term impact (<3 months recovery time) to land or water providing habitat for flora and fauna that can be remediated within 3 months	Long term impact (>5 years recovery time) to land or water that provides habitat for flora and fauna OR Medium term impact (<3 months recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Direct impact to individual flora/fauna of threatened species	Permanent or irreversible widespread impact to land or water that provides habitat for flora and fauna OR Long term impact (>5 years recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Irreversible impact to scheduled, listed or declared rare and/or threatened species of flora or fauna (>5 individuals)	Permanent or irreversible widespread impact to land or water providing habitat for threatened flora or fauna species or a mangrove community
Land and Soils	Local impact to land or water that can be remediated within 24 hours.	Localised impact (<24 hours recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Medium term impact (<3 months recovery time) to land or water providing habitat for flora and fauna that can be remediated within 3 months	Long term impact (>5 years recovery time) to land or water that provides habitat for flora and fauna OR Medium term impact (<3 months recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Direct impact to individual flora/fauna of threatened species	Permanent or irreversible widespread impact to land or water that provides habitat for flora and fauna OR Long term impact (>5 years recovery time) to land or water providing habitat for threatened flora or fauna species or a mangrove community OR Irreversible impact to scheduled, listed or declared rare and/or threatened species of flora or fauna (>5 individuals)	Permanent or irreversible widespread impact to land or water providing habitat for threatened flora or fauna species or a mangrove community
Rehabilitation and Mine Closure	Site is safe, stable and non-polluting and post land use is not adversely affected	The site is safe, all major landforms are stable, and any stability or pollution issues are contained and require no residual management. Post-mining land use is not adversely affected.	The site is safe, and any stability or pollution issues require minor, ongoing maintenance by end land-user	The site cannot be considered safe, stable or non-polluting without long-term management or intervention. Agreed end land-use cannot proceed without ongoing management.	The site is unsafe, unstable and/ or causing pollution or contamination that will cause an ongoing residual affect. The post-mining land use cannot be achieved.

Table A2-3: Risk Matrix

Risk Matrix (5 x 5)							
RHH Risk Evaluation Matrix			Likelihood Rating				
			Rare	Unlikely	Possible	Likely	Almost Certain
			1	2	3	4	5
			Residual Risk Rating (RRR)				
Consequence/Impact		Factors	5	7.5	15	20	30
Severity Level	Severe	10	High (50.00)	High (75.00)	Extreme (150.00)	Extreme (200.00)	Extreme (300.00)
	Major	5	Medium (25.00)	Medium (37.50)	High (60.00)	Extreme (100.00)	Extreme (150.00)
	Moderate	2	Low (10.00)	Medium (15.00)	Medium (30.00)	Medium (40.00)	High (60.00)
	Minor	1	Low (5.00)	Low (7.50)	Medium (15.00)	Medium (20.00)	Medium (30.00)
	Slight	0.5	Low (2.50)	Low (3.75)	Low (7.50)	Low (10.00)	Medium (15.00)

Table A2-4: Risk Assessment - Groundwater

Risk Pathway/Unwanted Event	Description of Impact	Phase(s) Unwanted Event likely to occur	Inherent Risk				Risk Treatments	Phase(s) Treatments to be Implemented	Residual Risk		
			Consequence	Likelihood	Risk Rating	Data Certainty			Consequence	Likelihood	Risk Rating
Water Resources											
Drawdown related to pit dewatering	Groundwater levels will be drawn down. This may impact stygofauna habitat and other groundwater users in the area (i.e., station bores for livestock and water supplies for nearby Aboriginal communities). No groundwater-dependent vegetation has been identified in the area.	Operations / Closure	Moderate	Likely	M-40	High	• Excess water is to be injected into the groundwater system thereby limiting the extent of drawdown from the immediate mining area (accepting recirculation of groundwater). • Comprehensive baseline and operational monitoring of groundwater levels in and around areas of dewatering and nearby groundwater users that may be impacted. • Provision of water supply to "unduly affected" groundwater users. • Backfilling of the pits at closure will allow groundwater levels to return to near pre-development conditions. • Confirmation of the presence of stygofauna within the impact areas. Confirmation of the presence of stygofauna outside of the impact area downstream of the impact area. • Modelling and subsequent assessment of impacts to stygofauna habitat – limits placed on habitat removal.	Operations / Closure	Moderate	Likely	M-40
Change in groundwater flow direction related to pit dewatering	As a result of dewatering, more saline groundwater from the valley area will be drawn towards the pit areas and the saline interface may rise in the broader cone of depression. This may impact stygofauna habitat and other groundwater users in the area (station bores for livestock).	Operations	Moderate	Unlikely	M-15	High	• Groundwater modelling predictions suggest that changes to groundwater salinity resulting from dewatering are modest with respect to beneficial use and stygofauna habitat. • Distribution of stygofauna across the landscape (based on statistical analyses of functional groups and salinity) indicate that stygofauna have tolerances greater than the predicted changes to groundwater salinity. • Habitat for stygofauna is contiguous and continuous and changes to groundwater salinity • Habitat for stygofauna is contiguous and continuous and changes to groundwater salinity resulting from dewatering are modest with respect to stygofauna. • Confirmation of the presence of stygofauna within the impact areas. • Confirmation of the presence of stygofauna outside of the impact area downstream of the impact area. • MAR should reduce the potential hydrostatic changes in the broader cone of depression.	Operations	Moderate	Unlikely	M-15
Groundwater mounding resulting from MAR	Groundwater will mound in areas of aquifer MAR. Mounding will reduce potential troglofauna habitats. If groundwater mounds into the root zone for extended periods of time, this will have a detrimental impact on the vegetation. Mounding may also result in the surface expression of groundwater which, in the claypan areas, or at the break of slopes down-gradient from MAR areas. This could result in salinisation of the freshwater surface features. Potential impact on aesthetic and cultural heritage values.	Operations	Moderate	Possible	M-30	Medium	• Water from in-pit sump pumping will not be re-injected without appropriate treatment for removing sediment. • Comprehensive baseline and operational monitoring of groundwater levels in MAR areas. • Reduction of MAR if required. • Multiple MAR areas to allow flexibility of MAR and periods of recovery (i.e. reduced MAR in one area and increased in another). • Review dewatering and mine schedule, if required.	Operations	Minor	Unlikely	L-7.5

