Annual Monitoring Review and Management Report 2022-2023

MMG Rosebery

Date: 30/09/2023
Prepared by MMG Rosebery

Table of Contents

List of Tables

List of Figures

Appendices

Executive Summary

This report has been prepared in accordance with the requirements of Environmental Protection Notice's (EPN) 7153/3 and 8815/2 for the annual monitoring period 1 July 2022 to 30 June 2023.

The MMG Operating Model, Safety, Security, Health and Environment (SSHE) and Social Performance Standards allow MMG Rosebery to deliver an internal management system that facilitates continuous improvement in the management of material environmental risks. MMG Rosebery is progressively implementing MMG risk management processes to regularly review its risk profile and confirm that the right actions are occurring to mitigate risk effectively.

The 2016-2021 Environment Management Plan Review report submitted on 30 November 2021 discussed the broad environmental implications of mine activities and outlined MMG Rosebery's strategy for 2021-2025. Recent Asset Business Plan (ABP) planning completed in September 2023 did not vary this strategy and as such it remains current and appropriate.

This Annual Monitoring Review and Management Report (AMRMR) found the environmental commitments outlined in EPN 7153/3 and EPN 8815/2 have been met. Detailed reporting on these commitments can be found in the accompanying consultancy reports, by environmental aspect (e.g. water).

Environmental improvement activities in the reporting period saw the commencement, continuation, completion or planning of several projects aimed at capturing seepage both at the 2/5 Dam and Bobadil Tailings Storage Facilities (TSF). Smaller scale environmental improvement projects also include reducing stormwater contamination, revegetation and rehabilitation, and the design phase utilising a customised drill rig for geological exploration upon Mt Read to ensure protection of sensitive alpine vegetation.

MMG Rosebery received five community grievances during the reporting period. All grievances were promptly investigated and closed out to the satisfaction of the complainant.

The estimate for current remediation liabilities for MMG Rosebery is AUD$77.7 million based on the approved Mine Closure Plan submitted to the EPA and MRT in 2018. MMG Rosebery are in the process of conducting detailed closure prefeasibility studies for Rosebery and Hercules to inform an updated Mine Closure Plan. This work is expected to be completed in 2024.

In the reporting period, 778,010 tonnes of tailings were placed in final disposal location and all waste rock was returned as mine backfill. A total of 186.8 tonnes of non-mineral waste was disposed of at the onsite landfill.

A review of water quality monitoring results for the reporting period is encompassed within the AMRMR. Of note, there were no exceedances of the site discharge point (BO) compliance limits during the reporting period. Biological monitoring surveys of the Stitt and Ring rivers were also undertaken in spring 2022 and autumn 2023. The results for the Stitt River survey reflect ongoing improvement in the condition of the lower Stitt River. The Ring River results were consistent with previous years.

A review of air quality monitoring results for the reporting period is encompassed within the AMRMR. Of note, no compliance limits were exceeded, and the results indicate that the Rosebery Mine activities are a low environmental risk to air quality and the current dust mitigation controls are appropriate.

A review of noise and vibration monitoring results for the reporting period is encompassed within the AMRMR. Of note, the report found that annual average LAeq, LA90 and LA10 15-minute noise levels were similar to those measured in the previous year. Data availability from the continuous noise monitoring program ranged from 94%-99%. There were no exceedances during the reporting period of ground vibration or air blast overpressure related to blasting activity.

The Bobadil TSF and 2/5 Dam TSF were managed and monitored in accordance with the Australian National Committee on Large Dams (ANCOLD) Guidelines and complied with the Tasmanian Water Management (Safety of Dams) Regulation 2015 and related guidelines. There were no significant issues identified with any of the MMG tailings and water dams during the reporting period.

1. Purpose

This report was prepared in accordance with the annual reporting requirements outlined in Environmental Protection Notice (EPN) 7153/3 (issued 10 November 2011) and EPN 8815/2 (3 Level Waste Rock Dump (WRD); issued 13 February 2015). This AMRMR report covers the period 1 July 2022 to 30 June 2023.

Requirements of these EPN's are summarised in Table 1 below.

This report is made publicly available through MMG Rosebery's community liaison office in Rosebery and available on the MMG website.

Table 1 – Report coverage of EPN requirements

EPN	EPN Requirement		Section
7153/3	G7 1	The AMRMR must be made publicly available...	1
	G7 2.1	An Executive Summary.	Executive Summary
	G7 2.2	A review of environmental aspects and impacts register against environmental controls and documentation	4.1
	G7 2.3	A review of activity compliance and annual external compliance audit against EPN requirements.	7.1
	G7 2.4	Environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the activity, for but not limited to the management period.	4.2 and 4.3
	G7 2.5	A review of environmental commitments and process changes (including annual tonnage) for, but not limited to, the management period.	3.1 and 4.4
	G7 2.6	A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends.	Appendix E
	A4-3	Analysis of yearly climate.	Appendix D
	A5-3	Tabulated high volume air sampler, and dust and metal deposition results for the entire year, showing intermediate values as well as final monitoring results. Tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs of monthly results. Summaries of all exceedances, describing the results of any investigations undertaken and the mitigation measures that were adopted in response. Any supporting data analysis or description necessary to aid interpretation of the dataset.	Appendix G
	M4-3	If the concentrations in effluent from Bobadil Tailings Dam end-of-pipe discharge of parameters listed in EPN do not comply with the levels specified. (Investigation Trigger Level) then an investigation must be conducted and a report summarising the outcomes of all such investigations be submitted in MMG Rosebery's AMRMR.	Appendix E
	E5-1.2	Monitor the level of groundwater contamination (mass load of pollutants) due to seepages from the Bobadil, No.2 and No.5 and rehabilitated No.1 tailings storage facilities on the Stitt River and Lake Pieman.	Appendix E

EPN	EPN Requirement		Section
	E3	Annual biological survey and ambient water quality monitoring program of the Stitt River and Lake Pieman to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal biological and chemical changes within the lake and progress the development of site-specific toxicity guidelines for sulphate and zinc in Lake Pieman.	Appendix E Appendix F
	N1-1.8	Results of the continuous noise monitoring program and noise related complaints must be reported in the AMRMR.	5.2 Appendix H
	G7 2.7	Environmental performance, including incident management and community complaints and the corrective and preventative processes implemented.	5.2 and 6.7
	WM1 2.4	Any environmental or stability issue identified and associated with all tailings dams further outlined to the Director in the AMRMR.	6.8
	G7 2.8	Any approvals or written notifications received in relation to this notice.	5.1
	G7 2.9	A summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities.	5.3
	G7 2.10 / WM3-2	An inventory of wastes disposed of on The Land during the previous 12 months, including details of the quantities of each waste stream and the location of its disposal.	5.4
8815/2	G4-4	Annual review of the surface and ground water monitoring program in accordance with Appendix B of the Detailed Design Report, including an assessment of surface and groundwater impacts from the 3 Level WRD.	6.2 and 6.3 Appendix E
	M3 1.2	Results of 3 Level WRD surface and groundwater monitoring program.	6.2 Appendix E

2. Endorsement

“I hereby certify that to the best of my knowledge, the information within this Annual Monitoring Review and Management Report is true and correct.”

Name: Steve Scott

Position: General Manager MMG Rosebery

Date: 30 September 2023

3. Operational History

3.1 Operational History

EPN 7153/3, G6 1.1.1 Site and operational history, particularly where it relates to the environmental performance of the activity.

EPN 7153/3, G7 2.5 A review of environmental commitments and process changes (including annual tonnage) for, but not limited to, the management period.

MMG Limited (MMG) acquired Rosebery in June 2009. MMG Rosebery is Australia's largest volcanic hosted metals (zinc, lead, copper, gold and silver) mine and its concentrator has been in continuous operation since 1936. As such, environmental performance at Rosebery is influenced by historical mining practices that preceded MMG's management of the operation.

The consolidated mining lease is 4913 hectares, which includes the Rosebery mine, the decommissioned Hercules mine and more than 178 minor legacy sites and remnant features. The Rosebery mining operations are located within Mining Lease No. 28M/1993, approximately 300 kilometres north-west of Hobart and 125 kilometres south of Burnie. Maps of MMG Rosebery operational areas are detailed in Appendix A.

Zinc, lead and copper concentrates and gold doré are produced at Rosebery using mechanised underground mining methods and crushing, grinding and flotation processes. Rosebery concentrates are transported by rail to the Port of Burnie where they are shipped in bulk carriers to smelters in Hobart, Port Pirie and overseas. Gold doré bars are sold to a refinery in Australia where they are refined into gold bullion.

MMG Rosebery production data is provided in Table 2. Waste rock and tailing tonnages are provided in section 5.4.1.

Table 2 – Rosebery production

	Unit	2021-2022	2022-2023
Ore Mined*	dry tonnes	924,190	902,353
Ore Milled**	dry tonnes	940,177	905,717
Gold doré**	oz	22,285	18,131
Copper concentrate**	dry tonnes	7003	7611
Lead concentrate**	dry tonnes	32,988	27,053
Zinc concentrate**	dry tonnes	102,213	93,032

*Data sourced from the MMG Reconciled EOM Reports – for period 1 July to 30 June.
** Data sourced from MMG Quarterly Production Reports – for period 1 July to 30 June.

Process changes and improvement projects that have influenced Rosebery's production and environment performance in 2012-2023 are detailed in Table 3.

Table 3 – Operational history and major environmental improvement projects (2012-2023)

Activity	Milestone	Details
Underground Mine	2012	Change in stability methods from mesh and bolts to fibrecrete and resin bolts, to improve ground support. Concrete batch plant used in fibrecrete approved by West Coast Council (PID 6021427).
	2014	Installation of concrete batching plant (PID 6021427) and noise attenuation wall.
	2015	Surface vent (PSF1) fan upgrade to meet increased ventilation flow demand as mine extended (Approval DA14195).
	2015	Installation of a new 120,000L capacity, self-bunded fuel bay and decommissioning of the existing fuel bay site.
	2018	Introduction of grouting for remnant mining.
	2019	Development activity in the 11L, requiring vibration monitoring in the Rosebery township.
Processing Plant	2014	Commissioning of refurbished MG3 Ball Mill (Approval H287020) to support increased throughput in grinding circuit and reduced grind size. No significant change in noise profile.
	2014	Installation and commissioning of a second Knelson concentrator to improve gold recovery to doré (Approval H316091).
	2015	Installation of a tertiary crushing circuit to increase throughput and enable a finer grind size, which improves recovery of all commodities and is beneficial for tailings transport.
	2021	Filter plant storm water drainage system works completed.
Tailings Storage	2012	Completed Stage 7 works at Bobadil TSF, which raised the TSF to RL 195m (EPN 8574/1).
	2012	Bobadil polishing pond stability analysis to improve understanding of embankment seepage.
	2013	Completed Stage 8 embankment raise at Bobadil TSF to RL 197m (EPN 8781/1).
	2014	Completion of Bobadil polishing pond redevelopment to improve water treatment (EPN 8814/1).
	2015	Completed Stage 9A upstream embankment raise to the southern portion of the facility to a crest of RL 199m at Bobadil TSF (EPN 9139/1).
	2016	Completed Stage 9B embankment raise at Bobadil TSF to provide storage capacity to allow continued production until 2017. Works include raising the northern portion of the facility to a crest of RL 199m using the upstream construction method and the construction of a new spillway that has been designed for closure (EPN 9139/1).
	2016	Construction of the 2/5 Dam TSF to a crest of RL 170m. The construction is a single continuous embankment formed via upstream and downstream construction over and around the previous 1, 2 and 5 Dam complex, originally constructed between 1950 and 1970 (PCE 9084).
	2018	Tailings deposition commenced in Q1 2018 at the 2/5 Dam (PCE 9084).
	2019	Bobadil Polishing Ponds de-sludging works. Work commenced in Q1 2020 with a floating pontoon pumping sludge within geo-tubes.

Activity	Milestone	Details
	2020	Murchison Highway mitigation works to reduce seepage water entering the Stitt River.
	2021	2/5 Dam TSF Subaerial deposition infrastructure works, to allow deposition during construction of a Stage 2 raise (conditional subaerial approval).
	2021	Bobadil TSF 10A upstream and stepped in embankment raise to a crest of RL 201m completed and deposition commences (EPN 10504/1).
	2021	2/5 Dam TSF Stage 2 downstream raise construction to crest of RL 173m commenced (PCE 9084).
	2022	Bobadil TSF 10B upstream and stepped in embankment raise to a crest of RL 201m completed incorporating a 9-hectare trial closure cover over the stepped in area at RL 199m (EPN 10504/1).
	2022	Completion of works to separate the 2/5 Dam TSF seepage from stormwater drainage adjacent Murchison Highway.
Waste rock management	2015	Commenced construction of Waste Rock Dump at the 3 Level Open Cut Area (3 Level WRD) in accordance with EPN 8815/2. Stage 1 Establishment phase has been completed and construction of Stages 1a and 1b was completed in September 2015.
Water Management	2012	Site water balance developed and used on an ongoing basis to refine water management controls.
	2012	Upgrade to site sewerage system.
	2012	Works on 1 Dam Surface drainage, stormwater management for 2 Dam, and hydrological studies on 1/2/5 Dam as part of site water balance model development (Superseded by the construction of the 2/5 Dam TSF).
	2014	Construction of 3 Level clearwater diversion drain to divert up-gradient uncontaminated water to Rosebery Creek.
	2022	Separation of seepage from stormwater drainage adjacent Murchison Highway completed and functional.
Closure	2012-2013	Decommissioning and removal of redundant infrastructure (old administration building, Heritage Centre, old tank on Filter Plant Road, Assay Laboratory, three sandfill and cement silos).
	2018-2019	Minor Legacy workings closure project commenced.
	2019	Rosebery & Hercules Closure PFS project commenced.

3.2 Current Environmental Improvement Projects

A summary of the status of environmental improvement projects that were proposed for commencement or continuation during the reporting period is provided in Table 4. Refer to section 5.3 for details on research studies undertaken to fill knowledge gaps and inform closure planning.

Table 4 – Environmental improvement projects – status as at 30 June 2023

	Project Details	Status	Status Details
1	2/5 Dam TSF Eastern Seep Redirection Project A reverse filter wall was designed and constructed under the 2/5 Stage 2 construction project, but a subsequent project has been created to ensure eastern seepage is caught and passively flows into the seepage ponds.	Commenced in Q3 2023	Forecasted completion Q4 2023
2	2/5 Dam TSF Road Realignment Part of the 2/5 Dam TSF Stage 2 construction project, the road realignment is required due to recommissioning of overhead powerlines and to facilitate construction of the 2/5 Dam TSF screening bund.	Commencedt in Q3 2023	Forecasted completion Q4 2023
3	2/5 Dam TSF Screening Bund Revegetated along Murchison Highway.	Commenced	Forecasted completion Q4 2023
4	2/5 Dam TSF Stage 2 Raise Including increased seepage mitigation measures and French drain construction.	Commenced	Forecasted completion Q4 2023
5	Bobadil Underdrainage Redirection Capture seepage prior to entry into the polishing ponds and pump back into the Bobadil TSF.	Awaiting Commencement	Forecasted commencement 2024
6	Bobadil Flume Instrumentation Improved instrumentation to monitor the flume.	Awaiting Commencement	Forecasted commencement 2024
7	Water/Sludge Management Project aim is to understand long-term water treatment requirements at site	Commenced	Preliminary investigations forecasted completion Q3 2023
8	Repairs and Maintenance on Concentrate Shed Will contain concentrate eliminating historical build up in inaccessible areas and prevent concentrate entering drainage lines.	Commenced	Forecasted completion Q3 2023
9	Drill Rig Elevation and Water Recirculation Underground drill rig mounted on an elevated working platform with enviro-matting below and recirculated water, towed by a tractor, to be used with geological exploration to reduce impacts on sensitive vegetation types.	Commenced	Staged trial in place for refinement before exploration drilling commences on Mt Read.

	Project Details	Status	Status Details
10	Minor Filter Plant Drainage Upgrade Installation of a new bund around the drainage pit and diversion pump in the upgradient road will reduce likelihood of overflow water entering the HVAS pond.	Awaiting Commencement	Forecasted commencement Q4 2023
11	Lead Thickener Pump Lid Installation of a lid following a historic noise complaint to reduce environmental nuisance.	Commenced	Temporary lid installed, due for completion Q4 2023

4. Planning

4.1 Risk Assessment

EPN 7153/3, G7 2.2 A review of environmental aspects and impacts register against environmental controls and documentation.

The annual risk profile review for Rosebery's Material risks was performed in Q1 2023. During this review a new critical control relating to bushfire was identified following a bushfire within the mining lease in late December 2022. This critical control was added to the existing material risk Major Fixed Plant Fire.

Risk analysis of material risks and design of critical controls continues as part of MMG's risk management processes. MMG Rosebery conducted its last annual review of the Environmental risk register against environmental controls and documentation in Q3 2021. Further review of the register is planned for Q4 of 2023.

MMG Rosebery is committed to mitigating risk through continuous improvement of environmental controls. The Intermediate Inspection audit and report, as required by ANCOLD, were undertaken by the Engineer of Record (EoR) in January 2023 for the 2/5 Dam and Bobadil TSFs (Appendix B and Appendix C). In 2022, an Independent Tailings Review Board (ITRB) was established to conduct evaluations of all aspect of Rosebery's TSFs on an annual basis. Since its inception, the ITRB has convened in both July 2022 and in May 2023 at Rosebery. The inspections by the EoR and the ITRB evaluations provides Rosebery with actions to improve our facilities and mitigate risks.

A dust suppressant trialed during the 2022-2023 summer at the 2/5 Dam TSF was found to be successful and will be implemented operationally for contingency use once all relevant approvals have been received.

4.2 Environmental Planning

EPN 7153/3, G7 2.4 Environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the activity, for but not limited to the management period.

A core component of MMG's growth strategy is to identify opportunities to maximise the potential of our existing assets. MMG has a coordinated approach to Integrated Business Planning (IBP) which is supported by MMG Group office in Melbourne. IBP is a four-stage process; Corporate and Assets Strategy (Strategically focused), Strategic Development Planning (Directionally focused), Asset Business Planning (Delivery focused), Annual Business Plan (Execution focused).

Annual Business Plans are developed that are aligned with the broader IBP stages. This enables flexible investment decisions and typically result in two business scenarios (production and productivity cases). The IBP process provides consistent direction on long-term operational strategy and guides the annual (short-term) and rolling three-year (medium-term) budget plans. The IBP also provides a primary basis for internal, whole-of-life business valuation (net present value). A key constraint on the current Life of Asset (LoA) is the securing of additional tailings storage capacity beyond 2025.

During the reporting period, MMG continued studies on extensions to the 2/5 Dam and Bobadil TSF's as well as investigations into new tailings storage options. Given the challenges with tailings storage capacity beyond 2025, MMG's key forward environmental planning projects will include both tailings storage and closure prefeasibility studies.

4.3 Objectives and Targets

EPN 7153/3, G7 2.4 Environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the activity for but not limited to, the management period.

In support of MMG's commitment to minimise its environmental footprint and efficient use of natural resources, MMG's Executive Committee has made a commitment to align with the International Council on Mining and Metals (ICMM), Mining Principles Performance Expectations. The ICMM's new Mining Principles and corresponding Performance Expectations provide a comprehensive set of environmental and social requirements, including issues such as mine closure, pollution and waste.

MMG was one of the member companies involved in the development and review process for the Performance Expectations and commenced implementation of the ICMM Performance Expectations in 2020, incorporating robust, site-level validation. At a site level, MMG Rosebery creates annual business plans that provide a framework for departmental targets. Environmental goals and targets as per the Rosebery 2023 Business Plan are outlined in Table 5.

Table 5 – Environmental and social targets

GOAL	Target	Status as at 1 July 2023
Improvement in environmental performance	1) Zero actual significant environmental events (rated 5 or above) 2) Zero actual environmental legal non-compliances (rated 4 or above) 3) >80% compliance against environmental monitoring plan 4) Hercules Closure Plan submitted 5) Progress Global Industry Standard Tailings Management (GISTM) compliance 6) Develop Climate Resilience and Decarbonisation Action Plan detailing timing of green energy contract and fleet electrification.	1) No significant events (≥ Level 5) within the reporting period 2) No significant events (≥ Level 4) within the reporting period 3) Monitoring plan implemented to >80% compliance with permits within the reporting period 4) Hercules Closure Plan is being further reviewed in line with the revised exploration program 5) Forecasted to achieve ~80% conformance to GISTM by August 2023, including either fully or partially meeting the 200 criteria items under GISTM 6) Development of a site Climate Resilience Management Plan and site Greenhouse Gas Reduction Plan underway. Green contracts are being investigated with climate specialists and a hybrid loader trial is underway.
Improvement in social performance	1) Response to any grievance within seven days of receipt 2) 75% of grievances closed out within 60 days 3) 15% improvement on previous reporting period in average resolution time 4) Increase community engagement over the reporting period.	1) 100% compliant 2) 100% compliant 3) 32% improvement compared to last reporting period 4) 119% improvement in community engagement communications.
Implement the Rosebery Social Strategy Management Plan	1) Implement Social Performance Management Plan.	1) Social strategy under continued current review: - Stakeholder mapping workshop planned for Q3 2023 to inform the overarching social strategy - Borealis software training planned for Q3 2023 to improve stakeholder communication management and data capture for analytics - Dialogue training completed aimed at increasing community voice - Closure visioning workshop completed with findings used to support strategic position on the Social Performance Management Plan.

4.4 Environmental Commitments Review

EPN 7153/3, G7 2.5 A review of environmental commitments and process changes (including annual tonnage) for, but not limited to, the management period.

Key environmental commitments and their current status are outlined in Table 6. Refer to Table 2 for annual tonnages.

Table 6 – Environmental commitments – status as at 30 June 2023

Commitment	Details	Current Status
Extend seepage collection drainage at 2/5 Dam TSF to capture seepage from the eastern embankment	Following an incident in February 2022, MMG committed to extending the seepage collection to the eastern embankment.	Design phase is complete and construction of the eastern seepage pipeline is forecast to commence in Q3 2023.
Review use of the flume for transporting tailings to Bobadil	Following the flume overtopping event in February 2022 MMG committed to reviewing the use of the flume.	A risk assessment has been completed and flume stability investigated during Q4 2022 and Q1 2023. Outcomes resulted in plans for remedial work on the flume, ongoing surveys and monitoring of the embankment and a project to install instrumentation in the flume during the next reporting period.
Construction of the 3 Level WRD in accordance with EPN 8815/2 and submission of periodic 6-monthly construction audit reports	Within 30 days of audit date	Stage 2 raise 1 of the 3 Level WRD is under construction. No waste rock is currently being disposed of on the surface. Two construction audits were conducted over the reporting period with audit reports provided to the EPA.
Installation of suitable dust suppression system to control ground level dust (Dust Mitigation Plan, submitted June 2015)	December 2020 (Approval date)	A review of the Dust Mitigation plan was completed as part of the 2/5 Dam TSF subaerial conversion submission and subsequently approved in December 2020. The review identified the current dust suppression systems onsite are sufficient to control ground level dust. Extra sprinklers and a back-up sprinkler system were installed for summer during the reporting period. Final completion of the sprinkler system at 2/5 Dam TSF is forecasted for Q4 2023.
Submission of a Closure Plan for 3 Level WRD.	31 October 2018 (Submission date)	Submitted by the due date, awaiting EPA response.

Refer to section 7.1 for details of the external compliance audit against commitments in EPN 7153/3.

5. Implementation and Operation

5.1 Approvals and Notification

EPN 7153/3, G7 2.8 Any approvals or written notification received in relation to this notice.

An update to the progress of Environmental Approvals within the reporting period are detailed in Table 7.

Table 7 – Environmental approval update for the reporting period

Activity	Approval Reference	Approval Date	Details
South Marionoak TSF	-	EIS in preparation	Notice of Intent (NOI) and EPBC referral submitted for the proposal. EIS guidelines issued.
2/5 Dam TSF Stage 2 subaerial operation & closure	-	EIS in preparation	Notice of Intent (NOI) submitted, and EIS guidelines issued.
2/5 Dam TSF Stage 3	-	EIS in preparation	Notice of Intent (NOI) submitted, and EIS guidelines issued.
Bobadil Stage 11	-	EIS in preparation	Notice of Intent (NOI) submitted, and EIS guidelines issued.
Batch Plant	EPN 7153/3 – DA 2023/19	-	Construction of temporary batch plant at 4L to facilitate change of contract supplier.
2/5 Dam - Quarry Extension	EPN 9084 - DA 2015/00034	06/04/2023	2/5 Dam Stage 2 construction works required additional rock buttress material, approval for extension of the existing quarry to the west was granted.

5.2 Community Feedback

EPN 7153/3, G7 2.7 Environmental performance, including community complaints and the corrective and preventative processes implemented.

EPN 7153/3, N1 – 1.8 Noise related complaints must be reported in the Annual Monitoring Review and Management Report.

During the reporting period, MMG Rosebery received five community grievances related to environmental harm and nuisance, refer to Table 8. All five grievances were noise related. Investigations into the grievances found that two of the grievances pertaining to the 2/5 Dam TSF were unfounded due to the results of 2/5 Dam TSF noise monitoring program. Monthly review of 2/5 Dam TSF noise data is undertaken by a third-party consultant, whose reports identified that MMG did not exceed any of its noise related exceedance limits at the time of the grievances being lodged. The remaining three grievances were found to be mistakenly associated with MMG activity (the actual noise source was confirmed to be a private New Year's Eve party).

Table 8 – Grievances received from the community during the reporting period*

Category	Date	Details
Noise	3/12/2022	Grievance received from Rosebery resident regarding noise impacts from 2/5 Dam TSF seepage pumps – 2/5 Dam TSF noise monitoring program did not record any noise exceedances surrounding the time of the complaint
Noise	3/01/2023	Grievance received from Rosebery resident regarding noise – Investigation found the noise was related to a private New Years' party unrelated to MMG Rosebery mining operations
Noise	3/01/2023	Grievance received from Rosebery resident regarding noise – Investigation found the noise was related to a private New Year's party unrelated to MMG Rosebery mining operations
Noise	3/01/2023	Grievance received from Rosebery resident regarding noise – Investigation found the noise was related to a private New Year's party unrelated to MMG Rosebery mining operations
Noise	6/01/2023	EPA received an anonymous complaint regarding noise emanating from the 2/5 Dam TSF – 2/5 Dam TSF noise monitoring program did not record any noise exceedances surrounding the time of the complaint

*All community feedback that is frivolous, vexatious, invalid or considered an issue rather than a grievance is not included in this report

5.3 Rehabilitation and Closure

EPN 7153/3 G7 2.9 A summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities.

5.3.1 Closure Liability

The estimate of current remediation liabilities for MMG Rosebery is AUD$77.7 million, based on the Closure Management Plan submitted to the EPA and MRT in May 2018. Following completion of the Closure Prefeasibility Study (PFS), the Mine Closure Plan will be updated. The closure liability will be revised within the updated Mine Closure Plan that will be submitted to the EPA in compliance with condition DC3 of EPN 7153/3.

5.3.2 Progressive Rehabilitation

No rehabilitation projects pertaining to EPN 7153/3 were commenced or completed during in the reporting period. Being an underground mine, the disturbance area is largely limited to operational areas that continue to be used or are planned to be used in the future and are therefore not available for rehabilitation. Current operating areas with potential to be progressively rehabilitated pertain to construction activity at the 2/5 Dam TSF, which is reported under the PCE 9084 AER. A project initiated in 2018, in conjunction with EPA and MRT, to close out minor legacy workings throughout Mining Lease (ML 28M/1993) identified 178 sites/features for remediation. This project is ongoing with 14 sites currently remediated. The project is set to be reinitiated during Q1 2024 with the aim of remediating approximately six sites per year.

Other areas undergoing rehabilitation based projects include the Hercules mine site and Bobadil TSF. The status of the Hercules closure prefeasibility study aimed at the long-term closure and rehabilitation of the Hercules site is discussed below, see section 5.3. Monitoring of a nine-hectare closure cover trial that was installed during the last reporting period at the Bobadil TSF has been continued, producing preliminary results. The cover trial was not intended for long-term rehabilitative purposes but is mentioned here due to its significance in informing future TSF closure and rehabilitation (see section 5.3.4).

5.3.3 Hercules

Hercules comprises legacy workings located on the southwest portion of the Rosebery lease (ML 28M/1993). The area is managed and monitored in accordance with the approved Care and Maintenance Plan and MMG continues to undertake a work program to refine the understanding of the site and develop long-term, sustainable closure outcomes. Over the past 12 months, MMG has completed the following tasks within the Hercules closure prefeasibility project:

- Refined the contaminant source model through the inclusion of additional data collected from previously inaccessible adits;
- Further developed the understanding of surface water conditions, through the collection and analysis of additional surface water and rock samples along the extent of Baker Creek, to inform the development of final rehabilitation options;
- Refined the hydrogeological model using addition groundwater data that was collected during the reporting year;
- Completed, in partnership with Flinders University, detailed collection and analysis of waste and screened material from across the site and along the extent of Baker Creek;
- Completed, in partnership with the University of Tasmania, a geodiversity and geo-tourism study to inform future land use planning; and
- Completed a geotechnical risk assessment across the site to inform landform rehabilitation options.

Revegetation works were undertaken at Hercules from 2005 to 2008 and subsequently assessed annually using the Hercules Assessment Index for Rehab (HAIR). Annual monitoring was decreased to biannually upon transition from active treatment to monitoring only in 2017. The last HAIR assessment was undertaken in 2021 and the results were consistent with previous years. In the absence of any on ground work since 2008, a transition of sample results grade to a consistent set of values (pH and nutrient values approaching base line values and vegetation cover parameters levelling off) has been observed. During the 2021 survey the only observation dissimilar to previous years was a significant decline in the exotic versus native parameter back to levels recorded in 2015. The next survey is scheduled for summer 2023.

5.3.4 Bobadil Tailings Storage Facility

During the last reporting period, a nine-hectare closure cover trial was installed at the Bobadil TSF as part of the continuation of a comprehensive PFS (PFS Part B, begun in 2020) that will inform and advise the final closure design of the facility. The trial monitors performance of two cover variants that aim to reduce rainfall infiltration and oxygen ingress. Monitoring and data collection throughout the current reporting period has facilitated preliminary results. These results show one of the cover options fulfils both primary and secondary cover option requirements, with seepage shown to be <1% of cumulative rainfall and oxygen concentrations below the geosynthetic clay liner limited to <2%. Field results have also allowed the development of a model (showing good correlation with observed results) that can be used to predict long-term cover performance. The trial will continue as vegetation continues to establish, facilitating stronger results.

5.4 Waste Disposal

EPN 7153/3 G7 2.10 An inventory of waste disposed of on The Land during the previous 12 months, including details of the quantities of each waste and the location of its disposal.

5.4.1 Waste Rock and Tailings

The mineral waste mined to develop declines and access the ore body is primarily used to backfill underground mine stopes and voids. All waste rock that cannot be stored underground is sent to the surface and placed in the 3 Level Waste Rock Dump (3LWRD). MMG Rosebery is currently experiencing a waste rock deficit, as such waste rock has not been carted to surface since February 2017.

Since inception of the 2/5 Dam TSF in April 2018, tailings have primarily been deposited at the 2/5 Dam TSF. Following completion of the Bobadil Stage 10A & 10B embankment raises, tailings are now deposited at Bobadil intermittently depending on operational strategies. A total of 458,264 tonnes of dry tailings was deposited at

2/5 Dam TSF and 319,749 tonnes at the Bobadil TSF during the reporting period. Waste rock and tailings production is summarised in Table 9.

Table 9 – Waste rock and tailings production (tonnes)

	July 2021-June 2022	July 2022-June 2023	% Change
Waste rock mined	330,135	325,618	-1.37
Waste rock to underground	330,135	325,618	-1.37
Waste rock to 3 Level WRD	0	0	0
Dry tailings (Total)	797,973	778,010	-2.50
Dry tailings (Bobadil TSF)	229,006	319,749	39.62
Dry tailings (2/5 Dam TSF)	568,966	458,261	-19.46

5.4.2 Onsite Landfill

In accordance with EPN 7153/3 Condition WM3, the Bobadil Landfill is an authorised, onsite landfill. The Bobadil landfill is used for the disposal of lead contaminated inert materials, including used filter cloths (usually buried underground), poly pipe and other plastics, timber, rubber (but not tyres) and non-recyclable metal.

The amount of waste disposed of at the Bobadil landfill was 186.8 tonnes during the reporting period (as determined by load cells fitted to the bin collection vehicle and tracked by the authorised waste management contractors by way of a docket book), a decrease of 34.8% from the previous reporting period.

6. Checking and Corrective Action

6.1 Meteorological Monitoring

EPN 7153/3, A4-3 Analysis of yearly climate.

In accordance with EPN 7153/3, A4-3, MMG commissioned a review of meteorological data for the reporting period. The report found temperature, relative humidity and rainfall data for reporting period indicated that the mine experienced a cool, wet and humid climate with wetter winter and autumn months and drier summers. Results are summarised in Appendix D (EY, 2023).

6.2 Water Monitoring – 3 Level Waste Rock Dump (EPN 8815/2)

EPN 8815/2, G4-4 Annual review of the surface and ground water monitoring program in accordance with Appendix B of the Detailed Design Report, including an assessment of surface and groundwater impacts from the 3 Level WRD.

EPN 8815/2, M3 1.2 Results of 3 Level WRD surface and groundwater monitoring program.

In accordance with EPN 8815/2, G4-4 and M3 1.2, MMG continued its water quality monitoring program at the 3LWRD and commissioned a review of surface and ground water monitoring results for the reporting period. Results are summarised in section 14 of Appendix E (Koehnken, 2023).

During the reporting period no additional waste rock was added to the 3 Level (3L) Waste Rock Dump (WRD). All surface runoff from the 3L WRD continues to be collected and directed to the Effluent Treatment Plant (ETP) for treatment. The report indicated surface water impacts beyond the immediate area of the 3L WRD are minimal, as all surface runoff from the 3L WRD is collected at the 4 Level (4L) settlement pond and directed to the ETP for treatment and discharge via the Bobadil Outfall (BO). There were no discharges from the settlement pond to Rosebery Creek during the reporting period. Results across parameters were generally consistent with historic trends, except for zinc which returned the highest result at sample location OC5 since 2019, and the observance of an increasing trend in zinc concentration over the last three years at sample location OC3.

Long-term trends from water quality monitoring at the 3L WRD indicate the increase in zinc and sulphate in Rosebery Creek is attributable to diffuse sources entering the waterway. The relative increase in zinc continues to be greater than that of sulphate, suggesting sources other than sulphide oxidation are contributing zinc to the waterway. As previously stated, MMG is conducting a comprehensive closure PFS for the site that includes an assessment of the performance of the 3L WRD.

6.3 Water Monitoring – Rosebery (EPN 7153/3)

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends.

EPN 7153/3, M4-3 If the concentrations in effluent [from Bobadil Tailings Dam end-of-pipe discharge] of parameters [listed in EPN] do not comply with the levels specified ... (95th Percentile Investigation Trigger Level) ... then an investigation ... must be conducted and a report summarising the outcomes of all such investigations be submitted ... in MMG Rosebery's Annual Monitoring Review and Management Report.

EPN 7153/3, E3 Annual ... ambient water quality monitoring program ... to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal ... chemical changes within the lake and progress the development of site-specific toxicity guidelines for sulphate and zinc in Lake Pieman.

In accordance with EPN 7153/3 conditions G7 2.6, M4-3 and E3, MMG continued its water quality monitoring program and commissioned a review of surface and ground water monitoring results for the reporting period. Results are summarised in Appendix E (Koehnken, 2023). Additionally, all water quality monitoring data pertaining to EPN 7153/3 is submitted to the EPA on a quarterly basis.

A review of the water quality monitoring data for the reporting period found water quality monitoring was conducted in accordance with requisite conditions and that water treatment was effective in reducing metals concentrations in the discharge water. Water chemistry results recorded at the authorised discharge point, Bobadil Outfall (BO), complied with EPN discharge limits for all parameters.

The 95th percentile values for the reporting period were below the 95th percentile investigative triggers for all parameters except total nitrogen, which had a 95th percentile value of 5.6 mg/L compared to the investigative limit of 5.5 mg/L. In August 2022, an investigation into sources of nitrogen in the discharge water concluded the nitrogen is likely derived from explosives and lime used in the neutralisation plant. Quarrying associated with construction at the 2/5 Dam TSF potentially contributed to increased total nitrogen concentrations due to the increased use of explosives above normal mining operations. The annual water quality review stated the 95th percentile value of 5.6 mg/L would pose a low risk to the receiving environment given the overall low concentration, the short duration of the elevated values and the rapid mixing that occurs within the receiving environment.

Significant trends throughout the reporting period found metal retention in the Bobadil TSF is high due to good pH control resulting in low metal concentrations in the discharge water. Mercury and TPH were below the limit of reporting for all monitoring periods. Median sulphate levels were lower than any previous year, which may be due to low rainfall in the area reducing the volume of mine water and stormwater reporting to the ETP. Water quality results also showed consistency with longer-term trends. Zinc concentrations for the reporting period remained within historic ranges though the median value for this reporting period was 0.029mg/L compared to 0.015mg/L last reporting period. The likely reason for the higher concentration is decreased flow from Bobadil TSF during the reporting period as a result of increased water recycling, resulting in a decreased volume of clean water input.

Monitoring of Lake Pieman highlighted the impact Bastyan Dam Power Station operations has on water quality within the lake. Intermittent operation of the dam prior to monitoring throughout the reporting period resulted in a well-mixed water column showing near uniform profiles for electrical conductivity, pH and temperature at most sites. Significant trends throughout the reporting period found small localised variation in electrical conductivity at sampling location PBS3 (contributing factors remain unknown), filtered and total zinc results were similar at sampling locations PBS3 and PBS6, and sulphate concentrations showed consistency with electrical conductivity and remained ≤17 mg/L. Comparison with Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) found total zinc and total copper to be higher than the 95th percentile trigger values, but remained lower than the *No Observable Effects* levels obtained through site specific toxicity testing by MMG using Lake Pieman water and local ceriodaphnia in 2006.

Water quality results from the reporting period were generally consistent with long-term trends observed within Lake Pieman. Total zinc concentrations throughout the reporting period were within the historic range and showed consistency with long-term trends of increasing downstream. In general, results from the reporting period are consistent with the understanding of mixing within Lake Pieman and highlight the role hydrology, and especially the role power station operations, play in mixing in the lake. This reporting period in particular demonstrates that short, intermittent power station operations are sufficient to maintain a well-mixed water column and relatively low metal concentrations. Sources downstream of BO remain substantial contributors of zinc and other parameters to the lake.

MMG Rosebery's water quality monitoring program is comprehensive, for a more detailed review of results from the reporting period refer to Appendix E (Koehnken, 2023).

6.4 Biological Monitoring

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends.

EPN 7153/3, E3 An annual biological survey and ambient water quality monitoring program of the Stitt River and Lake Pieman must be undertaken in accordance with columns 1 to 4 of Table 6 of Attachment 2 and columns 1 to 6 of Table 7 of Attachment 2 to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal biological and chemical changes within the lake, and progress the development of site specific toxicity guidelines for sulphate and zinc in Lake Pieman.

In accordance with EPN 7253/3 conditions G7 2.6 and E3, MMG continued its biological monitoring program (encompassing an annual survey of Lake Pieman and biannual spring and autumn surveys of the Stitt and Ring rivers) and commissioned a review of the monitoring results upon completion of the surveys. Results are summarised in Appendix F (Freshwater Biomonitoring, 2023).

6.4.1 Lake Pieman

The Lake Pieman biological monitoring program assesses the ecological status of the receiving environment in Lake Pieman influenced by discharge from the Bobadil polishing ponds, the mine site's authorised discharge point. Biological monitoring of Lake Pieman was last conducted in Q1 2022 and is planned for Q3 2023, therefore the report is unavailable for the AMRMR. Once received MMG will submit to the Director within 30 days of receipt.

6.4.2 Ring and Stitt Rivers

Biological monitoring of the Ring and Stitt rivers assess the ecological status of the riverine ecosystem and is used to evaluate changes over time and relate this back to environmental conditions and management actions associated with MMG mining operations. Biological monitoring of the Ring and Stitt rivers was undertaken in spring 2022 and autumn 2023. Results are summarised in Table 10 and Table 11, and monitoring locations are shown in Figure 1 and Figure 2. For a more detailed review of results, refer to Appendix F (Freshwater Biomonitoring, 2023).

Table 10 – Key findings from biological monitoring of the Ring River

Nature of Change	Findings of Monitoring Program
Status of environmental conditions	The lower reaches of the Ring River remain in a degraded condition from contamination by heavy metals emanating primarily from the Hercules mine. Contamination from the Hercules mine is entering the Ring River via Baker Creek (TRCI scores indicate Moderate river condition upstream of the Baker Creek confluence transitioning to Poor river condition downstream of confluence).
Status of understanding of temporal, spatial and seasonal biological changes	Physical and biological indicators exhibit no significant temporal trend in the ecological status of the river. The river has remained degraded over time as a result of heavy metal contamination from both Dolcoath Creek and to a greater extent Baker Creek. Spatial trends confirm ongoing contamination from Bakers Creek through increased conductivity and decreased AUSRIVAS Mean O/Epa Band and TRCI scores downstream of the Bakers Creek confluence (AUSRIVAS Mean O/Epa Band decreased from B to D, and TRCI score decreased from Moderate to Poor) in Autumn 2023. There is no significant seasonal variation within the observed trends.

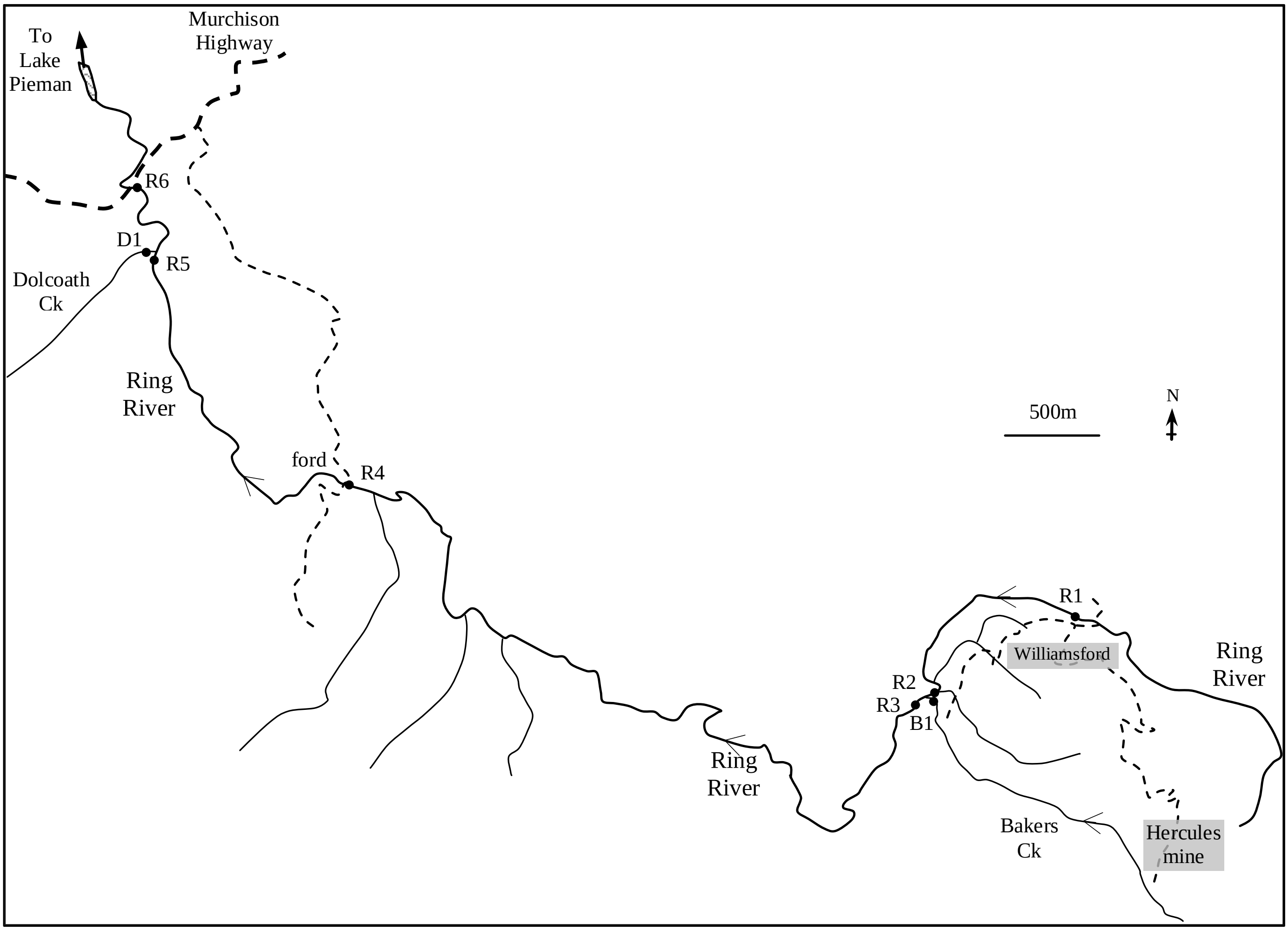


Figure 1 – Map of Ring River sampling locations

Table 11 – Key findings from biological monitoring of the Stitt River

Nature of Change	Findings of Monitoring Program*
Status of environmental conditions	Overall, the Stitt River is in a substantially better ecological condition than the Ring River. There appears to have been some improvement in the condition of the lower Stitt River over recent years, with a range of clean-water macroinvertebrate taxa now present at all sites in the Stitt River, including in the lower reaches. This is confirmed by TRCI scores of Moderate river condition across all sample locations.
Status of understanding of temporal, spatial and seasonal biological changes	As mentioned above, physical and biological indicators exhibit an improving temporal trend in the ecological status of the Stitt River. This is evident by six of seven sites classified by AUSRIVAS as Mean O/Epa Band A (same as the reference site), and TRCI scores of Moderate river condition across all sample locations in Autumn 2023. Historically, spatial trends have shown a decline in the ecological status of the Stitt River between the upper and lower reaches, likely due to legacy seepage of mine contaminants into the lower Stitt from a range of sources. This spatial trend has shown further improvement in autumn 2023, with only the most downstream sample location (S6) scoring a Mean O/Epa Band B instead of A. There is no significant seasonal variation within the observed trends other than conductivity, which was consistently higher across all sample locations in autumn 2023 compared with spring 2022. It's worth noting conductivity across both seasons was shown to increase moving downstream. Adult trout were caught at all sample locations and juvenile trout at sample location S5 during sampling conducted in spring 2022. Adult and juvenile brown trout have been regularly recorded in the lower reaches of the Stitt River since autumn 2020, although the numbers of trout remain consistently lower compared to the upper reaches of the river. Nevertheless, the consistent capture of adult and juvenile trout at all sites in the Stitt River indicates that a self-sustaining population of trout now occurs throughout the Stitt River, including in the lower reaches.

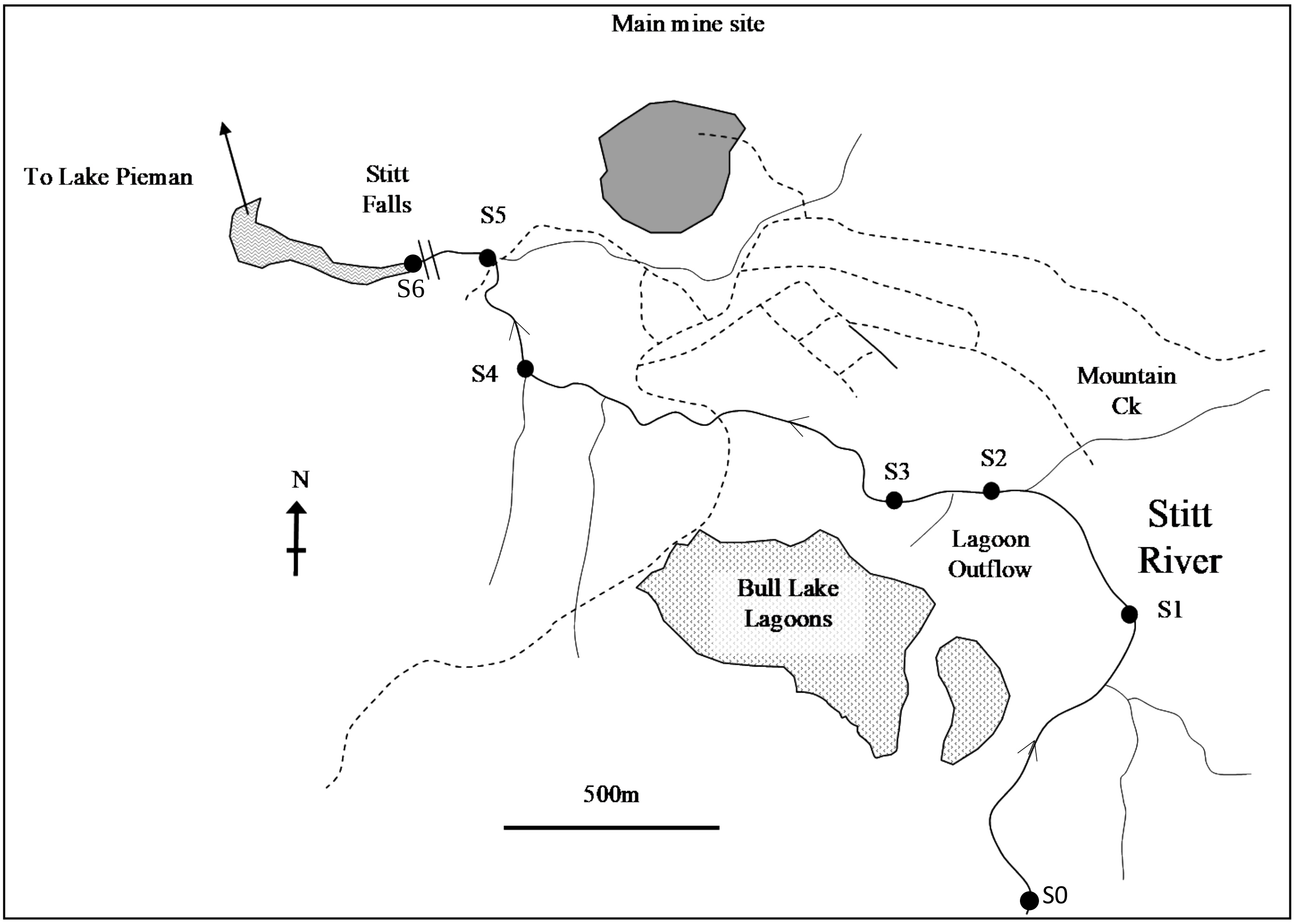


Figure 2 – Map of Stitt River sampling locations

6.5 Dust Monitoring

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring location, including discharge and ambient monitoring points that illustrate significant trends. Include a review of the accuracy of the sampling procedure, sampling schedule, sample locations and test methods applied.

EPN 7153/3, A5-3 Tabulated high-volume air sampler, and dust and metal deposition results for the entire year, showing intermediate values as well as final monitoring results. Tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs <of monthly results>. Summaries of all exceedances ..., describing the results of any investigations undertaken and the mitigation measures that were adopted in response. Any supporting data analysis or description necessary to aid interpretation of the dataset.

In accordance with EPN 7153/3 conditions G7 2.6 and A5-3, MMG continued its dust deposition and ambient air quality monitoring program and commissioned a review of the monitoring results for the reporting period. Results are summarised in Appendix G (EY, 2023).

A review of dust deposition and ambient air quality monitoring data for the reporting period found monitoring was conducted in accordance with requisite conditions and that current management measures prescribed in MMG Rosebery's Dust Mitigation Plan were sufficient for mitigating fugitive dust. Throughout the reporting period there were several exceedances of trigger levels and compliance limits, though none have been linked to fugitive dust emanating from mining activities and no dust related grievances were received from the community.

HVAS results remained below EPN trigger levels and compliance limits for all parameters. Continuous DustTrak's monitoring found the Inspection and Mitigation levels for 15 and 60-minute averages were breached at sample location AD2.1 on two occasions: December 2022 resulting from a bushfire and March 2023 resulting from an onsite barbeque. Trigger levels for total monthly deposited dust and background adjusted monthly deposited dust were also breached on two occasions; In July 2022 at sample location AD21, September 2022 at sample location AD11. The exceedance at AD11 in July 2022 was found to be an outlier and likely the result of an isolated event in close proximity to the monitoring location. This is supported by ALS commentary at the time of analysis. The exceedance investigation at AD21 in September 2022 is ongoing.

The review found MMG's Rosebery Mine poses a low environmental risk to air quality and that the current dust mitigation controls are appropriate. It is therefore recommended that the air quality monitoring network be reviewed and consolidated. Considering the low environmental risk to air quality and the typical annual rainfall, it's recommended a small, targeted network could provide more meaningful information regarding the mine's dust impact.

Part of the review and consolidation would be to address EPN 7153/3 condition A3-4. This condition allows for the removal of 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) once an annual pattern can be established. These sites have been collecting data for more than 11 years and upon data analysis it is recommended these sites be removed from the monitoring network.

6.6 Noise and Vibration Monitoring

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations ... that illustrate significant trends.

EPN 7153/3, N1 1.8 Results of the continuous noise monitoring program and noise related complaints must be reported ...

In accordance with EPN 7153/3 conditions G7 2.6 and N1 1.8, MMG continued its noise and vibration monitoring program and commissioned a review of monitoring results for the reporting period. Results are summarised in Appendix H (Tarkarri, 2023).

A review of the noise and vibration data for the reporting period was undertaken and found that annual average LAeq, LA90 and LA10 15-minute noise levels were similar to those measured in the previous year. Data availability for continuous noise monitoring ranged from 94-99% and 58-65% post quality control between noise monitoring stations. The review suggests an overhaul of data download and calibration procedures to mitigate data loss. MMG Rosebery is investigating the use of telemetry to eliminate the requisite for manual data download. It is also recommended time intervals be changed from 15 minutes to 10 minutes in line with EPN 7153/3 condition N3.3 which pertains to triennial noise survey requirements. This change would also allow for improved accuracy in relating noise data with weather data (which records every 10 minutes).

Review of ground vibration and air blast overpressure monitoring for the reporting period found MMG remained below exceedance limits during blasting times. Exceedances of the upper limit for air blast over pressure occurred on 26 occasions outside of blasting times. These exceedances were found to be the result of poor weather conditions and are unrelated to MMG blasting activity. For a more detailed review of results, refer to Appendix H (Tarkarri, 2023).

6.7 Environmental Event Management

EPN 7153/3, G7 2.7 Environmental performance, including incident management ... and the corrective and preventative processes implemented.

EPN 7153/3, G3 If an incident causing or threatening environmental nuisance, serious environmental harm of material environmental harm from pollution occurs in the course of the activity, then the person responsible for the activity must immediately take all reasonable and practicable action to minimise any adverse environmental effects from the incident.

During the reporting period, MMG Rosebery recorded 12 environmental incidents other than those concerning compliance with EPN limits (which have been assessed separately and reported in section 6 and referenced Appendices). Environmental incidents are detailed in Table 12.

There is general alignment between MMG Rosebery's Risk Consequence Criteria ratings and the Environmental Management and Pollution Control Act 1994 (EMPCA) definitions for incidents resulting in Serious (rating ≥4) and Material (rating 3) Environmental Harm referenced in condition G3. All environmental incidents during the reporting period were confined onsite, and in accordance with EMPCA, no environmental incidents that occurred during the reporting period resulted in material or serious environmental harm.

All incidents were entered in to MMG's Incident Event Management (IEM) system and required an incident investigation. The investigation process records all incident details and reports on immediate actions taken, applies a risk rating as per MMG's Risk Consequence Criteria, and identifies control failures and corrective actions required. The IEM system ensures that in all cases corrective and preventative processes were developed and implemented to reduce the likelihood of reoccurrence.

The majority of controls implemented were administrative or to a lesser extent engineered. There is currently one event still open: ID 2979307. Critical engineering controls have been implemented, the delay in closing out the event is due to prolonged project delivery time of non-critical but additional mitigative engineering controls. Excluding event ID 2979307, average close out time on incident investigations during the reporting period was 17 days.

Table 12 – Environmental incidents during the reporting period

Event Date	Event Description	Risk Consequence Criteria Rating*		Reported to EPA	Event Status
		Actual	**Potential**		
07.07.2022	2819498: Stitt River elevated turbidity	Level 1	Level 1	Yes	Closed
30.08.2022	2870621: Minor diesel contaminated water spill through crusher section	Level 1	Level 1	No	Closed
13.12.2022	2965393: Minor diesel spill at access gate Mt Read	Level 1	Level 1	No (Reported to MRT)	Closed
4.01.2023	2979307: Concentrate spill on Tomy Wagon 41, Lid 13	Level 1	Level 2	No	Investigation completed
10.01.2023	2984138: Minor hydrocarbon leak on ROM pad	Level 1	Level 1	No	Closed
19.01.2023	2989247: Zinc concentrate on train wagon lid	Level 0	Level 0	No	Closed
22.01.2023	2989233: Minor hydraulic oil line rupture on mobile rock breaker	Level 0	Level 0	No	Closed
30.01.2023	2993052: Minor hydrocarbon spill from blown tail gate cylinder hose	Level 1	Level 1	No	Closed
9.04.2023	3041677: Large inflow of water from underground	Level 0	Level 1	No	Closed
30.05.2023	3089850: Minor HVAS Pond overtopping	Level 0	Level 1	No	Closed
28.06.2023	3113735: Hydraulic hose failure on excavator boom	Level 1	Level 1	No	Closed
29.06.2023	3115319: Minor HVAS Pond overtopping	Level 1	Level 2	No	Closed

*Refers to MMG Rosebery's Risk Consequence Criteria.

6.8 Tailings Dam Management

EPN 7153/3, WM1 2.4 (all tailings' dams must) have any environmental or stability issue identified and associated with it reported to the Director within 24 hours of becoming aware of the issue and further outlined to the Director in the Annual Monitoring Review and Management Report.

The Bobadil and 2/5 Dam TSF's undergo monthly on-site surveillance by ATC Williams under supervision by the EoR. The intermediate annual inspection was also undertaken by the EoR in January 2023 on the 2/5 Dam and Bobadil TSFs as part of the biennial surveillance program for the facilities under the Australian National Committee on Large Dams (ANCOLD) guidelines.

In 2022, an autonomous Independent Tailings Review Board (ITRB) was established to conduct evaluations of all aspect of Rosebery's TSFs on an annual basis. Since its inception, the ITRB has convened in both July 2022 and in May 2023 at Rosebery. The inspections by the EoR and the ITRB evaluations provides Rosebery with actions to improve the facilities. During the reporting period, there were no significant issues identified with any of the MMG tailings and water dams (Appendix B and Appendix C).

7. Review

7.1 EPN Compliance

EPN 7153/3, G7 2.3 A review of activity compliance and annual external compliance audit against EPN requirements.

An independent on site and remote, external audit against EPN requirements was carried out on the week beginning 18 September 2023. This audit report will be submitted once finalised.

8. Acronyms

Acronym	Definition
AMRMR	Annual Monitoring Review and Management Report
DPIPWE	Department of Primary Industries, Water and Environment
EPA	Environment Protection Authority
EPN	Environmental Protection Notice
ETP	Effluent Treatment Plant
HVAS	High Volume Air Sampling
HAIR	Hercules Assessment Index for Rehabilitation
MRT	Mineral Resources Tasmania
PM10	Fraction of total particles suspended in the air, having diameters less than 10µm
PFS	Pre-Feasibility Study
QA/QC	Quality assurance / quality control
SHEC	Safety, Health, Environment and Community
TSF	Tailings Storage Facility
TSP	Total suspended particles – the term given to the fraction of total particles suspended in the air having diameters generally less than 50µm
WRD	Waste rock dump

9. References

ATCW (2023), 2/5 Dam TSF 2022 Engineer of Record Annual Inspection. ATC Williams. 222-225 Beach Road, Mordialloc, VIC 3195.

ATCW (2023), Bobadil TSF and Polishing Pond 2022 Engineer of Record Annual Inspection. ATC Williams. 222-225 Beach Road, Mordialloc, VIC 3195.

EY (2023), Annual Air Quality Report – FY23, MMG Rosebery Mine. Ernst & Young. Level 23, 8 Exhibition St, Melbourne VIC 3000.

EY (2023), Annual Meteorological Report – FY23, MMG Rosebery Mine. Ernst & Young. Level 23, 8 Exhibition St, Melbourne VIC 3000.

Mallick (2023), Biological Condition of the Ring and Stitt Rivers: Spring 2022 and Autumn 2023. Freshwater Biomonitoring. 18 Stoney Steps, South Hobart, TAS 7004.

Koehnken (2023), MMG Rosebery Annual Water Quality Monitoring Review 2022-2023. Technical Advice on

Tarkarri (2023), Rosebery Mine Environmental Noise, Ground Vibration and Air Blast Overpressure Annual Monitoring Data Review. Tarkarri Engineering. PO Box 506, Kings Meadows, TAS 7249.

Appendix A Location Maps

Scale: 1 : 10,000
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1991
Grid: Map Grid of Australia, Zone 55

MMG Rosebery Mine and Rosebery Township
Annual Monitoring Review and Management Report
2022-2023

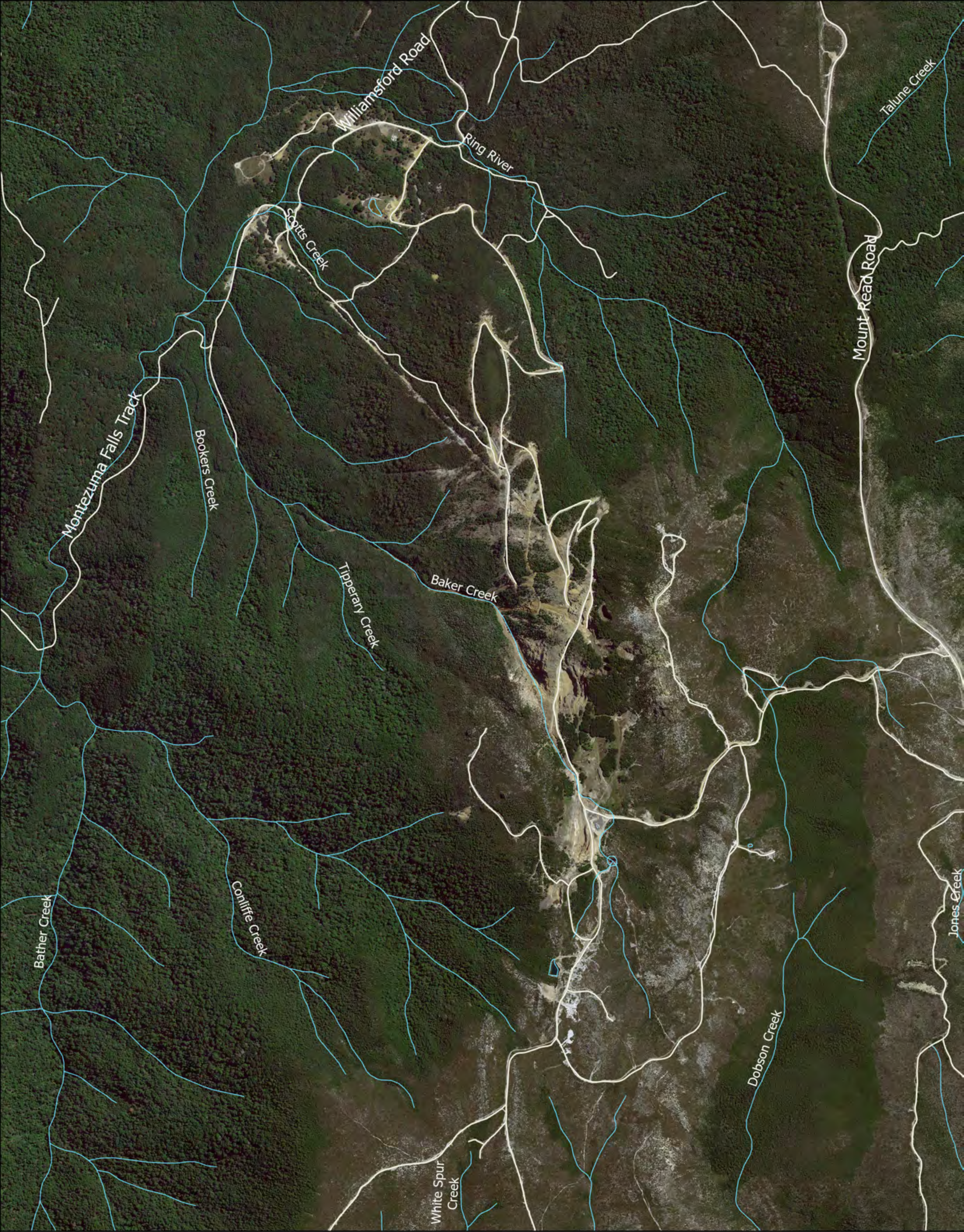
Scale: 1 : 6,000
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1991
Grid: Map Grid of Australia, Zone 55

2/5 Dam Tailings Storage Facility
Annual Monitoring Review and Management Report
2022-2023

Scale: 1 : 6,000
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1991
Grid: Map Grid of Australia, Zone 55

0 0.07 0.15 0.3 0.45
Kilometers

Bobadil Tailings Storage Facility
Annual Monitoring Review and Management Report
2022-2023



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Horizontal Datum: Geocentric Datum of Australia 1991
Grid: Map Grid of Australia, Zone 55

0 0.17 0.35 0.7 1.05
Kilometers

Hercules and Mount Read
Annual Monitoring Review and Management Report
2022-2023

Appendix B 2/5 Dam TSF 2022 Engineer of Record Annual Inspection (ATCW, 2023)

REPORT

MMG ROSEBERY MINE
ABN: 23 004 074 962

2/5 DAM TSF
2022 Engineer of Record Annual Inspection

107031.68R10
JUNE 2023

TAILINGS.WATER.WASTE.

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Project Number:	107031.68

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Issue Register

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MMG Rosebery Mine	14/06/2023

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EXECUTIVE SUMMARY

This Report documents the 2022 Engineer of Record (EoR) inspection of the 2/5 Dam Tailings Storage Facility (TSF) at the MMG Rosebery Mine, Rosebery, Tasmania.

The inspection has been carried out as part of the obligations of the EoR to MMG and provides an overview of the performance of the structures and adherence to the Operations and Maintenance Manual (O&MM). The inspection was conducted on 23rd and 24th January2023 by Mark Dillon (EoR) from ATC Williams (ATCW).

Since the 2021 annual inspection the following works have been carried out:

- Sub-aerial deposition has continued;
- Stage 2 construction has been ongoing throughout the period;
- Additional instrumentation has been installed downstream of the northern embankment and upstream and downstream of the screening bund; and
- The design for the southern extension of the eastern embankment was modified to capture fugitive seepage.

Stage 2 construction of the 2/5 Dam has been delayed due to material availability. A number of recommendations have arisen from the 2022 EoR annual inspection. These are a combination of previous audit actions that have not been completed and new action items as a result of the inspection.

Recommendations have been developed based on the site visit, review of monitoring information and discussions with site personnel. Each recommendation has been assigned a priority as follows:

- High priority – A possible current threat to the integrity of the tailings storage facility due to direct evidence of a deficient and non-conformances against requirements; or not meeting expected MMG or industry requirements; or through urgency due to a limited window of opportunity to address a recommendation.
- Medium priority – A possible longer-term issue with the tailings storage facility management that may result in a future threat to the integrity of the facility.
- Low priority – Does not represent a threat and mainly associated with maintenance or operational aspects.

Table ES1 presents the recommendations stemming from the 2022 EoR annual inspection. All accepted recommendations should have an action plan developed.

TABLE ES1 RECOMMENDATIONS

Item	Aspect	Recommendation	Priority
1	Instrumentation	Construction has progressed to a stage where instrumentation can be connected to telemetry systems. This is critical to dam safety.	High
2	Seepage	The remedial works associated with management of seepage downstream of the screening bund is complete, however seepage was observed within the concrete pit downstream of the Murchison Highway suggesting minor fugitive seepage is still occurring. The source and quality of this seepage should be investigated.	Medium

Item	Aspect	Recommendation	Priority
3	Seepage Collection Ponds	Investigation of the split lining system in the western cell identified the damage is more widespread than anticipated. The Stage 3 design is currently in progress and may impact the current configuration of the ponds. Following completion of the design an action plan should be developed that compliments the Stage 3 design and possible modification to the ponds and seepage collection/return infrastructure considered.	Medium
4	Erosion	Erosion observed in the clean water diversion should continue to be inspected monthly.	Low
5	Vegetation Management	Ongoing clearing of drains should be planned as part of routine maintenance.	Low

Based on the Inspection and a detailed review of all inspection and monitoring data, it is considered that Governance associated with the 2/5 Dam TSF is of a high standard and is being inspected and monitored in general accordance with the requirements of the overarching Operation and Maintenance Manual and in accordance with the construction TARPs, and relevant ANCOLD guidelines.

It is considered that the 2/5 Dam TSF does not present a significant risk to the environment downstream of the facility and is suitable for the on-going storage of tailings generated at the Rosebery Mine.

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

This Report documents the 2022 Engineer of Record (EoR) inspection of the 2/5 Dam Tailings Storage Facility (TSF) at the MMG Rosebery Mine, Rosebery, Tasmania.

The inspection has been carried out as part of the obligations of the Engineer of Record (EoR) to MMG and provides an overview of the performance of the structures and adherence to the Operations and Maintenance Manual (O&MM).

The previous annual inspection of the structures was the 2021 intermediate audit and was carried out by ATC Williams (ATCW) in February 2022 and is documented in the previous Surveillance Report **[1]**.

The O&MM outlines the frequency of inspections, with intermediate audits completed annually by the EoR (ATCW) and comprehensive audits completed biannually by an independent consultant. The previous independent audit (comprehensive) was carried out by KCB in September 2021 **[2]**. Accordingly, an independent (comprehensive) audit is required in 2023.

The EoR inspections are carried out in January and covers the previous calendar year monitoring data.

Since the 2021 annual inspection the following works have been carried out:

- Sub-aerial deposition has continued;
- Stage 2 construction has been ongoing throughout the period;
- Additional instrumentation has been installed downstream of the northern embankment and upstream and downstream of the screening bund; and
- The design for the southern extension of the eastern embankment was modified to capture fugitive seepage.

2 SCOPE OF WORK

The inspection was completed by the EoR in accordance with the requirements for intermediate inspections outlined in ANCOLD **[3]**.

3 GENERAL INFORMATION

3.1 Operational Status

The 2/5 Dam TSF was commissioned in April 2018. The facility was the primary tailings storage at Rosebery until mid-2022 when Bobadil Stage 10 was commissioned. Tailings are now batch discharged between the two facilities.

The facility is nearing its Stage 1 capacity. The remaining capacity in 2/5 Dam Stage 1 indicates the facility will be filled to freeboard by the end of Q1 2023,noting that the January 2023 bathymetric surveys are not yet complete. The bathymetry may indicate that the discharge is possible into Q2 2023. This estimate of remaining capacity is based of splitting tailings discharge between Bobadil and 2/5 Dam on a rotating basis in accordance with the current operational plan.

Construction of Stage 2 commencing in early 2021 and is currently scheduled to be completed in mid-2023.

3.2 Physical Details

The 2/5 Dam is located approximately 1 km southeast of the Rosebery Mine. The site is fenced off to the general public, but pedestrian access is possible. A general site location plan is presented in **Figure 1**. The general layout of the 2/5 Dam TSF, with January 2023 aerial imagery, is presented on **Figure 2**, whilst typical sections are presented on **Figure 3** and **Figure 4**.

The facility can be described as a side hill facility. There is a clean water diversion to the south of the TSF to reduce inflow from the surrounding catchment area. The catchment area of 2/5 Dam is approximately 45 hectares (Ha), inclusive of the natural topography between the TSF and clean water diversion to the south. A Seepage Collection Pond (SCP) is located to the north of the main embankment.

The facility, in its current form, is a single continuous embankment formed via upstream and downstream construction over and around the previous 1, 2 and 5 Dam complex, originally constructed between 1950 and 1970. The facility currently has varying crest levels due to ongoing Stage 2 construction. At the time of the inspection the crest elevation varied from RL 173.0 m (Stage 2 crest on the western and southern embankments) to RL 170 m (northern embankment Stage 1 crest elevation). The eastern embankment elevation is approximately RL 171 m. For the purpose of operations, the current Stage 1 spillway invert (RL 169 m) and northern embankment crest governs freeboard and operational criteria.

The Consequence Category of the 2/5 Dam was reassessed as part of Stage 2 design and is clarified as a High A based on ANCOLD **[3]**.

An overview of historical 1,2 and 5 dam construction together with a discussion of the 2015 design, storage, and flood capacity of the current 2/5 TSF is provided in **Appendix A**. Note that the historical information will be updated to include Stage 2 development once Stage 2 is commissioned.

3.3 Surveillance Program

3.3.1 Frequency

ANCOLD (2019) **[3]** indicates that for a "High A" Consequence Category dam, routine visual inspections should be carried out on a daily to 3 times per week basis, that intermediate inspections are carried out annually and that comprehensive inspections are carried out at 2 yearly intervals.

3.3.2 Routine Visual Inspections

Routine visual inspections of the 2/5 Dam TSF and SCP are specified in the O&MM **[4]** and are required to be conducted on a shift/daily, weekly, and monthly basis. Refer to **Section 5** of this Report for a more detailed discussion of these inspections and their implementation.

3.3.3 Monitoring

The facility is monitored on a monthly basis and a monthly report is prepared to summarise the findings. Monitoring includes measurement of phreatic conditions, pond water levels, embankment movement or settlement, internal drainage, and seepage from the facility. In addition, a bathymetric survey is conducted on a 6-monthly basis to assess the stored density and elevation of the tailings and associated water cover depth. These requirements are detailed in the O&MM **[4]**.

Further details regarding monitoring, including a review of results for the audit period, are presented in **Section 5** of this Report.

Figure 5 presents the locations of piezometers and seepage monitoring instrumentation around the TSF.

4 SURVEILLANCE INSPECTION

4.1 Details of Inspection

The Inspection was conducted on 23rd and 24th January 2023 by Mark Dillon (EoR) from ATCW. Pamela Soto (MMG Manager Tailings & Water Australia) was also in attendance during the inspection.

The weather during the inspection was sunny and hot. There was a brief storm late in the afternoon on 23rd January. The weather conditions were not a factor during the inspection.

Details of the inspection, in the form of the monthly checklist is presented in **Appendix B**. A summary of inspection observations is presented in **Figure 6**.

4.2 Photographic Record

Representative photographs taken during the audit inspection are presented in **Appendix C**. The approximate locations of the photographs are presented as **Figure 7**.

4.3 2/5 Dam

4.3.1 Freeboard, Spillway, Diversion and Decant

The pond elevation at the time of the inspection was RL 167.49 m. The beach elevation varies around the facility as shown on **Figure 2**. The freeboard criteria is a minimum beach freeboard of 0.3 m for the facility, considering sub-aerial deposition. The beach elevation against the northern embankment is RL 168.0 m and along the western embankment varied between RL 168.0 m and RL 168.5 m. This suggests a wall freeboard of between 1.5 m and 2 m. In terms of pond freeboard, the pond elevation is 1.51 m below the Stage 1 spillway.

The decant inlet was clear of obstructions but it was noted that the safety grate covering the entrance to the decant had been removed, which poses a safety risk. The decant grate should be replaced.

The spillway was in good condition. Culvert sections, old HDPE pipe and the generator for the sprinkler system are currently located within the base of the spillway. Whilst of no concern at this point in time, it is not best practice to use the spillway cutting as a storage area or for the installation of infrastructure. As part of Stage 2 works the generator and pipework will be relocated to near the valve station (RL 173 m).

The diversion channel was observed to be in good condition. There is evidence of possible loosening of rock in the western cut face between benches 1 and 2. Comparison between photographs taken in February 2022 and those taken as part of this inspection suggest some loosening of rock. An exclusion zone has been established below this area. The low flow drain (in the base of the diversion channel, has been backfilled with granular fill since the previous inspection. It is understood this was done to improve the width of the haulage route for Stage 2 construction.

Two filter walls, nominally 1 m high have been constructed across the northern end of the diversion channel, one at the outlet and the other approximately 50 m to the south. These were observed to have performed well since installation and remain in very good condition.

These sediment walls, haul road fill and low flow drain backfill are all temporary structures and will be removed upon completion of Stage 2 construction and the base of the diversion channel returned to its pre Stage 2 condition.

4.3.2 Embankments

Construction activities associated with the Stage 2 raise were in progress. The status of construction is summarised below:

- Northern embankment – toe buttresses complete but the raise to the crest has not been commenced,
- Western embankment – raised to final level, upstream geosynthetic liner installed,
- Eastern embankment – in progress, crest varies. Seepage mitigation reverse filter has been completed.
- Southern embankment – earthworks completed, final upstream tie-in of the geosynthetic lining system still be completed.

The completed embankments were in very good condition, with those under construction being kept in a tidy condition.

The upstream lining system, both Stage 1 and that placed for Stage 2 was observed to be in good condition. The two specific defects noted in the previous EoR report have been actioned. No major defects were observed, noting that minor defects may exist. We did note that the upstream lining system had been damaged by dragging the sprinkler pipeline against the upstream face of the eastern embankment. Once the liner has been cleaned as part of the Stage 2 lining works the existing liner should be carefully inspected and repaired as required.

4.3.3 Embankment Seepage

Seepage was observed from the downstream toe of the northern and eastern embankments. Seepage remediation works along the Murchison Highway have been completed.

The majority of historical seepage from the northern embankment has been covered by Stage 2 construction but the two predominant areas at the toe are still visible, these being:

- Toe seep at low point @ 379071E, 5373120N (point A on **Figure 6**).
- Toe seep at old drain @ 379103E, 5373102N (point B on **Figure 6**).

Both of these seepage points have been instrumented to monitor seepage rate. A small weir has been formed to capture seepage from points A and B (**Figure 6**) and a pump has been installed to transfer the collected seepage to the Seepage Collection Ponds.

Seepage from the downstream toe of the original 5 Dam embankment, defined by channels cut to the seepage collection drain, were:

- Broad area of toe seepage @ 379338E, 5372805N (point C on **Figure 6**).
- Original 5SP03 toe train outlet (point D on **Figure 6**).
- At the southern end of the eastern embankment @ 379254E, 5372297N (point E on **Figure 6** and associated with the original southern abutment of 5 Dam.
- Concentrated seep with some tailings presents in the decommissioned clean water diversion drain (point F on **Figure 6**).
- Minor seep emanating approximately 1.5 m up downstream batter at original southern abutment of 5 Dam (point G on **Figure 6**).
- Minor toe seep from the Stage 2 downstream toe @ 379071E, 5373120N (point H on **Figure 6**)

The majority of the seeps were assessed as low flow and were clear. Iron precipitates were present at seepage points C and E. Reeds are present in general proximity to the seeps.

The seepage flow in the decommissioned clean water diversion drain was high. A reverse filter has been incorporated into the downstream shell of Stage 2 works in this area to reduce the risk of tailings carry through.

Pre-existing seepage from the old northern 5 Dam embankment remains. These seeps are mainly associated with chimney drain discharge (points D and H).

4.3.4 Screening Bund

At the time of the inspection, modifications to the screening bund were approximately 95% complete. The status of works is summarised below:

- Ground improvement: Jet grouting between the toe of the Stage 1 screening bund and Murchison Highway was complete.
- Downstream toe buttress: Complete. Planting was in progress at the time of the inspection.
- Seepage collection system: Complete. Permanent pumping system is still to be completed.
- Stormwater system: Complete.
- Crest: Northern section under construction.

The works were observed to be of high quality.

It was noted that some seepage is still present at the road crossing and within the v-notch located to the west of the Murchison Highway. The source of this water will need to be investigated further.

4.3.5 Tailings Deposition

There was no deposition into 2/5 Dam at the time of the inspection but is ongoing with discharge either to 2/5 Dam or Bobadil.

Tailings beaches adjacent to the northern, eastern, and western embankments were present and were uniform with very little channeling observed.

Pipelines were present on the crest of the northern embankment and were observed to be in good condition. Pipelines on the eastern and western embankments had been removed due to Stage 2 construction.

The sprinkler system was operational, with sprinklers located on the eastern embankment operational. In addition, a small sprinkler line has been placed on the tailings beach upstream of the western embankment to maintain moisture in the exposed tailings.

The valve station was generally in good condition but one of the pipe/valve supports has been dislodged and should be repaired. This was observed during the previous inspection in early 2022.

4.3.6 Seepage Collection Drains

There are two perimeter surface seepage collection drains. One is located at the toe of the existing 5 Dam (eastern drain) and collects all seepage from the eastern part of the TSF. The other drain is located at the toe of the Northern Embankment (western drain). Seepage into the eastern drain reports to the Seepage Collection Ponds after passing through a V-notch weir. Seepage collected from the western drain collects a low point where it is pumped to the Seepage collection Pond.

Additionally, internal toe drains have been installed within the North Embankment. The pipelines have been extended as part of Stage 2 construction and the three pipe outlets discharge into a channel, pass through a V-notch weir and discharge into the Seepage Collection Pond.

The drain along the toe of the eastern portion of 5 Dam has been filled with coarse rock to facilitate access along the toe by articulated trucks. The coarse rock appears to have sufficient capacity to pass the flowrate within the drain. The coarse rock will need to be removed once the construction works are complete. Beyond the area where coarse rock has been placed the drain is in good condition but becoming overgrown. Flow was clear. Reeds and grasses are present within the drain which is constricting flow slightly but is of no concern at this point in time. Consideration should be given to including clearing the drain as part of annual maintenance.

4.3.7 Clean Water Diversion

The clean water diversion drain, located to the south of the TSF had minor flow over the control weir, located towards the eastern end, at the time of inspection. Flow commenced approximately half way along the drain at the intersection with an ephemeral creek line. Up gradient the drain was dry.

An eroded section, with associated slumping was observed on the upstream side slope through low strength glacial clays/silts around 379247E, 5371843N. The flow has cleared the slumped material observed in January 2022. Whilst the slumped material has been cleared, undercutting of the glacial material remains present so this area should be monitored.

A slump was also observed at 378945E, 5372080N. This appears to be associated with an old glacial infill area. Further slumping can be expected and there is a possibility that small trees at the top of the slump may fall. It is likely that slumping will be ongoing. This area will need to be monitored monthly.

Extensive cracking of the safety bund on the downstream edge of the access road associated with the drain was observed in places towards the mid to western end of the drain. This is associated with areas where the access road is in fill (noting that the entire drain is in cut). The cracks have rounded edges with vegetation litter present, and vary in width from hairline to approximately 100 mm. The rounded edges suggest that cracking is old or very slowly developing. Of note is that the area of the drain above the active quarry presented no evidence of new cracking from blast vibrations but has increased in width. The cracks have been mapped by ATCW site engineers and are monitored on a monthly basis.

As a risk mitigation measure a bund has been placed across the access track to limit access to pedestrian traffic.

The box culvert CWD outlet was in good condition. There is some undercutting of the culvert on the downstream side but does not appear to have increased in extent since the January 2022 inspection. It is not of concern at this stage but should continue to be monitored monthly.

4.4 Seepage Collection Pond

The crest, upstream downstream slopes were observed to be in good condition. There are potholes on the crest of the ponds that need maintenance.

The lower (western) pond has been drained and pressure washed. The cleaning and pressure washing process has exposed considerable damage to the liner in the form of split seams and liner tears. An action plan needs to be developed to assess remedial measures for the western cell of the Seepage Collection Pond.

The spillway crest was clear of obstructions. The two seepage inlet structures are in good condition.

The seepage return pump and the pump bridge appear to be in good condition.

The Low Flow structure between the two cells was observed to be in good condition and free of debris. One stop board was in place at the time of inspection.

5 REVIEW OF SURVEILLANCE

5.1 Review of Previous Inspection Reports

5.1.1 General

MMG now capture recommendations in the IEM register which presents the actions, presents timeframes and nominated the responsible MMG person. The IEM register was reviewed as part of the annual inspection. In addition, MMG provided documentation in relation to the implementation of actions via a memorandum dated 18/12/2022.

5.1.2 Review of 2021 EoR Inspection Report

The 2021 EoR inspection report prepared by ATCW **[1]** was reviewed. Issues raised, and corrective action completed, as presented in the IEM register is presented in **Table 5.1.**

TABLE 5.1 ACTION ITEMS STATUS FOR 2021 INSPECTION

Item	Item Reference	Description	Status
1	2019 - 2021	Vegetation Management and clearing of drains should be planned as part of routine management.	Ongoing routine maintenance, budgeted.
2	2019 - 2021	Erosion observed in the clean water diversion should be inspected monthly. If this impedes flow remedial works will be required.	Ongoing monitoring in accordance with OMM, develop action plan if required. Monitoring is normal practice by: • monthly inspection by ATCW) and • quarterly surface geotechnical inspections • implemented in second half of 2022. Commitment to continue to do this is ongoing.
3A	2019	The split liner seam in Seepage Collection Pond should be repaired	Closed, refer item 4
3B	2021	The split liner seam in Seepage Collection Pond should be repaired	Flushing and cleaning of the ponds for inspection before repair commenced in October 2022. Repair is budgeted in January 2023 - to coincide with liner works at the 2/5 dam for the Stage 2 Raise. Note that remediation plan for repair will be deferred until the impacts of Stage 3 design on the current pond geometry is known.
4	2021	The variance in piezometric surface within the foundation of the eastern embankment requires investigation	During ITRB (July 22) this was discussed and noted as not critical for ongoing operation of the dam due to many competing priorities. No action required. Agreed in ITRB that this should not distract more important work.

5.2 Routine Inspections

5.2.1 General

Routine Inspection procedures for the mandatory surveillance of the 2/5 Dam TSF and SCP are specified in the O&MM **[4]**. The inspection requirements are as follows:

- Shift/Daily and Weekly Routine Inspections – relating to issues that may develop over time and impact on the safety of the dam or the environment.

- Monthly Routine Inspections – relating to issues that may develop over time and routine monitoring.

In addition to the above routine monitoring, the results are compiled into monthly reports to provide MMG with a summary of the performance of the facility.

5.2.2 Routine Shift/Daily and Weekly Inspections

The Manager - Concentrator is responsible for coordinating the shift/daily and weekly inspections and reporting. The inspections are recorded electronically in the Effluent System Change Register which includes the checklists from the O&MM.

The previous review of the register was to 31 December 2021. The register was reviewed for compliance with the O&MM for the 12-month period ending 31 December 2022. The findings summarised below:

- Shift/Daily Inspections – 100% completion.
- Weekly Inspection – 98% completion.

From review of the register, it is apparent that the high level of compliance with regard to inspections has been maintained throughout the 12-month period since the previous review.

Based on review of the register it is considered that the inspections are being carried out in general accordance with the requirements of the O&MM.

5.2.3 Routine Monthly Inspections and Reports

Routine monthly inspections are the responsibility of the Concentrator Department, who have contracted ATCW to complete the monitoring and inspections. Monthly inspections are stored by MMG within their electronic library. The inspections are presented in a TARP format. The inspections have been completed in accordance with the O&MM.

5.2.4 Non-scheduled Inspections and Corrective Action

There was one Non-scheduled inspections associated with operations which was associated with loss of containment of tailings from the southern end of the eastern embankment. In addition, there were non-scheduled inspections/reviews relating to piezometers exceeding Construction TARP trigger levels, required during the period. More frequent monitoring (weekly) has been carried out at times in accordance with the TARP set out within the O&MM.

The incident associated with the loss of containment was observed during the January monthly inspection (early February) and the response was in accordance with the O&MM. The EoR was notified, and a meeting held to develop an action plan. A site visit was made by a senior engineer and followed by an EoR inspection. It was identified that the incident was not an immediate dam safety risk and remedial measures implemented and incorporated into the Stage 2 construction to mitigate the risk.

5.3 Monitoring

5.3.1 General

Routine monitoring of the facility has been carried out monthly during the audit period, with additional monitoring (weekly) completed at times due to construction trigger exceedances. The following monitoring was carried out.

- Water Level within the TSF has been measured at the decant since June 2018. Readings are taken manually.

- Seepage on a weekly basis from:
    - western end of the Northern embankments (V-notches 2 and 3 installed in May 2022)
    - Internal drainage from the northern embankment (V-notch 4).
    - Eastern flank of the facility (V-notch 5).
    - Southern end of the eastern embankment (V-notch 6).
    - Possible seepage and stormwater flow at the stormwater outlet culvert located on the western side of the Murchison Hwy to the north of the Screening Bund (V-notch 1).
- Phreatic surface within the facility daily/weekly depending on the area of Stage 2 construction works (45 Piezometers).
- The settlement monuments installed at the 2/5 Dam TSF were removed/destroyed in April 2021 as part of Stage 2 construction. A total of 20 settlement plates were installed in early 2022 within the northern embankment downstream buttress as part of the Stage 2 embankment works for construction induced movement monitoring. The settlement plates are monitored on a daily basis as part of the construction monitoring and reported daily in the daily report.
- Daily/weekly lateral movement of embankment and foundation via monitoring using inclinometers. Note that inclinometers are read more frequently (daily/weekly depending on the area of Stage 2 construction) during construction in accordance with the construction TARP.

The following sections provide a discussion and summary of the monitoring.

5.3.2 Monitoring Piezometer Water Levels

There are 45 vibrating wire piezometers installed in the 2/5 Dam TSF to measure the phreatic surface within the embankments and tailings. There are 35 piezometers on the northern and eastern embankments, including 12 new piezometers installed on the Northern Embankment during 2022, and 10 piezometers located upstream and downstream of the screening bund including 5 new piezometers installed during 2022. The locations of the vibrating wire piezometers are shown on **Figure 5**.

The observed water levels within the North and East embankments piezometer are summarised in **Figures 8** to **11.**

The figures show that many piezometers installed within the northern embankment have shown a response to Stage 2 raise construction works taking place on the northern embankment, particularly on the central and eastern sections. The increase and subsequent dissipation of pore water pressure has been monitored closely, with recordings taken on a 6-hourly basis during Stage 2 construction works. TARP levels are assessed and revised by ATCW for each phase of the Stage 2 raise. Piezometers unaffected by construction loading have remained steady throughout 2022.

The exception to the above is VWP 43 (tip A and B) which reported unrealistically high pore pressure responses soon after installation. A standpipe piezometer (SPVW40)) was installed next to the VWP in January 2023. During installation of the standpipe the VWP pore pressure dropped to a level similar to the surrounding the VWP's but since has risen to the unrealistically high pore pressures. The ore pressure associated with VWP43 is considered erroneous based on the adjacent standpipe and surrounding VWP's.

The piezometers installed within the 5 Dam show a strong correlation to pond elevation.

Piezometers were installed either side of the screening bund in May 2019, and 3 new piezometers have been installed in September 2022 to monitor construction works associated with the screening bund. The piezometers upstream of the screening bund reported a decrease of approximately 1 m before increasing again in November 2022 and appearing to stabilise. From September 2020 the pore pressures appear to stabilise independent of the pond elevation. **Figure 12** summarises the pore pressures since installation.

Review of piezometer records indicate that all piezometers installed within the 2/5 Dam, as of January 2022 are within the Normal TARP level.

5.3.3 Monitoring Internal Drainage and Seepage

There are six V-Notches installed within 2/5 Dam TSF to monitor seepage flow. The locations are shown on **Figure 5.**

V-Notches 2, 3 and 4 are used to measure internal drainage and seepage from the western flank of the North embankment whilst V-Notch 5 measures seepage from the eastern part of the facility. V-notch weir 1 measures seepage and stormwater flow to the north of the screening bund at the stormwater outlet. V-notch 6 monitors toe seepage from the southern end of the eastern embankment.

Monitoring of the V-notch weirs has been carried out on a monthly basis up to May 2022 and on a weekly basis from June 2022 by the ATCW 25 Dam site engineer . A summary of monitoring results since January 2018, or installation is provided in **Figure 13**.

Monitoring since the start of 2022 Indicates:

- Northern Flank Seepage (measured at V-Notches 2 and 3):
  - These V-notches were installed as part of Stage 2 works in the latter part of 2022. V-notch 2 measures seepage from the western abutment and along the western toe of the Northern embankment. This seepage is currently being pumped back into the seepage collection pond using an automated pump, hence, V-notch 2 reports zero flow. V-notch 3 measures seepage at the northwestern toe of the TSF. This V-notch is sensitive to rainfall and the readings vary between 0.9 l/s to 2.1 l/ s.
- Northern Embankment Internal Drainage (measured at V-Notch 4):
  - The flow rate has decreased slightly over the reporting period in response to consolidation of the tailings reducing the seepage flux into the embankment. The average flow rate is approximately 6.7 l/s with a high of approximately 8.2 l/s in June 2022. The internal drainage rate continues to be independent of rainfall.
- East Embankment Seepage (measured at V-Notch 5):
  - The V-notch is manually read; hence the readings can only be related to rainfall immediately preceding (day of or previous day) the measurements. Based on this approach there is a correlation between rainfall and flow.
  - The flow varies from a peak of 16 l/s to a low of approximately 0.2 l/s.
  - Base flow of seepage, from the original 5 Dam embankment during periods of little or no rainfall is approximately 1.0 l/s.
- Northern End Screening Bund (measured at V-Notch 1):
  - The flow has decreased significantly since installation of a french drain and a seepage collection system downstream of the Screening Bund.
  - The monitoring suggests a weak correlation with rainfall, indicating likely flow of seepage from the TSF or other source of water ingress around the site.
  - After construction of the Stage 2 screening bund seepage collection system in April 2022 , the flow varies from a peak of approximately 2.0 l/sec to a low of 0.5 l/sec and a median flow rate of approximately 1.7 l/sec, significantly less than the previous year's monitoring.
- Southern End of Eastern Embankment (measured at V-Notch 6):
  - The V-Notch measures the seepage emanating at the southern end of the Eastern Embankment.
  - The V-Notch was removed in July for construction of reverse filter and reinstalled in November 2022. Readings since November suggest a seepage base flow rate of approximately 1.0 l/s.

5.3.4 Settlement and Movement Monitoring

The settlement monuments (pins and prisms) installed on the downstream were read monthly until April 2021 when they were removed as part of Stage 2 construction.

Settlement plates have been installed to monitor settlement induced by Stage 2 construction. The settlement plates are monitored daily using a robotic total station during construction and reported in the daily site reports. To date movement measured is within the green (expected) TARP level.

5.3.5 Inclinometer Monitoring

A total of 9 inclinometers (IC5-IC10 and SAVV1 -SAVV3), including the newly installed three inclinometers (IC8, IC9 and IC10), are located within the toe buttress downstream of the Northern embankment. All inclinometers, excluding IC5 and IC7, are equipped with in-place segments and a data logger. IC7 is a damaged inclinometer and provides data to a depth of approximately 7 m but this data only provides relative movements as the base is no longer fixed to a defined position. IC5 has previously equipped with a shape accel array to the full depth.

Inclinometers IC8 and IC9 were installed in April 2022. IC4 was blocked approximately 8.5 m below the surface in 2021 and this was grouted following installation of IC8 and IC9.

In-place segments were installed in all the other inclinometers except IC7 and IC5 in April -May 2022. IC10 was installed in November 2022 in the vicinity of IC4 and IC7, replacing both IC4 and IC7.

The inclinometer locations are presented on **Figure 5**.

Review of the inclinometer information indicates:

- The inclinometer plots indicate that minor movement of the embankment is occurring at a rate 0.2 – 0.4 mm/day. It is considered that the movements are likely due to ongoing primary and secondary consolidation of the foundation silt due to the new embankment load and post construction settlement of rockfill due to particle breakage.
- IC6 and IC7 show distinct consolidation in at depth of 6 m to 18 m (IC6) and, 10 m to 13 m (IC7). Maximum displacements of 38 mm (IC6) and 42 mm (IC7) in a downstream direction are reported.
- IC5 (SAAF) - movement of approximately 20 mm over the previous 3 month period at, or just above, the embedded liner and a total movement of 145 mm since installation in June 2018.
- IC6 – monitoring, since re-installation in April 2022, suggests movement in the upper 6 m of inclinometer of 5 mm has occurred. In addition, consolidation of the soft silts between 6 m and 18 m below surface is occurring. Deflections of up to 38 mm are present within the soft zone.
- IC7 – monitoring, since re-installation in mid-2018, suggests consolidation is occurring between in the upper 3 m. There has been very little movement over the previous 12 month period. Deflections below this depth vary from +35 mm to – 30 mm.
- IC8 is showing very little movement since installation in December 2022. Maximum deflections occur at a depth of 5 m to 9 m, and range from +6mm to -5 mm.
- IC9 -monitoring, since installation in April 2022, suggests movement in the upper 11 m of inclinometer of 5 mm has occurred. Consolidation of the soft silts between 11 m and 18 m below surface has been noticed with the maximum deflection up to 40 mm within the soft zone.
- IC10 data plots indicate generally minor movements since installation in November 2022. Based on limited data, some consolidation appears to be occurring between 6 m and 20 m, ranging between ±6 mm.
- SAAV1 is showing consolidation at a depth of between approximately 12 m and 18 m since installation of in-place segments in April 2022. Deflections of +38 mm to -24 mm are reported within this zone. Deflections within the top 10 m of the inclinometer are less than 5 mm.

- SAAV2 is showing displacement at a depth of 8.5 m of approximately 10 mm in a downstream direction since installation of in-place segments in April 2022. The top 8.5 m is exhibiting uniform displacement, with the exception of the top 4 m, with deflections up to 13 mm likely caused by northern embankment construction works.
- SAAV3 is showing displacement at a depth of 11 m of approximately +19 mm and -18 mm, and between depths of approximately 4 m and 8 m, with maximum deflections ranging between ±14 mm below this depth since installation of in-place segments in April 2022.
- The movements within the foundation at approximately RL 140 m are consistent with IC5 and SAAV2.

The most recent inclinometer plots are presented in **Figures 14 to 22**.

5.3.6 Tailings and Decant Pond Level

The storage volume occupied by tailings is assessed via bathymetric survey which is generally undertaken on a 6-monthly basis. Three bathymetric surveys have been carried out during this audit period.

The storage volume has been estimated from the most recent bathymetric survey completed on 24th February 2023. The bathymetric survey indicates the stored tailings volume since commissioning is approximately 2.22 Mm^3. Approximately 3.47 Mt of tailings has been discharged into the TSF between commissioning and February 2023. The estimate of emplaced tailings density based on volume and tonnage is approximately 1.56 t/m^3, which is much higher that the design density of 1.25 t/m^3. It is possible that settlement of the existing tailings has occurred and is contributing to this result.

The pond elevation at the time of the bathymetric survey was 167.67 m.

An assessment of the February 2023 bathymetric and Lidar surveys indicates:

- Tailings level in the TSF varies with the maximum beach level of RL 169.5 m near the southern end of the eastern embankment and the minimum beach level of RL 163.1 m in the middle of the TSF.
- Average beach slopes for sub-aerial tailings and sub-aqueous tailings are 1% and 3.2% respectively.
- Approximate volume of water in the facility at the time of survey is 522,700 m^3.

At the time of the annual inspection the pond elevation had risen to RL 167.49 m. Based on the Stage 1 spillway invert of RL 169.0 m the available freeboard was 1.51 m which exceeds the minimum design freeboard of 1.2 m.

5.3.7 Remaining Capacity

The Stage 1 storage capacity including the expected additional capacity from subaerial deposition is approximately 3.5 Mt. Hence, the available capacity as of 24th February 2023 is 0.3 Mt. At a nominal tailings deposition rate of 560,000 tpa (70% of throughput) it is expected that the 2/5 Dam TSF will reach its full capacity by August 2023, provided the available space is freely and efficiently utilised.