Risk Pathway/Unwanted Event	Description of Impact	Phase(s) Unwanted Event likely to occur	Inherent Risk				Risk Treatments	Phase(s) Treatments to be implemented	Residual Risk		
			Consequence	Likelihood	Risk Rating	Data Certainty			Consequence	Likelihood	Risk Rating
Change to groundwater quality resulting from MAR	Due to the variable groundwater salinity across the project area, MAR will change the groundwater quality in the MAR areas. This may impact stygofauna habitats and other groundwater users (station bores for livestock and water supplies for nearby Aboriginal communities).	Operations	Moderate	Possible	M-30	Medium	• Groundwater modelling predictions suggest that changes to groundwater salinity resulting from MAR are modest with respect to beneficial use and stygofauna habitat and of limited extent (<2 km). • Distribution of stygofauna functional groups based on statistical modelling indicate stygofauna tolerances are higher than predicted changes and changes will be modest with respect to stygofauna tolerances within Salinity Impact Area. • Comprehensive baseline and operational monitoring of groundwater quality in and around MAR areas and nearby groundwater users that may be impacted. Confirmation of the presence of stygofauna within the impact areas. Confirmation of the presence of stygofauna outside of the impact area downstream of the impact area. • Provision of water supply to "unduly affected" groundwater users.	Operations	Moderate	Unlikely	M-15
Change in groundwater flow direction related to MAR	Groundwater mounding in MAR areas will result in local changes to groundwater flow directions. This may result in water quality changes beyond the immediate MAR areas which may impact stygofauna habitats and other groundwater users (station bores for livestock and water supplies for nearby Aboriginal communities).	Operations	Moderate	Possible	M-30	Medium	• The location of MAR sites near to the mining area, limits the spatial extent of changes to the groundwater system. • Groundwater modelling predictions suggest that changes to groundwater salinity resulting from MAR are modest with respect to beneficial use and stygofauna habitat. • Comprehensive baseline and operational monitoring of groundwater quality in and around MAR areas and nearby groundwater users that may be impacted. Confirmation of the presence of stygofauna outside of the impact area downstream of the impact area. • Provision of water supply to "unduly affected" groundwater users.	Operations	Moderate	Unlikely	M-15
Contamination of groundwater from waste rock dumps / spills etc	Potential for pollutants such as hydrocarbons or metals to reach the groundwater system. Potential toxicity to biodiversity and deterioration of shallow aquifer salinity.	Operations	Moderate	Unlikely	M-15	Moderate	• Efficient water management during operations, dewatering abstraction is predominantly ex-pit, prior to inflow to the pit therefore reduced risk of contaminating water for MAR. Water from in-pit sump pumping will not be re-injected without appropriate treatment. • Comprehensive baseline and operational monitoring of groundwater quality. • Sampling to confirm presence of stygofauna following exceedance of trigger values set for hydrocarbons and metals.	Operations	Moderate	Rare	L-10