6 OPERATION, MAINTENANCE AND EMERGENCY MANAGEMENT

The O&MM was last updated in February 2022 **[5]** as part of the conversion of the facility to sub-aerial deposition for the remainder of the Stage 1 life.

In addition to the February 2022 update, construction TARPs were developed for the northern embankment piezometric levels and movements. These TARPs will remain in place until commissioning of Stage 2.

7 REVIEW OF DAM STATUS

Based on the Inspection and a detailed review of all inspection and monitoring data, it is considered that Governance associated with the 2/5 Dam TSF is of a high standard and is being inspected and monitored in general accordance with the requirements of the overarching Operation and Maintenance Manual and in accordance with the construction TARPs, and relevant ANCOLD guidelines.

It is considered that the 2/5 Dam TSF does not present a significant risk to the environment downstream of the facility and is suitable for the on-going storage of tailings generated at the Rosebery Mine.

8 SUMMARY OF RECOMMENDATIONS

A number of recommendations have arisen from the 2022 EoR annual inspection. These are a combination of previous audit actions that have not been completed and new action items as a result of the inspection.

Recommendations have been developed based on the site visit, review of monitoring information and discussions with site personnel. Each recommendation has been assigned a priority as follows:

- High priority – A possible current threat to the integrity of the tailings storage facility due to direct evidence of a deficient and non-conformances against requirements; or not meeting expected MMG or industry requirements; or through urgency due to a limited window of opportunity to address a recommendation.
- Medium priority – A possible longer-term issue with the tailings storage facility management that may result in a future threat to the integrity of the facility.
- Low priority – Does not represent a threat and mainly associated with maintenance or operational aspects.

Table 8.1 presents the recommendations stemming from the 2022 EoR annual inspection. All accepted recommendations should have an action plan developed.

TABLE 8.1 RECOMMENDATIONS

Item	Aspect	Recommendation	Priority
1	Instrumentation	Construction has progressed toa stage where instrumentation can be connected to telemetry systems. This is critical to dam safety.	High
2	Seepage	The remedial works associated with management of seepage downstream of the screening bund is complete, however seepage was observed within the concrete pit downstream of the Murchison Highway suggesting minor fugitive seepage is still occurring. The source and quality of this seepage should be investigated.	Medium

Item	Aspect	Recommendation	Priority
3	Seepage Collection Pond	Investigation of the split lining system in the western cell identified the damage is more widespread than anticipated. The Stage 3 design is currently in progress and may impact the current configuration of the ponds. Following completion of the design an action plan should be developed that compliments the Stage 3 design and possible modification to the ponds and seepage collection/return infrastructure considered.	Medium
4	Erosion	Erosion observed in the clean water diversion should continue to be inspected monthly.	Low
5	Vegetation Management	Ongoing clearing of drains should be planned as part of routine maintenance.	Low

9 CLOSURE

Your attention is drawn to the “Conditions of Report” which appear at the end of this report.

REFERENCES

[1] ATC Williams Pty Ltd (2023). 2/5 Dam TSF, 2021 Engineer of Records Annual Inspection, Reference 107031.68R08, January.

[2] KCB (2022). Rosebery Mine 2/5 Dam Tailings Storage Facility – 2021 Dan Safety Review, reference 220318R_25Dam_DSR, D10307AO7, March.

[3] ANCOLD (2019). Guidelines on Tailings Dam Planning, Design, Construction, Operation and Closure. July.

[4] ATC Williams Pty Ltd (2018). MMG Rosebery Mine, 2/5 Dam Tailings Storage Facility Operating Manual and 2/5 Dam Monitoring Programme, Rev 3. reference 107031.33R11. March.

[5] ATC Williams Pty Ltd (2022). MMG Rosebery Mine, 2/5 Dam Tailings Storage Facility Stage 1 Modification to Sub-Aerial Deposition Operating Manual, Rev 1. reference 107031.69R03. March.

CONDITIONS OF REPORT

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FIGURES

NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023
2.- 2-5 DAM TSF IMAGE DATED JANUARY 2023
3.- IMAGE OF EXTENDED ROSEBERY AREA DATED JANUARY 2022

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

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MMG ROSEBERY MINE
2022 EOR INSPECTION

GENERAL LOCATION PLAN

DWG. No.

FIGURE 1

SHEET SIZE	A3	Rev.	A

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SHEET 1 OF 1

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\2-5\Figure 1 - 2-5 General Location Plan.dwg

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NOTE:
1.- 2-5 DAM TSF IMAGE DATED JANUARY 2023
2.- EXTENDED 2-5 DAM TSF IMAGE DATED JANUARY 2022

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2/5 DAM TSF
GENERAL LAYOUT

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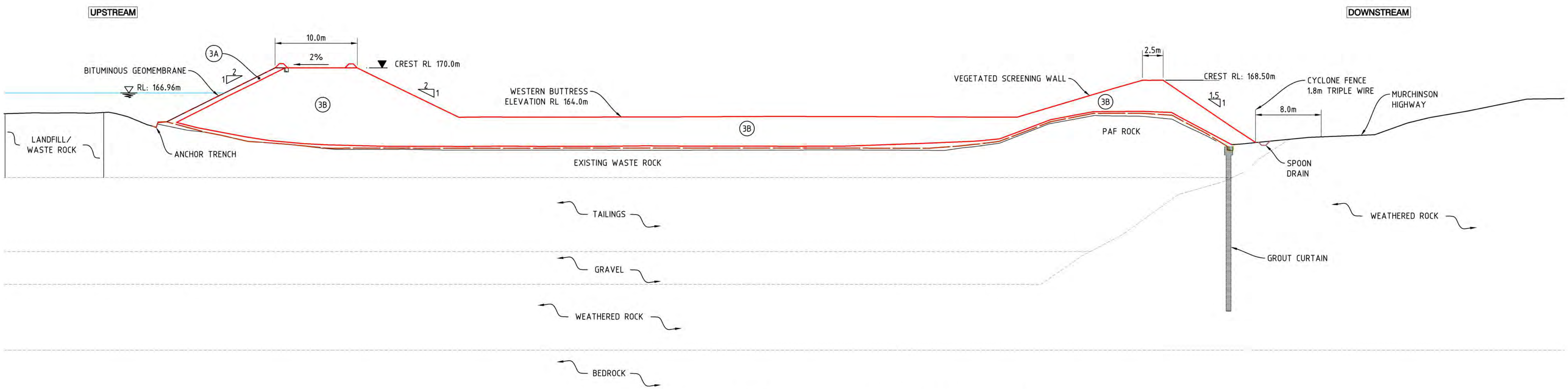
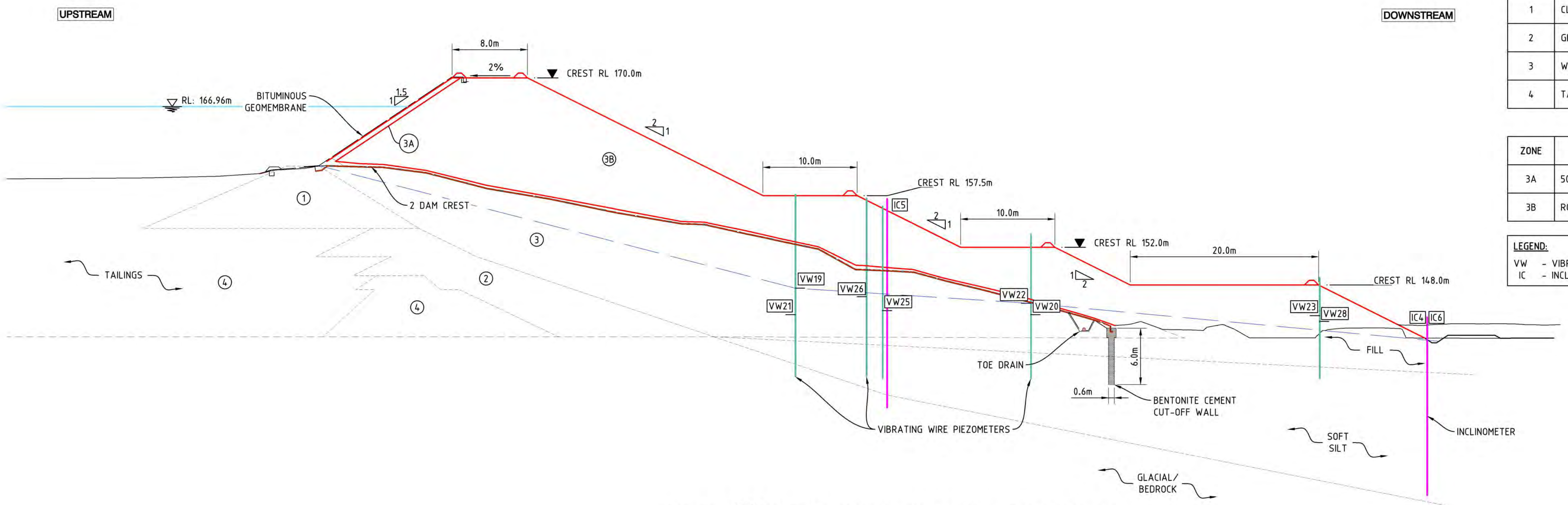
FIGURE 2

SHEET SIZE A3 Rev. A

SHEET 1 OF 1



SECTION A WESTERN EMBANKMENT - TYPICAL SECTION
SCALE 1:500
FIG 2



SECTION B NORTHERN EMBANKMENT (2 DAM) - TYPICAL SECTION
SCALE 1:500
FIG 2

ZONE	MATERIAL IN EXISTING DAM
1	CLAY AND WASTE ROCK
2	GLACIAL FILL
3	WASTE ROCK
4	TAILINGS

ZONE	MATERIAL
3A	50mm ROCKFILL
3B	ROCKFILL

LEGEND:
VW - VIBRATING WIRE PIEZOMETER
IC - INCLINOMETER

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2/5 DAM TSF
TYPICAL SECTIONS
WESTERN AND NORTHERN EMBANKMENTS

DWG. No.
FIGURE 3

SHEET SIZE	A3	Rev.	A

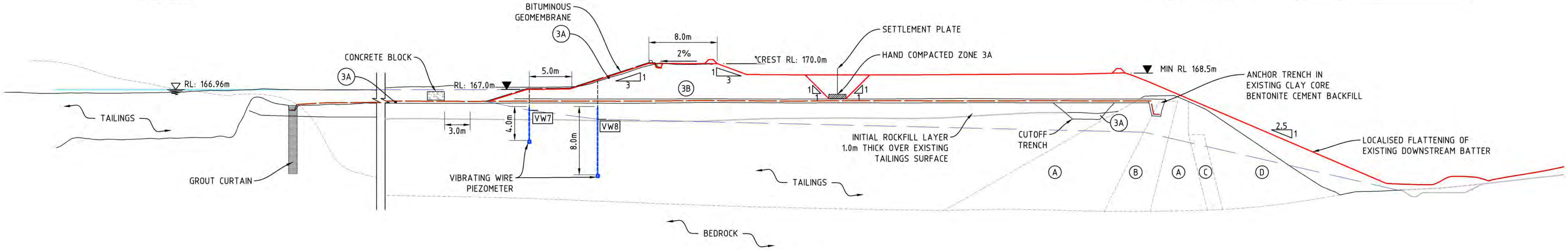
SHEET 1 OF 2

ZONE	MATERIAL IN EXISTING DAM
A	GLACIAL TILL CONTAINING SOME FINES
B	CLAYEY SILT, SANDY CLAYS AND GRAVELLY CLAYS
C	SANDY GRAVEL - MAX 4% PASSING BS 100 SIEVE
D	GLACIAL TILL WITH MINIMUM FINES

ZONE	MATERIAL
3A	50mm ROCKFILL
3B	ROCKFILL

UPSTREAM

DOWNSTREAM



SECTION C / FIG 2 EASTERN EMBANKMENT (5 DAM) - TYPICAL SECTION

SCALE 1:500

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2/5 DAM TSF
TYPICAL SECTIONS
EASTERN EMBANKMENT

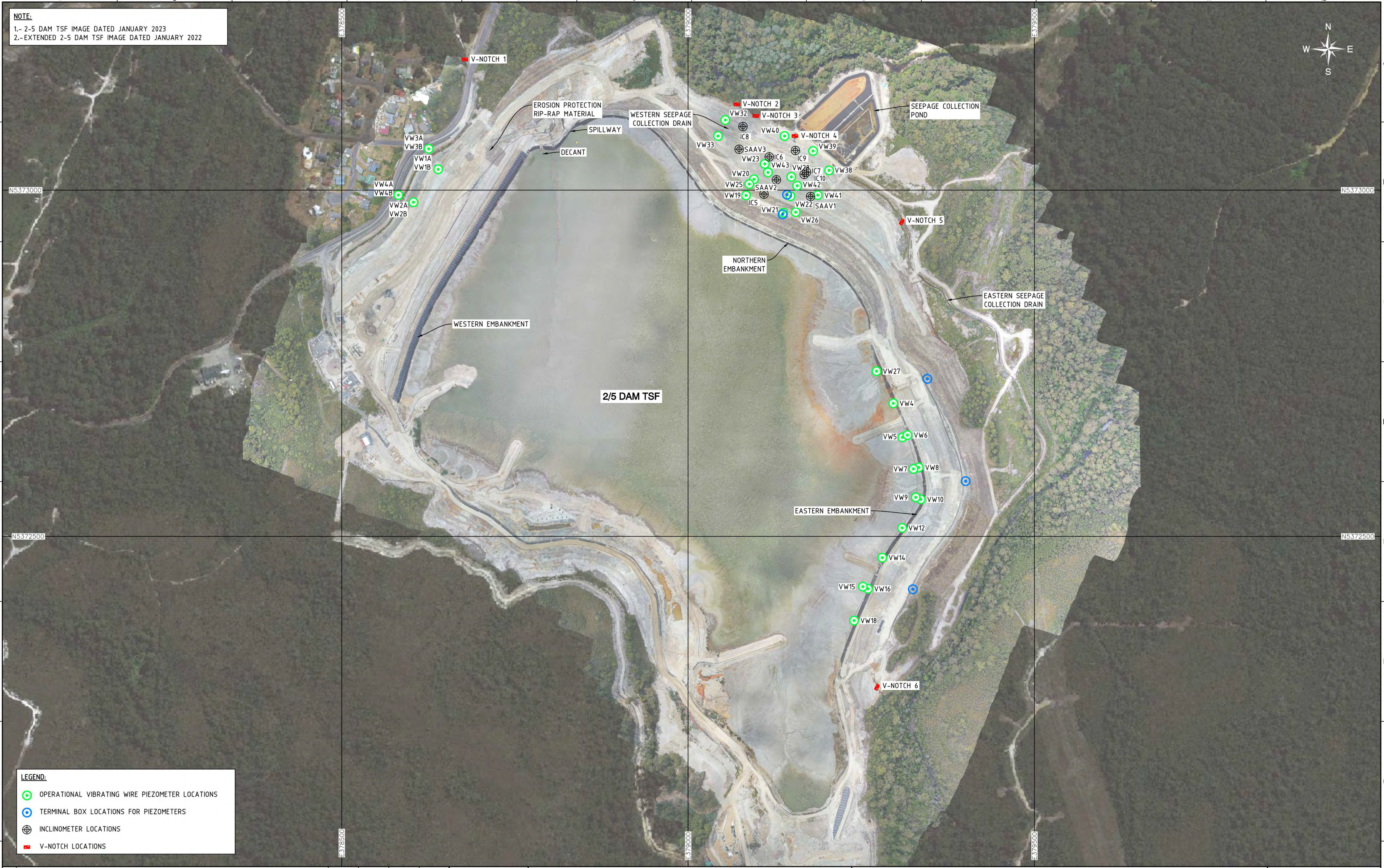
DWG. No.
FIGURE 4

SHEET SIZE	A3	Rev.	A

SHEET 2 OF 2

<u>NOTE:</u>

1.- 2-5 DAM TSF IMAGE DATED JANUARY 2023
2.-EXTENDED 2-5 DAM TSF IMAGE DATED JANUARY 2022



<u>LEGEND:</u>

◉	OPERATIONAL VIBRATING WIRE PIEZOMETER LOCATIONS
◉	TERMINAL BOX LOCATIONS FOR PIEZOMETERS
⊕	INCLINOMETER LOCATIONS
▬	V-NOTCH LOCATIONS

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2/5 DAM TSF
PIEZOMETER AND SEEPAGE MONITORING LOCATION PLAN

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FIGURE 5

SHEET SIZE	A3	Rev.	A

SHEET 1 OF 1

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\2-5\Figure 5 - 2-5 Dam Monitoring Location Plan.dwg

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2/5 DAM TSF
INSPECTION OBSERVATIONS

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FIGURE 6

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SHEET 1 OF 1

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\2-5\Figure 6 - 2-5 Dam Inspection Observations.dwg

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NOTE:

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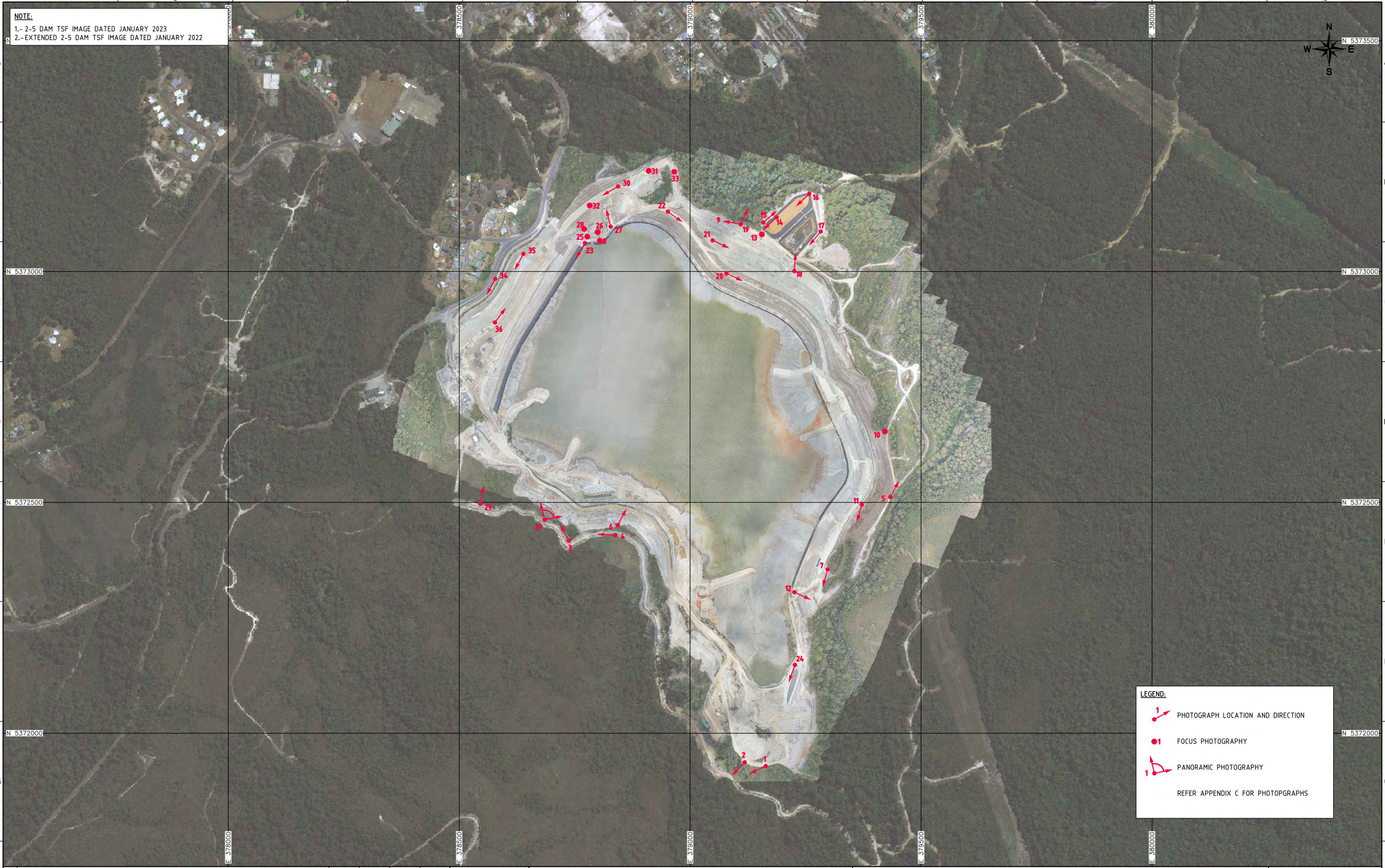
2.-EXTENDED 2-5 DAM TSF IMAGE DATED JANUARY 2022



LEGEND:

1 ↗	PHOTOGRAPH LOCATION AND DIRECTION
● 1	FOCUS PHOTOGRAPHY
1 ⊾	PANORAMIC PHOTOGRAPHY
	REFER APPENDIX C FOR PHOTOPGRAPHS

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2/5 DAM TSF
PHOTOGRAPH LOCATIONS

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FIGURE 7

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J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\2-5\Figure 7 - 2-5 Photograph Locations.dwg

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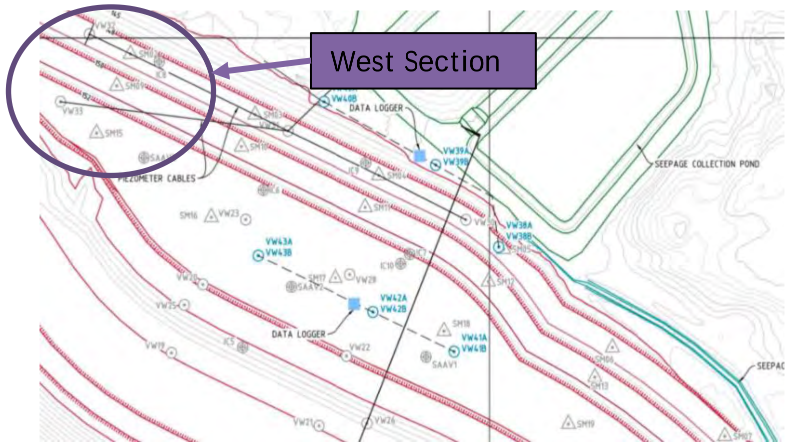

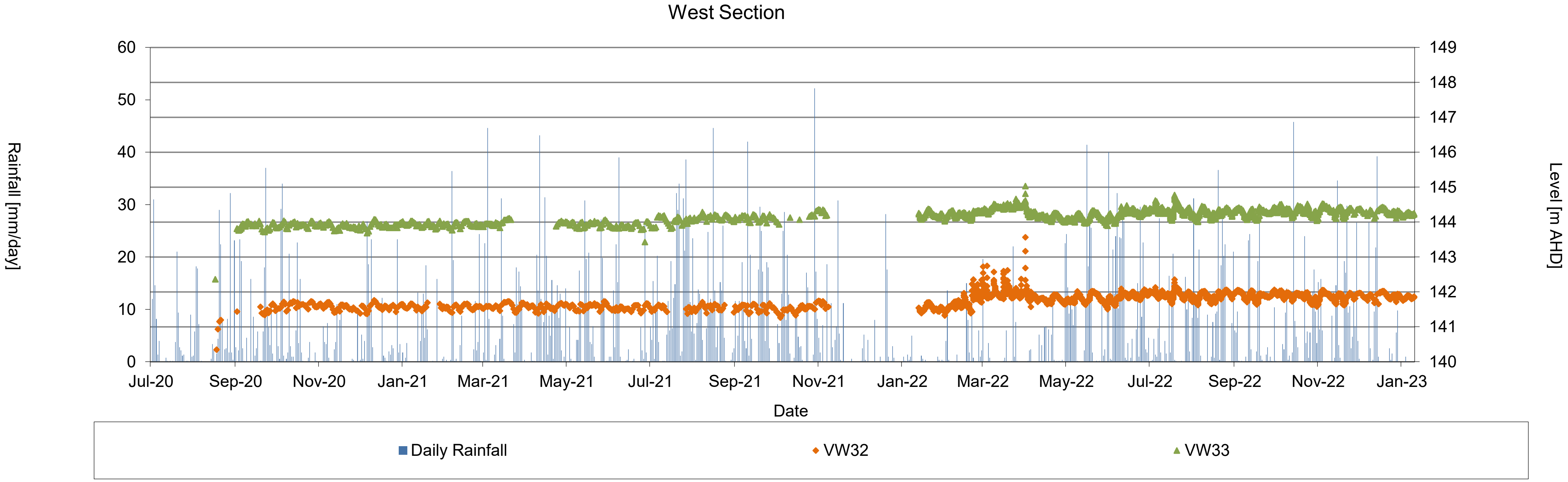

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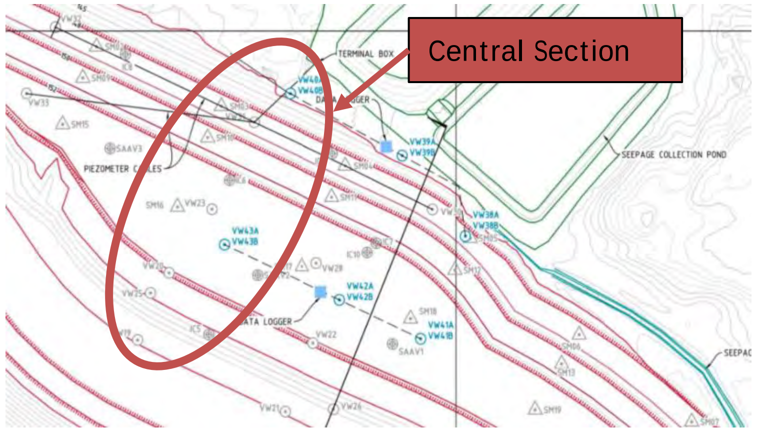
2022 EOR INSEPCTION

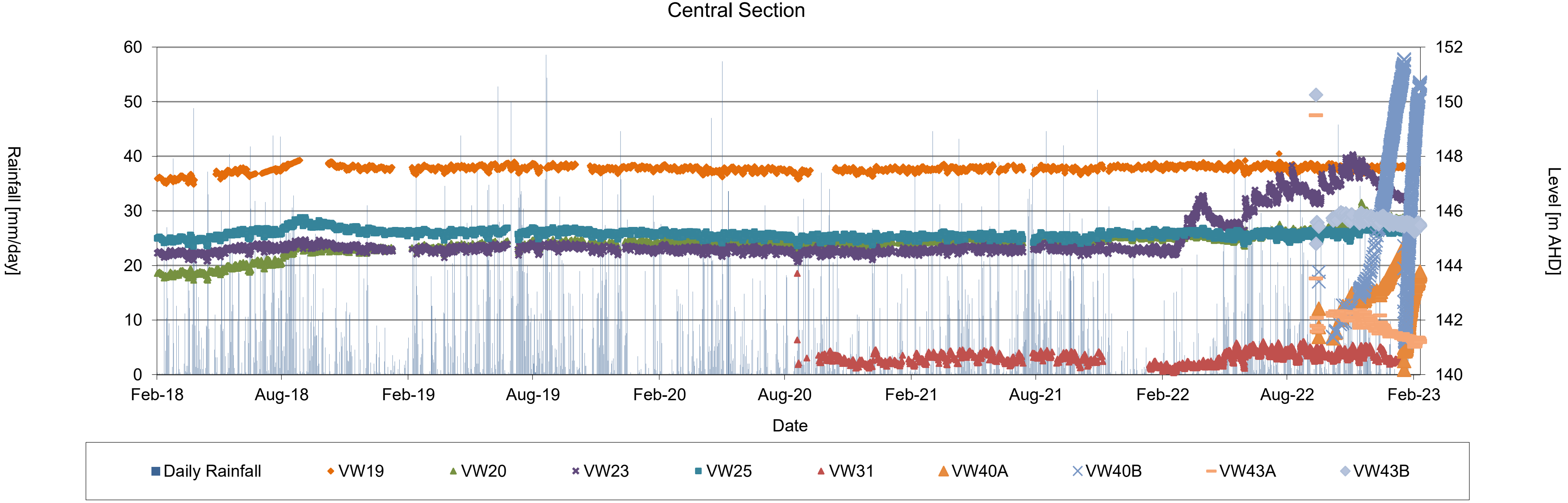
2-5 DAM TSF - NORTHERN EMBANKMENT (WEST) PIEZOMETER LEVELS

JULY 2020 TO JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 8**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December





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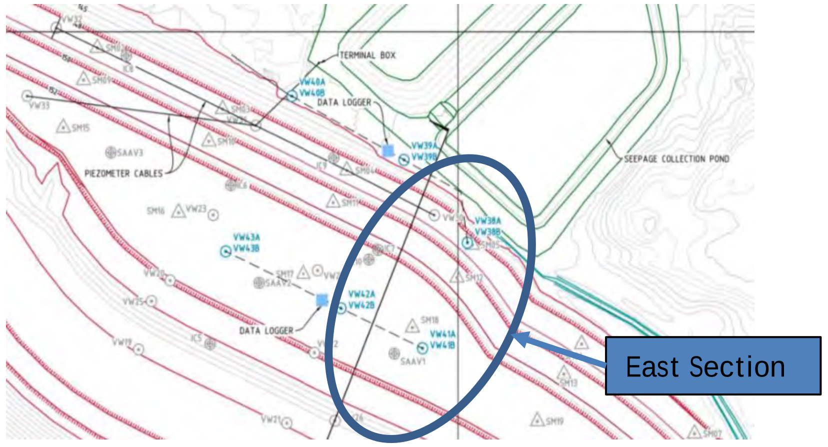
2022 EOR INSEPCTION

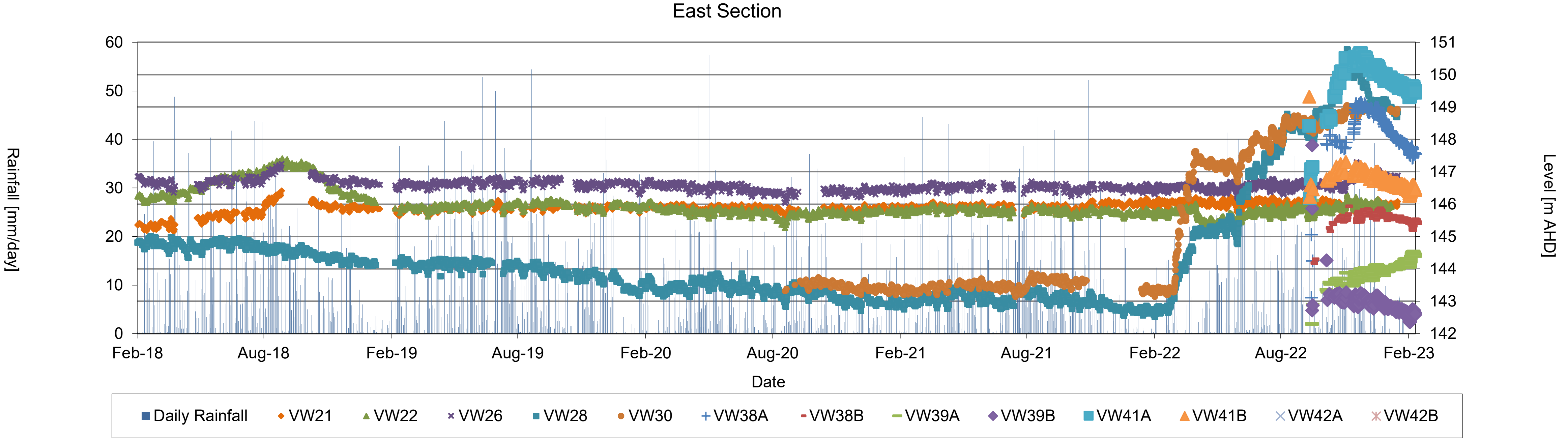
2-5 DAM TSF - NORTHERN EMBANKMENT (CENTRAL) PIEZOMETER LEVELS

FEBRUARY 2018 TO JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 9**

VW38A
VW38B
VW39A
VW39B





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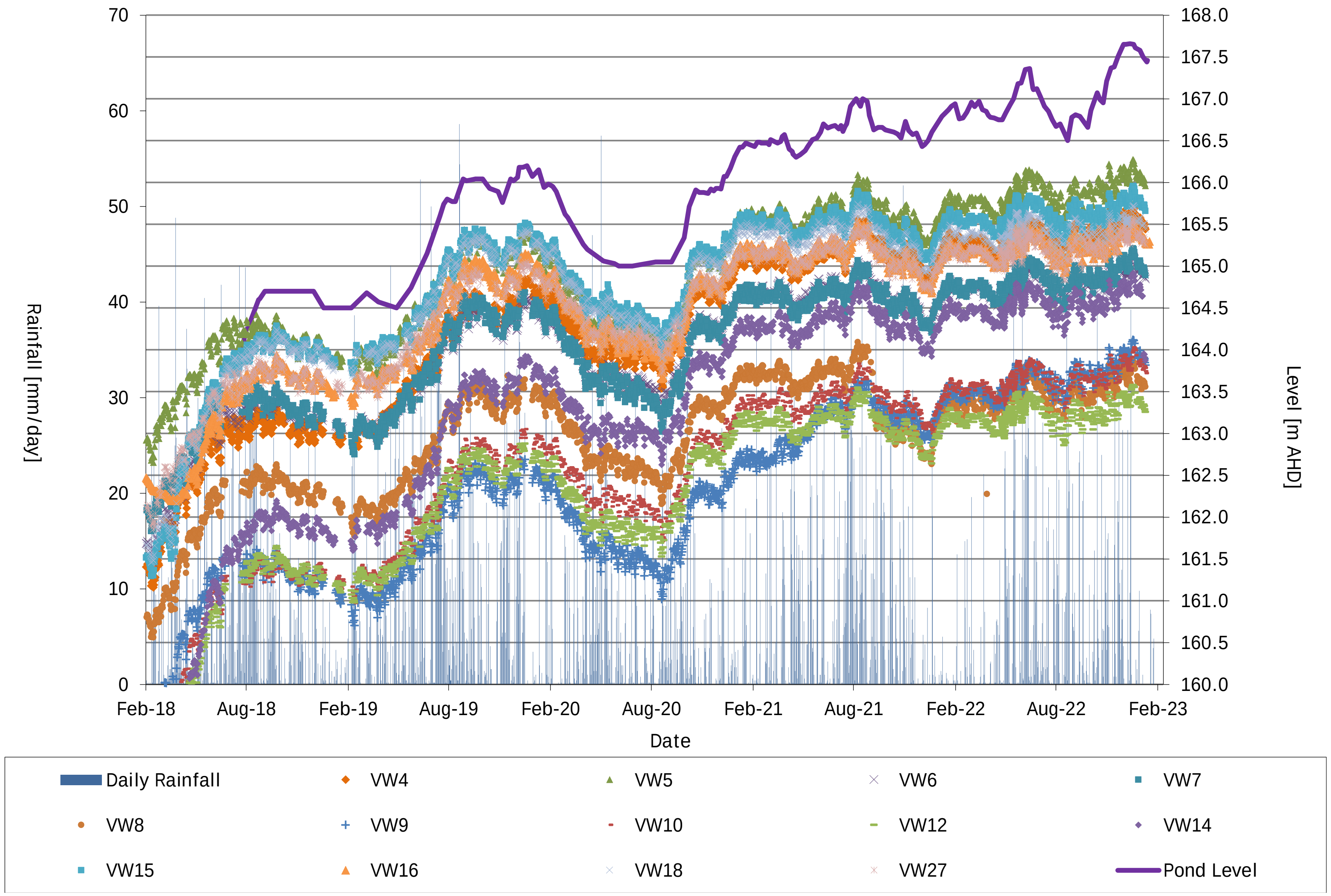
2022 EOR INSEPCTION

2-5 DAM TSF - NORTHERN EMBANKMENT (EAST) PIEZOMETER LEVELS

FEBRUARY 2018 TO JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 10**



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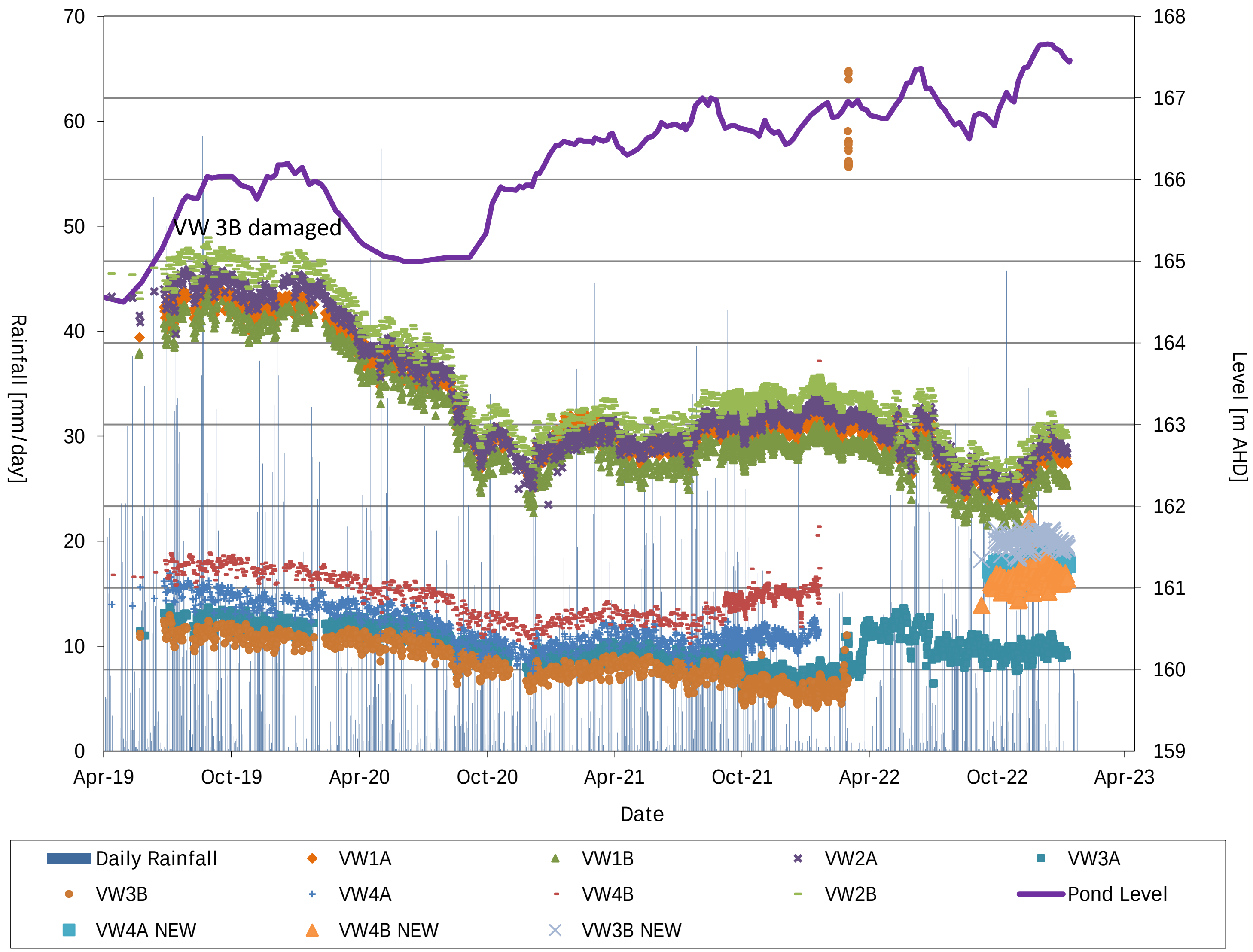
2022 EOR INSEPCTION

2-5 DAM TSF - EASTERN EMBANKMENT PIEZOMETER LEVELS

FEBRUARY 2018 to JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 11**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December



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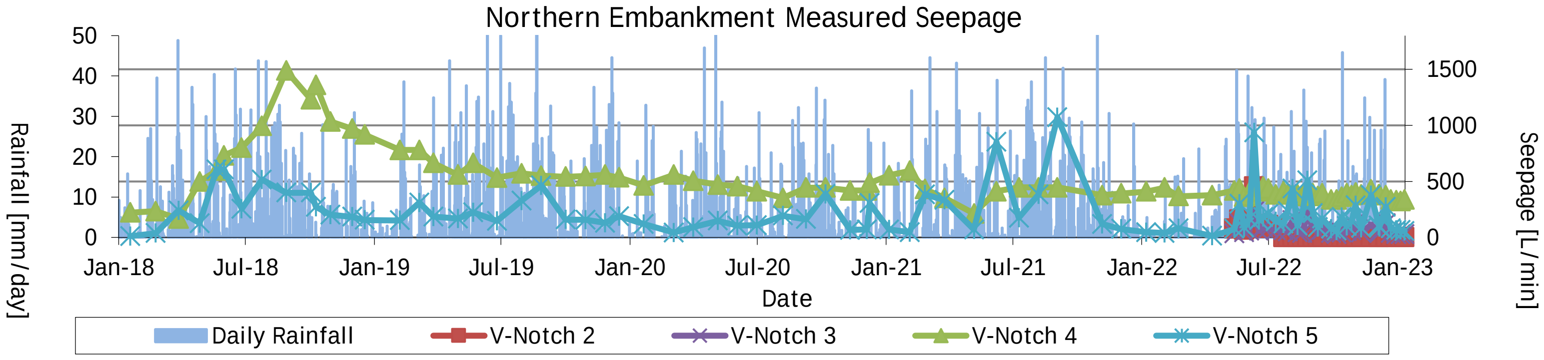
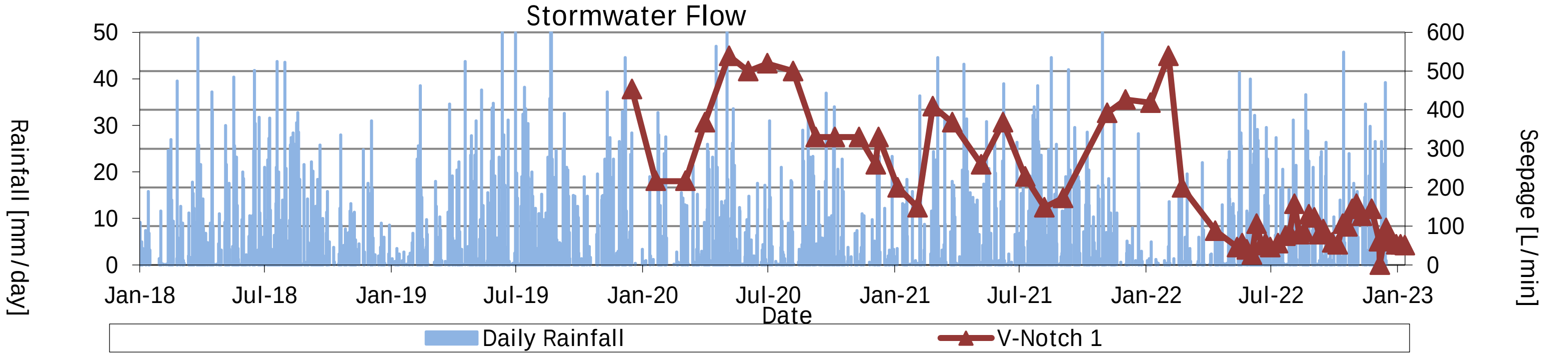
2022 EOR INSEPCTION

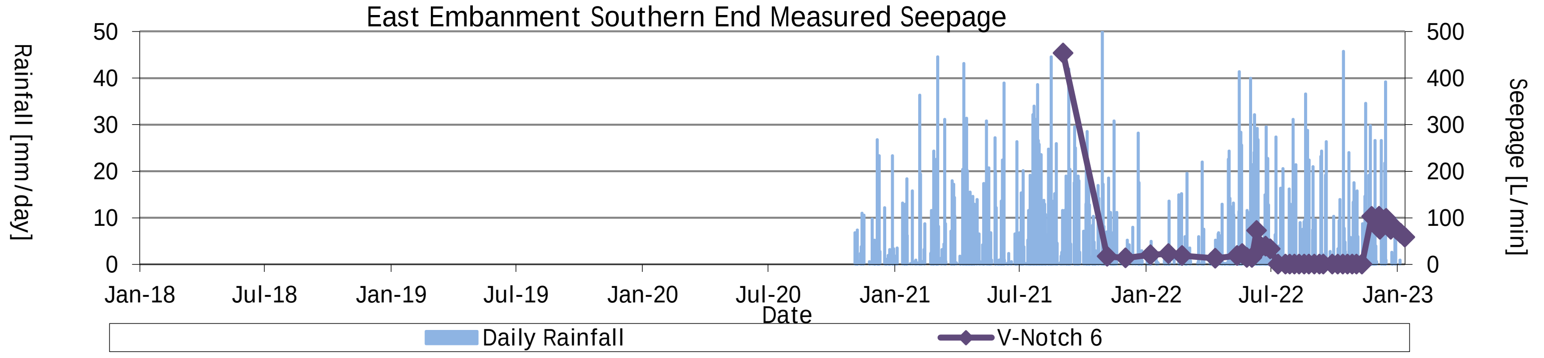
SCREENING BUND PIEZOMETER LEVELS

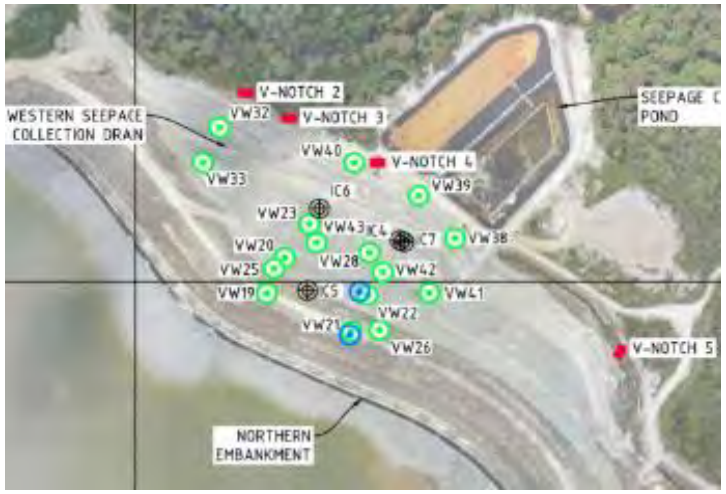
APRIL 2019 to JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 12**









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MMG ROSEBERY MINE

2022 EOR INSEPCTION

MEASURED SEEPAGE

JANUARY 2018 to JANUARY 2023

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 13**

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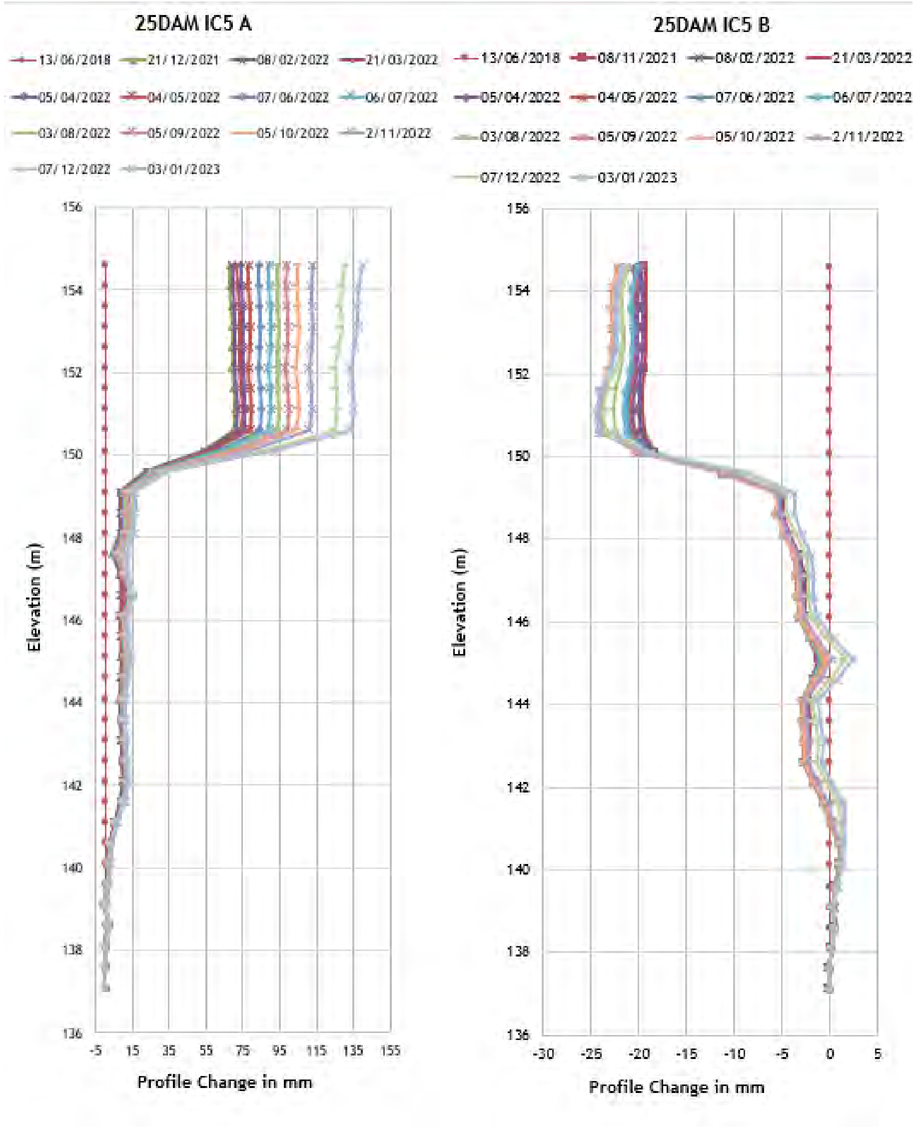

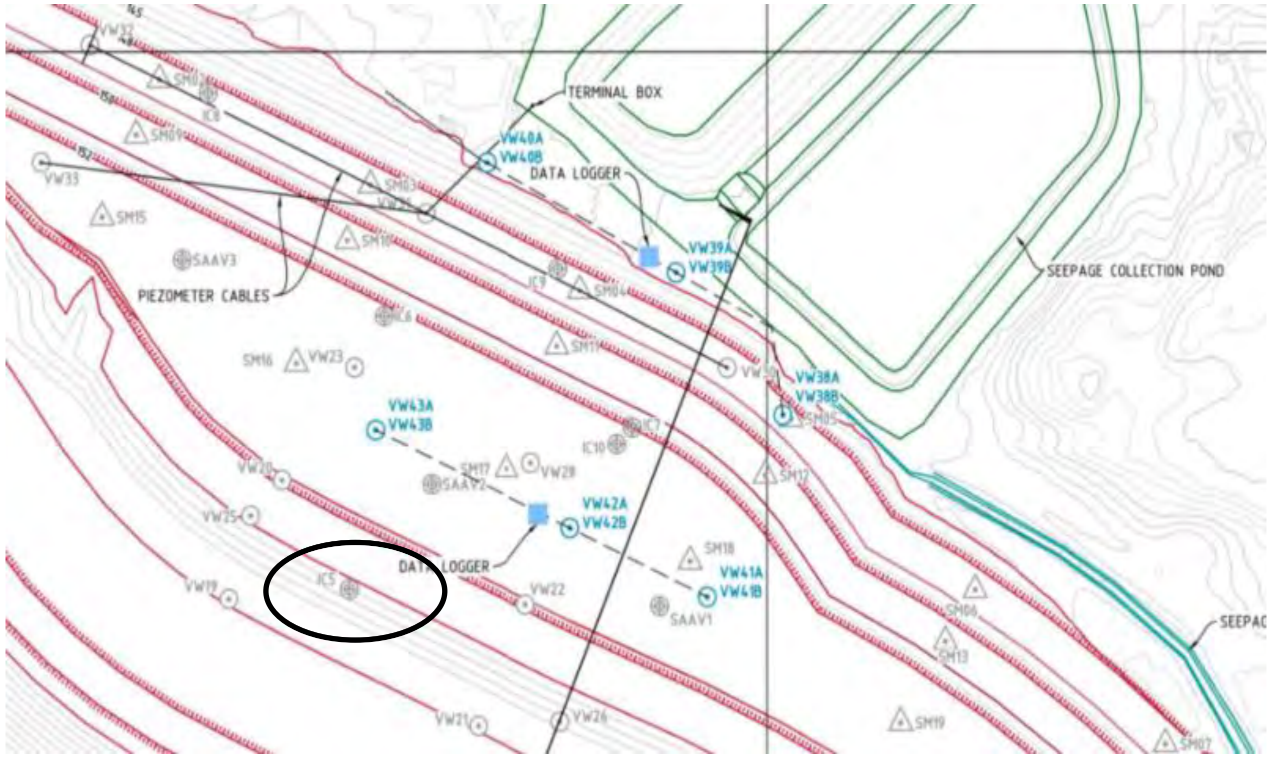

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2022 EOR INSPECTION

INCLINOMETERS

IC5 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 14**

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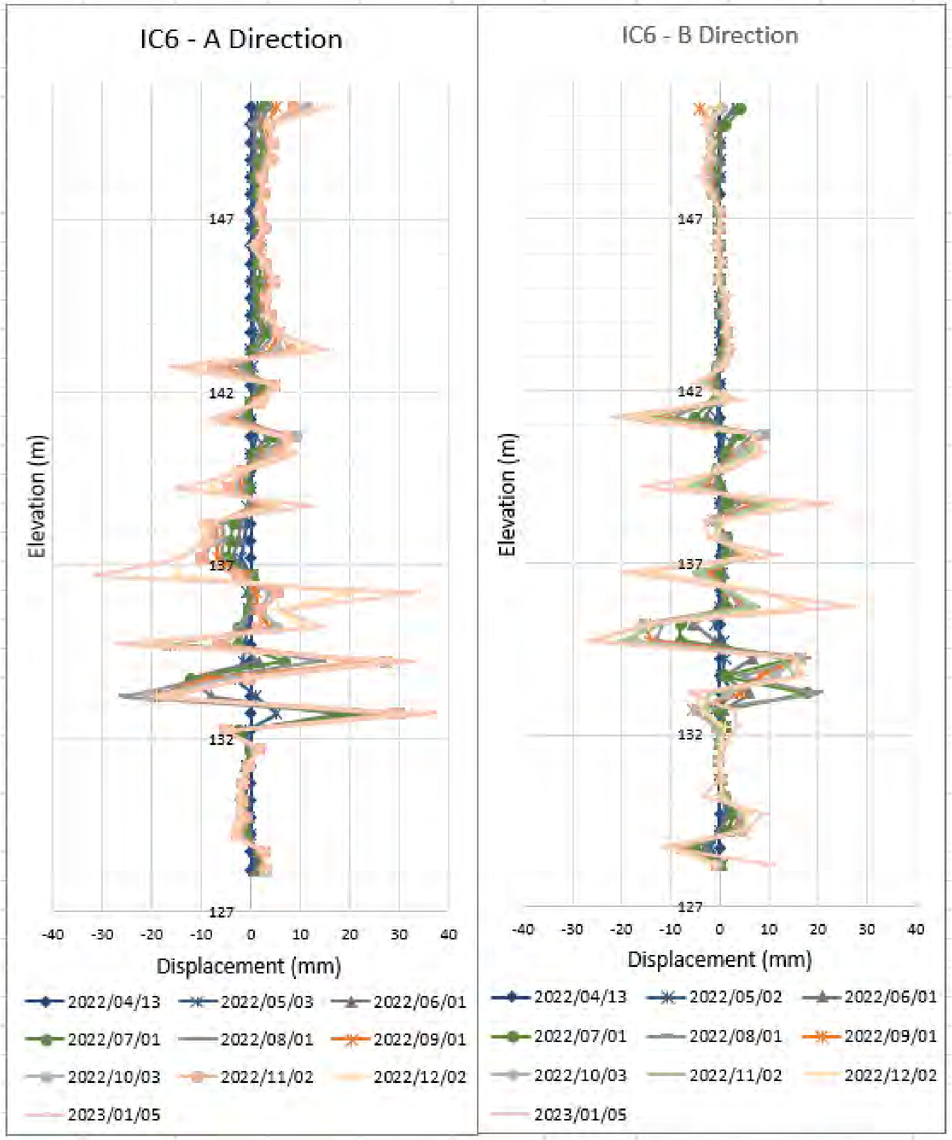

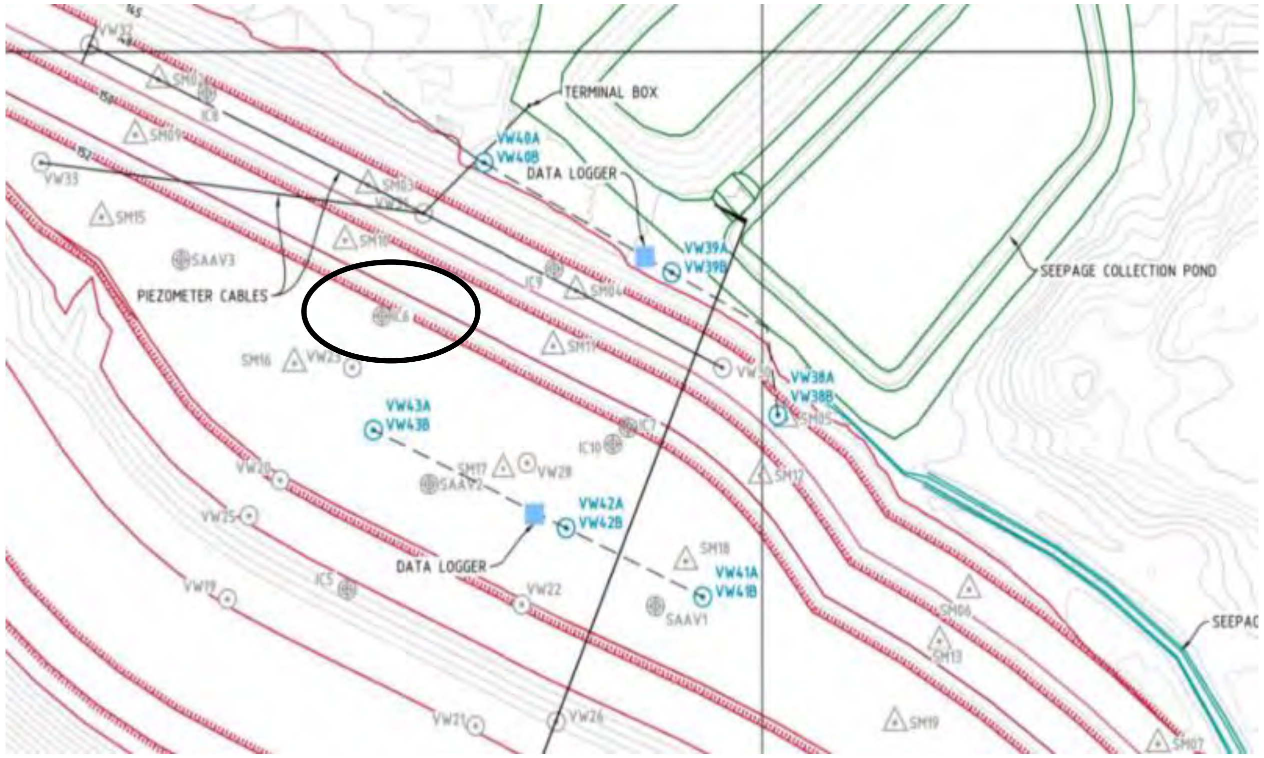

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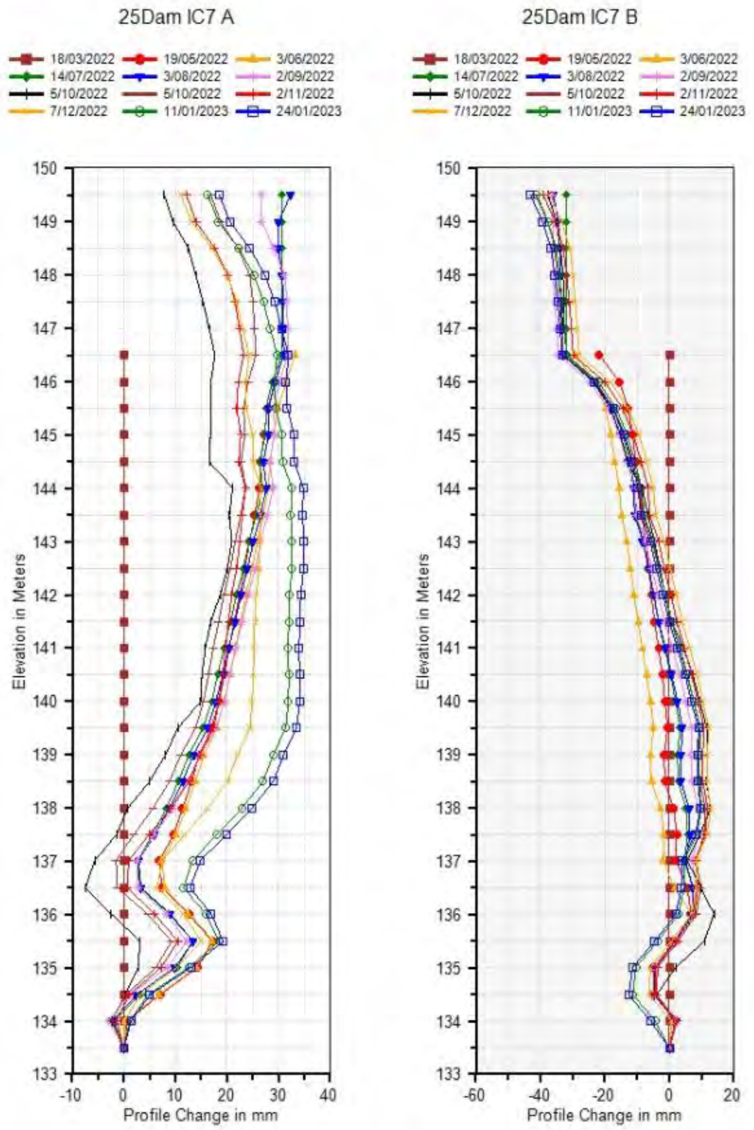
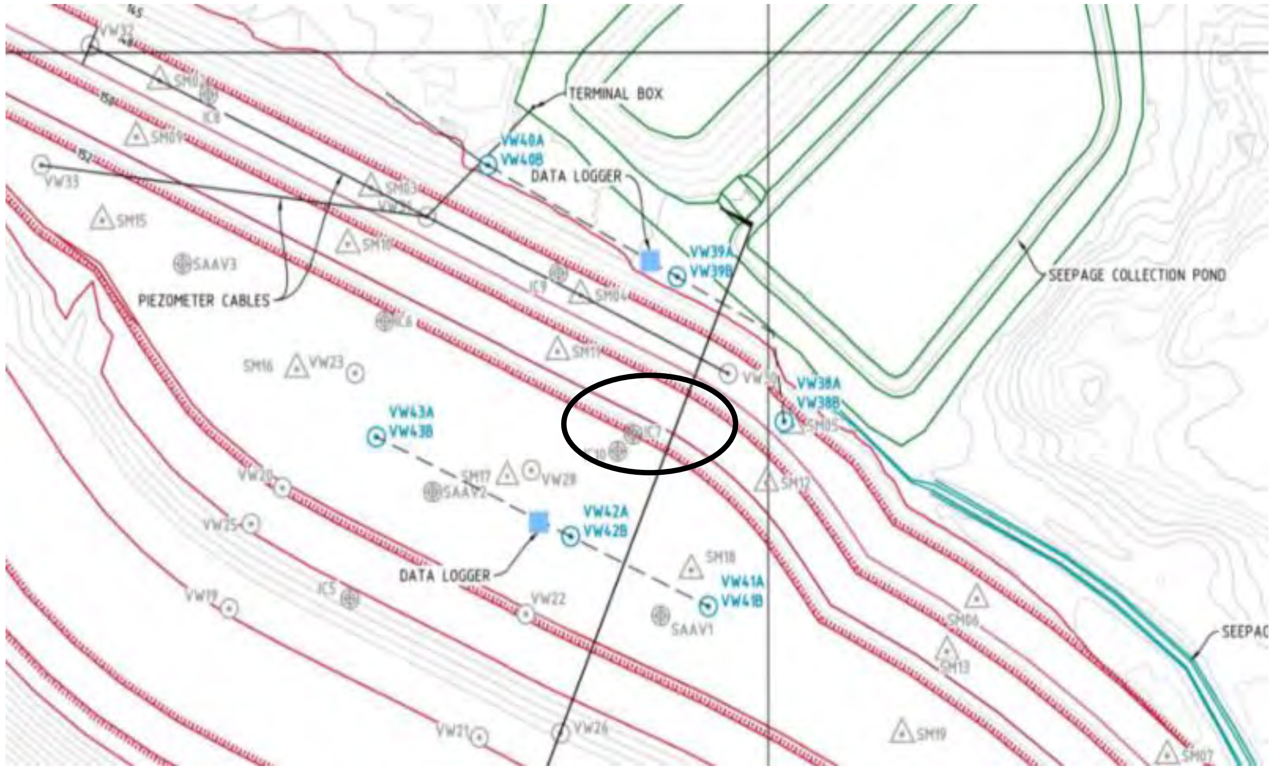
2022 EOR INSPECTION

INCLINOMETERS

IC6 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 15**





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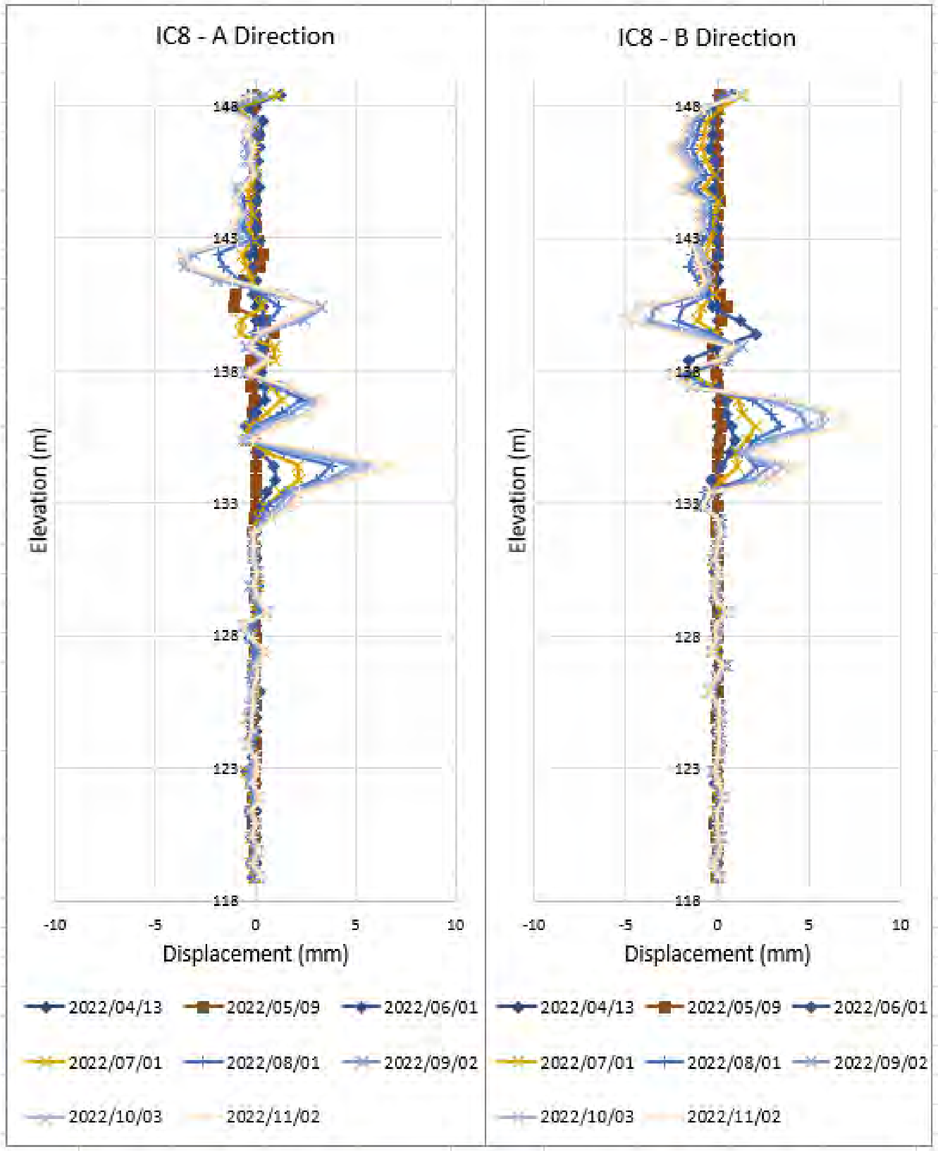
MMG ROSEBERY MINE

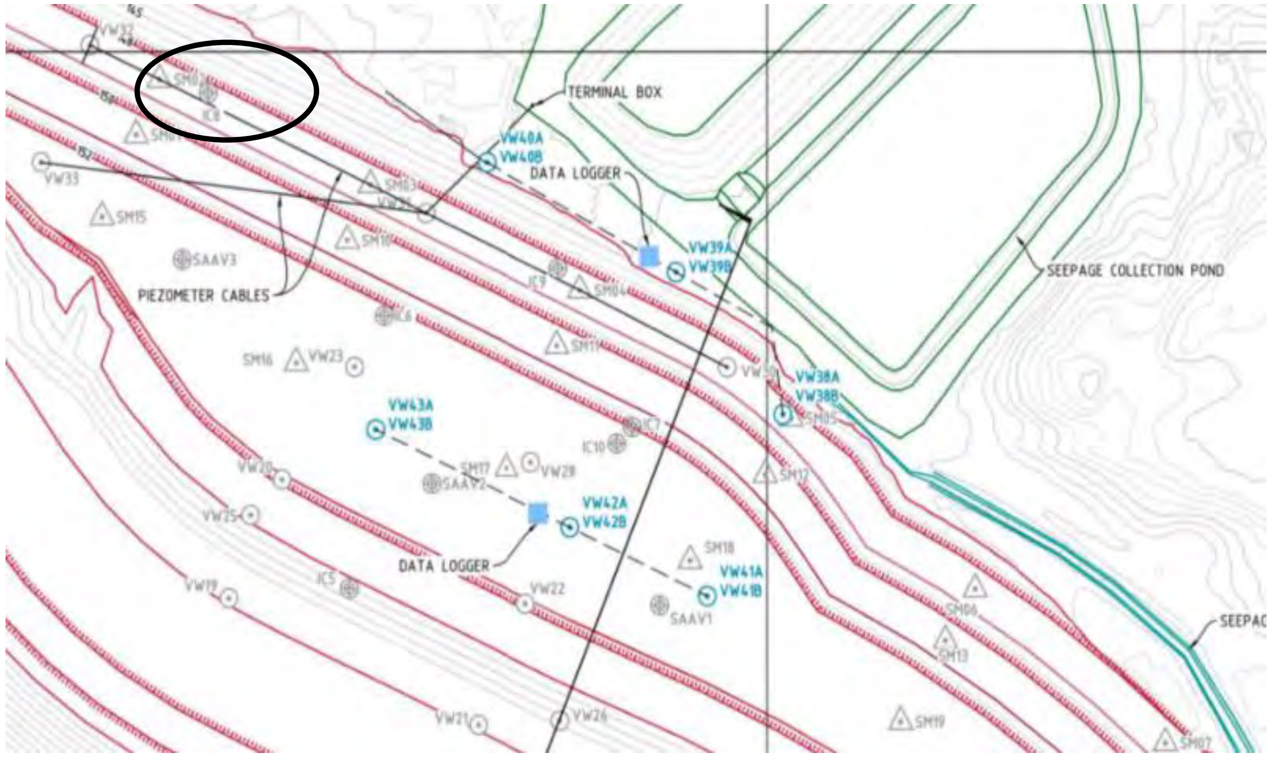
2022 EOR INSPECTION

INCLINOMETERS

IC7 - PROFILE CHANGE

Date:	14/06/2023	Job No:	107031.68	FIGURE 16





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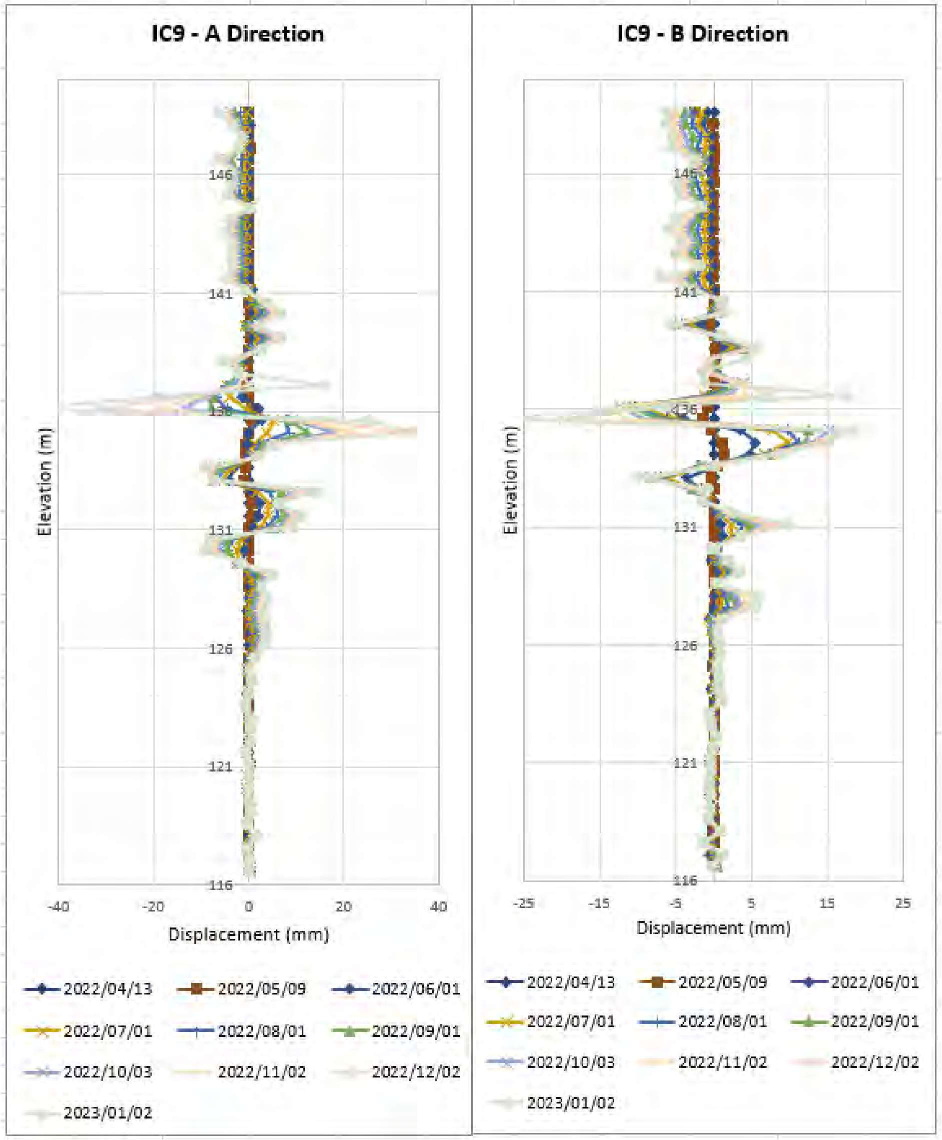
2022 EOR INSPECTION

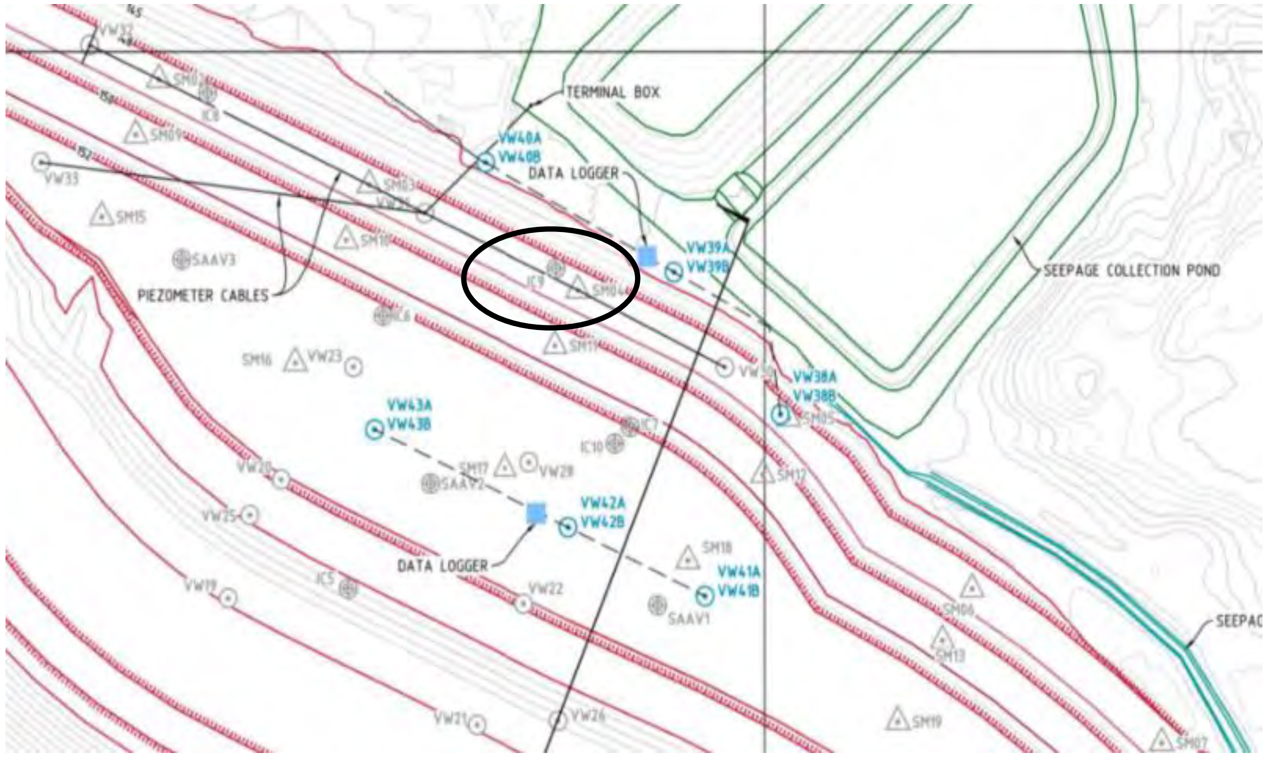
INCLINOMETERS

IC8 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 17**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December





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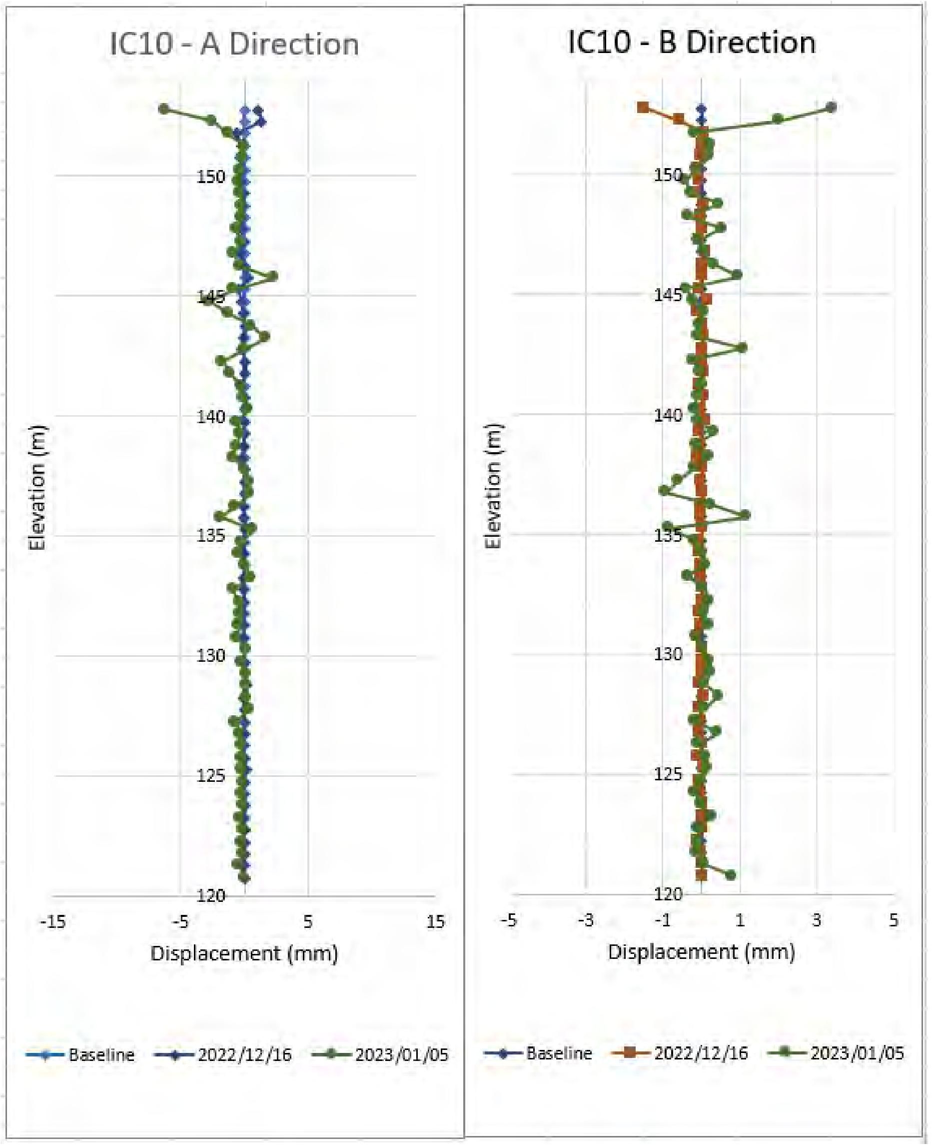
2022 EOR INSPECTION

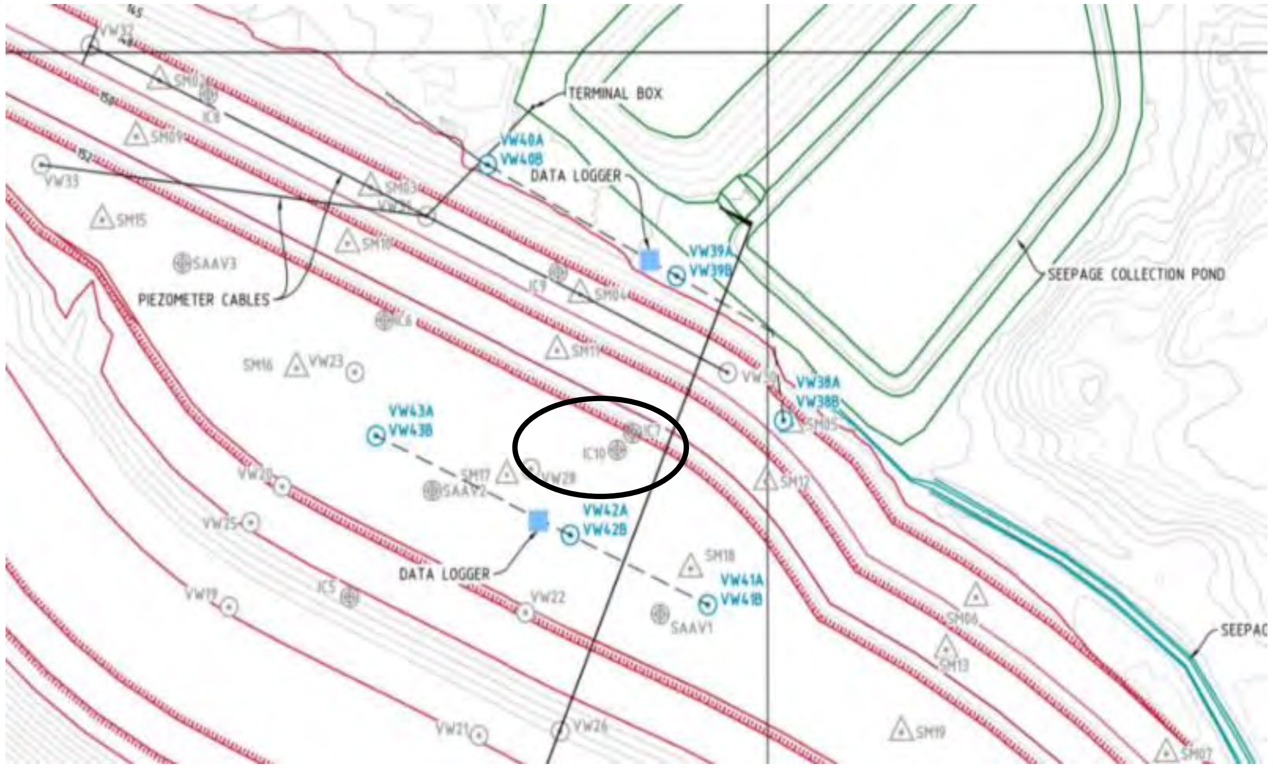
INCLINOMETERS

IC9 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 18**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December





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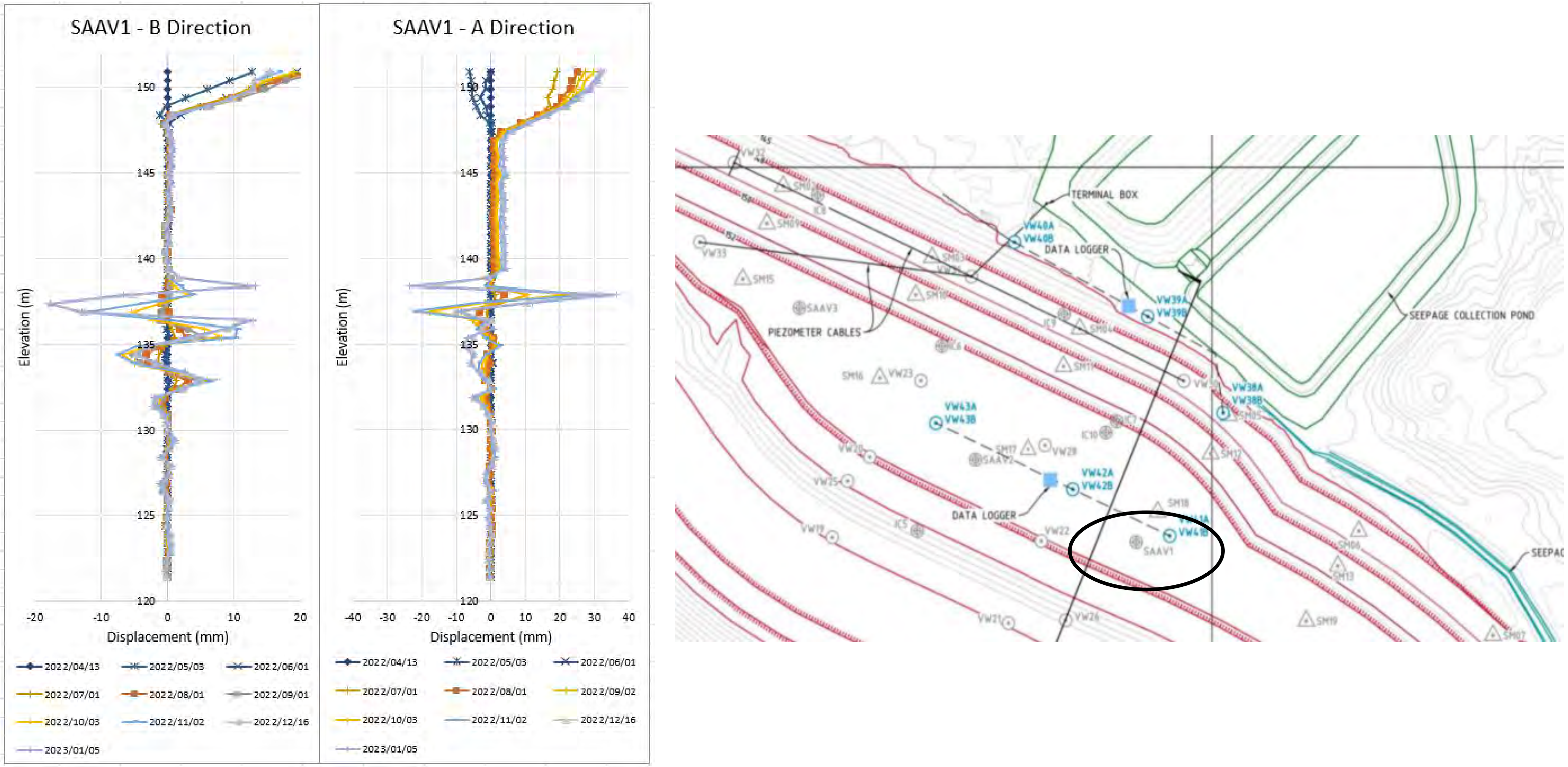
2022 EOR INSPECTION

INCLINOMETERS

IC10 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 19**



MMG ROSEBERY MINE

2022 EOR INSPECTION

INCLINOMETERS

SAAV1 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 20**

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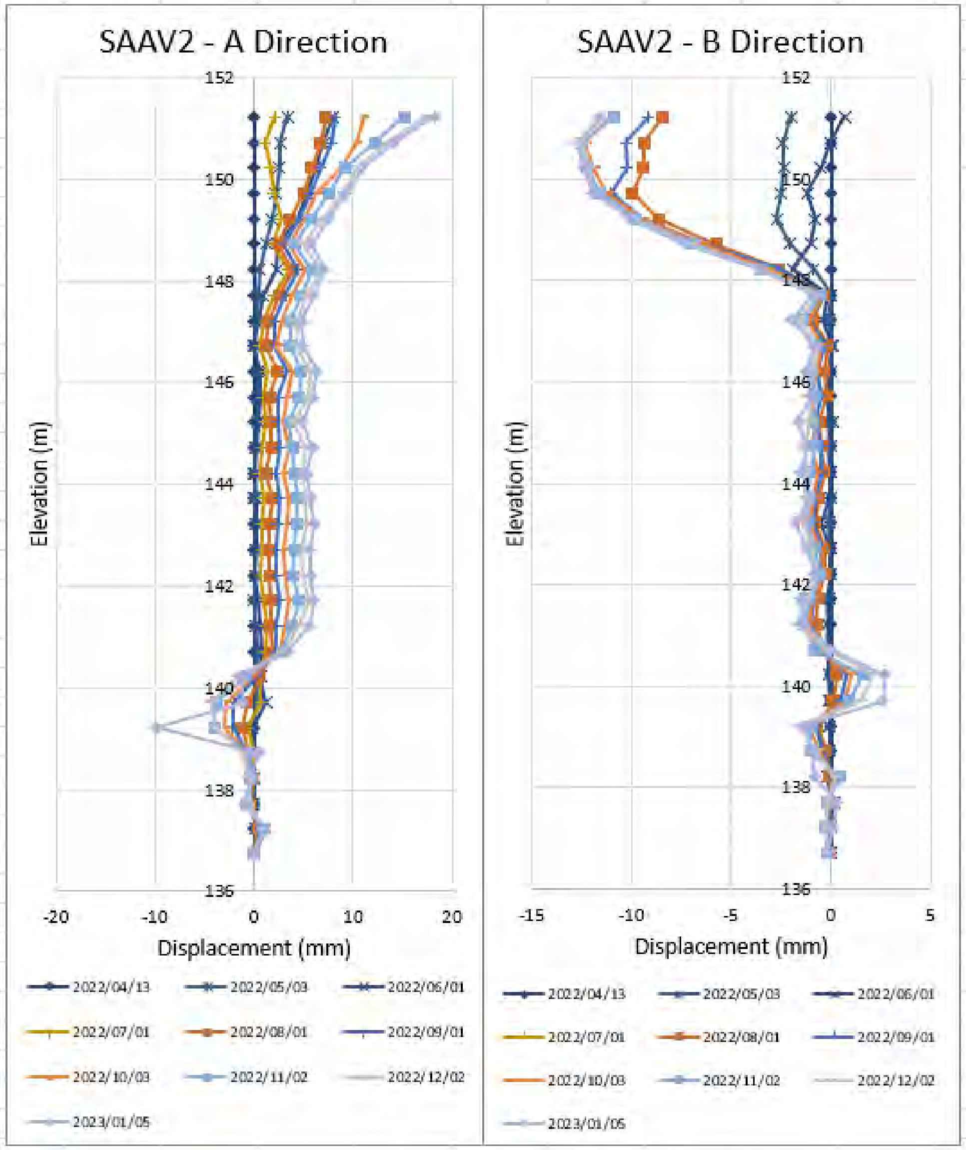

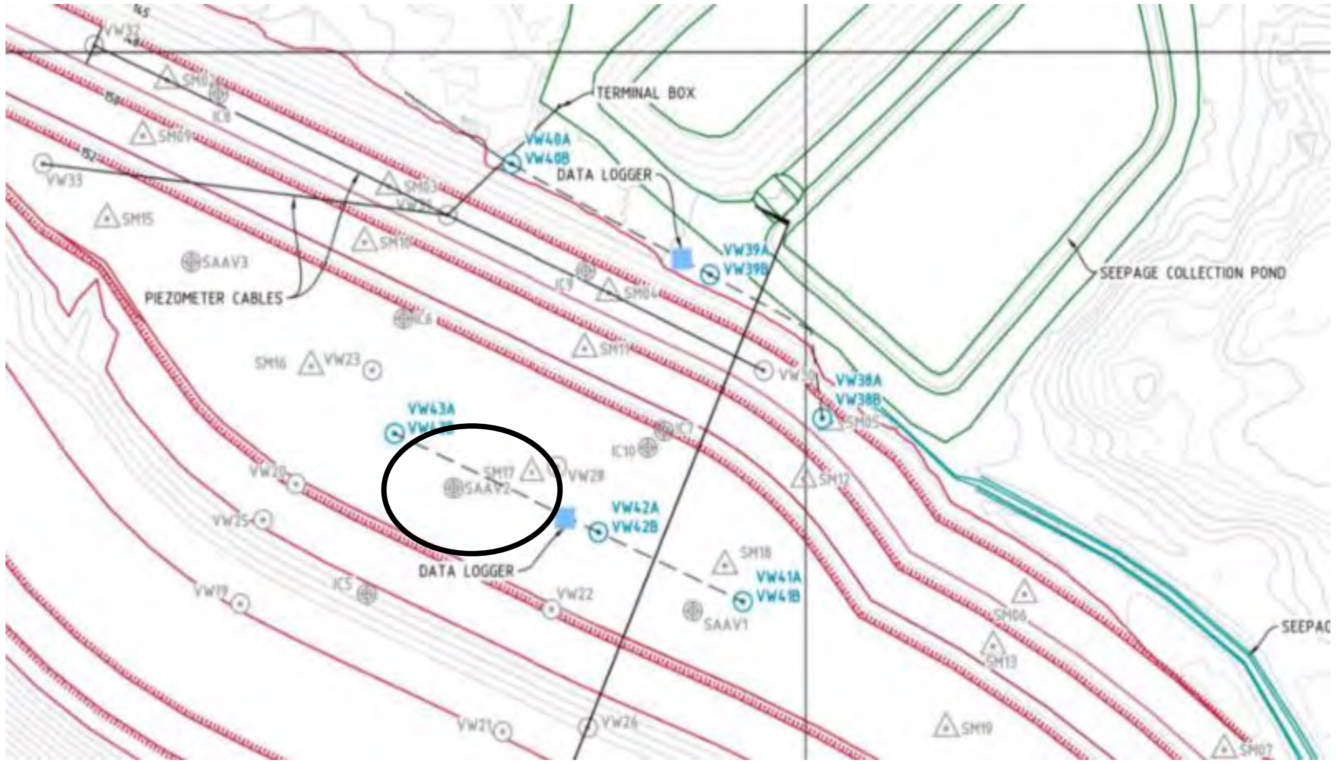

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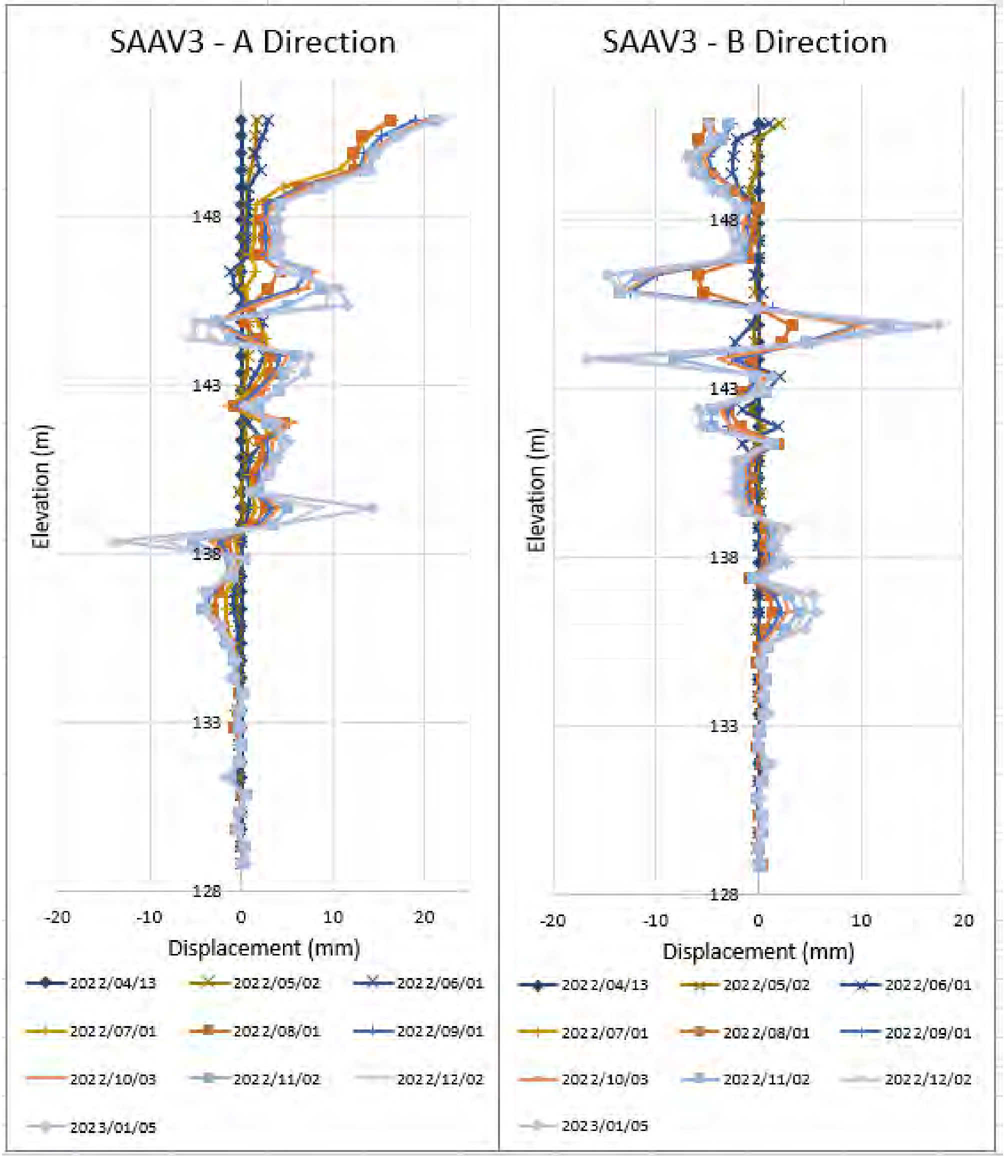
2022 EOR INSPECTION

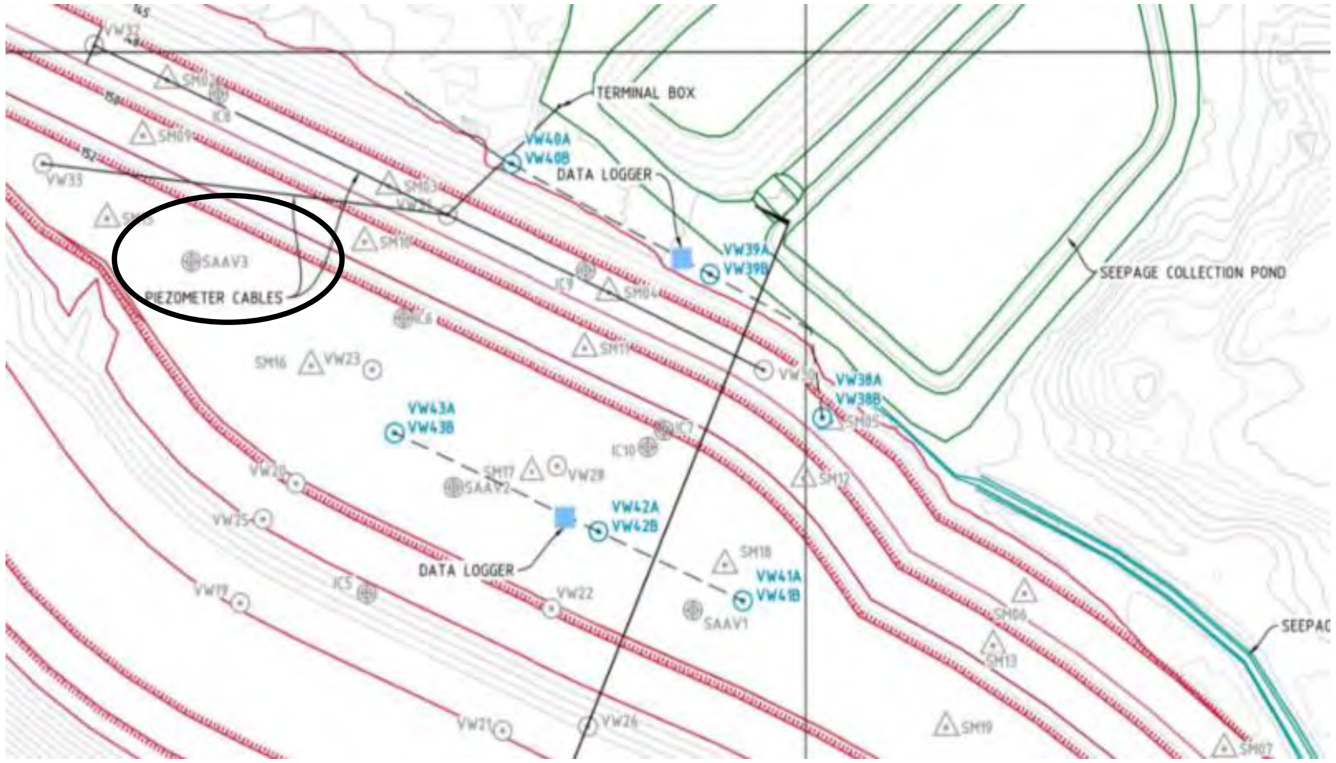
INCLINOMETERS

SAAV2 - PROFILE CHANGE

Date: 14/06/2023 **Job No:** 107031.68 **FIGURE 21**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December





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MMG ROSEBERY MINE

2022 EOR INSPECTION

INCLINOMETERS

SAAV3 - PROFILE CHANGE

Date:	14/06/2023	**Job No:**	107031.68	**FIGURE 22**

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\2-5 Dam\EoR surveillance spreadsheet 2-5 Dam December

APPENDICES

APPENDIX A – 2/5 DAM TSF DISCUSSION

DISCUSSION OF HISTORIC AND RECENT DESIGN AND CONSTRUCTION

1 BACKGROUND

The 2/5 Dam TSF encompasses the previous 1, 2 and 5 Dams which were originally built between 1950 and 1970. The 2 Dam Embankment was constructed using waste rock sourced from mine operations, which has been classified as Potentially Acid Forming (PAF) material. Hence, the new TSF has been designed to not only provide storage for future tailings, but also to remediate unresolved acid drainages and seepage issues from the previous TSFs.

2 PHYSICAL DETAILS

2.1 Location

Topographic Series Map Name:	DUNDAS
Number:	3636
Australian Mapping Grid Co-ordinates:	378750 E, 5372500 N

The 2/5 Dam is located approximately 1 km south east of the Rosebery Mine. The site is fenced off to the general public, but pedestrian access is possible. A general site location plan is presented in **Figure 1**. The general layout of the 2/5 Dam TSF is presented on **Figure 2.**

2.2 Historical Dam Information

The 2/5 Dam TSF was constructed across 1 and 5 Dams and also was formed as a downstream raise to the existing 2 Dam embankment. The following subsections explain the background of dams 1, 2 and 5 and the current 2/5 facility:

Dam 1

- After rehabilitation, 1 Dam was used as a sports field. Historical data indicated that tailings were deposited within the area and then capped using waste rock from mine operations.
- A pocket of landfill on the upstream side of the Western Embankment was identified between 2 Dam and 1 Dam but its extents could not be adequately defined.

Dam 2

- 2 Dam was constructed in 1955. It was raised on three (3) occasions, until 1991.
- Between 1991 and 2001 additional waste rock was placed on the downstream face of the dam, and the crest width was widened.
- The embankment final height was RL 161 m, and presented a 10 m wide crest, with an upstream edge safety windrow.
- Tailings deposition ceased in 1996 at which time the facility was flooded with water/treated effluent from the Rosebery Sewerage Scheme and was treated as a wetland.

Dam 5

- The embankment was constructed on the east of the facility to a crest elevation of RL 166 m in 1970.
- Construction drawings show that the 5 Dam has an internal sand filter that helps alleviate phreatic levels caused by seepage within the embankment, and it presents a clay core as a lower permeability barrier.
- Tailings deposition ceased in 1995 and the facility was flooded with water/treated effluent from the Rosebery Sewerage Scheme in 1996.

2.3 Current Dam Information

2.3.1 Description

The current 2/5 Dam TSF includes:

- A western embankment across the old 1 Dam area;
- A northern embankment against the downstream face of the existing 2 Dam;
- An eastern embankment the eastern side of 5 Dam. The embankment was constructed across tailings and on natural ground (towards the southern end);
- The TSF Embankment is of zoned rockfill construction, with an exposed waterproofing bituminous geomembrane (BGM) liner on the upstream face, an embedded lining system comprised of BGM liner sandwiched in a lower and upper layer of non-woven geotextile (Bidim A64) and a combination of foundation grout curtain along the perimeter of the facility through rock and cement bentonite walls through glacial and historic fill materials.;
- Seepage collection drains adjacent to the downstream toe of the eastern and northern embankments to manage near surface seepage;
- A seepage collection pond was constructed downstream of the northern embankment to capture seepage and pump it back into the TSF;
- A screening wall adjacent to the Murchison Highway to both provide a vegetation screen to the South Rosebery residents and to act as a diversion wall in the highly unlikely event of failure of the western embankment;
- A clean water diversion drain along the southern side of the TSF to reduce rainfall inflows to the TSF; and
- A diversion drain and spillway between the western and northern embankments to direct the flood waters to the north of the site resulting from an unlikely spillway discharge during operations and from the flood resulting from highly unlikely failure of the western embankment.

2.3.2 2/5 Dam Geometry

The current geometry of the facility is presented on **Figure 2**, whilst typical sections are presented on **Figure 3** and **Figure 4**. The current geometry of the embankment is a uniform crest elevation of RL 170 m with a crest width of 8 m for the northern and eastern embankments and a 10 m width for the western embankment. The maximum embankment height is about 26 m at the Northern Embankment toe adjacent to the Seepage Collection Ponds (SCP).

Each embankment presents different upstream and overall downstream slopes. A summary of the geometry of the embankments is given below:

- Crest Level
    - *Perimeter Embankment* = RL 170 m
    - *Screening Wall* = RL 168.5 m
- Crest Width
    - *Northern and Eastern Embankment* = 8 m
    - *Western Embankment* = 10 m
    - *Screening Wall* = 2 m
- Embankment Slopes
    - *Northern Embankment* Upstream = 1.5:1 (H:V)
      Downstream = 2:1 (H:V)
      with intermediate benches at RL 157.5 m, RL 152 m, RL 148 m and a lower toe buttress of RL 145.5 m.
    - *Eastern Embankment* Upstream = 3:1 (H:V)
      with a 5m wide upstream bench at RL 167.0m
      Downstream = 2.5:1 (H:V)
    - *Western Embankment* Upstream = 2:1 (H:V)
      Downstream = 2:1 (H:V)
    - *Western Screening Wall* Upstream = 2:1 (H:V)
      Downstream = 2:1 (H:V)

2.3.3 2/5 Dam Storage Capacity

The facility has been designed as a 2-stage facility. The current crest elevation of RL 170 m (Stage 1) has been designed to store approximately 3 Mt of tailings over 3.75 years with an allowance for a 2 m water cover. The design stored dry density is 1.25 t/m^3, this equates to approximately 2.4 Mm^3 for tailings storage and 0.9 Mm^3 of water.

2.3.4 2/5 Dam Catchment Characteristics

The catchment area of the facility excluding the catchment attributed to the clean water diversion drain is about 45 Hectares.

2.3.5 Consequence Category

A Consequence Category “High C” was adopted for the 2/5 Dam TSF as part of the design **[Ref. 3]**. This was based on the following:

- Population at Risk in the event of failure: 1 to 10
- Damage and loss severity level: Major

2.3.6 2/5 Dam Flood Capacity

The decant system for the 2/5 Dam TSF consists of a concrete inlet structure with provision for inserting stop boards across the inlet. The capacity of the decant is about 80 l/s.

The TSF has a spillway located at the west, between the northern and western embankments. which has been cut into the existing rock and outlets into the diversion drain. The spillway is 20 m wide at the base and 1.0 m deep. The invert elevation of the Spillway is at RL 169 m. The estimate capacity of the spillway is 35.5 m^3/s. A flood routing study was completed as part of the 2/5 Dam TSF design report for a Probable Maximum Precipitation (PMP) rainfall event. The flood routing results indicated a maximum flood height of 0.77 m for the critical storm duration of 3 hours. Hence, the spillway would safely discharge the runoff and process inputs resulting from the design storm (PMP).

2.4 Seepage Collection Pond

2.4.1 Purpose of Dam

The lined Seepage Collection Ponds purpose is to collect all seepage from the downstream toe area of the North and East Embankments. The collected water is pumped back into the TSF through a return water pipe.

2.4.2 Physical Details

2.4.2.1 Location

The Seepage Collection Ponds are located downstream of the Northern Embankment as shown on **Figure 2**.

2.4.2.2 General Layout

The structure comprises two lined confining cells separated by an intermediate embankment, a low flow concrete structure, an intermediate weir, two inlet concrete culverts, emergency spillway, and submerged pump sump with associated pumping infrastructure at its lowest elevation.

The structure is mainly founded below ground level, and only low height embankments were constructed on the west and north flanks. The eastern side of the facility abuts natural ground.

A general locality plan is shown on the aerial photograph presented on **Figure 2**.

2.4.2.3 Geometry

The eastern cell is 2 m deep with a crest elevation of RL 145.5 m. The floor of this cell falls at a grade of 0.5% towards the north west corner. A dividing embankment al RL 145.5m separates the two cells. At its northern end, the dividing embankment contains a low flow control structure, consisting of an inverted box culvert fitted with removable marine grade aluminium stop logs, set at an invert level 100 mm above the floor of the cell. The water level within the upper cell can be controlled by inserting or removing stop logs. A 5 m wide emergency overflow weir with an invert 0.5 m below crest elevation is located at the southern end of the dividing wall.

The western cell has been formed primarily in cut, with a floor level of RL 140.5 m and a crest level of RL 144.0 m. The floor was shaped with a 0.5% grade towards a sump located in the south west corner. The western cell has been constructed with an emergency spillway, 0.5 m deep, located on the western wall.

Both cells have been lined with a geomembrane sealing system comprised of BGM bituminous liner.

A pump bridge has been constructed between the western wall of the west cell and pump sump to facilitate access to the submersible pump, at the concrete sump in the base of the lower pond.

2.4.2.4 Storage Capacity

The storage capacity of the Seepage Collection Ponds is approximately 15,000 m^3. The upper pond has a capacity of 6,000 m^3 while the lower pond has a greater capacity at 9,000 m^3 **[Ref. 5]**.

2.4.2.5 *Catchment Characteristics*

The contributing catchment area is approximately 18.5 Ha. It also accepts seepage and internal drainage from the TSF.

2.4.2.6 *Flood Capacity*

The pond was sized to have sufficient capacity to store the 1:100, 24-hour AEP rainfall event **[Ref. 5]**.

The emergency spillway is 5 m wide at the base and has a depth of 0.5 m. The estimated capacity of the spillway is about 5 m^3/s and is designed to discharge runoff from a rainfall event of 1 in 1,000-year return period.

2.4.3 Consequence Category

A Consequence Category “LOW” was adopted for the Seepage Collection Pond as part of the design **[Ref. 3]**. This was based on the following:

- Population at Risk in the event of failure: <1
- Damage and loss severity level: Medium

2.4.4 Water Management

The water level is remotely monitored on a daily basis from the ultrasonic probe. The water is pumped back to the TSF based on pre-set pond elevations.

APPENDIX B – EOR INSPECTION CHECKLIST

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
2/5 DAM TAILINGS STORAGE FACILITY

Monitored By : Mark Dillon (EoR)
Date of Inspection : 23rd and 24th January 2023
Weather Conditions : Sunny and hot both days, heavy showers late on 23rd.
Rainfall : Late heavy showers on 23rd

WESTERN EMBANKMENT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Crest	Condition of surface	Y	good, recently raised	
	Condition of safety bund	Y	good	
Downstream Batter	Slumps, bulging or rilling of rockfill	Y	planar	
	Seepage / soft spots	Y	nil	
	Tree / shrub growth	Y	nil	
Upstream batter	Slumps/bulging /heave	Y	nil	
	Condition of geomembrane	Y	Recently installed, good condition	23
Tailings Beach	Location of beach development	Y	short but well defined beach	
	Operating spigots at time of inspection	Y	no spigots on wall at time of inspection	
Other Comments	1. small sprinklers have been placed on the tailings beach as part of dust mitigation measures.			

WESTERN BUTTRESS

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Surface	Condition of surface	Y	Good condition generally, the site is currently being used as a haul road and stockpile area.	

SCREENING BUND

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Crest	Condition of surface	Y	currently construction area. Completed area is in good condition	36
Downstream Batter	Slumps, bulging or rilling of rockfill	Y	None Observed, Topsoil and planting underway.	
	Seepage / soft spots	Y	Seepage mitigation works currently being carried out along downstream, toe.	
	Tree / shrub growth	Y	established over the majority of the upper face, lower bench has been vegetatedand planted.	
Downstream Bench	Condition of surface	Y	Good, road base to be placed for access to seepage pump chamber	34
Downstream Toe	Condition/seepage	Y	buttress in place. No seepage evident	
Stormwater Drain	condition	Y	good condition, no evidence of impacts	
Upstream batter	Slumps, bulging or rilling of rockfill	Y	Under construction	35
	Tree / shrub growth	Y	None Observed	
Other Comments	seepage chambers have temporary pumps in place butpermanentheadwork piping has been installed and fenced.			

SPILLWAY

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Spillway	Obstructions or erosion	Y	Good condition. Generator, associated with sprinkler system located within the spillway channel. No concern at this time as sufficient storage capacity to cater for design storm without engaging spillway.	
	Stability of side slopes	Y	Good	
Other Comments	generator will be removed as part of Stage 2 works.			

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
2/5 DAM TAILINGS STORAGE FACILITY

Monitored By : Mark Dillon (EoR)
Date of Inspection : 23rd and 24th January 2023
Weather Conditions : Sunny and hot both days, heavy showers late on 23rd.
Rainfall : Late heavy showers on 23rd

DIVERSION CHANNEL

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Diversion Channel	Obstructions or erosion	Y	temporary haul road placed for access during Stage 2 construction. Channel to be reinstated once Stage 2 is complete. Obstruction is not of concern.	27
	Stability of side slopes	Y	1. Generally good condition. 2. Potentially some loosening of blocks in cut face between bench 1 and 2 (Refer plan of observations, Figure 6).	30, 32
	Seepage	Y	None observed	
	Outlet	Y	Condition changed - 2 x seepage bunds have been installed ~ 1 m high as part of environmental management plan. Will need to be removed once construction complete.	31, 33
Other Comments	obstructions due to earthworks are temporary works and will be removed once Stage 2 works are complete.			

DECANT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Decant	Obstructions or tailings build up	Y	None Observed	
	Obstructions or blockages	Y	None Observed	25
	Decant pond clarity	Y	Clear	
	Obstructions to flow at decant pipe inlet	Y	None Observed.	
	Pond Level	Y	RL166.96 m.	26
Other Comments	Tailings discharge pipelines have been rubbing the liner where buoys are present. Will require remedial works as part of Stage 2 construction (Refer plan of observations, Figure 6).			8

NORTH EMBANKMENT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Crest	Condition of surface	Y	Poor, some settlement evident, potholes present.	
	Condition of safety bund	Y	Reasonable, height degraded due to vehicular traffic.	
Tailings Beach	Location of beach development	Y	short but well defined beach, discharge from 2 x spigots at time of inspection.	
Downstream Benches	Condition of bench surface	Y	1. Generally good. 2. All lower benches recently completed and in very good condition 3. localised settlement and pooled water, potholes on upper bench used as access road. Not a concern as will be repaired as part of Stage 2 raise.	20, 21, 22
	Condition of safety bund	Y	Good	
Downstream Batter	Slumps, bulging or rilling of rockfill	Y	Nil	
	Seepage / soft spots	Y	Nil	
	Tree / shrub growth	Y	Nil	
Upstream batter	Slumps/bulging /heave	Y	Nil	
	Condition of geomembrane	Y	Good, Iron staining present where seepage return water was discharged. No impacts from tailings discharge.	
Downstream Toe	Seepage / soft spots	Y	Downstream environment has changed significantly. Seepage from lowest point present and was clear, captured in sump and pumped to seepage collection pond.	9, 19
Other Comments				

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
2/5 DAM TAILINGS STORAGE FACILITY

Monitored By : Mark Dillon (EoR)
Date of Inspection : 23rd and 24th January 2023
Weather Conditions : Sunny and hot both days, heavy showers late on 23rd.
Rainfall : Late heavy showers on 23rd

EAST EMBANKMENT

				Photo Reference
Crest	Condition of surface	Y	under construction	
	Condition of safety bund	Y	under construction	
Downstream bench	Condition of surface	Y	Good	
	Condition of safety bund	Y	Good	
Downstream Batter	Slumps, bulging or rilling of rockfill	Y	None Observed	
	Seepage / soft spots	Y	1. Seepage continues from the southern end of the eastern embankment, adjacent to the quarry. V-notch weir installed to monitor flow (Refer plan of observations, Figure 6). 2. seepage from the downstream toe of the embankment within the old CWD. 3. seepage present at north east corner and old chimney drain outlets (Refer plan of observations Figure 6).	5, 7, 10, 11, 12
	Tree / shrub growth	Y	Minor vegetation, but of no concern at this time.	
Upstream batter	Slumps/bulging /heave	Y	under construction	
	Condition of geomembrane	Y	Good, damage to liner at southern end of embankment has been repaired.	24
Other Comments				

SEEPAGE COLLECTION DRAINS

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Eastern Seepage Collection Drains	main drain	Y	Generally good condition. The southern end has been infilled with coarse rock to allow earthmoving equipment to access the area. This will be removed once works are complete.	
	finger drains	Y	Drains flowing	
Other Comments	Vegetation growing within the majority of the drains.			

SEEPAGE COLLECTION POND

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Crest	Condition of surface	Y	Reasonable, numerous potholes present. Water ponding on east side of the upper SCP.	17
	Condition of safety bund	Y	Good	
Dividing Embankments	General condition	Y	Good	
Downstream Batter	Slumps, bulging, rilling of rockfill	Y	None Observed	
	Seepage / soft spots	Y	None Observed	
	Tree / shrub growth	Y	Minor vegetation, no concern at this point in time.	
Upstream batter	Slumps/bulging /heave	Y	None Observed	
	Condition of geomembrane	Y	Good	
Floor	Condition of geomembrane	Y	Eastern cell OK, Western Cell poor condition with numerous tears and split seams	16, 18
Pump Station	Operation of pump	Y	OK	
	Condition of pump bridge	Y	Good	
Spillway	Obstructions to spillway	Y	None Observed	15
Freeboard	Estimate of spillway freeboard	Y	Approximately 2m	
Other comments	Refer report in relation to recommendations pertaining to the seepage collection ponds			

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
2/5 DAM TAILINGS STORAGE FACILITY

Monitored By :	Mark Dillon (EoR)
Date of Inspection :	23rd and 24th January 2023
Weather Conditions :	Sunny and hot both days, heavy showers late on 23rd.
Rainfall :	Late heavy showers on 23rd

CLEAN WATER DIVERSION DRAIN

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Diversion Channel	Obstructions or erosion	Y	Generally good condition. Minor undercutting at places (refer plan of observations, Figure 6).	
	Stability of side slopes	Y	Good, soil section being undercut near southern end. There is a minor slump but not obstructing the flow (Refer plan of observations, Figure 6).	2, 3, 4
Other Comments	there are numerous tension cracks along the outer safety bund, these appear stable but will require ongoing monitoring (Refer plan of observations, Figure 6)			

APPENDIX C – PHOTOGRAPHIC SUMMARY

Photograph 1 – Flow measuring weir installed at eastern end of CWDD

Photograph 2 – CWDD eroded upstream side slopes through glacial clays/silts. Does not interfere with water flow and does not affect access road profile. Has continued to slightly increase in extent compared to 2021 insepction.

Photograph 3 – Condition of cracking in safety bund on downstream edge of CWDD.

Photograph 4 – Condition of cracking in safety bund on downstream edge of CWDD.

Photograph 5 – Concentrated clear seepage within old chimney drain outlet.

Photograph 6 – overview of Stage 2 quarrying activities downstream of the CWDD.

Photograph 7 – filter bund downstream of eastern embankment within old CWDD.

Photograph 8 – damage to Stage 1 liner on upstream face of eastern embankment due to dragging of pipeline.

Photograph 9 – seepage at the western end of northern embankment.

Photograph 10 – Toe seepage from original 5 Dam chimney drain outlet.

Photograph 11 – pooled seepage from original 5 Dam chimney drain outlet.

Photograph 12 – toe seepage from toe of original 5 Dam / 2 Dam interface.

Photograph 13 – v-notch weir 4 downstream of the Stage 2 northern embankment buttress.

Photograph 14 – Culverts into the SCP from v-notch 4.

Photograph 15 – SCP spillway, clear of obstructions.

Photograph 16 – overview of lower SCP, looking south from north.

Photograph 17 - Low points on eastern crest of the SCP. Maintenance required.

Photograph 18 – seepage return pipeline previously located on SCP liner has caused damage to the lining system and will require repair.

Photograph 19 – sediment laiden seepage water (legacy seepage) downstream of the Stage 2 northern embankment buttress.

Photograph 20 – northern embankment bench, pooling water, looking east.

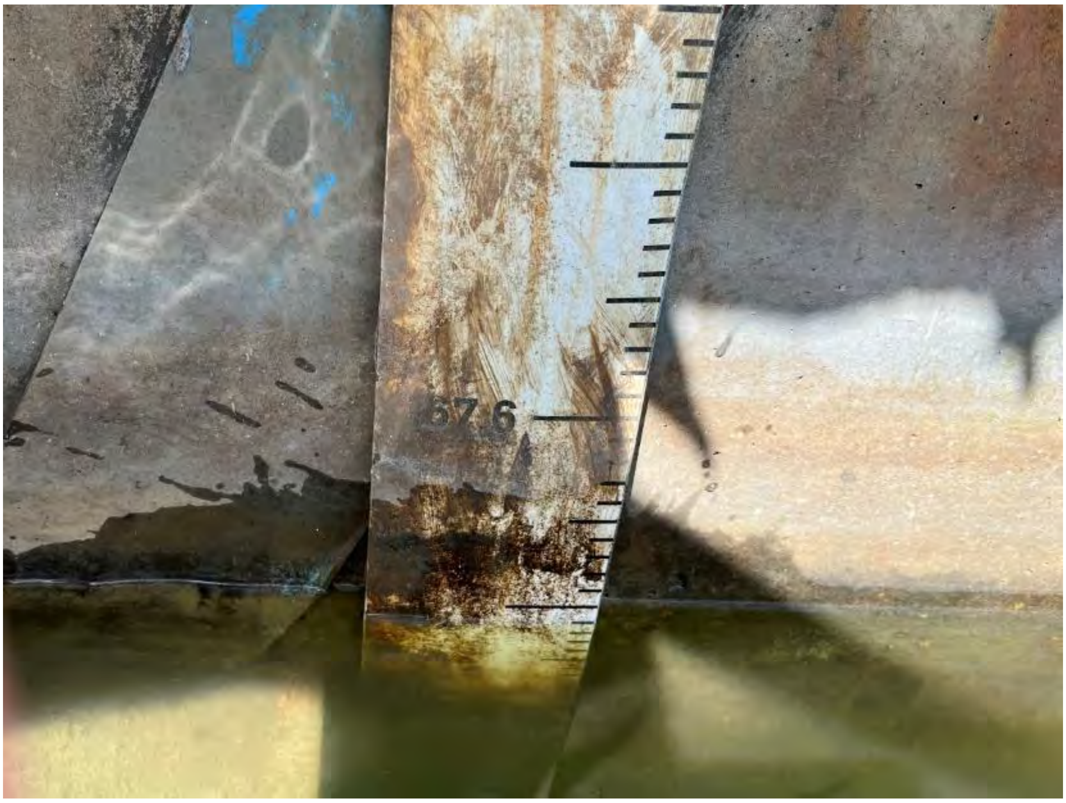
Photograph 21 – northern embankment lower bench.

Photograph 22 – downstream slope of northern embankment looking east, good condition.

Photograph 23 – upstream face of western embankment, looking south. Stage 2 raise recently completed.

Photograph 24 – southern embankment, upstream face and liner.

Photograph 25 – decant, clear of obstructions



Photograph 26 – decant gauge board, RL167.49

Photograph 27 – spillway, pump for sprinkler system will need to be removed as part of Stage 2 works

Photograph 28 – Footing at valve station has been repaired since previous inspection.

Photograph 29 – overview of western embankment, looking north from CWDD.

Photograph 30 – Diversion channel, looking south. Fill material placed to allow construction traffic to operate will need to be removed on completion of Stage 2 works.

Photograph 31 – northern end of diversion channel. Note fill material placed for construction traffic will need to be removed once Stage 2 works are complete.

Photograph 32 – loose rock in western cut face of the diversion channel

Photograph 33 – bund formed across the outlet to the diversion channel (to be removed once stage 2 works are complete.

Photograph 34 –downstream area of screening bund, adjacent to Murchison Highway.

Photograph 35 – Overview of downstream face of screening bund, looking north.

Photograph 36 – crest and upstream slope of screening bund.

Photograph 37 – overview of 2/5 Dam from CWDD.

Appendix C Bobadil TSF and Polishing Pond 2022 Engineer of Record Annual Inspection (ATCW, 2023)

ATC
WILLIAMS

REPORT

MMG ROSEBERY MINE
ABN: 23 004 074 962

BOBADIL TSF AND POLISHING POND
2022 Engineer of Record Annual Inspection

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EXECUTIVE SUMMARY

This Report documents the 2022 Engineer of Record (EoR) inspection of the Bobadil Tailings Storage Facility (TSF) and Polishing Pond at the MMG Rosebery Mine, Rosebery Tasmania.

The inspection has been carried out as part of the obligations of the EoR to MMG and provides an overview of the performance of the structures and adherence to the Operations and Maintenance Manual (O&MM). The Inspection was conducted on 24th January 2023by Mark Dillon (EoR) from ATCW.

Since the 2021 annual inspection the following works have been carried out:

- Completion of the Stage 10 embankment raise;
- Installation of a dust trial; and
- General site vegetation management.

The facilities were observed to be in generally good condition at the time of the inspection. Discharge of tailings is split between Bobadil and 2/5 Dam. At times when discharge of tailings is directed to 2/5 Dam, Bobadil received treated mine water. Precipitates from mine water remain a concern to efficient operation although the impacts have reduced compared to the period where Bobadil was only receiving mine water.

Main observations made during the inspection can be summarised as:

- Beaching is even and generally uniform, with the southern portion of the facility at, or near freeboard;
- The extent of seepage observed in the railway cutting has increased;
- Seepage from the downstream slope of the Levee embankment has increased; and
- Cells 1 to 3 of the Polishing Ponds are full of precipitates, reducing the efficiency of the system;
- The monitoring system is yet to be fully automated.

A number of recommendations have arisen from the 2022 EoR annual inspection. These are a combination of previous audit actions that have not been completed and new action items as a result of the inspection.

Recommendations have been developed based on the site visit, review of monitoring information and discussions with site personnel. Each recommendation has been assigned a priority as follows:

- High priority – A possible current threat to the integrity of the tailings storage facility due to direct evidence of a deficient and non-conformances against requirements; or not meeting expected MMG or industry requirements; or through urgency due to a limited window of opportunity to address a recommendation.
- Medium priority – A possible longer-term issue with the tailings storage facility management that may result in a future threat to the integrity of the facility.
- Low priority – Does not represent a threat and mainly associated with maintenance or operational aspects.

Table ES1 presents the recommendations stemming from the 2022 EoR annual inspection. The recommendations include currently open actions. Items that are currently “in plan” such as routine monitoring, vegetation management, etc are not included as these items are well established standard operating activities.

All accepted recommendations should have an action plan developed.

TABLE ES1 RECOMMENDATIONS

Item	Aspect	Recommendation	Priority
1	Instrumentation	VWP's are connected to telemetry system but there remain concerns with the telemetry systems for the inclinometers, and the GPS positioning beacons currently provide no data. All electronic instrumentation should be connected to telemetry to allow real-time monitoring. This is critical to dam safety.	High
		Seepage pipes and monitoring weirs should be maintained in the best possible condition to provide correct measurements. Consider adding sensors to key weirs as part of proposed rationalisation of the monitoring system.	Low
2	Seepage	Develop action plans to investigate source of seepage present at: • Southern embankment. • Levee embankment • Railway cutting The action plan should include identification of source and mechanism.	Medium
3	Polishing Ponds Storm Storage	The Polishing Pond spillway is undersized. An action plan should be developed that considers a risk based approach to assess future requirements.	Medium
4	Polishing Ponds Storage Capacity	The storage capacity, and hence attenuation time in the ponds is significantly reduced. by sedimentation, that could lead to environmental non-compliance of discharge water. A plan to dredge is in the planning phase.	Medium

Based on the Inspection and a detailed review of all inspection and monitoring data, it is considered that Governance associated with the Bobadil TSF is of a high standard and is being inspected and monitored in general accordance with the requirements of the overarching Operation and Maintenance Manual and in accordance with the TARPs, and relevant ANCOLD guidelines.

It is considered that the Bobadil TSF does not present a significant risk to the environment downstream of the facility and is suitable for the on-going storage of tailings generated at the Rosebery Mine.

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

This Report documents the 2022 Engineer of Record (EoR) inspection of the Bobadil Tailings Storage Facility (TSF) and Polishing Pond at the MMG Rosebery Mine, Rosebery Tasmania.

The inspection has been carried out as part of the obligations of the EoR to MMG and provides an overview of the performance of the structures and adherence to the Operations and Maintenance Manual (O&MM).

The previous annual inspection of the structures was an intermediate audit and was carried out by ATC Williams (ATCW) in February 2022 and is documented in the 2021 Audit Report **[1]**.

The O&MM outlines the frequency of inspections, with intermediate audits to be completed annually by the design engineer (ATCW) as well as comprehensive audits completed biannually by an independent consultant. The previous independent audit (comprehensive) was carried out by KCB in September 2021 **[2]**. Accordingly, an independent (comprehensive) audit is required in 2023.

This report covers the previous calendar year monitoring data.

Since the 2021 annual inspection the following works have been carried out:

- Stage 10 raise has been completed;
- Installation of a dust trial; and
- General site vegetation management.

2 SCOPE OF WORK

The inspection was completed by the EoR in accordance with the requirements for intermediate inspections outlined in ANCOLD **[3]**.

3 GENERAL INFORMATION

3.1 Operational Status

Tailings are discharged into either Bobadil TSF or 2/5 Dam TSF. Either facility receives the full tailings flow for 50% of the time. When tailings are discharged at 2/5Dam, Bobadil receives treated mine water.

Tailings are discharged into the Bobadil TSF from 5 to 7 spigots from one of 4 pipelines located on the crest of the facility. For operational reasons discharge is generally split between the southern and northern portion of the facility to facilitate future construction stages.

The Polishing Pond is used to condition decanted mine water from the Bobadil TSF prior to release to the Pieman River. The discharge point from the Polishing Pond is MMG Rosebery Mine's licensed discharge point for water from the Bobadil facility.

The 2/5 Dam TSF was commissioned in April 2018. The facility was the primary tailings storage at Rosebery until mid-2022 when Bobadil Stage 10 was commissioned. Tailings are now batch discharged between the two facilities.

The facility is nearing its Stage 1 capacity. The remaining capacity in 2/5 Dam Stage 1 indicates the facility will be filled to freeboard by the end of Q1 2023, noting that the January 2023 bathymetric surveys are not yet complete. The bathymetry may indicate that the discharge is possible into Q2 2023. This estimate of remaining capacity is based of splitting tailings discharge between Bobadil and 2/5 Dam on a rotating basis in accordance with the current operational plan.

Construction of Stage 2 commencing in early 2021 and is currently scheduled to be completed in mid-2023.

3.2 Physical Details

The facility is located about 3 km from the mill area and is accessed via the flume road. The location of the Bobadil TSF and Polishing Pond, in relation to the mill is shown on **Figure 1**. A recent aerial photograph (January 2023) is presented as **Figure 2** which shows the general arrangement of the Bobadil TSF and Polishing Pond at the time of the inspection.

Both Bobadil and the Polishing Pond can be described as side-hill facilities. There is a clean water diversion to the east of Bobadil to reduce inflow from the surrounding catchment area. The catchment area of Bobadil is approximately 72 hectares (Ha).

Bobadil has been constructed in ten stages, commencing on the 1970's. Stage 1 and 2 were constructed as earthfill embankments. Stages 3 to 9, commencing in 1996 were all constructed using the upstream construction method, generally in 1 m to 3 m increments. A buttress was constructed downstream of the western embankment in 2005. The current crest elevation (Stage 10) has a crest elevation of RL 201 m. The maximum embankment height of approximately 33 m is along the western flank. The cross section varies around the facility as shown on **Figure 3**.

The Polishing Pond was constructed in the 1980's as a single stage homogenous earthen dam. Internal embankments were constructed in 2013/2014 to improve water flow through the pond.

3.3 Storage Capacity

Total tailings tonnage discharge into Bobadil since commissioning in the 1970's is approximately 19 Mt. Previous estimates of average dry density of the stored tailings are 1.5 t/m^3, indicating a volume of stored tailings of approximately 12.9 Mm^3.

The facility had been filled to freeboard along the southern flank and adjacent to the Levee embankment. It is noted that tailings deposition in the area of the Levee embankment was undertaken to facilitate the installation of dust monitoring equipment.

The January 2023 survey of Bobadil indicates a remaining capacity (to cater for design storm storage and freeboard) of approximately 0.44 Mt at an average dry density of 1.5 t/m^3.

The designed storage capacity of the Polishing Pond was 66,500 m^3. This storage volume is greatly diminished due to the build-up of sediment in cells 1 to 3 over time. Dredging of the Polishing Pond is currently in the planning phase, for execution later in 2023.

3.4 Catchment Characteristics

The Bobadil TSF is an off-stream storage. The catchment area of the facility has reduced due to the configuration of the Stage 10 embankment raise. The instep of the embankments varies from 25 m (northern) to 50 m (western and southern), resulting in a reduction of catchment area by approximately 7 hectares (Ha). The resultant catchment is approximately 65 Ha.

The catchment area comprises the tailings surface area (44 Ha) and the natural catchment including the old rock quarry that has been converted to the decant pond (21 Ha). There is a storm water diversion drain above the quarry and along the eastern flank of the facility that diverts rainfall runoff away from the facility.

The catchment area of the Polishing Pond comprises the pond surface area and the natural topography between the pond and western toe of Bobadil to the east. Its total catchment area of about 15 Ha, but it also accepts decant and seepage water from the Bobadil TSF.

3.5 Consequence Category

The Consequence Category was last assessed as part of the Stage 10 design **[3]** in accordance with ANCOLD **[4]** and assigned a Consequence Category of HIGH C for Bobadil. The Polishing Pond has previously been assigned a Consequence Category Significant in accordance with ANCOLD, however as it forms part of an integrated system for water management the same Consequence Category as Boabdil is adopted for operation and monitoring criteria.

3.6 Flood Capacity

Water can be removed from the surface via gravity decant structures or emergency spillways.

Bobadil has a decant located in the northern quarry void (**Figure 2**) which has a capacity of approximately 1 m^3/s. The spillway is located in the north east corner of the facility and has been designed to pass a Probable Maximum Precipitation (PMP) event (15 m^3/s) with a remaining freeboard of approximately 0.1 m.

The Polishing Pond has two decants, which when operating at full capacity can discharge a 1:50 year EAP event. The facility has a spillway located at the southern end of cell 1 (**Figure 2**). The capacity of the spillway is approximately 1.4 m^3/s. It has previously been identified that the spillway is inadequate to discharge the design storm and that a second spillway should be constructed **[5]**. However, a risk assessment is proposed to inform a final decision on the need for the second spillway.

3.7 Surveillance Programme

3.7.1 Frequency

ANCOLD (2019) **[3]** indicates that for a “High C” Consequence Category dam, routine visual inspections should be carried out on a daily to 3 times per week basis, that intermediate inspections are carried out annually and that comprehensive inspections are carried out at 2 yearly intervals.

The Operation and Maintenance Manual (O&MM) was updated in May 2022 **[6]** to include a Stage 10 construction Trigger Action, Response Plan (TARP). The updated TARP includes phreatic conditions triggers during construction. .

3.7.2 Routine Visual Inspections

Routine visual inspections of the Bobadil TSF and Polishing Pond are specified in the O&MM **[6]** and are required to be conducted on a shift, daily, weekly, and monthly basis. Refer to **Section 5.2** of this Report for a more detailed discussion of these inspections and their implementation.

3.7.3 Monitoring

The facilities are monitored on a monthly basis by ATCW and a report prepared to summarise the findings is issued to MMG in the format of a monthly TARP report. Monitoring includes measurement of phreatic conditions (VWP and standpipe), in-place inclinometers, pond water levels, internal drainage discharge and seepage from the facility. These requirements are detailed in the O&MM **[6].** Some of the instrumentation is now remotely monitored.

Further details regarding monitoring, including a review of results for the audit period, are presented in **Section 5.3** of this Report.

Figure 4 presents the location of piezometers(Vibrating Wire Piezometers (VWP) and Standpipe Piezometers (SP), whilst **Figure 5** presents internal drainage and seepage monitoring points. **Figure 6** presents the location of other instrumentation (inclinometers and GPS movement monitors).

4 SURVEILLANCE INSPECTION

4.1 Details of Inspection

The Inspection was conducted on 24th January 2023 by Mark Dillon (EoR) from ATCW. Pamela Soto (MMG Manager Tailings & Water Australia) was also in attendance during the inspection.

The weather during the inspection was sunny and hot. The weather conditions were not a factor during the inspection.

Details of the inspection, in the form of the monthly checklist is presented in **Appendix A**. A summary of inspection observations is presented in **Figure 7**.

4.2 Photographic Record

Representative photographs taken during the audit inspection are presented in **Appendix B**. The approximate location of the photographs is presented as **Figure 8**.

4.3 Bobadil

4.3.1 General

Mine water discharge into Bobadil since cessation of tailings deposition in April 2018 has resulted in sediment/sludge deposition on the tailings surface as well as the southern quarry void. There has been an increase in the rate of sludge deposition within the Polishing Ponds as a result of the mine water. Of note is the increased presence of iron precipitates within the majority of drainage pathways between Bobadil and the Polishing Pond. Geotubes have been installed on the tailings beach of Bobadil to minimise sediment/sludge build-up due to the discharge of mine water. A bank of Geotubes is also located above the Polishing Ponds that were used for dewatering dredged material from the Polishing Ponds during 2020.

A recent aerial photograph of the facility is presented as **Figure 2**.

4.3.2 Freeboard, Tailings Beach and Pond Storage

The southern portion of the facility is either nearing minimum wall freeboard or at minimum wall freeboard. The wall freeboard generally increases towards the north, with the largest freeboard towards the eastern end of the northern embankment. The exception to this is adjacent to the northern portion of the Levee embankment where the tailings were purposely filled to minimum wall freeboard to facilitate the installation of a dust monitoring equipment.

Tailings are discharged on a campaign basis between Bobadil and 2/5 Dam, with facility receiving 100% plan tailings for 50% of the time. Bobadil received mine water from the ETP 100% of the time. At the time of the inspection tailings was being discharged from the northern embankment.

Review of recent aerial survey of the tailings beaches indicates a beach profile with slopes ranging from 3.0% to 0.5% near the head of beach, and 0.5% to 0.2% close to the decant pond. The achieved average beach slope is in general alignment with the design beach slope.

4.3.3 Embankments

The crest was observed to be in good condition, with some minor rutting present. Windblown tailings are present on the crest and in places on the downstream slope.

The upstream batters are generally in good condition where exposed with some isolated slumps on the upstream face due to rainfall and spigot conductor pipe spills. Slumps that have occurred during the period have been repaired in consultation with the EoR. The slumps are of no concern as these will be supported by tailings are the facility is filled.

The downstream batters between the Stage 10 crest and the trial closure cover (Stage 9 tailings beach) were also observed to be in very good condition with some windblown tailings deposits present. A sapling is present on the downstream slope at the eastern end of the northern embankment.

4.3.4 Tailings Trial Cover

The trial cover area was observed to be in good condition. There have been some issues identified with uplift of the BGM lined drainage lines after rainfall events. This has been overcome by piercing the BGM liner just upstream of the perimeter road culvert crossings to depressurise the underside of the liner. These are of little concern to the overall performance of the trial cover and will be repaired in the near future.

4.3.5 Western Buttress

The crest of the Western Buttress was in reasonable condition with evidence that water ponds adjacent to the downstream toe of the RL 199 m embankment crest. Water ponds in low points in this area due to consolidation of the underlying tailings. Select areas were scarified during Stage 10 construction, however further works will be required to improve drainage.

The downstream face, between the crest and RL 199 m trial cover area was observed to be in good condition with windblown tailings deposits present in the southern portion of the facility. The downstream batter between the buttress crest and downstream toe was also observed to be in good condition with only minor, isolated vegetation present. The vegetation observed was of no concern.

4.3.6 Seepage

Seepage is limited to specific locations on the downstream face and toe of the facility. Changes were observed in both extent of impact of some of the seepages since the previous EoR inspection in January 2022. No new seepage of interest was observed.

The observed seepage is as shown on **Figure 7** and is summarised below.

- Southern seepage:
  - Seepage is present at the downstream toe from two discrete channelised areas, as well as a moss and algae covered area at the toe of the embankment, monitored via BDSP-01 which has reported a flow of between 9 l/min (summer) and 153 l/min (winter) and an average of 32 l/min over the period since the 2021 EoR inspection. At the time of this inspection the flow was approximately 16 l/min.
  - Seepage at the toe of the southern access ramp was first observed in 2020 and is located to the east and below the Low Lift Pump Station. Over the 12 month period the extent of the seepage appears to have increased but is flowing at a low rate. Algae is present in the area.
  - There is a weep at the abutment of the rockfill and natural ground, approximately 4 m up the slope. This did not appear to be flow and the extent was bounded by moss. This is at the approximate elevation of the southern access ramp seepage, suggesting a seepage front is possibly migrating through the glacial soils.
- Levee Embankment:
  - Three areas of previous seepage, in the form of iron staining were observed on the downstream face towards the northern end of the Levee embankment. These appear to be originating between the Stage 4/5 and 5/6 raise interfaces. These have previously been observed during monthly monitoring of the Bobadil TSF. At the time of the inspection the location of the seepage was dry, and the extent does not appear to have increased over a number of years.
  - A concentrated seep is located towards the top of the levee embankment near the bypass ramp. This was observed in early 2021 and has been routinely monitored during the Stage 10 construction works. At the time of the inspection the seep was noted as dry.

    - There is a broad area of seepage present at the southern end of the Levee embankment, possibly originating at the Stage 4 and 5 raise interface. The extent of the seepage is from the bypass ramp (south end) and extends to approximately 20 m north of the levee drainage pipes. The area has become covered with reeds and wind-blown tailings, but it was noted that the reeds are in poor condition suggesting the seepage environment has changed. There is a defined upper fringe to the seepage noted by salts and there are numerous locations where algae and weeping seeps are present approximately 5 m lower down the slope. The ground was soft and waterlogged under foot.
    - Water was also observed to be flowing from around the white (lowest) seepage drainage pipe. No water was observed flowing around the upper two black seepage pipes.
- Northern Embankment:
    - Seepage at the northern embankment is located at the western end, emanating on the old ramp (approximate raise 5/6 interface). The seepage was dry, however there is extensive salt present at the origin and down the ramp that suggests the seep is active. The upper fringe of the seep extends across the ramp to the top of the Railway cutting.
- Railway cutting:
    - During the previous EoR inspection (January 2022), salt precipitates and seepage were observed at the northern end of the railway cutting at and just above the toe. The extent of seepage and salt has increased considerably over the 12 month period.
    - The extent of salt precipitates extends over a length of approximately 100 m and is generally limited to the lower 3 m of the slope. The exception is a location where seepage was observed at the western end of the Northern embankment. At this location the salt is present on the cutting to full height.
    - Two distinct areas of water were overserved at the toe as shown on **Figure 7**.

The changes in seepage need to be considered in more detail, primarily:

1. Southern seepage: investigate whether a seepage front is starting to emanate through the natural glacial soils from the eastern side of the old railway cutting.
2. Levee seepage: the extent of the seepage at the southern end has changed and become more extensive. This is likely a seepage front. An action plan will need to be developed to assess the risk this seepage poses.
3. Railway cutting: investigate whether a seepage front is starting to emanate through the natural glacial soils of the cutting.

An action plan should be developed that considers the above areas of interest. The extents of the above three areas are presented on **Figure 7**

4.3.7 Erosion

Erosion is limited to the glacial fill between the top of the railway cutting and the Stage 5 bench of the Levee embankment. The erosion occurred some years ago due to breaks in the safety bund on the Stage 5 bench and has not increased over the inspection period.

4.3.8 Toe and Seepage Drains

A toe drain is located downstream of the western embankment and the southern (old railway) embankment. There is also a drain located along the downstream toe of the southern end of the Levee embankment. These drains discharge into either the decant drain or bypass drain (refer **Figure 2** for general layout).

The inspection of the drains is summarised as follows:

- Levee Toe Drain:
    - The drain, located at the crest of the railway cutting predominantly collects water from the Levee beach drains (three outlet pipes). The drain is clear and flowing well. The v-notch

    weir located upstream of the bypass ramp (v-notch - VW1) has considerable sediment against its face which requires clearing. The V-notch is damaged and should be replaced. Salt precipitates are present on the upstream side of the drain.

- Western buttress toe drain:
    - The downstream toe drain was in reasonable condition. Vegetation has been cleared.
    - The BDSP pipes predominately have algae below the outlets and in places algae growing within the pipe outlet, whilst the WB pipes predominantly have iron precipitates below the outlets and the majority of the pipe outlets are partially blocked by the same precipitates. These differences indicate differing water quality/chemistry from the two different elevations within the tailings.
    - Precipitates are present within the drain which is common.
    - Water is ponding in the drain in the area of BDSP 10 to BDSP 11.
    - There is a partial blockage at the pit located near BDSP 9A.
    - There is dense vegetation blocking access around the outlets of BDSP 9A and WB 3.
- Southern toe drain:
    - The drain is clear and flowing well.
    - There is a junction pit in the pipeline that runs under the railway line that is leaking. This has been observed during the monthly inspections.
    - The section of drain, between the pipes and its entry to the bypass drain, is becoming overgrown and flow from the western drain outlet pipe is obscured.
    - V-notch weir BDSP03 has considerable sediment build-up against the face and appears to be damaged in the base of the "v". and requires clearing. Drainage outlets (from the western toe drain) and overgrown and require vegetation to be removed.
- Bypass drain:
    - Is generally in good condition, vegetation management is adequate.
    - Pipe from the pit near BDSP 9A was flowing clear. No flow was observed from other pipe outlets.
    - Cipolletti weir CW4 has sediment build-up against its face and at its approach.
    - Cipolletti weir CW3 has precipitates on the weir. These precipitates affect measurement and hence ability to properly measure flow.
- Northern Drain, west of decant channel:
    - The drain is full of sediment meaning that the seepage monitoring pipes (BDSP 20-BDSP 22) cannot be measured.

An action plan should be developed that considers the following:

1. Improve drainage in area of BDSP 10 to BDSP 11.
2. Clear sediment from upstream of weirs and pit inlets (general).
3. Investigate / repair leaking pit southern seepage drain.
4. Relocate / repair V-notch BDSP03.
5. Clear northern drain.

The above areas of interest are presented on **Figure 7**

4.3.9 Decant, Decant Channel and Bypass

The decant is located at the northern end of the northern quarry void. It has been raised to final elevation (RL 195 m). At the time of the inspection the decant was relatively clear and the entrance was observed to be clear of obstructions.

A decant filter wall was constructed as part of Stage 10 works. At the time of the inspection the filter wall was operating although the flow through the wall was lower than expected. The majority of water flow from the surface of Bobadil is directed via a channel to the southern quarry void where it spills over into the northern quarry void. There is considerable sediment present in the southern quarry void.

The decant channel was clear from the decant outlet to the bypass channel. The railway culverts were clear of obstructions.

Sediment was observed upstream of Cipolletti weir CW1 which should be cleared.

The spillway drain outlet, located adjacent to the decant outlet pipe was flowing but measurement is not possible to due to sediment and vegetation. This should be cleared.

The BDSP outlet pipes, located in the old railway cutting downstream of the eastern end of the northern wall cannot be measured due to access and vegetation.

The bypass valve appeared closed, thereby directing decant discharge to Cell 3 of the Polish Pond, however, it was observed the bypass valve is heavily caked with precipitates and hence is unlikely to close fully. This needs some action.

was open approximately 50% at the time of the inspection, directing flow into Cell 1 and Cell 3 of the Polishing Pond. The channel to both Cell 1 (beyond the diversion from the bypass drain) and Cell 3 are densely vegetated.

Figure 7 presents the above areas of interest.

4.3.10 Railway Cutting

The Railway Cutting was observed to be in good condition with no evidence of slumping or cracking. Vegetation on the cut slopes was observed to generally be in good condition with some areas of distress trees associated with seepage and salt (refer **Section 4.3.6** for a discussion on seepage).

4.3.11 Spillway

The spillway was observed to be in good condition and clear of obstructions. The low flow channel and the sill beam were also observed to be in good condition.

4.4 Polishing Pond

The Polishing Pond is generally in good condition. Cells 1 to 3 were dredged in 2020/2021 but have since become clogged with sediment.

The embankment of the Polishing Pond was in good conditions. There are isolated potholes on the crest.

The upstream face is densely vegetated whilst vegetation on the downstream face is well managed.

Freeboard at the perimeter embankment varies due to the cascading nature of the ponds. Freeboard at the northern end (cell 3/4) is approximately 1 m whilst at the southern end of the ponds (cell 6) the freeboard was approximately 1.5 m.

The internal cross walls are in good condition and cleared of vegetation. The internal control structures between cells (internal spillways and culvert section were in good operational condition. It was noted that the internal spillway between cells 2 and 5 has been backfilled due to the increase in water level in cells 1 to 3 due to sediment build-up.

The water level within the cell 3 is raised resulting in flow through both the cell 3 to 4 control discharge point and internal spillway.

Both decants were clear of obstructions. The southern decant (Decant 1, cell 6) was operational whilst stop boards had been installed in the northern decant (Decant 2, cell 3). The main outlet channel from the southern decant was clear of obstructions. The outlet from the northern decant is generally clear with some saplings becoming established towards the southern end of the channel.

Seepage was not observed, however the three areas on the downstream face of cell 6 where seepage has previously been noted was covered in moss and reeds and was soft under foot. This suggests that the area has high moisture, and it is likely that the evaporation rate in warmer summer months balances to a certain degree the seepage rate.

The spillway was observed to be clear of obstructions at the time of the inspection. There was no noticeable change in the condition of the spillway when compared to photographs taken during the previous inspection.

The two outlet V-notch weirs, shown on **Figure 5**, were inspected. The southern v-notch was dry and clear of sediment, whilst the northern V-notch was flowing and had iron precipitates present upstream.

It is understood that MMG are in the process of implementing a Polishing Pond dredging program that is supported by the EoR and hence does not form a recommendation in the report.

5 REVIEW OF SURVEILLANCE

5.1 Review of Previous Surveillance Reports

5.1.1 General

MMG now capture recommendations in the IEM register which presents the actions, presents timeframes and nominated the responsible MMG person. The IEM register was reviewed as part of the annual inspection. In addition, MMG provided documentation in relation to the implementation of actions via a memorandum dated 18/12/2022.

5.1.2 Review of 2021 EoR Inspection Report

The 2021 EoR inspection report prepared by ATCW **[1]** was reviewed. Issues raised, and corrective action completed is presented in **Table 5.1**.

TABLE 5.1 ACTION ITEMS STATUS FOR 2021 INSPECTION

Item	Item Reference	Description	Status
General			
1	2019	Consideration be given to rationalising the monitoring system, i.e., tracing seepage and water flows, and implementation of real time cloud based, or similar, monitoring	In plan, refer IEM register
Bobadil TSF			
1	ongoing	Vegetation/reeds within the west embankment toe should be cleared to access BDSP locations and to improve water flow within the drains.	Ongoing maintenance, budgeted.
2	2018	The crest of the western buttress should be regraded to minimise water ponding on the crest.	In plan, as part of Bobadil Stage 11 construction
3	2020	Repair V-notch 01 and BDSP03	In plan, to be actioned as part of General Item 1.
4	2021	The origin of the salt precipitates on railway fill batter above bypass drain should be investigated	Action Plan to be developed.
5	2021	Seepage at the toe of the southern access ramp should be investigated to identify the source of the seepage	Action Plan to be developed.
Polishing Pond			
1	Comprehensive Audit Findings 2017	~~Stability assessment should be undertaken for the~~ Polishing Pond and trigger levels should be set for the piezometers.	Complete
2	2018	The second spillway should be constructed.	Action Plan to be developed - Risk based approach
3	2019	Monitoring of piezometers ~~and development of TARP~~	Ongoing
4	2020	Vegetation management required on the internal structures to facilitate inspection.	Complete, ongoing maintenance budgeted.

5.2 Routine Inspections

5.2.1 General

Routine Inspection procedures for the mandatory surveillance of the Bobadil TSF and Polishing Pond are specified in the Operation and Maintenance Manual **[6]**. The inspection requirements are as follows:

- Shift/Daily and Weekly Routine Inspections – relating to issues that may develop over time and impact on the safety of the dam or the environment.

- Monthly Routine Inspections – relating to issues that may develop over time and routine monitoring.

In addition to the above routine monitoring, the results are compiled into monthly TARP reports by ATCW to provide MMG with a summary of the performance of the facility.

5.2.2 Routine Shift/Daily and Weekly Inspections

The Manager - Concentrator is responsible for coordinating the shift/daily and weekly inspections and reporting. The inspections are recorded electronically in the Effluent System Change Register which includes the checklists from the O&MM.

The previous review of the register was to 31 December 2021. The register was reviewed for compliance with the O&MM for the 12-month period ending 31 December 2022. The findings summarised below:

- Shift/Daily Inspections – 100% completion.
- Weekly Inspection – 98% completion.

From review of the register, it is apparent that the high level of compliance with regard to inspections has been maintained throughout the 12-month period since the previous review.

Based on review of the register it is considered that the inspections are being carried out in general accordance with the requirements of the O&MM.

5.2.3 Routine Monthly Inspections and Reports

Routine monthly inspections are the responsibility of the Concentrator Department, who have contracted ATCW to complete the monitoring and inspections. Monthly inspections are stored by MMG within their electronic library. The inspections have been completed in accordance with the O&MM.

5.2.4 Non-scheduled Inspections and Corrective Action

No non-scheduled inspections were needed after completion of Stage 10 works except review of abnormal inclinometer data received at times.

5.3 Monitoring

5.3.1 General

Routine monitoring of the facilities has been carried out daily / monthly during the period. The following monitoring was carried out.

- Water Level within Bobadil and the Polishing Pond at the decant. This is remotely measured on a daily basis.
- Bobadil Internal Drainage Discharge Monitoring (BDSP and WB) flow rate and water clarity (monthly).
- Polishing Pond seepage monitoring (VW 2 and VW 3) (monthly).
- Phreatic surface within the facilities at varying frequency: (60 piezometers at Bobadil and 6 monitoring bores at the Polishing Pond) – standpipes monitored monthly and vibrating wire piezometers twice daily via remote system.
- Settlement/Movement Monitoring of the Western embankment during Construction.

The following sections provide a discussion and summary of the monitoring.

5.3.2 Bobadil

5.3.2.1 Monitoring Piezometer Water Levels

The locations of the piezometers are shown on **Figure 4**. The piezometers are grouped into section lines to allow an understanding of the phreatic conditions. The data is plotted monthly within the monitoring TARP as a phreatic surface cross section along with the time series for the piezometers. The time series levels for each of the sections plotted against rainfall are presented on **Figures 9** to **17**. **Figures 18** to **26** present the piezometric cross section as of the start of February 2023 and the TARP trigger levels.

Monitoring indicates that, over the past 12-month period, the piezometers have remained relatively stable with minor responses to mine water discharge, tailings deposition and rainfall and remained within TARP limits. The phreatic surface trend cannot be compared to previous years due to the cessation of deposition of tailings prior to the completion of Stage 10 operations. The phreatic conditions over the review period are within expectations.

Tabulated monthly data and cross sections along each of the piezometer groups are presented in **Appendix C**.

5.3.2.2 Monitoring Internal Drainage (Drainage and Seepage)

The locations of the internal drainage outlets, referenced as BDSP and WB, are shown on **Figure 5**.

The monitoring points are grouped into regions, these being the Northern, Levee, Western, Southern Embankments and Western Buttress. The discharge by region plotted against rainfall is presented on **Figure 27**.

The measured discharge rates over the previous 12 months are summarised below.

- Northern embankment : 21 – 28 l/min (average 24 l/min).
- Western embankment : 21 – 60 l/min (average 39 l/min).
- Southern embankment : 49 – 98 l/min (average 98 l/min).
- Levee drainage : 78 – 222 l/min (average 127 l/min).
- Western buttress : 56 – 150 l/min (average 109 l/min).

Monitoring indicates that over the past 12-month period the internal drainage discharge has generally responded to rainfall; lower drainage rates apply during the drier summer months. The measured rates are similar to the long-term trends. The levee drainage was previously reported to exhibit an increasing trend since September 2021 corresponding to the commencement of discharge from the levee embankment. Levee drainage flow rate has decreased since this time and measured rates now appear similar to long-term trends.

The discharge rates are within expectations.

Tabulated monthly data is presented in **Appendix C**.

5.3.2.3 Settlement/Movement Monitoring

The majority of the settlement monuments installed at the Bobadil TSF were removed/destroyed in late 2020 as part of Stage 10 construction. Inclinometers and GPS movement monitors have been installed as follows:

- 4 No. in-place inclinometers (SAA01 - SAA04) were installed in April 2021 within the western buttress as part of the Stage 10 embankment works for construction induced movement monitoring. The inclinometer locations are presented on **Figure 6**.
- 17 No. GPS based NAVSTAR movement monitors were installed in February 2022 to allow for remote monitoring of movement on the raised embankments crest and also on the western buttress as shown on **Figure 6.**

The inclinometers (SAA01 -SAA04) were equipped with in-place 0.5 m segments and monitored on a weekly basis during Western embankment Stage 10 raise until March 2022. Issues have been encountered with the SAA instruments since March 2022 staring with missing data at some nodes and this extended to majority of the nodes later on. . At times during the 2022 audit period the segments also started showing abnormal large readings concentrated around isolated nodes. This was reviewed at each time and assessed by ATCW as a false reading. Recently, it has been concluded that the segments at the Bobadil inclinometers are defective and an alternate inclinometer type should be considered for future monitoring.

The GPS based NAVSTAR monitors are yet to be connected to the telemetry system and hence no data is available from these instruments. This is of concern as no movement information is available other than the SAA located on the western buttress. There is a standing recommendation for the instruments to be connected to the telemetry system as a matter of urgency.

5.3.3 Polishing Pond

5.3.3.1 Monitoring Piezometer Water Levels

The locations of the piezometers are shown on **Figure 4**. The measured water level has remained relatively static with an average variance of approximately 0.3 m for the duration of the reporting period, typically in response to rainfall.

The time series levels for each of the eastern and western sections of the Polishing Pond, plotted against rainfall, are presented on **Figures 28**and **29** respectively.

5.3.3.2 Seepage Monitoring

Seepage is monitored at two V-notch weirs, referenced as VW 2 and VW 3.

The V-notch weir (VW 2) installed downstream of the north western part of the Polishing Pond indicates that the seepage rate varies between approximately 48 L/min and 110 L/min, with an average of 64 l/min. The flowrate measured appears to cycle in response to rainfall.

The V-notch weir (VW 3) installed downstream of the southern part of the Polishing Pond was recorded to be dry with no seepage recorded for the entire reporting period.

A time series levels for the V-notch weirs is presented on **Figure 30**.

Tabulated monthly data is presented in **Appendix C**.

6 OPERATION, MAINTENANCE AND EMERGENCY MANAGEMENT

The O&MM for the Bobadil TSF **[6]** was revised in May 2022 as part of the commitments associated with the Stage 10 embankment raise. The main update was the addition of a construction TARP.

7 REVIEW OF DAM STATUS

Based on the Inspection and a detailed review of all inspection and monitoring data, it is considered that Governance associated with the Bobadil TSF is of a high standard and is being inspected and monitored in general accordance with the requirements of the overarching Operation and Maintenance Manual and in accordance with relevant ANCOLD guidelines.

It is considered that the Bobadil TSF does not present an immediate significant risk to the environment downstream of the facility and is suitable for the on-going storage of tailings generated at the Rosebery Mine.

It is noted that there are some actions associated with seepage that need to be addressed.

8 SUMMARY OF RECOMMENDATIONS

A number of recommendations have arisen from the 2022 EoR annual inspection. These are a combination of previous audit actions that have not been completed and new action items as a result of the inspection.

Recommendations have been developed based on the site visit, review of monitoring information and discussions with site personnel. Each recommendation has been assigned a priority as follows:

- High priority – A possible current threat to the integrity of the tailings storage facility due to direct evidence of a deficient and non-conformances against requirements; or not meeting expected MMG or industry requirements; or through urgency due to a limited window of opportunity to address a recommendation.
- Medium priority – A possible longer-term issue with the tailings storage facility management that may result in a future threat to the integrity of the facility.
- Low priority – Does not represent a threat and mainly associated with maintenance or operational aspects.

Table 8.1 presents the recommendations stemming from the 2022 EoR annual inspection. The recommendations include currently open actions. Items that are currently "in plan" such as routine monitoring, vegetation management, etc are not included as these items are well established standard operating activities.

All accepted recommendations should have an action plan developed.

TABLE 8.1 RECOMMENDATIONS

Item	Aspect	Recommendation	Priority
1	Instrumentation	VWP's are connected to telemetry system but there remain concerns with the telemetry systems for the inclinometers, and the GPS positioning beacons currently provide no data. All electronic instrumentation should be connected to telemetry to allow real-time monitoring. This is critical to dam safety.	High
		Seepage pipes and monitoring weirs should be maintained in the best possible condition to provide correct measurements. Consider adding sensors to key weirs as part of proposed rationalisation of the monitoring system.	Low
2	Seepage	Develop action plans to investigate source of seepage present at: • Southern embankment. • Levee embankment • Railway cutting The action plan should include identification of source and mechanism.	Medium

Item	Aspect	Recommendation	Priority
3	Polishing Ponds Storm Storage	The Polishing Pond spillway is undersized. An action plan should be developed that considers a risk based approach to assess future requirements.	Medium
4	Polishing Ponds Storage Capacity	The storage capacity, and hence attenuation time in the ponds is significantly reduced by sedimentation, that could lead to environmental non-compliance of discharge water. A plan to dredge is in the planning phase.	Medium

REFERENCES

[1] ATC Williams Pty Ltd (2022). 2021 Engineer of Records Annual Inspection: Bobadil TSF and Polishing Pond, Reference 107031.68R07, December.

[2] Klohn Crippen Berger (2022). Biennial Dam Safety Review, Rosebery Mine Bobadil Tailings Storage Facility, Rev 7, Reference D10307A07, March.

[3] ATC Williams Pty Ltd (2020). Bobadil Tailings Storage Facility, Stage 10 Embankment Raise Detailed Design, Reference 107031.60R01, July

[4] ANCOLD (2019). Guidelines on Tailings Dam Planning, Design, Construction, Operation and Closure. July.

[5] ATC Williams Pty Ltd (2017). Bobadil Polishing Pond Spillway Capacity Assessment, Reference 107031.42-001, January

[6] ATC Williams (2022). MMG Rosebery Mine, Bobadil Tailings Storage Facility Operating Manual, Rev 7, Reference 107031R03, May.

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FIGURES

NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023
2.- 2-5 DAM TSF IMAGE DATED JANUARY 2023
3.- IMAGE OF EXTENDED ROSEBERY AREA DATED JANUARY 2022

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE:	1:25,000
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MMG ROSEBERY MINE
2022 EOR INSPECTION

GENERAL LOCATION PLAN

DWG. No.

FIGURE 1

SHEET SIZE	A3	Rev.	A

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SHEET 1 OF 1

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\MMG\Figure 1 - MMG General Location Plan.dwg

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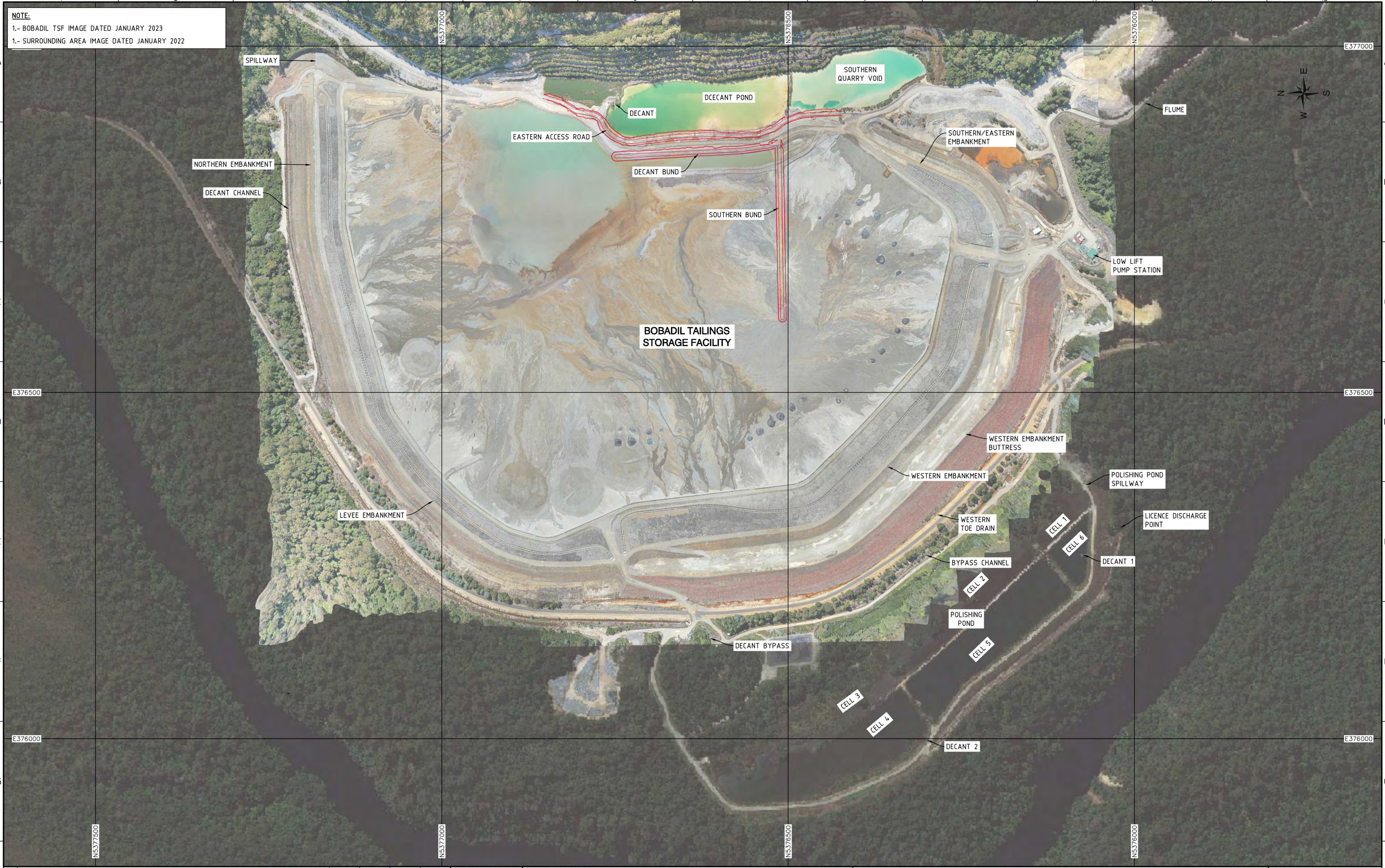

NOTE:
1.- BOBADIL TSF IMAGE DATED JANUARY 2023
1.- SURROUNDING AREA IMAGE DATED JANUARY 2022

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2022 EOR INSPECTION

BOBADIL TSF AND POLISHING POND
AERIAL PHOTOGRAPH

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FIGURE 2

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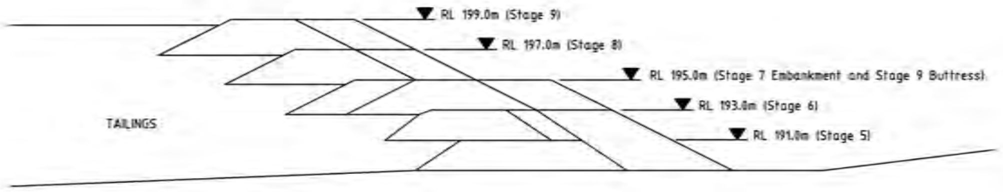

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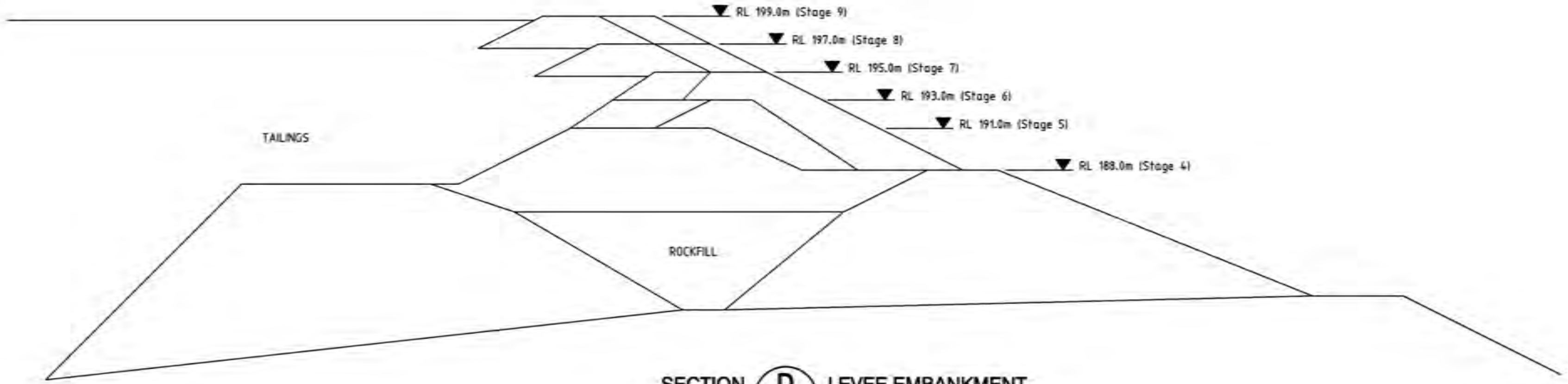

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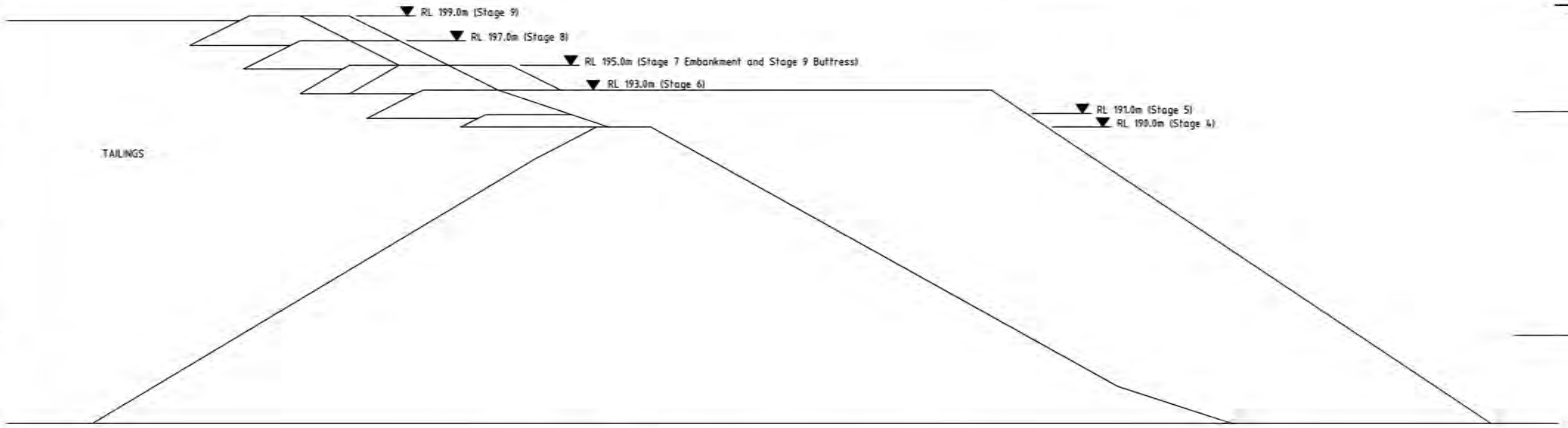

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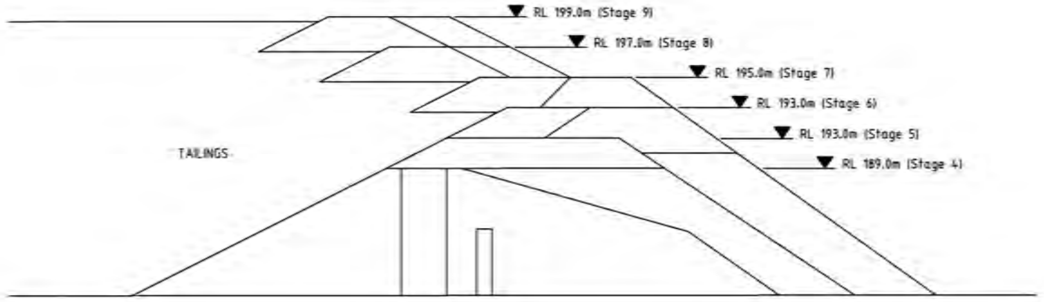

SECTION E NORTHERN EMBANKMENT
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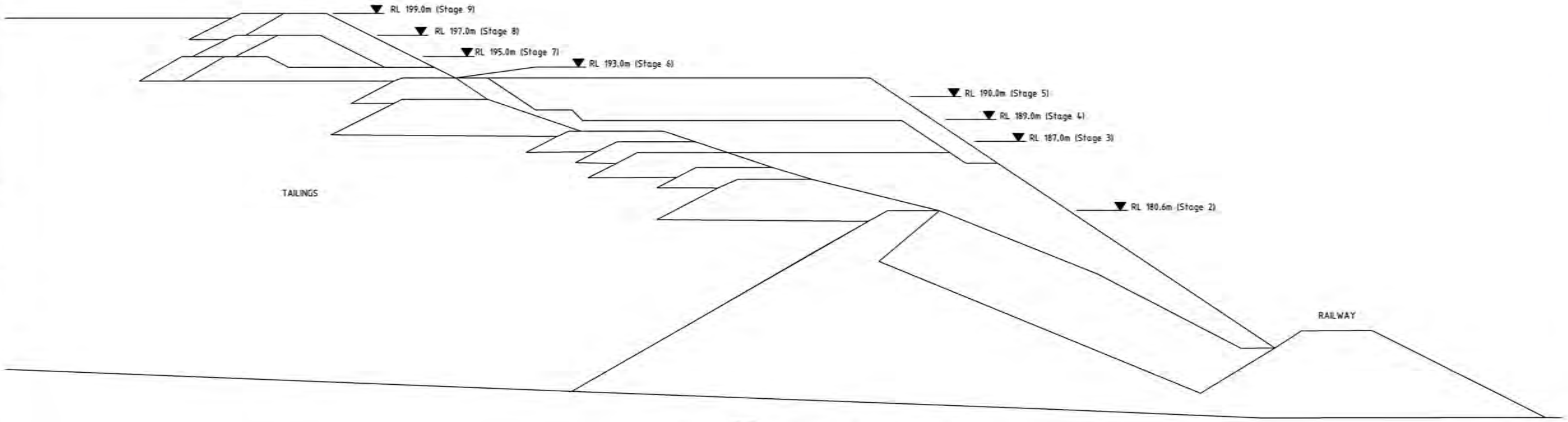

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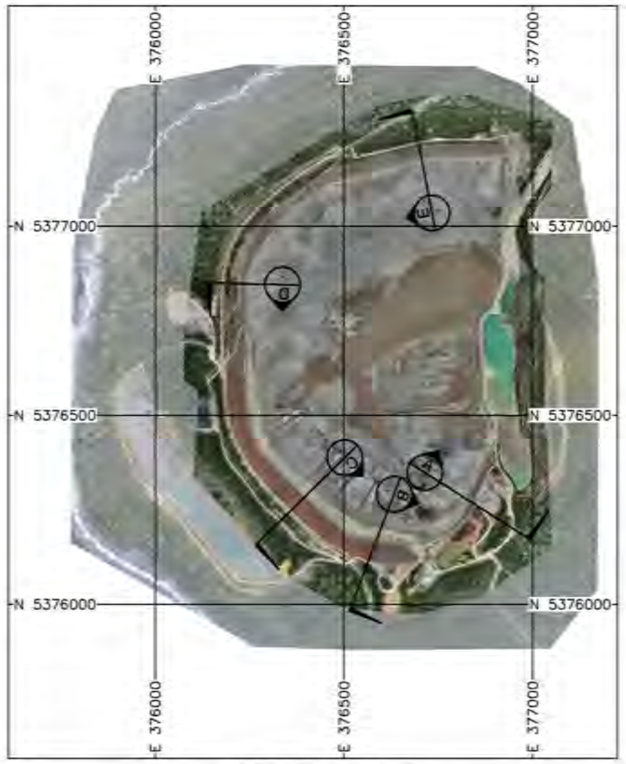

SECTION LAYOUT
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MMG ROSEBERY MINE
2020 EOR INSPECTION

BOBADIL TSF
TYPICAL EMBANKMENT SECTIONS

DWG. No. FIGURE 3

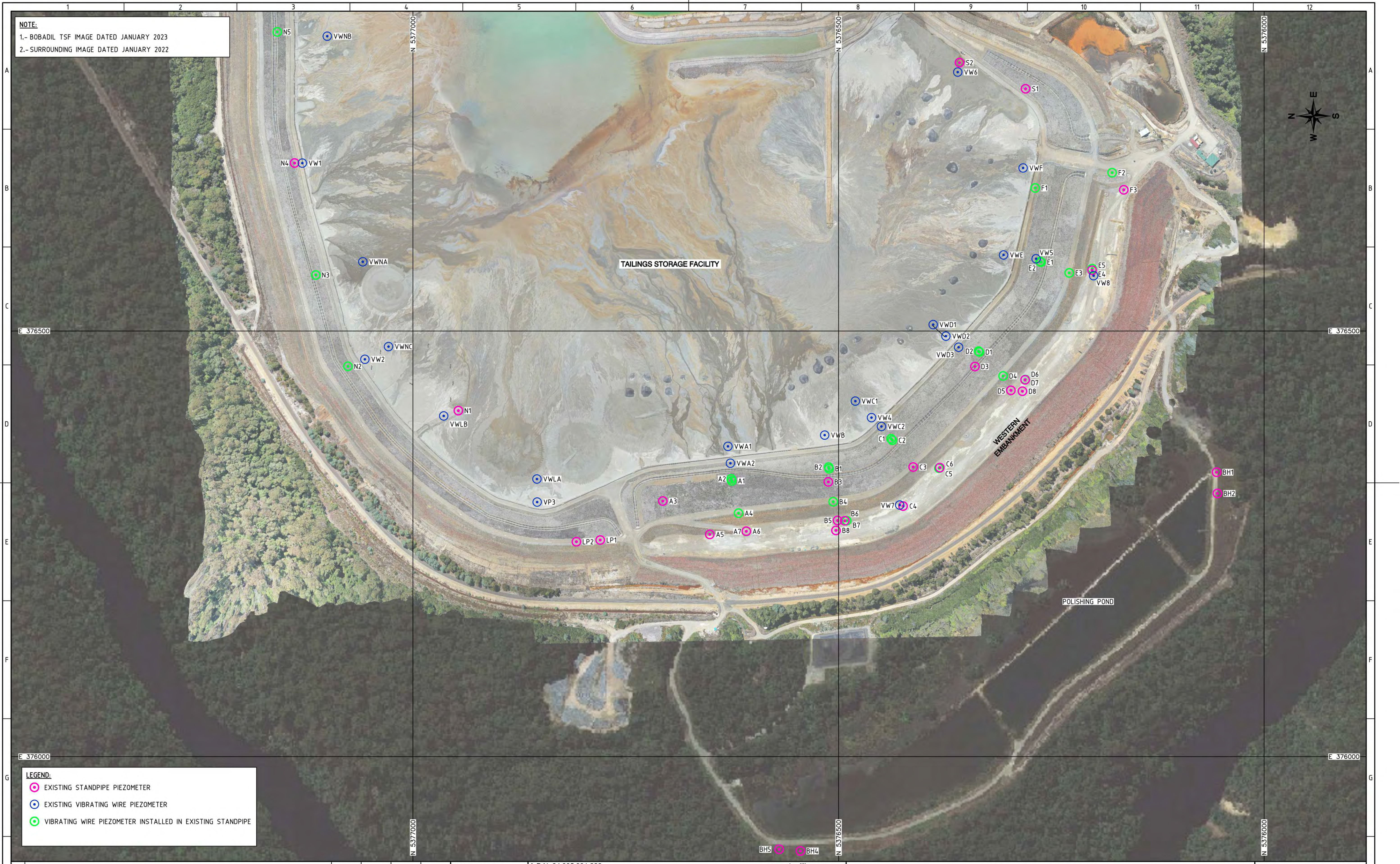
SHEET SIZE	A3	Rev.	A

SHEET 1 OF 1

NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023

2.- SURROUNDING IMAGE DATED JANUARY 2022



LEGEND:

- ◎ EXISTING STANDPIPE PIEZOMETER
- ◉ EXISTING VIBRATING WIRE PIEZOMETER
- ◎ VIBRATING WIRE PIEZOMETER INSTALLED IN EXISTING STANDPIPE

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BOBADIL TSF AND POLISHING POND PIEZOMETER LOCATION PLAN

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FIGURE 4

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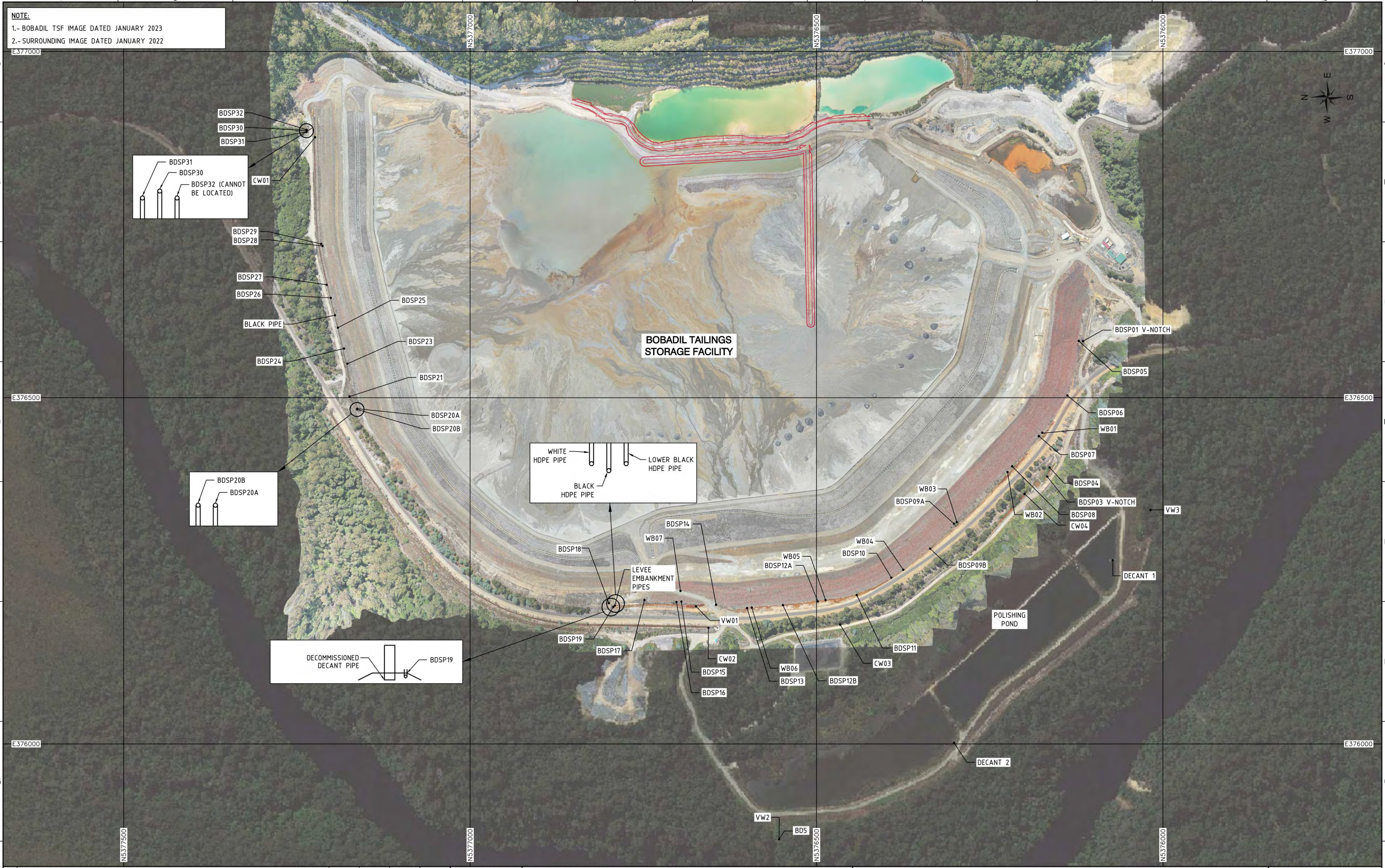
J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\MMG\Figure 4 - MMG Bobadil and Polishing Pond Piezometer Location Plan.dwg Thursday 08, June 2023 12:10:33



NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023

2.- SURROUNDING IMAGE DATED JANUARY 2022

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BOBADIL TSF AND POLISHING POND DRAINAGE MONITORING LOCATION PLAN

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FIGURE 5

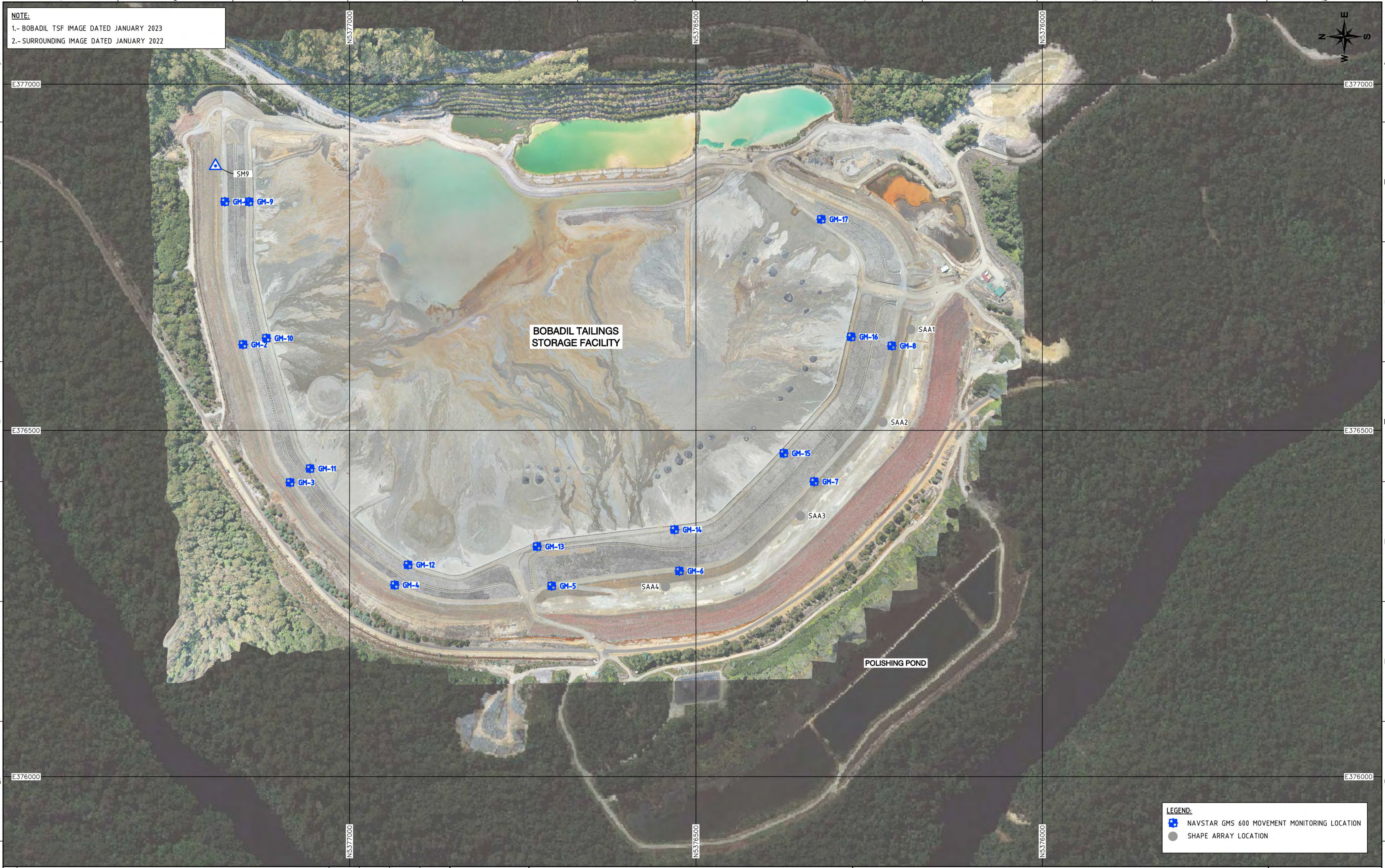
SHEET SIZE	A3	Rev.	A

SHEET 1 OF 1

NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023

2.- SURROUNDING IMAGE DATED JANUARY 2022



LEGEND:

- ▣ NAVSTAR GMS 600 MOVEMENT MONITORING LOCATION
- ● SHAPE ARRAY LOCATION

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BOBADIL TSF AND POLISHING POND
OTHER INSTRUMENTATION LOCATION PLAN

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FIGURE 6

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J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\MMG\Figure 6 - MMG Bobadil and Polishing Pond Movement Monument Location Plan.dwg

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NOTE:

1.- BOBADIL TSF IMAGE DATED JANUARY 2023

2.- SURROUNDING IMAGE DATED JANUARY 2022

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BOBADIL TSF AND POLISHING POND INSPECTION OBSERVATIONS

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FIGURE 7

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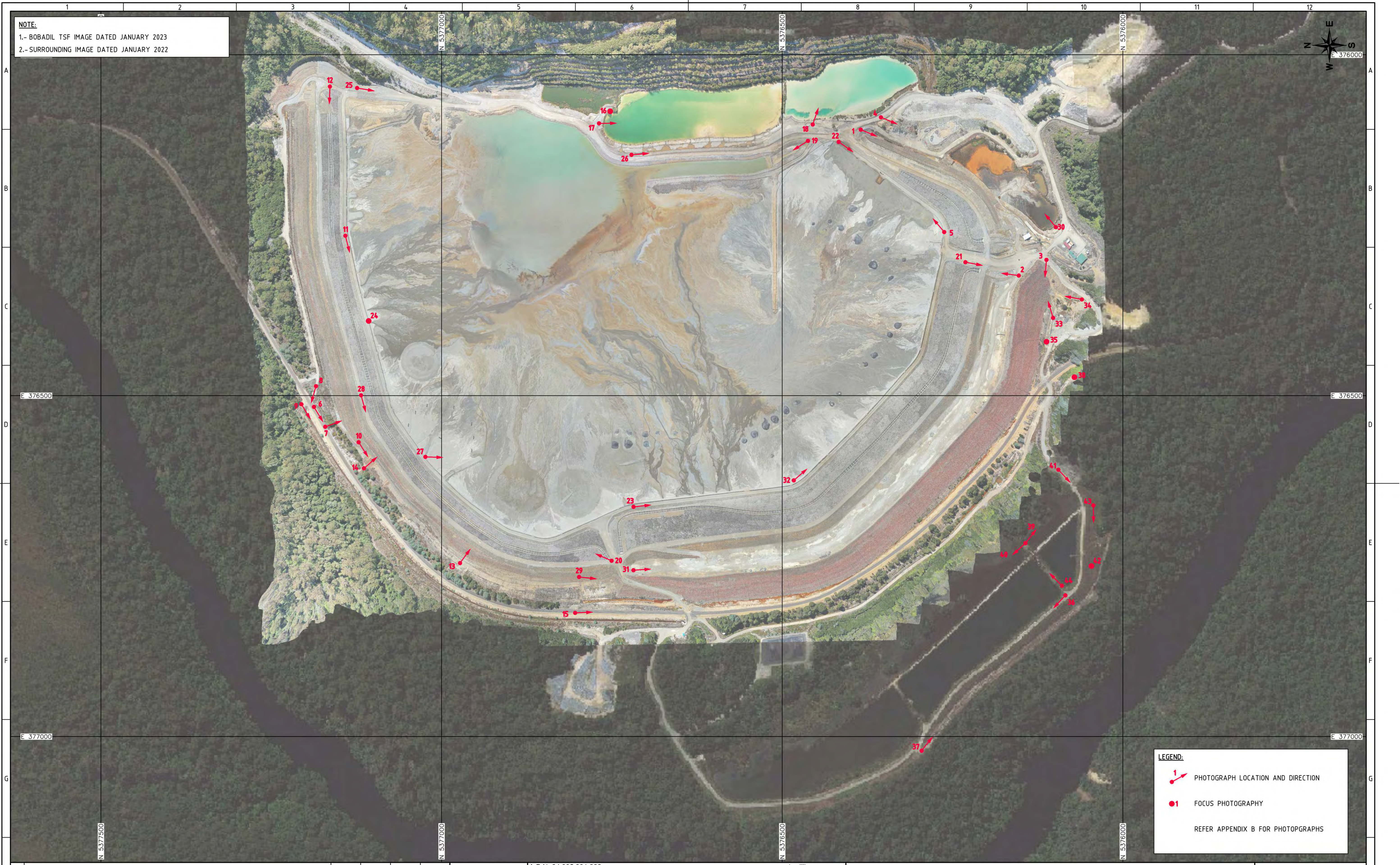
SHEET 1 OF 1



NOTE:
1.- BOBADIL TSF IMAGE DATED JANUARY 2023
2.- SURROUNDING IMAGE DATED JANUARY 2022

LEGEND:

↗ 1	PHOTOGRAPH LOCATION AND DIRECTION
● 1	FOCUS PHOTOGRAPHY
	REFER APPENDIX B FOR PHOTOPGRAPHS

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MMG ROSEBERY MINE
2022 EOR INSPECTION

BOBADIL TSF AND POLISHING POND
PHOTOGRAPH LOCATIONS

DWG. No.
FIGURE 8

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SHEET 1 OF 1

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\CADD\CAD\2022\MMG\Figure 8 - MMG Photograph Locations.dwg

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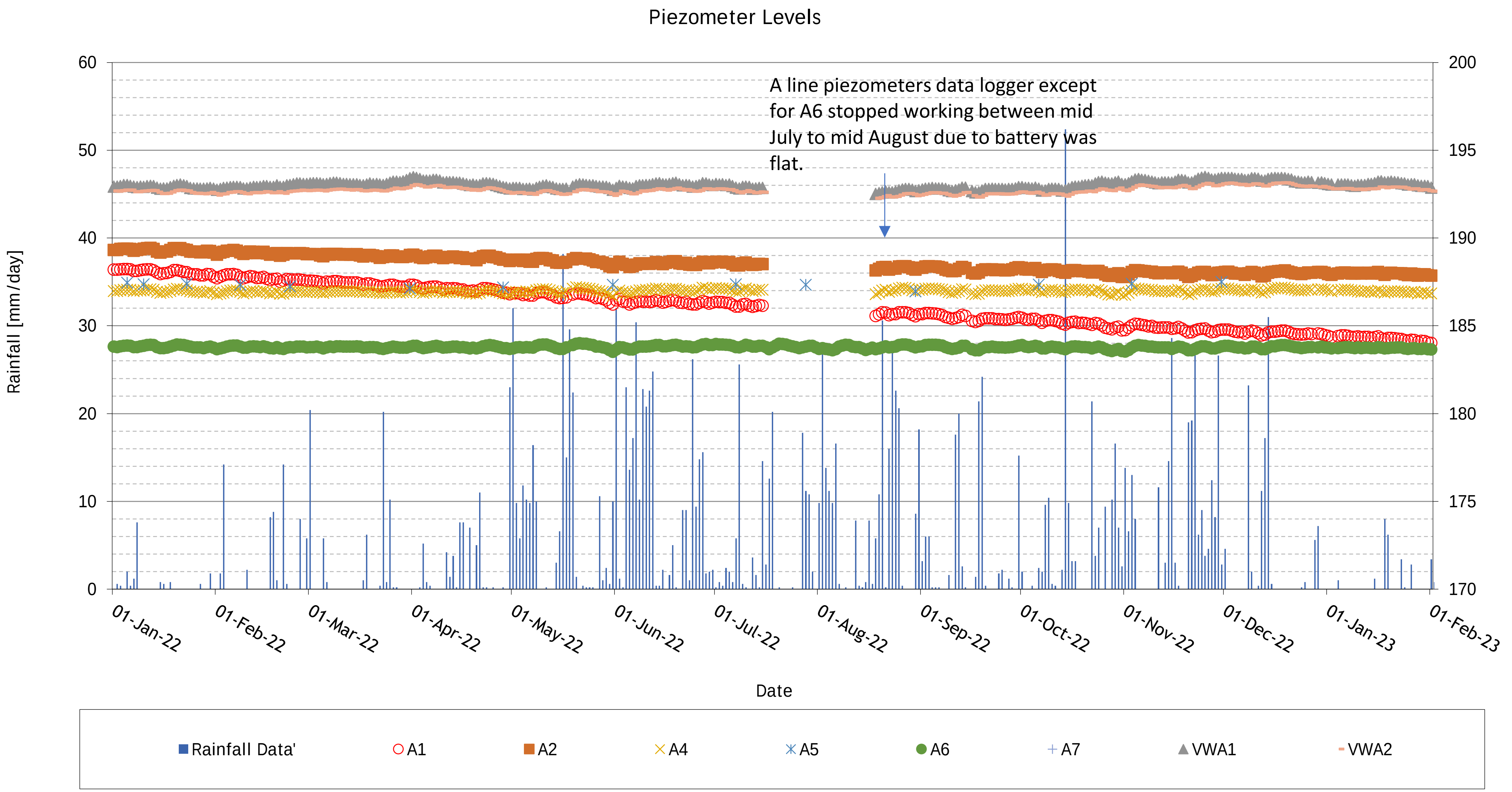

A line piezometers data logger except for A6 stopped working between mid July to mid August due to battery was flat.