Table A2-5: Risk Assessment – Surface Water

Risk Pathway/Unwanted Event	Description of Impact	Phase(s) Unwanted Even likely to occur	Inherent Risk				Risk Treatments	Phase(s) Treatments to be implemented	Residual Risk		
			Consequence	Likelihood	Risk Rating	Data Certainty			Consequence	Likelihood	Risk Rating
Water Resources											
Reduction of water to downstream environment	Runoff collected within, and ponding upstream of, the pit, waste dumps, stockpiles and borrow pits will reduce the runoff to the downstream environment, resulting in areas of water shadowing. This may impact the vegetation in the downstream environment.	Construction / Operations / Closure	Major	Likely	E-100	High	• Diversions around mine disturbance and development areas. • With proposed mitigation measures, there is an estimated reduction of 10% in the catchment area of the Gnalka Gnoona Claypan, if no water from the pits/waste dumps reports downstream. The Koodjeepindarranna Claypan catchment area is reduced by <0.5% and the combined claypan catchment area is reduced by 2%. • Flood modelling comparisons of predicted baseline and LOM water distributions from small recurrence events (such as the 50% AEP) indicate that the reduction in water levels within the Fortescue Valley within these rain shadow areas is limited to approximately 0.1m. • Water balance modelling of the claypan water levels indicate that the reductions in catchment areas result in only a negligible impact on the hydroperiod (how long they hold water) and water levels of the claypans. • Runoff collected from pits, waste dumps and stockpiles will be contained and released to the environment following sediment treatment.	Construction / Operations / Closure	Slight	Possible	L-7.5
Reduction of water to downstream environment	Water shadowing on the downstream side of road and rail embankments (and pipeline installations) caused by ponding and potential redirection and concentration of surface water flows through culverts along their alignments.	Construction / Operations	Moderate	Likely	H-60	High	• Culverts positioned to allow flow of surface water across linear infrastructure areas. • Flood modelling comparisons of the predicted baseline and LOM water distributions from the small recurrence events (such as the 50% AEP) indicate reductions in flood depths on the downstream side of linear infrastructure are less than 0.1m. • Burial of pipeline at drainage lines/ creek crossings to prevent disruption to flows • Raise pipelines at regular intervals to allow local surface water runoff to flow downstream	Construction / Operations	Slight	Rare	L-2.5
Reduction of water to downstream environment	Diversion of drainage lines around development areas and into a different downstream drainage line	Construction / Operations / Closure	Minor	Possible	M-15	High	• All diversions to be returned back to the same downstream catchment/drainage path where possible. • Flood modelling comparisons of baseline and LOM water distribution from small recurrence events (such as the 50% AEP) indicate that the reduction in water levels within the Fortescue Valley within these rain shadow areas is limited to approximately 0.1m.	Construction / Operations / Closure	Slight	Rare	L-2.5
Increased inundation of water on upstream side of development areas	Blockage of drainage lines may result in prolonged inundation in areas where it may not have occurred previously. This may lead to vegetation health impacts due to water logging and changes to the vegetation composition of communities. Likely to be limited in extent to local area upstream of disturbance footprints.	Construction/Operations/ Closure	Moderate	Likely	H-60	High	• Diversion of drainage lines around disturbance areas. • Design of culverts as detailed in the Environmental Compliance Standard (HNR-0000-EN-STD-0001)	Construction / Operations / Closure	Slight	Rare	L-2.5
Water quality impacts (sediment)	OSA face failure due to erosion along waste dump toe leading to sediment reporting to Fortescue Valley and claypans	Construction / Operations / Closure	Major	Unlikely	M-20	Medium	• Diversions around mine disturbance areas to protect the toe of the waste rock dumps. • Diversions required for closure to have flood damage resilience for up to 1:10,000 yr event.	Construction / Operations / Closure	Slight	Rare	L-2.5
Water quality impacts (sediment)	Ongoing sediment release to downstream environment from frequent rainfall events leading to increased sediment load to Fortescue Valley and claypans	Construction / Operations	Moderate	Likely	H-60	High	• Containment of sediment laden runoff from pits and waste rock dumps and stockpile areas and passing this runoff through sediment basins prior to release downstream.	Construction / Operations	Minor	Rare	L-3.75
Water quality impacts (sediment)	Ongoing sediment release to downstream environment from frequent rainfall events leading to increased sediment load to Fortescue Valley and claypans	Closure	Moderate	Likely	H-60	High	• Closure landform designs, revegetation of landform slopes and armouring as required.	Closure	Minor	Rare	L-3.75

Risk Pathway/Unwanted Event	Description of Impact	Phase(s) Unwanted Even likely to occur	Inherent Risk				Risk Treatments	Phase(s) Treatments to be implemented	Residual Risk		
			Consequence	Likelihood	Risk Rating	Data Certainty			Consequence	Likelihood	Risk Rating
Water quality impacts (chemical)	Dust suppression application impacting on local fauna/vegetation	Construction / Operations	Minor	Possible	M-15	Low	• Dust suppression operations to be managed to prevent over-watering of roads. • Road spoon drains to prevent dust suppression runoff to surrounding areas. • Vegetation health monitoring adjacent to roads	Construction / Operations	Moderate	Rare	L-10
Water quality impacts (chemical)	Runoff from within mine development areas containing pollutants such as hydrocarbons or metals etc. entering local waterways and downstream Fortescue Valley and claypans	Construction / Operations	Moderate	Likely	M-40	Medium	• Local runoff management practices deployed within plant and mining areas as outlined in the HPPL Environmental Management System, including: o Containment of runoff and wastewater at washdowns, workshops etc. and passed through an oil/water separator with re-use of runoff water within the process prioritised. o Deployment of spill kits to clean up local oil spills immediately when they occur. o Ongoing monitoring of groundwater and surface water for potential contaminants which could occur from the mining process.	Construction / Operations	Moderate	Rare	L-10
Water quality impacts (chemical)	Dewatering / MAR pipeline burst resulting in spill of water with elevated salinity.	Operations	Major	Possible	H-60	High	• Appropriate (conservative) design of transfer piping and pumping systems, including: o pressure rating of pipeline o high pressure and low flow protection settings on the transfer system o leak detection systems to shut off pumping in the event of pipeline burst and operator warnings in the event of pipeline leaks o burial of pipeline sections at drainage lines/ creek crossings to prevent widespread surface discharge of leaks o routine inspection and maintenance	Operations	Minor	Unlikely	L-7.5

Appendix 3 – Bore Specific Interim Trigger Levels and Threshold Criteria and Bore Locations

Table A3-1: Drawdown Monitoring Bores Triggers and Thresholds

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status	Tenement Status	Groundwater Level (mbgl)*	Modelled Drawdown (m)	Groundwater Level Trigger**	Groundwater Level Threshold
MDE_MON_1	645718	7556531	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed	Tenement Required	9.5	<1	1 m ddn	tbc
MDE_MON_7	671873	7543379	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed	Tenement Granted	3.5	~1	1 m ddn	tbc
MDE_MON_9	675125	7547815	Dewatering	Water Level - Drawdown Extent	Other GW Users	Proposed	On Tenement	20	<1	1 m ddn	tbc
MDE_MON_13	658610	7537800	Dewatering	Water Level - Drawdown Extent	Other GW Users - Youngaleena	Proposed	On Tenement	4.5	~1	1 m ddn	tbc
MDPZ7462A, B, C	644800	7548089	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing	On Tenement	4.67	<1	1 m ddn	tbc
MDPZ7461	656010	7542996	Dewatering	Water Level - Drawdown Extent	Other GW Users - Youngaleena	Existing	On Tenement	4.41	~2.5	2.5 m ddn	tbc
MDPZ7463	642867	7553588	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing	On Tenement	5.36	<1	1 m ddn	tbc
MDPZ7472	670921	7555275	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing	On Tenement	15.18	<1	1 m ddn	tbc
MDWB0011	660244	7557808	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing	On Tenement	22.6	<1	1 m ddn	tbc
MDWB0013	665270	7556265	Dewatering	Water Level - Drawdown Extent	Other GW Users	Existing	On Tenement	17.08	<1	1 m ddn	tbc

ddn = drawdown

tbc = to be confirmed based on trigger level assessment

* Groundwater levels for proposed bores are estimates

** Groundwater level depth (as opposed to drawdown) will be identified prior to operation, based on complete set of baseline data