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MMG ROSEBERY MINE

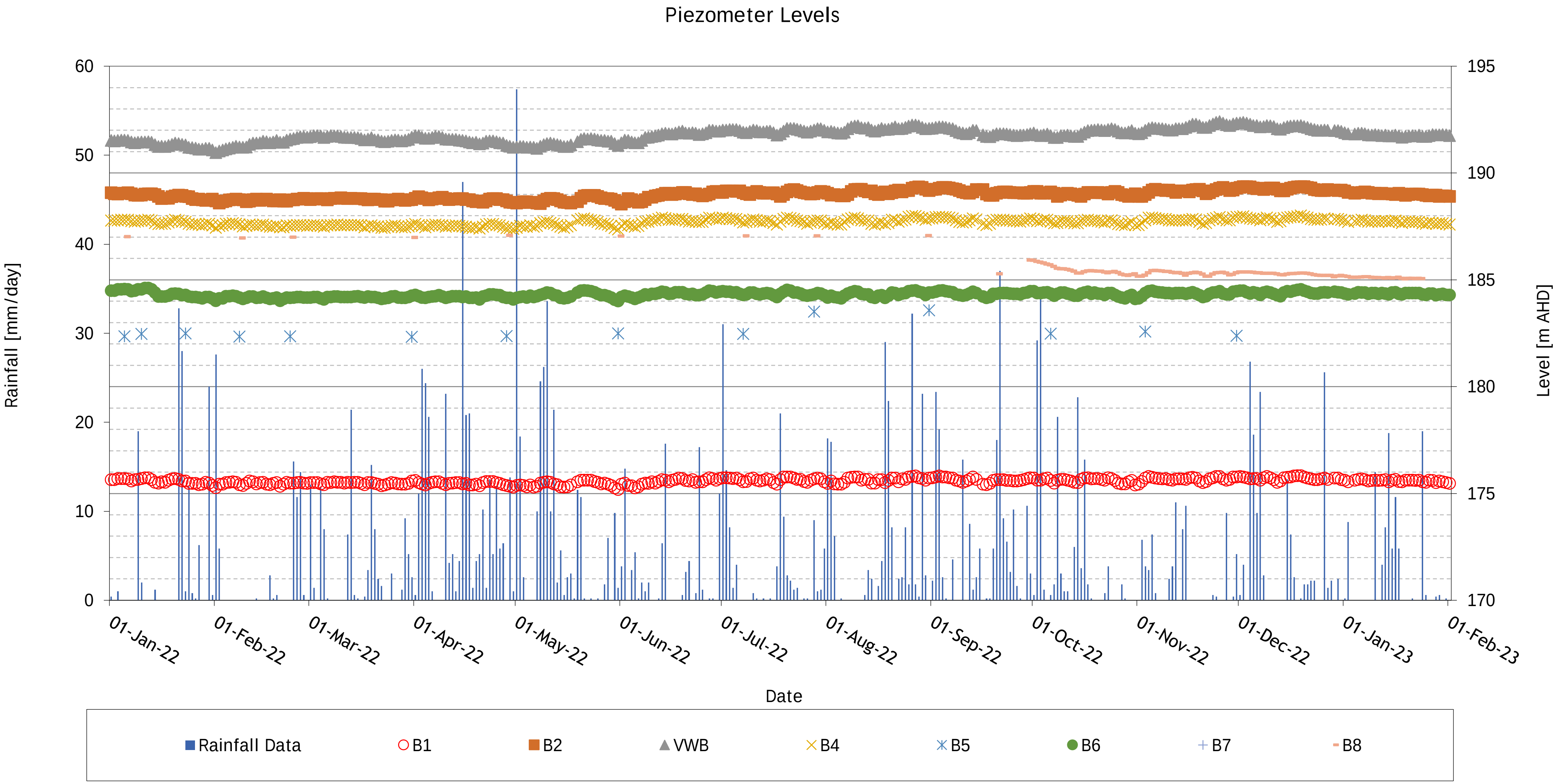
2022 EOR INSPECTION

BOBADIL TSF - GROUP A PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 9



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MMG ROSEBERY MINE

2022 EOR INSPECTION

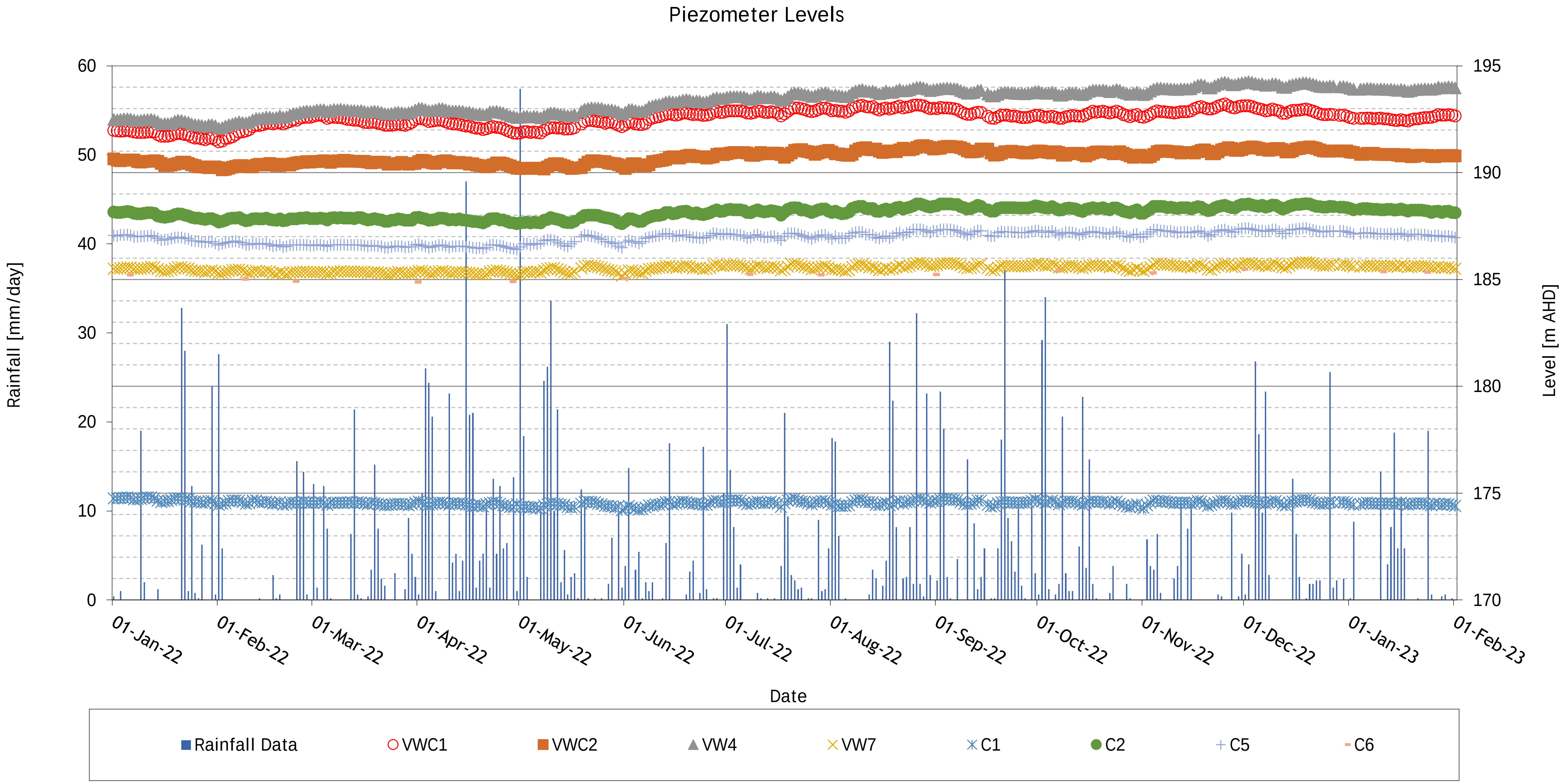
BOBADIL TSF - GROUP B PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 10

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



MMG ROSEBERY MINE

2022 EOR INSPECTION

BOBADIL TSF - GROUP C PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

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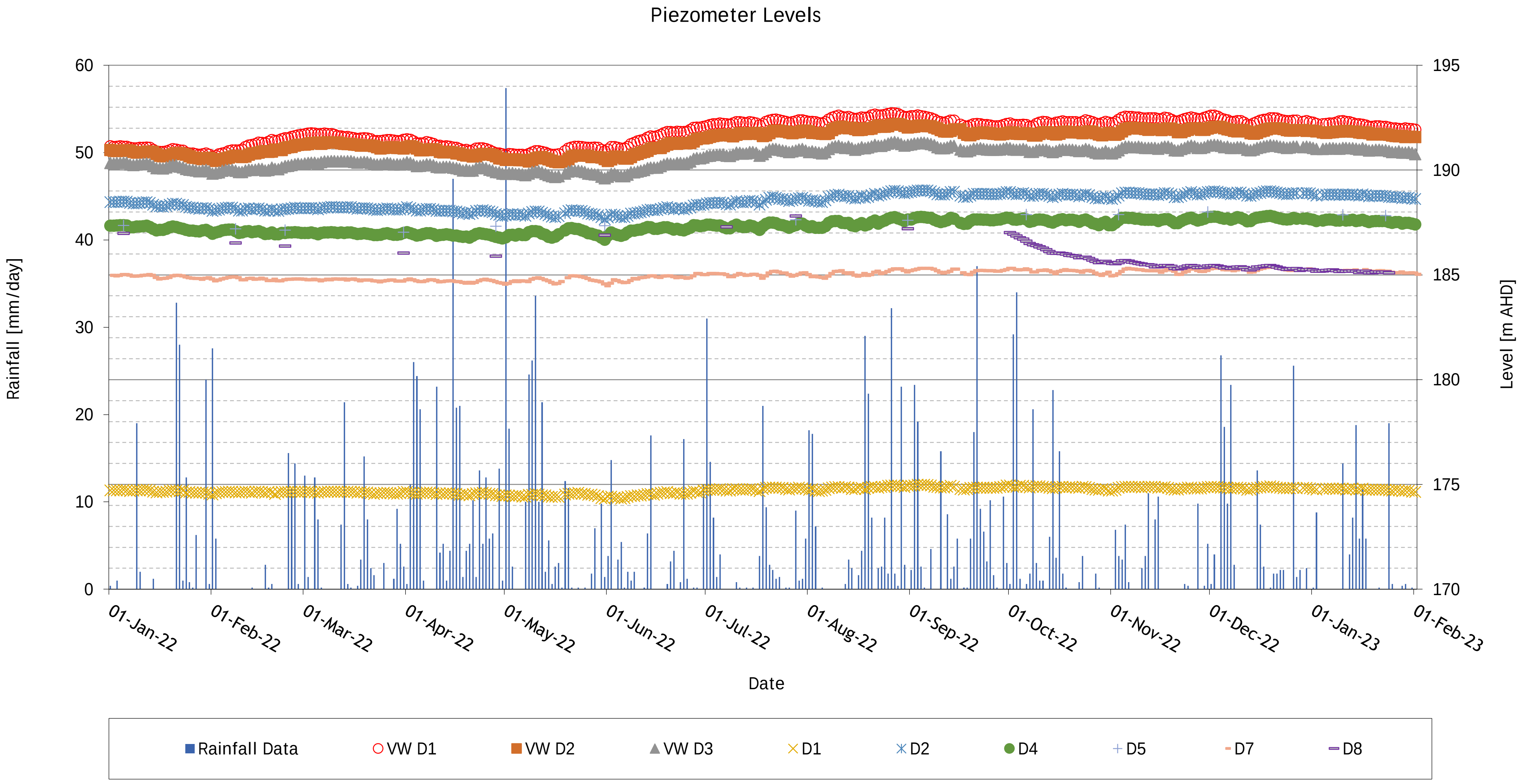
Date: 8/06/2023 **Job No:** 107031.68

FIGURE 11

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

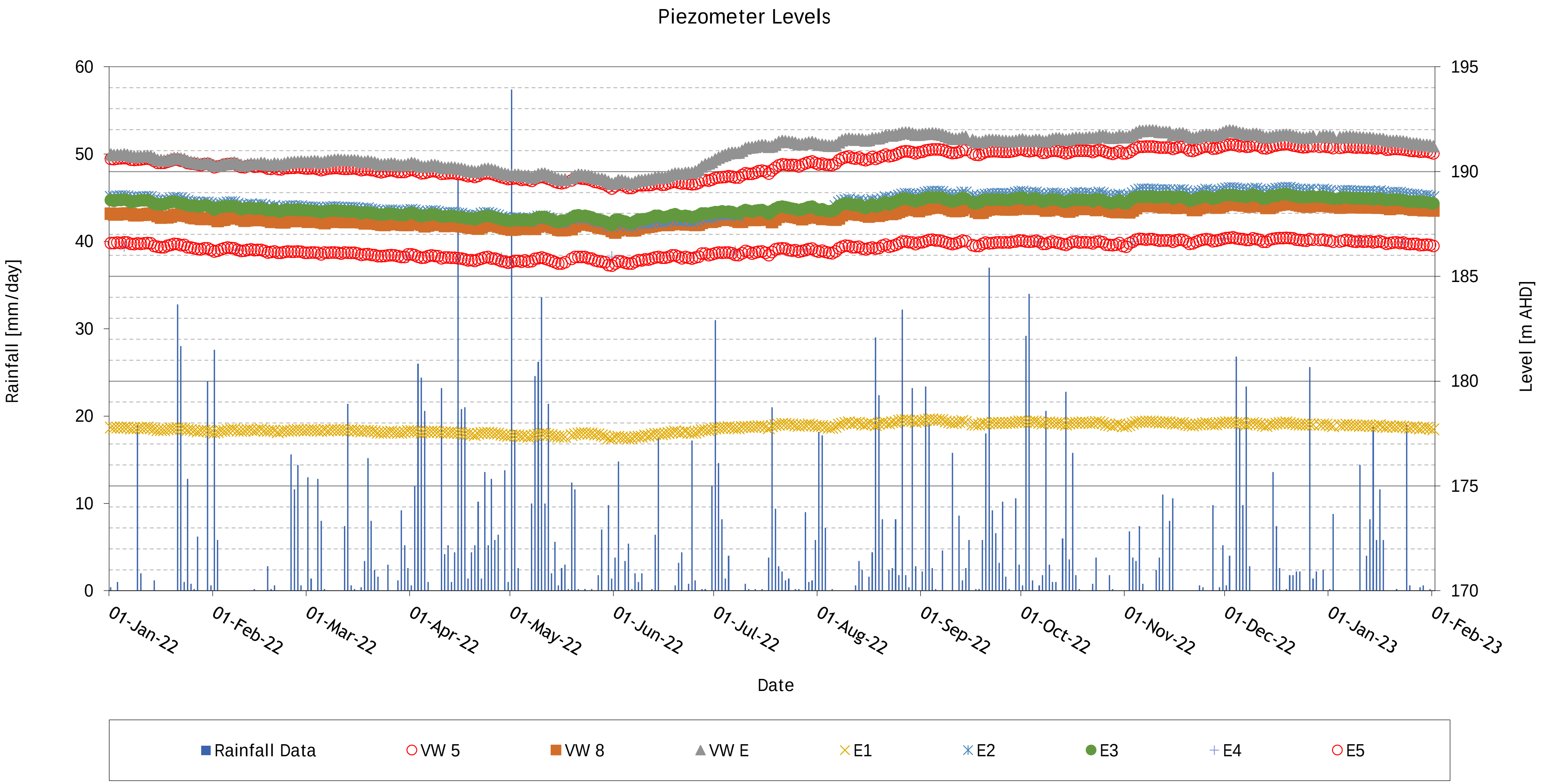
BOBADIL TSF - GROUP D PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 12

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

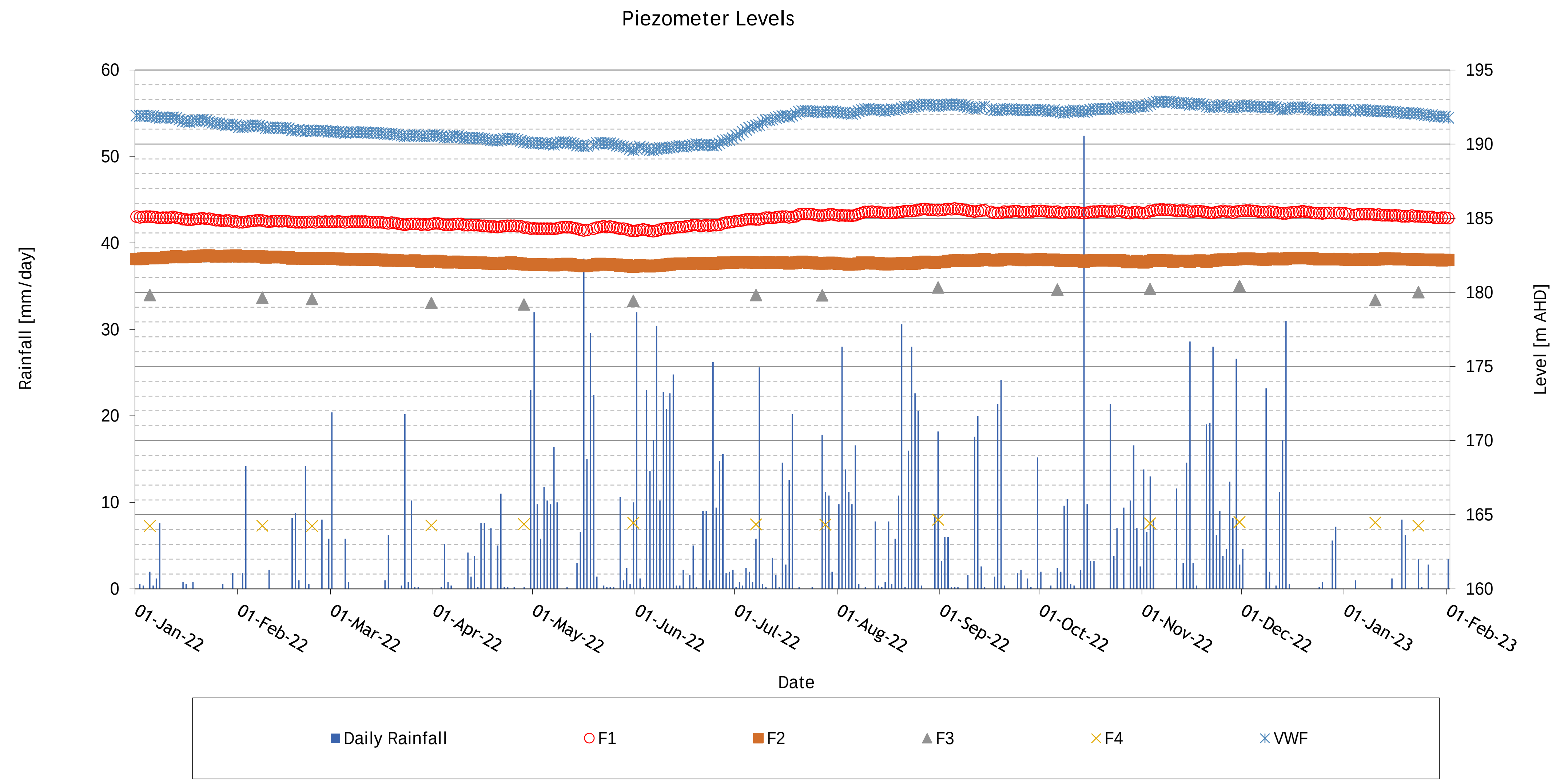
BOBADIL TSF - GROUP E PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 13

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

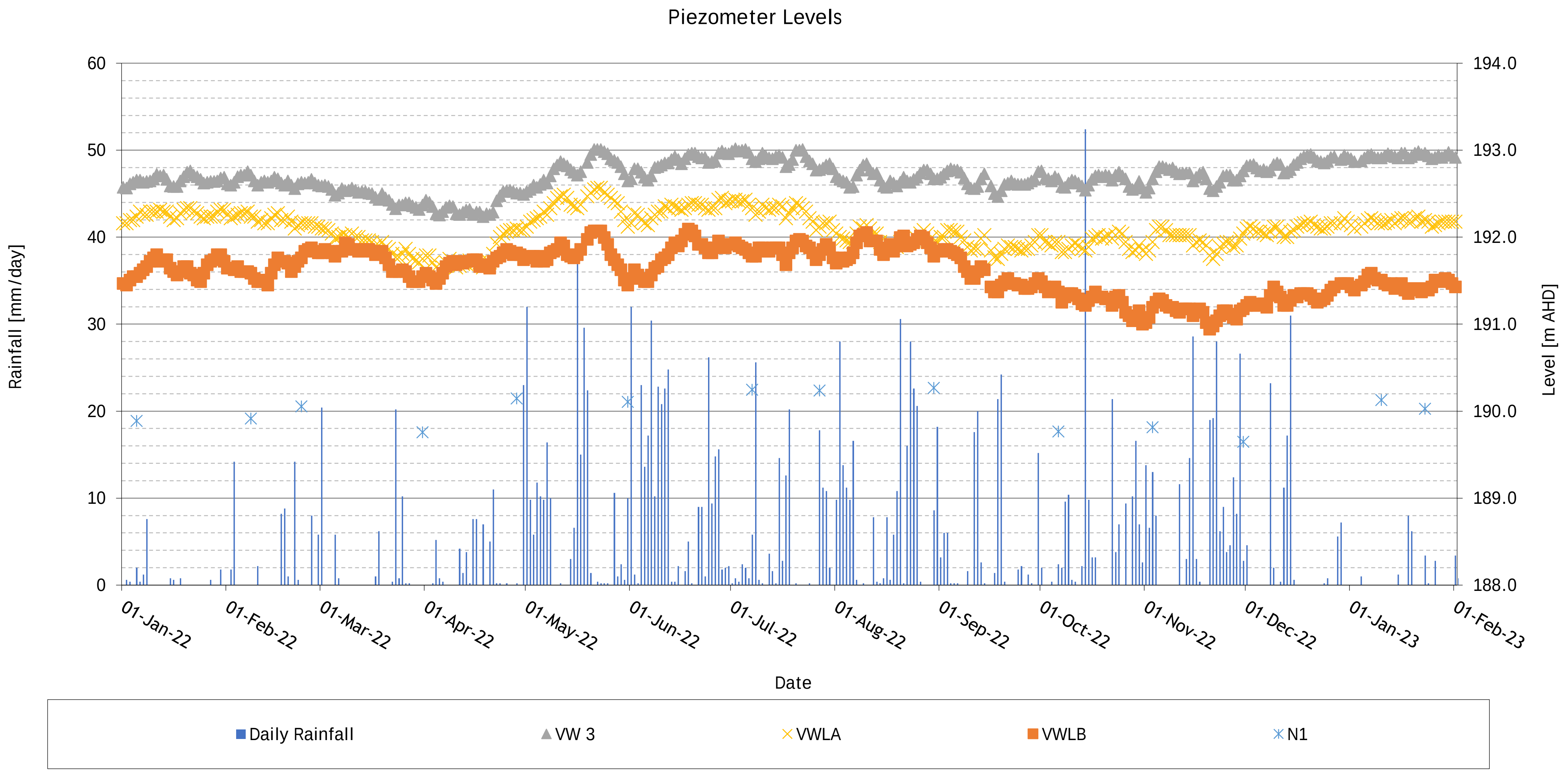
BOBADIL TSF - GROUP F PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 14

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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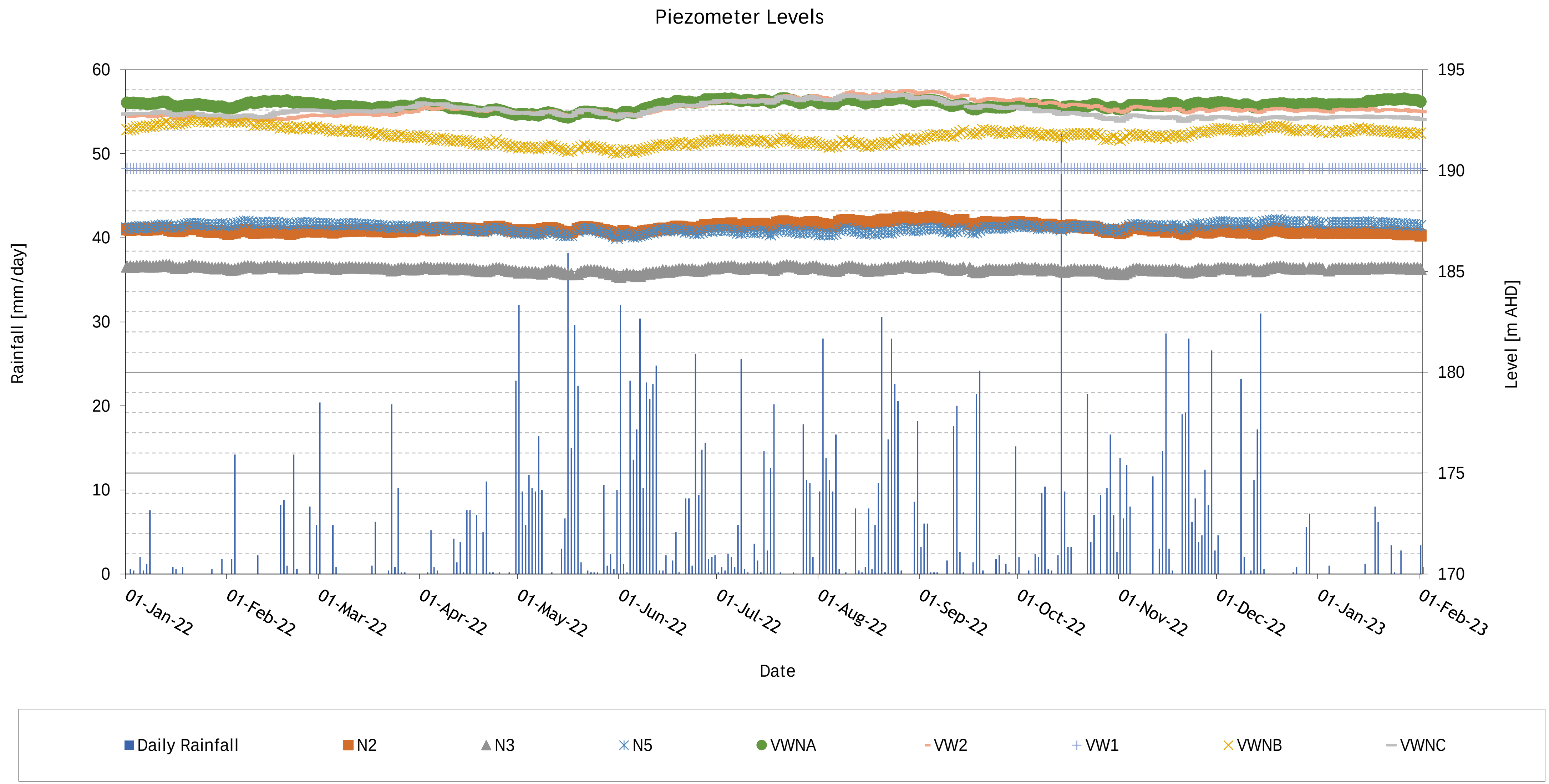
2022 EOR INSPECTION

BOBADIL TSF - GROUP L PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 15



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2022 EOR INSPECTION

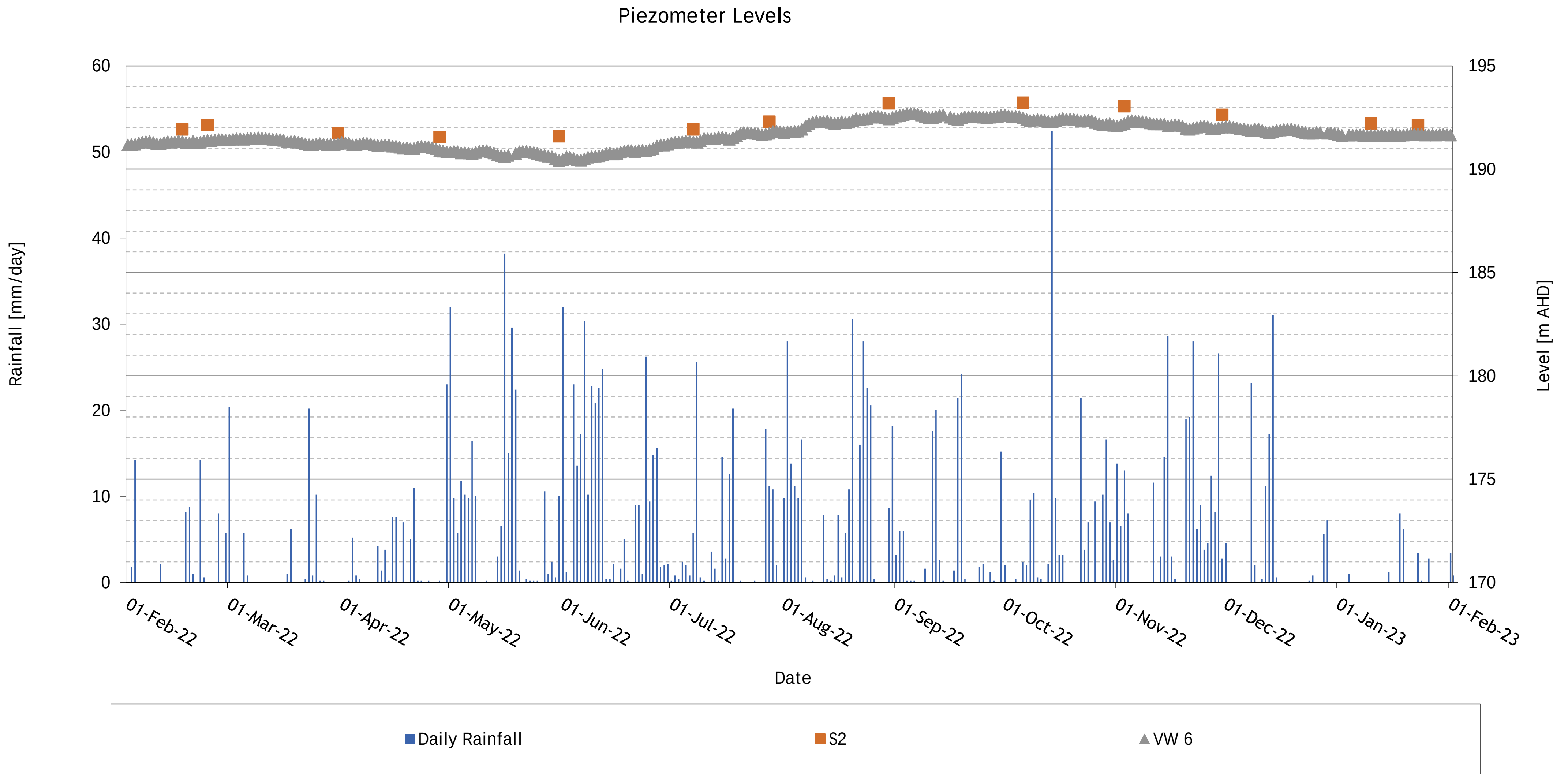
BOBADIL TSF - GROUP N PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 16

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

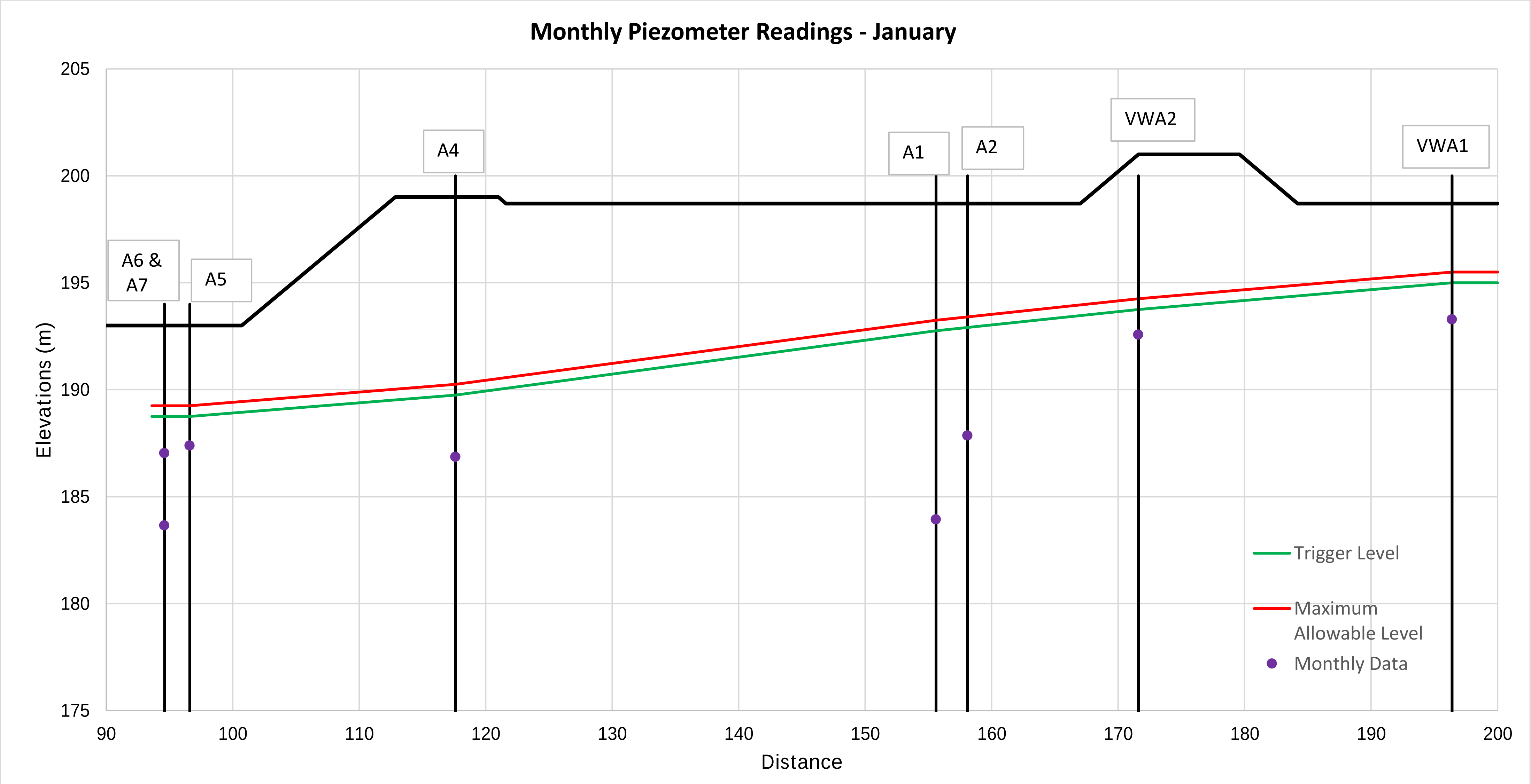
BOBADIL TSF - GROUP S PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 17

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

BOBADIL TSF - GROUP A PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

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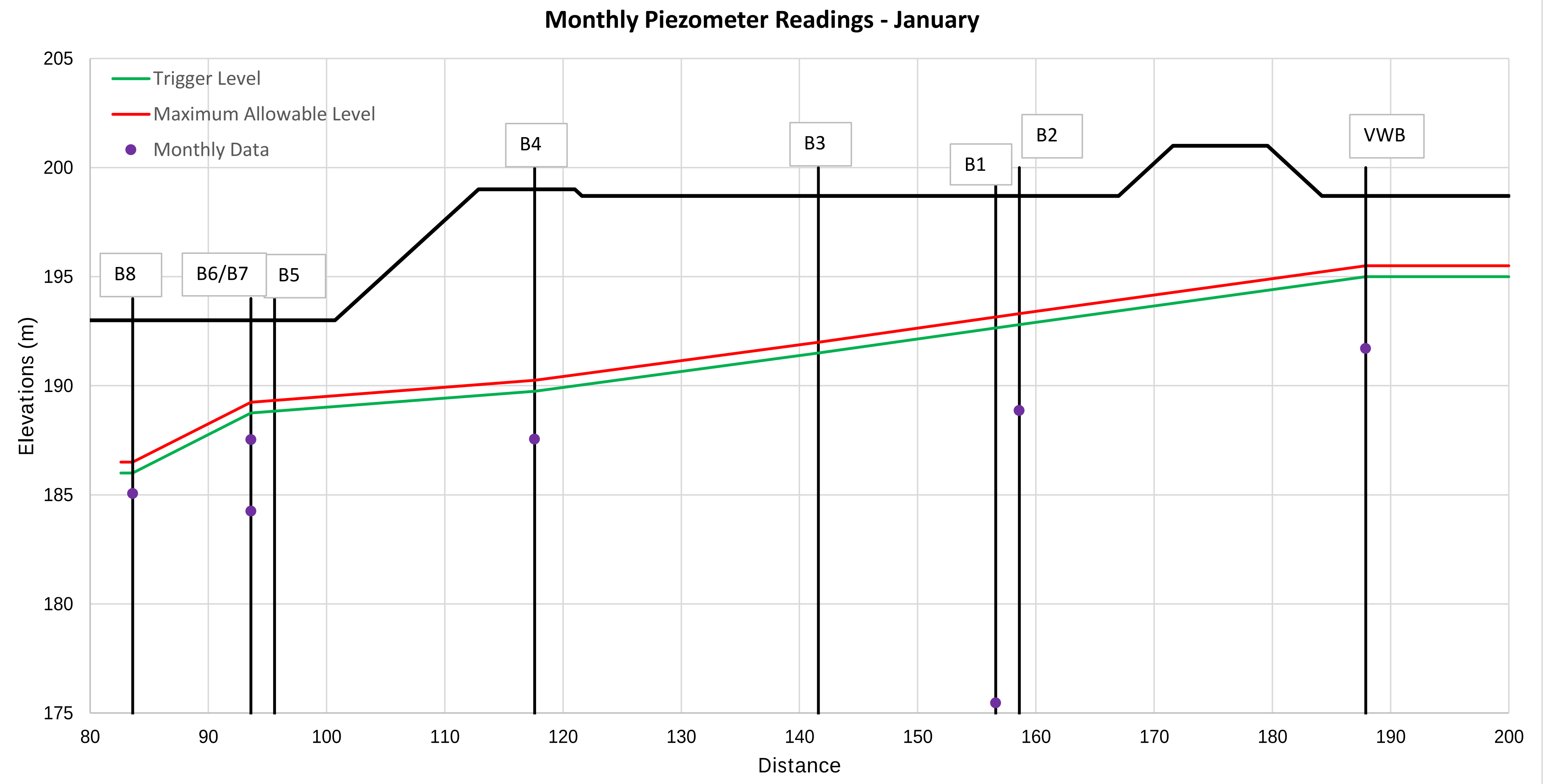
Date: 8/06/2023 **Job No:** 107031.68

FIGURE 18



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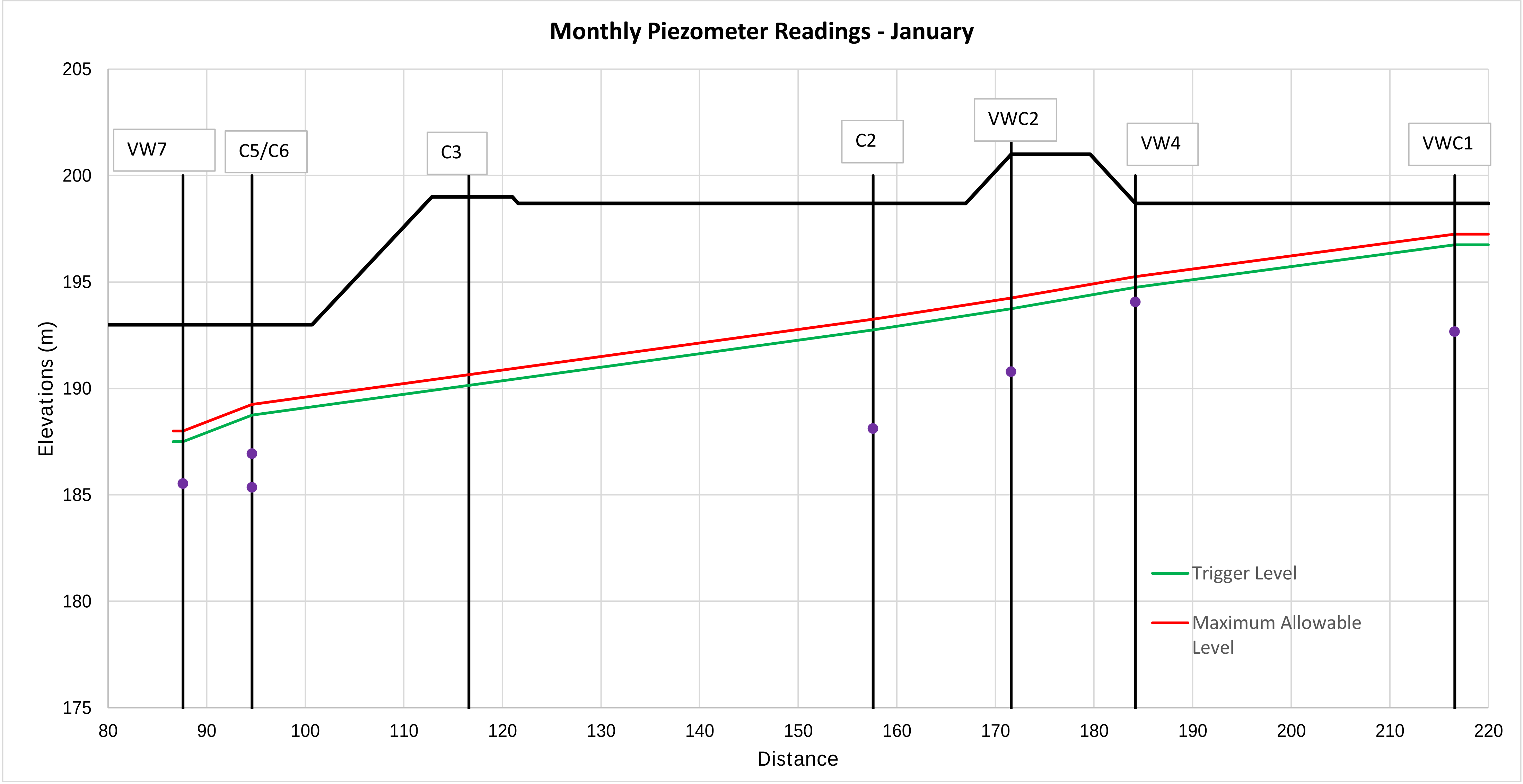
2022 EOR INSPECTION

BOBADIL TSF - GROUP B PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date:	8/06/2023	**Job No:**	107031.68	**FIGURE 19**



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2022 EOR INSPECTION

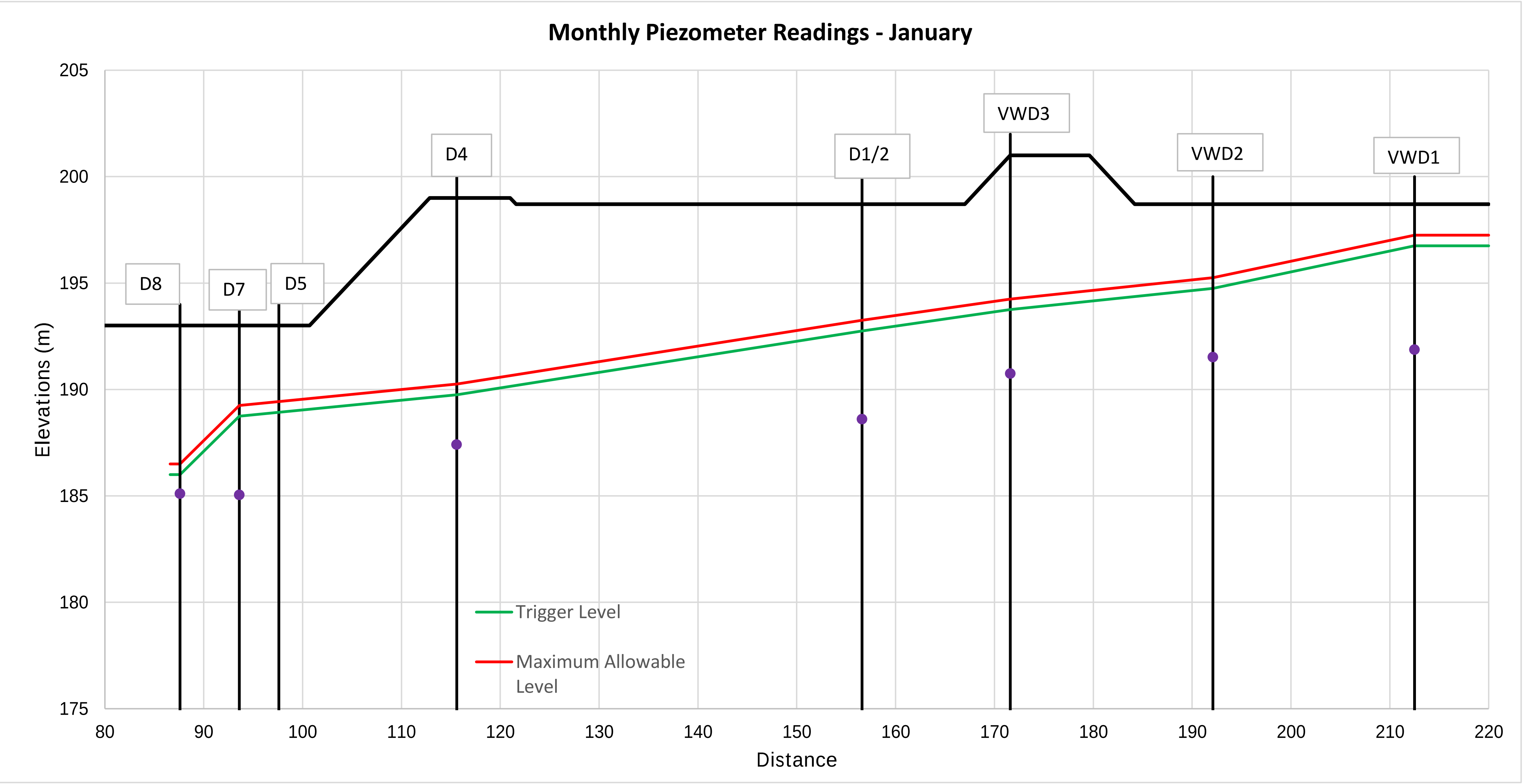
BOBADIL TSF - GROUP C PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 20

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

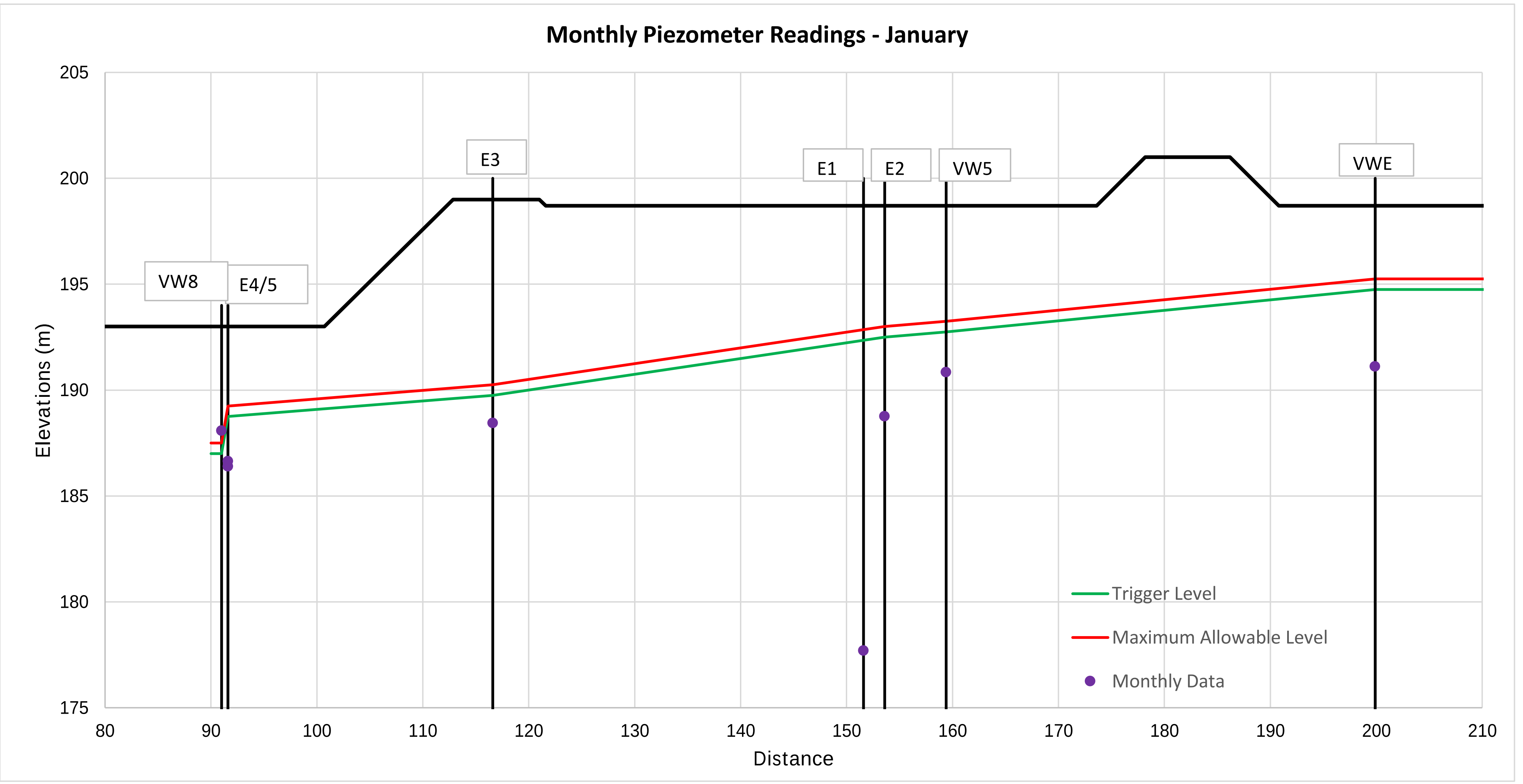
BOBADIL TSF - GROUP D PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 21

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

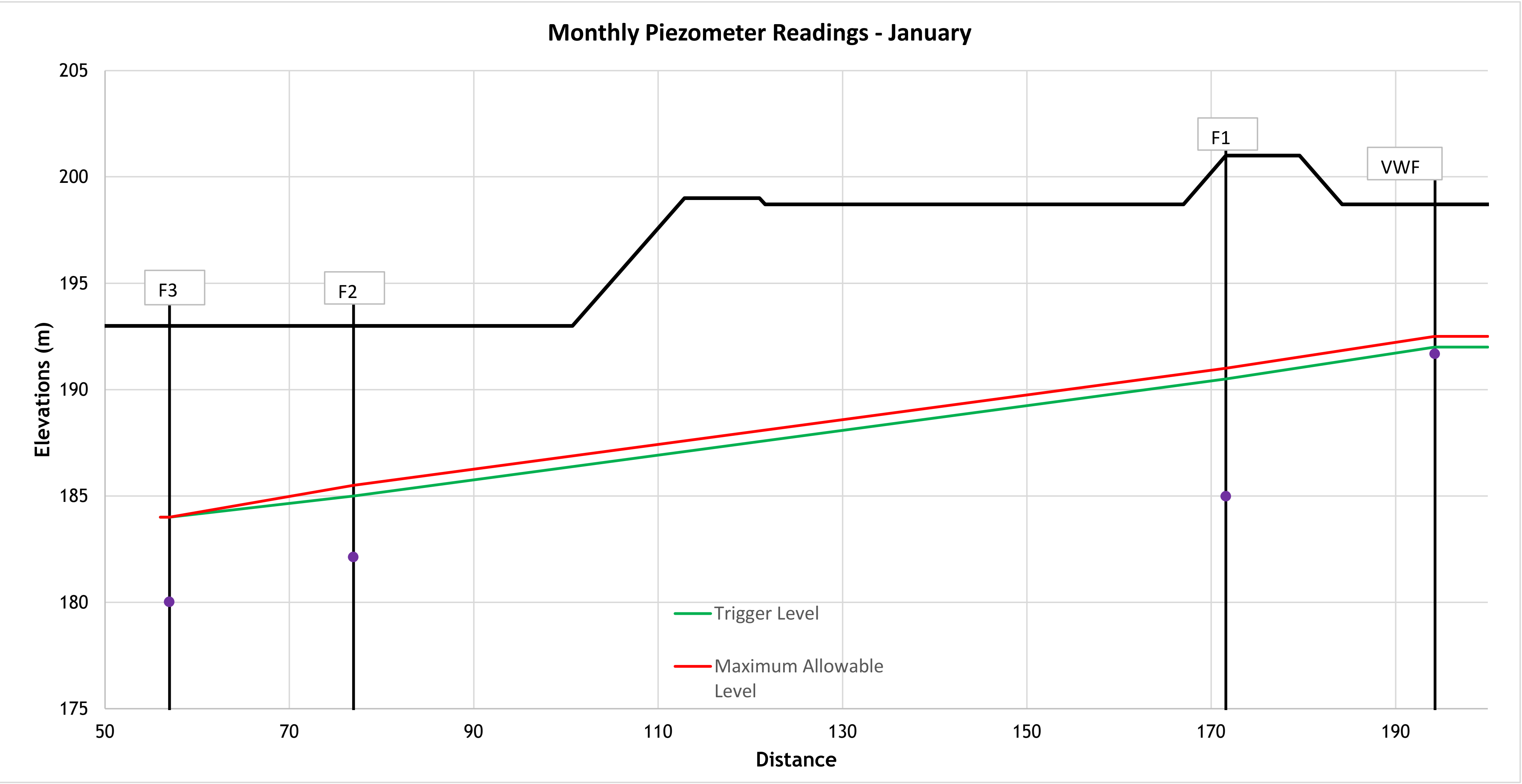
BOBADIL TSF - GROUP E PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 22

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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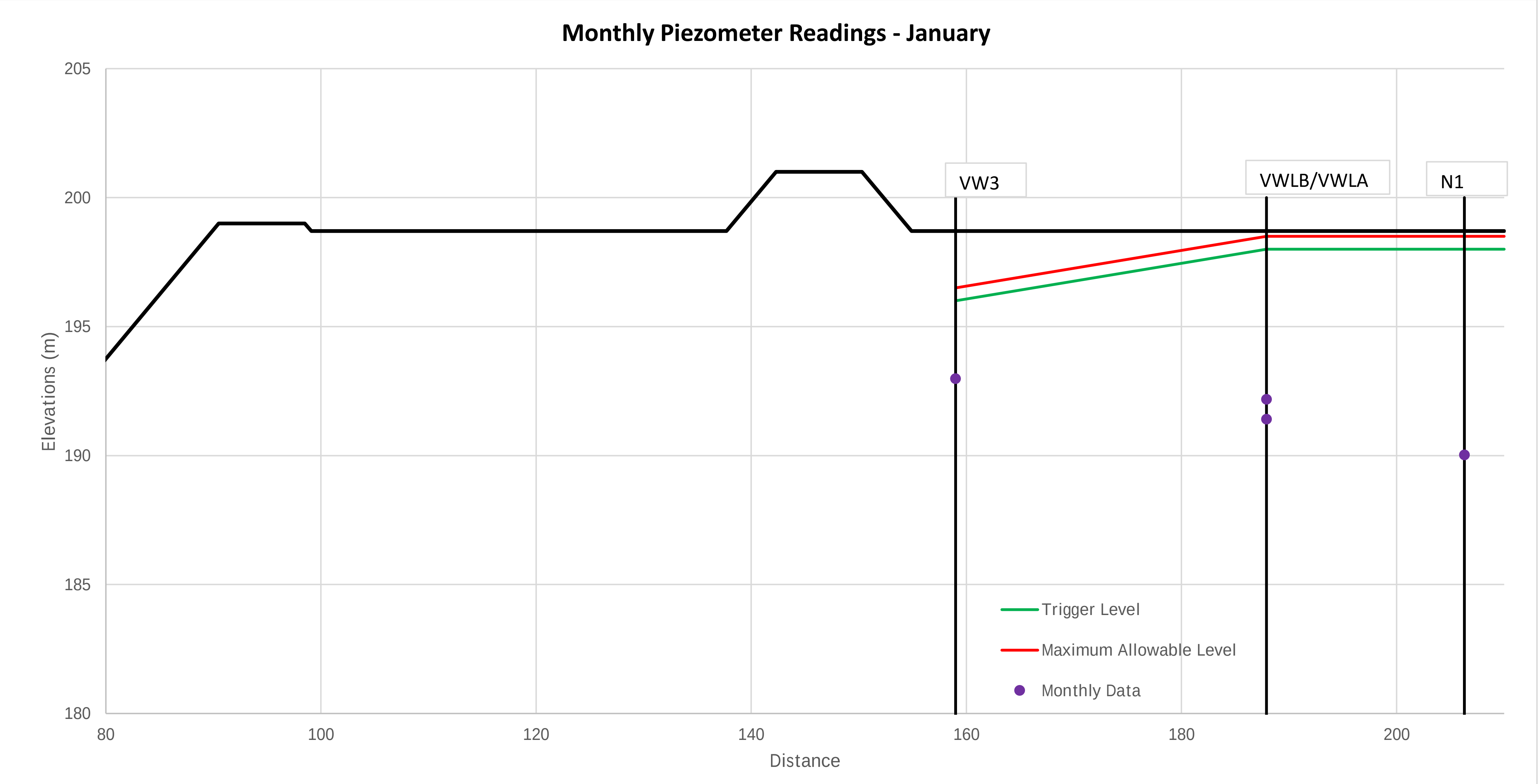
2022 EOR INSPECTION

BOBADIL TSF - GROUP F PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 23



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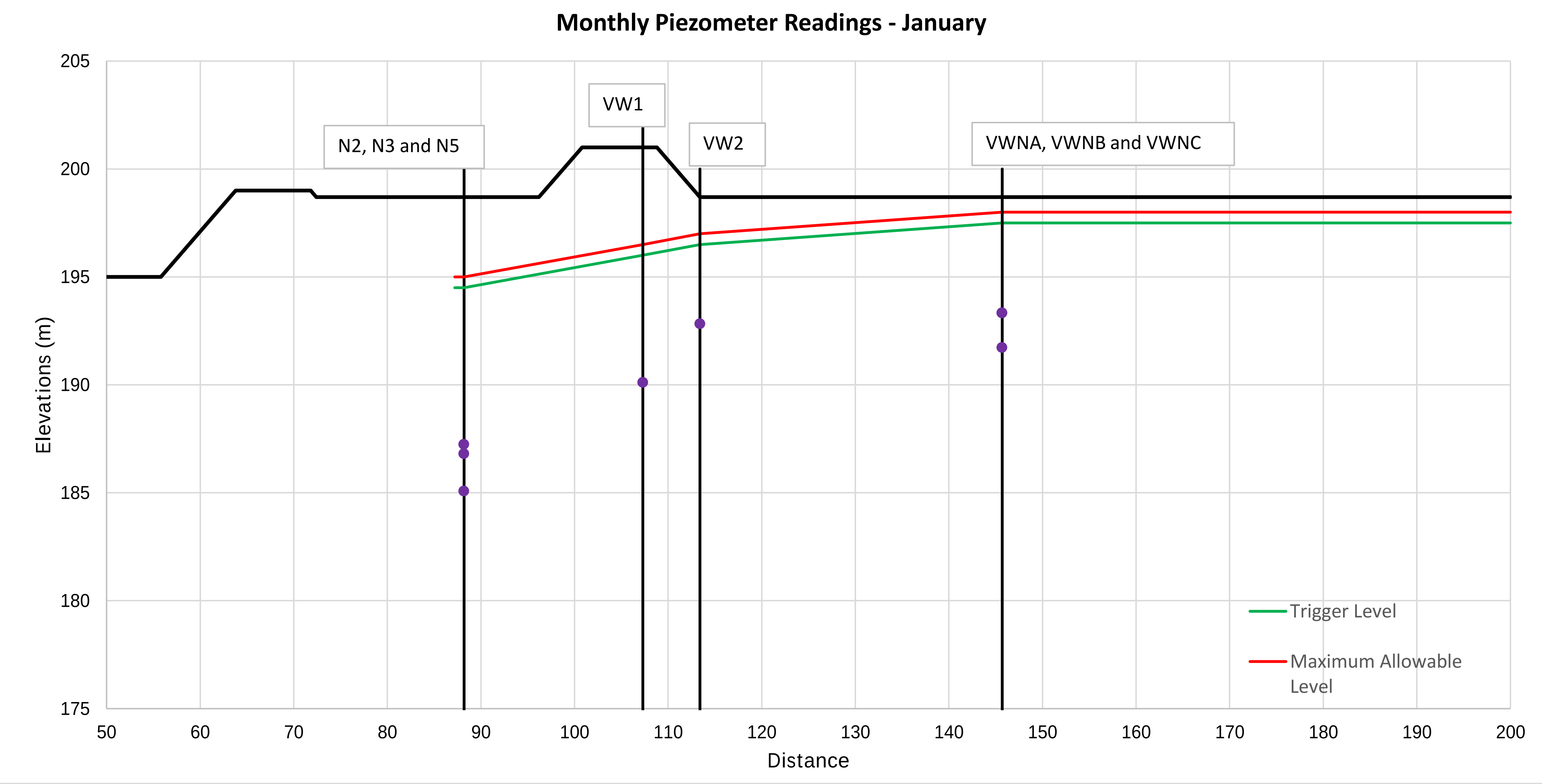
2022 EOR INSPECTION

BOBADIL TSF - GROUP L PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 24



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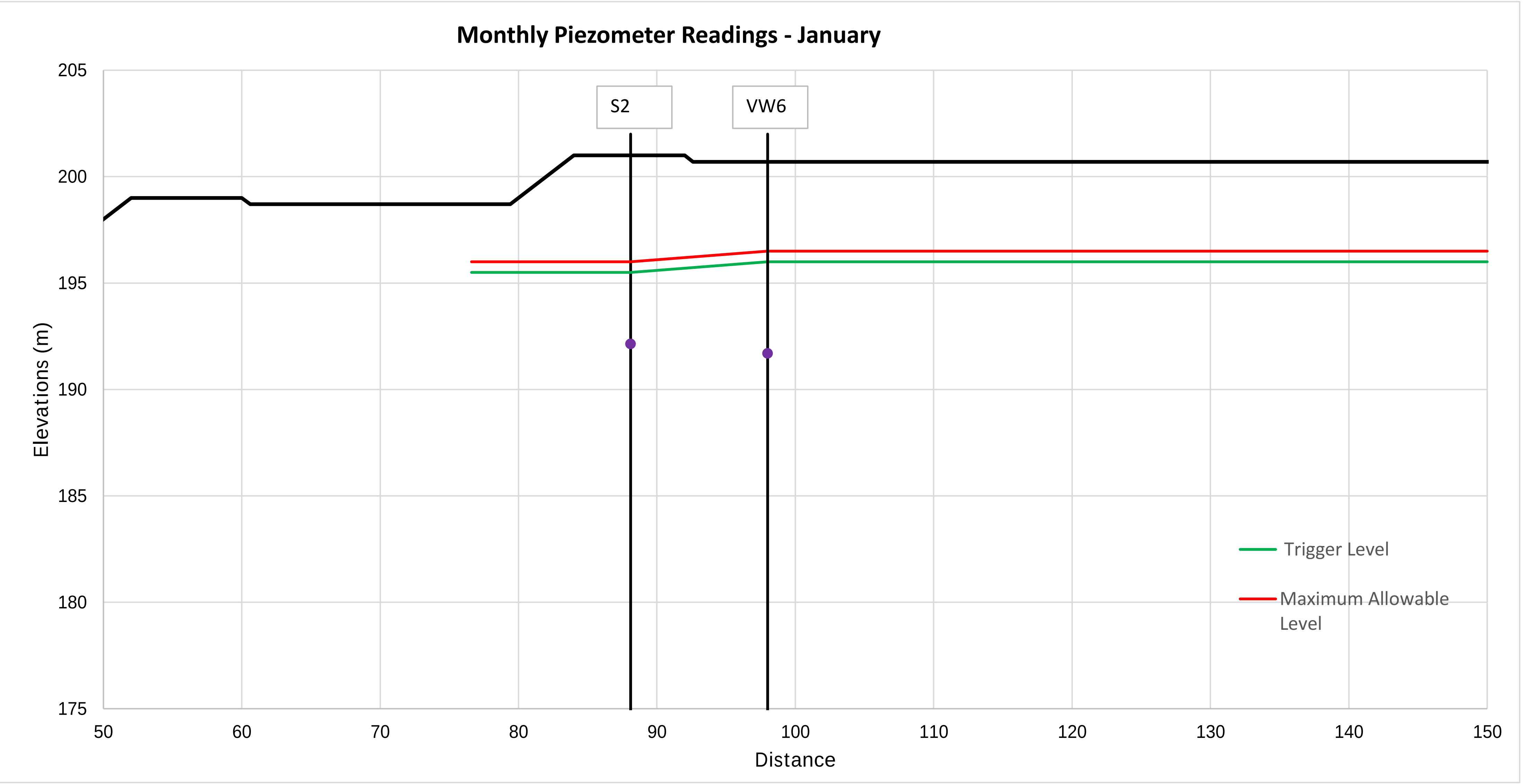
2022 EOR INSPECTION

BOBADIL TSF - GROUP N PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 25



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2022 EOR INSPECTION

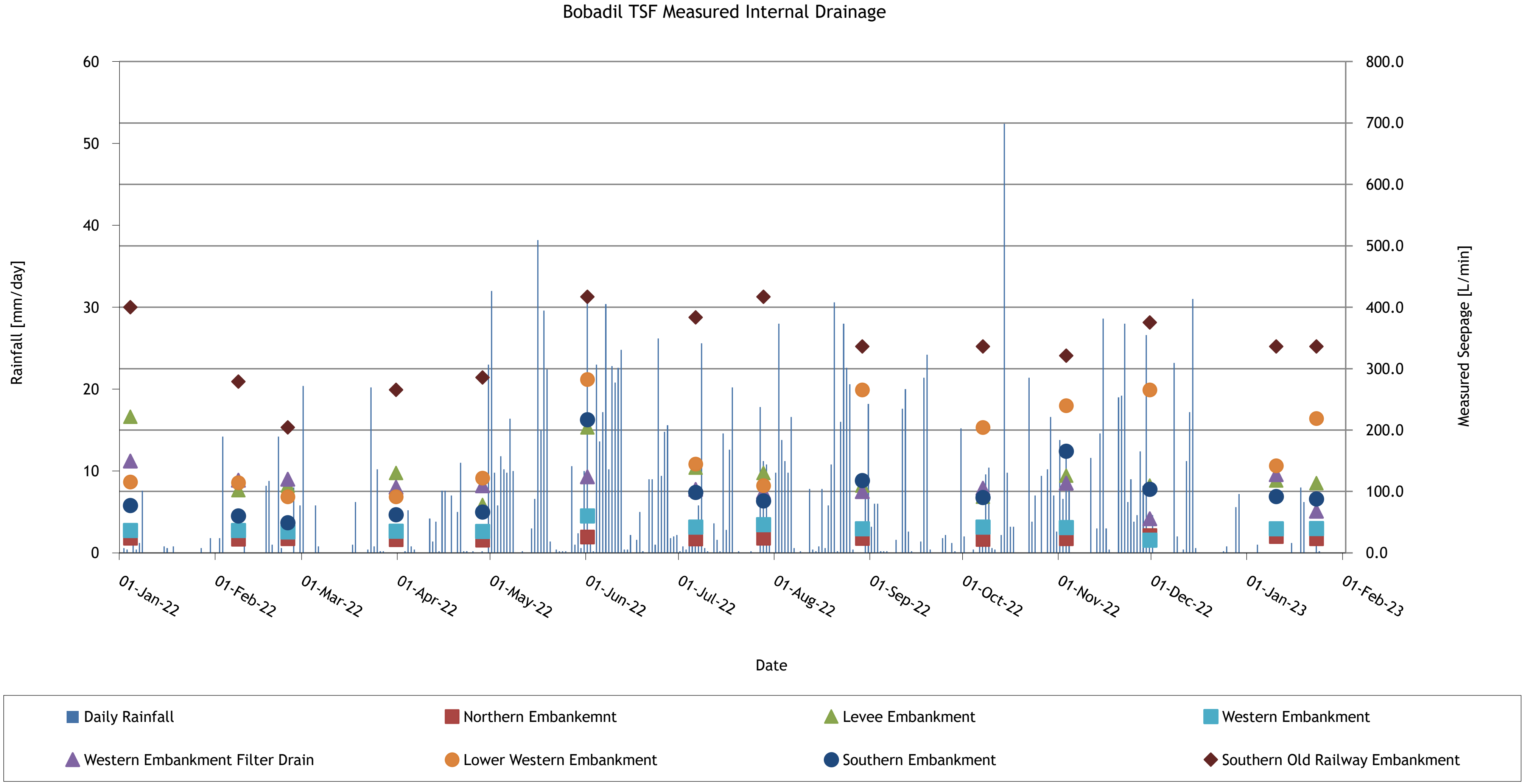
BOBADIL TSF - GROUP S PIEZOMETER LEVELS

10 FEBRUARY 2023 PIEZOMETER DATA WITH TRIGEER LEVELS

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 26

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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MMG ROSEBERY MINE

2022 EOR INSPECTION

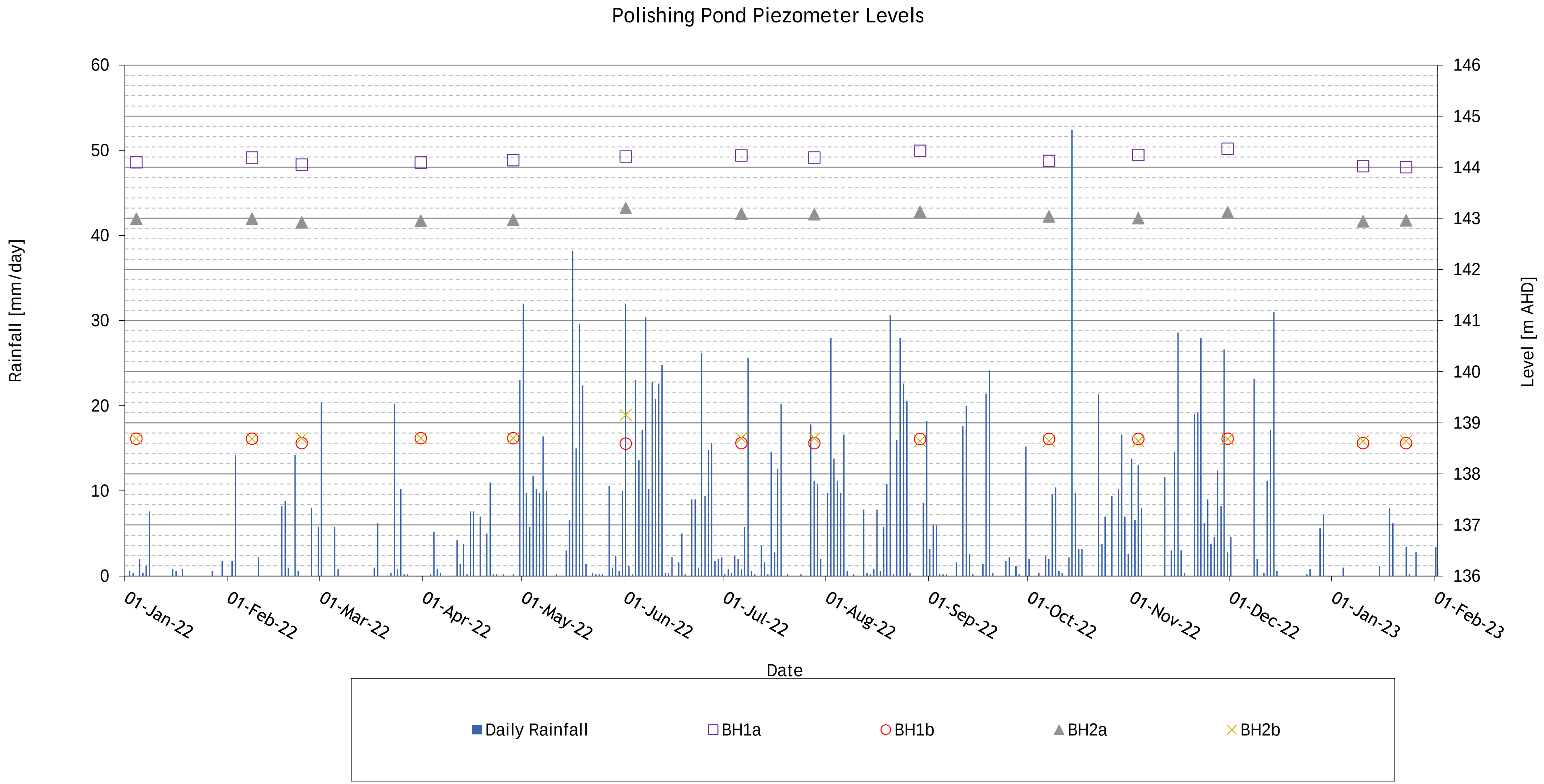
BOBADIL TSF - MEASURED INTERNAL DRAINAGE DISCHARGE RATES

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 27

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\Monthly surveillance Spreadsheet - Bobadil January (Figures)



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MMG ROSEBERY MINE

2022 EOR INSPECTION

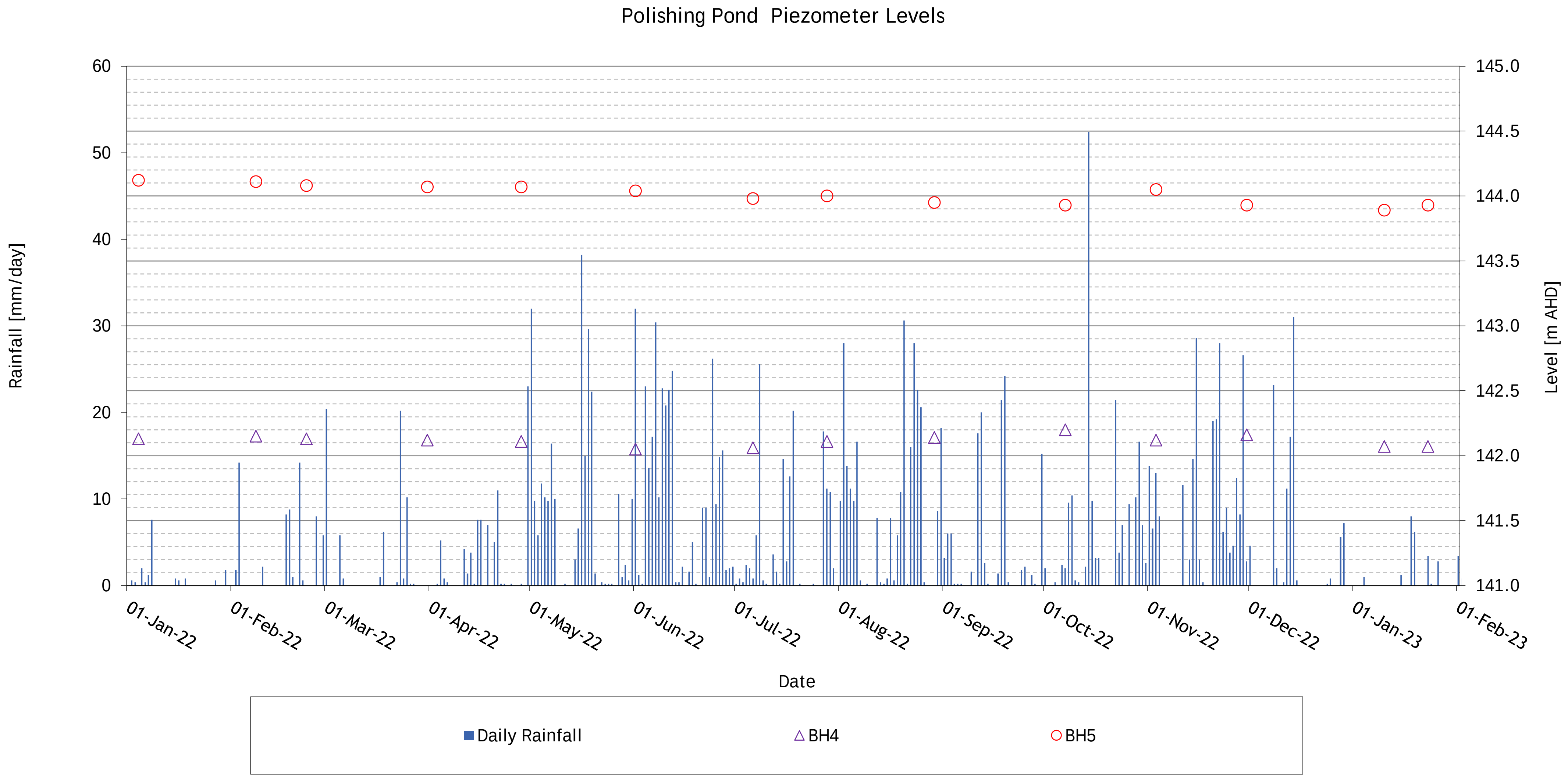
BOBADIL POLISHING POND - EASTERN PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 28

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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MMG ROSEBERY MINE

2022 EOR INSPECTION

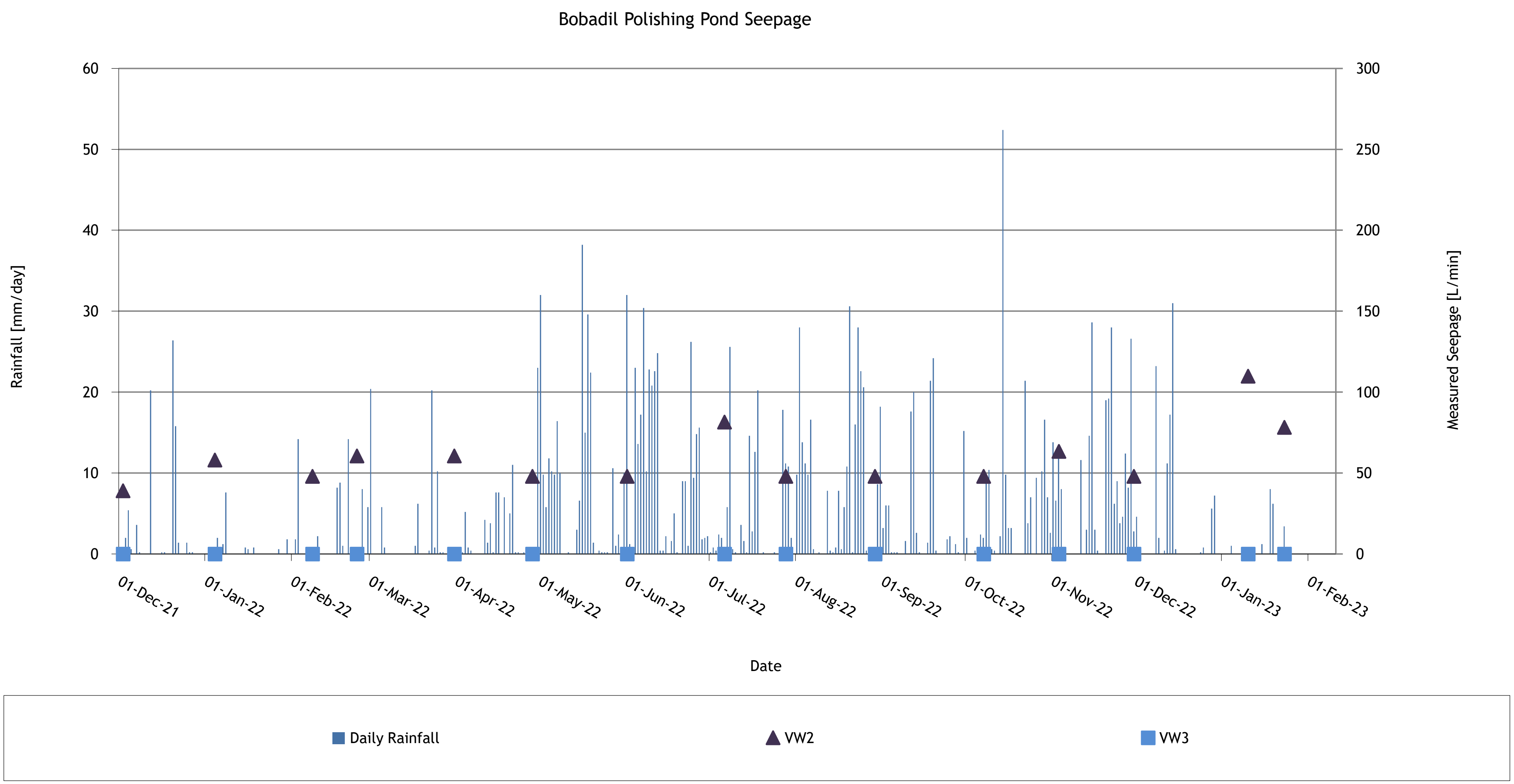
BOBADIL POLISHING POND - WESTERN SECTION PIEZOMETER LEVELS

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 29

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\EoR surveillance Spreadsheet - Bobadil January (Figures)



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2022 EOR INSPECTION

BOBADIL TSF - MEASURED POLISHING POND DISCHARGE RATES

JANUARY 2022 - FEBRUARY 2023

Date: 8/06/2023 **Job No:** 107031.68

FIGURE 30

J:\2007\107031 Rosebery Bobadil FY 07-09\68 EoR Activities\Data and Calcs\monitoring 2022 audit period\Bobadil\Monthly surveillance Spreadsheet - Bobadil January (Figures)

APPENDICES

APPENDIX A – EOR INSPECTION CHECKLIST

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
BOBADIL TAILINGS STORAGE FACILITY AND POLISHING POND

Monitored By :	Mark Dillon (EoR)
Date of Inspection :	24th January 2023
Weather Conditions :	Sunny and hot
Rainfall :	nil

NORTH EMBANKMENT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
RL 201 m Crest	Condition of surface	Y	Good	
	Condition of safety bund	Y	Good	
Downstream Batter (RL 201 to RL 199 m)	Slumps, bulging or rilling of rockfill	Y	nil	
	Seepage	Y	nil	
	Tree / shrub growth	Y	nil	
Upstream batter	Slumps, bulging or erosion	Y	Localised slump below spigot NS23	24
	Wave erosion	Y	nil	
Tailings Beach	Location of beach development	Y	Good development	11
	Operating spigots at time of inspection	Y	2 spigots	
RL 199 Bench	Condition of peat cover	Y	Good, vegetation established	12
	Condition of drain	Y	Good.	
	Condition of perimeter road	Y	Good, some minor, isolated potholes present	28
	Condition of safety bund	Y	Good	
	Condition of drain outlets	Y	Good	
Downstream Batter (RL 199 m to toe)	Slumps, bulging or rilling of rockfill	Y	nil	
	Seepage / soft spots	Y	salt expression at western end approx. half way up old ramp.	
	Tree / shrub growth	Y	some sparse vegetation.	
Other Comments	Tailings beach sprinklers in operation. Dust monitoring program at western end			27

SPILLWAY

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
RL 200.4 m Spillway Crest	Obstructions or erosion	Y	Good	25
Spillway Channel	Stability of side slopes	Y	Good	
	Seepage in channel base	Y	nil	
Other Comments				

BYPASS CHANNEL

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Bypass Valve	Check if operational	Y	Considerable build-up of scale. Requires maintenance	
Bypass channel	Obstructions and vegetation growth	Y	Good condition and clear of obstructions	
Other Comments	1. BDSP 3 (v-notch damaged, requires replacement)			
	2. CW04 - sediment build-up, requires maintenance			
	3. CW03 - scale of weir plate, requires maintenance			

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
BOBADIL TAILINGS STORAGE FACILITY AND POLISHING POND

Monitored By :	Mark Dillon (EoR)
Date of Inspection :	24th January 2023
Weather Conditions :	Sunny and hot
Rainfall :	nil

RAILWAY CUTTING

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
	Slumps, bulging or erosion	Y	several points of localised very minor erosion associated with low points in the levee embankment bench at the top of the cutting	
	Stability of railway cutting	Y	Good condition	
	Vegetation growth on railway cutting	Y	Generally healthy vegetation comprising a mix of saplings and mature trees. Vegetation at the southern most end of the cutting has been slashed.	
	Seepage / soft spots	Y	Seepage and considerable salt precipitation evident towards the northern end of the cutting. Seepage and salt is below seep at top of slope.	6, 7
Other Comments	1. seepage and salt expression requires investigation.			

DECANT CHANNEL

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
From Decant pipe to railway crossing	Stability of side wall	Y	Good condition	9
	Condition of BDSP internal drainage discharge points	Y	Reasonable condition	
	Obstructions to culvert under railway	Y	Clear	8
From railway crossing to Polishing Pond culvert crossing	Stability of side wall	Y	Good condition	
	Obstructions to culvert under access to Polishing Pond	Y	Clear	
Decommissioned Decant Channel from headwall to BDSP14	Stability of side wall	Y	Good condition	
	Obstructions and vegetation growth	Y	Clear	
Other Comments	1. CW02 - sediment upstream, requires maintenance			
	4. V-notch BDSP01 at the southern end of the decommissioned decant channel needs to bee repaired.			

LEVEE EMBANKMENT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
RL 201 m Crest	Condition of surface	Y	Good	
	Condition of safety bund	Y	Good	
Downstream Batter (RL 201 to RL 199 m)	Slumps, bulging or rilling of rockfill	Y	nil	
	Seepage	Y	nil	
	Tree / shrub growth	Y	nil	
Upstream batter	Slumps, bulging or erosion	Y	Good	
	Wave erosion	Y	nil	
Tailings Beach	Location of beach development	Y	Good development	
	Operating Spigots at time of inspection	Y	Open end discharge, southern end of embankment section	

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
BOBADIL TAILINGS STORAGE FACILITY AND POLISHING POND

Monitored By : Mark Dillon (EoR)
Date of Inspection : 24th January 2023
Weather Conditions : Sunny and hot
Rainfall : nil

RL 199 Bench	Condition of peat cover	Y	Good, vegetation established	
	Condition of drain	Y	Good. Some water under BGM liner adjacent to outlet headwall.	
	Condition of perimeter road	Y	Good	
	Condition of safety bund	Y	Good	
	Condition of drain outlets	Y	Good	
Downstream Batter (RL 199 m to top of railway cutting)	Slumps, bulging or rilling of rockfill	Y	5 point of concentrated erosion, none change from previous inspection	13
	Seepage / soft spots	Y	1. iron staining on downstream slope at 3 locations at the interface of Stage 6/7 raises.	14
			2. concentrated seep towards the southern end of the batter at ~ RL 188 m .	
			3. Broad seepage/damp ground over a broad area between bypass ramp and levee pipes at ~ RL 186 m.	15, 29
			4. Salt at top of ramp at northern end, evidence of past seepage. Located about seepage/salt in railway cutting.	10
	Tree / shrub growth	Y	sparce vegetation, more dense at toe.	
Other Comments	The broad seepage at ~RL186m has increased and requires further investigation/assessment.			

WESTERN EMBANKMENT

Item	Criteria	Checked	Comment	Photo Reference
RL 201 m Crest	Condition of surface	Y	Good	22, 23
	Condition of safety bund	Y	Good	
Downstream Batter (RL 201 to RL 199 m)	Slumps, bulging or rilling of rockfill	Y	nil	
	Seepage	Y	nil	
	Tree / shrub growth	Y	nil	
Upstream batter	Slumps, bulging or erosion	Y	nil	
	Wave erosion	Y	nil	
Tailings Beach	Location of beach development	Y	nil	32
	Operating spigots at time of inspection	Y	nil	
RL 199 Bench	Condition of peat cover	Y	Good, vegetation established	
	Condition of drain	Y	Good. Water under BGM liner upstream of outlet headwall.	20, 21
	Condition of perimeter road	Y	Good	
	Condition of safety bund	Y	Good	
	Condition of drain outlets	Y	Good	
Downstream Batter (RL 199 m to crest of Western Buttress)	Slumps, bulging or rilling of rockfill	Y	nil	
	Seepage / soft spots	Y	nil	
	Tree / shrub growth	Y	nil	
Other Comments	Wind blown tailings present towards the southern end of the downstream batter (RL 199 m to western buttress crest)			

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
BOBADIL TAILINGS STORAGE FACILITY AND POLISHING POND

Monitored By : Mark Dillon (EoR)
Date of Inspection : 24th January 2023
Weather Conditions : Sunny and hot
Rainfall : nil

WESTERN BUTTRESS

Item	Criteria	Checked	Comment	Photo Reference
Buttress Crest	Condition of surface	Y	Good	31
	Condition of safety bund	Y	Good	
Buttress Downstream Batter	Slumps, bulging or rilling of rockfill	Y	nil	3
	Seepage / soft spots	Y	nil	
	Seepage at downstream toe	Y	nil	
	Tree / shrub growth	Y	nil	
Downstream Toe Drain	Vegetation growth	Y	generally clear, dense vegetation around some of the BDSP monitoring points impeding access (BDSP 9A & WB3 as example). Some maintenance required	
	Obstructions and impeded flow.	Y	1. Some regrading of the drain required between BDSP 10 and 11 to improve flow.	
			2. Drainage pit adjacent to BDSP 9A is flowing but with considerable sediment build-up. Requires clearing.	
			3. Drainage pit between WB1 and WB2 is flowing but with considerable sediment build-up. Requires clearing.	
Other Comments	a plan should be developed to address toe drain water management.			

SOUTHERN EMBANKMENT

Item	Criteria	Checked	Comment	Photo Reference
RL 201 m Crest	Condition of surface	Y	Good	
	Condition of safety bund	Y	Good	
Downstream Batter (RL 201 to RL 199 m)	Slumps, bulging or rilling of rockfill	Y	nil	1
	Seepage	Y	nil	
	Tree / shrub growth	Y	nil	
Upstream batter	Slumps, bulging or erosion	Y	nil	
	Wave erosion	Y	nil	
Tailings Beach	Location of beach development	Y	Good, sprinklers operating	5
	Operating spigots at time of inspection	Y	nil	
RL 199 Bench	Condition of peat cover	Y	Good, vegetation established	
	Condition of drain	Y	Good, minor water under BGM liner upstream of outlet headwall	
	Condition of perimeter road	Y	Good	
	Condition of safety bund	Y	Good	
	Condition of drain outlets	Y	Good	
Downstream Batter (RL 199 m to toe)	Slumps, bulging or rilling of rockfill	Y	nil	4
	Seepage / soft spots	Y	1. Seepage at eastern abutment, below low lift pump station, moss and moist	
			2. Seepage on eastern abutment bench, below low lift pump station has increased. Requires further investigation	34
			3. Seepage from downstream toe, moss and moist.	33
	Tree / shrub growth	Y	some sparse vegetation.	
Other Comments	The seepage at the eastern abutment, below low lift pump station requires further investigation.			

MMG ROSEBERY MINE EOR ANNUAL INSPECTION
BOBADIL TAILINGS STORAGE FACILITY AND POLISHING POND

Monitored By :	Mark Dillon (EoR)
Date of Inspection :	24th January 2023
Weather Conditions :	Sunny and hot
Rainfall :	nil

DECANT

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Approach Channel to Southern Pond	Obstructions or tailings build-up	Y	Clear, sediment buildup, rock weir has been raised	19
	Pipes into pond	Y	Clear	
Filter wall	Obstructions or blockages		Good.	
	Flow		Flow increased but below expectations	26
Decant	Obstructions or blockages	Y	No obstructions	16
	Decant pond clarity	Y	Clarity ok at main pond. Southern Pond contains sludge.	17, 18
	Obstructions to flow at decant pipe outlet	Y	No obstructions	
	Location of Decant pond	Y	Against upstream side of filter wall as per design	
Other comments				

BORROW PIT / TAILINGS BYPASS

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Water Level	Water level	Y	relatively low	
Tailings	Are tailings exposed?	Y	Yes	30
Other comments	Exposed tailings are oxidising, evidenced by iron precipitates. Consider removal of exposed tailings.			

POLISHING POND

Item	**Criteria**	**Checked**	**Comment**	**Photo Reference**
Crest	Condition of surface	Y	Good. Some potholes.	36
	Condition of downstream safety bund	Y	bund consists of large rocks	
Dividing Embankments	General condition	Y	Good, crests clear of vegetation	
Downstream Batter	Slumps, bulging, rilling of rockfill	Y	nil	
	Seepage / soft spots	Y	none observed, noting that known seep near monitoring point B3 could not be accessed due to vegetation.	
	Tree / shrub growth	Y	southern batter to B0 monitoring point has been slashed, remaining batter to north yet to be slashed.	
Upstream batter	Slumps, bulging or erosion	Y	nil, vegetated	
	Wave erosion	Y	none observed	
Decant	Obstructions or blockages to original decant	Y	No obstruction	
	Obstructions or blockages to 2nd decant	Y	No obstruction	
	Channel from 2nd decant	Y	Clear	37
Spillway	Obstructions to spillway	Y	No obstruction	41
Freeboard	Estimate of spillway freeboard	Y	1.5	
Other comments	considerable sediment build-up in cells 1 and 2 has reduced capacity considerably. Dredging is in plan.			39, 40

APPENDIX B – PHOTOGRAPHIC SUMMARY

Photograph 1 – Southern embankment downstream slope and soil cover ara.

Photograph 2 – Southern access ramp

Photograph 3 – Downstream slope western buttress and dense vegetation in toe drain, looking north.

Photograph 4 – Southern embankment downstream slope

Photograph 5 – overview of downstream slope of northern embankment, looking south

Photograph 6 – salt on railway cutting batter

Photograph 7 -seepage and salt at toe of railway cutting

Photograph 8 – bypass drain culverts beneath rail.

Photograph 9 – Decant channel, looking west from outlet pipe.

Photograph 10 – Downstream slope of northern embankment, looking west towards Levee Embankment, note salt precipitation.

Photograph 11 – northern embankment crest (Stage 10), looking west.

Photograph 12 – Trial cover area, north wall (RL 199 m), looking west.

Photograph 13 – Erosion below Levee bench (typical).

Photograph 14 – Iron staining on downstream slope of the Levee embankment, looking south. The iron staining is originating betwee the Stage 5/6 raises.

Photograph 15 – condition of the old decant drain, looking south from headwall.

Photograph 16 – Overview of decant, clear water being decanted.

Photograph 17 – Overview of decant pond, looking south.

Photograph 18 – Overview of southern quarry void. Note the water is very shallow due to sludge settlement.

Photograph 19 – New Decant approach channel showing energy dissipation weir.

Photograph 20 - Western soil cover outlet drain.

Photograph 21 – Western soil cover outlet drain and culvert.

Photograph 22 – Crest of southern embankment (Stage 10), looking west.

Photograph 23 – Levee embankment crest (Stage 10), looking south.

Photograph 24 – Typical slump on the upstream face due to rainfall and spigot conductor pipe spills

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Photogrpah 25 – Stage 10 side entry spillway

Photograph 26 – Decant filter wall crest, looking south.

Photograph 27 – Dust monitoring equipment on tailings beach near levee embankment.

Photograph 28 – Levee embankment crest general condition.

Photograph 29 – reeds on downstream batter of Levee embankment signify the upper extent of broad wet area.

Photograph 30 – old clay borrow, tailings bypass area.

Photograph 31 –western buttress overview, note wind blown tailings.

Photograph 32 – Tailings deposition from Stage 10, Levee Embankment, looking south west.

Photograph 33 – seepage from downstream toe of Southern embankment.

Photograph 34 – Seepage at southern access ramp, looking north.

Photograph 35 – Moss and algae build around V-notch BDSP-01 requires clearing. Sediment build-up upstream of BDSP-01 should be removed.

Photograph 36 – Polishing Pond – typical condition of the crest

Photograph 37 – Licensed Point of Discharge channel.

Photograph 38 – Leaking pit downstream of the railway line near BDSP 01.

Photograph 39 – Polishing Pond Cell 1. Large amounts of sludge have accumulated within several cells.

Photograph 40 – Polishing Pond Cell 3. Large amounts of sludge have accumulated within several cells.

Photograph 41 – Polishing Pond embankment concrete spillway.

Photograph 42 – Polishing Pond –V-notch weir (VW 3)

Photograph 43 – Polishing Pond – Old seepage point at the Northern end, below Decant 1– Moist at the time of inspection.

Photograph 44 – Polishing Pond – overgrown cell 3/4 dividing embankment slashed. Vegetation at internal spillway (background) should also be removed.