Table A3-2: Mounding Monitoring Bores Triggers and Thresholds

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status	Tenement Status	Groundwater Level (mbgl)*	Groundwater Level Trigger	Groundwater Level Threshold
MDE_MON_4	665185	7546959	MAR	Water Level - Mounding	Mounding at break of slope	Proposed	Tenement Pending	4.5	3 mbgl	2.5 mbgl
MDE_MON_5	667964	7545368	MAR	Water Level - Mounding	Mounding at break of slope	Proposed	Tenement Granted	4	3 mbgl	2.5 mbgl
MDE_MON_6	669255	7543432	MAR	Water Level - Mounding	Mounding on valley floor	Proposed	Tenement Required	3.5	min baseline DTW	min baseline DTW less 0.5m
MDE_MON_7	671873	7543379	MAR	Water Level - Mounding	Mounding at break of slope	Proposed	Tenement Pending	3.5	min baseline DTW	min baseline DTW less 0.5m
MDE_MON_8	666653	7542993	MAR	Water Level - Mounding	Mounding on valley floor	Proposed	Tenement Pending	3.5	min baseline DTW	min baseline DTW less 0.5m
MDPZ0704	659649	7549220	MAR	Water Level - Mounding	Mounding at break of slope	Existing	On Tenement	4.43	3 mbgl	2.5 mbgl
MDPZ7449A,B,C	655657	7551787	MAR	Water Level - Mounding	Mounding at break of slope	Existing	On Tenement	4.71	3 mbgl	2.5 mbgl
MDPZ7450A, B, C	652219	7552541	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing	On Tenement	5.78	3 mbgl	2.5 mbgl
MDPZ7451A, B, C	651347	7550579	MAR	Water Level - Mounding	Mounding near Claypans	Existing	On Tenement	4.34	3 mbgl	2.5 mbgl
MDPZ7456A, B,C	665851	7547907	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing	On Tenement	7.91	3 mbgl	2.5 mbgl
MDPZ7460A, B, C	663202	7547987	MAR	Water Level - Mounding	Mounding at break of slope	Existing	On Tenement	4.68	3 mbgl	2.5 mbgl
MDPZ7464	649944	7552428	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing	On Tenement	6.47	3 mbgl	2.5 mbgl
MDPZ7465, MDPZ0757	670005	7547881	MAR	Water Level - Mounding	Tracking mounding for break of slope	Existing	On Tenement	15.48	3 mbgl	2.5 mbgl
MDPZ7468A, B, C	647191	7551524	MAR	Water Level - Mounding	Koodjeepindarranna Claypan	Existing	On Tenement	4.49	3 mbgl	2.5 mbgl
MDPZ7469A, B, C	657312	7550011	MAR	Water Level - Mounding	Mounding at break of slope	Existing	On Tenement	2.96	min baseline DTW	min baseline DTW less 0.5m
MDPZ7470A, B, C	661399	7546377	MAR	Water Level - Mounding	Mounding on valley floor	Existing	On Tenement	3.61	min baseline DTW	min baseline DTW less 0.5m
MDPZ7471A, B, C	646686	7549394	MAR	Water Level - Mounding	Koodjeepindarranna Claypan	Existing	On Tenement	3.86	3 mbgl	2.5 mbgl

Table A3-3: Salinity Monitoring Bores Triggers and Thresholds

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status	Tenement Status	Baseline EC (uS/cm)*	Salinity Trigger (TDS as mg/L)
MDE_MON_1	645718	7556531	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users and stygofauna	Proposed	Tenement Required	1,000	4,500
MDE_MON_2	654703	7551910	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	On Tenement	3,500	4,500
MDE_MON_4	665185	7546959	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Pending	4,500	4,500
MDE_MON_5	667964	7545368	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Granted	4,500	4,500
MDE_MON_7	671873	7543379	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Pending	4,300	4,500
MDE_MON_9	675125	7547815	MAR	Water Quality - Salinity	Other GW Users - Wirrilimarra	Proposed	On Tenement	1,000	4,500
MDE_MON_10	676395	7546188	MAR	Water Quality - Salinity	Other GW Users - Wirrilimarra	Proposed	Tenement Required	1,500	4,500
MDE_MON_11	669636	7547030	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Required	3,500	4,500
MDE_MON_12	671595	7545400	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Required	3,500	4,500
MDE_MON_6	669255	7543432	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Proposed	Tenement Required	5,000	4,500
MDPZ7449B	655657	7551787	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	2,000	4,500
MDPZ7456C	665851	7547907	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	4,400	4,500
MDPZ7464	649944	7552428	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	2,200	4,500
MDPZ7465, MDPZ0757	670005	7547881	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	1,700	4,500
MDPZ7469C	657312	7550011	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	3,200	4,500

Bore / Site	Easting	Northing	Stressor	Monitoring Parameter	Receptor	Status	Tenement Status	Baseline EC (uS/cm)*	Salinity Trigger (TDS as mg/L)
MDWB0034	652853	7555585	MAR	Water Quality - Salinity	Shallow Fresher GW - Other GW Users	Existing	On Tenement	1,500	4,500