APPENDIX C – MONITORING SUMMARY

TABLE C1
BOBADIL TSF PIEZOMETER READINGS
AUDIT PERIOD JANUARY 2022 - DECEMBER 2022

Piezometer Name	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water	RL (m) Water
SPA5	187.46	187.34	187.25	187.12	187.19	187.37	186.96	187.35	187.39	187.50	187.37	187.39
SPA7	186.75	186.66	186.64	186.63	186.79	190.22	189.53	187.02	187.45	187.93	187.11	187.04
SPB5	182.35	182.34	182.35	182.32	182.36	182.46	-	182.48	182.57	182.37	182.46	182.49
SPB6	182.34	182.35	182.32	182.36	182.49	182.46	183.50	183.57	182.48	182.57	182.37	182.46
SPB8	186.96	187.00	186.98	187.08	187.05	187.06	187.06	187.07	185.92	185.17	185.37	185.19
SPC6	185.22	185.02	184.92	184.88	184.91	185.25	193.71	185.40	185.31	185.48	185.37	185.35
SPD5	187.36	187.20	187.13	187.04	187.32	187.34	187.91	187.63	187.60	187.88	187.88	188.00
SPD8	187.01	186.55	186.40	186.07	185.92	187.32	184.63	193.33	-	-	-	-
SPD8VWP	-	-	-	-	-	-	-	-	-	187.03	185.55	185.45
SPD9	150.53	150.55	150.57	-	150.54	150.43	150.54	148.95	150.53	150.54	150.54	150.54
SPE4	186.45	186.25	186.15	185.92	185.87	186.19	186.65	186.66	186.66	186.80	186.70	186.64
SPF3	179.83	179.64	179.56	179.29	179.18	179.83	180.34	180.19	180.23	180.44	179.48	180.02
SPF4	164.24	164.27	164.25	164.28	164.37	164.36	164.67	164.28	164.43	164.52	164.47	164.27
SPN1	189.89	189.92	190.06	189.76	190.15	190.25	190.27	189.77	189.82	189.65	190.13	190.03
SPS2	192.33	191.92	192.14	191.75	191.56	191.59	191.93	192.29	193.18	193.21	193.05	192.62
VW1	190.11	190.11	190.11	190.11	190.11	190.11	190.11	190.11	190.11	190.11	190.11	190.11
VW2	192.55	192.73	193.04	192.86	192.63	193.39	193.67	193.85	193.54	192.95	193.05	192.98
VW3	192.61	192.59	192.42	192.52	192.67	192.99	192.70	192.69	192.76	192.51	192.82	192.90
VW4	192.18	192.86	192.92	192.58	192.73	193.47	193.69	193.87	193.79	193.68	194.19	193.99
VW5	190.21	190.15	190.10	189.66	189.31	189.69	190.34	190.95	191.06	190.87	191.26	191.17
VW6	191.27	191.40	191.24	190.83	190.42	191.20	191.81	192.50	192.62	192.12	192.03	191.72
VW7	185.28	185.33	185.40	185.23	185.26	185.67	185.46	185.67	185.73	185.39	185.75	185.64
VW8	187.65	187.62	187.56	187.24	187.20	187.70	187.75	188.21	188.28	188.06	188.44	188.33
VWA1	192.74	193.10	193.46	192.85	192.85	193.08	192.51	192.76	192.89	193.06	193.42	193.08
VWA2	192.45	192.72	193.04	192.58	192.52	192.81	192.51	192.49	192.63	192.70	193.12	192.85
VWB	190.95	191.69	191.75	191.22	191.41	192.01	192.51	192.10	191.87	191.83	192.35	191.89
VWC1	191.44	192.63	192.55	191.85	192.23	192.87	192.89	192.99	192.69	192.59	193.12	192.57
VWC2	190.12	190.51	190.57	190.19	190.27	190.92	190.88	191.14	191.00	190.71	191.16	190.94
VWD1	190.63	191.69	191.46	190.70	190.98	192.10	192.29	192.57	192.22	192.22	192.59	192.26
VWD2	190.44	191.24	191.15	190.49	190.51	191.59	191.78	192.08	191.80	191.69	192.06	191.85
VWD3	189.84	190.32	190.37	189.82	189.69	190.67	190.86	191.23	191.04	190.80	191.19	191.06
VWE	190.28	190.46	190.41	189.83	189.46	190.58	191.29	191.78	191.53	191.64	191.93	191.68
VWF	191.15	190.86	190.62	190.07	189.68	190.58	192.13	192.62	192.33	192.56	192.58	192.31
VWLA	192.25	192.10	191.79	192.12	192.16	192.41	192.04	192.00	192.02	191.81	192.10	192.14
VWLB	191.64	191.82	191.58	191.76	191.53	191.92	191.70	191.84	191.49	191.02	191.21	191.43
VWNA	193.13	193.31	193.25	192.77	192.72	193.53	193.42	193.46	193.29	193.07	193.37	193.33
VWNB	192.54	192.16	191.68	191.21	190.87	191.47	191.38	191.56	191.94	191.60	192.03	191.99
VWNC	192.72	192.98	193.25	192.83	192.63	193.41	193.57	193.63	193.19	192.52	192.67	192.65
VWSPA1	187.70	187.58	187.33	186.86	186.45	186.37	192.51	185.67	185.46	184.76	184.78	184.43
VWSPA2	189.05	189.08	189.05	188.74	188.51	188.65	192.51	188.31	188.31	187.79	188.06	187.95
VWSPA4	186.80	186.93	187.04	186.89	186.89	187.15	192.51	187.04	187.11	186.76	187.13	187.02
VWSPA6	183.66	183.79	183.85	183.71	183.64	183.96	192.51	183.83	183.90	183.54	183.85	183.75
VWSPB1	175.27	175.50	175.60	175.37	175.42	175.73	175.46	175.73	175.71	175.42	175.79	175.62
VWSPB2	188.59	188.78	188.88	188.61	188.65	189.15	188.97	189.24	189.13	188.90	189.36	189.09
VWSPB4	187.44	187.54	187.60	187.44	187.52	187.90	187.60	187.86	187.84	187.56	187.95	187.76
VWSPB6	184.02	184.17	184.29	184.15	184.19	184.46	184.17	184.40	184.46	184.13	184.48	184.36
VWSPC1	174.45	174.55	174.60	174.35	174.30	174.63	174.45	174.63	174.63	174.30	174.65	174.50
VWSPC2	187.68	187.85	187.91	187.64	187.72	188.26	188.13	188.44	188.42	188.09	188.50	188.32
VWSPC5	186.60	186.58	186.64	186.52	186.75	187.14	186.89	187.26	187.28	186.99	187.39	187.18
VWSPD1	174.52	174.66	174.64	174.48	174.42	174.74	174.74	174.93	174.95	174.70	174.90	174.78
VWSPD2	188.05	188.17	188.23	187.84	187.74	188.42	188.54	188.95	188.95	188.62	188.97	188.85
VWSPD4	186.97	187.00	187.04	186.79	186.88	187.39	187.27	187.64	187.71	187.38	187.77	187.62
VWSPD7	184.72	184.78	184.82	184.59	184.61	185.07	184.93	185.24	185.31	184.98	185.31	185.22
VWSPE1	177.55	177.66	177.62	177.41	177.34	177.74	177.85	178.10	178.08	177.85	178.04	177.89
VWSPE2	188.39	188.30	188.18	187.76	187.49	187.91	-	188.93	189.05	188.82	189.20	189.09
VWSPE3	188.19	188.15	188.03	187.65	187.69	188.07	188.17	188.67	188.77	188.49	188.88	188.75
VWSPE5	186.20	186.12	186.05	185.69	185.62	186.11	186.18	186.63	186.70	186.41	186.83	186.70
VWSPF1	184.73	184.78	184.66	184.32	184.17	184.82	185.18	185.57	185.50	185.34	185.50	185.32
VWSPF2	182.43	182.28	182.11	181.86	181.77	182.05	181.94	182.05	182.24	182.03	182.28	182.22
VWSPN2	186.93	186.98	187.12	187.00	186.79	187.31	187.40	187.57	187.46	186.96	187.02	186.98
VWSPN3	185.12	185.19	185.17	184.94	184.72	185.17	185.17	185.19	185.17	184.88	185.15	185.15
VWSPN5	187.33	187.37	187.21	186.90	186.65	187.04	186.90	187.06	187.29	187.02	187.39	187.43

Note: All Elevations are in m AHD

▨ Indicates instances where the reading has exceeded the trigger level

TABLE C2
BOBADIL TSF AND POLISHING POND DISCHARGE MONITORING
AUDIT PERIOD JANUARY 2022 - DECEMBER 2022

Monitoring Point	January 2022	Februaury 2022	March 2022	April 2022	May 2022	June 2022	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2022
Southern Embankment Toe													
BDSP01 (V-notch) (L/min)	12.7	10.7	8.9	13.8	24.5	152.8	24.5	24.5	27.8	13.8	78.2	13.8	16.1
BDSP05 (L/min)	11.2	10.3	9.6	8.6	8.1	8.6	10.8	9.8	12.9	11.4	12.3	9.5	11.8
BDSP06 (L/min)	10.3	7.5	Invert in water	9.0	8.2	10.0	11.3	11.0	12.6	11.5	11.4	11.7	10.9
BDSP07 (L/min)	1.0	1.0	0.8	0.9	0.9	0.9	0.7	0.7	0.6	0.6	0.6	0.6	0.4
BDSP08 (L/min)	9.4	7.1	6.0	5.4	6.0	6.7	7.3	7.4	7.7	7.3	7.7	8.1	6.8
BDSP09A (L/min)	6.4	5.0	5.2	4.0	4.4	10.0	10.3	11.3	16.5	14.8	15.1	16.5	14.0
BDSP09B (L/min)	10.9	7.0	6.9	7.1	1.7	12.0	12.2	10.7	15.4	12.9	15.8	17.9	11.9
BDSP10 (L/min)	7.6	5.2	5.0	6.3	5.4	8.6	10.7	9.6	12.3	10.3	13.0	15.5	9.8
BDSP11 (L/min)	7.9	6.5	6.9	7.1	7.3	7.5	10.8		12.3	8.0	11.6	10.1	10.2
Total (L/min)	77.3	60.2	49.3	62.2	66.5	217.0	98.6	84.8	118.0	90.5	165.8	103.7	91.8
Western Embankment Toe													
BDSP12A (L/min)	15.8	17.8	15.4	16.1	17.4	20.0	20.5	25.1	18.0	20.8	20.7	0.9	21.1
BDSP12B (L/min)	6.7	5.9	5.9	5.8	5.6	25.0	4.9	5.3	4.9	4.5	4.8	3.9	3.6
BDSP13 (L/min)	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.3	0.3	0.4	0.4
BDSP14 (L/min)	13.8	13.0	12.8	13.2	12.0	15.0	16.4	15.2	16.4	16.6	15.7	15.8	14.1
Total (L/min)	36.5	36.8	34.3	35.3	35.2	60.3	42.1	45.9	39.6	42.2	41.5	21.0	39.3
Levee Bank Drainage													
Black PE (160mm pipe)	7.2	6.6	Medium	Medium	4.7	8.6	12.1	medium	medium	medium	12.0		8.9
White Sewer pipe	46.3	44.1	Medium	Medium	34.6	20.0	57.6	Large	Large	Large	57.9		HIGH FLOW
Black PE (200mm pipe)	61.7	52.6	Low	Low	47.3	60.0	56.8	low	low	low	58.5		35.3
BDSP15 (L/min)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	Trickle	Trickle	DRY	DRY	DRY	DRY
BDSP16 (L/min)	DRIP	DRIP	DRIP	DRIP	DRIP	DRIP	DRIP	Trickle	Trickle	Trickle	Trickle	Trickle	Trickle
BDSP17 (L/min)	DRIP	Trickle	DRY	DRY	0.1	DRIP	DRIP			DRY	DRY	DRY	Trickle
BDSP18 (L/min)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	dry	dry	DRY	DRY	DRY	DRY
BDSP19 (L/min)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.0	dry	DRY	DRY	1.0	DRY
V-notch Weir (VW1)	221.7	102.3	109.8	130.3	78.2	204.5	139.0	130.3	109.8	91.5	126.0	109.8	117.8
Total (L/min)	221.7	102.3	109.8	130.3	78.2	204.5	139.0	130.3	109.8	91.5	126.0	109.8	117.8
Northern Embankment Toe													
BDSP20A (L/min)	Submerged	Submerged	Submerged	Submerged	Submerged	Submerged	Submerged			0.0		5.1	2.0
BDSP20B (L/min)	DRY	DRY	DRY	DRY	DRY	DRY	DRIP	Dry	Dry	Dry	Dry	2.4	Trickle
BDSP21 (L/min)	0.2	0.1	DRIP	DRIP	0.1	DRIP	DRIP	Trickle	DRY	0.5	0.1		DRIP
BDSP23 (L/min)	9.0	8.7	7.5	7.0	6.3	7.5	7.8	9.5	10.7	9.5	6.7	9.7	9.1
BDSP24 (L/min)	2.2	2.3	3.0	3.1	3.2	3.5	2.1	2.0	0.9	0.5	3.6	0.8	0.7
BDSP25 (L/min)	5.5	5.4	5.6	6.0	5.1	5.0	5.8	6.3	6.0	6.0	6.7	2.8	7.1
BDSP26 (L/min)	2.7	2.6	3.6	3.0	3.0	6.0	3.1	3.3	3.1	3.0	3.6	3.6	4.2
BDSP27 (L/min)	0.7	0.7	0.9	0.8	1.0	1.5	2.0	0.9	0.9	0.8	0.9	0.8	0.8
BDSP28 (L/min)	2.6	2.6	2.6	1.8	1.8	1.4	1.8	1.6	1.9	1.8	1.6	2.3	2.4
BDSP29 (L/min)	DRY	DRY	DRY	DRY	DRY	1.0	DRY	dry	DRY	DRY	DRY	0.5	DRY
BDSP30 (L/min)	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4		TRICKLE	TRICKLE	0.5	0.5
BDSP31 (L/min)	0.8	DRIP	DRIP	DRIP	0.1	0.1	DRIP	DRIP	DRIP	DRIP	DRIP	DRIP	DRIP
Total (L/min)	23.9	22.6	23.3	21.8	20.7	26.0	23.0	23.9	23.5	22.1	23.1	28.4	26.9
Western Buttress Filter Drains													
WB01 (L/min)	1.3	0.7	0.6	0.5	0.4	0.2	0.3	0.4	0.4	0.6	0.5	1.0	1.8
WB02 (L/min)	36.3	22.2	21.0	16.5	15.0	15.0	10.6	9.5	10.4	10.1	17.8	10.7	11.5
WB03 (L/min)	30.8	22.7	22.5	16.0	18.6	20.0	20.1	20.7	19.5	19.2	15.4	20.3	26.6
WB04 (L/min)	51.6	45.6	45.0	45.1	48.5	60.0	51.9	45.4	42.0	50.0	51.4	Large flow	58.9
WB05 (L/min)	27.3	24.8	28.5	26.5	25.5	20.0	20.1	23.0	26.9	24.3	27.1	22.5	27.6
WB06 (L/min)	2.2	2.1	2.4	2.1	1.1	8.6	0.6	0.5	0.7	1.2	1.0	1.3	1.2
WB07 (L/min)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	DRY
Total (L/min)	149.7	118.2	120.0	106.9	109.1	123.8	103.5	99.4	100.0	105.4	113.4	55.7	127.5
Total Monitored Flow (L/min)	**509**	**340**	**337**	**356**	**310**	**631**	**406**	**384**	**391**	**352**	**470**	**319**	**403**

The following weirs collect drainage from the western and southern toe drains and the partial flows are accounted for in the above table.

Bypass Drain from Northern Toe Drain													
Cipolletti Weir (CW1)	3781.2	3653.1	2828.9	4941.8	5905.3	8083.7	6723.6	9014.6	7032.0	1468.1	4462.4	4941.8	4216.3
Cipolletti Weir (CW2)	3166.7	3051.5	2828.9	4941.8	4570.4	7799.2	6251.9	8381.5	6808.2	3558.7	4534.2	5134.1	4391.2
Cipolletti Weir (CW3)	2883.6	2539.1	1970.8	5330.8	4753.9	329.4	2197.1	1468.1	1291.4	1759.0	4391.2	840.4	409.4
Bypass Drain from Western Toe Drain													
Cipolletti Weir (CW4)	113.8	106.0	91.5	91.5	121.8	265.4	134.6	109.8	265.4	204.5	239.9	265.4	126.0
Southern Drain (From Old Railway Embankment)													
V-notch Weir (BDSP3)	400.1	278.8	204.5	265.4	285.6	417.1	383.5	417.1	336.1	336.1	321.2	375.3	336.1
Polishing Pond													
V-notch Weir (VW2)	58.0	48.0	60.6	60.6	48.0	48.0	81.4	48.0	48.0	48.0	63.4	48.0	109.8
V-notch Weir (VW3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix D Annual Meteorological Report – FY23 (EY, 2023)

Annual Meteorological Report - FY23

MMG Rosebery Mine

7 August 2023

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Ernst & Young ("**EY**") was engaged on the instructions of MMG Rosebery Mine ("**Client**") to review the meteorological data in regard to their EPN and PCE conditions ("**Project**"), in accordance with the engagement agreement dated 2 June 2023 ("the **Engagement Agreement**").

The results of EY's work, including the assumptions and qualifications made in preparing the report, are set out in EY's report dated 27 July 2023 ("**Report**"). You should read the Report in its entirety including any disclaimers and attachments. A reference to the Report includes any part of the Report. No further work has been undertaken by EY since the date of the Report to update it.

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Executive Summary

MMG Rosebery Mine has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its meteorological, dust deposition and ambient air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.7 & PCE 9084 conditions A4-5, G6 & M3).

As per EPN Condition A4-3, an analysis of the annual climate is required and is contained in this report. The meteorological report for FY23 shows that westerly winds dominate during the afternoon hours at Rosebery mine, particularly at the 2/5 Dam and Carpark stations. The high percentage of calm conditions and low wind speeds observed at all stations are likely due to the surrounding terrain which modify the prevailing westerly winds and shelters the mine site. Temperature, relative humidity and rainfall data for FY23 indicated that the mine experiences a cool, wet and humid climate with wetter winter and autumn months and drier summers.

Table of contents

1. Introduction

MMG Rosebery Mine has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its meteorological, dust deposition and ambient air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.7 & PCE 9084 conditions A4-5, G6 & M3).

As per EPN Condition A4-3, an analysis of the annual climate is required. MMG Rosebery Mine engaged EY to complete the annual report for the FY23 period. This report provides a summary of the recorded annual meteorological data, compares the variability between the three meteorological stations and the diurnal and seasonal variability of wind speed and direction, temperature, relative humidity, and rainfall.

2. Monitoring Station Locations

MMG Rosebery Mine operates three meteorological stations with 10 metre (m) masts that are located close to the mine, as shown in Figure 1.

Figure 1: Meteorological Station Locations

3. Meteorological Analysis

The meteorological stations at the Rosebery Mine record wind speed and direction, temperature, relative humidity and rainfall with values reported on a 10 minute and hourly average basis.

Previously, a comparison exercise was completed to confirm the averaging technique for the hourly data for the FY19 annual meteorological report[1]. The comparison showed that the hourly vector averaging technique was considered appropriate for use in the data analysis. This methodology is still currently used by MMG, and the hourly averaged data was used in this report.

3.1 Comparison of Data

The meteorological dataset was analysed taking into consideration calibrations, data statistics and comparison to historical data. All three meteorological stations passed the calibration tests completed in October 2022. The comparison steps considered the following from the Australian Standards AS3580.19:2020 - Methods for sampling and analysis of ambient air[2]:

- All data shall be treated as *valid*[3] unless there is evidence or sound scientific principles that support the 'invalidation' of the data;
- When data are *invalidated* it should be confirmed that previous reported data are not affected;
- When critical criteria or operational criteria exceed the specified control limits, data shall be *invalidated* back to the most recent calibration or *valid* measurements; and
- Identify causes of *invalidation* of data, such as power failure or instrument malfunction.

An error with the wind speed sensor at the Bobadil station was observed from May 2022 to October 2022, and the sensor was replaced during calibrations performed in October 2022. Due to the error in the wind speed sensor, the wind speed and direction data from the Bobadil station between 1 July 2022 to 5 October 2022 were excluded from the data analysis.

A summary of the FY23 meteorological data status is presented in Table 1.

Table 1: Summary of Meteorological Review – FY23

Summary and Meteorological Parameter		**Station**		
		2/5 Dam	**Bobadil**	**Carpark**
Data Capture (%)	Wind speed and direction	99.95%	73.56%	99.86%
	Temperature	99.95%	99.98%	99.86%
	Relative Humidity	99.95%	99.98%	99.86%
	Rainfall	99.95%	99.98%	99.86%
Data Quality [b]	Wind speed and direction	High	High	High
	Temperature	High	High	High
	Relative Humidity	High	High	High
	Rainfall	High	High	High
Variability between stations	Wind speed and direction	Predominant north westerlies	Predominant northerlies and south westerlies	Predominant north westerlies
	Temperature	Little variability between the three stations with the warmest mean temperatures observed in		

---

[1] ERM (2019) *Annual Meteorological Review – Rosebery Mine*, Project No.: 0516238, ERM, issued 6 August 2019.

[2] Australian Standard *AS3580.19:2020 (2020). Methods for sampling and analysis of ambient air, Method 19: Ambient air quality data validation and reporting*

[3] AS 3580.19-2020 defines *valid* as accurate, complete or meets specified criteria. This expands on the typical definition that means to be correctly formatted and stored.

Summary and Meteorological Parameter		Station		
		2/5 Dam	Bobadil	Carpark
		January 2023 and coolest mean temperatures observed in July 2022.		
	Relative Humidity	Little variability between the three stations with higher humidity observed in winter and lower humidity observed in summer.		
	Rainfall	Similar trends were observed between the three stations with May 2022 recording the highest rainfall. The highest recorded rainfall was observed at the 2/5 Dam station.		

Notes:
a. Due to an error with the wind speed sensor, the wind speed and wind directions from the Bobadil station was excluded from 1 July 2022 to 5 October 2022.
b. Data quality is based on instrument maintenance and calibrations as per manufacturer's standards. High data quality is defined as less than 10% of data removal required outside of known errors or issues, medium data quality is defined as more than 10% and less than 25% data removal and low data quality is defined as more than 25% of data removal.

3.2 Wind Speed and Wind Direction

Wind roses were used to understand the dominant wind patterns at Rosebery Mine. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (N, NNE, NE, etc.). The bar at each wind direction in the wind rose represents winds blowing from that direction, e.g., north. The length of the bar represents the frequency of occurrence of winds from that direction, while colour of the bar corresponds to wind speed category. With the resulting figure, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

Wind roses for FY23 for the three stations onsite are presented in Figure 2. The 2/5 Dam and Carpark wind roses show predominate north westerly and westerly wind directions with infrequent easterlies. The Bobadil wind rose shows the predominate winds were south westerly and northerly. The differences in the dominant wind directions observed between the stations are most likely a consequence of the surrounding terrain, with the dominant westerly flow in the region being slightly modified by the surrounding terrain. A comparison of the predominant wind directions to FY22 showed consistency at the Bobadil and Carpark stations, however a slight variation of predominant westerly to north westerly wind directions was observed for the 2/5 Dam station. The location of the weather station and status of the surrounding environment were observed to be similar to FY22, indicating the wind directions were not influenced by substantial changes to the surrounding environment.

The wind roses indicate that wind speeds were very low at Rosebery mine for FY23, with a high frequency of calm conditions[4]. The low wind speeds observed at all stations are likely a result of the surrounding elevated terrain that shelter the Rosebery Mine site from winds.

Seasonal wind roses for each meteorological station are shown in Figure 3 to Figure 5. There was minimal seasonal variation in wind direction at the 2/5 Dam and the Carpark stations, with easterly winds being slightly more common in winter and spring. South westerly winds dominated at the Bobadil station during summer with a smaller frequency of northerly winds. Both northerly and south westerly winds were frequent during autumn at the Bobadil station with a lower intensity and frequency compared with summer. The winter and spring wind roses are not considered representative of conditions during these periods, due to an error with the wind speed sensor that not replaced until October 2022 during the annual calibrations.

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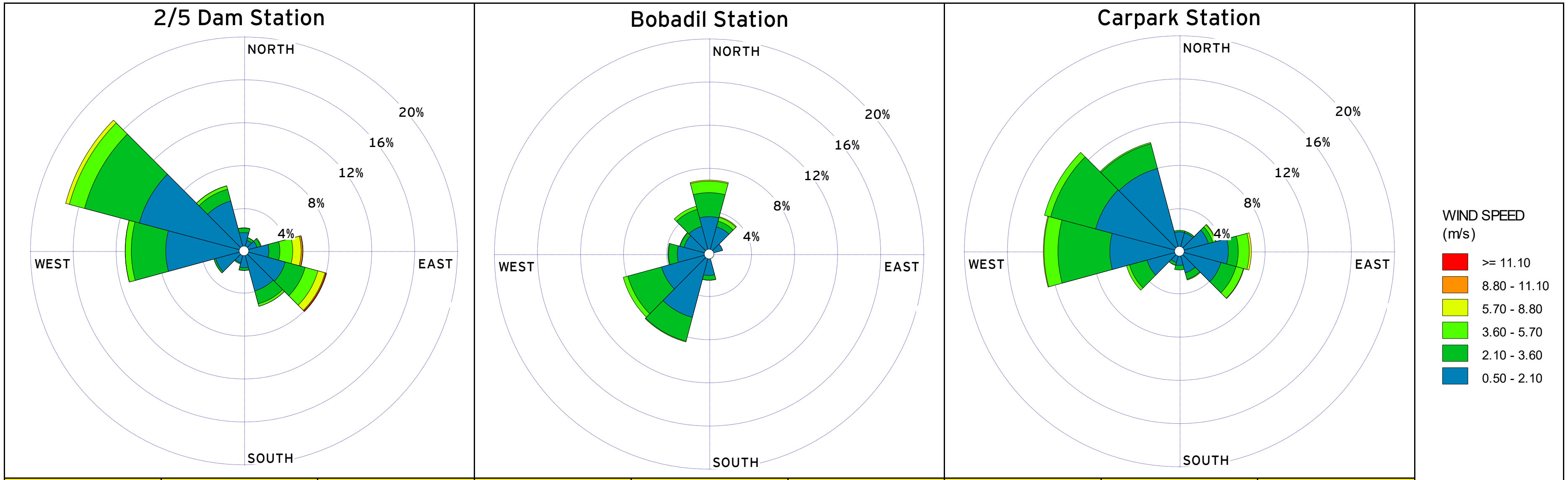
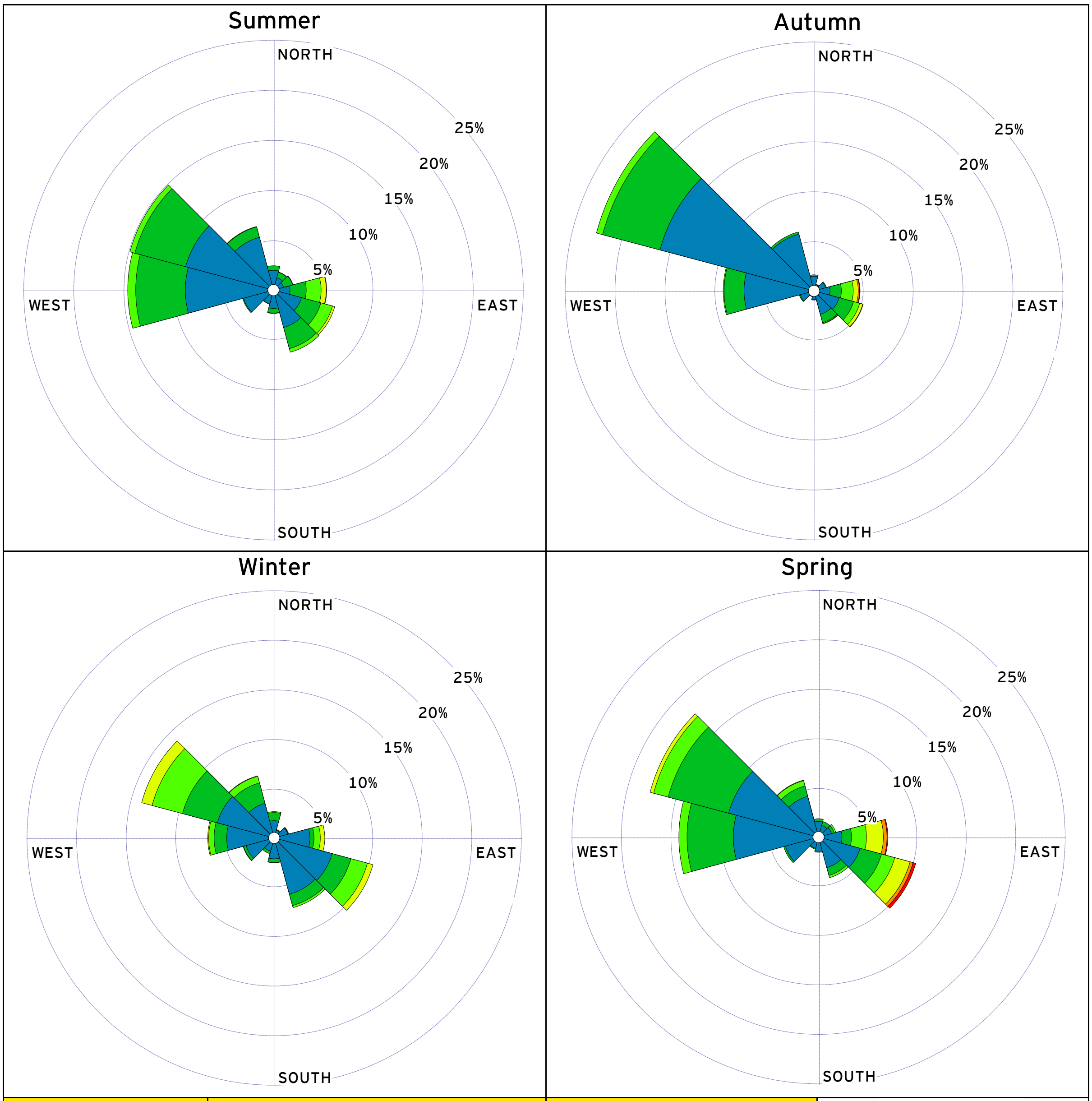
[4] Calm conditions are defined with a wind speed less than 0.5 m/s.

The time of day wind rose for each meteorological station are shown in Figure 6 to Figure 8. Westerly and north westerly winds were particularly dominant during afternoon hours (between 12pm and 6pm) at the 2/5 Dam and the Carpark station. South westerly winds were also frequent at the Bobadil station in the afternoon (between 12pm and 6pm), highlighting the dominance of westerly winds in the region. Afternoon winds were most common at all stations with the Bobadil station more sheltered from morning winds (12am to 12pm) compared to the Carpark and 2/5 Dam stations.



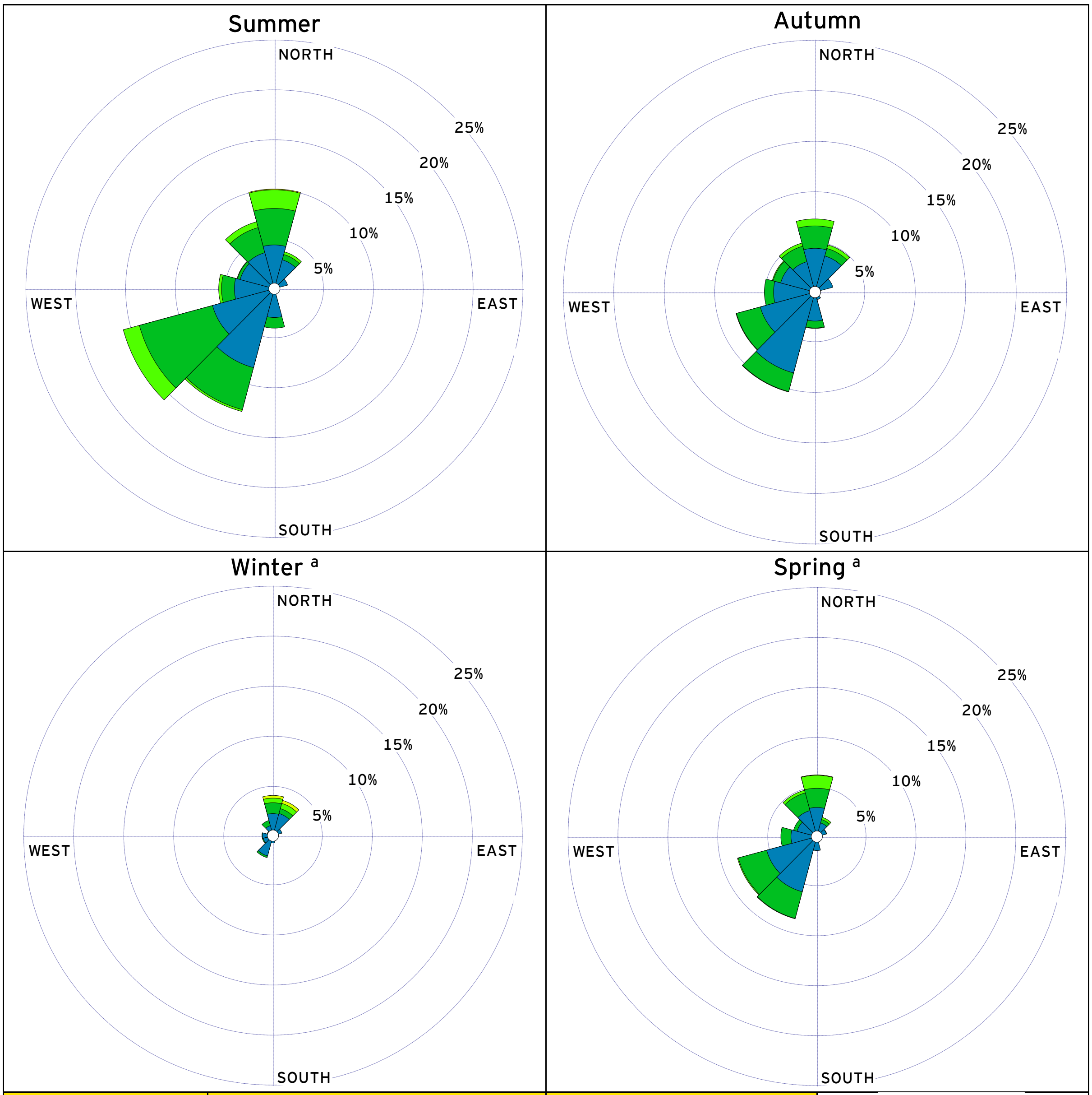
Average Wind Speed (m/s)	Calm Winds (%)	Data Availability (%)	Average Wind Speed (m/s)	Calm Winds (%)	Data Availability (%)	Average Wind Speed (m/s)	Calm Winds (%)	Data Availability (%)
1.3	35	99.99	1.0	30	74	1.2	32	99.99

Figure 2: Annual Wind Roses for FY23



Season	Average Wind Speed (m/s)	Calm Winds (%)
Summer	1.3	32
Autumn	1.0	42
Winter	1.2	37
Spring	1.6	28

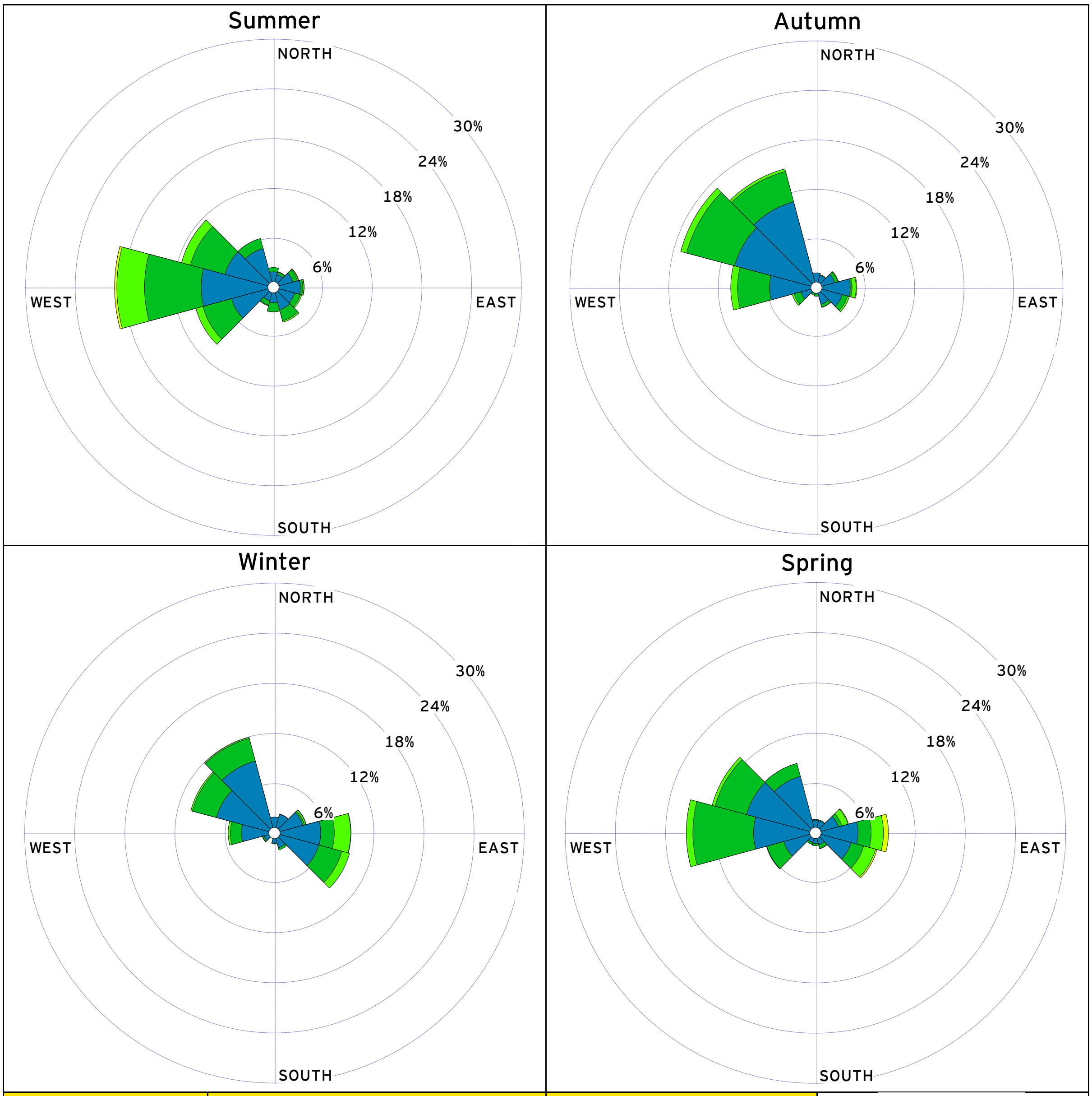
Figure 3: Seasonal Wind Roses– 2/5 Dam Station



Season	Average Wind Speed (m/s)	Calm Winds (%)
Summer	1.2	35
Autumn	0.8	47
Winter [a]	0.9	15
Spring [a]	1.1	23

a. *Due to an error with the wind speed sensor, the wind speed and wind directions from the Bobadil station were excluded until October 2023.*

Figure 4: Seasonal Wind Roses– Bobadil Station

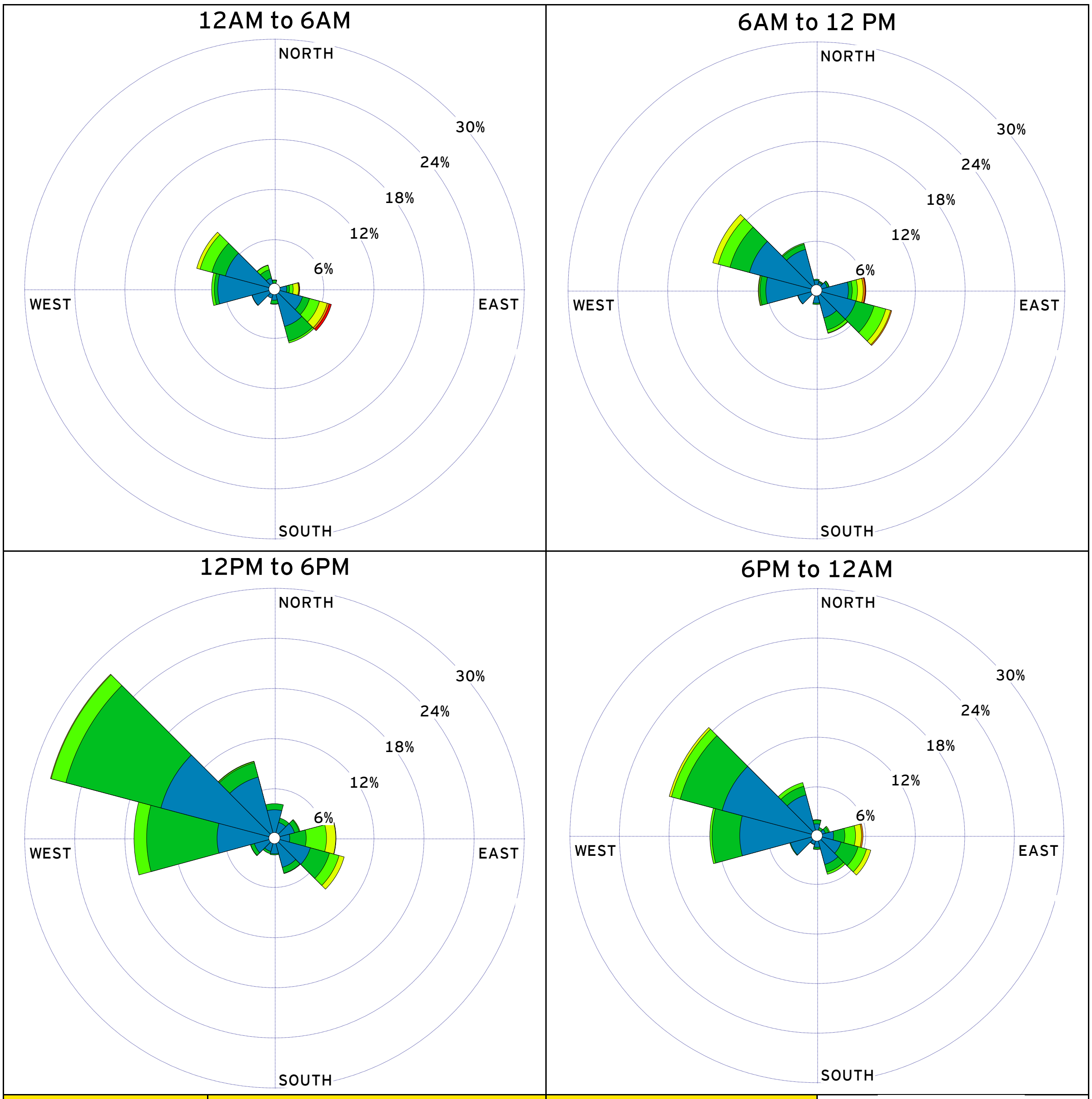


Season	Average Wind Speed (m/s)	Calm Winds (%)
Summer	1.4	28
Autumn	1.1	34
Winter	1.0	39
Spring	1.3	28

WIND SPEED
(m/s)

🟥	>= 11.10
🟧	8.80 - 11.10
🟨	5.70 - 8.80
🟩	3.60 - 5.70
🟩	2.10 - 3.60
🟦	0.50 - 2.10

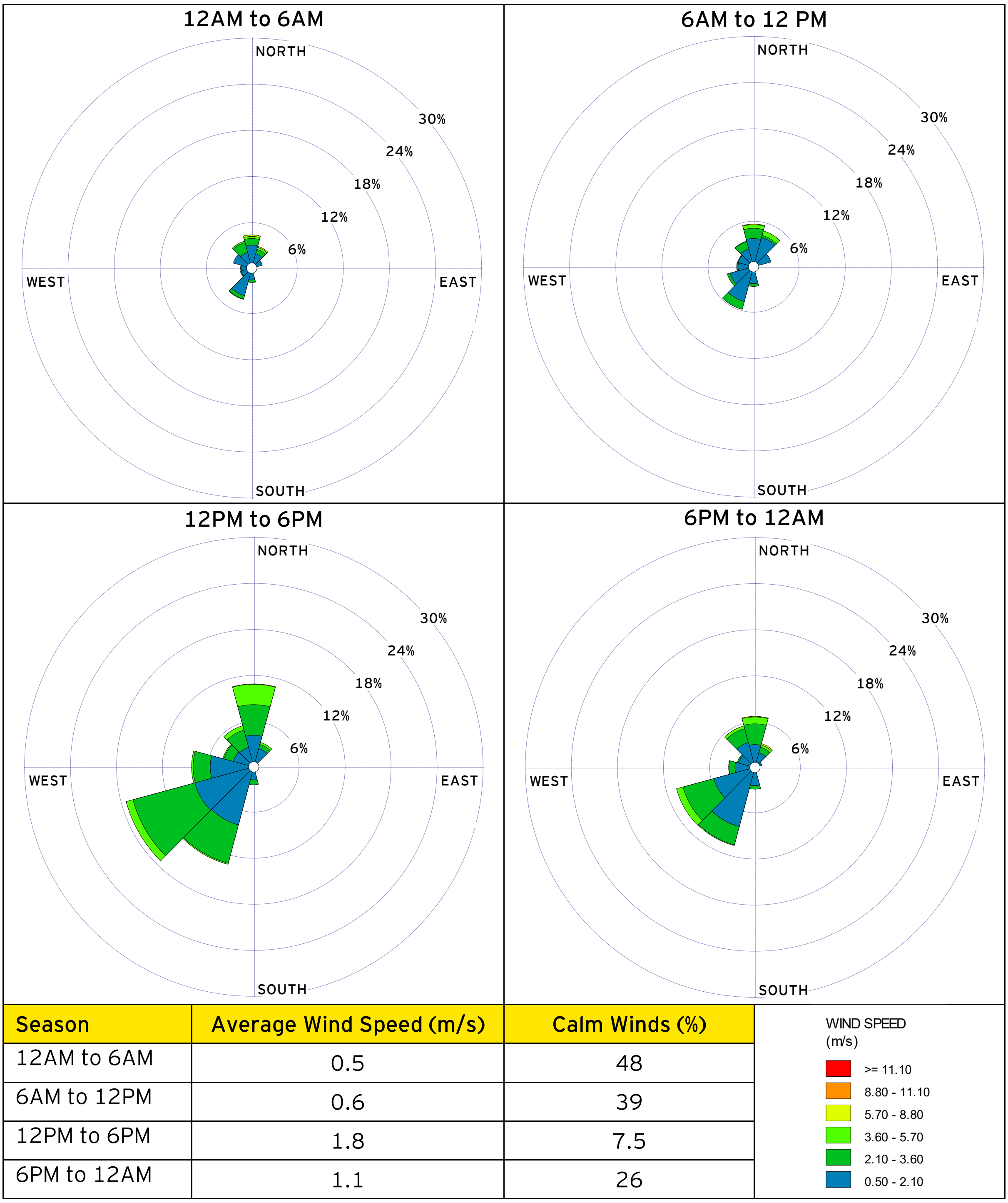
Figure 5: Seasonal Wind Roses– Carpark Station



Season	Average Wind Speed (m/s)	Calm Winds (%)
12AM to 6AM	0.9	55
6AM to 12PM	1.0	44
12PM to 6PM	1.9	8.0
6PM to 12AM	1.2	33

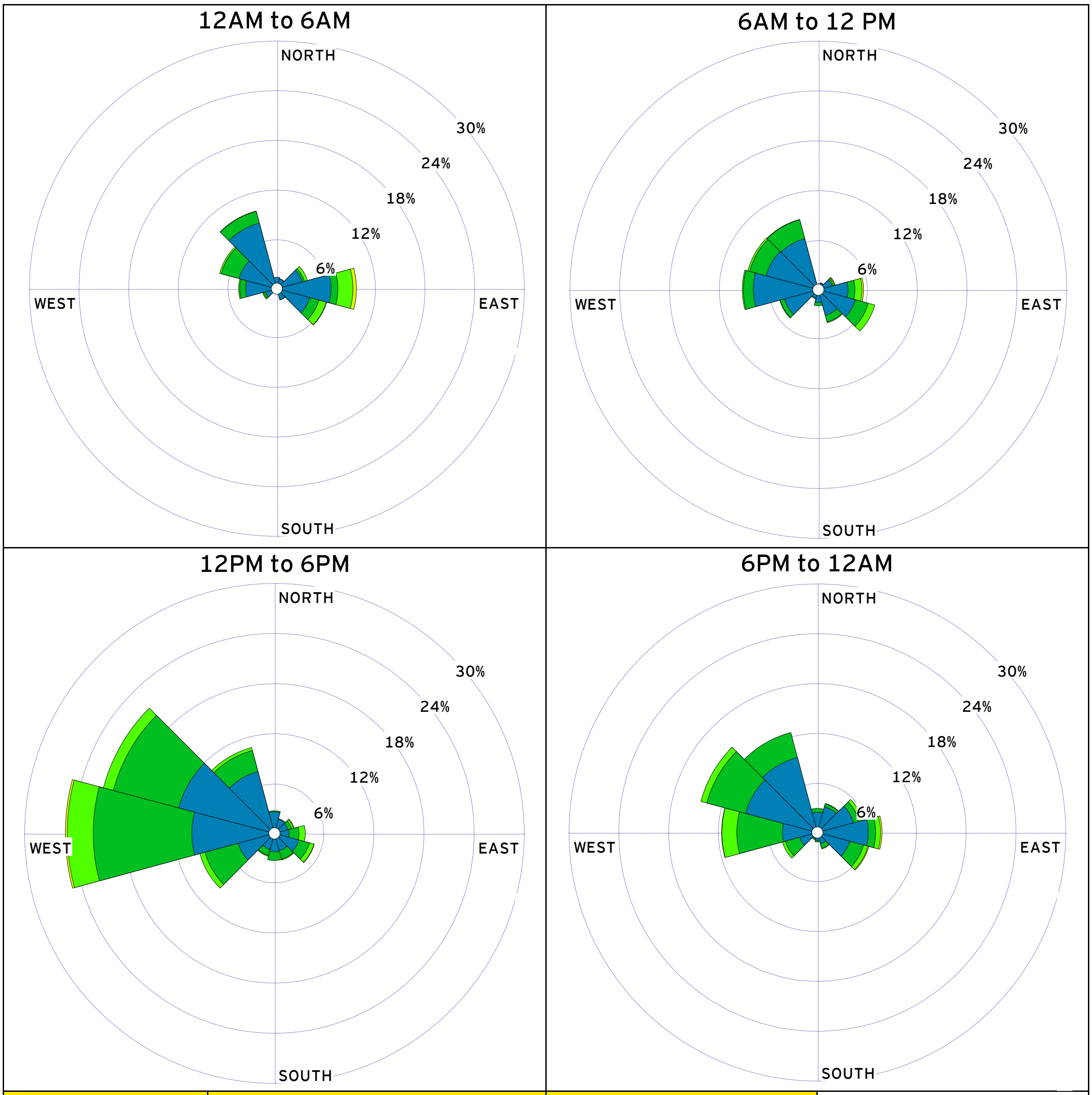
WIND SPEED
(m/s)
🟥 >= 11.10
🟧 8.80 - 11.10
🟨 5.70 - 8.80
🟩 3.60 - 5.70
🟩 2.10 - 3.60
🟦 0.50 - 2.10

Figure 6: Time of Day Wind Roses – 2/5 Dam



Season	Average Wind Speed (m/s)	Calm Winds (%)
12AM to 6AM	0.5	48
6AM to 12PM	0.6	39
12PM to 6PM	1.8	7.5
6PM to 12AM	1.1	26

Figure 7: Time of Day Wind Roses – Bobadil



Season	Average Wind Speed (m/s)	Calm Winds (%)
12AM to 6AM	0.8	51
6AM to 12PM	0.8	44
12PM to 6PM	1.9	8.0
6PM to 12AM	1.3	26

WIND SPEED
(m/s)

🟥 >= 11.10
🟧 8.80 - 11.10
🟨 5.70 - 8.80
🟩 3.60 - 5.70
🟩 2.10 - 3.60
🟦 0.50 - 2.10

Figure 8: Time of Day Wind Roses – Carpark

3.3 Temperature

The mean, maximum and minimum monthly temperatures at the three weather stations are presented in Figure 9 to Figure 11. These figures show that the Rosebery Mine site experiences a cool climate with the warmest mean temperatures occurring in January 2023 (~18 °C) and the coolest mean temperatures occurring in July 2022 (~ 6°C). The maximum temperatures occurred in December 2022 (~35 °C) with the minimum temperatures occurring in July 2022 (~-2 °C).

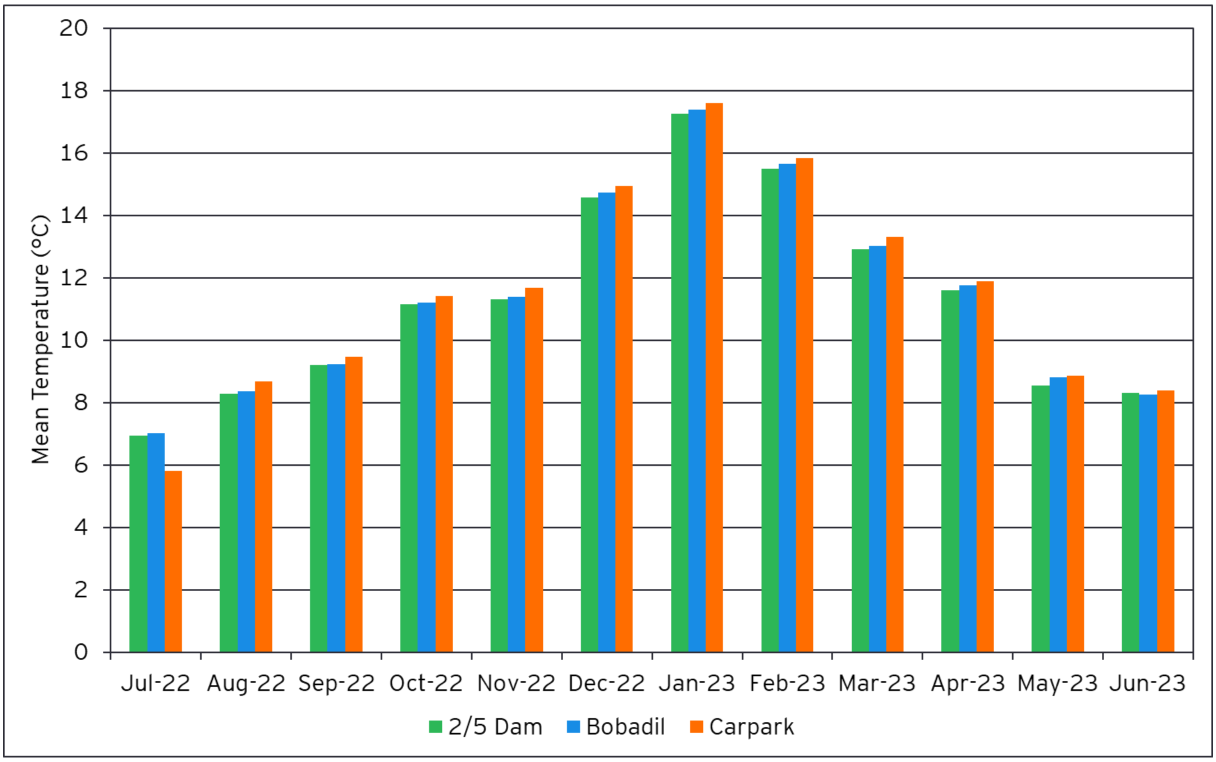


Figure 9: Mean Monthly Temperatures at All Stations

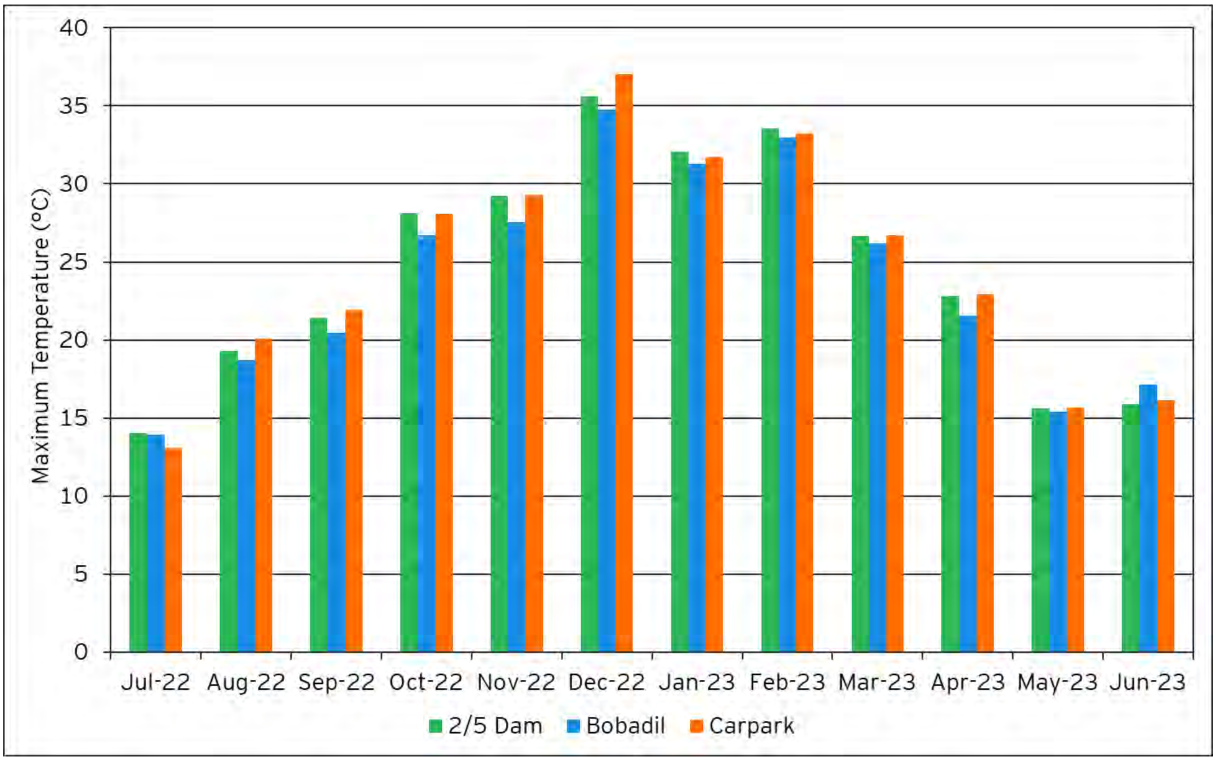


Figure 10: Maximum Monthly Temperatures at All Stations

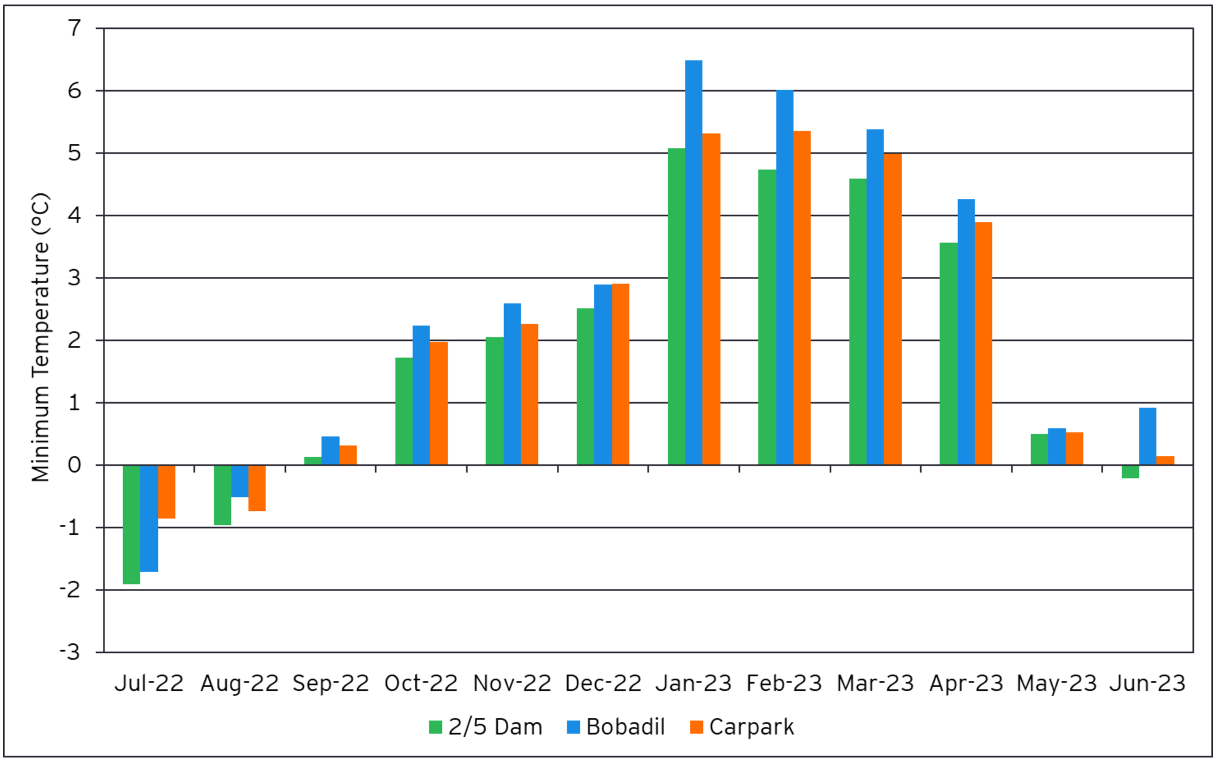


Figure 11: Minimum Monthly Temperatures at All Stations

3.4 Relative Humidity

The mean relative humidity at the three weather stations are presented in Figure 12. Humidity was highest in winter months (>85%) and lowest during the spring and summer months (~70%).

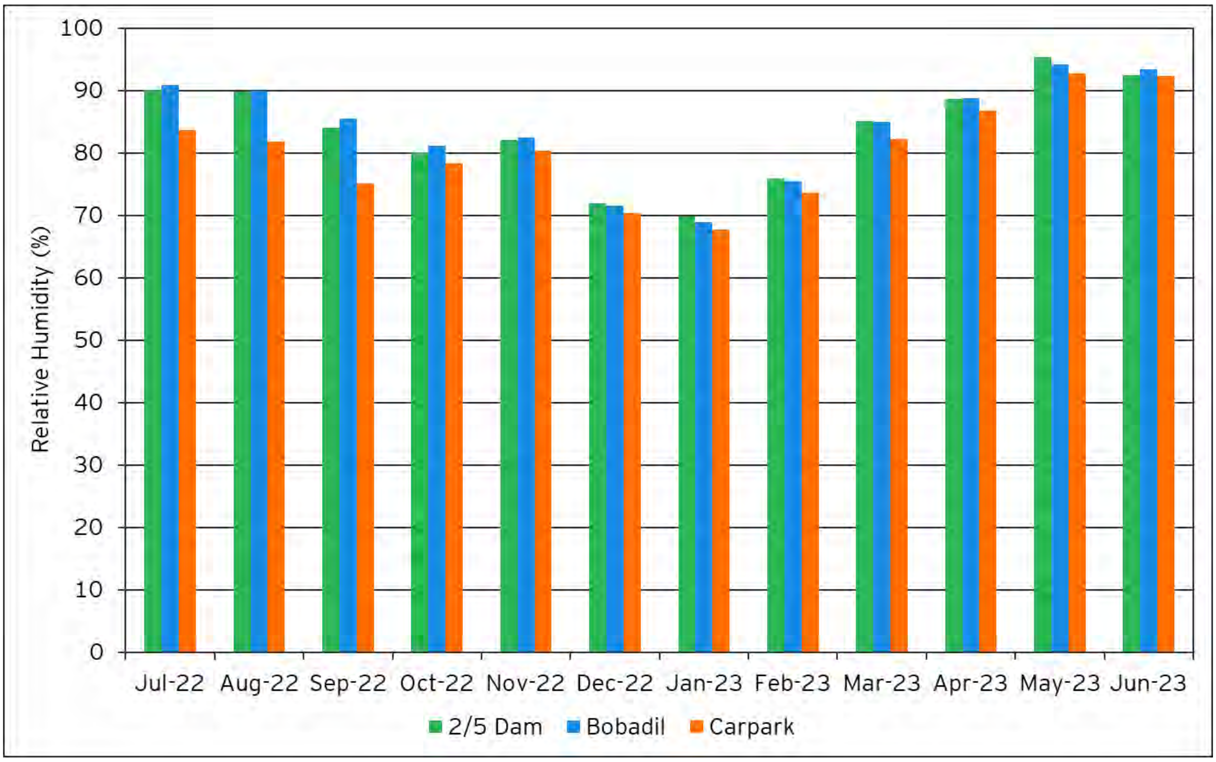


Figure 12: Mean Monthly Relative Humidity at All Stations

3.5 Rainfall

The total monthly rainfall at all stations is presented in Figure 13. This figure shows the Rosebery mine site experienced a wet winter with less rainfall observed in the summer months. The highest rainfall was observed for all stations in May 2023. The lowest rainfall was observed for all stations in January 2023. The trend of lower rainfall during July 2022 was also observed at the Bureau of Meteorology Rosebery weather station[5]. Rainfall was generally higher at the 2/5 Dam station for FY23 compared to the other two stations, which was also observed in FY21. FY23 experienced more annual rainfall compared with the FY22 annual meteorological report.

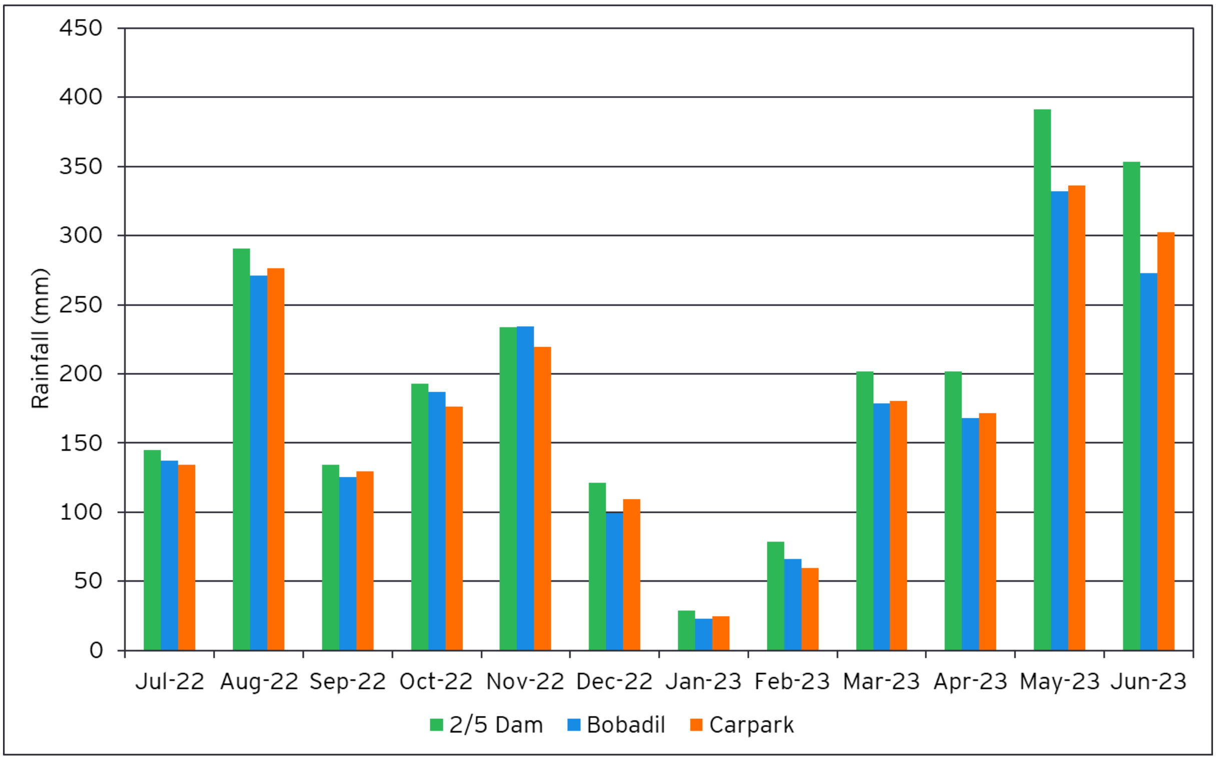


Figure 13: Total Monthly Rainfall at All Stations

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[5] Bureau of Meteorology – Daily Rainfall – Rosebery (Clemons Street) - http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2022&p_c=-1885477699&p_stn_num=097093

4. Meteorological Summary

A summary of the meteorological parameters for the FY23 period for all stations are provided in Table 2.

The meteorological report for FY23 shows that westerly winds dominate during the afternoon hours at Rosebery Mine, particularly at the 2/5 Dam and Carpark stations. The high percentage of calm conditions and low wind speeds observed at all locations are likely due to the surrounding terrain that modifies the prevailing westerly winds and shelters the Rosebery mine site. Temperature, relative humidity and rainfall data for FY23 indicated that the mine experiences a cool, wet and humid climate with wetter winter and autumn months and drier summers.

Table 2: FY22 Meteorological Data Summary

Station	Mean air temperature (°C)	Maximum air temperature (°C)	Minimum air temperature (°C)	Average wind speed (m/s)	Average relative humidity (%)	Total Rainfall (mm)
2/5 Dam	11.3	35.6	-1.9	1.33	84	2,373
Bobadil	11.4	34.8	-1.7	1.10	84	2,096
Carpark	12.1	37.0	-0.86	1.25	80	2,112
Average	11.6	35.8	-1.5	1.23	83	2,194

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Appendix E MMG Rosebery Annual Water Quality Monitoring Review 2022-2023 (Koehnken, 2022) – Including surface water and groundwater monitoring results and review for 3 Level Waste Rock Dump

MMG Rosebery Annual Water Quality Monitoring Review 2022-2023

FINAL

15 September 2023

A Report to MMG Rosebery

Lois Koehnken

💧💧💧*Technical Advice on Water*💧💧💧

DOCUMENT TYPE:	Report	
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DISTRIBUTED TO:	Adam Pandelis, MMG Michael Crawford, MMG Danielle Zanetto, MMG	Electronic .doc

Contents

1 Introduction

The following tables and graphs summarise water quality results from MMG Rosebery for the monitoring period 1 July 2022 to 30 June 2023. Table 1 summarises chemical parameter names and acronyms used in the description of water quality results.

Table 1-1. Summary of terms and water quality parameter names.

Name	Description/Definition
2/5	Redeveloped 2 and 5 Tailings Storage Facility (TSF)
Al	Aluminium
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
BO	Bobadil Outfall monitoring point (licenced discharge point for MMG)
BTEX	Volatile organic compounds: benzene, toluene, ethylbenzene, and xylene
Cd	Cadmium
Cu	Copper
CN	Cyanide
DO	Dissolved Oxygen – measured in either mg/l or percent saturation (%Sat)
EC	Electrical conductivity, measured in the units µS/cm
ETP	Effluent Treatment Plant
EPA	Environment Protection Authority Tasmania
Fe	Iron
GB	Groundwater bore
Mn	Manganese
NATA	National Association of Testing Authorities (Australia)
Pb	Lead
pH	Measure of concentration of hydrogen ions in water
T	Temperature
TN	Total nitrogen
TP	Total phosphorus
TPH	Total Petroleum Hydrocarbons
TSF	Tailings Storage Facility
TSS	Total suspended solids
WAD-CN	Weak acid dissociable cyanide - the component of cyanide that is most biologically available and reactive
WRD	Waste Rock Dump
Zn	Zinc

1.1 Changes to water management since EPN 7153/3 was issued

The MMG Rosebery site, including the decommissioned Hercules site, operates under EPN 7153/3 which was issued in October 2011. Since that time, substantial changes to water management at MMG Rosebery have occurred, including re-development of the 2/5 Dam TSF which is now the primary site for tailings disposal. Water quality monitoring at the 2/5 Dam TSF is governed by a revised water quality monitoring plan that was initially approved in 2018 and revised and subsequently approved in July 2021.

In the 2022 – 2023 monitoring year, similar volumes of tailings were discharged to the 2/5 Dam TSF and Bobadil. The process water, seepage return water and any additional water required for tailings conveyance to the 2/5 Dam TSF is returned to the ETP for lime-dosing and discharge to Lake Pieman via the Bobadil TSF. Stormwater runoff and mine water continue to be collected, treated at the ETP, and discharged via the Bobadil TSF, along with tailings. The licenced discharge point, Bobadil Outfall (BO) remains unchanged.

1.2 Note on presentation of results

The MMG 2022-2023 monitoring results are presented in a range of graphical formats, including boxplots. Where the recent monitoring results are being compared to the EPN discharge limits at BO, or to long-term historic results such as storm water monitoring, boxplots encompassing the 5th to 95th percentile values are used. Where monitoring results are presented to summarise recent monitoring results at sites without discharge limits or show long-term trends, boxplots encompassing the 25th to 75th percentile values are used to provide more detail of the distribution of results.

2 Environmental incidents in the July 2022 to June 2023 monitoring year

One environmental incident occurred on the MMG Rosebery site that was reported to the EPA.

2.1 Turbidity in Stitt River

On 7 July 2022, MMG Rosebery notified the EPA via email regarding the discharge of turbid water from the emergency spillway and northern wall of the 2/5 Dam TSF embankment into the Stitt River. The event was caused by 37 mm of rain falling in the previous two days mobilising sediment from construction areas around the 2/5 Dam TSF (Figure 2-1). The company reported that the runoff was observed late in the afternoon with additional controls to reduce sediment runoff implemented the next morning. Management measures included the construction of additional silt fences and 'eco logs', and the positioning of pumps that can be used to transfer turbid water back to the TSF if required (Figure 2-2). The company also implemented a sediment control review at the site and conducted an audit of contractors HSE policies.

Figure 2-1. Photos of the Stitt River during the turbidity event and short-term immediate measures to reduce sediment discharge to the river.

Figure 2-2. Implementation of improved sediment retention infrastructure following discharge of turbid water to the Stitt River (left), and use of pumps to transfer turbid water to the TSF (right).

3 Bobadil Tailings Storage Facility Discharge

Treated water and tailings from the ETP are discharged to the Bobadil TSF via a gravity flume system. Within the TSF, water drains into the Decant Ponds, and is directed to the Polishing Ponds via the Decant Channel (Figure 3-1). The water flows through the Polishing Ponds before being discharged to Lake Pieman via the licenced discharge point, Bobadil Outfall (BO). A summary of the monitoring results collected during the 2022-2023 monitoring period at BO is contained in Table 3-1.

Figure 3-1. Bobadil TSF showing the main dam, Decant Ponds, decant line, Polishing Ponds, and the licenced discharge point from the Polishing Pond (BO).

Table 3-1. Bobadil tailings discharge monitoring results during the 2022-2023 monitoring period.

Requirement	Findings
Monitoring Frequency	Continuous, weekly, and monthly parameters were monitored as per requirements in the EPN with the following exceptions (notwithstanding contradictions in EPN, e.g., nutrients listed as both weekly and monthly): • Results for continuous pH and EC measurements are missing between 27 Dec 2022 at 3:15 pm and 30 Dec 2022 at 9:30 am. • Temperature is not recorded at BO on a continuous basis, but weekly results are collected. • All parameters required to be monitored on a weekly or monthly basis were determined, with some parameters monitored more frequently than required in the EPN.
Compliance with EPN discharge limits	• Rainfall during the 2022-2023 monitoring year was highly variable, with some months falling well below long term averages, and other greatly exceeding average values (Figure 3-2). The summer months (Dec to Feb) were all dry and resulted in low flows at BO. Overall, the rainfall total at Bobadil was 2,110 mm, which is within 10% of the long-term average of 2,224 mm (1911 – 2018 at Renison Bell, Tasmania, Figure 3-2). • Moderate flow was recorded at BO during the year, with maximum discharges of ~0.38 m3/s, and average flows of 0.20 m^3/s. This is considerably lower than previous years. An investigation by Entura confirmed the accuracy of the flow rates for 2022-23, and found that flow rates recorded during previous years were likely over estimated due to the accumulation of debris in the discharge channel that affected the water level at the gauging station. • The continuous and field pH levels remained well above discharge limits in the TSF, with lab results consistently one or more pH units lower than recorded in situ (Figure 3-3). This decline post sampling does not affect metal concentrations as the metals have already been removed and captured in the TSF. • At Bobadil, the low summer discharge did not result in EC or sulphate values above EPN limits, as has previously occurred (Figure 3-4, Figure 3-5).
Comparison with EPN investigation trigger levels	The 95th percentile values of the samples collected between 1 July 2022 to 30 June 2023 were below the 95th percentile investigative triggers for all parameters except total nitrogen which had a 95th percentile value of 5.6 mg/l compared to the investigative limit of 5.5 mg/l (Figure 3-6). In August 2022 MMG completed an investigation into the sources of nitrogen in the discharge and concluded that nitrogen is derived from explosives and the lime used in the neutralisation plant. Quarrying associated with construction at the 2/5 Dam TSF required explosive use above normal mining operations and was suggested as a potential contributor to the TN levels. The 95th percentile value of 5.6 mg/l would pose a low risk to the receiving environment given the overall low concentration, the short duration of the elevated values and the rapid mixing that occurs within the receiving environment.

Significant trends - reporting period	• Metal retention in the TSF is high due to the good pH control, resulting in low metal concentrations in the discharge from BO over the monitoring year (Figure 3-7). Mercury and TPH were below the LoR for all monitoring periods.
Significant trends - longer period	• Zinc concentrations remain within historic ranges (Figure 3-8, Figure 3-9). The median value for the present monitoring year was 0.029 mg/L, compared to 0.015 during the previous year. The likely reason for the higher concentrations is the lower flows from Bobadil during the year due to increased water recycling at the site resulting in a decrease in the volume of clean water introduced into the process. Median sulphate levels were lower than any previous year, which may be due to the low rainfall in the area reducing the volume of mine water and stormwater reporting to the ETP.
Comment	The monitoring requirements at BO should be revised to reflect the present water management system, and the lack of sewage entering the 2/5 Dam TSF. Parameters that should be reviewed with the aim of eliminating or reducing the frequency of monitoring include Faecal Coliform / Thermotolerant coliforms, total nutrients (which are listed on both the weekly and monthly monitoring schedule) mercury (which isn't listed in the monitoring schedule but has a discharge limit) and TPH which is listed as both monthly and six-monthly. Monitoring frequency should be included in the review based on the large number of parameters that are consistently below discharge targets. The monitoring frequency of parameters that have recorded below LoR levels for multiple years should be reduced.

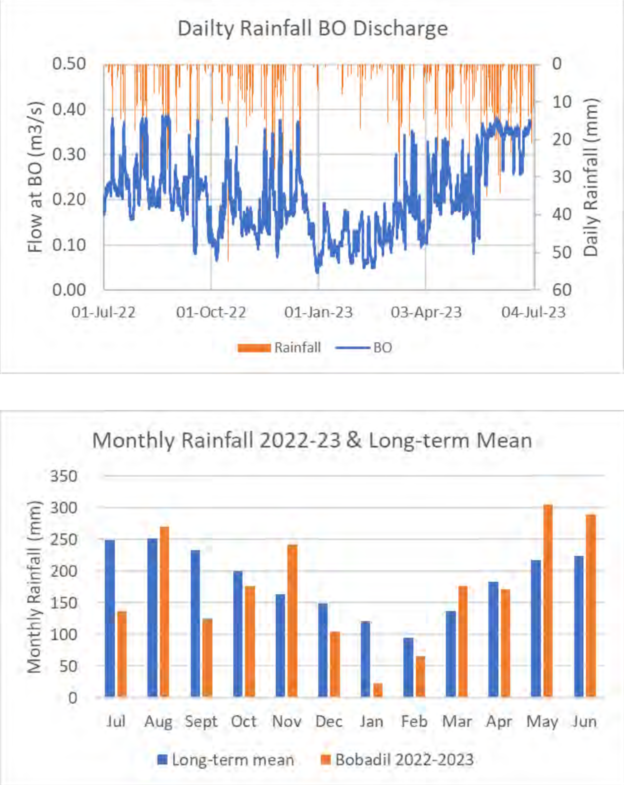

Figure 3-2. Daily rainfall at Bobadil and discharge at BO 1 July 2022 to 30 June 2023 (top), and 2022-2023 monthly rainfall at Bobadil weather station compared to long-term (1911-2018) monthly averages at Renison Bell (Renison data from BOM) (bottom).

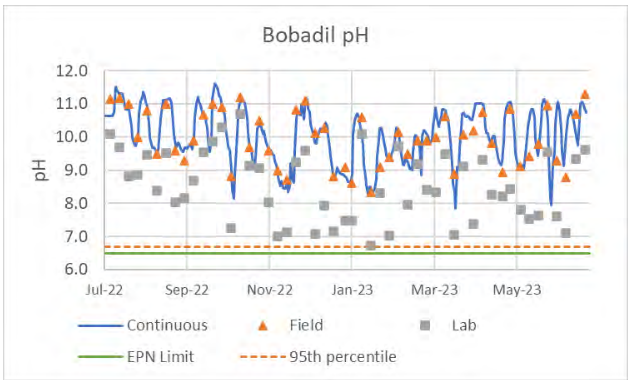

Figure 3-3. Weekly field, laboratory, and continuous pH (daily averaged) results from BO, July 2022-June 2023.

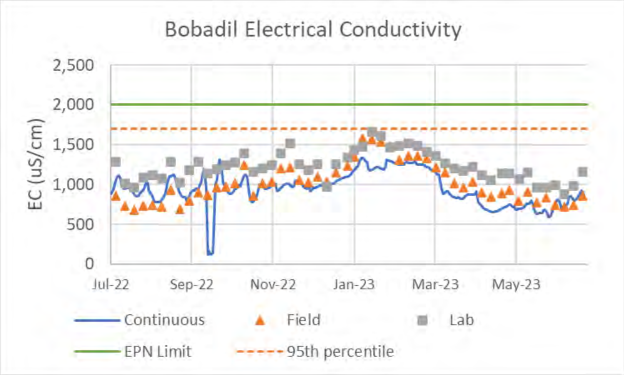

Figure 3-4. Weekly field, laboratory and continuous EC results from BO, July 2022-June 2023.

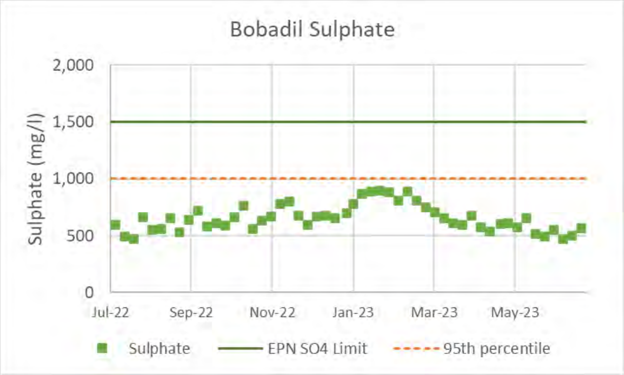

Figure 3-5. Weekly sulphate at BO from July 2022 to June 2023 with EPN discharge limits for sulphate indicated.

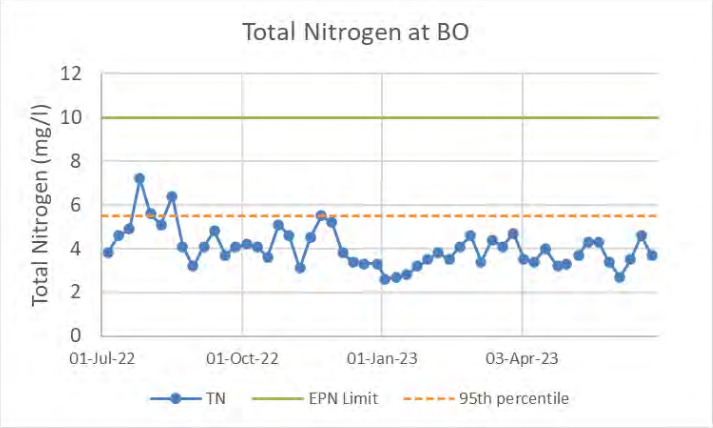

Figure 3-6. Time-series of total nitrogen at BO from 1 July 2022 to 30 June 2023.

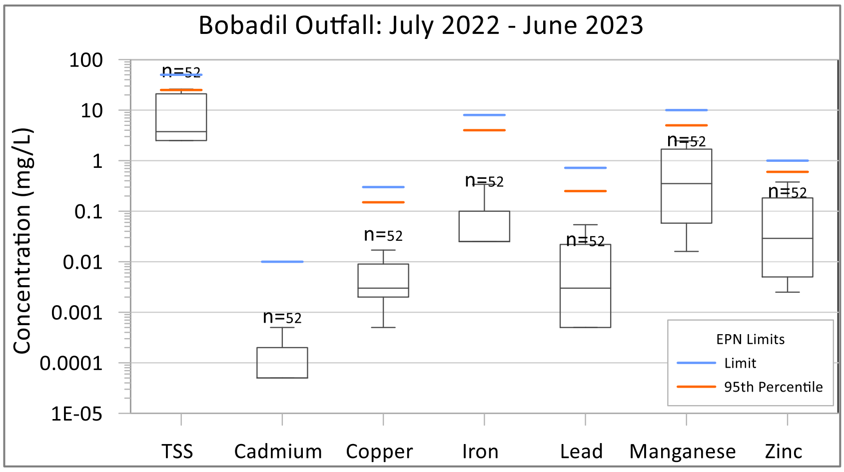

Figure 3-7. Box and whisker plot of TSS and total metal monitoring results at BO for July 2022 to June 2023 compared to EPN limits and 95th percentile trigger. The box encompasses 5th to 95th percentile values, with minimum and maximum values indicated by the whiskers.

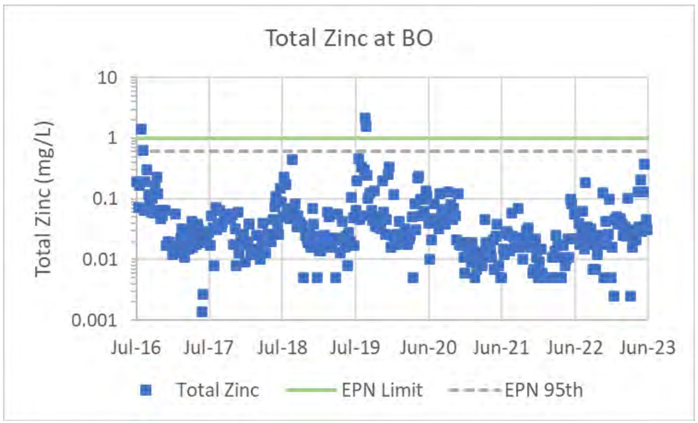

Figure 3-8. Total zinc concentrations from July 2015 to June 2023.

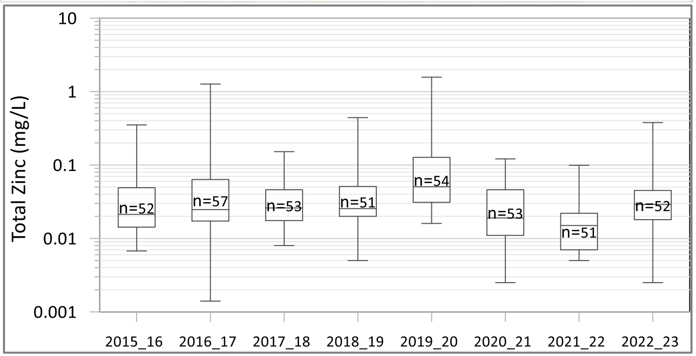

Figure 3-9. Comparison of total zinc concentrations at BO over the past 8 monitoring years (July to June). The box encompasses the 25th to 75th percentile values, and the 'whiskers' extend to the minimum and maximum values.

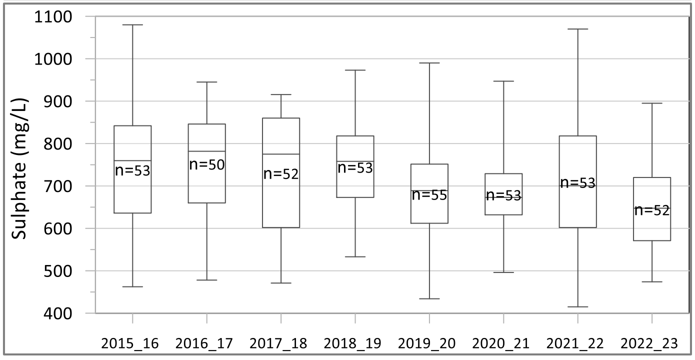

Figure 3-10. Comparison of sulphate concentrations at BO over the past 8 years. The box encompasses the 25th to 75th percentile values, and the 'whiskers' extend to the minimum and maximum values.

4 Internal Bobadil TSF Monitoring (BI and BF)

The monitoring locations for internal sites BI (Bobadil Intermediate) and BF (Bobadil Flume) are shown in Figure 4-1, and the results are summarised in Table 4-1. BF is located at the head of the flume that transports tailings and treated water to the Bobadil TSF.

Figure 4-1. Internal monitoring locations BF (head of Flume) and BI (Bobadil intermediate). The discharge point BO is also indicated.

Table 4-1. Summary of monitoring results from internal monitoring sites at Bobadil TSF for 2022-2023.

Requirement	Findings
Monitoring Frequency	At BI and BF all parameters were monitored 12 times monthly, with several parameters monitored weekly (WAD CN, Tot CN, pH, EC).
Significant trends reporting period	• pH trends are similar to previous years with pH declining between BF, BI and BO, with the largest decline between BI and BO as the water moves through the polishing pond (Figure 4-2). • Sulphate concentrations at the sites showed seasonality, with higher concentrations in the summer months due to lower inflows. Median values increased by about 17% (551 mg/L to 648 mg/L) between BI and BO, recognising the difference in sample numbers. The increase is likely attributable to seepage input to the Polishing Pond from the main TSF (Figure 4-3). • TSS results at BF were variable, depending on whether tailings were being discharged to Bobadil or the 2/5 Dam TSF. TSS at BI was < 40 mg/l on all monitoring dates demonstrating a high retention of solids in the main TSF (Figure 4-4).
Comment	The monthly results from BF and BI are not used for day-to-day management of the site but are useful for identifying potential changes following the reduction in tailings deposition. To date Bobadil

	continues to retain solids and metals even with the reduction in tailings input.

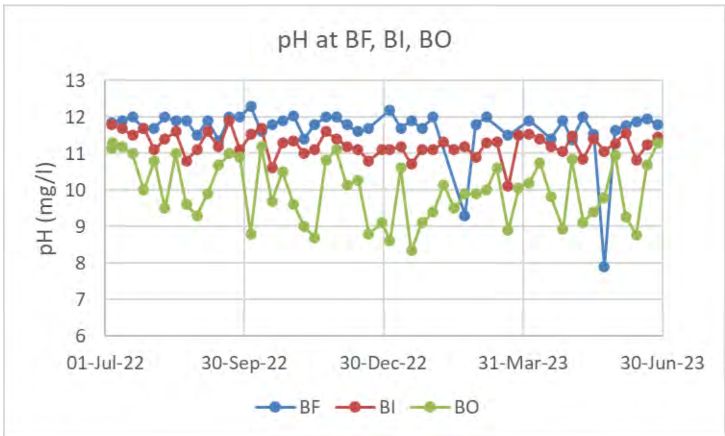

Figure 4-2 Comparison of Field pH at BF, BI and BO for July 2022-June 2023.

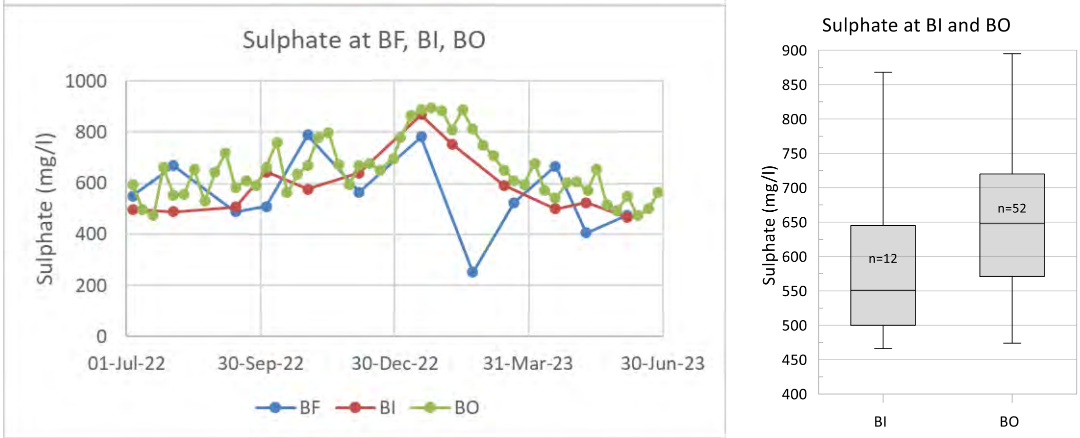

Figure 4-3. (left) Time series of sulphate at BF, BI and BO July 2022-June 2023 (right) box and whisker plots comparing concentrations at BI and BO. Boxes contain the 25th to 75th percentile values, with the minimum and maximum indicated by the 'whiskers.

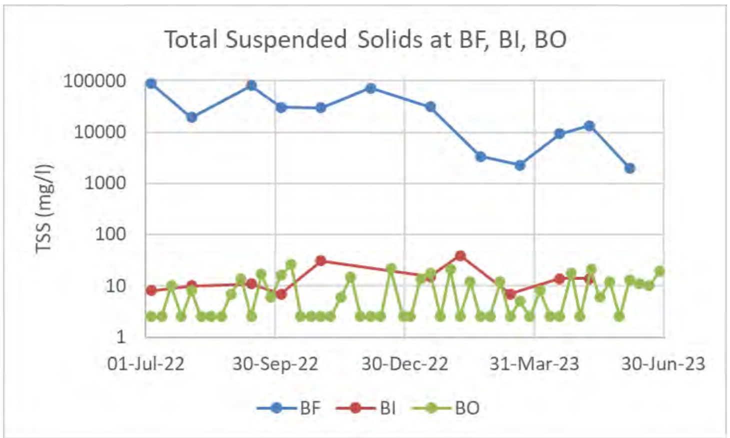

Figure 4-4. TSS at BF, BI and BO July 2022 – June 2023. Values reported as below the LoR of 5 mg/L are shown as 2.5 mg/L.

5 Bobadil TSF Seeps

EPN 7153/3 includes a requirement to monitor seepage from the Bobadil TSF based on observations of seepage flows at the time the EPN was issued in 2011. The intention of seepage monitoring is to understand diffuse inputs to the environment from the TSF. Since that time, several lifts of the dam wall have been completed, and the sub-surface hydrology of the site has altered, as evidenced by the lack of flow in several historic seepage points. Other seeps have been eliminated by expansion of the TSF. The seeps that are monitored are shown in Figure 5-1 with a summary of the monitoring results contained in Table 5-1.

Figure 5-1. Seepage monitoring locations at Bobadil TSF.

Table 5-1. Summary of monitoring results from Bobadil TSF seeps in 2022 – 2023 monitoring year.

Requirement	Findings
Monitoring Frequency	Quarterly monitoring was completed as required. Samples were not collected at site BD1 in September or December 2022 due to a lack of flow at the site. Seeps in addition to those listed in the EPN are monitored.
Compliance with EPN	All parameters were determined on the collected samples as required. Flow was not recorded at BD1 or BD2 on any occasion due to no flow occurring at the sites.
Significant trends - reporting period	• Overall, the water quality results are similar to previous years. • Seeps BD3 and BD5 continue to have pH in the range of 6 to 8 with pH in BD1 and BD2 ranging between 4 and 5 (Figure 5-2). • Total zinc values in BD1 and BD2 continue to be elevated as compared to seeps BD3 and BD5 (Figure 5-3), with a maximum zinc concentration of 3.7 mg/L in the monitoring year. • Lead results continue to show variability within the historic range of results (Figure 5-4). • Sulphate concentrations in BD3 and BD5 ranged from 530 mg/l to 700 mg/l, which is in the range of the discharge from Bobadil (range = 500 – 900 mg/l). Concentrations in seep BD2 continue to be considerably lower, <60 mg/L, suggesting the seep receives clean catchment inflow as well as seepage from the TSF. Sulphate in BD1 is variable and intermediate between the other seeps. • BD5 contains elevated iron (8-10 mg/l) and manganese (~7 mg/l) and low DO (<4 mg/l), indicative of a groundwater fed source. The DO in the

	other seeps is generally >6.5 mg/l, suggesting the water has been in recent contact with the atmosphere. • Zinc fluxes at BD3 ranged from <0.1 to 1.0 g/day (n=4), and at BD5 from <0.1 to1.4 g/day (n=4). Sulphate fluxes from the same sites ranged from 2 to 69 kg/day at BD3, and from 1 to 57 kg/day at BD5.
Comments	• The Closure PFS being conducted by MMG includes monthly monitoring of all TSF seepage points (n≅20) with most seeps reporting to the Polishing Pond. These results should be used to redesign the seepage monitoring program to target active seeps entering the environment.

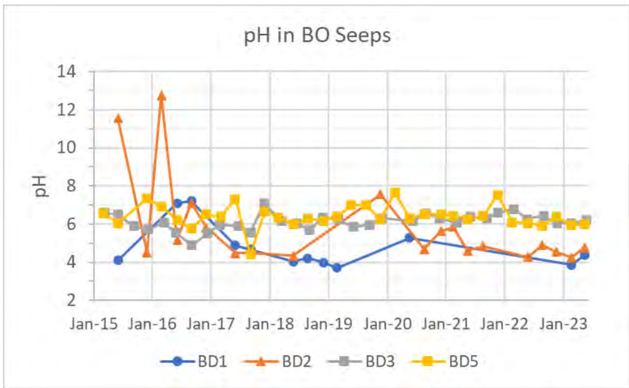

Figure 5-2. pH results from Bobadil seeps, June 2015 to June 2023.

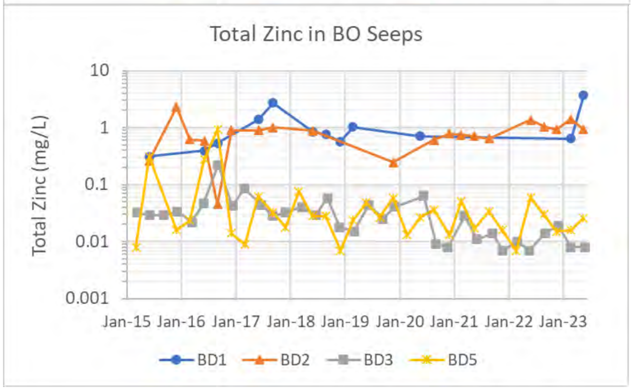

Figure 5-3. Total zinc results from Bobadil seeps, June 2015 to June 2023. Note log scale.

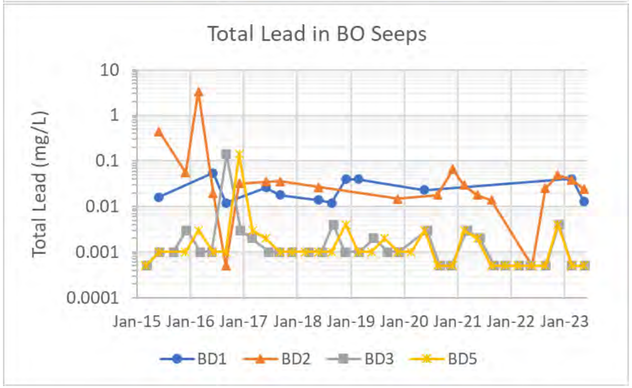

Figure 5-4 Total lead results from Bobadil seeps, June 2015 to June 2023. Note log scale.

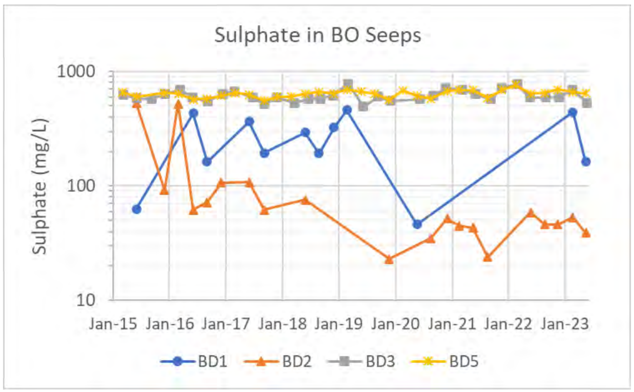

Figure 5-5 Sulphate concentrations in the Bobadil seeps June 2015 to June 2023. Note log scale.

6 Bobadil TSF Groundwater Monitoring

The location of groundwater monitoring bores near the Bobadil TSF is shown in Figure 6-1, and a summary of groundwater monitoring results is contained in Table 6-1.

Figure 6-1. Location of groundwater monitoring bores near the Bobadil TSF.

Table 6-1. Summary of the 2022-2023 monitoring results from the groundwater bores located near Bobadil TSF.

Requirement	Findings
Monitoring Frequency	• Monitoring of bores GB4, GB6 (D&S), GB7 (D&S), and GB8 (D&S) was completed in October 2022 and April 2023. At GB7 (D&S), field parameters were recorded on both monitoring occasions, but a water sample was only able to be collected in April 2023. • Bore GB5 does not exist due to expansion of the TSF facility. • Bore GB9 was decommissioned in September 2020 following approval from the EPA to discontinue monitoring at the site due to sampling difficulties.
Compliance with EPN	All parameters were determined on acquired samples as specified in the EPN
Significant trends - reporting period	• The results are consistent with previous monitoring. The deeper bores (GB6D, GB7D, GB8D and GB9) tend to have higher pH and higher concentrations of alkalinity (Figure 6-2, Figure 6-3). This may reflect limited impact from seepage from the TSF entering the deeper aquafers. • The shallow bores (GB4, GB6S, 7S, and 8S) generally have higher concentrations of zinc, manganese and sulphate as compared to the deeper bores, consistent with the TSF being a source to these bores (Figure 6-4 to Figure 6-6). • Bore GB7S, located between the northern extent of the dam and Lake Pieman continues to record the highest total zinc levels. The deep water in the bore (GB7D) contains comparatively low levels of zinc and sulphate. • In April 2023, manganese and sulphate levels were higher than previously recorded in bore GB8S, but in GB8D, concentrations

	remained low and consistent with previous results. GB8 is located adjacent to the Polishing Pond and may be receiving seepage. - The results continue to support a conceptual model of the shallow aquifer, composed of glacial till, being hydraulically connected to the dam, with elevated zinc, manganese and sulphate derived from the TSF seepage. The deeper groundwater system appears to be largely isolated from TSF impacts.
Other comments	The groundwater monitoring results should be interpreted in the context of the groundwater model being developed as part of the MMG Closure PFS, when it is available.

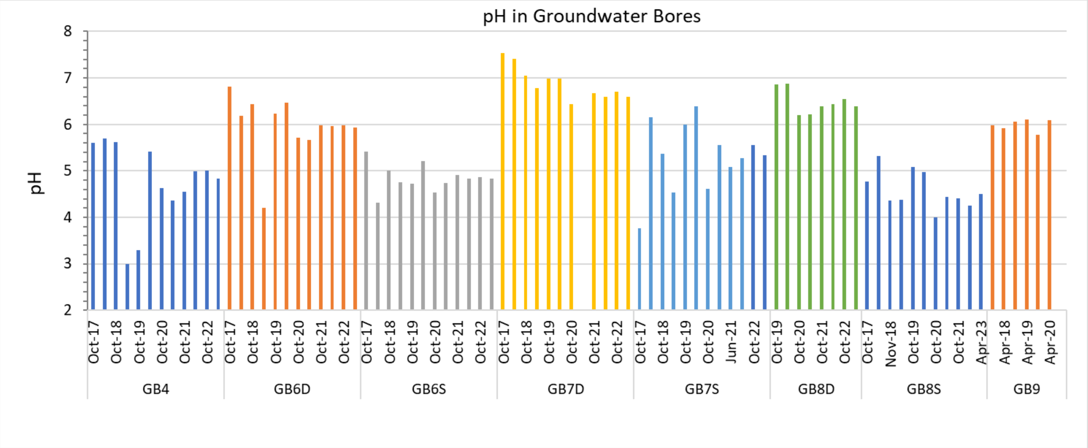

Figure 6-2. pH in groundwater samples collected near Bobadil TSF 2017 – April 2023.

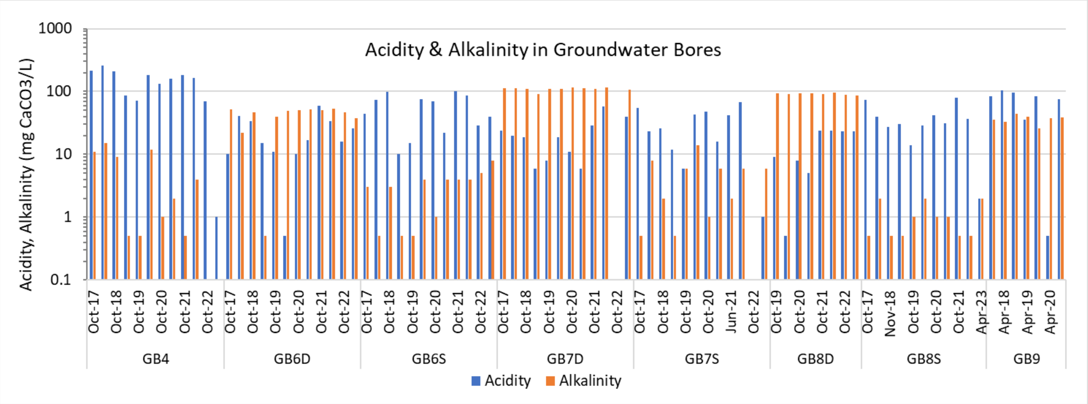

Figure 6-3. Alkalinity and acidity in groundwater samples collected near Bobadil TSF, 2017- April 2023.

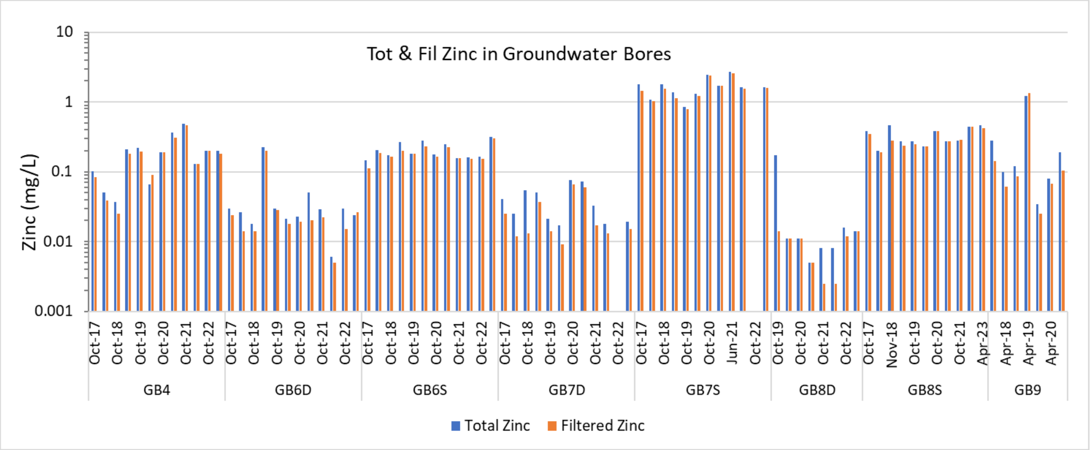

Figure 6-4. Total and filtered zinc results from groundwater samples collected near Bobadil TSF, 2017- April 2023.

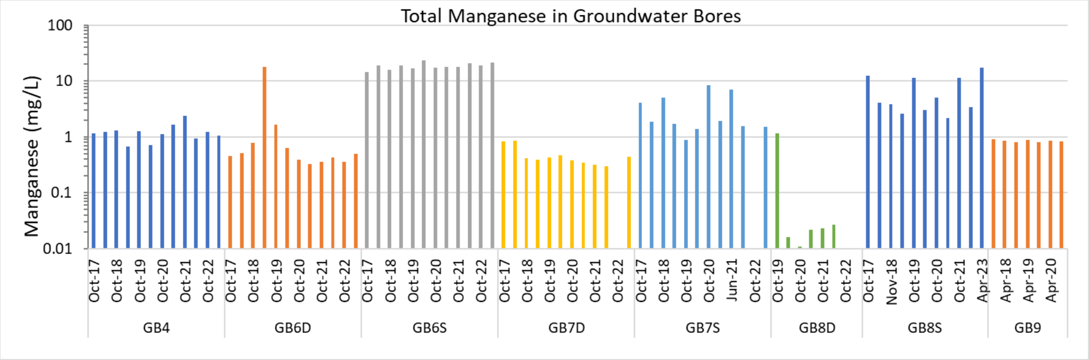

Figure 6-5. Manganese results from groundwater samples collected near Bobadil TSF 2017 –April 2023.

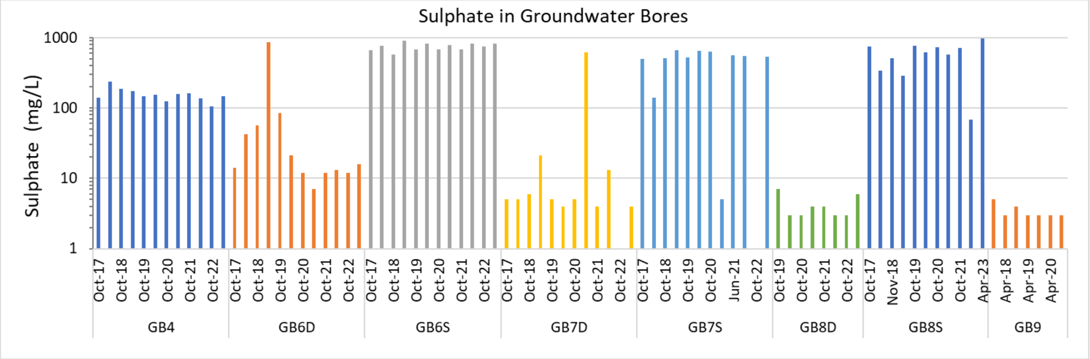

Figure 6-6. Sulphate results from groundwater samples collected near Bobadil TSF 2017 – April 2023.

7 2/5 Dam TSF Monitoring Results

The redevelopment of the 2/5 Dam TSF required a revision to the water quality monitoring regime listed in EPN 7153/3. The monitoring strategy has been amended twice, once in February 2018 and most recently in July 2021 based on the Pitt & Sherry (April 2021) monitoring plan. The water quality monitoring sites related to the 2/5 Dam TSF that were sampled in July 2022 to June 2023 are listed in Table 7-1.

During the 2022 – 2023 monitoring year construction of the Stage 2 lift continued at the site. The works to extend the grout curtain along the western embankment and isolate seepage from stormwater along the Murchison Highway were finished and commissioned early in the monitoring year. This has resulted in the water quality and flow monitoring results collected at MHS2 reflecting stormwater rather than a mixture of seepage and stormwater. The seepage being collected and returned from the western embankment to the 2/5 Dam TSF is monitored at sites 'A' and 'B', which have been added to the monitoring schedule.

During the 2022 – 2023 monitoring year there was no discharge of decant water from the 2/5 Dam TSF to the Stitt River. Compliance water quality monitoring is based on the sites listed in Table 7-1 and Figure 7-2, and monitoring compliance is summarised in Table 7-2.

Table 7-1. Summary of water quality monitoring at 2/5 dam since redevelopment of the TSF as approved by the EPA in 2021.

Water	**Type of Monitoring or Location**	**Station Names in MMG Database**
Surface Water	**Grab samples**	
	Decant Return	DW01
	Clean Water Diversion upstream of TSF	CWDD01
	Seepage Collection Drain	SCD01, SCD02
	Seepage Collection Pond	SCP01
	Discharge to Stitt River*	SD
	Stitt River upstream of 2/5	WL8
	Stitt River downstream of TSF	SR02
	Stitt River upstream of Stitt Falls	SR03
	Stitt River upstream of L Pieman (downstream of Rosebery Ck)	U/S Pie
	Originally seepage from TSF emanating along Murchison Highway mixed with stormwater. Since July 2022 only stormwater reports to this site	MHS2
	Seepage from downstream TSF emanating along Murchison Highway	MHS3
Groundwater**	Pumped from groundwater bores	GB12, 13, 14S, 14D, 15, 16, 21H, 22H, 23H, 25H, 26H, 27H, 28H

***Only monitored if there is overflow from the TSF**

***Groundwater bores previously designated as GB21 – GB28 are now designated as GB21H-GB28H to avoid confusion with bores located near the 3 Level Open Cut with the same numbering.**

Figure 7-1. Tailings decant and surface water monitoring associated with the 2/5 Dam TSF. Monitoring site U/S Pie is located downstream of SR03, off the aerial photo.

Figure 7-2. Groundwater bore monitoring locations associated with the 2/5 Dam TSF.

Table 7-2. Summary of monitoring results related to discharge from the 2 and 5 Dam in 2022-2023.

Requirement	Findings
Compliance with Water Quality	Monitoring at 2/5 Dam was completed as required under the modified July 2021 Monitoring Plan with samples collected from all sites except:

Monitoring Strategy	• SD: Spillway- No water quality results were collected because no water was discharged from the 2/5 Dam TSF into the Stitt River. • Groundwater bore GB21H was decommissioned and is no longer being monitored. Parameters in addition to those listed in the monitoring strategy were reported for many of the surface water sites, and sampling occurred more frequently than required at most sites.
Significant trends during reporting period	TSF Decant water: • The behaviour of zinc in the TSF is consistent with previous results, with higher total zinc concentrations coinciding with lower pH levels (Figure 7-3). Total zinc in the TSF ranged from 0.13 mg/L to 1.4 mg/L as pH varied from 8.1 to 6.4. The elevated zinc concentrations have no impact on the environment as all return water is treated in the ETP. • Sulphate and EC (Figure 7-4) showed similar seasonal trends, with EC varying between ~350 to 730 μS/cm and sulphate between 170 to 335 mg/l. Concentrations of sulphate in the 2/5 Dam TSF are substantially lower as compared to the discharge at BO, with the higher values at BO attributable to the addition of mine water, storm water and seepage from the BO TSF. Seepage: • Seepage from the dam at site SCD01 shows a stronger response to rainfall as compared to SCD02 which is relatively constant through the year (Figure 7-5). High flows were recorded in the autumn following prolonged rainfall. • There is good agreement between the flow rates recorded at the seepage collection points and the volume pumped back to the TSF from the seepage collection pond (SCP01, Figure 7-6). The balance is a marked improvement since last year and is attributable to upgrades to flow monitoring infrastructure. • The volumetric contribution of seepage pumped back from SCP01 relative to the volume of water pumped back to the ETP from the 2/5 Dam TSF is relatively small for most of the year, although in late summer and autumn 2023 the seepage contributed up to 50% of the return flow volume (ignoring evaporation, Figure 7-7). The return flow to the ETP includes stormwater collected at MHS2. • pH values in SCD02 and the seepage collection pond (SCP01) have increased over the past several years but remain lower than results from SCD01 and DW01 (Figure 7-8). The pH in the seepage collection pond is intermediate between SCD01 and SCD02, consistent with the mixing of the seepage in the pond. • Total zinc concentrations in SCD01 follow similar trends to the DW01 results, with higher concentrations during the winter months when the pH in the TSF is lower. (Figure 7-9). • Sulphate shows similar trends, with SCD02 having the highest concentrations and SCD01 being similar to DW01. In contrast to total zinc, sulphate concentrations are highest in the summer rather than the winter (Figure 7-10). This is due to sulphate not being affected by pH, with reduced rainfall onto the TSF in summer increasing concentrations.

	• Iron concentrations at the seepage and TSF sites show similar trends as previous years, with elevated levels in SCD02 and SCP01. Total iron in the DW01 return increased during the summer and autumn of 2023 whereas the levels in the seepage did not. It is plausible the increase is associated with recycling of surface water in the TSF for dust suppression picking up fine particulates, as the dissolved iron concentrations in DW01 remained low and consistent with previous results (frequently below the LoR). • Overall, SCD02 continues to have poorer water quality as compared to SCD01. The similarity between SCD01 and DW01 suggests that water in the TSF may be the source of the SCD01 seep, whereas SCD02 is likely derived from underlying historic acid producing material. Trends in the Stitt River (Additional analysis of the Stitt River results is provided in Section 8): • pH levels in the Clean Water Diversion (CWDD01) fluctuate between pH 4.5 and 7, which likely reflects relative amounts of surface runoff and groundwater ingress. The pH levels at the sites in the Stitt generally ranged from 5.5 to 7.0 and are typically higher than at the CWDD01 site (Figure 7-12). • Total zinc at CWDD01 is consistently higher than in the Stitt at WL8, reflecting the high dilution provided by the Stitt mixing with the inflow from the cut-off drain. Total zinc at WL8 in April 2023 was 0.6 mg/l, which is the highest recorded value since at least 2018. The filtered result was similar, and the source of the zinc is unknown. • Zinc concentrations consistently increase between WL8 and the upstream Lake Pieman (U/S Pie) site. There is a moderate increase in zinc between WL8 and SR02 reflecting diffuse inputs from the TSF and the activities on the northern side of the river. Increases in zinc downstream of SR02 are attributable to stormwater, diffuse inputs from the fill underlying Stitt Park, developments on both sides of the river and inflow from Rosebery Creek (Figure 7-13). • Sulphate concentrations remain low in the Stitt River, at <20mg/L. Concentrations downstream of WL8 were higher during the dry summer months and decreased in the autumn (Figure 7-14). Groundwater: • pH results from the groundwater bores surrounding the 2/5 Dam TSF were generally below the long-term median values for both the Nov 22 and May 23 sampling runs, except in GB23H, located near the western embankment, where the November 2022 pH result was elevated relative to previously results. The reason for generally low pH values is unknown (Figure 7-15). • The total zinc results for the bores are variable, and do not show a consistent trend. Some of the variability in bores along the western and northern embankment may have been related to earthworks including the extension of the grout curtain, which likely affected groundwater flows (Figure 7-16,). • Sulphate and zinc concentrations in bore 14S were elevated in May 2022 and remained elevated in the 2022-2023 monitoring year. These increases could be related to the Stage 2 embankment lift (Figure 7-17).

	• All TPH and BTEX values were below the LoR except in bore GB12D where TPH was 0.12 mg/L on both sampling dates. The TPH consisted of the C_{16}-C_{34} component, which is the range of diesel fuel and engine oil. This bore also had detectable TPH in the 2021-2022 monitoring year. Construction activities continue to be completed at the TSF, but not in the immediate vicinity of the groundwater bore, so the source is unknown. It is possible that the TPH is derived from naturally occurring organic compounds that are detected by the general TPH screening method. More details analyses would be required to determine the source of the TPH. Murchison Highway Stormwater and Seeps (MHS2, MHS3): • The sump and pump infrastructure implemented along the western embankment of the 2/5 Dam TSF collects seepage from the dam and returns it to the TSF, resulting in the MHS2 monitoring results reflecting predominantly storm water. This has resulted in a substantial decrease in metals and sulphate recorded at MHS2 during the 2022-2023 monitoring year (Figure 7-18, Figure 7-19). The elevated pH values recorded at MHS2 are likely associated with runoff during construction of the grout curtain and seepage infrastructure. • Seepage at MHS3 is derived from the local fill around Stitt Park. Sulphate shows strong seasonality due to higher rates of infiltration in the wet months. The metal concentrations in the 2022 – 2023 monitoring results are similar to the previous year (Figure 7-20, Figure 7-21).
Recommendations	• The results of the groundwater model developed for the Closure PFS should be used to guide future groundwater monitoring at the TSF. • Field blanks and duplicates should be included in the groundwater bore monitoring regime to evaluate the potential for contamination during sampling. • The seepage collected along the western embankment is monitored by MMG. The 2/5 Monitoring Plan should be updated to include these sites. It is recommended this site is monitored on a monthly basis. • The monitoring site MHS2 should be renamed to clarify it is a stormwater site rather than a seepage site and to avoid confusion with the historic MHS2 seepage data set. It is recommended this site be monitored on a quarterly basis consistent with the other stormwater monitoring sites.

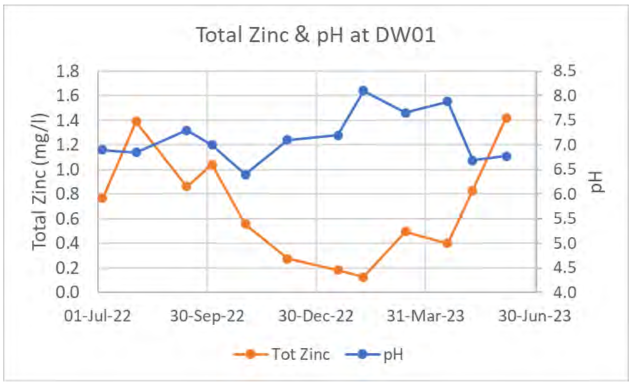

Figure 7-3. pH and total zinc in 2/5 Dam TSF decant return (DW01), July 2022 to June 2023.

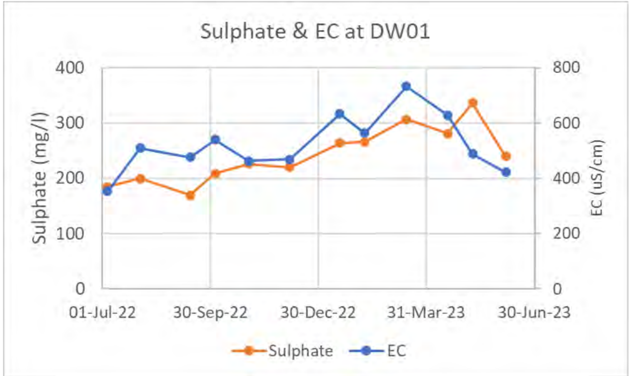

Figure 7-4. Sulphate and EC in the 2/5 Dam TSF decant return, July 2022 to June 2023.

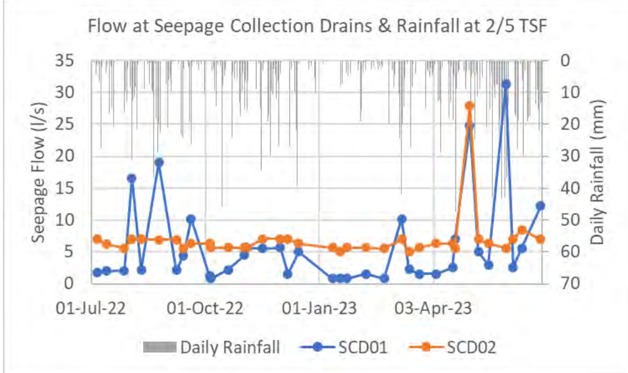

Figure 7-5. Average daily flow rates in SCD01 and SCD02 compared to daily rainfall at the 2/5 Dam TSF 1 July 2023 to 1 July 2023.

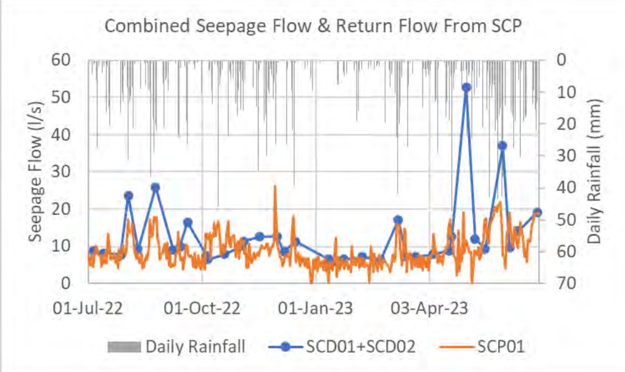

Figure 7-6. Comparison of combined flow rates in SCD01 and SCD02 with average daily return flow from SCP01 to 2/5 dam.

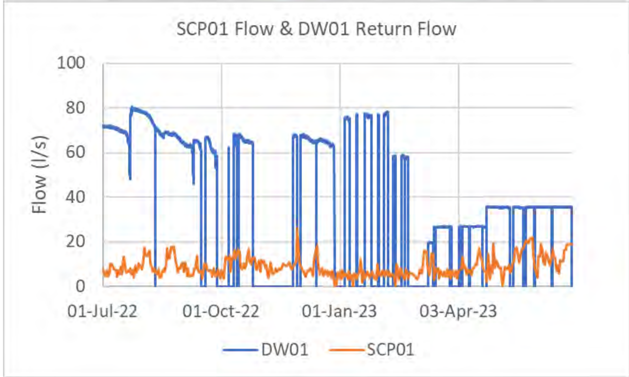

Figure 7-7. Comparison of seepage inflow to 2/5 Dam TSF and Decant return from 2/5 dam to ETP. Decant return includes stormwater from MHS2.

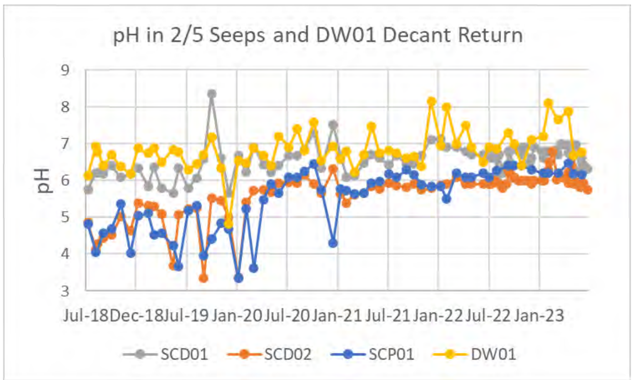

Figure 7-8. pH in 2/5 seepage drains SCD01 and SCD02 and in the seepage collection pond SCP01 July 2018 to June 2023.

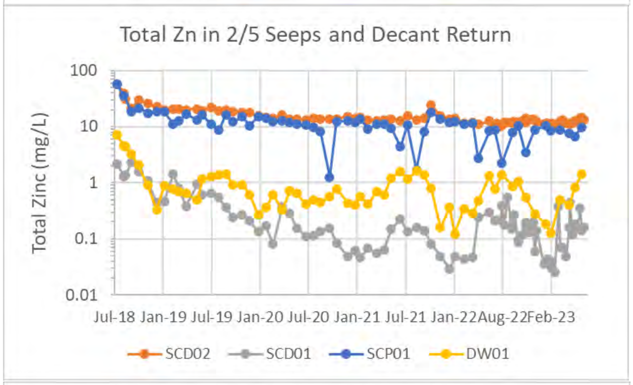

Figure 7-9. Total Zinc in 2/5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant return to ETP July 2018 to June 2023. Note log scale.

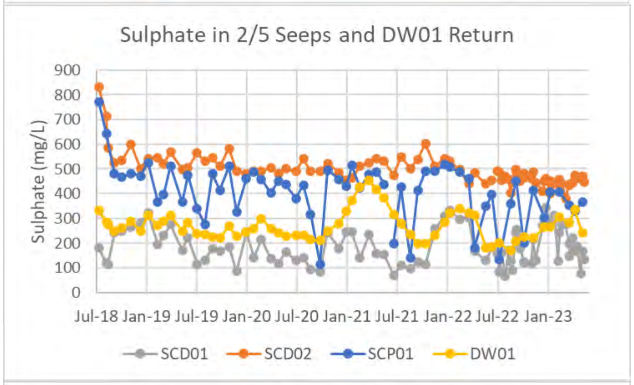

Figure 7-10. Sulphate in 2/5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant July 2018 to June 2023.

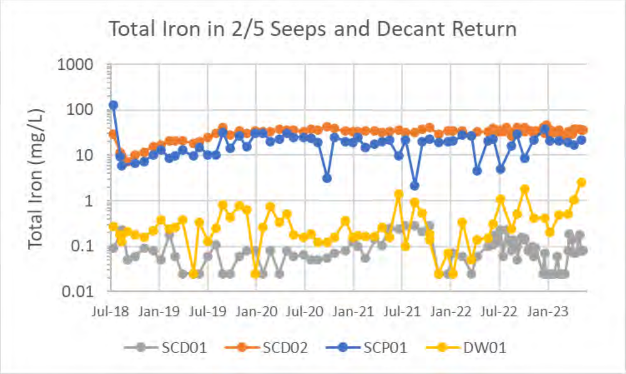

Figure 7-11. Total iron in 2/5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant July 2018 to June 2023. Note log scale.

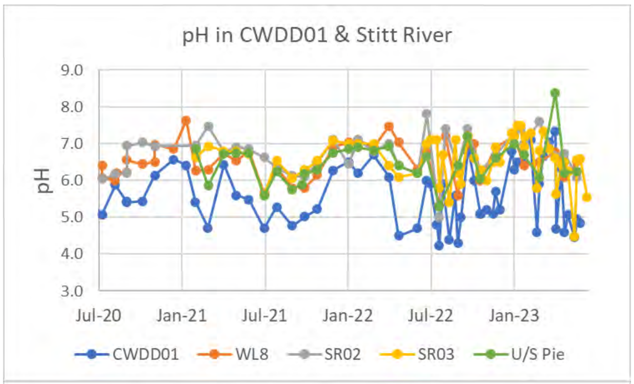

Figure 7-12. pH at Clean Water Diversion Drain and the Stitt River at WL8, SR02, SR03 and U/S Pie from July 2020 to June 2023.

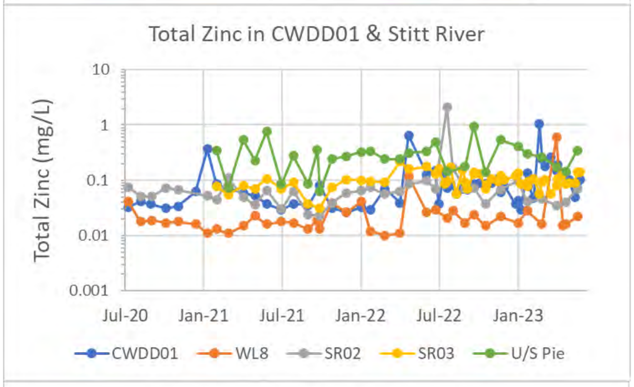

Figure 7-13. Total zinc concentration in the Clean Water Diversion Drain and the Stitt River at WL8, SR02, SR03 and U/S Pie from July 2020 to June 2023. Note log scale.

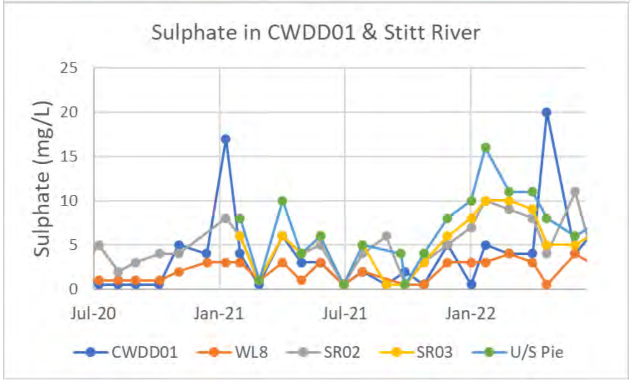

Figure 7-14. Sulphate concentrations in the Clean Water Diversion and the Stitt River at WL8, SR02, SR03 and U/S Pie from July 2020 to June 2023.

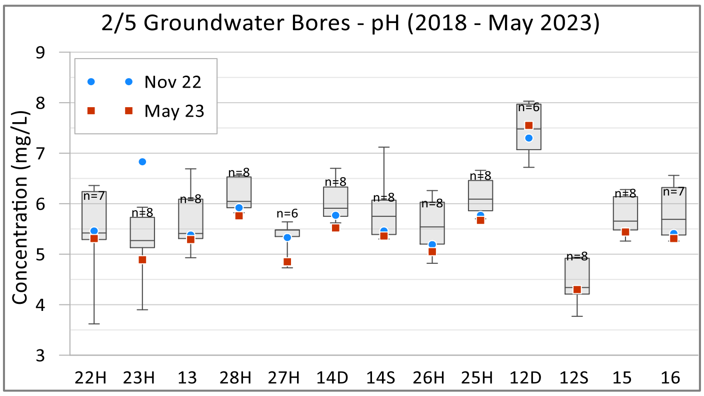

Figure 7-15. pH in the 2/5 Dam TSF ground water bores. Sites are shown in clockwise direction beginning at site GB22H, located on the southern side of the impoundment. Sites GB15 and GB16 are located east of the Stitt River. pH results from October 18 to May 2022 are summarised in the box and whisker plots (box shows the 25th to 75th percentile results, with minimum and maximum shown by the whiskers). Results collected in November 2022 and May 2023 are shown as data points.

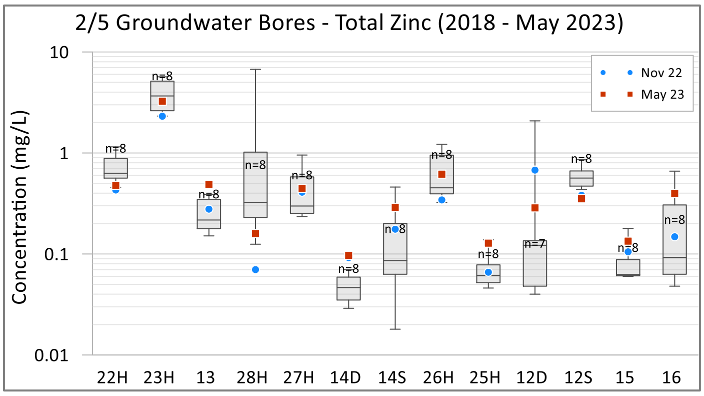

Figure 7-16. Total zinc in 2 and 5 groundwater bores.

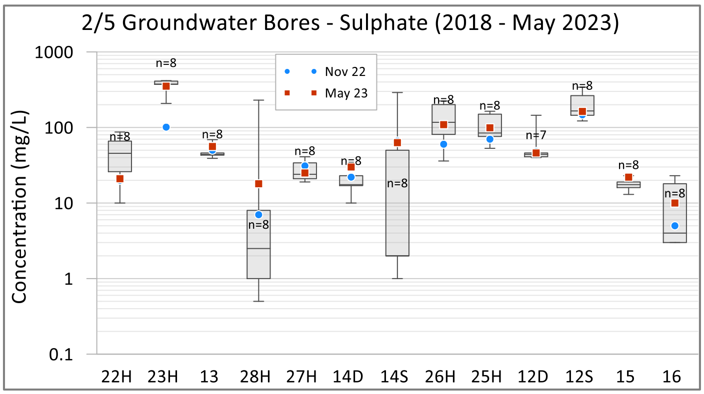

Figure 7-17. Sulphate in 2 and 5 groundwater bores. impoundment.

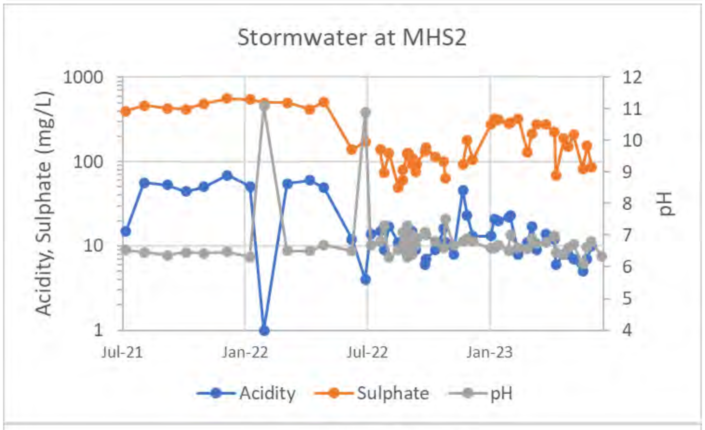

Figure 7-18. Acidity, sulphate, and pH in the MHS2 Seep, July 2021 – June 2023. Note log scale.

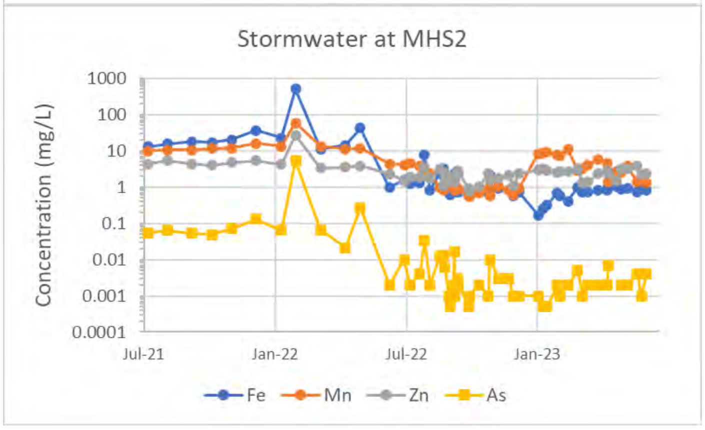

Figure 7-19. Total iron, manganese, zinc, and arsenic in the MHS2 Seep, July 2021 – June 2023. Note log scale.

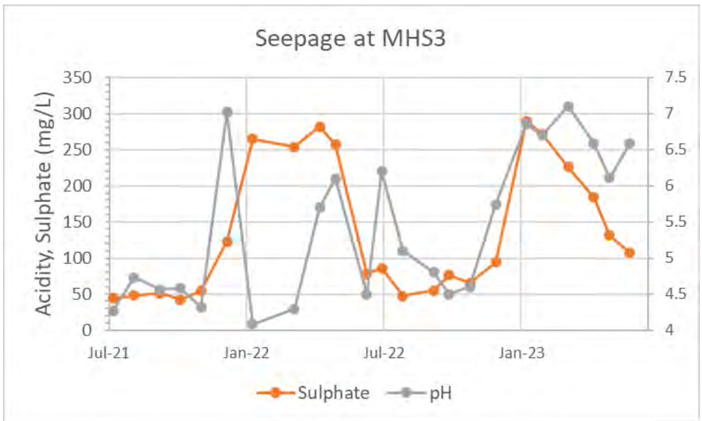

Figure 7-20. Sulphate and pH in the MHS3 Seep, July 2021 – June 2023.

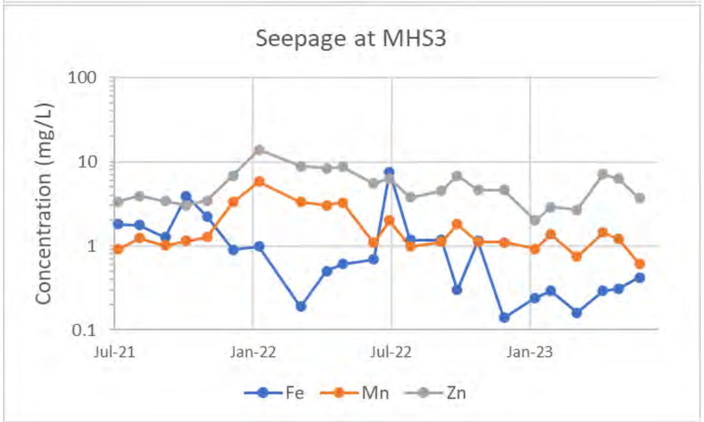

Figure 7-21. Total iron, manganese, and zinc in the MHS3 Seep, July 2021 – June 2023.

8 Stitt River upstream of 2 and 5 Dam

A summary of the monitoring results collected at site WL8 upstream of the 2/5 Dam TSF is contained in Table 8-1.

Table 8-1. Summary of monitoring results from the Stitt River upstream of 2 and 5 Dam in 2022-2023.

Requirement	Findings
Monitoring Frequency	Monitoring requirements were amended in July 2021 under the revised 2/5 Dam TSF Water Quality Monitoring Plan. • Continuous river level is recorded in the Stitt River upstream of the 2/5 Dam TSF by Entura under contract to TasWater, with flow results made available to MMG (Figure 8-1). • Continuous Electrical Conductivity and Temperature are no longer monitored at the site, but weekly monitoring of these parameters is completed as shown in Figure 8-2. • All other parameters were monitored on a monthly basis as required.
Compliance with EPN	All parameters were determined at the required frequency.
Significant trends reporting period	• Flow in the Stitt River was highly episodic in the 2022-23 monitoring year. There were 9 flow events exceeding 20 m^3/s, with two events exceeding 40 m^3/s. Despite the high flow events, median flow in the river was <1 m^3/s, and the annual average flow was 2.1 m^3/s. Monitoring coincided with flow rates of 0.12 to 11 m^3/s through the year (Figure 8-1).

	- pH and EC values were similar to previous years, with pH values between 5.5 and 7.5, and EC ranging up to 60 µS/cm. (Figure 8-2). - Metal concentrations were low and similar to previous years (Figure 8-3). - Maximum concentrations of total and filtered cadmium, copper, lead, manganese, and zinc all occurred on the same day in April 2023, with manganese and zinc results shown in Figure 8-4. The total and filtered metal results were similar and TSS in the sample was <5 mg/l, suggesting particulates are not the source of the elevated metals. The sulphate concentration in the sample was 10 mg/l, which is higher than usual, but not consistent with elevated metal concentrations. It is unknown why the metals were elevated. - Sulphate concentrations were at or below 10 mg/l throughout the year.
Long-term trends	- With the exception of the one sample with elevated metals, the water quality in the Stitt has remained consistent compared to previous monitoring years.

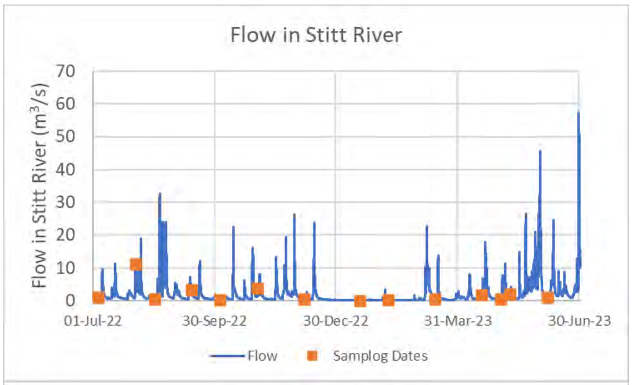

Figure 8-1. Discharge in the Stitt River at WL8 July 2022 to June 2023. Sampling dates are indicated by orange markers.

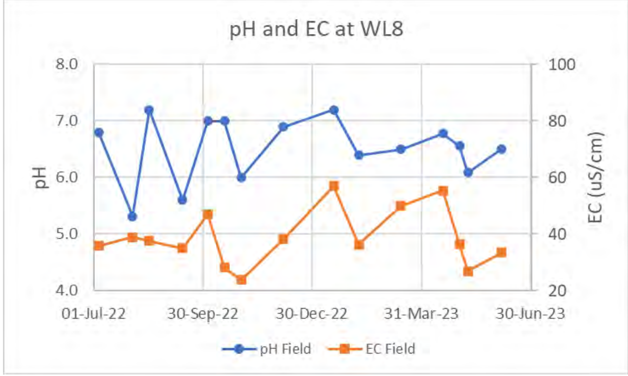

Figure 8-2. Field and laboratory pH, and Electrical Conductivity in the Stitt River July 2022 – June 2023.

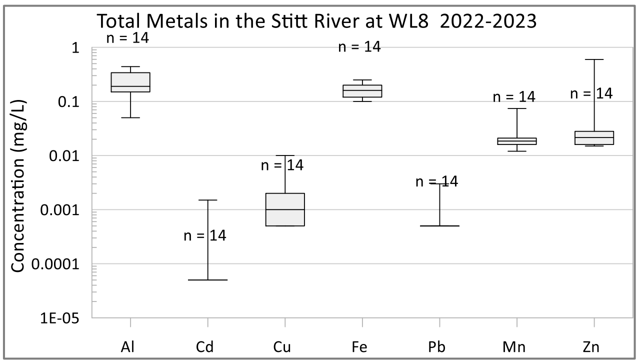

Figure 8-3. Box and whisker graph of metals in Stitt River upstream of 2 and 5 dam (WL8) for July 2022 to June 2023. Box and whisker plot as described in Figure 3-7, with the box encompassing the 25th to 75th percentile values.

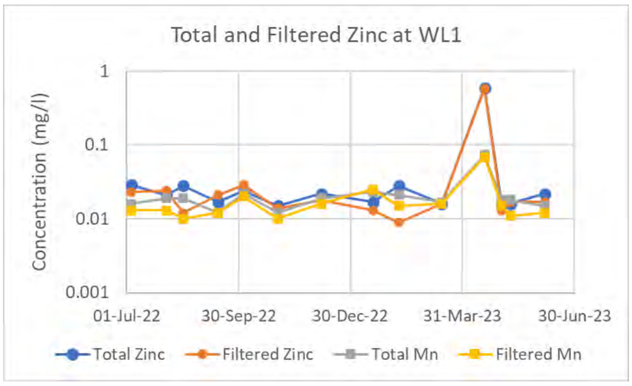

Figure 8-4. Total and filtered manganese and zinc values at WL8 in July 2022-to June 2023.

9 Hercules Monitoring

Monitoring sites on the Hercules site are shown in Figure 9-1. Monitoring site Ring at Highway (RAH) is located downstream on the Ring River at the Murchison Highway, north of the extent of the photo. Monitoring site MPW is associated with the South Hercules lease and is discussed in Section 15. A summary of the monitoring results for Hercules is contained in Table 9-1.

Figure 9-1. Surface water monitoring locations at the Hercules Mine site. Monitoring site Ring at Highway (RAH) is located downstream on the Ring River at the Murchison Highway, north of the extent of the photo.

Table 9-1. Summary of monitoring results from the Hercules Mine site collected in 2022-2023.

Requirement	Findings
Monitoring Frequency	All sites were monitored for the required parameters and at the frequency required except for the following:

	- Continuous flow, EC, pH, and Temperature are not recorded at 7L Composite, but have historically been recorded at WSP. Due to leakage at the WSP causing inaccurate measurements, no continuous measurements were collected at the site after 13 October 2022. Monthly water quality samples were collected at the 7 Composite site, due to a lack of flow at the site. - There were twelve 1-to-2-day gaps in continuous flow (15 minute) recorded at the Ring River upstream of Baker Creek (RRusBC). - Acidity was not determined in September 2022 at any of the Hercules monitoring sites due to the laboratory erroneously testing for alkalinity rather than acidity
Compliance with EPN	Monitoring frequency and parameters determined are the only requirements in the EPN. With the exception of the previously listed data gaps all monitoring was completed as required.
Significant trends - reporting period	- Flow results at BC2 continue to be substantially lower than pre-2020 results, with an annual average flow of 0.12 m^3/s as compared to 0.40 m^3/s in the 2018-2020. This is attributable to site upgrades and improved maintenance at the site. Flows varied at BC2 between <0.01 m^3/s to 4.6 m^3/s (median = 0.04 m^3/s) and at RRusBC between 0.01 to 3.3 m^3/s (median = 0.13 m^3/s; Figure 9-2). - The pH trends in the Ring River and Baker Creek are consistent with historic trends, with pH decreasing in the Ring and increasing in Baker Creek during periods of high flow. At both sites, and for the available record at WSP there is poor agreement between the field and continuous pH results with the field measurements consistently lower than the continuous results. (Figure 9-2, Figure 9-4, Figure 9-6). - EC at the sites decreases with increased flow due to the inflow of surface water. The Field EC results were also consistently lower than the continuous recorded values (Figure 9-3, Figure 9-5, Figure 9-7). - The range of monthly metal concentrations is similar to previous years, with the 7Level Composite having the highest concentrations (but lowest flows). The concentrations in Baker Creek are slightly lower but flow rates are substantially higher. Concentrations at the RRusBC are the lowest and result from the flow in the Ring River mixing with the overflow and leakage from the WSP (Figure 9-8). - Seasonal patterns continue to be present in the time-series of metal concentrations, with the highest concentrations occurring during the drier summer months (Figure 9-9). Down the length of the Ring River zinc concentrations change substantially. At the Ring at Bridge site (upstream of Hercules) zinc ranged up to 1 mg/L (Figure 9-9). A large increase occurs between the Bridge site and the Ring above Baker Creek site, due to the inflow from the WSP and runoff from the mine road. Baker Creek has the highest zinc concentrations, which ranged from 19 mg/l to 142 mg/l. The concentrations in the lower Ring River at Highway (RAH) are considerably lower at 1.7 mg/ to 6.7 mg/l, due to the inflow of catchment runoff downstream of Baker Creek. There is a net increase of between 1.4 mg/l to 6.1 mg/l at the most downstream site compared to the Ring River at Bridge site. - Metal and sulphate loads on monitoring days based on the water quality results and flow rate at the time of sampling are higher as compared to the previous year. This is likely due to the average flow during

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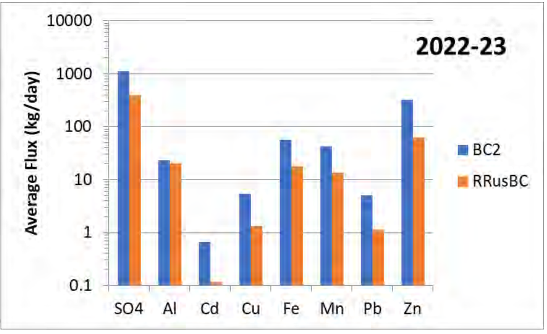
monitoring at BC2 being higher in 2022 to 2023 (0.12 m^3/s) as compared to 2021 to 2022 (0.07 m^3/s).

- The average daily zinc and sulphate fluxes from the site are estimated at 0.38 tonnes/day and 1.5 tonnes/day respectively. The results show Baker Creek continues to transport the largest load even with the lower flow rates (Figure 9-10).



- Using the flow and water quality results from the Ring River at the Murchison Highway site yields the zinc and sulphate fluxes shown in Figure 9-11 and Figure 9-12. In general, there is a good balance for zinc between the sites for all months except March 2023 when monitoring occurred on a day with rapidly increasing flow rates. The sulphate fluxes are consistently higher in the lower Ring River as compared to the sum of the upstream sites. These results suggest that the Hercules site is the predominant source of zinc to the lower river, but other historic acid drainage inputs are likely contributing sulphate.

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- The continuous recording pH and EC probes, and field EC meters should be checked and intercalibrated as frequently as feasible. Inter-comparisons of the field instruments with a NATA lab are recommended.
- The WSP is in poor condition and does not provide any environmental or logistical benefit. It is recommended that the flow, EC, and pH probes from WSP be relocated to the 7Level Composite site, and that flow from the 7L site be redirected into Baker Creek. This would result in a substantial improvement in water quality in the Ring River between the WSP and the RRusBC site.

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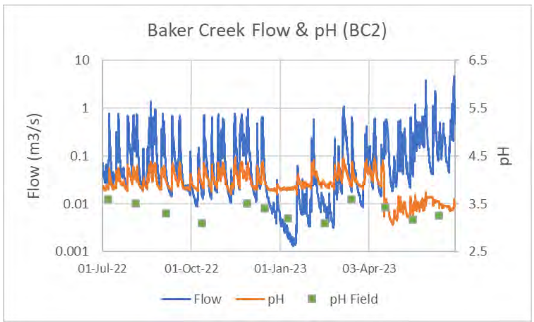


Figure 9-2. Continuous flow, pH, and monthly field pH results in Baker Creek upstream of the Ring River.

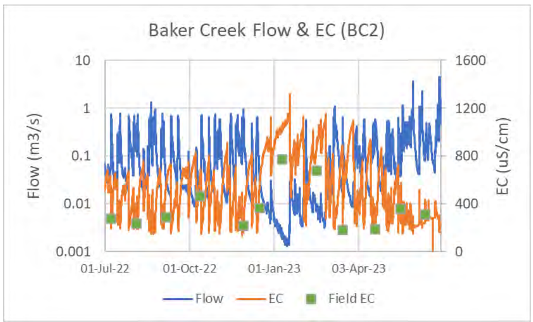


Figure 9-3. Continuous flow, EC, and monthly field EC results in Baker Creek upstream of the Ring River.

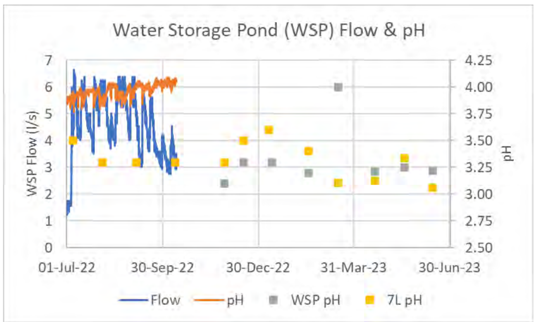


Figure 9-4. Continuous flow, pH, and monthly field pH results in the Williamsford Settling Pond.

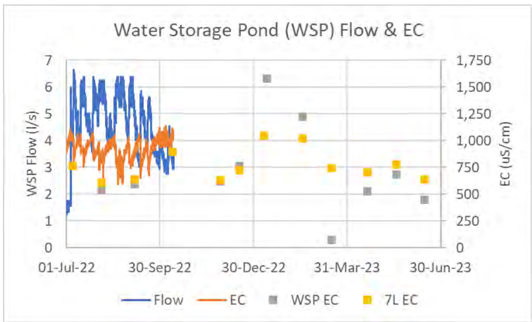


Figure 9-5. Continuous flow, EC, and monthly field EC results in the Williamsford Settling Pond.

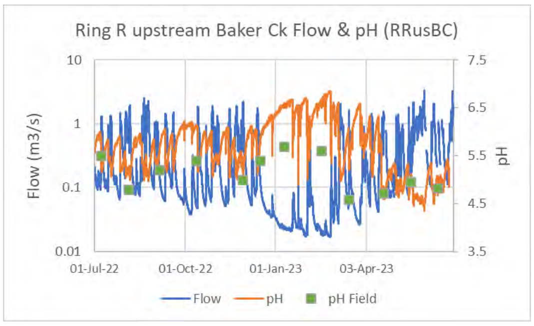


Figure 9-6. Continuous flow, pH, and monthly field pH results in the Ring River upstream of Baker Creek.

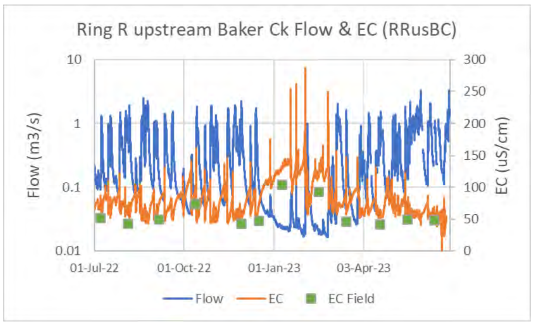


Figure 9-7. Continuous flow, EC, and monthly field EC results in the Ring River upstream of Baker Creek.

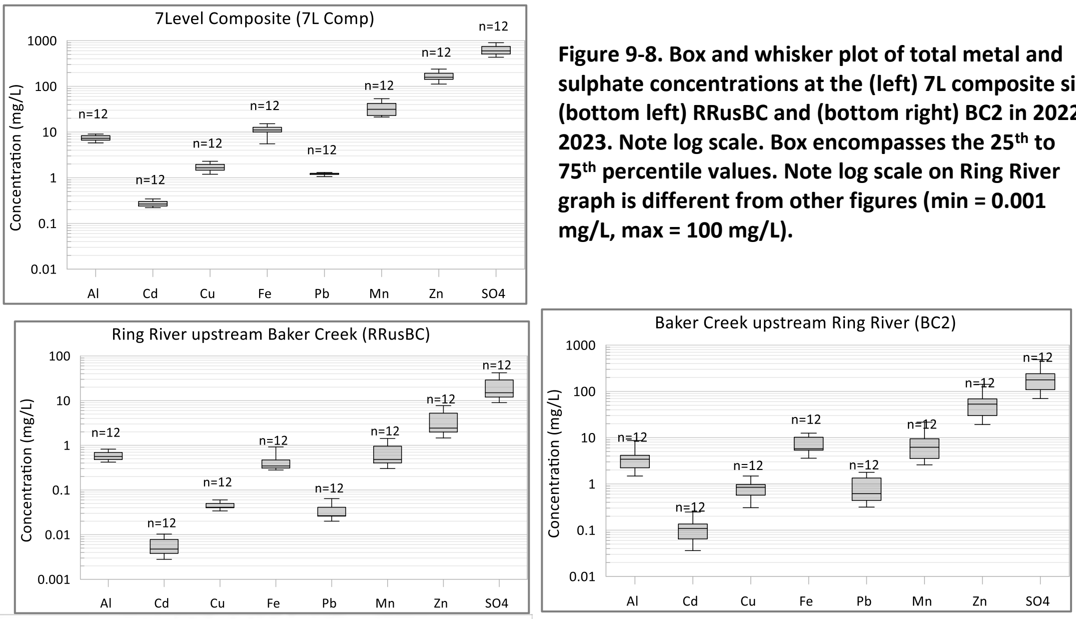


Figure 9-8. Box and whisker plot of total metal and sulphate concentrations at the (left) 7L composite site (bottom left) RRusBC and (bottom right) BC2 in 2022-2023. Note log scale. Box encompasses the 25th to 75th percentile values. Note log scale on Ring River graph is different from other figures (min = 0.001 mg/L, max = 100 mg/L).

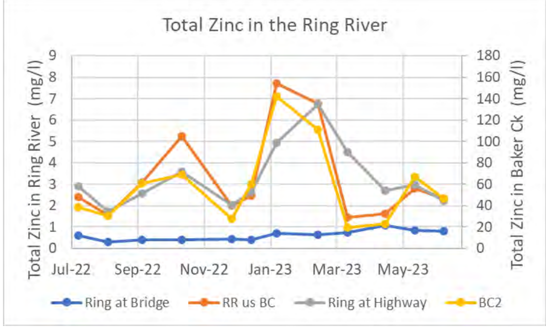


Figure 9-9. Total zinc in Ring River at Bridge upstream of WSP, upstream of confluence with Baker Creek (RR us BC), in Baker Creek upstream of Ring River and at the Murchison Highway (Ring at HW). Note Baker Creek scale is 20-times greater than Ring River scale

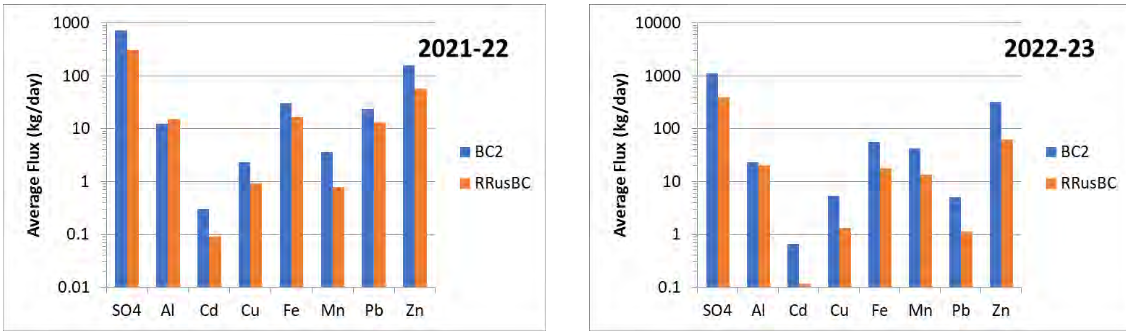


Figure 9-10. Average sulphate and total metal loads in Baker Creek and the Ring River above Baker Creek based on the monthly monitoring results and average daily flow on the monitoring date (left) 2021-2022 and (right) 2022-2023. WSP results not available for 2021-2023. Note different minimum and maximum on log scales for the two time periods.

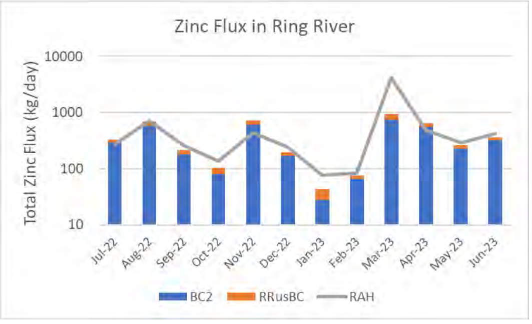


Figure 9-11. Comparison of combined zinc fluxes in Baker Creek and Ring River above Baker Creek, with the zinc flux at Ring River at Murchison Highway July 2022 to June 2023.

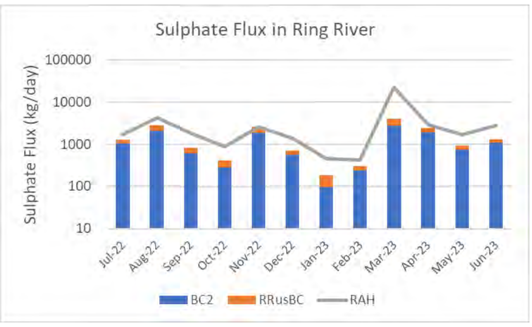


Figure 9-12. Comparison of combined sulphate fluxes in Baker Creek and Ring River above Baker Creek, with the sulphate flux at Ring River at Murchison Highway July 2022 to June 2023.

10 Stormwater monitoring

Stormwater monitoring sites at Rosebery are shown in

Figure 10-1, and a summary of the monitoring results collected in 2022-2023 is contained in Table 10-1. The improved collection and treatment of stormwater on the mining lease over the past years has resulted in a large reduction of runoff from the site. All flow in upper Filter Plant Creek (FPC1 and FPC2) and Primrose Creek (PC1 and PC2) is collected and directed to the ETP for treatment. Site FPC3 is located downstream of the Filter Plant ponds and collects predominantly runoff from the residential area, including inflows from historic waste rock located around the residential area. Filter Plant Creek ultimately enters Lake Pieman in the flooded arm of the Stitt River.

Water diverted away from the site via Assay Creek enters the Stitt River below Stitt Falls. Water that has come in contact with the WRD areas is collected and directed to the ETP for treatment and discharge via Bobadil.

Rosebery Creek is relatively undisturbed in its headwaters, has been diverted around the current MMG operational area in its middle reaches, and drains areas containing waste rock in its lower reaches. Rosebery Creek flows into the Stitt River upstream of Stitt Falls.

Figure 10-1. Stormwater monitoring sites at MMG Rosebery.

Table 10-1. Summary of stormwater monitoring results collected on the Rosebery mine lease in 2022-2023.

Requirement	Findings
Monitoring Frequency	Quarterly sampling was completed at all stormwater sites as required.
Compliance with EPN	All sites were monitored for the required parameters at the required frequency. There was flow at each of the sites on each of the quarterly monitoring dates. There were no accidental releases of stormwater to the environment during the monitoring year.
Significant trends - reporting period	• Stormwater captured wet and dry periods (Figure 10-2). The March 2023 sampling was conducted after an extended dry period and concentrations were highest during this sampling run at many of the sites. • The metal and sulphate results at AC1 continue to be higher as compared to AC2, which is attributable to more dilute water entering between the two sites (Figure 10-3). Flow at AC1 ranged from <0.5 l/s to 1.5 l/s, and from 0.5 to 4 l/s at AC2. Water quality results at both sites were within historic ranges. • In Primrose Creek, the results were within the historic ranges except at PC1 for lead in March when flow was negligible (unable to be recorded). The concentrations decrease between the sites, consistent with previous results (Figure 10-4). Recorded flow rates at both sites were <1 l/s when sufficient flow was present to be measured. • In Filter Plant Creek, results were elevated at FPC1 in September 2022, and generally lower than historic values in December 2022. At the downstream sites, results were within the historic ranges (Figure 10-5). • In Rosebery Creek, RC1 continues to have low metal and sulphate levels with an increase recorded at RC2 due to the influx of stormwater and other diffuse inputs, consistent with previous results (Figure 10-6).

	• Monitoring at RC2 was completed 28 times in the monitoring year as part of the Closure PFS (Figure 10-7). Total zinc fluxes at the site ranged from 3 kg/day to 80 kg/day with an average of 15 kg/day and median of 10 kg/day. • Average zinc loads in Rosebery Creek upstream of the Stitt based on the 35 quarterly stormwater monitoring results obtained since September 2014 are 20 kg/day, with a median value of 12 kg/day. The long-term average is about 30% higher than the average of the 2022 to 2023 results. This is likely attributable to inter annual variability, and/or remediation actions that have decreased inputs to Rosebery Creek over the past nine years.
Comments	Stormwater monitoring should be revised to reflect water streams leaving the lease site rather than streams that are collected within the lease site and directed to the ETP. The results of the Closure PFS should be used to update and refine the stormwater monitoring regime.

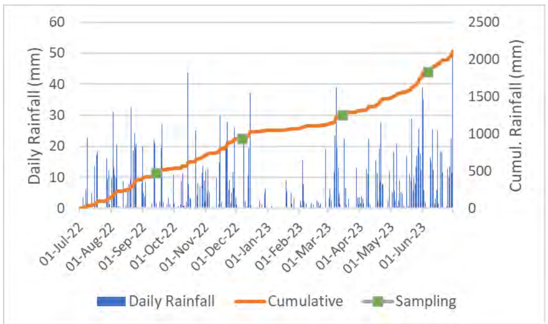


Figure 10-2. Daily and cumulative rainfall at the MMG Carpark during monitoring year and dates of quarterly stormwater sampling.

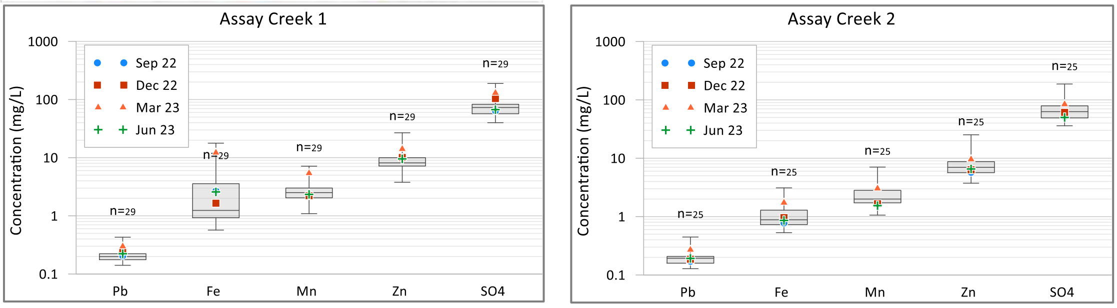


Figure 10-3. Total lead, iron, manganese, zinc and sulphate concentrations in Assay Creek 1 and Assay Creek 2 stormwater sites. The boxes encompass the 25th to 75th percentile monitoring results collected between January 2015 and June 2022, and the monitoring results collected from July 2022 to June 2023 are shown as data points.

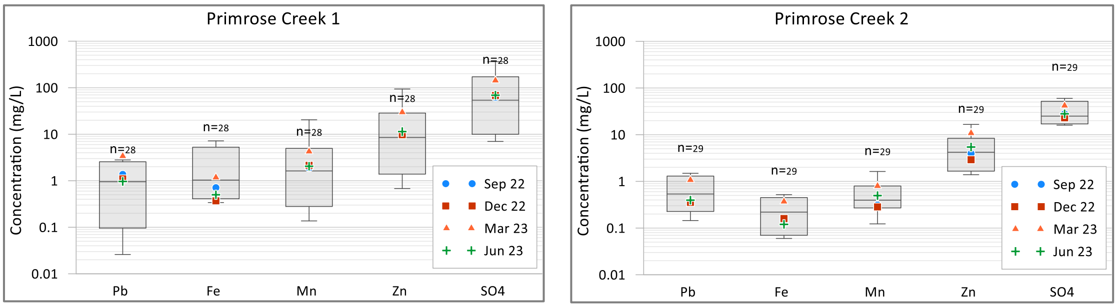


Figure 10-4. Total lead, iron, manganese, zinc, and sulphate concentrations in Primrose Creek stormwater sites PC1 and PC2. Description as per Figure 10-3.

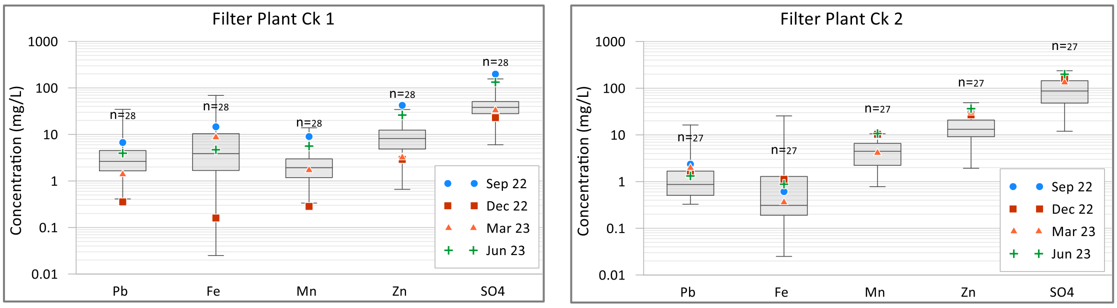
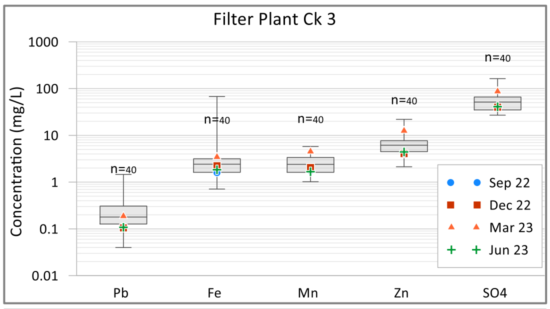


Figure 10-5. Total lead, iron, manganese, zinc, and sulphate concentrations in Filter Plant Creek stormwater sites FPC1, FPC2 and FPC3. Description as per Figure 10-3.



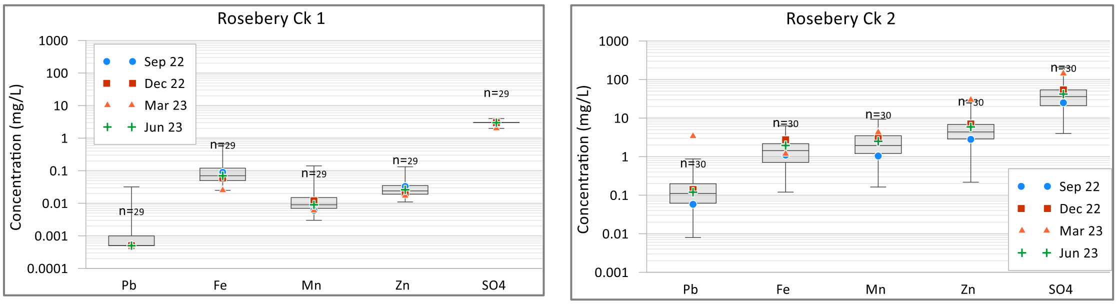


Figure 10-6. Total lead, iron, manganese, zinc, and sulphate concentrations in Rosebery Creek stormwater sites RC1 and RC2. Description as per Figure 10-3. Note different minimum scale on RC1 graph.

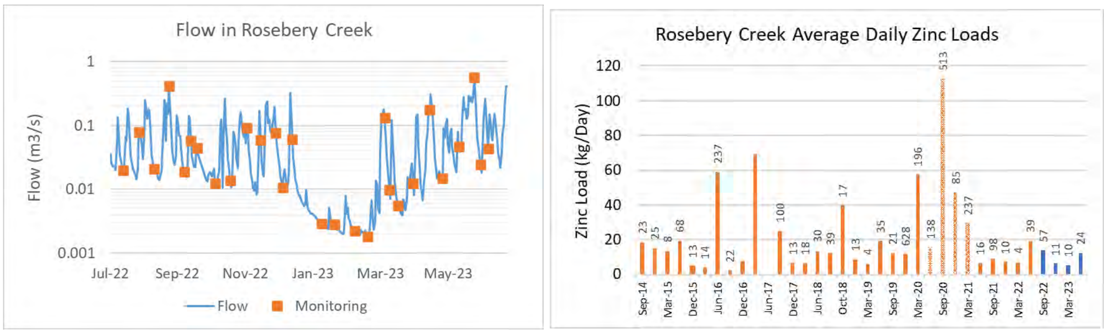


Figure 10-7. Discharge in Rosebery Creek July 2022 to June 2023 with monitoring days indicated (left); Estimated zinc loads at RC2 based on flow measurement at Rosebery Creek gauging site on stormwater monitoring days. Data labels indicate the flow rate in Rosebery Creek in l/s on the sampling day. Stippled fill indicates estimated flow, blue bars show 2022-2023 results (right).

11 Underground Mine Water Monitoring

The underground mine water monitoring locations are shown in Figure 11-1, and a summary of the monitoring results is contained in Table 11-1.

Figure 11-1. Underground mine water monitoring sites.

Table 11-1. Summary of underground mine water monitoring results for 2022-2023.

Requirement	Findings
Monitoring Frequency	Monthly sampling was completed at all sites as required. Additional weekly samples were collected at 8L Adit.
Compliance with EPN	All sites were monitored for the required parameters at the required frequency.
Comments	At different times during the monitoring year, elevated concentrations of metals relative to recent results were recorded at each of the underground sites. There was no increase at BO in metal concentrations during these periods demonstrating the efficacy of the ETP and Bobadil TSF with respect to metal removal. The reason for episodic higher levels is unknown but may be associated with management actions aimed at reducing water usage on the site (Figure 11-2).

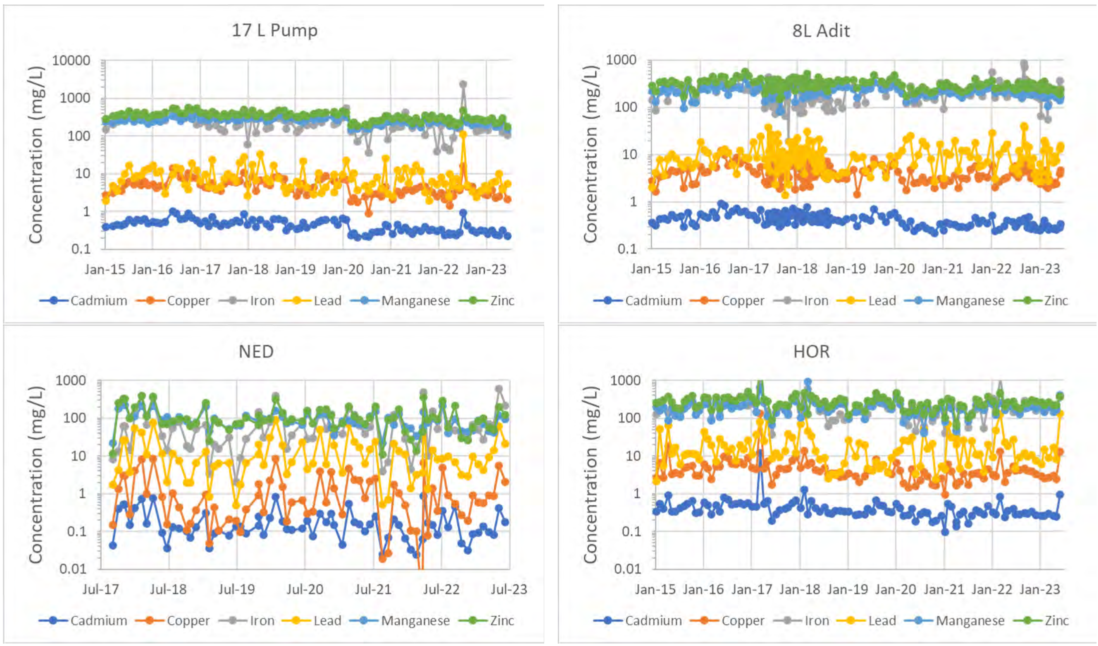


Figure 11-2. Total metal concentrations at underground sites through July 2023. The time series for NED is shorter due to no access to site between 2015 and 2017. Note different concentration scale at 17L Pump.

12 Lake Pieman Monitoring

Monitoring locations in Lake Pieman are shown in Figure 12-1. At each site water column profiles of physico-chemical parameters are collected, and water quality samples are collected from three depths (surface, mid-depth and deep). A summary of the monitoring results collected from Lake Pieman is contained in Table 12-1.

Figure 12-1. Monitoring locations in Lake Pieman. Samples are collected at the surface (S), mid-depth (M) and near the bed (D).

Table 12-1. Summary of monitoring results from Lake Pieman in 2022-2023.

Requirement	Findings
Monitoring Frequency	Quarterly water quality sampling and lake profiling was completed as specified in the EPN.
Compliance with EPN	There are no requirements in the EPN other than monitoring frequency and parameters determined. All parameters were determined as required.
Significant trends - reporting period	The Bastyan Power Station operated intermittently prior to and on the day of monitoring. This resulted in well mixed water column and uniform EC (Figure 12-3 to Figure 12-7), pH and temperature profiles at most sites: • Site PBS3, located well downstream of the inflow from BO and upstream of the Stitt River recorded higher and more variable EC. It is unknown what inputs may be contributing to these small, localised differences. • The total zinc results generally increased downstream as has been previously documented (Figure 12-4). The range of results is within the range of historic results at all three monitoring depths (Figure 12-5) • The filtered zinc results are similar to the total results at sites PBS6 and PBS3 (Figure 12-6). • Sulphate concentrations were ≤17 mg/L. The highest value occurred at PBS3 in September 2022, consistent with the slightly higher EC values recorded at the site (Figure 12-3). • The median and 95th percentile values for total zinc across all sites were 0.014 mg/L and 0.042 mg/L respectively, which are above the ANZG (2018) 95th percentile trigger value of 0.008 mg/L. The median is below the 90th percentile protection level (0.015 mg/L). These results are well below the No Observable Effects levels of 0.23 mg/L obtained through site specific toxicity testing by MMG using Pieman water and a local ceriodaphnia in 2006. The median and 95th percentile total copper values in 2022 – 2023 were 0.002 mg/l and 0.003 mg/l, respectively, slightly higher the ANZG (2018) 95th percentile trigger value of 0.0014 mg/l. The median and 95th percentile lead and cadmium results were below the ANZG (2018) 95th percentile protection trigger values.
Longer term trends	The results from 2022-2023 are consistent with the understanding of mixing within Lake Pieman, and highlight the role hydrology, and especially the power station operations play in mixing in the lake. Sources downstream of BO are substantial contributors of zinc and other parameters to the lake.
Comments	The 2022 – 2023 Lake Pieman monitoring runs demonstrate that short, intermittent power station operations are sufficient to maintain a well-mixed water column and relatively low metal concentrations. Where feasible, monitoring should target periods of extended power station shutdowns as these periods pose the greatest risk to Lake Pieman with respect to water quality.

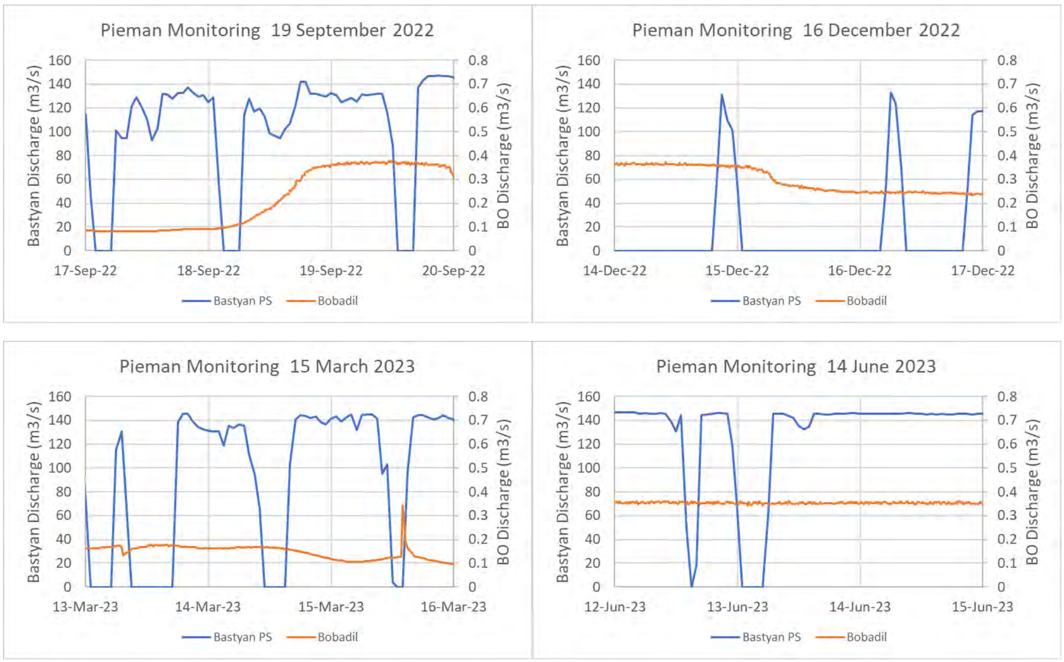


Figure 12-2. Discharge at Bastyan Power Station and Bobadil TSF the two days prior to, and on the day of, Lake Pieman monitoring (sampling dates shown on each graph). Note 200-fold difference in scales for the two discharge sites.

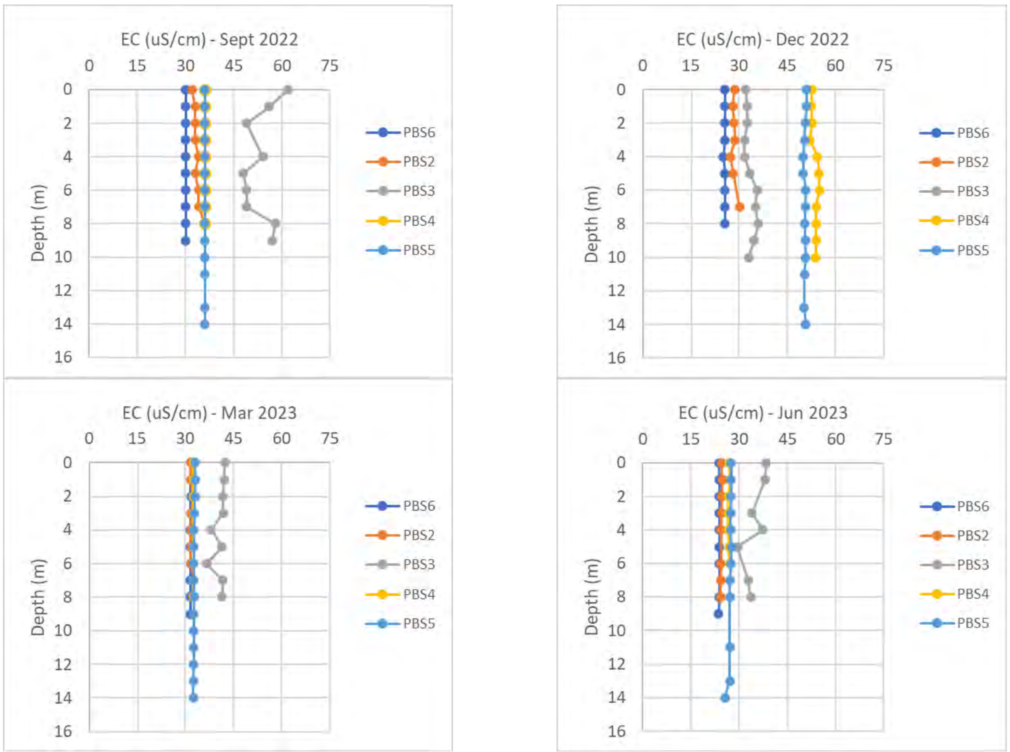


Figure 12-3. Electrical conductivity results for Lake Pieman monitoring sites on each monitoring date in 2022-2023. Results are listed in a downstream direction, e.g., PBS6 is at the upstream end of L Pieman.

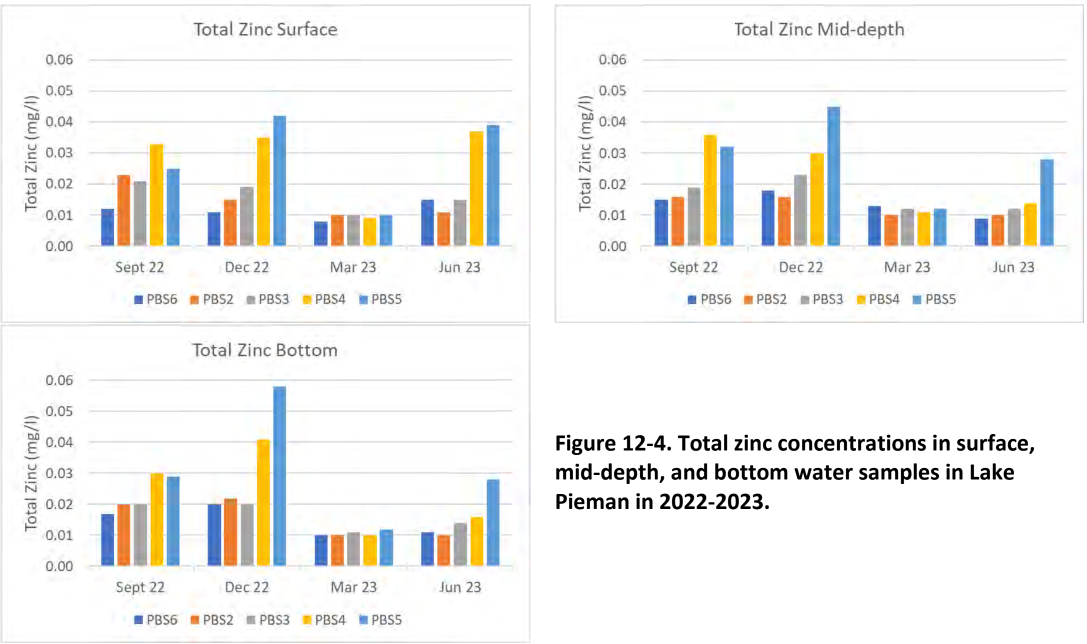
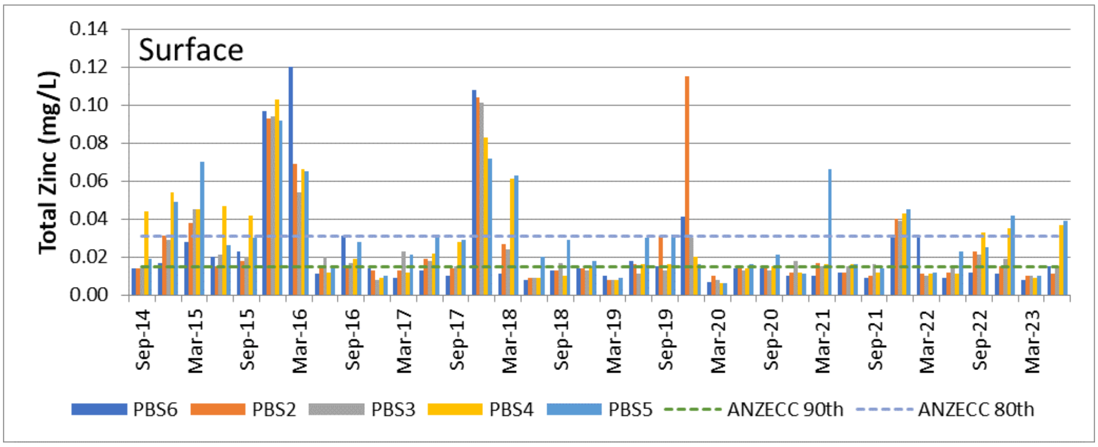
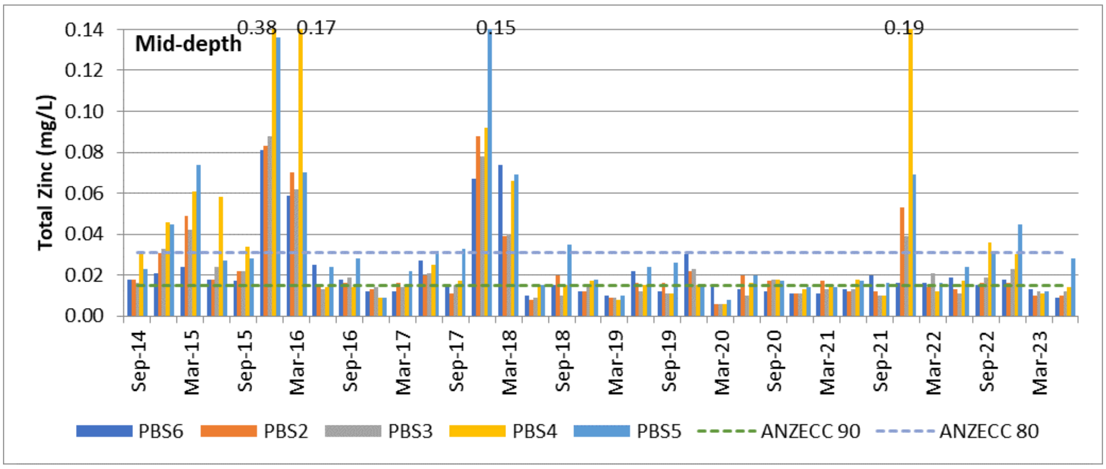


Figure 12-4. Total zinc concentrations in surface, mid-depth, and bottom water samples in Lake Pieman in 2022-2023.





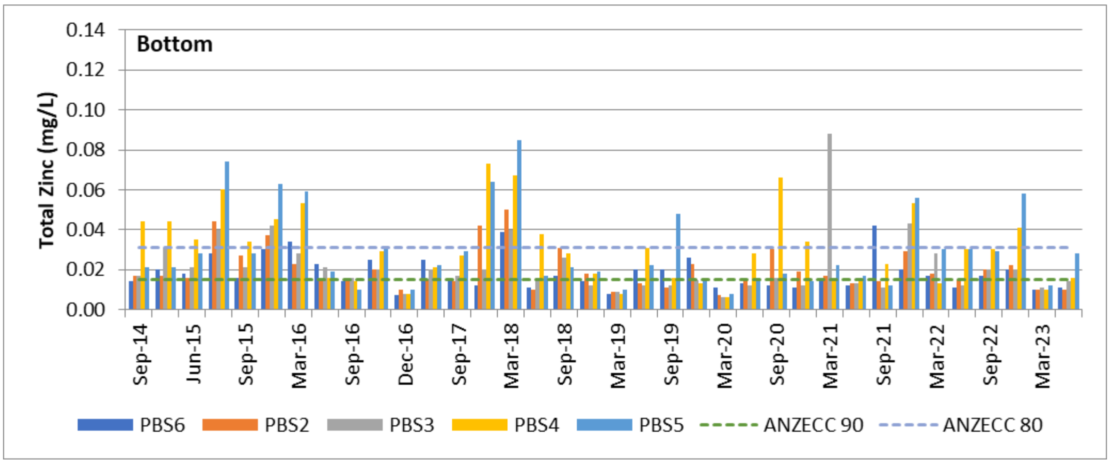


Figure 12-5. Total zinc in surface (top), mid-depth (middle) and bottom water (bottom) samples from September 2014 to June 2023. Labels indicate concentrations that extend beyond the limit of the graph in mid-depth graph.

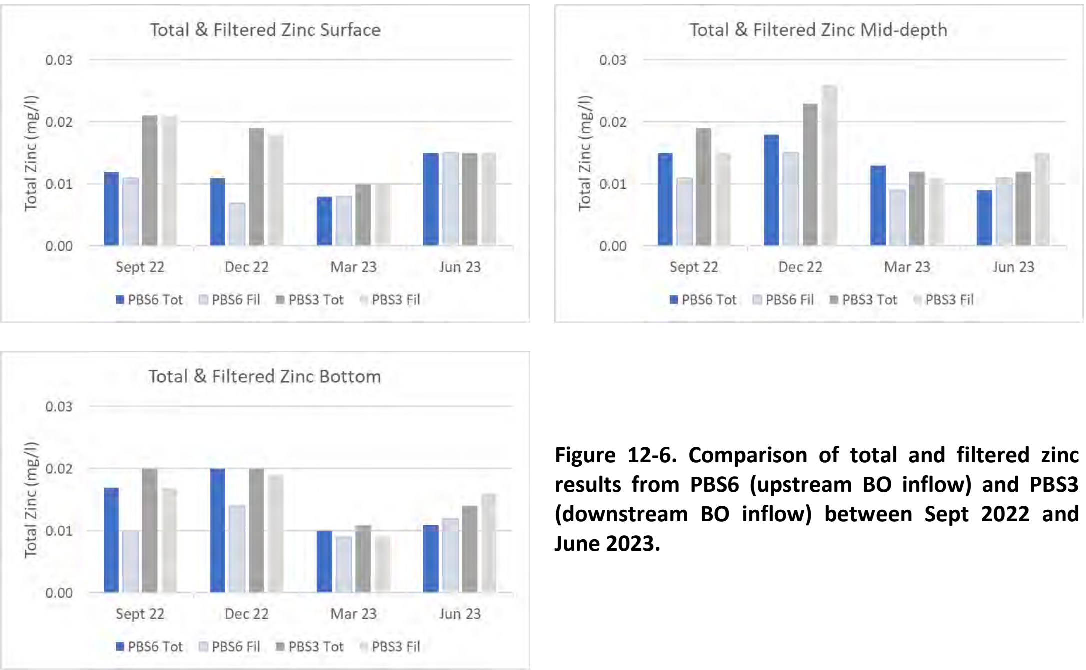


Figure 12-6. Comparison of total and filtered zinc results from PBS6 (upstream BO inflow) and PBS3 (downstream BO inflow) between Sept 2022 and June 2023.

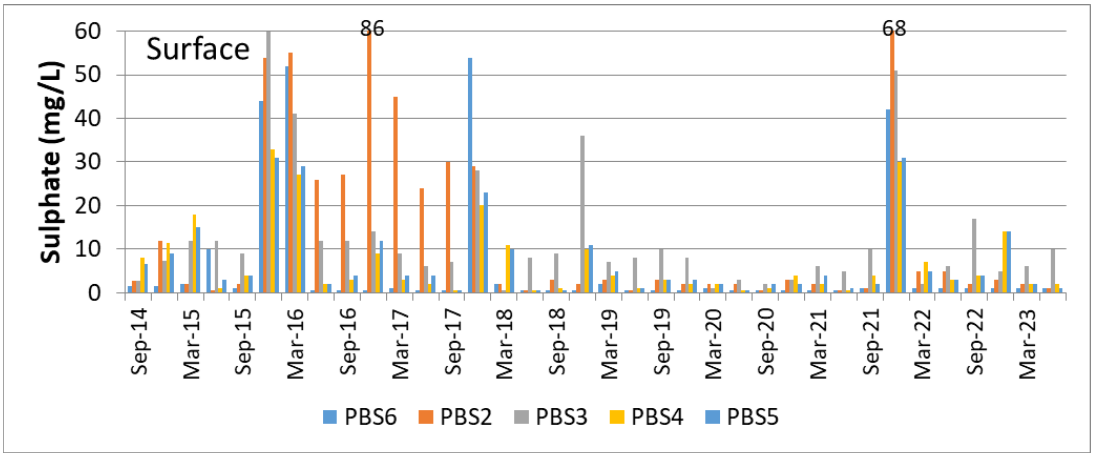


Figure 12-7. Sulphate concentrations in Lake Pieman surface water samples 2014 – 2023.

13 Review of Sampling Procedures and QA/QC of water quality monitoring

Item 2.6 under condition G7 of the EPN contains a requirement that the Annual Review include a review of field monitoring procedures, and accuracy of analytical procedures. MMG Rosebery has provided the information upon which the summary in Table 13-1 is based.

Monitoring information provided by MMG Rosebery includes Surface Water and Ground Water Monitoring Procedures that clearly outline the roles and responsibilities of each team member involved in monitoring, data management and reporting, and provides references to the standard methods that are to be adopted for the collection of samples and reporting of results. The procedures include timelines for completing tasks to ensure that reporting requirements under the EPN can be met, and to ensure that management is aware of potential environmental issues as they arise.

No site visit was completed as part of this review, but procedures have remained unchanged since the last site auditing visit in 2018 when all sites requiring monitoring were visited with the exception of the underground sites. All monitoring locations have remained unchanged since the last site visit, except for the inclusion of some new sites associated with the 2/5 Dam TSF and Stitt River. The staff have confirmed that there have been no changes to the monitoring procedures in the 2022-2023 year.

Based on information provided by the company, a new QA/QC program was implemented in 2019/2020 to ensure consistency between all environmental field technicians. The program consists of a series of field task observations to verify both technician competency and compliance with site procedures. Results are recorded and analysed with feedback provided to improve sampling consistency.

No laboratory visit or audit has been included as part of this review, but all results included in this review were completed in a NATA certified laboratory (ALS) that is subject to ongoing review and QA/QC checks under the NATA certification process. The laboratory runs duplicates of 1 in every 20 samples that must pass the internal QA/QC limits of the laboratory. Based on this, much of the discrepancies between the Compliance and Field duplicate samples are likely attributable to environmental variability rather than errors in sampling or analysis.

Table 13-1. Summary of field monitoring practices, applicability of monitoring sites and monitoring frequency, and analytical methods used by MMG Rosebery during the 2022-2023 monitoring year.

Requirement	Findings
Accuracy of the Sampling Procedures	• Water quality samples are collected by trained environmental contractors or the professional environmental staff at MMG Rosebery according to the standard monitoring procedures established by MMG. Samples required for EPN compliance are collected and submitted to a NATA approved lab using appropriate CoC procedures (ALS Melbourne). Field duplicates are collected at a rate of 1 per 20 samples and are also submitted to the primary lab with the locations selected on a random basis. The Relative Percent Difference (RPD) between the primary and duplicate sample results are

	tracked, and all discrepancies greater than 50% are noted in the data base. • A comparison of the weekly compliance results with field duplicates for a total and filtered metal (total and filtered zinc), nutrient (total nitrogen) and a 'general' parameter (total calcium) collected at BO are shown in Figure 13-1 through Figure 13-3. • The compliance and duplicate samples show good agreement for all parameters. In the total zinc results, there is one duplicate that returned a value below the LoR (plotted as 0.0025 mg/l, equivalent to 50% of the LoR), with the weekly sample recording a value of 0.023 mg/l. The discrepancy is likely attributable to variable amounts of particulate matter in the sample. • The MMG Rosebery Mill is responsible for maintenance of the pH and EC probes used for continuous monitoring. The probes are calibrated weekly. • MMG contract Entura to manage the water level probe at BO, the water level probe at the clean water diversion at 2/5 dam and the water level and water quality probes at Hercules. • Field probes are calibrated weekly as part of the routine monitoring by monitoring personnel according to the established procedures. Backup field instruments are calibrated and maintained on site. There are some discrepancies between continuous recording EC, field EC and laboratory EC at BO and at the Hercules monitoring site, and between field and continuous pH readings at the Hercules sites. Intercalibration between the continuous probes and the field and laboratory probes should be routinely conducted.
Applicability of sampling schedule and monitoring locations	• The sampling schedule at the BO outfall is suitable for capturing the water quality variability at the point of discharge. The continuous pH measurements at BO guides management of the ETP and provides an accurate indicator of the discharge water quality. • The monitoring plan and supplementary monitoring carried out by MMG for 2/5 dam is adequate to capture environmental releases from the dam to the environment should they occur, and to guide internal management. • There are inconsistencies within the EPN with respect to monitoring frequency at a number of sites, with parameters required to be monitored on both weekly and monthly, or monthly and 6-monthly basis. These should be reviewed and corrected. • The monitoring schedule and parameters required to be determined at all sites should be reviewed to ensure the information gained is relevant to present operations and providing useful information. The review should identify parameters at BO that are consistently below the discharge limits and could be considered for less frequent monitoring or elimination from the monitoring schedule.

Accuracy of analytical test methods	All field and analytical methods used in the determination of water quality parameters are consistent with established and appropriate methods. Analytical results are determined by independent NATA registered laboratories, and all water quality results provided by the labs incorporate QA/QC information, including results for blanks and replicates. The results from all internal and laboratory duplicate analyses are maintained within the water quality database along with the primary sample results enabling comparison of results. NATA registered laboratories only report results which are within the internal QA/QC limits of the laboratory, so the laboratory analyses are considered accurate within the context of NATA testing.
Recommendations	The MMG Closure PFS is nearing completion and is providing a wealth of new information about the water quality and hydrology of the site. The results from these intensive investigations should be used as the basis to revise the monitoring regime at MMG.

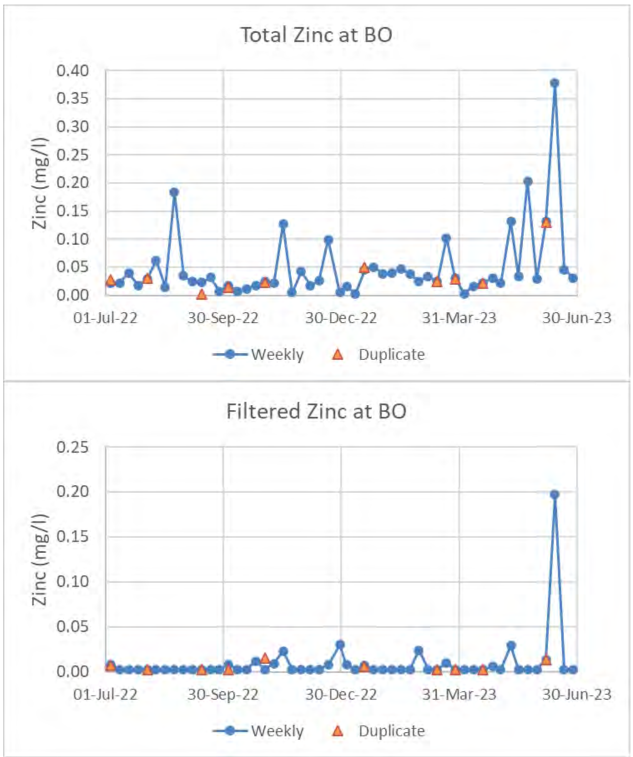


Figure 13-1. Comparison of weekly compliance sampling with field duplicates in (top) total zinc and (bottom) filtered zinc results collected at BO 2022-2023.