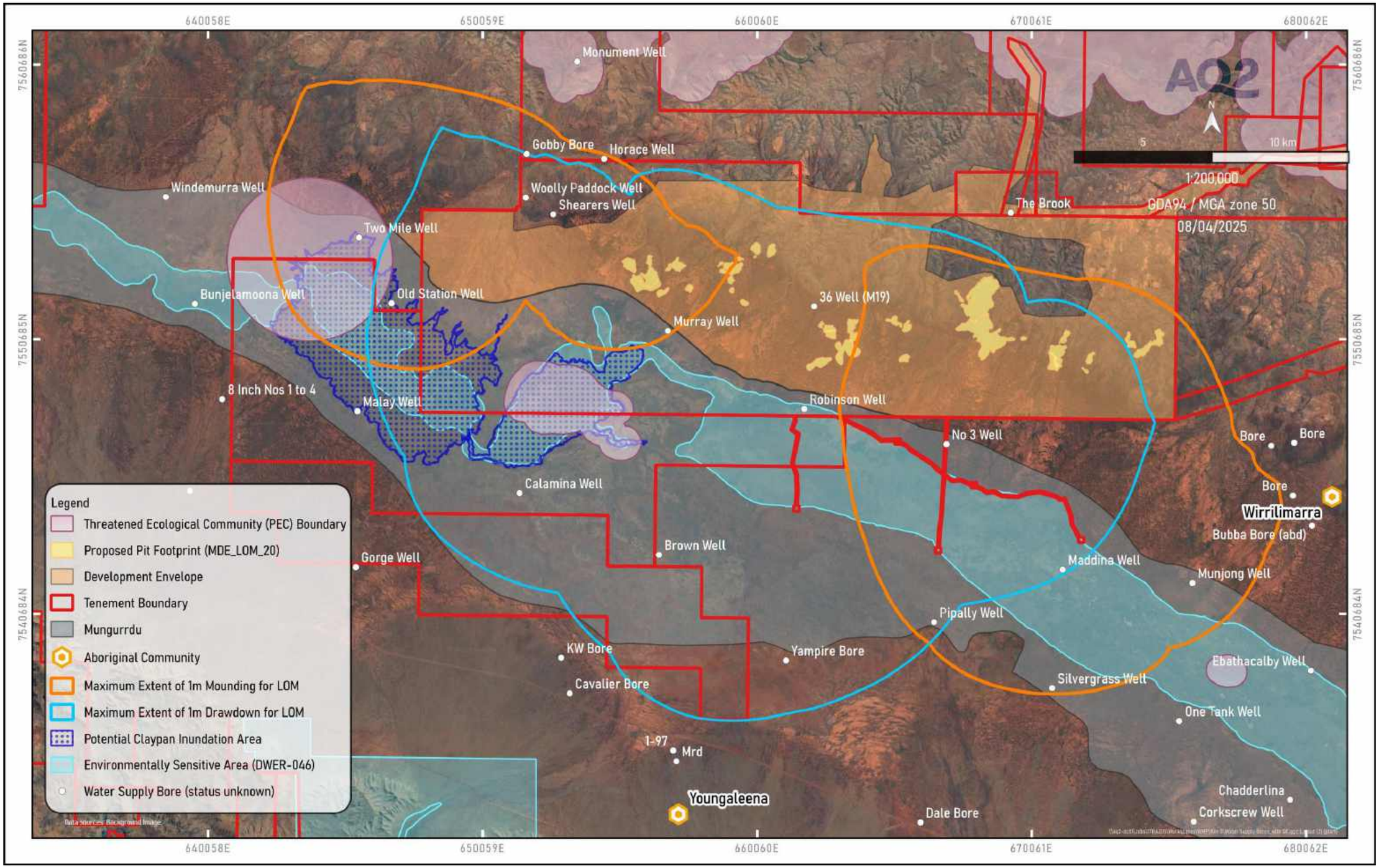

Figure A3-1: Ground user Water Supply Bores

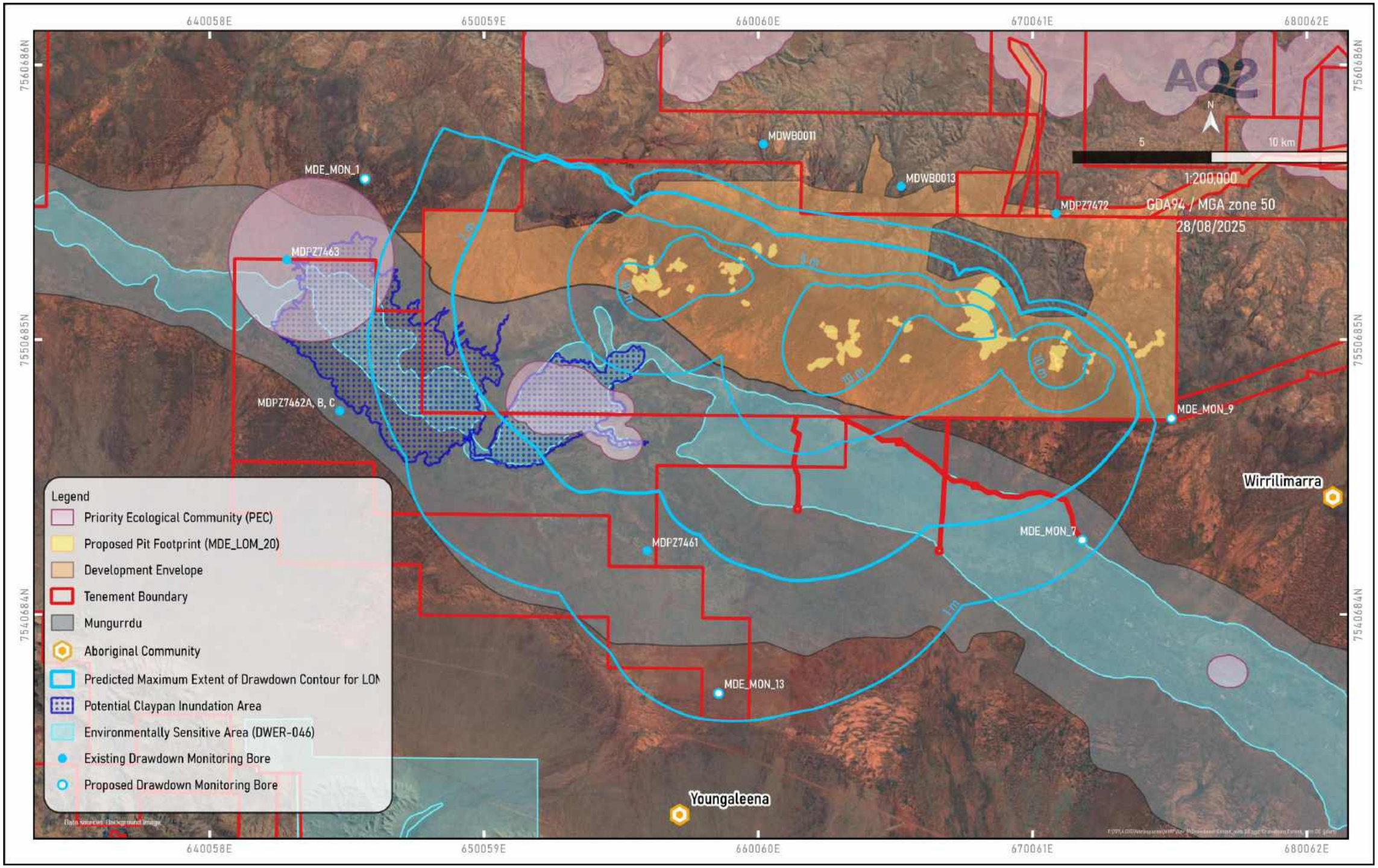

Figure A3-2: Drawdown Monitoring Bores

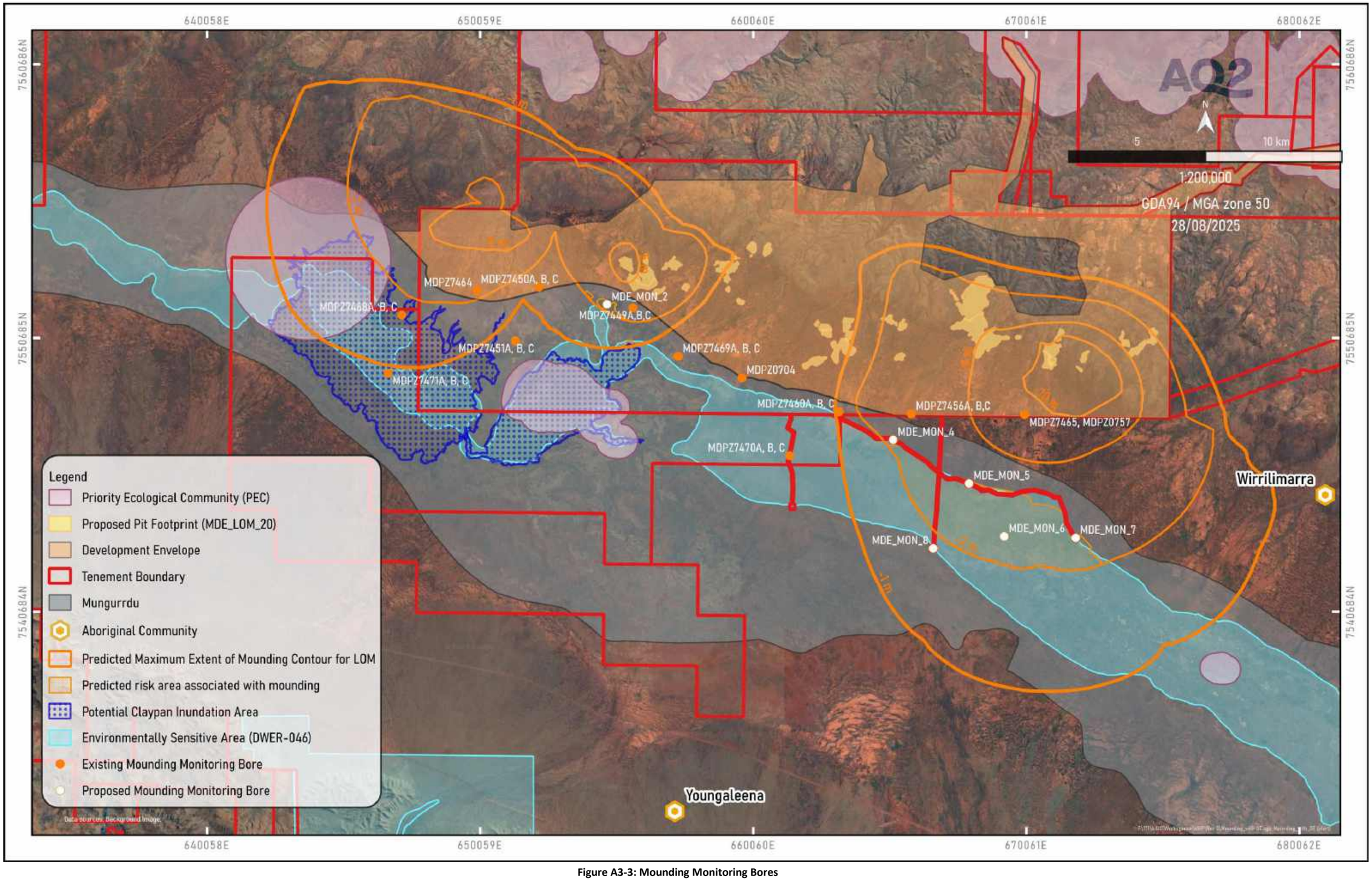