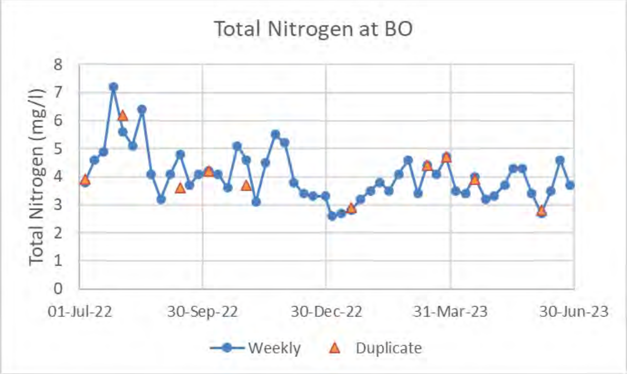


Figure 13-2. Comparison of total nitrogen results at BO in weekly compliance monitoring and Field duplicate samples collected in 2022-2023.

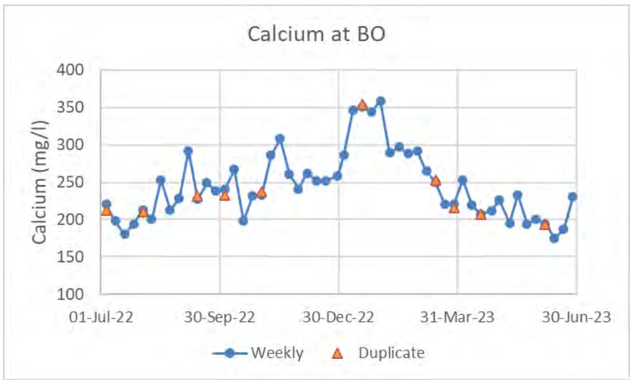


Figure 13-3. Comparison of total calcium at BO in weekly compliance monitoring and in field duplicate samples collected in 2022-2023.

14 3 Level Waste Rock Dump (EPN 8815/2)

During the 2022 – 2023 monitoring year, no additional waste rock was added to the 3 Level waste rock dump.

14.1 Surface water monitoring

Monitoring locations at the 3 Level WRD are shown in Figure 14-1 and a summary of the monitoring results is contained in Table 14-1.

Figure 14-1. Surface water and groundwater monitoring locations associated with the 3 Level WRD.

Table 14-1. Summary of surface water monitoring results for 3 Level WRD in 2022-2023.

Requirement	Findings
Monitoring Frequency and Parameters	Surface water monitoring is required to be completed on a quarterly basis as the 2015 EPN specifies monthly monitoring for three years, followed by quarterly thereafter. Monitoring was completed as required at all sites for all parameters when water was present. • No samples were collected at OC4 in March 2023 or OC5 in December 2022 due to a lack of flow. More parameters were determined at most sites as compared to the EPN requirements
Compliance with EPN – Assessment of surface water impacts from the 3 Level WRD	The EPN requires an assessment of surface water impacts associated with 3 Level WRD. • Surface water impacts beyond the immediate area of the WRD are minimal as surface runoff from the 3 Level WRD is collected at the 4 Level settlement pond and directed to the ETP for treatment and discharge via the Bobadil TSF. There were no discharges from the settlement pond to Rosebery Creek during the 2022-2023 monitoring year.

	• pH results from OC3, OC4 and OC5 are within the range of previous results, with OC3, located at the toe of the WRD having the lowest pH (Figure 14-2). • Zinc values at OC4 and OC5 are within previous ranges (Figure 14-3); the March 2023 total zinc value at OC5 (12 mg/l) was the highest result since March 2019. The monthly zinc results from OC3 show an increasing trend relative to the previous three years, with zinc ranging from 125 mg/L to 238 mg/L. The maximum value is the highest recorded at the site. • Total zinc increases with distance downstream, reflecting diffuse inputs rather than surface discharge from the WRD or open cut as all runoff is collected and directed for treatment (Figure 14-4, Figure 14-5). • A time-series of total zinc upstream (RC1) and downstream of the 3L WRD area (RC2) is shown in more detail in (Figure 14-6). RC1 shows relatively uniform zinc concentrations since 2014, whereas RC2 shows elevated zinc values, predominantly in the dry months, when groundwater inputs are greatest. The monthly monitoring in 2022-2023 recorded elevated values throughout the summer months. • Other metals at the site recorded concentrations within the range of previous monitoring (Figure 14-7).
Significant trends - longer period	All surface runoff from the 3L WRD continues to be collected and directed to the ETP for treatment. The increase in zinc and sulphate in Rosebery Creek is attributable to diffuse sources entering the waterway. The relative increase in zinc continues to be greater than that of sulphate, suggesting sources other than sulphide oxidation are contributing zinc to the waterway.

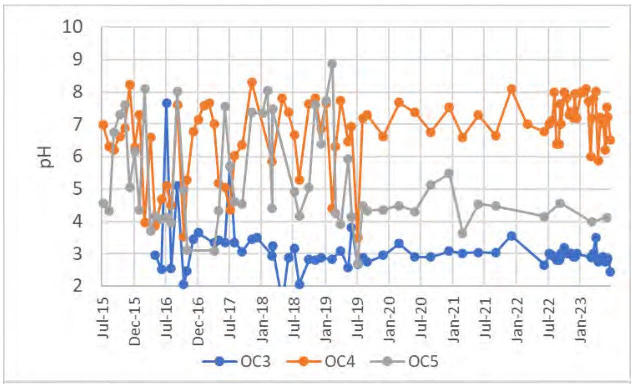


Figure 14-2. Time-series of pH in OC sites June 2015 – June 2023.

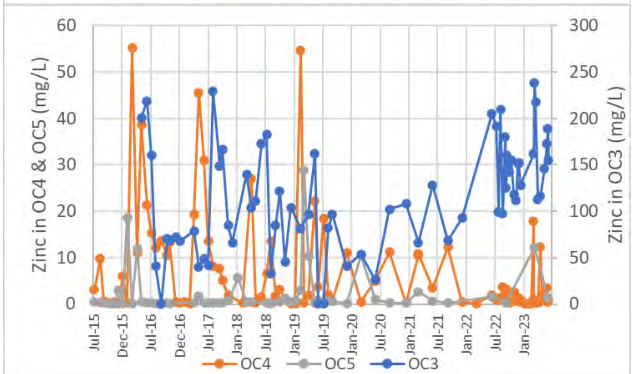


Figure 14-3. Time-series of total zinc in OC sites June 2015 – June 2023. Note OC3 scale is 5-times greater than RC1.

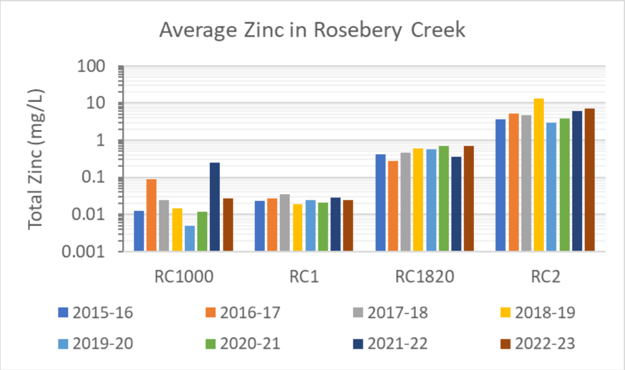


Figure 14-4. Average total zinc concentrations in Rosebery Creek in 2015 – 2023 monitoring years RC1000=background, RC1=upstream of WRD and open cut, RC1820 downstream of 3L WRD and open cut, RC2=upstream of confluence with Stitt River below all mine inputs.

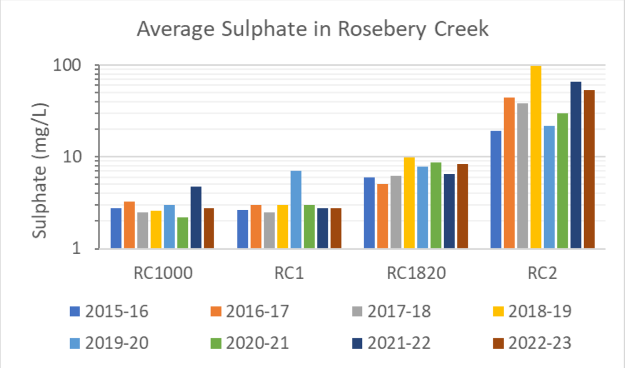


Figure 14-5. Average sulphate concentrations in Rosebery Creek in 2015 – 2023 monitoring years.

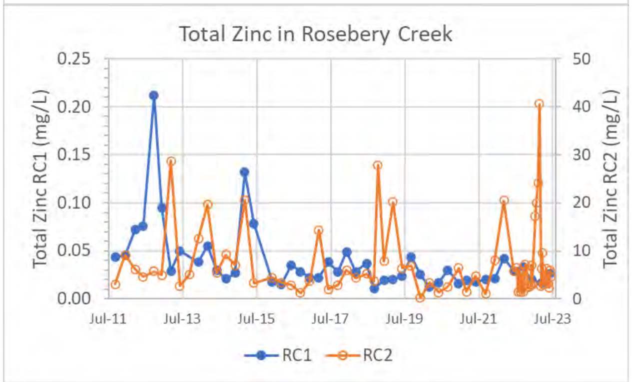


Figure 14-6. Comparison of total zinc concentrations at RC1 and RC2 from July 2011 to June 2023. Note RC2 scale is 20-times greater than RC1.

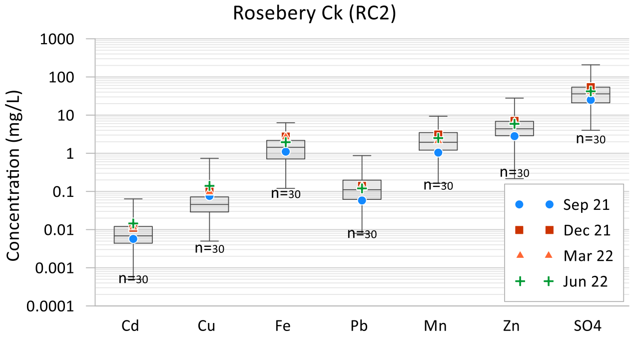


Figure 14-7. Total metals and sulphate at RC2 in 2022-2023 compared to results from Jan 2015 to June 2022. The boxes encompass the 25th to 75th percentile values.

14.2 Groundwater monitoring

A summary of the monitoring results collected from ground water sampling sites is contained in Table 14-2.

Table 14-2. Summary of groundwater monitoring results at 3 Level WRD 2022-2023.

Requirement	Findings
Monitoring Frequency and Parameters	Groundwater sampling at the 3 Level WRD was completed on a six-monthly basis as required. Parameters were determined as required when water was able to be collected from the bores.

	• GB25D was removed from the monitoring schedule following approval by the EPA for decommissioning in September 2020. • GB26 and GB45 continue to be dry and are not able to be monitored. This has occurred for many years. Additional parameters are reported for the ground water bores that are not listed in the EPN.
Compliance with EPN – Assessment of groundwater impacts from the 3 Level WRD	The EPN requires an assessment of groundwater impacts associated with 3 Level WRD. The relative position of the groundwater bores is shown in Figure 14-1. • Monitoring results were within the range of previous results for pH, sulphate, and zinc (Figure 14-8 to Figure 14-10) except at GB44 where the recorded pH in October 2022 was lower than previous results. • Bores near the top of the valley (GB21-GB25) continue to have higher pH and lower zinc and sulphate concentrations as compared to bores located downslope of the WRD and open cut. • The bores at the base of the WRD (GB27, GB36, GB44, GB46) are characterised by low pH and elevated zinc and sulphate concentrations. • Bore GB27, located within the PAF material in the WRD has consistently recorded the highest concentrations with iron, manganese, and zinc levels of 1-2 g/L, sulphate concentrations of ~10 g/L (Figure 14-11) and the lowest pH values. • Water levels in the groundwater bores generally show seasonal trends, with water levels increasing (e.g., decrease in depth to water surface) in October/Nov following the wet winter period, and decreasing in April, following the dry summer months. Water level changes since November 2021 have been greatest in bores GB21, GB24D and GB46. Water level shows little change in GB27, which contains the highest metal concentrations, suggesting water level changes are not the driver for sulphate oxidation and metal transport in this bore.
Significant trends - longer period	Bore GB23 continues to record elevated zinc (11-14 mg/L) and sulphate (103-126 mg/L) concentrations even though it is located well above the open cut and WRD. Identifying the source of this groundwater would be useful for understanding diffuse inputs to Rosebery Creek.

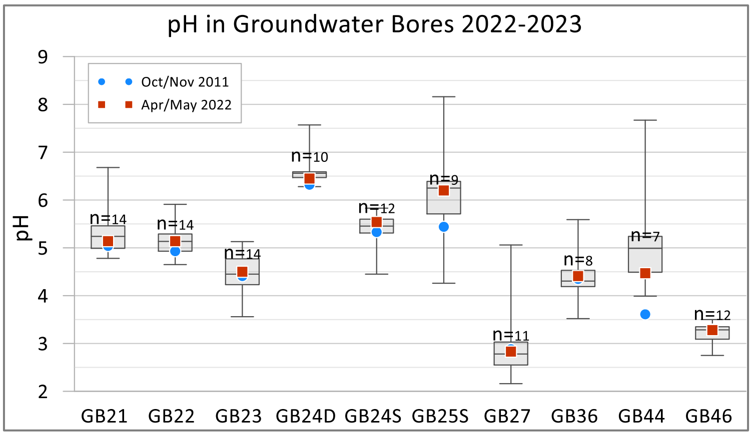


Figure 14-8. pH in groundwater at 3 Level WRD. Box encompasses the 25th to 75th percentile values from 2015 to June 2022, with the 2022-2023 results shown as data points. No data points indicate pH was not recorded at the site.

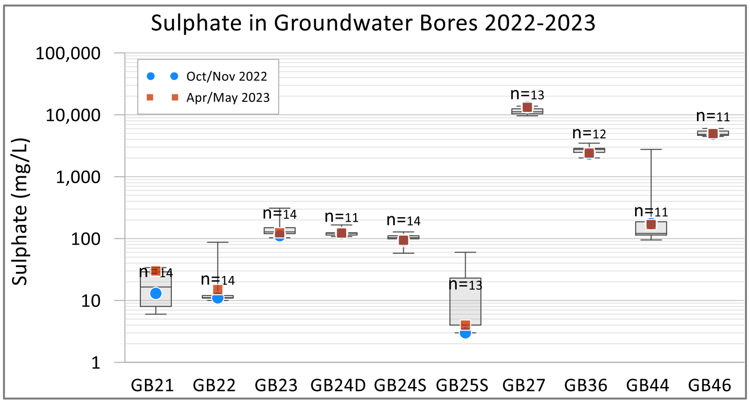


Figure 14-9. Sulphate in groundwater at 3 Level WRD. Box encompasses the 25th to 75th percentile values from 2015 to June 2022, with the 2022-2023 results shown as data points.

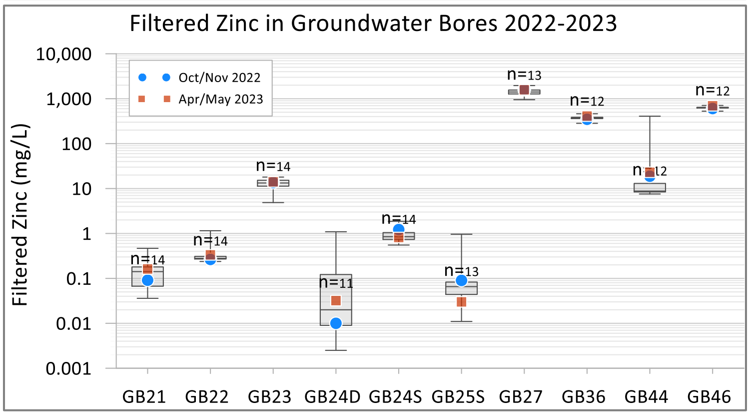


Figure 14-10. Dissolved zinc in groundwater at 3 Level WRD. Box encompasses the 25th to 75th percentile values from 2015 to June 2022, with the 2022-2023 results shown as data points.

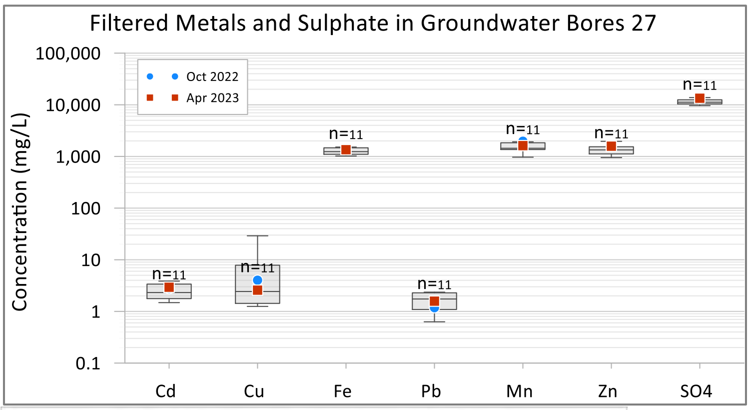


Figure 14-11. Filtered metals in GB27. Box encompasses the 25th to 75th values from 2015 to 2022. Data points show values recorded in October 2022 and April 2023.

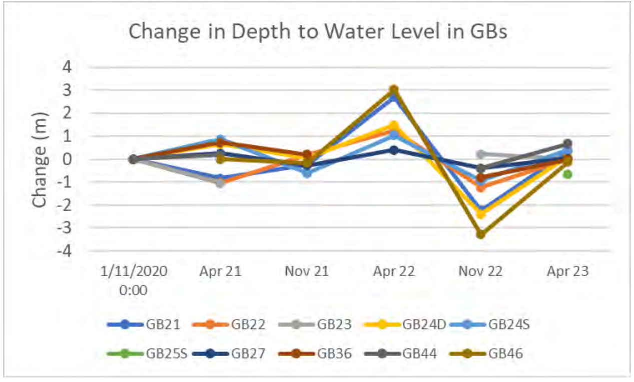


Figure 14-12. Change in the depth to the groundwater surface in the bores between sampling dates. A positive change indicates lower water level (e.g., greater depth to water surface). If no result is shown it indicates water level was not reported for the monitoring period.

14.3 Lysimeter Gas Sampling

A summary of the gas monitoring results collected from the lysimeters in the 3 Level WRD is presented in Table 14-3.

Table 14-3. Summary of lysimeter gas monitoring results from 3 Level WRD in 2022-2023.

Requirement	Findings
Monitoring Frequency and Parameters	Gas monitoring is required to be implemented at six horizontal gas monitoring pipes over the full construction of the WRD. Only the Stage 2 gas lysimeter has been installed. There are gas lysimeters installed in the Test Pads, but they do not reflect what is occurring within the main dump. Monitoring of the Test Pad ceased in October 2020, and the results until that date are only included here to provide an indication of changes over time within the material. Monthly monitoring for O_2, CO_2 and SO_2 was completed at all sites as required.
Compliance with EPN	The EPN sets a Preliminary Performance Objective of <3% *in situ* O_2 for the gas lysimeters. • All reported O_2 concentrations at the Stage 2 G1 lysimeter exceeded this value during the July 2022 – June 2023 monitoring period (Figure 14-13) indicating oxygen is not being excluded from the waste rock dump. The concentration in the lysimeter is similar to the atmospheric value of 20.95 %. Sulphide oxidation is not inhibited at these oxygen levels. • CO_2 levels in the Stage 2 gas lysimeter varied from 0% to 0.10% over the 12-months (Figure 14-14). CO_2 continues to show an increasing trend over time. • No SO_2 was detected in the gas lysimeter.
Significant trends	The results are consistent with the WRD not being fully constructed and capped, and not preventing the ingress of oxygen.

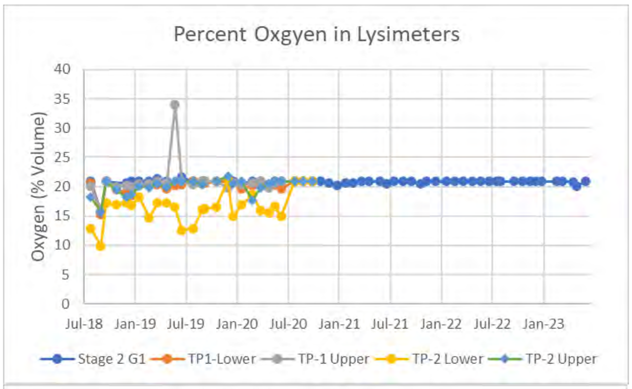


Figure 14-13. Oxygen results from the lysimeters installed in the 3L WRD July 2018 to June 2023.

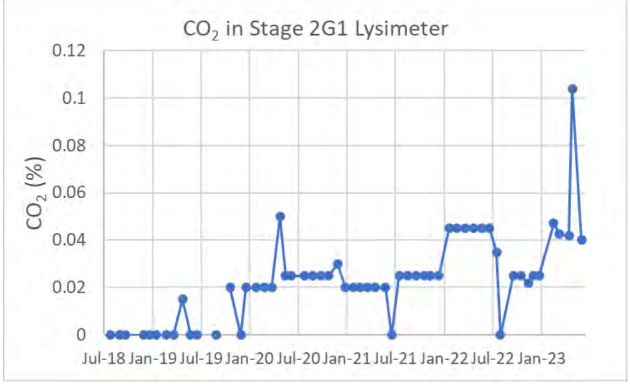


Figure 14-14. Carbon dioxide concentration in Stage 2 gas lysimeter, July 2018 to July 2023.

14.4 Lysimeter Water Sampling

A summary of the water quality monitoring results collected from the lysimeters installed in the 3 Level WRD is presented in Table 14-4.

Table 14-4. Summary of water quality results from lysimeters in 3 Level WRD in 2022-2023.

<table>
<tr><th>Requirement</th><th>Findings</th></tr>
<tr><td>Monitoring Frequency and Parameters</td><td>Water testing is required to be completed at six lysimeters across the completed footprint of the 3 Level WRD. To date, two lysimeters have been installed and are monitored on a monthly basis with samples collected if water is present. In 2022-2023, 12 monthly samples were collected from Stage 1 L1. The Stage 2 L1 lysimeter was dry on most occasions, and unable to be sampled. The procedure requires the addition of 2 L of distilled water to the lysimeter. Historically this water has been sampled, providing results that were uncharacteristic of the WRD (e.g. EC typically <30 μS/cm). This water is no longer being sampled, and no results are presented for Stage 1 L2, as no inflow from the WRD has occurred. All parameters were analysed as required at Stage 1 L1.</td></tr>
<tr><td>-Compliance with EPN</td><td>The EPN sets Preliminary Performance Objectives for pH, EC, Acidity and Alkalinity as indicated in Table 14-5.

At the Stage 1 L1 lysimeter, the pH, acidity and alkalinity results achieve the Performance Objectives.
All EC values continue to exceed the Performance Objective at the Stage 1 L1 lysimeter.
Sulphate in Stage 1 L1 ranged from 1120 mg/L to 1460 mg/L.
The pH and alkalinity values in the Stage 1 lysimeter combined with the elevated sulphate concentrations at the site are consistent with the dump creating neutral mine drainage. The generated sulphate contributes to the elevated EC value.

Table 14-5. Summary of water quality in lysimeters measured between July 2022-June 2023. L= lab result, F = Field reading
<table>
<tr><th></th><th>Min pH</th><th>Max EC</th><th>Max Acidity</th><th>Min Alkalinity</th><th>Comment</th></tr>
<tr><td>Prelim. Perf Target</td><td>>4.5
pH unit</td><td><600
μS/cm</td><td><50
mg$CaCO_3$</td><td>>1
mg$CaCO_3$</td><td></td></tr>
<tr><td>Stage 1-L1</td><td>6.6 L
6.9 F
n=12</td><td>2490 L
2040 F
n=12</td><td>24
n=12</td><td>26
n=12</td><td>Max alkalinity = 59 mg/L</td></tr>
</table>

Metal concentrations in the Stage 1 L1 lysimeters are relatively low (Figure 14-15).
</td></tr>
<tr><td>Significant trends</td><td>The water quality results are similar to previous years and consistent with sulphide oxidation occurring within the waste rock dump and being neutralised by carbonate to produce ‘neutral rock drainage’.</td></tr>
</table>

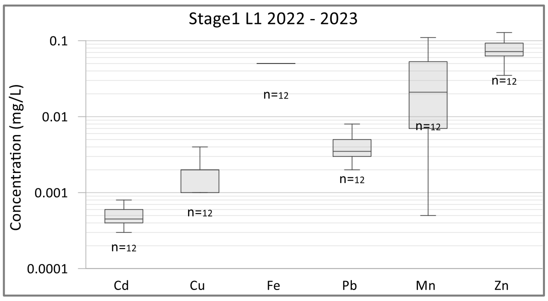


Figure 14-15.Filtered metal concentrations the Stage 1 L1 lysimeter, July 2022 – June 2023. The box encompasses the 25th to 75th percentile values.

15 South Hercules Mine Phase 1 (EPN 8034/1)

The South Hercules mining lease is managed by MMG Rosebery under a Care and Maintenance Plan approved by the EPA Tasmania in May 2015. No mining activity was undertaken within the July 2022 to June 2023 reporting period.

15.1 Surface water monitoring

A summary of the monitoring results collected from surface water sampling sites is contained in Table 15-1.

Table 15-1. Summary of surface water monitoring results for South Hercules July 2022 to June 2023.

Requirement	Findings
Monitoring Frequency and Parameters	MMG monitored surface water on a monthly basis at sites MPW and BC2 consistent with the Closure Plan (GHD 2015). All parameters were monitored on a monthly basis as required.
Compliance with EPN – Assessment of surface water impacts from S. Hercules	• The only compliance criteria in the Closure Plan are monitoring. • pH values are consistent with previous monitoring, with pH values at BC2 lower than at MPW due to the influx of acidic water from the decommissioned Hercules mine site (Figure 15-1). • Zinc and sulphate increase by about 10-fold between the two sites. Manganese is consistently about 6 mg/L at MPW, but ranges from 6 to 14 mg/L at BC2, suggesting that inflows other than groundwater are contributing half the manganese (Figure 15-2, Figure 15-3). • The MPW results show small seasonal changes, while the seasonal variability at the downstream site is much higher, due to the inflow of surface and possibly groundwater (including inflow from adits) from the Hercules mine site. • There is a substantial increase in metal concentrations between the MPW and BC2 monitoring sites due to inflows from the decommissioned Hercules site, which enter Baker Creek downstream of the South Hercules site (Figure 15-4).
Significant trends - longer period & comments	The water quality results are consistent with previous results since the site entered care and maintenance. The monitoring requirement should be reviewed as many parameters have shown long-term stability and could be eliminated from the monitoring schedule or reduced in monitoring frequency (e.g., mercury, nutrients, major ions).

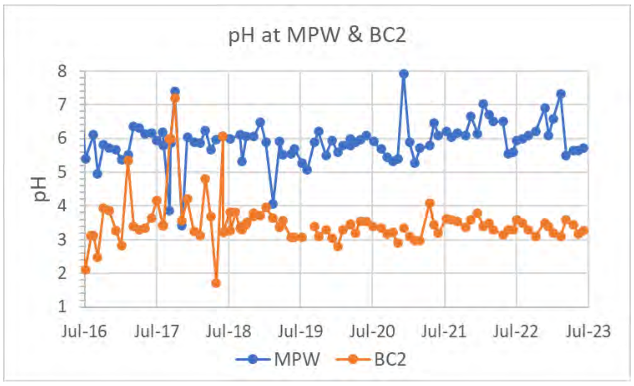


Figure 15-1. pH at the South Hercules surface water monitoring sites MPW and BC2, July 2015 to June 2023.

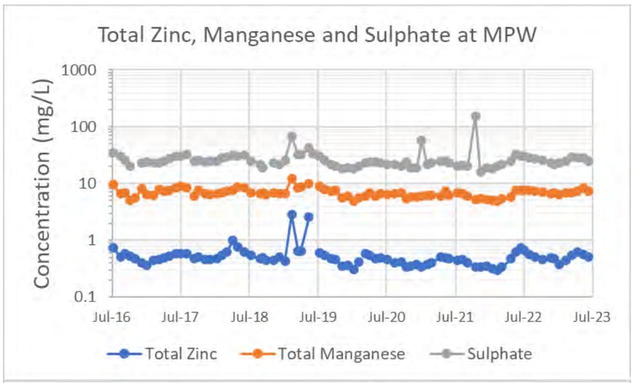


Figure 15-2 total zinc, manganese, and sulphate concentrations in the Mine Pit Water at the South Hercules 2015 to June 2023. Note log scale.

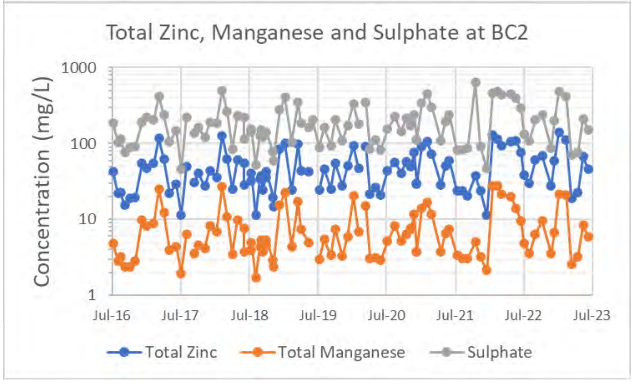


Figure 15-3 Total zinc, manganese, and sulphate concentrations at Bakers Creek above Ring River (BC2), July 2015 to June 2023. Note log scale.

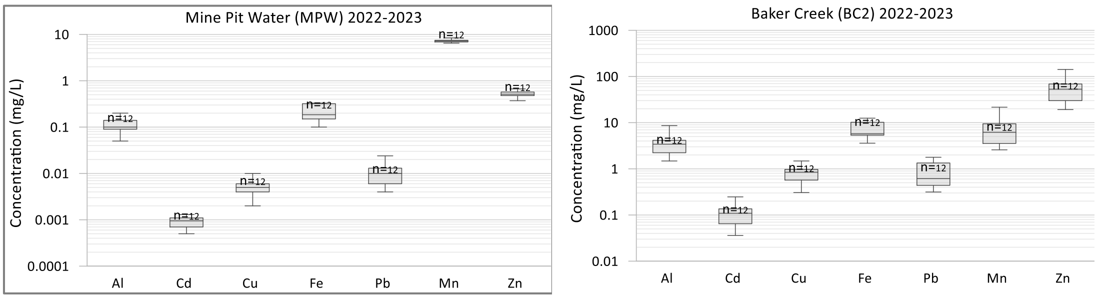


Figure 15-4. Total metal concentrations in the Mine Pit Water at South Hercules (left) and Baker Creek above Ring River (right). Note difference in log scales with Baker Creek scale 100-times higher than MPW. The box encompasses the 25th to 75th percentile values.

Appendix F Biological Condition of the Ring and Stitt Rivers: Spring 2022 and Autumn 2023 (Freshwater Biomonitoring, 2023)

Biological Condition of the Ring and Stitt Rivers: Spring 2022 and Autumn 2023

Report to MMG, Rosebery

SA Mallick

March 2023

fbm

Freshwater
Biomonitoring
Consulting Service
ABN 60875932248

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Summary

- The Ring and Stitt Rivers were surveyed for macroinvertebrates and fish in spring 2022 and macroinvertebrates in autumn 2023.
- The Ring River remains in a degraded condition, with a sharp decline in river condition downstream of Bakers Creek.
- Both Bakers Creek and Dolcoath Creek remain in a highly degraded condition.
- The primary reason for the poor condition of river fauna communities in the Ring River continues to be pollution from the Hercules mine via Bakers Creek.
- Overall, the Stitt River is in a substantially better ecological condition than the Ring River.
- There appears to have been further improvement in the condition of the lower Stitt River over recent years, with a range of clean-water macroinvertebrate taxa now recorded at all sites including in the lower reaches.
- In spring 2022, fish were surveyed in Stitt River sites S1 to S5 and in the Sterling River. Adult brown trout were recorded at all Stitt Rivers sites including substantial numbers of adult and juvenile brown trout captured at site S5 in the lower reaches of the river.
- Adult and juvenile brown trout have now been regularly recorded in the lower reaches of the Stitt River since 2020, with a self-sustaining population of trout apparently now established throughout the Stitt River including in the lower reaches.

Introduction and Aims

This report describes the results of surveys conducted in 2022/23 in the Ring and Stitt Rivers, comprised of one spring 2022 and one autumn 2023 seasonal sampling event for macroinvertebrates and fish.

This report forms part of what is now a routine biomonitoring exercise for the Ring and Stitt catchments required under EPN 7153/3. Surveys under this program have been previously reported for autumn and spring annually from 2005/06 to 2019/20 (Davies et al. 2005a, b; 2006a, b; 2007 – 2017; Mallick 2018, 2019, 2020, 2021, 2022).

The primary aims of this monitoring are to:

- describe the status of macroinvertebrate and fish assemblages in the Ring and Stitt Rivers; and
- evaluate changes over time and relate these to environmental conditions (especially habitat and water quality) and management actions associated with MMG mine operations.

The current monitoring program follows the protocol used by Davies et al. (2004), with sampling of instream fauna at a number of sites in the Ring River and selected tributaries, in the Stitt River both upstream and downstream of pollution sources, and in a reference river, the Sterling River.

2. Methods

2.1 Field sampling

A survey was conducted of benthic macroinvertebrates and fish in the Stitt and Ring Rivers, at:

1. Four sites in the mid to lower Stitt River, located:
    - downstream of the outflow of the wetlands associated with 2 & 5 Dam (Bull Lagoon) (site S3);
    - adjacent to the Rosebery sports ground (S4); and
    - immediately upstream of Stitt Falls (S5).
    - downstream of the Stitt Falls (S6) - as part of a survey of WWTP wastewater effects requested by TasWater, the results of which are also reported here;
2. Five sites in the Ring River located:
    - at Williamsford (site R1)
    - upstream of the Bakers Creek junction (R2)

    - downstream of Bakers Creek (R3)
    - upstream of the Dolcoath Creek inflow (R5); and
    - at the Murchison Highway Bridge (R6).
3. Two sites in Ring River tributaries:
    - In Bakers Ck and Dolcoath Creeks upstream of their junction with the Ring (sites B1 and D1).
4. Four reference ('control') sites:
    - three in the Stitt River upstream of the Bull Lagoon outflow (sites S0, S1 and S2 – with S0 added since autumn 2012); and
    - one site on an adjacent river system unaffected by acid drainage (the Sterling River, site STR1).

Site details are provided in Table 1, and locations shown in Figures 1 to 3. Spring 2022 sampling was conducted on 7-11 November 2022, and the autumn 2023 sampling was conducted on 26 – 30 March 2023.

Table 1. Details of stream study sites sampled for macroinvertebrates in the catchments of the Ring, Stitt and Sterling Rivers. 'Distance from source' is stream length measured on 1:25,000 map from the head of the stream drainage.

River or Creek	Site Code	Description	Easting (AGD)	Northing (AGD)	Distance from source (km)	Catchment area (km^2)	Altitude (m)
Ring River	R1	Williamsford Rd	376387	5368471	3	2.6	400
	R2	u/s Baker Ck	375587	5367946	4.25	5.5	340
	R3	d/s Baker Ck	375512	5367858	4.5	7.6	330
	R5	u/s Dolcoath Ck	371423	5371009	12.5	31	126
	R6	Murchison Hway	371312	5371495	12.9	34.9	120
Baker Ck	B1	u/s Ring R junction	375612	5367821	1.13	1.85	335
Dolcoath Ck	D1	u/s Ring R junction	371337	5371083	2.38	3.4	125
Sterling River	STR1	Murchison Hway	384453	5374898	5.5	16.6	170
Stitt River	S0	at top bridge	379451	5371735	5.2	19.8	190
	S1	u/s Mountain Ck	379687	5372833	6.8	33	145
	S2	u/s tailings	379387	5373173	7.3	35.9	140
	S3	d/s tailings	379072	5373181	7.6	36.5	137
	S4	Sports Gd footbridge	378287	5373533	8.6	36.7	128
	S5	road bridge	378187	5373871	9	37	120
	S6	d/s Stitt Falls	378012	5373883	9.2	39.9	101

2.1.1 Environmental variables

Several environmental variables were also measured at each site for use in bioassessment and analysis of relationships with the biota. These include % area of the study reach as riffle, run, pool and snag mesohabitats and of stream substrates (boulder, cobble, gravel, sand, silt and bedrock), as well as % cover of silts, moss, algae, and organic detritus, conductivity, temperature, channel gradient and dimensions, and ratings for bank erosion, and riparian, aquatic and trailing vegetation density.

2.1.2 Macroinvertebrates

At each site, two types of sampling for benthic macroinvertebrate were conducted – quantitative (surber) sampling, and semi-quantitative AUSRIVAS sampling. These methods give different types of information. Surber sampling provides a strictly quantitative assessment of abundance. AUSRIVAS sampling provides indices of difference in community composition from an ‘expected’ fauna under undisturbed ‘reference’ conditions.

The two sampling methods were conducted as follows:

Quantitative sampling: benthic macroinvertebrates were quantitatively sampled in riffle habitats, by taking 10 ‘surber’ samples of the benthos, by hand disturbance of the stream bed to a maximum depth of 10 cm into the substrate within a 30 x 30 cm quadrat immediately upstream of a 500-micron mesh net surber sampler. The 10 sample units were pooled at each site to provide a single composite sample, which was preserved in neutral buffered formalin (10%) prior to processing in the laboratory. Samples were subsequently elutriated with saturated calcium chloride solution, and the floated material (eluant) was separated. The remaining residue and the eluant were both hand sorted. All animals preserved were counted under magnification without identification.

AUSRIVAS sampling: rapid assessment protocol (RAP) sampling of benthic macroinvertebrates was conducted using the standard Tasmanian AUSRIVAS sampling protocol, in riffle habitat (fast flowing, typically cobble-bed, shallows). Sampling was conducted by foot-disturbance the stream substrate immediately upstream of a 250 micron mesh kick net, over a total length of 10 m of riffle. Samples were live-picked on site using the standard Tasmanian AUSRIVAS protocol, with picking for 30 min, maximizing the diversity in the picked sample of animals present in the kick net sample, while also preserving the relative abundance of the dominant taxa.

All quantitative and AUSRIVAS macroinvertebrate samples were identified and counted at the family level without identification.

2.1.3 Fish

Quantitative electrofishing was conducted in spring 2022 only in the Sterling (STR1) Stitt Rivers (S1-S5) to establish the abundances and fish species present. Sites were surveyed using a Smith-Root backpack electroshocker for a standard 20-minutes battery time. The survey involved moving slowly up- or down-stream at a site and attempting to cover the major habitat types present (riffle, runs, pools, edges). All captured fish were identified, assigned to an age class (juvenile/adult) and released at site of capture.

2.2 Data analysis

Several forms of data analysis are conducted for macroinvertebrates.

2.2.1 Abundance and diversity measures

Taxon richness (number of families) was derived from AUSRIVAS samples. Total abundance data was derived from quantitative Surber counts.

2.2.2 AUSRIVAS analysis

Spring and autumn season macroinvertebrate RAP data were entered into Tasmanian AUSRIVAS presence/absence models to derive O/E (observed over expected) scores. O/E scores allow deviations from reference condition to be quantified based on changes in the presence of expected taxa within the sample.

2.2.3 Tasmanian River Condition Index (TRCI) Aquatic Life Condition Assessment

For the TRCI assessment, sampling and data analysis followed the protocol described by NRM South (2009, 2009a). The TRCI Aquatic Life Macroinvertebrate Indicator (MI) provides an integrated score for the condition of benthic macroinvertebrate communities. The score takes into account three key aspects of macroinvertebrate community condition:

- *Expectedness* - the proportion of taxa expected to occur at the site under unimpaired conditions that are actually observed at the site (O/Epa scores), combined with the ratio of observed to expected scores for pollution sensitivity of the sampled community - the ‘SIGNAL’ score;
- *Abundance* - the density of individuals per unit area of river bed; and
- *Composition* - the proportion of environmentally sensitive taxa from the ‘EPT’ taxonomic grouping in the sample.

The above values were entered into the TRCI aquatic life condition scoring and integration algorithm (NRM South 2008) to generate scores for individual metrics and integrated scores and ratings for the overall condition of macroinvertebrates.

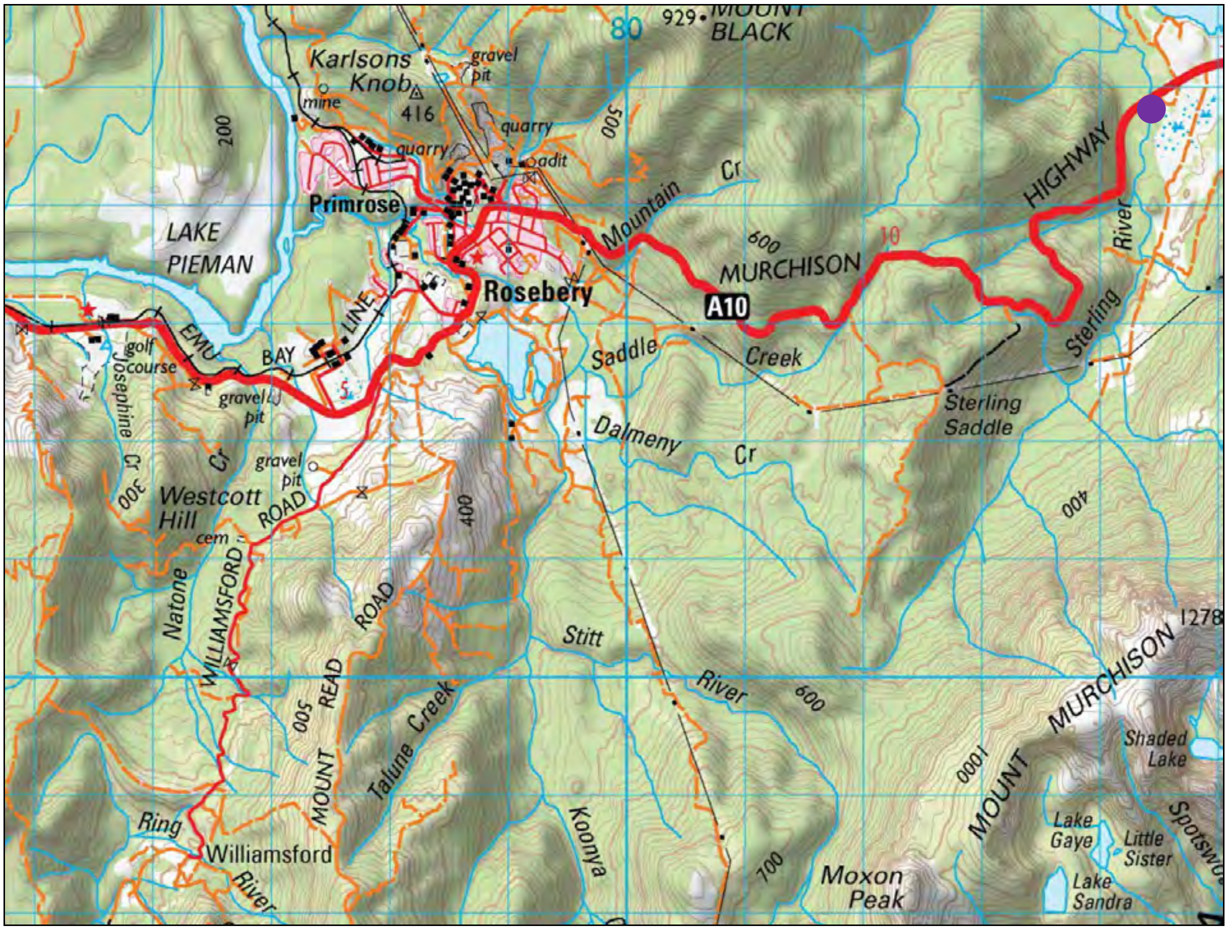

Figure 1. Map of study area showing location of Sterling River reference site (purple circle) in relation to the Stitt River and upper Ring River.

Grid squares = 1 km. Map scale 1:100 000 (TasMap).

Figure 2a. Map of study sites in the upper Ring River catchment. Blue arrow shows point of confluence between Bakers Creek and the Ring River.

Figure 2b. Map of study sites in the lower Ring River catchment. Blue arrow shows point of confluence of Dolcoath Creek and the Ring River

Figure 3a. Map of study sites in the upper Stitt River catchment.

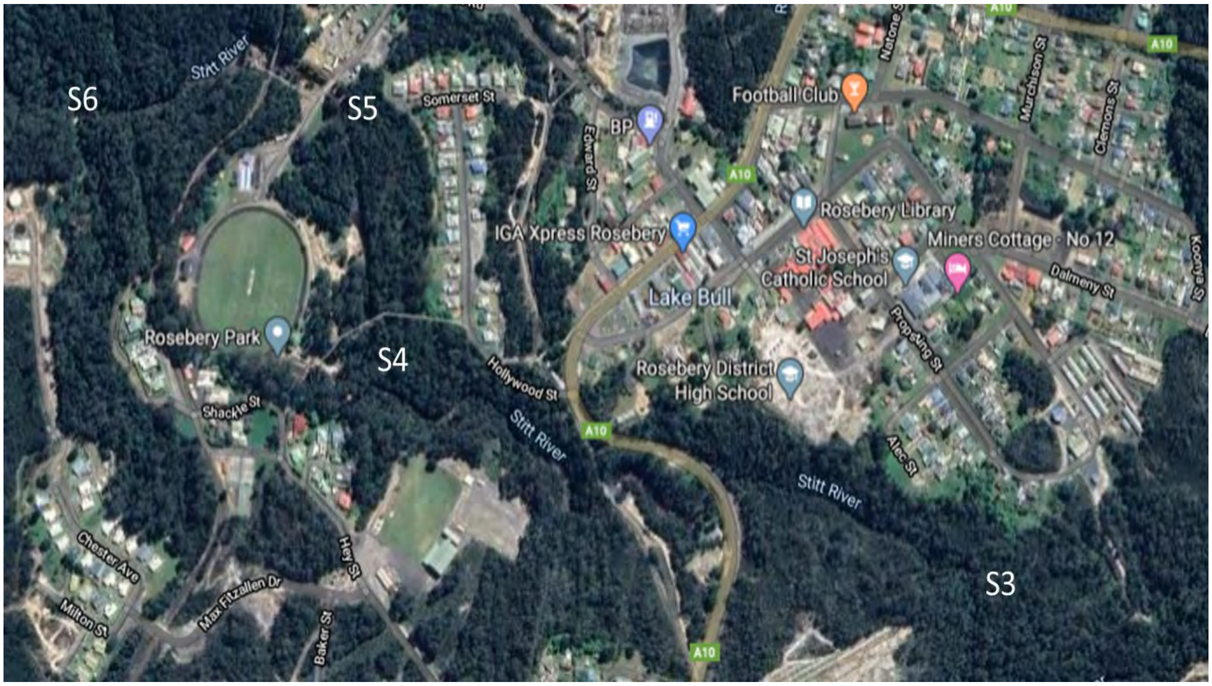

Figure 3b. Map of study sites in the lower Stitt River catchment.

3. Results

3.1 Reference sites

The macroinvertebrate fauna of the reference sites in the Sterling (STR1) and upper Stitt River (sites S0, S1, S2) continues to be relatively healthy and diverse (Tables 2 and 3). Overall reference means for family–level taxa per site (AUSRIVAS samples) were lower in spring 2022 (mean number of taxa/sample =14.5) compared to autumn 2023 (mean number of taxa/sample =18.25) (Tables 2 and 3).

The reference-site fauna continues to be dominated by Leptophlebiid mayflies, chironomid midges, Grypopterygid stoneflies, elmid beetles and a range of caddis larvae (Tables 2 and 3). This 'clean water' fauna has remained broadly consistent in composition since 2004. Several of these groups are sensitive to metals and acid mine drainage, and are generally absent or severely depressed in abundance when exposed to pollutants.

The results of the AUSRIVAS analyses for the Sterling River and three Stitt River reference sites are given in Tables 2 and 3. In spring 2022, reference sites were placed in the impairment band B ('similar to reference'), while in autumn 2023 reference sites were placed in impairment band A ('equivalent to reference') (Tables 2 and 3).

Table 2. Macroinvertebrate data from AUSRIVAS sampling in spring 2022, for the Stitt, Sterling and Ring Rivers, and for Bakers Creek and Dolcoath Creek. #1 and # 2 are replicate AUSRIVAS samples.

		Stream:	**Ring River**										**Baker Ck**	**Dolcoath Ck**
		Site:	R1		R2		R3		R5		R6		B1	D1
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#1
Annelida	Oligochaeta			3										
Arachnida	Acarina		1											
Crustacea	Amphipoda	Paramelitidae			1									
Insecta	Plecoptera	Eustheniidae	18	24	3	5		1	1	2		1		
		Austroperlidae		1										
		Gripopterygidae	11	9		4			1	6				
		Notonemouridae	3	6	14	2			6	8	7			
	Ephemeroptera	Leptophlebiidae		2										
	Hemiptera	Veliidae		1										
	Lepidoptera	Pyralidae					1		1					
	Diptera	Chironomidae:												
		subfam: Orthocladiinae	10	11		3			1	5		2		
		subfam: Podonominae	4	8	1									
		subfam: Tanypodinae			1									
		Simuliidae		1	1									
		Athericidae	1											
		Blephariceridae								1				
		Ceratopogonidae						1						
		Culicidae	1					1						
		Dip. Unid. Pup.							1					
	Trichoptera	Conoesucidae		1										
		Hydrobiosidae	1	1										
		Hydropsychidae	1											
		Leptoceridae			1									
		Philopotamidae		3		1								
	Coleoptera	ElmidaeA	1											
		ScirtidaeL	17	11	19	2			2					
		N Taxa	**12**	**14**	**8**	**6**	**1**	**3**	**7**	**5**	**1**	**2**	**0**	**0**
		O/Epa	**0.25**	**0.59**	**0.35**	**0.25**	**0.00**	**0.10**	**0.15**	**0.20**	**0.00**	**0.10**	**0.00**	**0.00**
		Band	**C**	**B**	**C**	**C**	**D**	**D**	**C**	**C**	**D**	**D**	**-**	**-**
		SIGNAL O/E	**1.12**	**1.12**	**0.92**	**1.19**	**-**	**1.16**	**1.16**	**1.10**	**1.00**	**1.16**	**-**	**-**
		EPT	**0.42**	**0.57**	**0.38**	**0.67**	**-**	**0.33**	**0.43**	**0.60**	**1.00**	**0.50**	**-**	**-**

		Stream:	**Sterling River**		**Stitt River**													
		Site:	STR1		S0		S1		S2		S3		S4		S5		S6	
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Nematomorpha		Gordiidae					1											
Annelida	Oligochaeta		20	22	1	2	4	4	2	2	6	3	1	5		5	5	
Arachnida	Acarina			3	1	5	1					3		4				2
Crustacea	Amphipoda	Paramelitidae	2	2		1	6	7	5	5	1	4	1					
Insecta	Plecoptera	Eustheniidae			4	8		4	7	4	1	1	2			2	2	1
		Austroperlidae					1	1	1				1	1				
		Gripopterygidae	5	5	7	18	7	7	13	7	7	5	12	9	12	10	19	40
		Notonemouridae													1	2		4
	Ephemeroptera	Leptophlebiidae	9	12	12	17	21	9	15	18	14	12	8	4	13	6	3	1
		Baetidae			14	17	6	4	10	5	14	6	4	5	1	2	1	
	Diptera	Chironomidae:																
		subfam: Chironominae	1				4	8	1		1	1	6	1	13			
		subfam: Orthocladiinae	6	6	3	3	7	4	2	6	8	4	10	6	14	3	14	17
		subfam: Podonominae	1		12	3	5	4	1	3	8	5	14	6	1	6	3	
		subfam: Tanypodinae	2	2						1	1				1			
		Simuliidae			4	3	3	1	2	4	13	8	3	1		5	1	2
		Tipulidae						2					2	1				2
		Athericidae										2	1		1		5	7
		Ceratopogonidae														1	1	1
	Trichoptera	Calocidae						1										
		Conoesucidae														1		
		Ecnomidae								1								
		Helicophidae				1												
		Helicopsychidae		1														
		Hydrobiosidae			9	16	6	10	16	16	15	14	12	8	5	7	7	7
		Hydropsychidae								1		1		1				
		Hydroptilidae	6	10														
		Leptoceridae	2	4			1		6	1	4	9	5	3	2	3	6	2
		Philopotamidae			1	4	2	3	1	4				1	1	3		
		Philorheithridae			1		2		1		1	2		2		1	3	1
	Coleoptera	ElmidaeA			1	3	3	1	4		15	10	8	6	9	4	4	4
		DytiscidaeA				1												
		ElmidaeL										2						
		ScirtidaeL	1	1						1	2	1	6	4	2	3		5
		PsepheniidaeL	1															
		N Taxa	**12**	**11**	**13**	**15**	**17**	**16**	**16**	**16**	**16**	**19**	**17**	**18**	**14**	**17**	**14**	**15**
		O/E	**0.54**	**0.49**	**0.59**	**0.59**	**0.74**	**0.74**	**0.74**	**0.69**	**0.69**	**0.84**	**0.74**	**0.79**	**0.54**	**0.69**	**0.64**	**0.59**
		Band	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**A**	**B**	**B**	**B**	**B**	**B**	**B**
		SIGNAL O/E	**0.80**	**0.83**	**1.07**	**1.04**	**0.97**	**1.03**	**1.02**	**0.94**	**0.93**	**0.99**	**1.00**	**1.02**	**1.03**	**1.04**	**1.04**	**1.12**
		EPT	**0.33**	**0.45**	**0.54**	**0.47**	**0.47**	**0.50**	**0.56**	**0.56**	**0.44**	**0.42**	**0.41**	**0.50**	**0.50**	**0.59**	**0.50**	**0.47**

Table 3. Macroinvertebrate data from AUSRIVAS sampling in Autumn 2022, for the Stitt, Sterling and Ring Rivers, and for Bakers Creek and Dolcoath Creek. #1 and # 2 are replicate AUSRIVAS samples.

		Stream:	**Ring River**										**Baker Ck**	**Dolcoath Ck**
		Site:	R1		R2		R3		R5		R6		B1	D1
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#1
Platyhelminthes	Turbellaria		1			1								
Annelida	Oligochaeta		2	3										
Arachnida	Acarina		1	1		1						1		
Crustacea	Amphipoda	Paramelitidae			1									
		Ceinidae											1	
Insecta	Plecoptera	Eustheniidae	28	30	6	4			1			6		
		Gripopterygidae	13	13	12	26	1		1		1	9		4
		Notonemouridae	7	20	5	4	3		1	1		1	1	3
	Ephemeroptera	Leptophlebiidae	3			3								
		Baetidae		1										
	Diptera	Chironomidae:												
		subfam: Chironominae											3	
		subfam: Orthocladiinae	7	3	1	1			1	1	2	4	1	
		subfam: Podonominae	19	19	1	4		1				1		1
		subfam: Tanypodinae				5								
		Simuliidae			3									
		Tipulidae								1				
		Athericidae								2				
	Trichoptera	Conoesucidae	1											
		Hydrobiosidae		1	1									
		Hydropsychidae									1	3		
		Philopotamidae	1		1									
		Philorheithridae			1						1			
	Coleoptera	ElmidaeA	1											
		ScirtidaeL	3	7	1	1								
		DytiscidaeL											2	
		N Taxa	**13**	**10**	**11**	**10**	**2**	**1**	**4**	**4**	**4**	**7**	**5**	**3**
		O/Epa	**0.72**	**0.70**	**0.68**	**0.49**	**0.12**	**0.06**	**0.24**	**0.24**	**0.23**	**0.40**	**0.17**	**0.17**
		Band	**B**	**B**	**B**	**B**	**D**	**D**	**C**	**C**	**C**	**C**	**C**	**C**
		SIGNAL O/E	**0.90**	**0.91**	**0.99**	**0.85**	**1.16**	**1.00**	**1.16**	**1.00**	**1.09**	**1.01**	**0.80**	**1.16**
		EPT	**0.46**	**0.50**	**0.55**	**0.40**	**1.00**	**0.00**	**0.75**	**0.25**	**0.75**	**0.57**	**0.20**	**0.67**

Table 3 (cont.)

		Stream:	Sterling River		Stitt River													
		Site:	STR1		S0		S1		S2		S3		S4		S5		S6	
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Nematomorpha		Gordiidae												1				
Annelida	Oligochaeta		3	1	1	2	3	3	1	4	1	6	5	9	3	8		1
Arachnida	Acarina		1	4	7	5	5	4	1	3		2		2	3	5	10	12
Crustacea	Amphipoda	Paramelitidae	16	4	1	7	9	4	4	9	5	8	1	1	1			
Insecta	Plecoptera	Eustheniidae	3	6	8	10	1	6	2	3	1	7	1	1				
		Austroperlidae		1														
		Gripopterygidae	7	3	3	14	3	12	2	5		2	4	1	1	2		5
		Notonemouridae													2	3	3	8
	Ephemeroptera	Leptophlebiidae	22	15	25	9	26	24	3	22	32	20	3	4	12	28	5	
		Baetidae	12	12	35	23	10	30	4	22	10	18	1	8	1	1		
	Odonata	Telephlebiidae				1										1		
	Diptera	Chironomidae:																
		subfam: Chironominae	2	4	3	2	1	1				3	1		1	1	2	1
		subfam: Orthocladiinae	1	2		3	1	3	3	2		5	3	6	3	1	5	5
		subfam: Podonominae	2	1	3	9	9	4	5	5	2			2	1	4	2	1
		Simuliidae	1	1		4	1	4		3	8	3	2	5	1	5	1	
		Tipulidae				1	2				2		1	2				
		Athericidae					1								2	3	3	8
		Ceratopogonidae													1			
	Trichoptera	Calocidae			1													
		Conoesucidae	4	3	2	1	2	5		1		1	1				1	
		Hydrobiosidae	12	16	20	17	28		4	23	35	21	24	10	10	11	14	12
		Hydropsychidae	1		5		2	1	1				1					
		Hydroptilidae	2	2			4						1					
		Leptoceridae	4	7	7	21	5	15	1	16	14	20	2	10	18	6	2	4
		Philopotamidae			1	5												
		Philorheithridae	1	8			3	11		5	4	8	3	5	3	4	1	
	Coleoptera	ElmidaeA	4	3	1	2	3	4	2	6	11	12	15	17		8		
		ElmidaeL		3	1			1			1	3					1	1
		ScirtidaeL	1		1		2	2	1	2	10	14	12	29	12	15	4	3
		PsepheniidaeL	1	1				1						1	1		1	
		N Taxa	**20**	**20**	**18**	**18**	**21**	**19**	**14**	**16**	**14**	**17**	**18**	**18**	**18**	**17**	**15**	**12**
		O/E	**1.12**	**1.12**	**1.05**	**1.05**	**1.16**	**1.11**	**0.79**	**0.91**	**0.79**	**0.96**	**0.96**	**0.96**	**1.00**	**0.94**	**0.83**	**0.66**
		Band	**A**	**A**	**A**	**A**	**A**	**A**	**B**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**B**
		SIGNAL O/E	**0.87**	**0.94**	**0.94**	**0.94**	**0.89**	**0.88**	**0.87**	**0.90**	**0.94**	**0.89**	**0.91**	**0.91**	**0.86**	**0.93**	**0.97**	**0.85**
		EPT	**0.30**	**0.35**	**0.33**	**0.33**	**0.29**	**0.32**	**0.36**	**0.38**	**0.36**	**0.35**	**0.33**	**0.33**	**0.28**	**0.35**	**0.20**	**0.17**

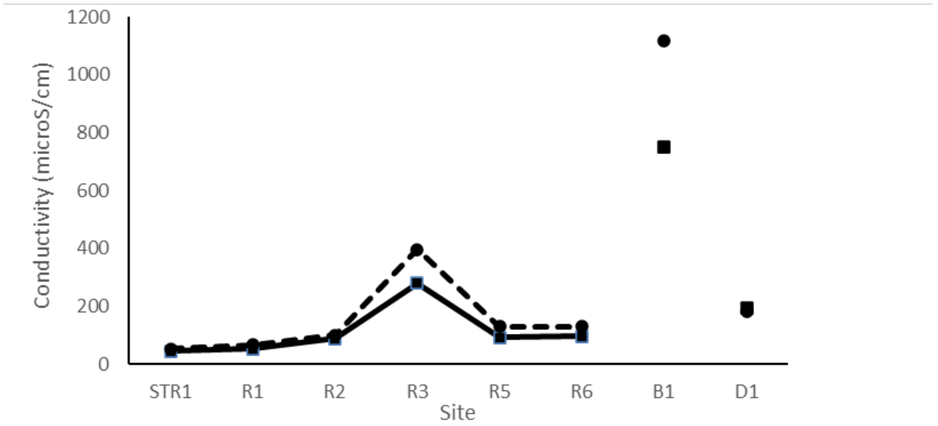

Figure 4. Conductivity (μS/cm) at the five Ring River sites (R1-6), plus the Sterling River reference site (STR1), Bakers Creek (B1) and Dolcoath Creek (D1), in spring 2022 (solid line) and autumn 2023 (dashed line).

3.2 Ring River

3.2.1 Conductivity

In both spring 2022 and autumn 2023, conductivity in the Ring River increased sharply immediately below Bakers Creek (R3), then declined to lower levels by the two most downstream sites. The conductivity in Dolcoath Creek was at intermediate levels in both seasons (spring 2022 and autumn 2023 conductivity: 193.4 and 180.0 microS/cm, respectively), while the conductivity in Bakers Creek was again very high in both seasons (spring 2022 and autumn 2023 conductivity: 750 and 1116 microS/cm, respectively) (Figure 4).

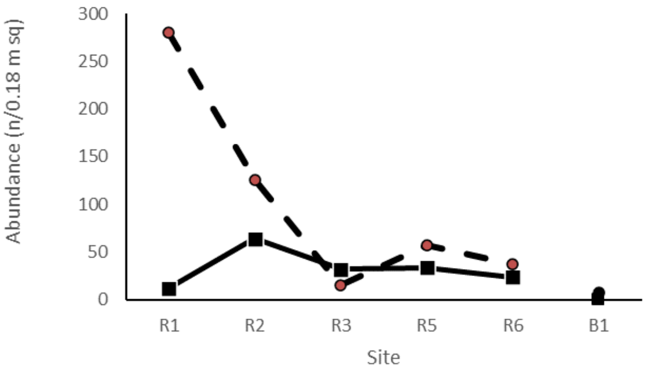

Figure 4. Trends in total benthic macroinvertebrate abundance (from Surber data) in spring 2022 (solid line) and autumn 2023 (dashed line) at the five Ring River sites (R1-6), and in Bakers Creek (B1).

3.2.2 Macroinvertebrates

In spring 2022, macroinvertebrate abundance was relatively low at all Ring River sites, and in particular for the most upstream site at Williamsford (Figure 4). Downstream of Williamsford, there was steady decline in abundance with very low abundance in the lower reaches of the Ring River (Figure 4). In autumn 2022, there was a marked decline in abundance between R1 and R3, with abundance rising slightly at the most downstream sites R5 and R6. Macroinvertebrate abundance in Bakers Creek was extremely low (< 10 animals/m^2 in both seasons), as has been the case in previous years.

In both seasons, macroinvertebrate diversity (from AUSRIVAS samples) declined between R1 to R3 in both seasons, with a partial recovery in taxon richness at the two most downstream sites R5 and R6 (Figure 5). No macroinvertebrates were captured in Bakers Creek and Dolcoath Creek in spring 2022. In autumn 2023, taxon richness in both Bakers Creek and Dolcoath Creek was comparable to the lower reaches of the Ring River (Figure 5).

The faunal composition of samples from the most upstream site R1 at Williamsford included a range of pollution sensitive taxa in both seasons, indicating relatively good water conditions in both seasons (Tables 2 and 3). Downstream of the Williamsford site, there was an incremental loss of pollution-sensitive taxa, particularly evident at the site downstream of Bakers Creek (Tables 2 and 3). Overall, the lower reaches of the Ring River continues to experience a degree of water quality impairment associated with metals.

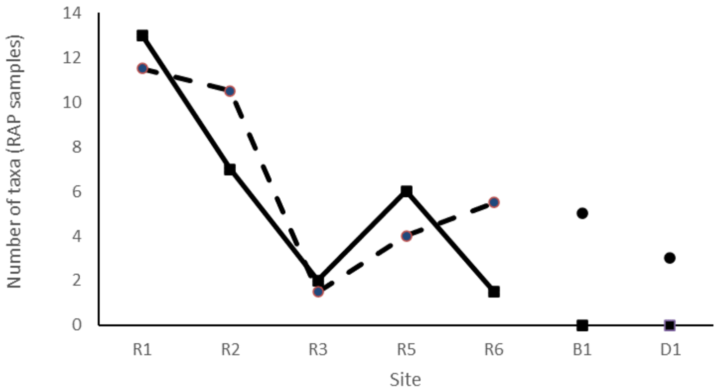

Figure 5. Trends in taxon richness (mean of two RAP samples) in spring 2022 (solid line) and autumn 2023 (dashed line) at the five Ring River sites (R1-6), and in Bakers Creek (B1) and Dolcoath Creek (D1).

The results of the AUSRIVAS analyses for the Ring River are given in Tables 2 and 3 for spring 2022 and autumn 2023, and are presented graphically in Figure 6 for the autumn seasons from 2019 to 2023. In all years including autumn 2023, the uppermost Ring River site at Williamsford has been located in the mid to lower range of AUSRIVAS impairment band B ('near reference condition') or in the upper range of impairment band C ('moderately impaired'). In autumn 2023, as has been the case in most years, there was a trend for O/E values to decline moving downstream from R1 to R3 (downstream of Bakers Creek), with O/E values then increasing slightly at the two lower Ring River sites R5 and R6.

Figure 6. Trends in O/Epa values at the five Ring River sites in the autumn seasons for 2019 to 2023. O/Epa values are the mean of two RAP replicates. AUSRIVAS impairment bands A - D are also shown.

3.3 Stitt River

3.3.1 Conductivity

Conductivity levels in the Stitt River in spring 2022 ranged between 49.1 to 62.4 µS/cm, while in autumn 2023, conductivity ranged between 55.5 to 73.4 µS/cm. In both seasons there was an overall trend for increasing conductivity moving downstream (Figure 7).

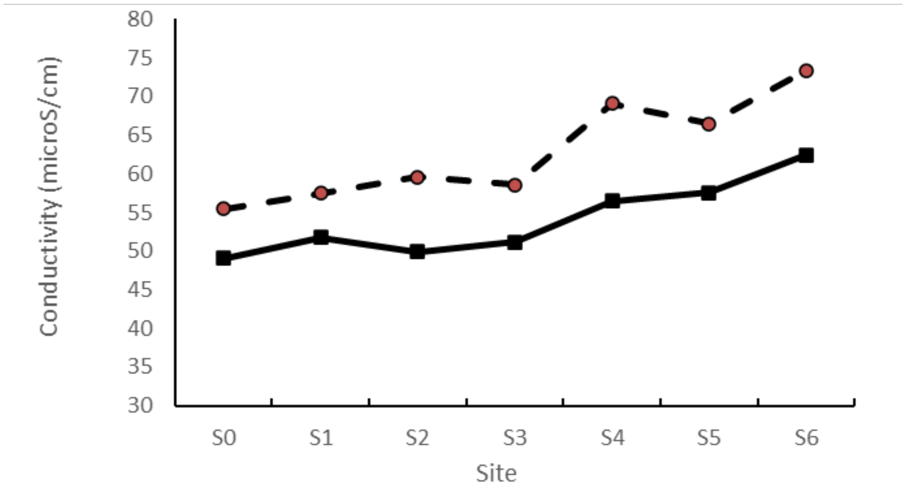

Figure 7. Conductivity (µS/cm) in spring 2022 (solid line) and autumn 2023 (dashed line) at the Stitt River sites S0 to S6.

3.3.2 Macroinvertebrates

Total macroinvertebrate abundances for the Sterling River (STR1) and Stitt River sites (S0 - S6) are shown in Figure 8. In spring 2022, abundance estimates in the Stitt River were relatively low across all sites (< 770 animals/m^2), with substantial variation between sites (Figure 8). In autumn 2022, abundance estimates for sites S0 – S4 were generally similar (400 – 600 animals/m^2), with a decline in abundance at the two most downstream sires S5 and S6 (Figure 8).

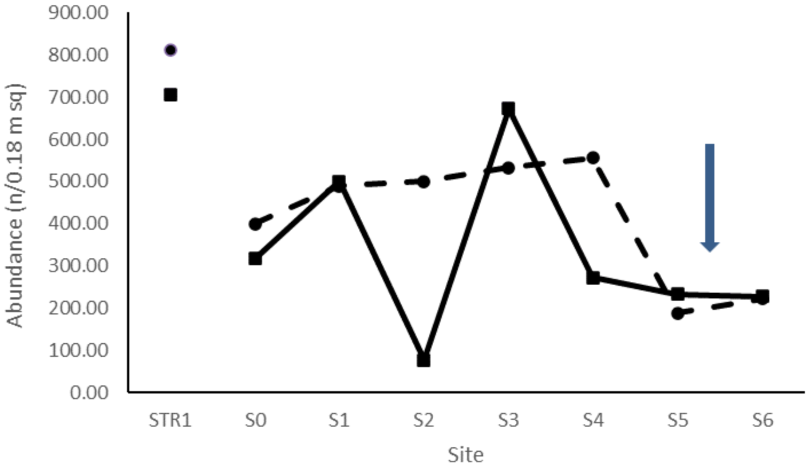

Figure 8. Trends in total benthic macroinvertebrate abundance (from Surber data) in spring 2022 (solid line) and autumn 2023 (dashed line) in the Sterling River (STR1) and in the Stitt River sites S0 to S6.

Macroinvertebrate diversity varied substantially between sites in both seasons, with no clear trend moving downstream in either season (Figure 9). The results of the AUSRIVAS analyses for the Stitt River are given in Tables 2 and 3, and the trends in the O/E ratio are shown in Figure 10. The O/E ratios were consistently higher in autumn 2023 compared to spring 2022. In spring 2022, the majority of Stitt River sites were placed in AUSRIVAS impairment band B ('near reference condition'), while in autumn 2023 most sites were placed in impairment band A ('same as reference' (Tables 2 and 3). There was no obvious trend for a decline in the O/E ratio in either season (Figure 10).

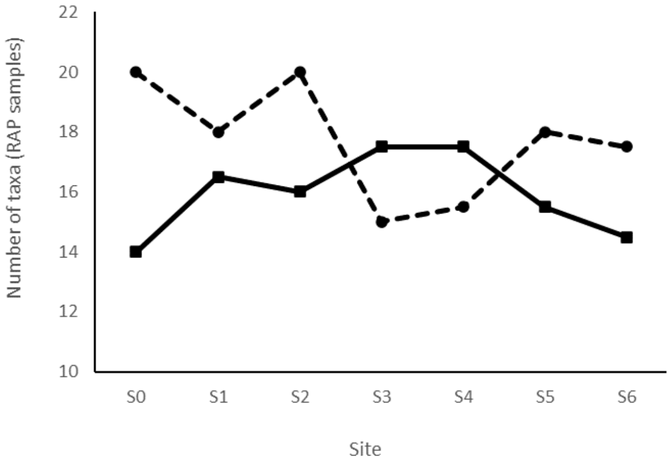

Figure 9. Trends in taxon richness (mean of two RAP samples) in spring 2022 (solid line) and autumn 2023 (dashed line) in the Sterling River (STR1) reference site and in the Stitt River sites S0 to S6.

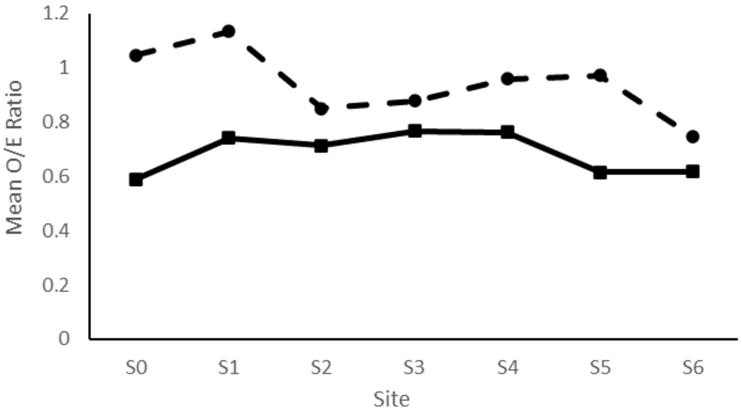

Figure 10. Trends in O/E values for the Stitt River sites S0 to S6 in spring 2022 (solid line) and autumn 2023 (dashed line).

3.2.3 Fish

Fish were surveyed in Stitt River sites S1 to S5 and in the Sterling River in spring 2022 (Table 4). Adult brown trout were recorded at all Stitt Rivers sites including substantial numbers of adult and juvenile brown trout captured at site S5 (Table 4).

Table 4. Fish caught in spring 2022 in the Sterling and Stitt Rivers.

		River:	**Sterling River**	**Stitt River**				
		Site:	at Murchison Hwy	u/s Mountain Ck	u/s tailings	d/s tailings	at footbridge	at road bridge
Species	**Life stage**		STR1	S1	S2	S3	S4	S5
Salmo trutta	**Adult**		22	15	8	16	1	16
	Juvenile							4

3.4. TRCI River Condition assessment

A TRCI analysis was carried for the autumn 2023 survey results. Macroinvertebrate monitoring results used as inputs to the TRCI scoring are shown in Table 5. The results of the TRCI assessment of macroinvertebrate community condition are shown in Table 6.

The condition of the macroinvertebrate community in two upper catchment sites in the Ring River was rated as Moderate, the site immediately downstream of Bakers Creek was rated in Extremely Poor condition, with the two most downstream sites rated in Poor condition (Table 6).

The Sterling River was rated in Good overall condition (Table 6). All sites in the Stitt River were rated in Moderate condition, due to relatively low scores for abundance at all sites (Table 6).

Table 5. Results for macroinvertebrates used to derive TRCI Indicator scores for Ring River and Stitt River sites in autumn 2023.

	Ring River					**Bakers Ck**	**Dolcoath Ck**
AUSRIVAS	**R1**	**R2**	**R3**	**R5**	**R6**	**B1**	**D1**
Mean O/Epa	**0.71**	**0.59**	**0.09**	**0.24**	**0.31**	**0.17**	**0.17**
Mean O/Epa Band	**B**	**B**	**D**	**C**	**C**	**C**	**C**
Mean SIGNAL O/E	**0.90**	**0.92**	**1.08**	**1.08**	**1.05**	**0.80**	**1.16**
Mean EPT	**0.48**	**0.47**	**0.50**	**0.50**	**0.66**	**0.20**	**0.67**
Abundance (per m^2)	**280**	**126**	**15**	**57**	**37**	**8**	**-**

	Stitt River							
AUSRIVAS	**STR1**	**S0**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Mean O/Epa	**1.12**	**1.05**	**1.13**	**0.85**	**0.88**	**0.96**	**0.97**	**0.75**
Mean O/Epa Band	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**B**
Mean SIGNAL O/E	**0.91**	**0.94**	**0.88**	**0.88**	**0.91**	**0.91**	**0.90**	**0.91**
Mean EPT	**0.33**	**0.33**	**0.30**	**0.37**	**0.36**	**0.33**	**0.32**	**0.18**
Abundance (per m^2)	**2,030**	**2,580**	**2,088**	**1,055**	**1,010**	**790**	**1,010**	**580**

Table 6. TRCI Macroinvertebrate scores for autumn 2023.

Stream	Site	Expectedness MIe	Abundance MIa	Composition MIc	Condition MI
Ring River	**R1**	High	Low	High	**Moderate**
	R2	High	Low	High	**Moderate**
	R3	Moderate	Low	High	**Poor**
	R5	Moderate	Low	High	**Poor**
	R6	Moderate	Low	High	**Poor**
Sterling River	**STR1**	High	High	Moderate	**Good**
Stitt River	**S0**	High	Low	Moderate	**Moderate**
	S1	High	Low	Moderate	**Moderate**
	S2	High	Low	High	**Moderate**
	S3	High	Low	High	**Moderate**
	S4	High	Low	Moderate	**Moderate**
	S5	High	Low	Moderate	**Moderate**
	S6	High	Low	Low	**Moderate**

4. Discussion

4.1. Ring River

The lower reaches of the Ring River remain in a degraded condition. In both spring 2022 and autumn 2023, there was a sharp decline in river condition downstream of Bakers Creek, with a slight improvement in the most downstream sites. Both Bakers and Dolcoath Creeks remain in a highly degraded condition. Bakers Creek is the principal source of contaminants for the Ring River, and Bakers Creek continues to have very high conductivity and low macroinvertebrate abundance and diversity. The primary reasons for poor condition of river fauna communities in the Ring continue to be pollution from the Hercules mine area via Bakers Creek.

4.2 Stitt River

Overall, the Stitt River is in a substantially better ecological condition than the Ring River. There appears to have been further improvement in the condition of the lower Stitt River, with a range of clean-water macroinvertebrate taxa now present at all sites in the Stitt River including in the lower reaches. In autumn 2023, most sites were placed in thd Stitt River were placed in impairment band A (‘same as reference’), and all sites were rated in Moderate overall condition using the TRCI integrative analysis.

Adult and juvenile brown trout have been regularly recorded in the lower reaches of the Stitt River since 2020, including in autumn 2023 although the numbers of trout tend to be reduced in the lower reaches of the river. Nevertheless, the consistent capture of adult and juvenile tout at all sites in the Stitt River indicates that a self-sustaining population of trout now occurs throughout the Stitt River including in the lower reaches.

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Appendix G Annual Air Quality Report – FY23 (EY, 2023)

Annual Air Quality Report - FY23

MMG - Rosebery Mine

20 September 2023

Building a better working world

RELEASE NOTICE

Ernst & Young ("**EY**") was engaged on the instructions of MMG Rosebery Mine ("**Client**") to assess the air quality data in regards to their EPN and PCE conditions ("**Project**"), in accordance with the engagement agreement dated 2 June 2023 ("the **Engagement Agreement**").

The results of EY's work, including the assumptions and qualifications made in preparing the report, are set out in EY's report dated 19 September 2023 ("**Report**"). You should read the Report in its entirety including any disclaimers and attachments. A reference to the Report includes any part of the Report. No further work has been undertaken by EY since the date of the Report to update it.

Unless otherwise agreed in writing with EY, any party accessing the Report or obtaining a copy of the Report ("Recipient") agrees that its access to the Report is provided by EY subject to the following terms:

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Ernst & Young's liability is limited by a scheme approved under Professional Standards Legislation.

Executive Summary

MMG's Rosebery Mine has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.6 & PCE 9084 conditions A4-5 & G6 1.7). The air quality monitoring programme includes the use of high-volume air samplers (HVAS) with co-located DustTraks and dust deposition gauges (DDG). The EPN and PCE include compliance and trigger limits for ambient concentrations of particulate matter (TSP, PM_{10}) and metals concentrations (lead, cadmium, zinc), along with dust deposition rates.

The FY23 period had no deviations from the EPN monitoring requirements as all analysis was completed by a NATA accredited laboratory for the relevant Australian Standard: ALS Environment - NATA Accreditation No. 825.

A total of 19 HVAS samples were considered invalid during FY23 monitoring period. Three of the invalid samples were due to HVAS unit disfunction. The remaining 16 invalid samples were missing due to a scheduling error in the changing of the filter papers between sample days, meaning a single filter was used for multiple sample days. Additionally, a total of three DDG samples were considered invalid due to laboratory error or contamination during the month collection period. An additional 59 DDG samples were invalid due to months with high rainfall events, which is typical of the region, causing all the DDG to overflow with water.

The HVAS and DDG compliance against the relevant EPN and PCE conditions are presented in Table 1 and Table 2, respectively. There were no reported exceedances of the compliance limits in FY23 indicating that the Rosebery Mine activities are a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Considering the low environmental risk to air quality and the typical high amount of annual rainfall, a small targeted network could provide more meaningful information regarding the mining operation's dust impact. Based on this assessment, it is recommended that the air quality monitoring network is consolidated.

In addition to the annual air quality report, the dust management performance was also assessed. The assessment concluded the Rosebery Mine should continue its current mitigation management and mitigation measures. It is also recommended that the proposed mitigation and inspection trigger levels are checked within three years to understand if they are sufficient to assist in the continued control of dust emissions from Rosebery Mine.

Table 1: HVAS Compliance against EPN 7153/3 Condition A2 and PCE 9084 Condition A4

Averaging period	Pollutant	AD3	AD2.1	Giblin St	Alec St	AD3	AD2.1	Giblin St	Alec St
		Trigger Level				Compliance Limit			
24 hour average	TSP	✓	✓	✓	✓	-	-	-	-
	PM_{10}	✓	✓	✓	✓	✓	✓	✓	✓
	Lead (as TSP)	✓	✓	✓	✓	-	-	-	-
	Cadmium (as PM_{10})	✓	✓	✓	✓	-	-	-	-
	Zinc (as PM_{10})	✓	✓	✓	✓	-	-	-	-
Annual average	TSP	-	-	-	-	✓	✓	✓	✓
90 day average	Lead (as TSP)	-	-	-	-	✓	✓	✓	✓

Notes:
Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit
Dash denotes the trigger level or compliance limit is not applicable

Table 2: DDG Compliance against EPN 7153/3 Condition A3 and PCE 9084 Condition A5

Site	Monthly Deposited Dust above background	Monthly Total Deposited Dust	Annual Average Deposited Dust above background	Annual Average Total Deposited Dust
	Trigger Level		Compliance Level	
AD3	✓	✓	✓	✓
AD4	✓	✓	✓	✓
AD11	x	x	✓	✓
AD21	x	x	✓	✓
AD22	✓	✓	✓	✓
BG3	✓	✓	✓	✓

Notes:
Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit

Table of contents

1. Introduction

MMG's Rosebery Mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania. MMG has an obligation under its Permits (Permit 1094 as varied by Environmental Protection Notice 7153/3, Permit 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its meteorological, dust deposition and ambient air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.6 & PCE 9084 conditions A4-5, G6 & M3).

Condition G7 of EPN 7153/3 requires that an analysis of air quality is performed annually. MMG Rosebery Mine engaged EY to complete the annual air quality analysis for FY23. This report provides a summary of the dust deposition and air quality monitoring data against the EPN and PCE conditions. In addition, an assessment of the Dust Mitigation Plan was performed to understand if the current plan is sufficient to minimise environmental risk.

The purpose of this report is to comply with the regulatory requirements outlined in EPN 7153/3. In that the report aims to understand the environmental risk to air quality resulting from the MMG Rosebery Mine activities based on the monitoring network data. Further, the report provides recommendations for additional/modification to the monitoring network or emissions mitigation measures aimed to better understand or reduce environmental risk.

1.1 EPN and PCE Requirements

MMG is required to comply with the conditions detailed in EPN 7153/3 and PCE 9084. Table 3 and Table 4 present the compliance limits and trigger levels for the high volume air sampling (HVAS) and dust deposition gauges (DDG) respectively. As per paragraph 2 in section A3 of EPN 7153/3, monthly deposition measurements must be adjusted to account for the background deposition rate. For each sampling month, the background is defined as the minimum of the measured dust deposition rates. Table 5 outlines the sections of this report that address conditions of the EPN section A5-3 Reporting of monitoring.

Table 3: EPN 7153/3 HVAS compliance limits and trigger levels

Pollutant	Compliance limit	Trigger levels
Total Suspended Particles (TSP)	0.090 mg/m^3 annual average	0.150 mg/m^3 24 hour average
Particulate Matter sub 10 micron (PM$_{10}$)	0.150 mg/m^3 24 hour average	0.050 mg/m^3 24 hour average
Lead (as TSP)	0.0015 mg/m^3 90 day average	0.0087 mg/m^3 24 hour average
Cadmium (as PM$_{10}$)	-	0.000003 mg/m^3 24 hour average[1]
Zinc (as PM$_{10}$)	-	0.015 mg/m^3 24 hour average[1]

Note:

[1] 24 hour average was not specified within the EPN and PCE documents but was applied to be consistent with the other trigger level averaging periods

Table 4: EPN 7153/3 dust deposition gauge compliance limits and trigger levels

Pollutant	**Compliance limit**	**Trigger levels**
Deposited dust	2.0 g/m^2/month as an annual average increase above background at/or beyond the site boundary.	2.0 g/m^2/month as an increase above background at/or beyond the site boundary (monthly trigger level).
Deposited dust	4.0 g/m^2/month as an annual average at/or beyond the site boundary.	4.0 g/m^2/month as total deposition experiences at/or beyond the site boundary (monthly trigger level).

Note: The site boundary is defined as the Rosebery Mine boundary.

Table 5: EPN 7153/3 condition A5-3 and relevant sections of this report

EPN 7153/3 condition A5-3		**Report section**
3.1	Tabulated high volume air sampler, and dust and metals deposition results for the entire year, showing intermediate values as well as final monitoring results	Final monitoring results are provided in Section 3.1 and 3.2 with additional plots showing intermediate values are provided in Appendix A
3.2	Tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs	Section 3.2 with additional plots provided in Appendix A
3.3	Monthly deposition isopleths or graphs of total dust and metal deposition and increment above 'background'	Section 3.2 with additional plots provided in Appendix A
3.4	Summaries of all exceedances occurring within the reporting year, describing the results of any investigations undertaken and the mitigation measures that were adopted in response	Section 3.1 and 3.2
3.5	Any supporting data analysis or description necessary to aid interpretation of the dataset	Additional plots showing intermediate values are provided in Appendix A

1.2 Monitoring Network Locations

As dictated within EPN 7153/3 and PCE 9084, the coordinates and IDs for the air quality monitoring locations are presented in Table 6 and Figure 1. The monitoring network, required by EPN 7153/3, consists of four HVAS locations measuring both TSP and PM_{10} and eleven DDGs located across the township of Rosebery, including a gauge at the Rosebery golf course (BG3). In additional to the HVAS and DDG locations, four DustTrak's are collocated with the HVAS monitors. The DustTrak units are used to provide real time alerts for the mitigation of dust from site as outlined in MMG Rosebery's Dust Mitigation Plan (MMG, 2020). As the criteria presented in Table 4 are applicable to locations at or beyond the site boundary, the trigger levels do not apply to the DDGs AD1.1, AD2, AD5, AD23 and AD25 as they are located within the Rosebery Mine site boundary. The deposition rates at locations outside of the site boundary are presented in graphical format in Appendix A.

Table 6: Monitoring locations

Monitoring site ID	Monitoring location description	Location (WGS 84 Zone 55S)	
		Easting (km)	Northing (km)
HVAS (EPN) and collocated DustTrak			
AD2.1	Former PMR Training Centre on Arthur Street (near the Core Shed)	378.63	5,374.00
AD3	15 Beech Street (near the Filter Plant)	377.71	5,374.49
Giblin St	Giblin Street	378.63	5,373.18
Alec St	Alec Street	378.97	5,373.41
DDG (EPN within the mine boundary)			
AD1.1	Mine Office Building on Hospital Road	378.81	5,374.19
AD2	Former PMR Training Centre on Mill Road	378.66	5,373.91
AD5	Breaker Station/Crusher	378.65	5,374.23
AD23	Filter Plant Carpark	377.78	5,374.51
AD25	Passing Bay on Filter Plant Road	378.27	5,374.21
DDG (EPN at/or beyond the mine boundary)			
AD3	15 Beech Drive (near the HVAS)	377.70	5,374.49
AD4	Near Rosebery Station	378.61	5,373.18
AD11	Front yard of 1 Howard Street	377.90	5,374.38
AD21	Backyard in 9 Murchison St	379.07	5,373.89
AD22	Front yard of 21 Dalmeny St	379.29	5,373.60
BG3	Rosebery Golf Course	375.59	5,372.78

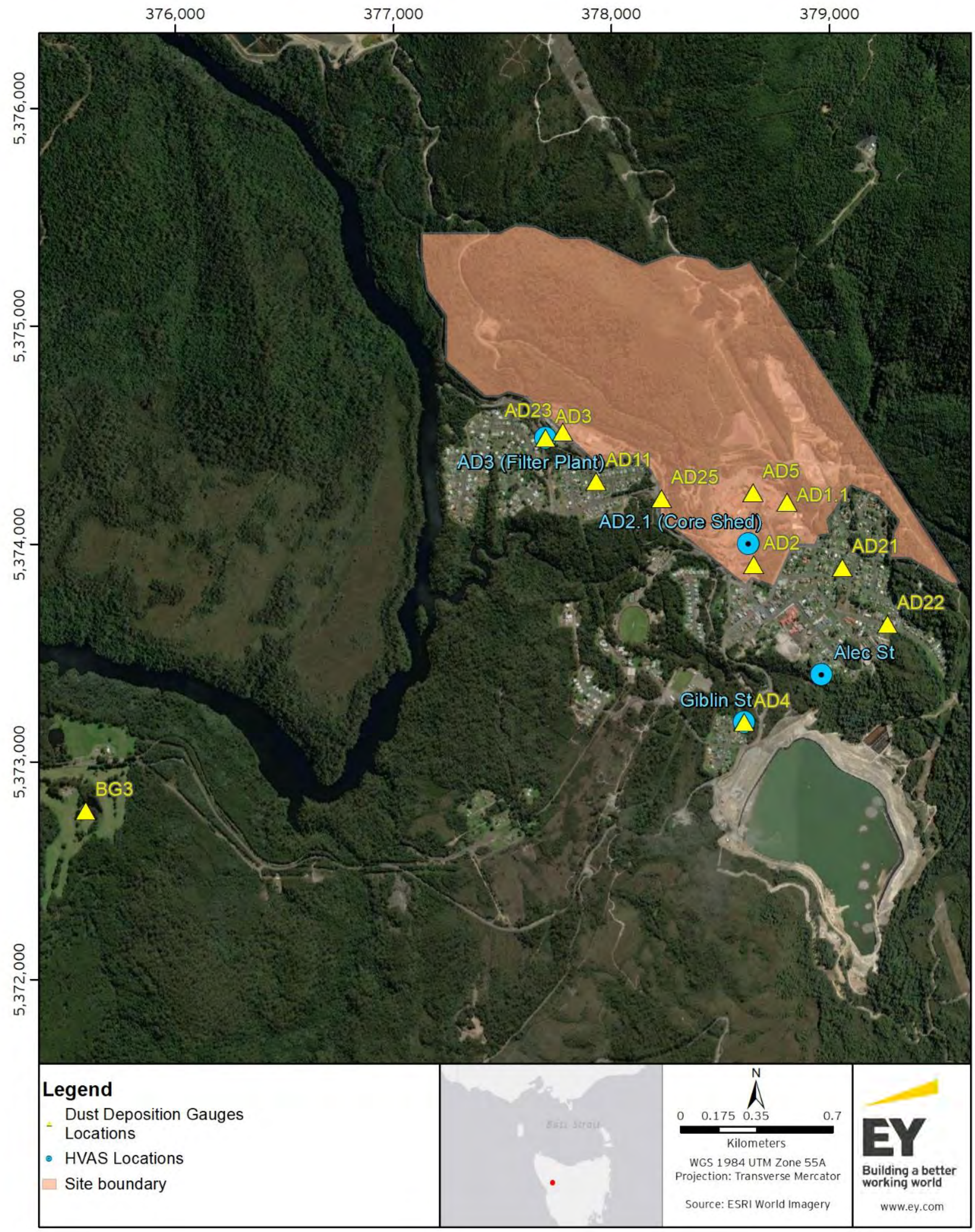

Figure 1: Air Quality Monitoring Locations

2. Sampling Procedures

2.1 High Volume Air Sampling

The HVAS monitors sample TSP and PM_{10} that is then analysed for compositions of lead (as TSP), cadmium (as PM_{10}) and zinc (as PM_{10}). Arsenic and copper are also analysed, however trigger levels and compliance limits of these substances are not included as part of EPN/PCE requirements. Sampling of the 24-hour average concentrations (µg/m^3) occurs once every 6 days.

A total of 19 samples were considered invalid[1] during FY23 monitoring period as summarised in Table 7. Three of the invalid samples were due to errors with the HVAS unit mechanical functions. The remaining 16 samples were missing due to a scheduling error causing the filter paper to be run for two sample days, which does not meet the sampling criteria. MMG has implemented a number of corrective actions based on the internal investigation of the missed sampling event (MMG, 2023). These include digitised versions of the monthly monitoring schedules and including HVAS run dates in the MMG Environmental Advisor's Calendar. Additional checks of daily tasks and schedules are to be completed by the MMG Environmental Advisor.

All HVAS monitors were externally calibrated by Ecotech on 24 January 2023 with periodic internal flow calibrations completed throughout the year.

Table 7: Invalid samples

Sample date	Location	Air pollutant	Comment
02/08/2022	AD2.1 (Core Shed)	TSP	Results were considered invalid due to a motor drive error or blockage errors of the HVAS unit.
04/02/2023	AD2.1 (Core Shed)	TSP	
29/05/2023	AD2.1 (Core Shed)	TSP	
22/06/2023	All locations	TSP and PM_{10}	Due to a scheduling error, filter papers were not changed on the correct date leading to two days sampled on the one filter paper. Results were not sent to ALS for analysis.
28/06/2023	All locations	TSP and PM_{10}	

Sampling and analysis of TSP was performed using the EA143-MV method and referenced to Australian/New Zealand Standards AS/NZS 3580.9.3:2015: Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method (Australian/New Zealand Standard, 2015).

Sampling and analysis of PM_{10} was performed using Australian Standards AS 3580.9.6:2015: Determination of suspended particulate matter – PM_{10} high volume sampler with size-selective inlet – Gravimetric method, Monitoring Analysis (Australian/New Zealand Standard, 2015).

TSP, PM_{10} and metals analysis was performed by a NATA accredited laboratory (ALS Environmental – NATA Accreditation No. 825, Site No. 1656). The HVAS samples were then digested in nitric acid and analysed for metals by inductively coupled plasma mass spectrometry (ICPMS).

There were no recorded deviations from the sampling procedures for the HVAS sampling in FY23. The HVAS air monitoring complies with the applicable elements of EPN 7153/3 condition M1 as samples are analysed as per Australian Standard at a NATA accredited laboratory.

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[1] AS 3580.19-2020 defines 'valid' as accurate, complete or meets specified criteria, therefore the term 'invalid' is defined as not meeting specified criteria, incomplete or is inaccurate.

2.2 Dust Deposition Gauges

Monthly dust deposition gauge bottles are sent to ALS Environmental for analysis (NATA Accreditation No. 825, Site No. 13778). Total solids (mg), total insoluble matter (TIM, g/m^2/month), total soluble matter (g/m^2/month) and metals (arsenic, cadmium, copper, lead, manganese and zinc, µg/m^2/month) are analysed. Note that only TIM has trigger levels and compliance limits in EPN 7153/3.

A total of 59 samples were invalid due to high rainfall events flooding the DDGs. The remaining three invalid samples were due to laboratory error or contamination during the month collection period.

Table 8: Invalid samples

Sample month	Location	Comment
August 2022	All locations	High rainfall events flooded the gauges, resulting in no recorded data.
October 2022	AD25	
November 2022	AD23, AD25	
March 2023	All locations	
April 2023	All locations	
May 2023	All locations	
June 2023	All locations	

Sampling for total soluble matter, TIM and total solids was conducted referencing Australian Standards AS/NZ 3580.10.1 2016: Methods for sampling and analysis of ambient Determination of particulate matter – Gravimetric method (Australian/New Zealand Standard, 2016).

There were no recorded deviations from the sampling procedures for the DDG sampling in FY23. The dust deposition monitoring complies with the applicable elements of EPN condition M1 as samples are tested at a NATA accredited laboratory which is analysed as per Australian Standards.

2.3 DustTrack

DustTrak units are calibrated on an annual basis with additional periodic checks completed by MMG staff. After the DustTrak units are calibrated annually, they are sent to EPA Tasmania for the specific calibration factors to be updated to reduce the amount of dust alarms of inspection and mitigation levels due to wood fire smoke haze from nearby residences.

DustTrack data is averaged on a 15 and 60 minute basis and are displayed within the Environmental Department office. The DustTrak data is not used for compliance purposes, it is used for operational investigation and real time alerts.

2.4 Sampling Quality Assurance and Quality Control Procedures

MMG Rosebery has a number of internal sampling quality assurance and quality control (QAQC) procedures. These include:

- Weekly verification quality checks of the DDG, HVAS and DustTrak data.
- Weekly analysis of the data to identify any inconsistent or incorrect results.
- Taking field and laboratory blanks at set frequency as referenced in the relevant Australian Standards.
- Tests and checks of the DustTrak units are completed on a regular basis with comments recorded on any issues with the units.
- Site visit reports, mostly recently completed for all HVAS locations in January 2023.

- Implementation of site visit report recommendations including to clearing of vegetation around the monitoring enclosures to comply with the Australian Standard AS/NZS 3580.1.1:2007: Methods for sampling and analysis of ambient air: Part 1.1: Guide to siting air monitoring equipment (Australian/New Zealand Standard, 2007).
- Maintenance of the HVAS and DustTrak units based on their operating manuals.

In addition to the QAQC procedures, the real time DustTrak concentrations and weather data are displayed within the Environmental Department office. Inspection and mitigation trigger alerts are automatically generated as per the Dust Mitigation Plan (MMG, 2020) and are sent to relevant employees via email.

3. Air Quality Monitoring Results

3.1 High Volume Air Sampling

This section presents the results of the FY23 HVAS monitoring data and analysis. Table 9 summarises the HVAS data and compliance against the trigger level and compliance limits.

The 24-hour average and 90-day average, provided in Table 9, represent the maximum averages for FY23.

In FY23, there were no exceedances reported of the trigger levels or compliance limits for all HVAS locations. As previously discussed, 19 sampling results were considered invalid due to mechanical issues with the HVAS and a scheduling error.

The graphical results for all HVAS data are presented in Appendix A.

Table 9: HVAS monitoring results

Averaging period	Pollutant	Trigger level (mg/m3)	Compliance limit (mg/m3)	AD3 (mg/m^3)			AD2.1 (mg/m^3)			Giblin St (mg/m^3)			Alec St (mg/m^3)		
				Value	TL	CL	Value	TL	CL	Value	TL	CL	Value	TL	CL
24 hour average [a]	TSP	0.150	-	0.043	✓	-	0.065	✓	-	0.034	✓	-	0.040	✓	-
	PM_{10}	0.050	0.150	0.019	✓	✓	0.030	✓	✓	0.024	✓	✓	0.024	✓	✓
	Lead (as TSP)	0.0087	-	0.0023	✓	-	0.0011	✓	-	0.00013	✓	-	0.00016	✓	-
	Cadmium (as PM_{10})	0.000003	-	0.0000027	✓	-	0.0000016	✓	-	0.0000004	✓	-	0.0000005	✓	-
	Zinc (as PM_{10})	0.015	-	0.00094	✓	-	0.00053	✓	-	0.00006	✓	-	0.00018	✓	-
Annual average	TSP	-	0.090	0.013	-	✓	0.028	-	✓	0.011	-	✓	0.014	-	✓
90 day average [b]	Lead (as TSP)	-	0.0015	0.00065	-	✓	0.00044	-	✓	0.00002	-	✓	0.00004	-	✓
Number of valid data points (TSP) [c]				59			56			59			59		
Number of valid data points (PM_{10}) [c]				59			59			59			59		
Number of invalid data points (TSP) [c]				2			5			2			2		
Number of invalid data points (PM_{10}) [c]				2			2			2			2		

Notes:

[a] *The 24 hour average represents the maximum average in FY23*

[b] *The 90 day average represents the maximum average in FY23*

[c] *19 sampling results were considered invalid due to motor or blockage issues of the HVAS unit disfunction or a scheduling error*

Green ticks denote compliance with the respective trigger level or compliance limit

Grey crosses denote exceedances of the respective trigger level

Red crosses denote exceedances of the respective compliance limit

Dash ('-') denotes no trigger level or compliance limit in the EPN or PCE

3.2 Dust Deposition Gauges

This section presents the results of the FY23 DDG monitoring data and analysis.