Figure A3-3: Mounding Monitoring Bores

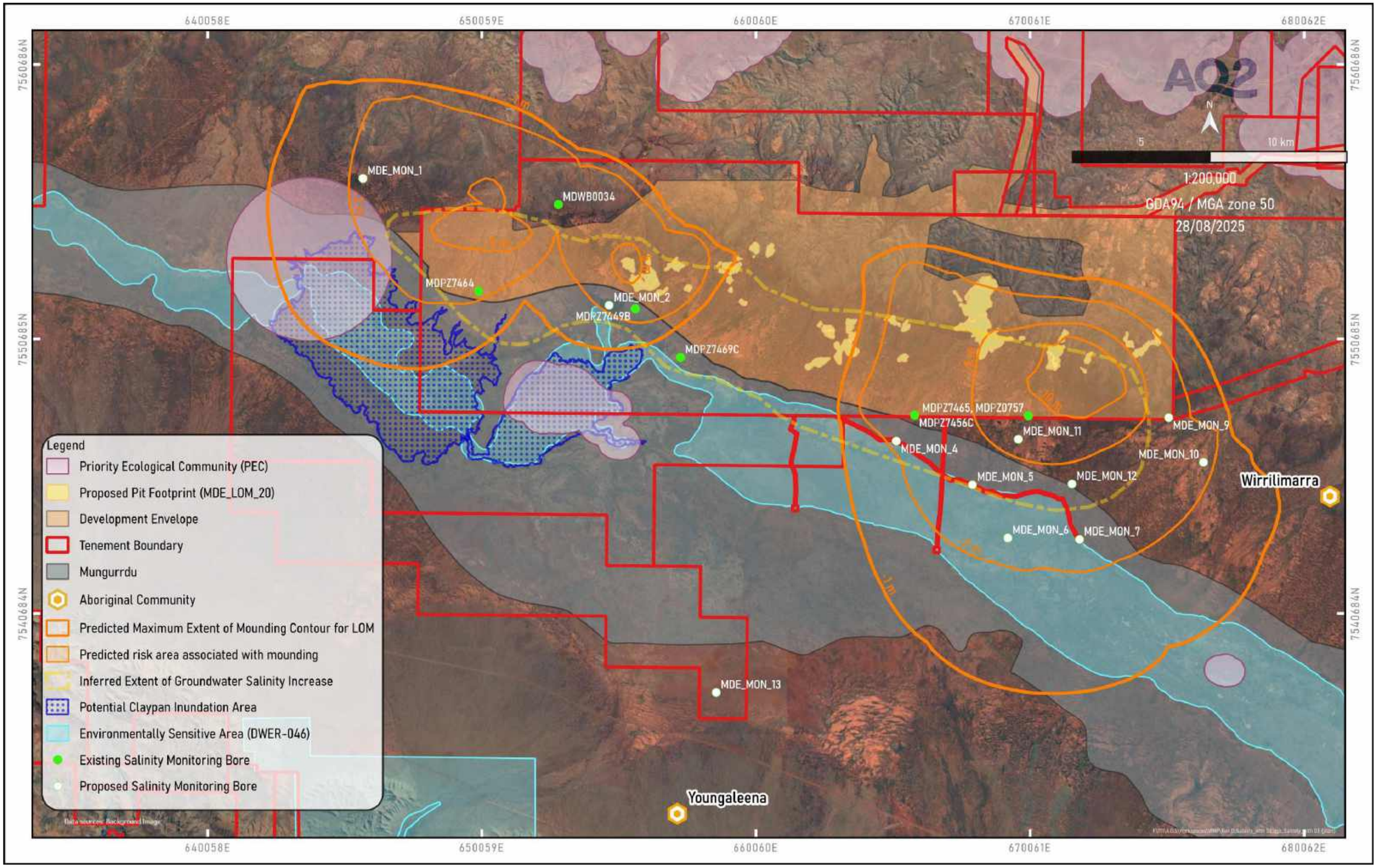

Figure A3-4: Salinity Monitoring Bores