Table 10 summarises the dust deposition rates of TIM against the trigger levels and compliance limits as presented in Table 4. The monthly deposition and background contributions for DDG at or beyond the site boundary are presented in Figure 2. All monthly DDG results for all locations are presented in Appendix A.

For each month, the background deposition rate was assumed to be the minimum TIM deposition rate across all locations. The monthly deposited dust above background for each location was calculated by subtracting the monthly background deposition rate from the deposition rate at each location.

It is important to note that five or more months were considered invalid at each location due to high rainfall events flooding the gauges, as shown in Table 10. However, as the invalid data are due to large amounts of rainfall, the dust deposition during these periods would likely be low due to the high moisture of the dust generating materials. This means that the calculated annual averages are a conservative representation of the annual conditions as invalid data points are considered blanks in the calculations.

No exceedances of the compliance limits were reported for any deposition gauges at or beyond the site boundary for FY23. Exceedances of the trigger levels were reported for AD11 and AD21. An investigation into the exceedance at AD21 has been completed and is further discussed in section 3.2.1. An investigation into AD11 is currently being undertaken to understand validity of laboratory reported values and to identify potential source(s) of the deposition results. No community complaints were received during the elevated deposition months at AD11 and AD21.

Table 10: DDG monitoring results at or beyond the boundary

Site	**Number of valid samples**	**Monthly Deposited Dust above background (g/m2/month) [a, b]**		**Monthly Total Deposited Dust (g/m2/month) [b]**		**Annual Average Deposited Dust above background (g/m^2/month) [a]**		**Annual Average Total Deposited Dust (g/m^2/month)**	
Trigger level		2.0		4.0		-		-	
Compliance limit		-		-		2.0		4.0	
AD3	6	1.0	✓	1.4	✓	0.25	✓	0.73	✓
AD4	7	1.1	✓	1.5	✓	0.53	✓	0.96	✓
AD11	7	5.8	x	6.2	x	1.4	✓	1.8	✓
AD21	7	5.4	x	5.5	x	0.91	✓	1.3	✓
AD22	7	1.2	✓	1.8	✓	0.79	✓	1.2	✓
BG3	7	1.1	✓	1.7	✓	0.41	✓	0.84	✓

Notes:
[a] The minimum monthly deposited dust value across all locations was adopted as the monthly background deposition rate
[b] The monthly deposited dust (above background and total) represent the maximum recorded values in FY23
Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit
Dash denotes the trigger level or compliance limit is not applicable
The minimum monthly deposited dust value across all locations was adopted as the monthly background deposition rate

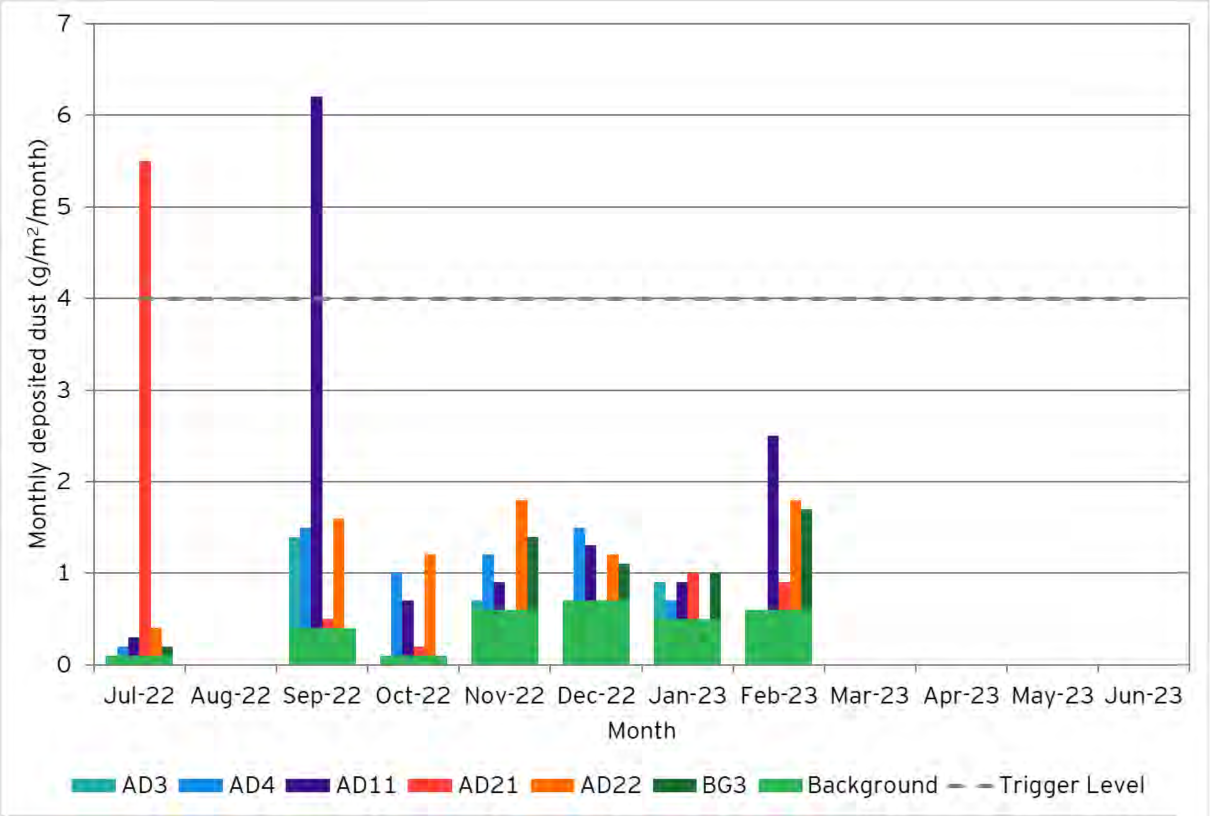

Figure 2: Total monthly deposition for sites at or beyond the site boundary

3.2.1 Trigger Level Exceedance Investigation Results – AD21

The trigger levels for total monthly deposited dust and monthly deposited dust above background were exceeded at AD21 for July 2022. An investigation into the exceedance was completed by MMG (MMG, 2023). The investigation included statistical analysis of the July 2022 results for the network and historical data, analysis of the metal deposition in comparison to Rosebery Mine materials, comparison of the HVAS and DustTrak, and analysis of weather during the monitoring period was also completed.

The investigation indicated that the high deposition rate was highly likely due to contamination at the gauge either during gauge installation, collection or during laboratory analysis.

3.2.2 Trigger Level Exceedance Investigation Pending – AD11

The trigger levels for total monthly deposited dust and monthly deposited dust above background were exceeded at AD11 for September 2022. An investigation into the exceedance is currently being undertaken by MMG.

3.3 Summary

There were no exceedances of the compliance limits for all HVAS and DDG locations. Exceedances of the monthly trigger levels were reported for AD21 and AD11. An investigation completed for AD21 suggested the results were likely due to contamination of the gauge. An investigation in AD11 is currently being undertaken.

As no exceedances of the compliance limits were reported, it is indicated that MMG's Rosebery Mine is a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Based on this report, it is recommended that the air quality monitoring network is consolidated. Considering the low environmental risk to air quality and the typical annual rainfall, a small targeted DDG network could provide more meaningful information regarding the mine's dust impact.

As per EPN 7153/3 condition A3-4:

> *Measurements at the 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) are to continue until such time as an annual pattern can be established and a full 12-month dataset is compiled. This data is to be analysed in a report presented to the Director, containing recommendations and a request for approval to remove specific 'additional sites' from the monitoring network. Monthly monitoring must continue at all of the 'additional sites' until the Director provides approval to remove the individual sites.*

These additional sites have been collecting data for over 11 years which is sufficient to establish an annual pattern. As per conditions A3-4, an analysis of these sites is recommended to be able to remove these additional sites from the monitoring network. This will allow for consolidation of the monitoring network.

4. Assessment of Dust Management Performance

MMG's Rosebery Mine has a dust mitigation plan (MMG, 2020) that outlines the mitigation measures for reducing the environmental risk associated with the generation of dust due to the operations and activities at the mine. The Dust Mitigation Plan fulfils the requirements of section A6 of EPN 7153/3. The assessment of the dust mitigation plan addresses the following:

- Sources of potential dust from the Rosebery Mine
- Details on the real-time monitoring network (four DustTrak's co-located with the HVAS monitors and site meteorological monitoring)
- The real-time inspection and mitigation level triggers, as presented in Table 11
- General responses when real-time inspection or mitigation level triggers occur
- Meteorological conditions that are considered conducive to dust events.

The inspection and mitigation levels are presented in Table 11.

Table 11: Real Time Dust Trigger Levels

Averaging period	Inspection Level (µg/m^3)	Mitigation level (µg/m^3)
15 minutes	300	500
60 minutes	200	350

Source: (MMG, 2020)

4.1 Summary of Inspection and Mitigation Level Alerts

The number of alerts and alert days[2] of the inspection and mitigation levels, as described in Table 11, are summarised in Table 12. The 15-minute and 60-minute rolling averages reported by the telemetry network were used in the analysis. In late 2020, with the assistance of EPA Tasmania, site specific calibration factors were applied to the DustTraks to reduce the amount of dust alarms of inspection and mitigation levels due to wood fire smoke haze from nearby residences. It is recommended that the calibration factors are validated yearly to assess their appropriateness.

It is noted that there were negative concentrations observed for the AD2.1 (Core Shed), AD3 (Filter Plant) and Alec Street DustTraks, however, these have not been removed for this analysis.

The alerts recorded in December 2022 at the AD2.1 location were due to smoke associated with a Rosebery bushfire. MMG also completed an investigation for the alerts at the AD2.1 location observed in March 2023, the outcome of the investigation suggested the elevated concentrations were due to smoke from a barbeque that was placed near the DustTrak location during the March 2023 mill shutdown.

Typically, there are alerts recorded for the AD3 (Filter Plant) location throughout the year, with both 15-minute and 60-minute inspection level alerts being recorded at AD3 in FY20, FY21 and FY22. Mitigation level alerts were also recorded for the AD3 in both FY20 and FY22. However, it is noted that there were no alerts for FY23, at the inspection or mitigation level. This is likely due to meteorological conditions throughout summer, with fewer strong easterlies and higher rainfall reducing the occurrence of high dust concentrations.

---

[2] An alert day is defined as a day where one or more alert of the mitigation or trigger level is raised.

Table 12: Number of alerts and alert days

	Averaging period	Monitoring site ID			
		AD3 (Filter Plant)	AD2.1 (Core Shed)	Giblin Street	Alec Street
Number of alerts					
Inspection level	15-minute	0	276	0	0
	60-minute	0	397	0	0
Mitigation level	15-minute	0	187	0	0
	60-minute	0	266	0	0
Number of alert days					
Inspection level	15-minute	0	4	0	0
	60-minute	0	3	0	0
Mitigation level	15-minute	0	3	0	0
	60-minute	0	1	0	0
Data capture		98.92%	98.80%	99.45%	99.96%

Note: Data capture excludes missing data points invalidated during the data analysis. These invalidated data points were included in the real-time alerts.

4.2 Summary of Dust Management Performance

Analysis of the air quality monitoring network (HVAS and DDG monitoring data) shows that the performance of the dust management plan at the Rosebery Mine is sufficient in mitigating fugitive dust. There were a number of alerts of the inspection and mitigation levels at the AD2.1 (Core Shed) DustTrak location due to bushfires and barbeques in the nearby area. No other DustTrak locations received alerts of the inspection or mitigation levels prescribed in the Dust Mitigation Plan (MMG, 2020).

4.3 Recommendations for Future Dust Management

Based on the assessment of the air quality monitoring network, it is recommended that the Rosebery Mine continue its current management and mitigation measures. It is also recommended that the mitigation and inspection trigger levels are checked in 2024 to understand if they are sufficient to assist in the continued control of dust from site.

5. References

Australian/New Zealand Standard. (2007). *Methods for sampling and analysis of ambient air - Part 1.1: Guide to siting air monitoring equipment*. Australian/New Zealand Standard.

Australian/New Zealand Standard. (2015). Methods for sampling and analysis of ambient air - Method 9.3: Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method. *AS/NZS 3580.9.3:2015*. Australian/New Zealand Standard.

Australian/New Zealand Standard. (2015). Methods for sampling and analysis of ambient air - Method 9.6: Determination of suspended particulate matter - PM10 high volume sampler with size selective inlet - Gravimetric method. *AS/NZS 3580.9.6:2015*. Australian/New Zealand Standard.

Australian/New Zealand Standard. (2016). Methods for sampling and analysis of ambient air - Method 10.1: Determination of particulate matter - Deposited matter - gravimetric method. *AS/NZS 3580.10.1:2016*. Australian/New Zealand Standard.

MMG. (2020). Dust Mitigation Plan. *Rosebery Mine*. MMG Limited.

MMG. (2023). *Memorandum - Subject: Missed HVAS Sampling – Investigation Summary*. MMG.

MMG. (2023). *Memorandum: Dust Deposition Exceedance AD21 July 2022*. MMG Limited.

Appendix A Additional Plots

Additional HVAS Data

The individual day 24-hour HVAS plots are presented in Figure 3 to Figure 7. The 90-day average lead (as TSP) is presented in Figure 8.

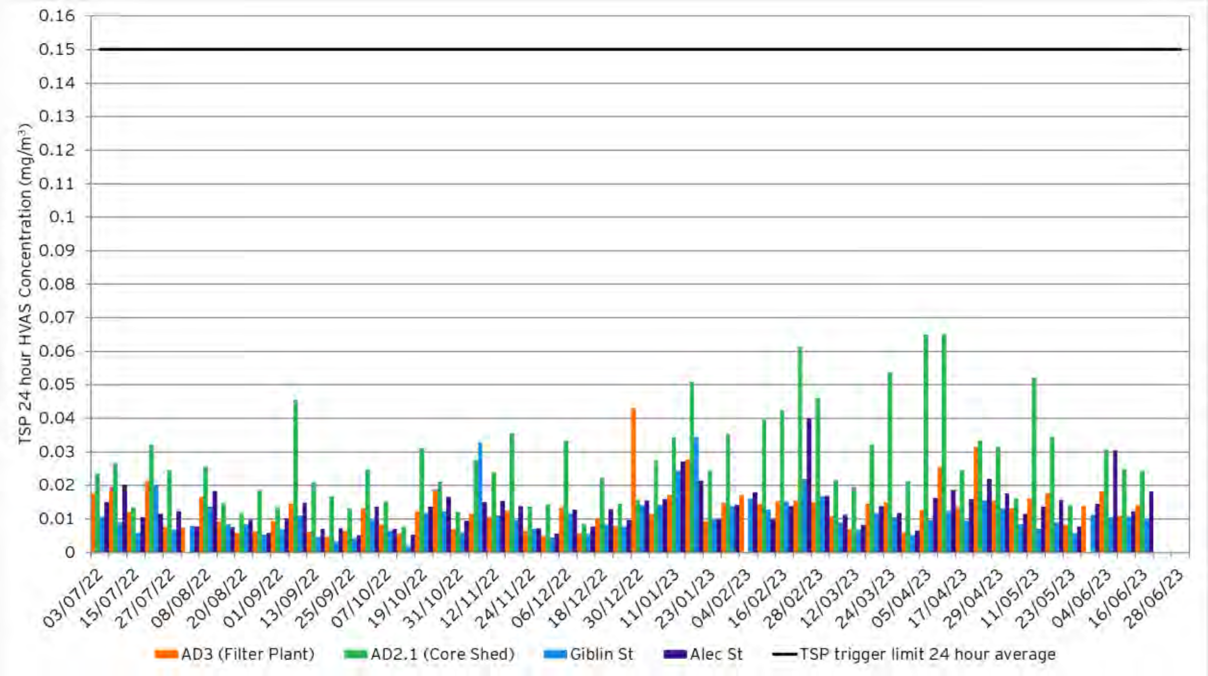

Figure 3: TSP HVAS 24-hour averages for FY23

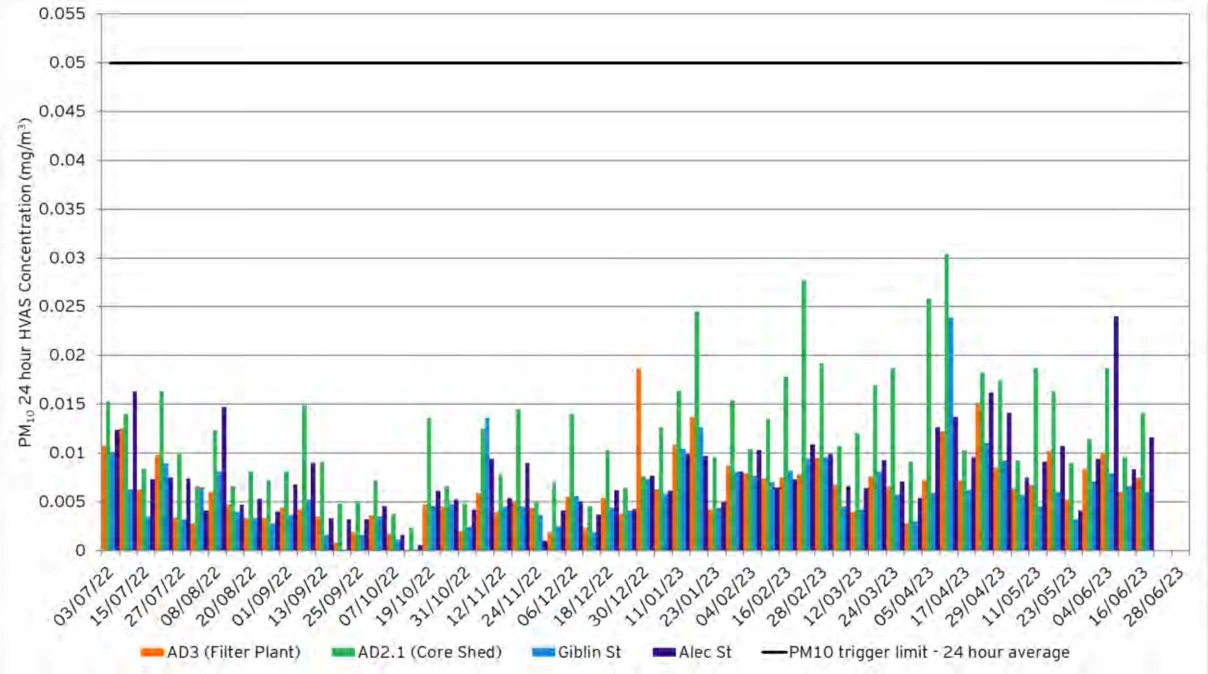

Figure 4: PM_{10} HVAS 24-hour averages for FY23

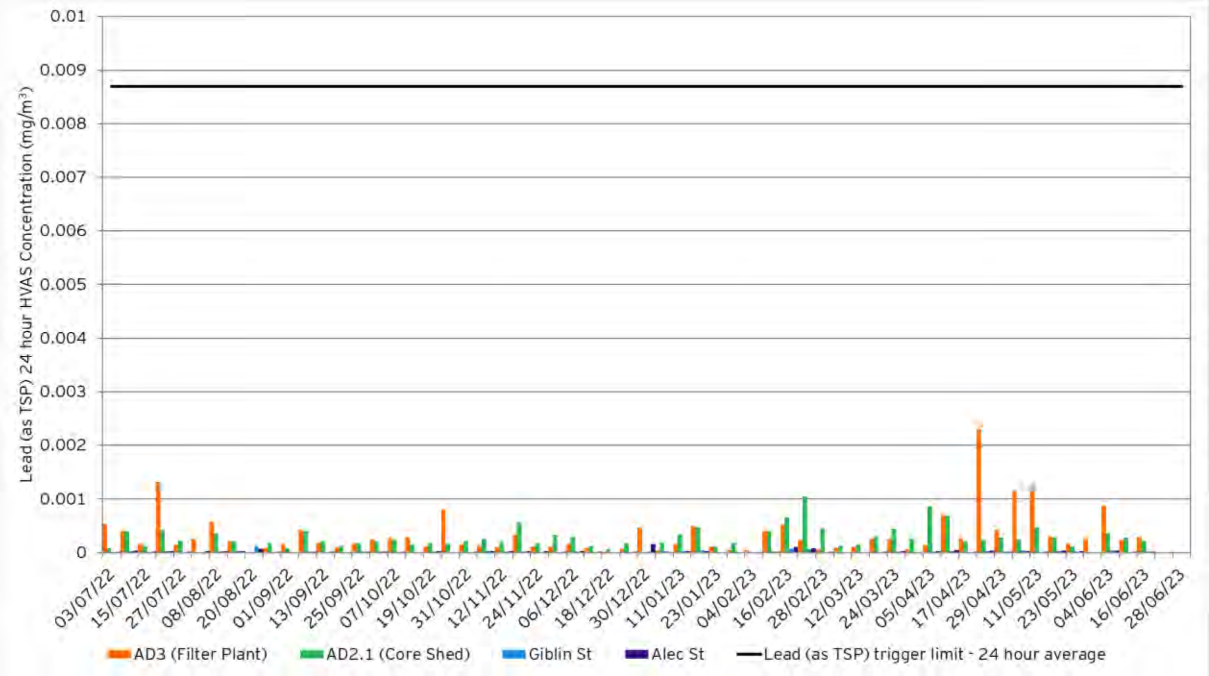

Figure 5 Lead (as TSP) 24-hour averages for FY23

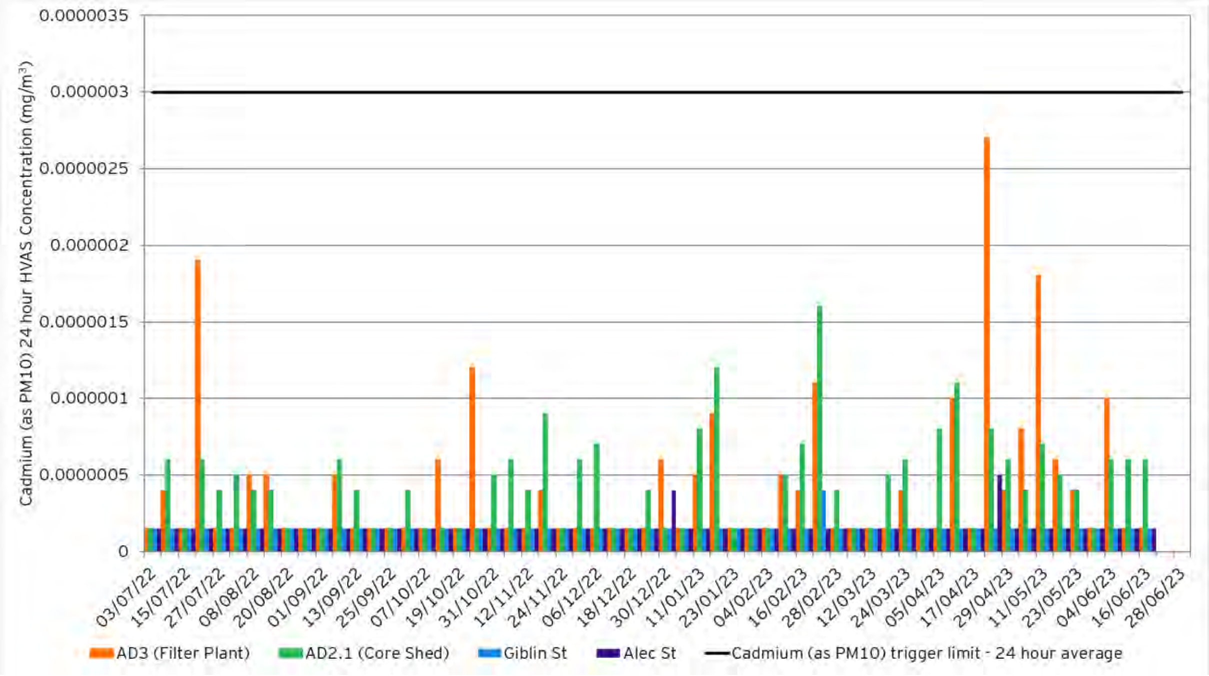

Figure 6: Cadmium (as PM_{10}) 24-hour averages for FY23

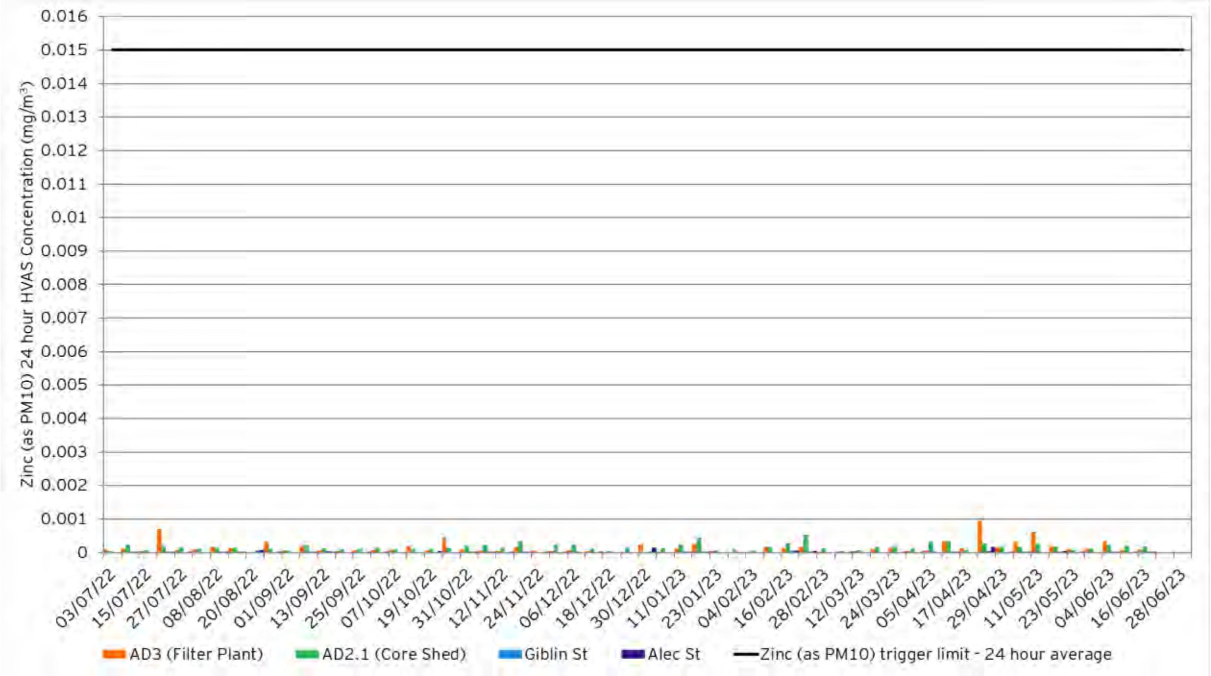

Figure 7: Zinc (as PM₁₀) 24-hour averages for FY23

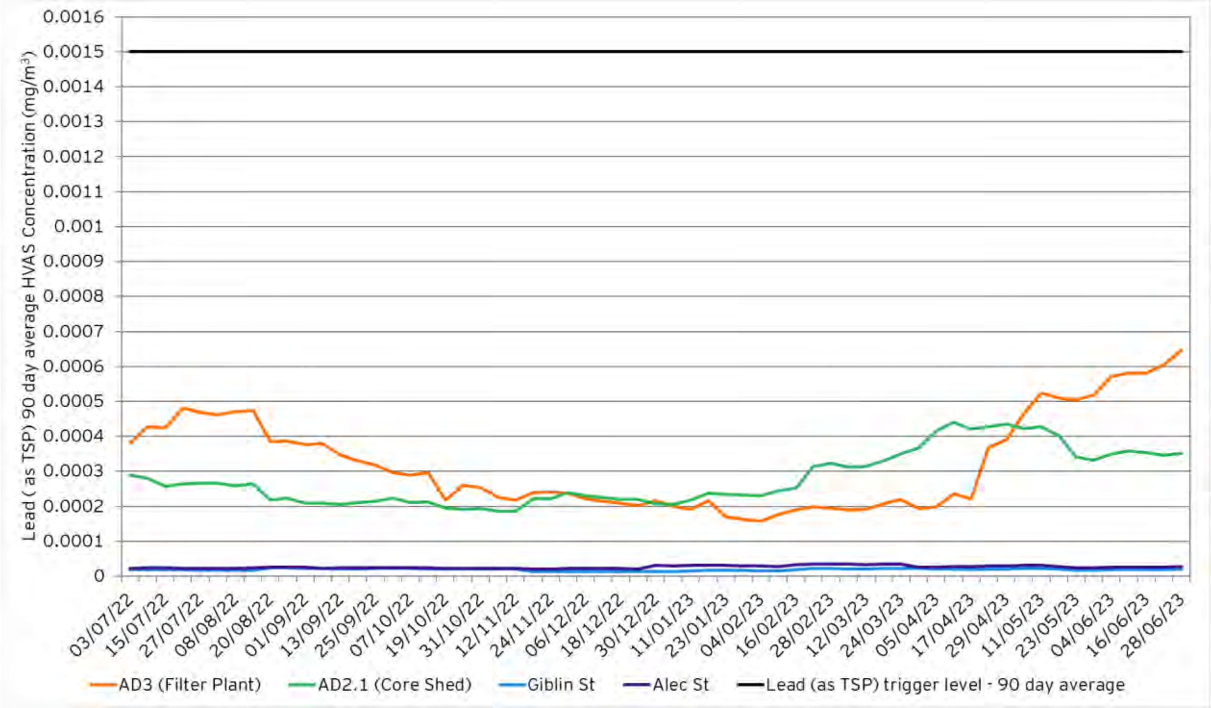

Figure 8: Lead (as TSP) HVAS 90-day average for FY23

Deposited data

The monthly dust deposition and monthly dust deposition above background for sites at or beyond the boundary are presented Figure 9 and Figure 10. The monthly dust deposition at all sites is presented in Figure 11.

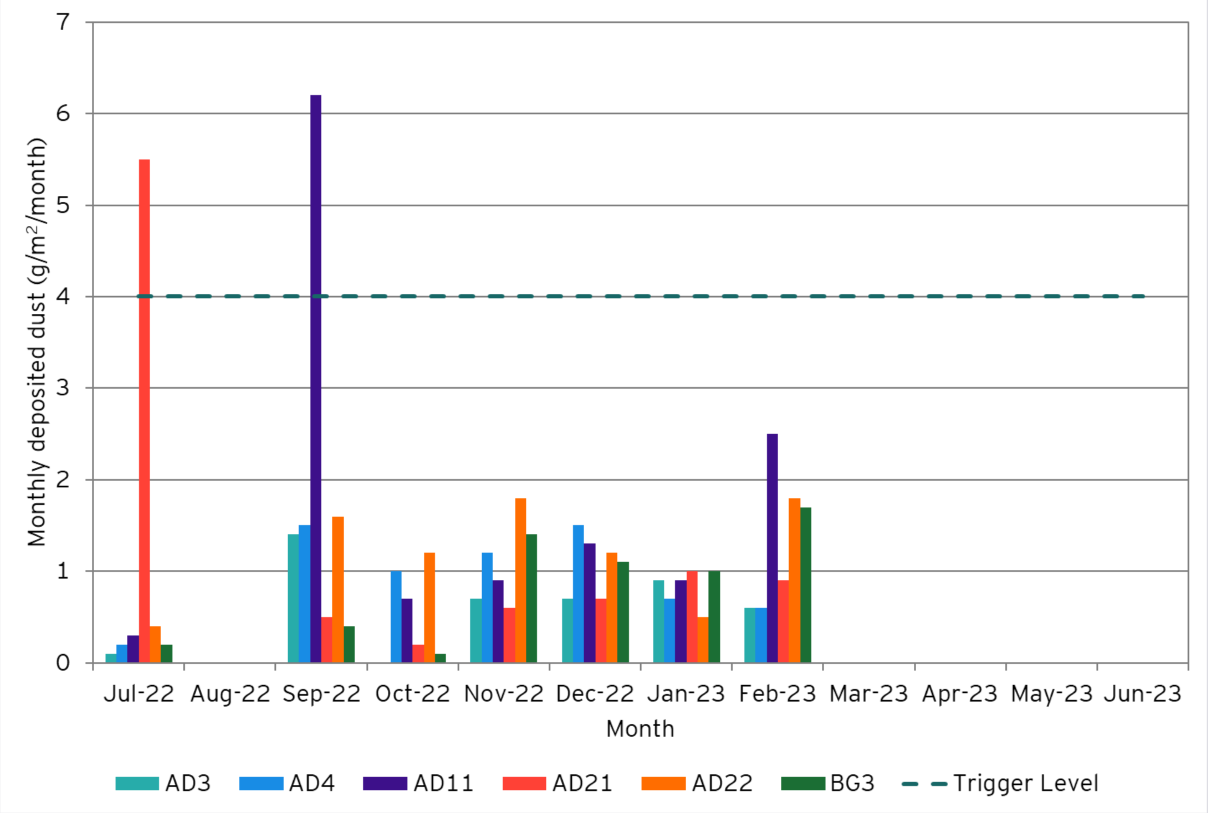

Figure 9: Monthly dust deposition for sites at or beyond the site boundary

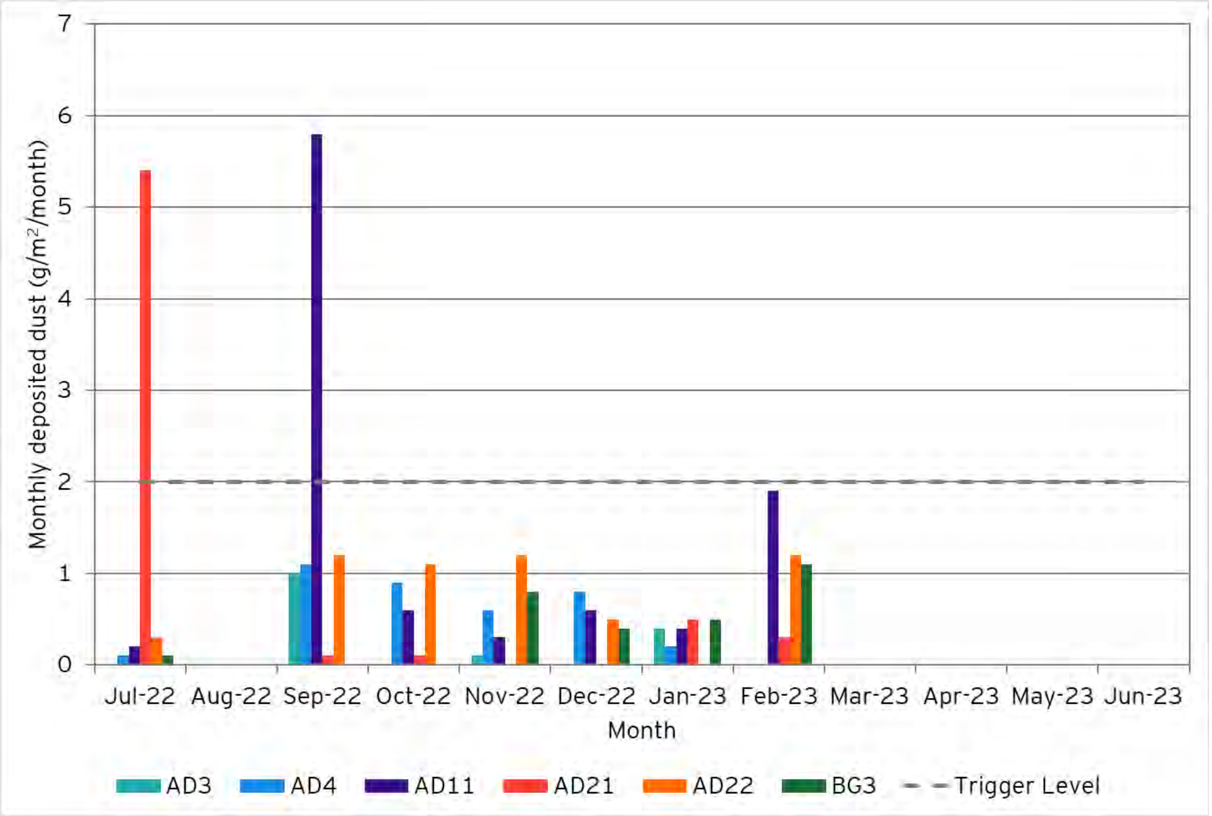

Figure 10: Monthly deposition above background for sites at or beyond the site boundary

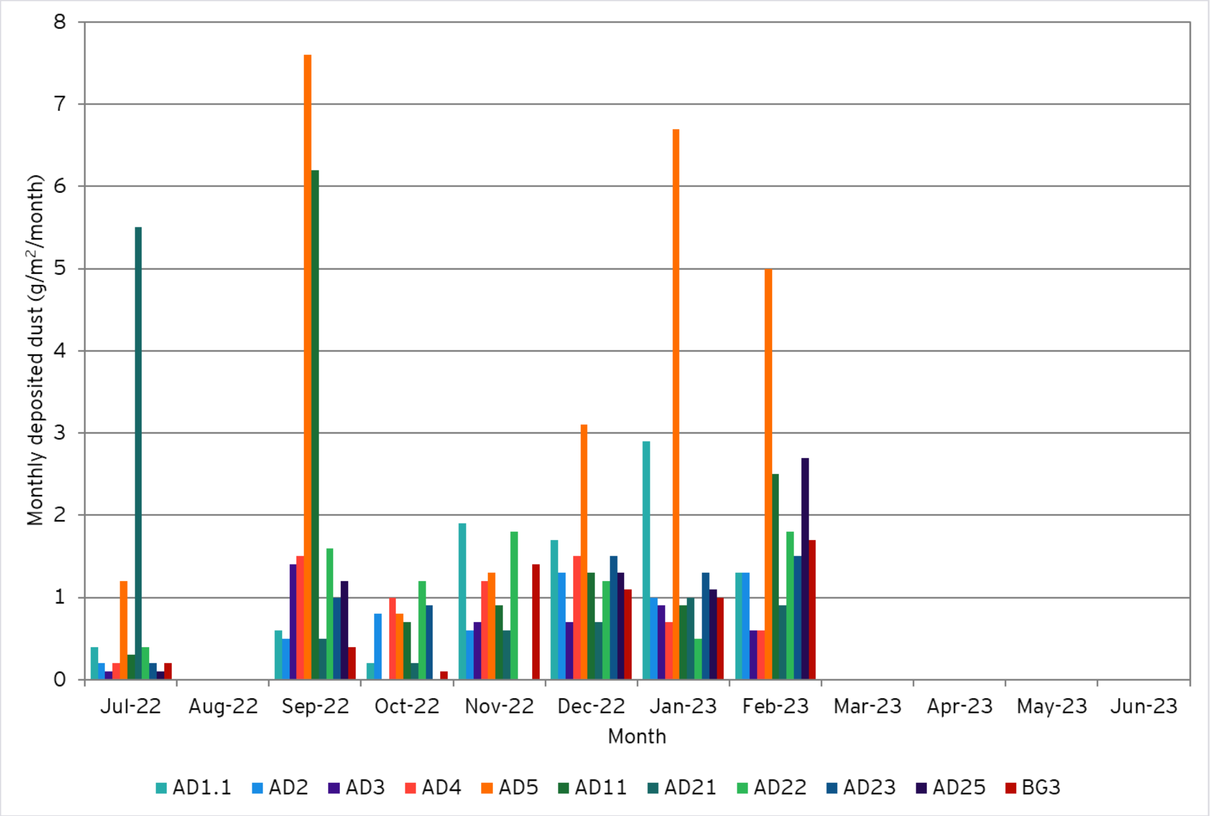

Figure 11: Monthly deposited dust at all sites

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ED 0923

Our report may be relied upon by MMG Rosebery Mine for the purpose to assess the meteorological and air quality data in regarding to their Environmental Protection Notice's (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) only pursuant to the terms of our engagement letter dated 02 June 2023. We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to or in any way connected with the contents of our report, the provision of our report to the other party or the reliance upon our report by the other party.

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Appendix H Rosebery Mine Environmental Noise, Ground Vibration and Air Blast Overpressure Annual Monitoring Data Review (Tarkarri, 2023)

MMG Limited

Rosebery mine
Environmental noise, ground vibration and air blast overpressure annual monitoring data review
2022-2023

Report No. 5830_ACVIB_R_R1

TARKARRI ENGINEERING PTY LTD
PO Box 506
Kings Meadows TAS 7249

September 2023

Tarkarri Engineering
Air Quality • Acoustics • Environment • Vibration

DOCUMENT CONTROL

MMG LIMITED
ROSEBERY MINE
ENVIRONMENTAL NOISE, GROUND VIBRATION AND AIR BLAST OVERPRESSURE ANNUAL MONITORING DATA REVIEW
2022-2023

Report No. 5830_ACVIB_R	Library Code ACVIB
Prepared for MMG Limited (Rosebery Mine) PO Box 21 Rosebery Tasmania 7470	Prepared by Tarkarri Engineering Pty Ltd PO Box 506 Kings Meadows Tasmania 7249
Contact Mr Danielle Zanetto ☎ +61 3 6473 9332 Mobile +61(0)407 040 566 Email Danielle.Zanetto@mmg.com	Contact Dr Alex McLeod ☎ +61 3 6343 2077 Mobile +61(0)439 357 297 Email alex.mcleod@tarkarri.com

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Reviewed	Alex McLeod Director / Principal Consultant	Date 25 September 2022

Revision History

Revision No.	Date Issued	Reason/Comments
0	13/09/2023	Initial release
1	26/09/2023	edits

Distribution

Copy No.______	Revision No.	Location
1	1	Project/Client File
2	1	Client
3	1	Tarkarri Engineering Library

Keywords environmental noise, dBA, L_{Aeq}, ambient, background (L_{A90}), GV, ABO

Table of Contents

List of figures

List of tables

References

[1] Environment Division, Department of Environment, Parks, Heritage and the Arts (July 2008) Noise Measurement Procedures Manual, 2nd Edition.

[2] 5684_ACVIB_R_MMG - Rosebery mine environmental noise, ground vibration and air blast overpressure annual monitoring data review 2021-2022.

Executive Summary

Tarkarri Engineering was commissioned to conduct an annual review of noise, ground vibration and air blast overpressure data collected over the 2022-23 financial year at MMG's Rosebery mine.

Average $L_{Aeq,15min}$ levels recorded by five fixed noise monitoring stations were similar to the previous year.

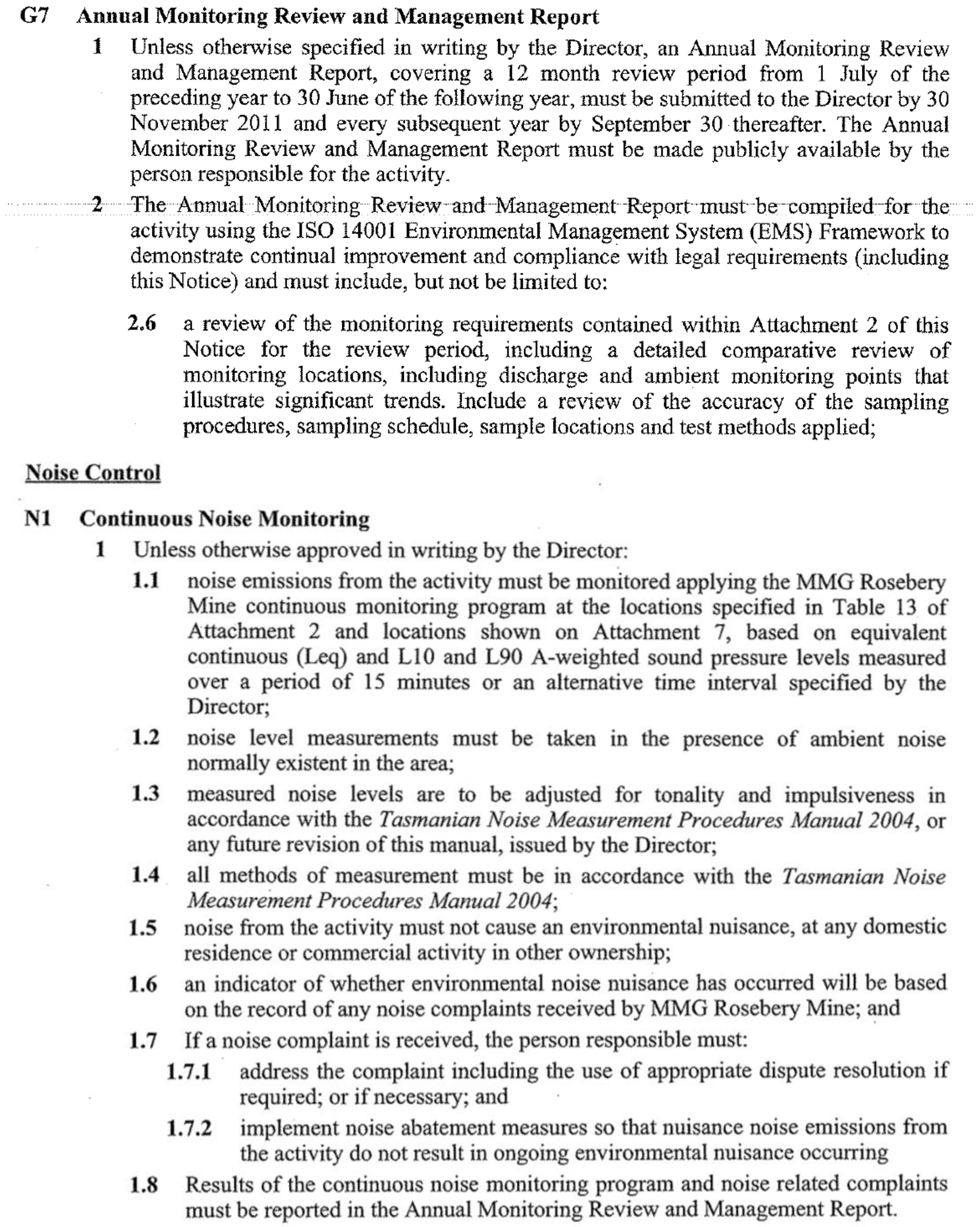
Ground vibration and air blast overpressure levels recorded during blasting times at the mine were below the allowable limits.

The noise, ground vibration and air blast overpressure levels reviewed show that there remains no indication of performance changes in environmental noise emission levels or blasting generated by Rosebery mine.

1 Introduction

MMG Rosebery commissioned Tarkarri Engineering to undertake an annual review of continuous environmental noise monitoring, and ground vibration (GV) and air blast overpressure (ABO) monitoring of blasting activities at their Rosebery mine. The review is a requirement under MMG Rosebery's Environmental Protection Notice (EPN) 7153/3, condition G7.

The relevant sections of the EPN regarding the annual review and environmental noise, GV and ABO conditions are:



G7 Annual Monitoring Review and Management Report

1 Unless otherwise specified in writing by the Director, an Annual Monitoring Review and Management Report, covering a 12 month review period from 1 July of the preceding year to 30 June of the following year, must be submitted to the Director by 30 November 2011 and every subsequent year by September 30 thereafter. The Annual Monitoring Review and Management Report must be made publicly available by the person responsible for the activity.

2 The Annual Monitoring Review and Management Report must be compiled for the activity using the ISO 14001 Environmental Management System (EMS) Framework to demonstrate continual improvement and compliance with legal requirements (including this Notice) and must include, but not be limited to:

2.6 a review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends. Include a review of the accuracy of the sampling procedures, sampling schedule, sample locations and test methods applied;

Noise Control

N1 Continuous Noise Monitoring

1 Unless otherwise approved in writing by the Director:

1.1 noise emissions from the activity must be monitored applying the MMG Rosebery Mine continuous monitoring program at the locations specified in Table 13 of Attachment 2 and locations shown on Attachment 7, based on equivalent continuous (Leq) and L10 and L90 A-weighted sound pressure levels measured over a period of 15 minutes or an alternative time interval specified by the Director;

1.2 noise level measurements must be taken in the presence of ambient noise normally existent in the area;

1.3 measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004*, or any future revision of this manual, issued by the Director;

1.4 all methods of measurement must be in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004*;

1.5 noise from the activity must not cause an environmental nuisance, at any domestic residence or commercial activity in other ownership;

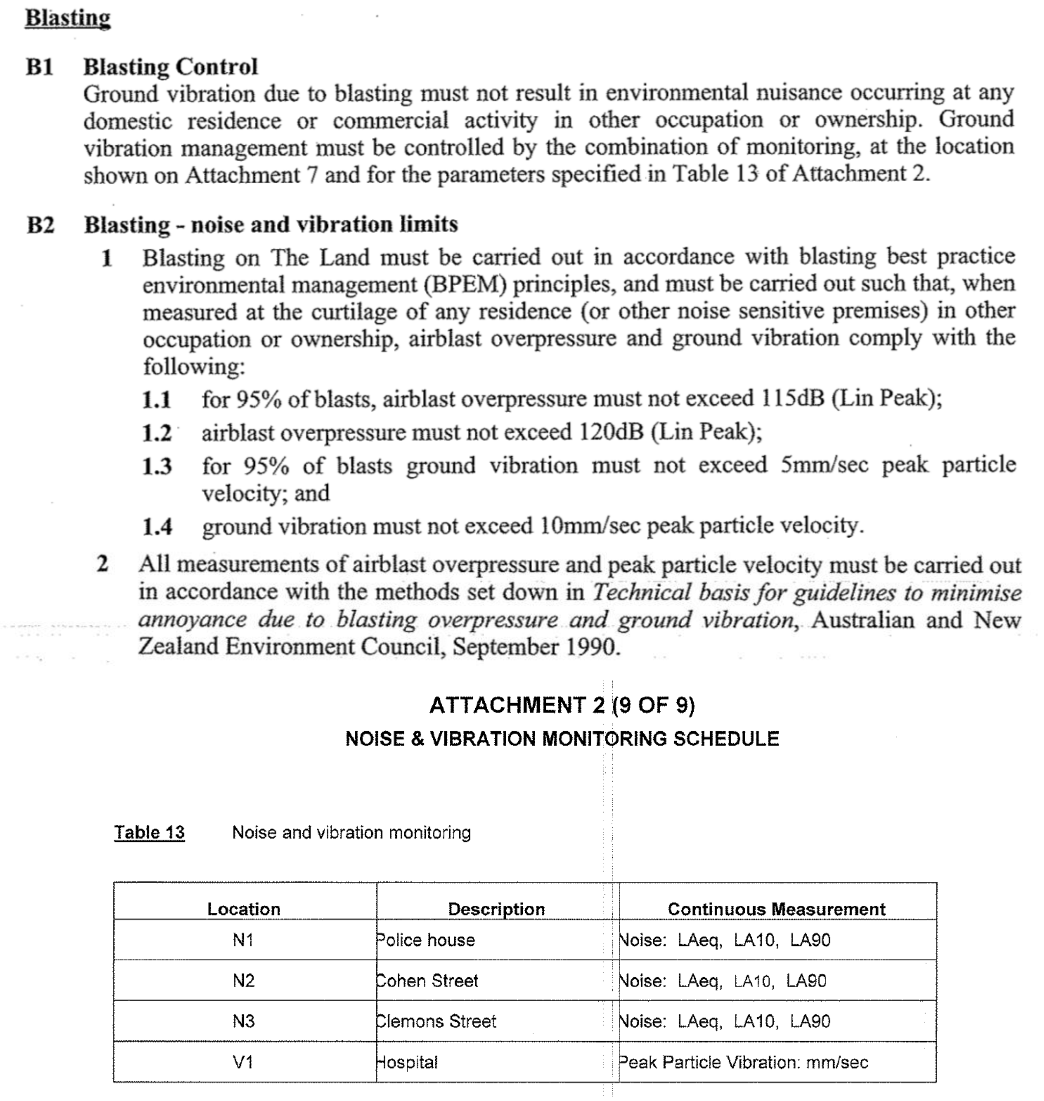
1.6 an indicator of whether environmental noise nuisance has occurred will be based on the record of any noise complaints received by MMG Rosebery Mine; and

1.7 If a noise complaint is received, the person responsible must:

1.7.1 address the complaint including the use of appropriate dispute resolution if required; or if necessary; and

1.7.2 implement noise abatement measures so that nuisance noise emissions from the activity do not result in ongoing environmental nuisance occurring

1.8 Results of the continuous noise monitoring program and noise related complaints must be reported in the Annual Monitoring Review and Management Report.



Blasting

B1 Blasting Control
Ground vibration due to blasting must not result in environmental nuisance occurring at any domestic residence or commercial activity in other occupation or ownership. Ground vibration management must be controlled by the combination of monitoring, at the location shown on Attachment 7 and for the parameters specified in Table 13 of Attachment 2.

B2 Blasting - noise and vibration limits

1. Blasting on The Land must be carried out in accordance with blasting best practice environmental management (BPEM) principles, and must be carried out such that, when measured at the curtilage of any residence (or other noise sensitive premises) in other occupation or ownership, airblast overpressure and ground vibration comply with the following:
   - **1.1** for 95% of blasts, airblast overpressure must not exceed 115dB (Lin Peak);
   - **1.2** airblast overpressure must not exceed 120dB (Lin Peak);
   - **1.3** for 95% of blasts ground vibration must not exceed 5mm/sec peak particle velocity; and
   - **1.4** ground vibration must not exceed 10mm/sec peak particle velocity.
2. All measurements of airblast overpressure and peak particle velocity must be carried out in accordance with the methods set down in *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*, Australian and New Zealand Environment Council, September 1990.

ATTACHMENT 2 (9 OF 9)

NOISE & VIBRATION MONITORING SCHEDULE

Table 13 Noise and vibration monitoring

Location	Description	Continuous Measurement
N1	Police house	Noise: LAeq, LA10, LA90
N2	Cohen Street	Noise: LAeq, LA10, LA90
N3	Clemons Street	Noise: LAeq, LA10, LA90
V1	Hospital	Peak Particle Vibration: mm/sec

This technical memo presents the results of the annual review for the period 1 July 2022 to 30 June 2023.

2 Site description

The MMG Rosebery mine is located on the lower south-west slope of Mount Black. The township of Rosebery borders the mine's above ground ore processing and train loading facilities to the south, south-west and west. Tailings storage facilities for the mine are located approx. 1.7 km north-west of the Rosebery township and to the south of the township on the southern side of the Murchison Hwy.

The mine produces zinc, lead, copper concentrates and gold dore bars via mechanised underground mining methods and employs crushing, grinding and flotation processes in their above ground processing facility.

Unattended monitoring of environmental noise is conducted at 5 locations across the township of Rosebery with GV and ABO monitored at a single location.

Table 2-1 presents spatial information for the environmental noise, GV and ABO monitoring locations. The table also provides location information on the weather stations for the mine that were used to filter environmental noise data. Figure 2-1 and 2-2 provide aerial views showing the monitoring locations with residential zones shaded in yellow.

Table 2-1: Information on environmental noise, GV and ABO and weather monitoring locations.

Environment noise; GV and ABO; and weather monitoring location information		
Number	Location	Coordinates (MGA)
Environmental noise		
N1	Police House	378530, 5373726
N2	Cohen St	377812, 5374410
N3	Mt Black	379195, 5374213
N4	Murchison St	379063, 5374101
N5	Alec St	378988, 5373396
GV and ABO		
V1	Hospital	378827, 5374072
Weather stations		
W1	Bobadil	376839, 5376290
W2	Overflow Carpark	378748, 5374012
W3	2/5 Dam	378491, 5372628

▨ EPN 7153/3 monitoring locations.

NB: Positions N4 and N5 are additional monitoring locations not specifically required under EPN 7153/3. They were implemented to monitor truck movements to and from the level 3 waste rock dump (WRD) (truck movements to and from this area seldomly occur as the WRD is no longer used) in the case of position N4 and the construction of the 2/5 Dam (as required under Permit Conditions Environmental no. 9084 (R1)), in the case of position N5.

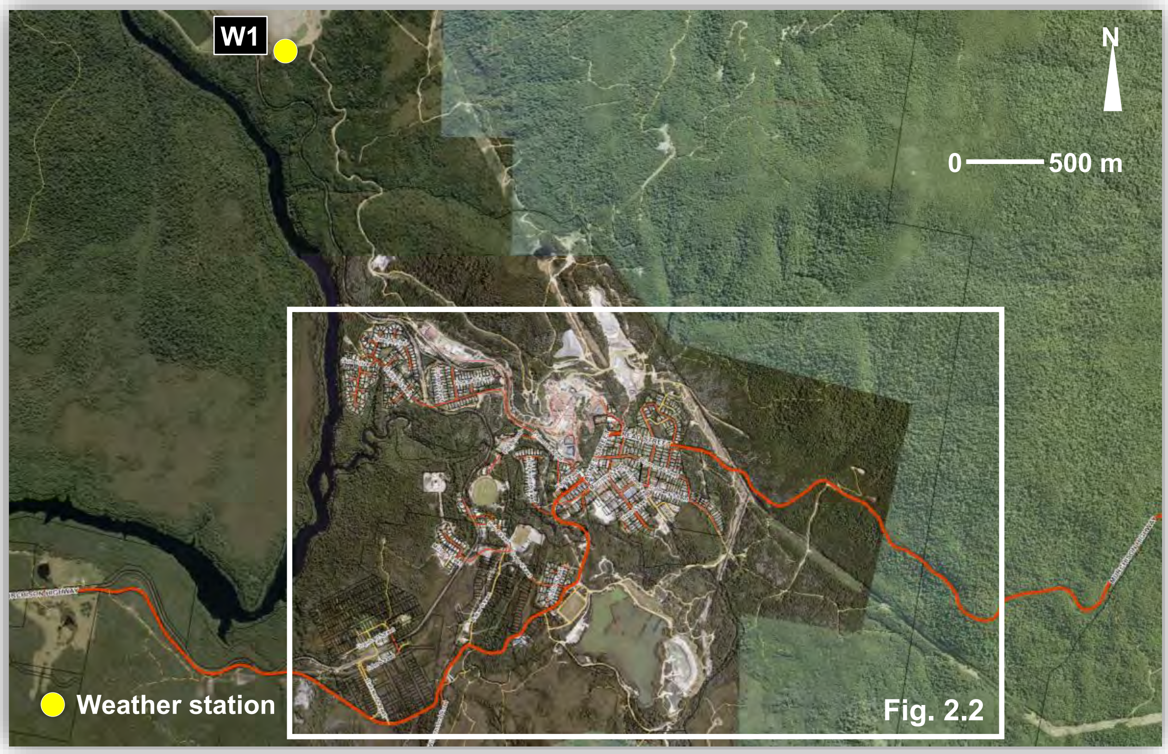


Figure 2-1: Aerial view of Rosebery and surrounds with the location of weather station 1 and the extent of Figure 2.2 marked.

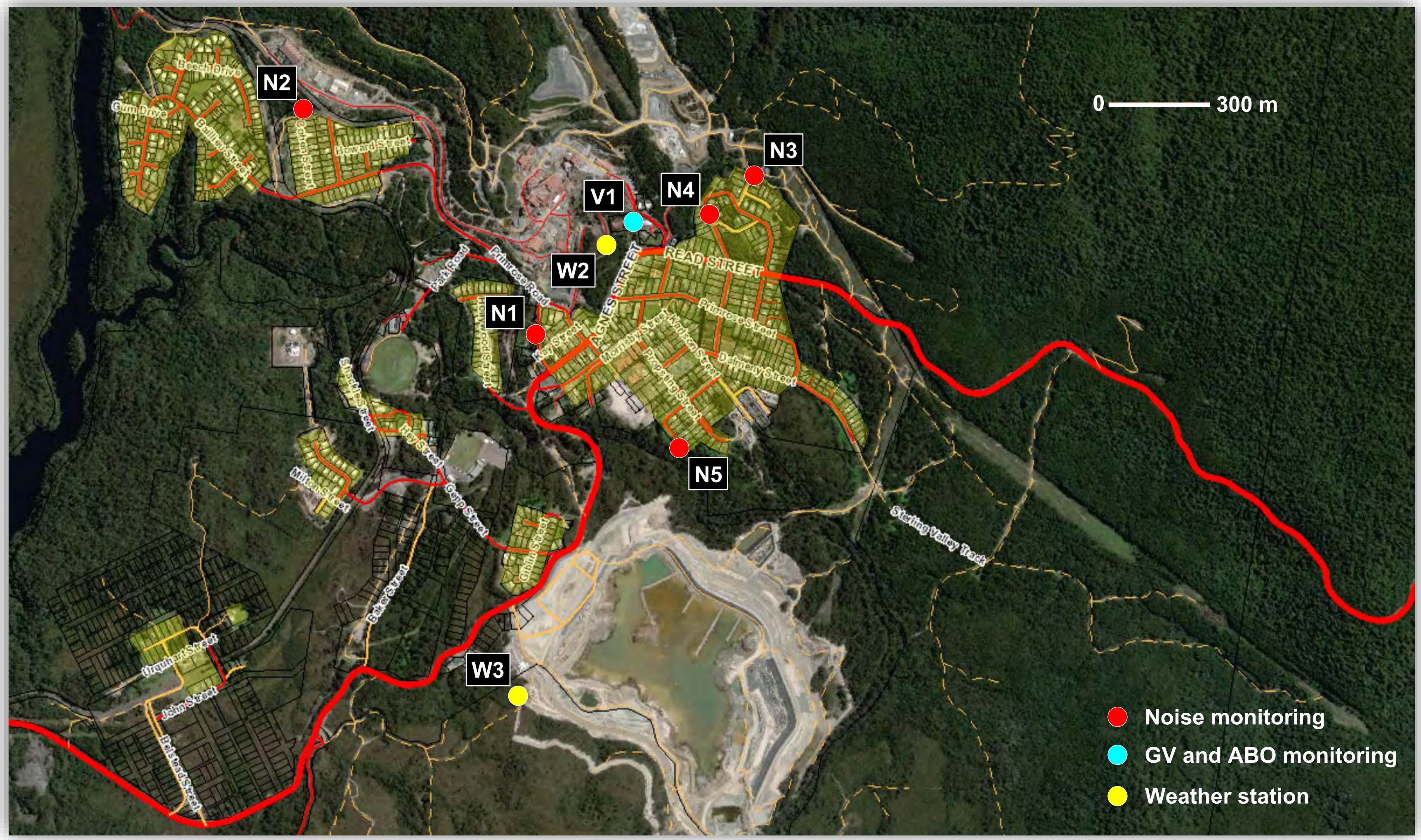


Figure 2-2: Aerial view of Rosebery with environmental noise; GV and ABO; and weather monitoring locations marked.

3 Environmental noise monitoring

Unattended continuous noise monitoring is conducted at 5 locations across the township of Rosebery as shown in Figure 2.2. Acoustic Research Laboratories Ngara Type 1 noise loggers are used to record fast response A-weighted sound pressure levels with 15-minute equivalent continuous (L_{eq}), min, max and 8 Ln-statistic levels (including L_{A90}, L_{A10}) extracted during post download data processing.

Field calibrations are completed approximately weekly, and factory calibration completed once every 2 years by a National Association of Testing Authorities (NATA) accredited laboratory. All monitored data presented here was from NATA laboratory calibrated loggers (calibration certificates, including field calibrators units, are provided in the appendix of this report).

The 5 environmental noise monitoring stations are in general accordance with requirements of section 4 and section 5.2 of the *Tasmanian Noise Measurement Procedures Manual, 2nd Edition* (July 2008)[1].

Available 15-minute interval data sets for each measurement location were filtered for erroneous data and poor weather conditions (i.e. winds speeds in excess of 5 m/s and precipitation), based on 10-minute weather data recorded at the three weather stations shown in Figures 2.1 and 2.2.

3.1 Data sets

Table 3-1 presents overall data availability as a percentage of the 35,040 possible 15-minute intervals available for analysis over the past monitoring year. Available data has subsequently been filtered against adverse weather conditions, measurement overload errors and measurement drift.

Table 3-1: Environmental noise monitoring data set summary.

Environmental noise monitoring data set summary				
Location	Recorded intervals		Intervals post filtering	
	count	%	count	%
Alec St	35,020	99.9	22,928	65.4
Cohen St	33,064	94.4	20,515	58.5
Mt Black	35,021	99.9	23,362	66.7
Murchison St	33,750	96.3	22,348	63.8
Police House	33,113	94.5	21,784	62.2

Data availability was generally greater than 96 % except for Police House and Cohen St where a number of USB and data conversion errors resulted in lost data.

After filtering out adverse weather conditions, meter overloads and data drift, approximately 58-67% of possible intervals were available for analysis. This is a 9-20% decrease in data availability from the previous reporting period[2]. Meter overloads and data drift appear to have been the result of overheating of the Ngara units. Consequently, significant periods of data were removed from further analysis.

3.2 Summary Monitoring results

Table 3-2 provides annual arithmetically averaged L_{Aeq}, L_{A90} and L_{A10} 15-minute levels calculated from the filtered data sets for each measurement location. Levels for the day, evening and night periods are provided with each period defined as follows:

- Day: 0700 to 1800 hrs
- Evening: 1800 to 2200 hrs
- Night: 2200 to 0700 hrs.

Annual average levels from the 2021/2022 year[2] are also provided for comparative purposes.

Table 3-2: Environmental noise monitoring summary data.

Environmental noise monitoring summary data, average 15-minute Ln-statistics (dBA)										
Location	Period	2022/2023			2021/2022			Difference (dB)		
		L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}
Police House	Day	52	47	53	53	48	54	-1	-1	-1
	Evening	51	47	52	52	48	52	-1	-1	0
	Night	49	47	50	50	48	51	-1	-1	-1
Cohen St	Day	52	50	53	52	49	52	0	1	1
	Evening	51	49	52	50	49	51	1	0	1
	Night	50	49	51	49	48	50	1	1	1
Mt Black	Day	45	40	46	46	41	47	-1	-1	-1
	Evening	43	40	44	42	39	43	1	1	1
	Night	41	39	42	40	38	41	1	1	1
Murchison St	Day	47	41	48	48	41	48	-1	0	0
	Evening	45	40	45	46	40	46	-1	0	-1
	Night	42	39	42	43	39	43	-1	0	-1
Alec St	Day	45	39	46	45	38	45	0	1	1
	Evening	42	37	43	41	37	42	1	0	1
	Night	39	36	40	39	36	40	0	0	0

Average annual noise levels were generally within 1 to 2 dB of levels seen in the last reporting period[2].

The following subsections provide graphs of monthly average $L_{Aeq,15min}$ day, evening, and night levels (from filtered data) measured at each of the 5 monitoring locations.

3.2.1 Police House

Figure 3-1 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Police House monitoring location.

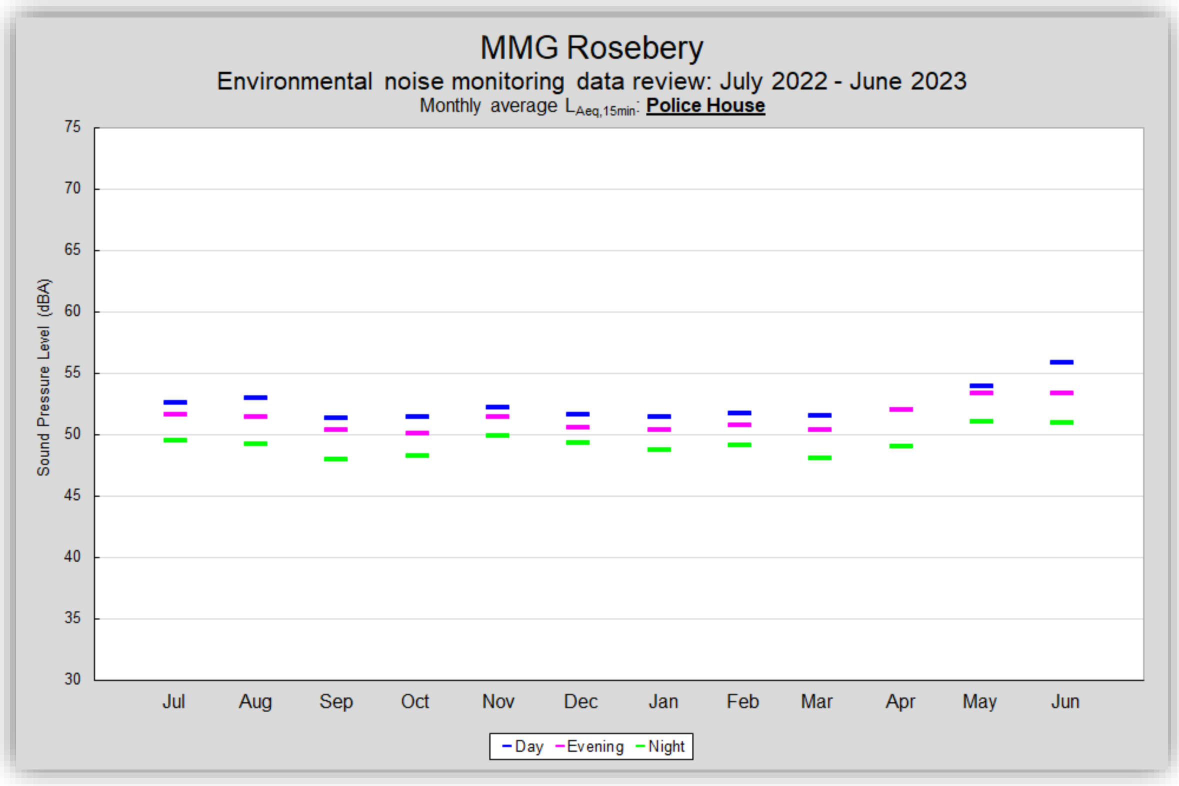


Figure 3-1: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Police House** (N1).

Monthly average LAeq,15min noise levels were relatively stable throughout the year. During most of the year, average levels were between 52 – 54 dBA during the day and 48 – 52 dBA at night suggesting a relatively stable noise environment. The month of June had day averages of 56 dBA due to the use of a rock breaker at a new house build in close proximity to the Police Station, with works expected to go into the 2023/24 recording period.

3.2.2 Cohen St

Figure 3-2 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Cohen St monitoring location.

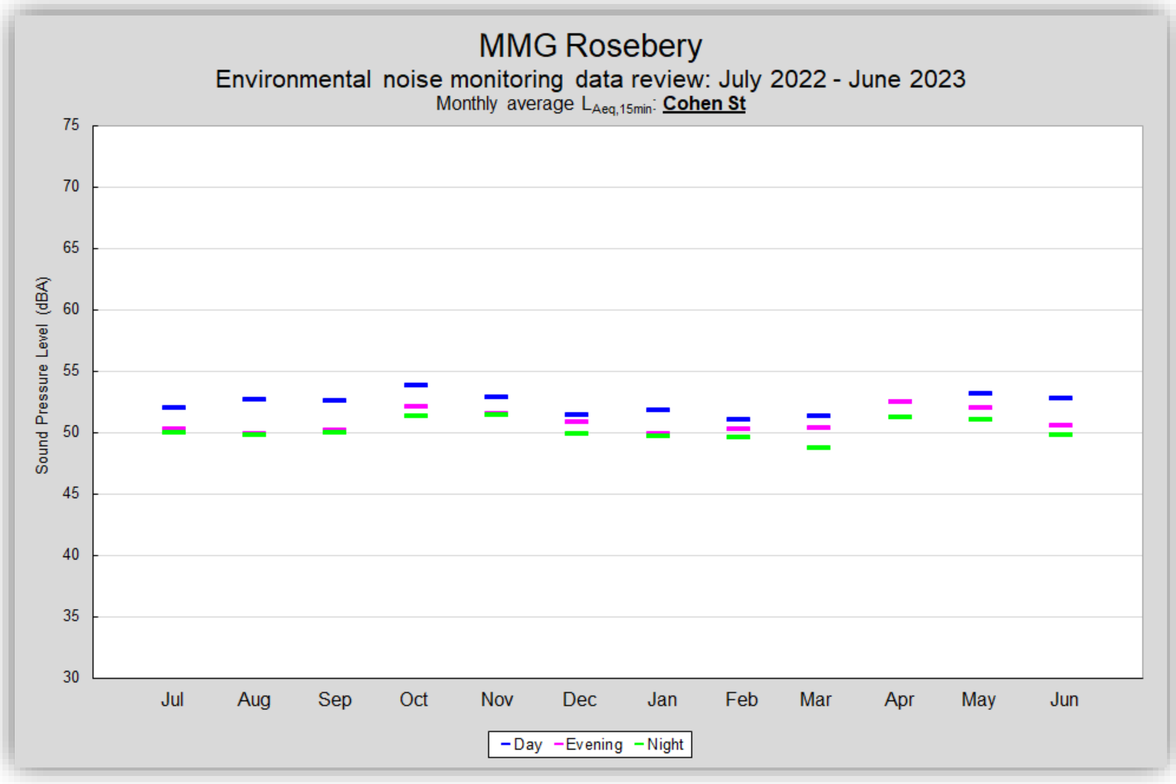


Figure 3-2: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Cohen St** (N2).

Monthly average LAeq,15min noise levels were stable throughout the year, with average levels typically within 3 dBA during the recording period. Measured levels were bounded between 53 dBA during the day and 52 dBA at night, suggesting a stable noise environment.

3.2.3 Mt Black

Figure 3-3 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Mt Black monitoring location.

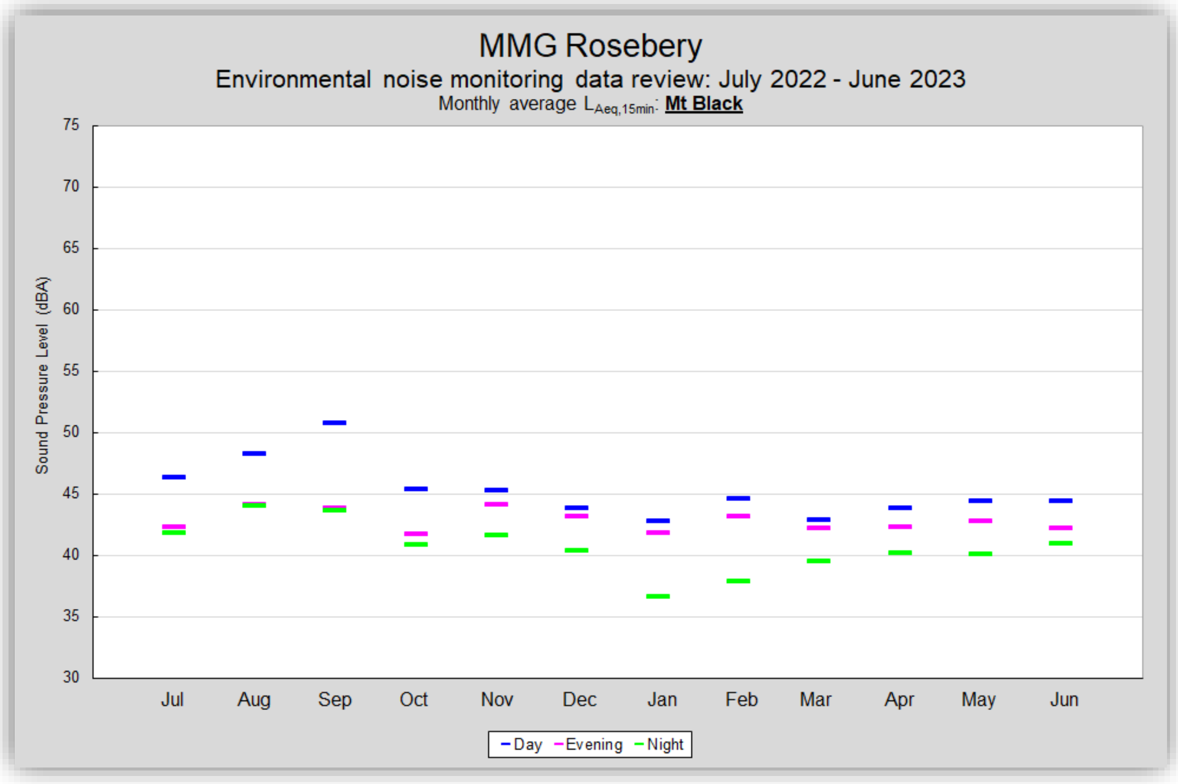


Figure 3-3: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Mt Black** (N3).

Monthly average day, evening, and night L_{Aeq} levels were fairly consistent at this location from October to June. The exception is January and February, which saw a significant reduction in the average night time noise, similar to that seen at the nearby Murchison St monitoring location. This is consistent with the previous reporting period[2]. This may be a direct result of reduced activity at the MMG site. Elevated day and night average noise levels are noted from July to September, with measured evening noise consistent with the remainder of the year. This time period coincides with the installation of a new water tank by TasWater with similar measurement levels seen in the previous reporting year[2] from February to June; thus is most likely a direct result of the TasWater construction project.

3.2.4 Murchison St

Figure 3-4 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Murchison St monitoring location.

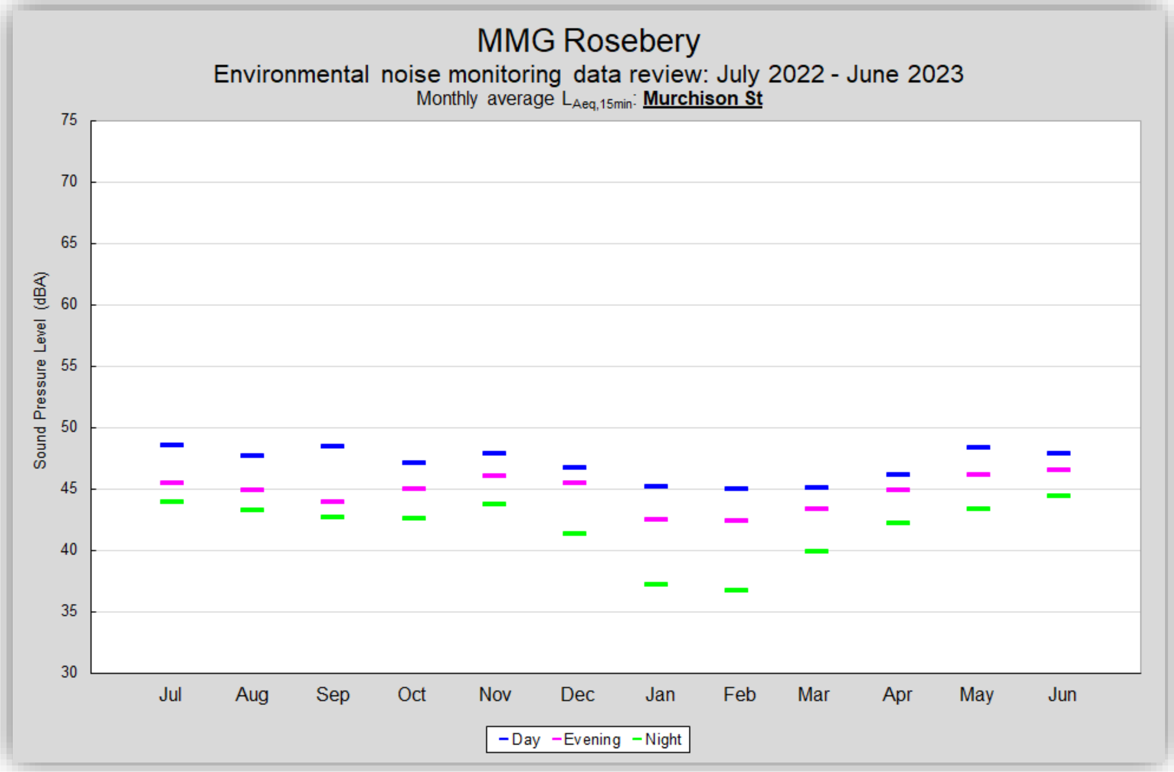


Figure 3-4: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Murchison St** (N4).

Day, evening, and night levels were consistently 2 – 3 dB above Mt Black station averages (170 m NE from this station) throughout the year, suggesting elevated levels could be a direct result of proximity to MMGs operations, as well as being closer to the Murchison Highway.

Significantly lower night-time average levels are apparent between December and March, along with slightly lower day and evening levels from January to March. Similar results were evident at the Mt Black monitoring location. This is consistent with the previous reporting period[2] and may be due to a direct result of reduced activity at the mine.

3.2.5 Alec St

Figure 3-5 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Alec St monitoring location.

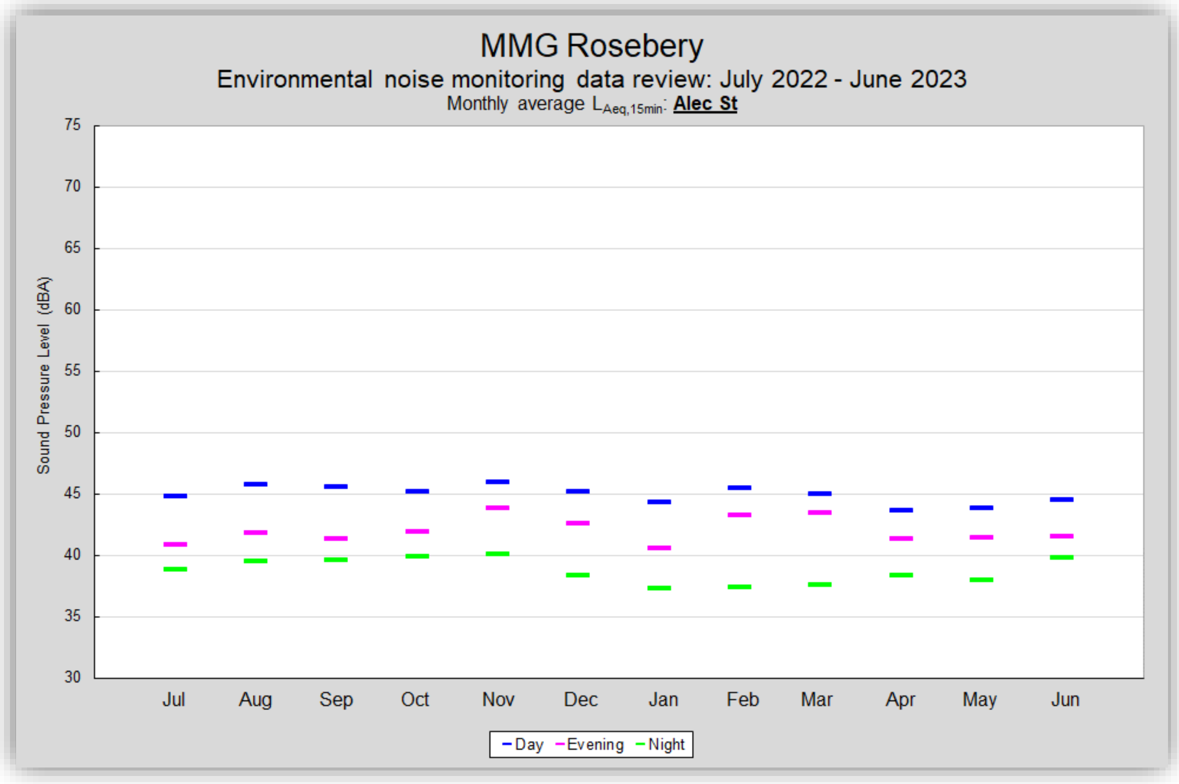


Figure 3-5: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Alec St** (N5).

Average day L_{Aeq} levels were consistent across the year, ranging from 44 – 46 dBA. Night levels were consistent, ranging from 37 – 40 dBA. These both being similar to the previous reporting period[2]. The minor fluctuations seen during the evening period are also similar to those seen in the previous reporting period; but with larger increases seen in November, February and March. This location is a significant distance from the mine and these evening variations are likely to be the result of noise environment local to the meter.

4 Blast monitoring

GV and ABO is monitored at a single location on the western side of the Rosebery Hospital. An Instantel Minimate Pro 4 monitor were used with an International Society of Explosives Engineers (ISEE) standard triaxial geophone and ISEE linear microphone.

15-minute peak particle velocity (mm/s) and peak linear sound pressure levels (dBL) have been recorded in the past and initially for the finical year being assessed here. For the majority of the reporting period shorter times intervals were utilised, 1-minute and at times sub-minute. The sub-minute recording was due to a hire units settings, in place during calibration of the MMG unit. Upon return of the MMG unit after calibration it was set to 1-minute intervals with no loss of data.

Blasting at the mine occurs during 2 time periods on a daily basis as follows:

- 0645 to 0700 hrs
- 1845 to 1900 hrs

Monitoring is undertaken in general accordance with the relevant guidelines including the *Australian and New Zealand Environment Council* (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (September 1990), *Australian Standard AS 2187.2-2006 Explosives storage and use. Use of explosives* and the Tasmanian *Quarry Code of Practice* (May 2017).

The measurement of GV and ABO is in general accordance with the provisions of the Appendix J sections J3.2 and 3.3 of *AS 2187.2-2006* with the exception of the location of the microphone which is close (approx. 5 – 10 cm) to the western wall of the Rosebery Hospital.

The Minimate Pro 4 unit is calibrated annually at a NATA accredited laboratory and all data presented here is from within the period of calibration.

4.1 Data set

Of the possible 35,040 15-minute data intervals within the monitoring year, 33,008 (94.2 % of the intervals) were available for analysis; This is an approx. 17 % improvement in data availability over last year's data[2].

The following summarises the significant periods of missing data from the July 2022 - June 2023 period:

- 06/10/2022 – 20/10/2022
- 04/02/2023 – 07/02/2023
- 04/03/2023 – 07/03/2023

4.2 Ground vibration monitoring

Figure 4-1 presents 15-minute peak particle velocity levels measured at the Hospital monitoring location (the highest value of the three orthogonal measurement directions was selected for each interval). Figure 4-2 presents measured levels at scheduled blasting times only. Results are assessed against the following limits applicable under EPN 7153/3:

- 5 mm/s for 95 % of blasts
- 10 mm/s for 100 % of blasts

Both limits are marked on graphs for the complete data set (Figure 4-1) and during scheduled blasting times (Figure 4-2):

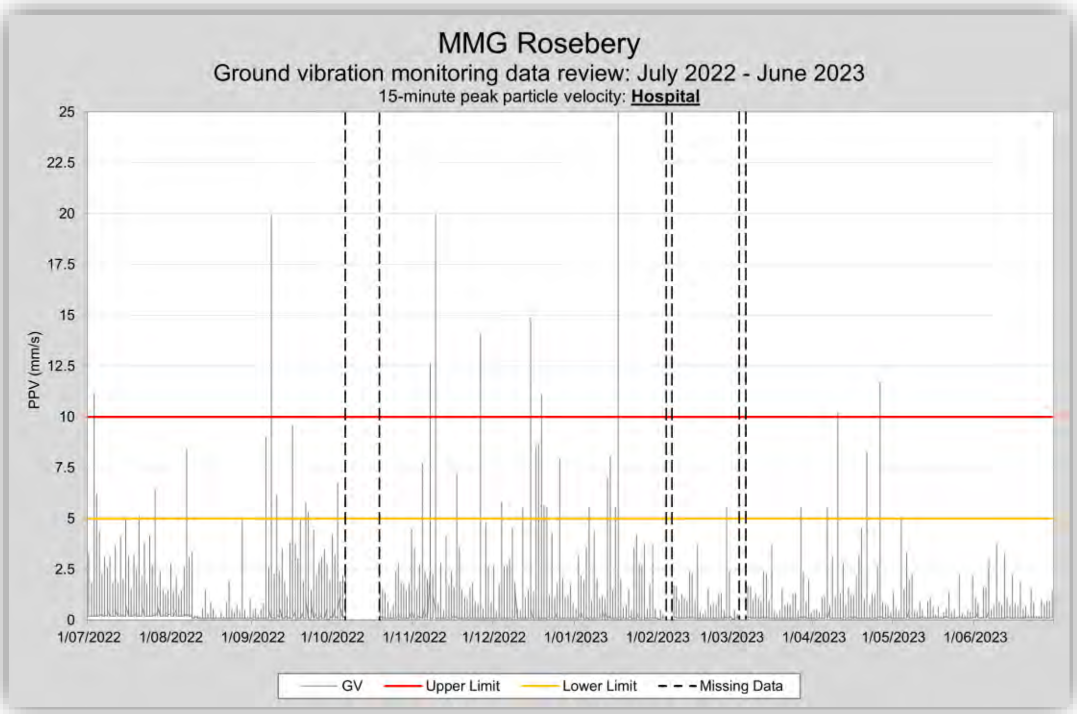


Figure 4-1: 15-minute peak particle velocity levels, **Hospital** (V2).

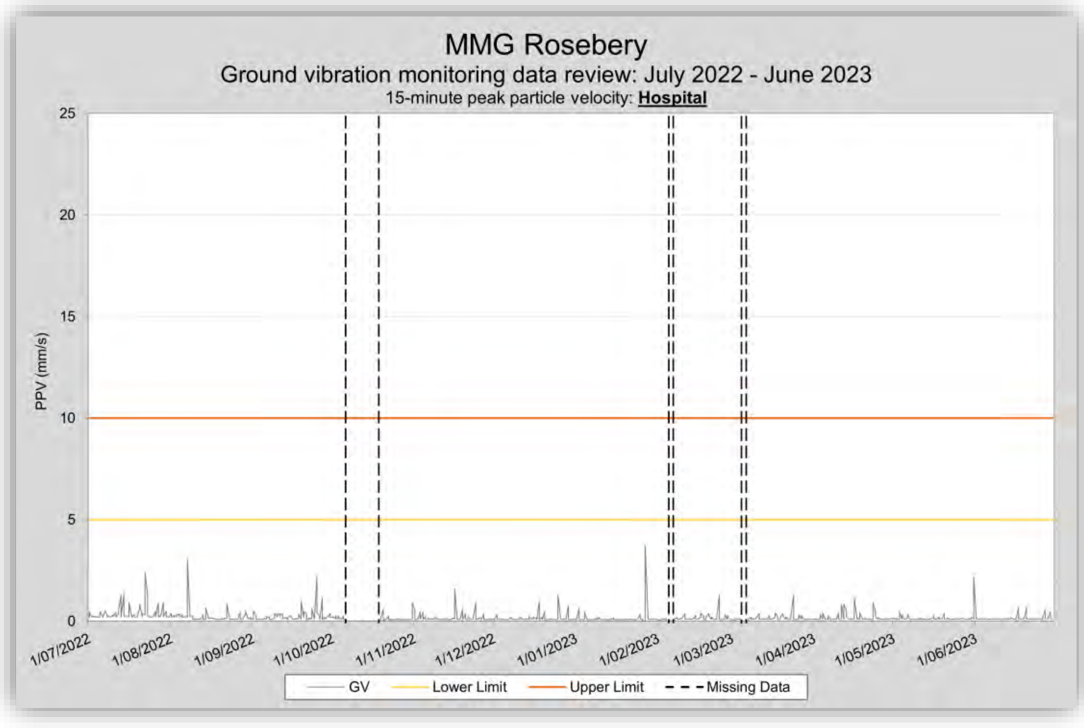


Figure 4-2: 15-minute peak particle velocity levels during scheduled blasting times, **Hospital** (V2).

From the above, Tarkarri Engineering notes no exceedance of the EPN limits occurred during scheduled blasting times.

4.3 Air blast overpressure monitoring

Figure 4-3 presents 15-minute peak linear sound pressure levels measured at the Hospital monitoring location. Figure 4-4 presents measured levels at scheduled blasting times only. Results are assessed against the following limits applicable under EPN 7153/3:

- 115 dBL for 95 % of blasts
- 120 dBL for 100 % of blasts

Both limits are marked on graphs for the complete data set (Figure 4-3) and during scheduled blasting times (

Figure 4-4):

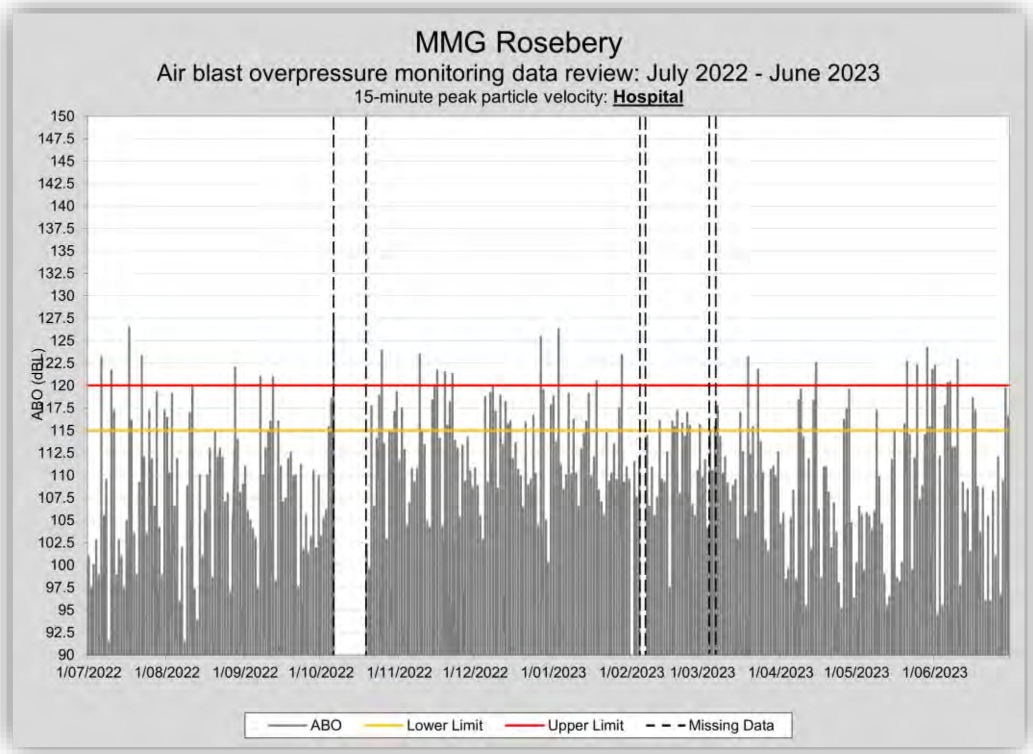


Figure 4-3: 15-minute peak linear sound pressure levels, **Hospital** (V2).

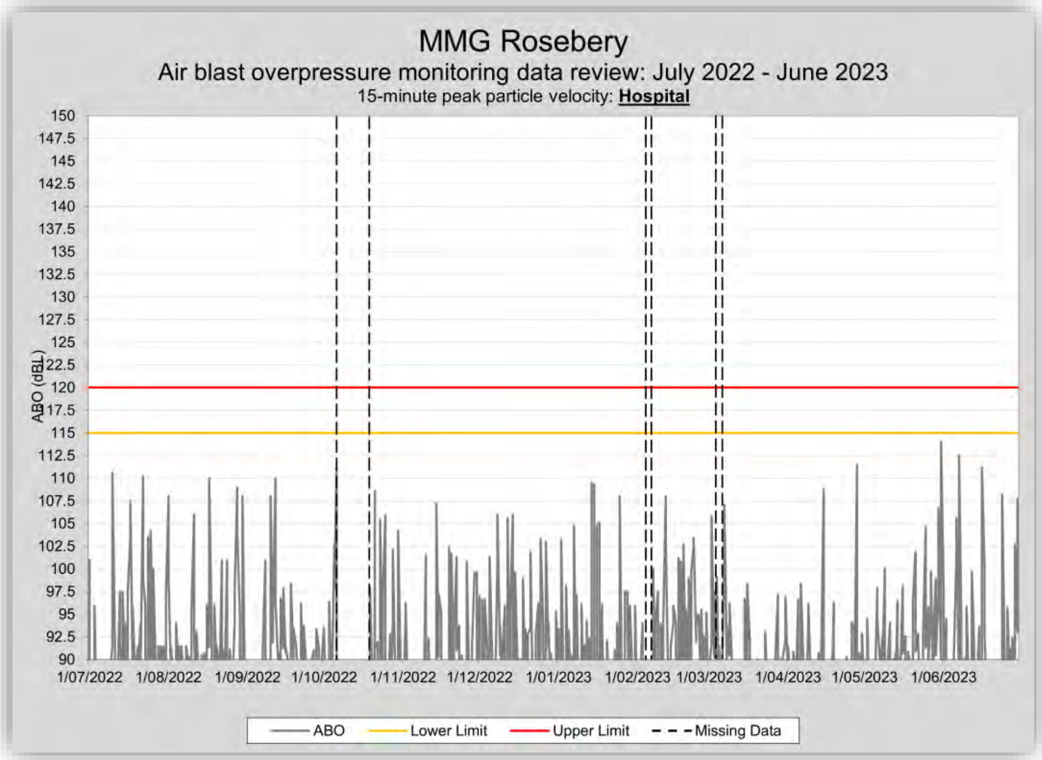


Figure 4-4: 15-minute peak linear sound pressure levels during scheduled blasting times, **Hospital** (V2).

No exceedance of the lower or upper limits occurred during the blasting times. Outside of blasting times, exceedances of the upper limit occurred 26 times. Upon analysis of the 3 MMG weather stations, poor weather conditions are likely responsible for exceedances outside of the blasting times.

5 Community noise nuisance

Table 5-1: Community noise nuisance events.

Community noise nuisance events			
Date	Complaint	Investigation	Corrective Action
03/12/2022	Noise from 2/5 Dam seepage pumps	Noise monitoring did not record any exceedances surrounding the time of complaint.	
03/01/2023	3 different noise complaints	Noise found to be attributed to a NYE party external to MMG Rosebery	
06/01/2023	Anonymous noise complaint	Noise monitoring did not record any exceedances surrounding the time of complaint.	
25/05/2023	Anonymous noise complaint regarding reverse alarms and extraction fans.	Investigation into validity of complaint.	Not specified

6 Conclusions and recommendations

Tarkarri Engineering has conducted a review of environmental noise, GV and ABO monitoring data recorded by MMG Rosebery between 1 July 2022 and 30 June 2023.

The environmental noise monitoring data typically showed annual averages for the L_{Aeq}, L_{A90} and L_{A10} 15-minute levels at monitoring positions N1, N2, N3, N4 and N5 similar to those measured in the previous year[2].

GV and ABO data showed that levels recorded during blasting times at the mine were below the EPN limits with no recorded exceedance of the lower EPN GV and ABO noted.

7 Recommendations

7.1 Noise monitoring

Under the site EPN an environmental noise survey is required on a tri-annual basis and the survey methodology requirements under the EPN call for a 10-minute measurement interval (condition N3 3.3.). Tarkarri Engineering recommends that loggers at the 5 monitoring locations are changed to record 10-minute intervals rather than the current 15-minute intervals to bring survey and unobserved monitoring data in line, as suggested in 2021-22 annual review[2]. This change would also increase accuracy in relating the noise data with weather data. Approval for this change should be sought from Director of the EPA as per condition N1 1.1 of the mine's EPN (see section 1 of this report for details).

Tarkarri Engineering notes that condition N1 1.3 states 'measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the Tasmanian Noise Measurement Procedures Manual 2004, or future revisions of this manual, issued by the Director'. For tonality to be addressed as required an '… A-weighted … one-third octave spectrum must be measured'[1]. and for impulsiveness to be addressed as required measurements '…using a sound level meter set initially to fast and then impulse time response'[1] must be taken. The current monitoring systems employed by MMG do not have the capability of measuring a 1/3-octave band spectrum or recording concurrent impulse time response noise levels.

NB: Tarkarri Engineering notes that without observation or directional noise measurement it would not be possible to determine the source of any tonal or impulsive noise emissions with any accuracy.

Lost data and inconsistencies in the data records indicate that download and calibration procedures utilised by MMG for the noise monitoring stations requires review and potential retraining of personnel to minimise loss of data. Particular focus should be on the following:

- Procedures drafted to assist future MMG personnel in properly downloading data. This may include leaving data on the meter until it has been properly transferred to MMG's data repository and reviewed.

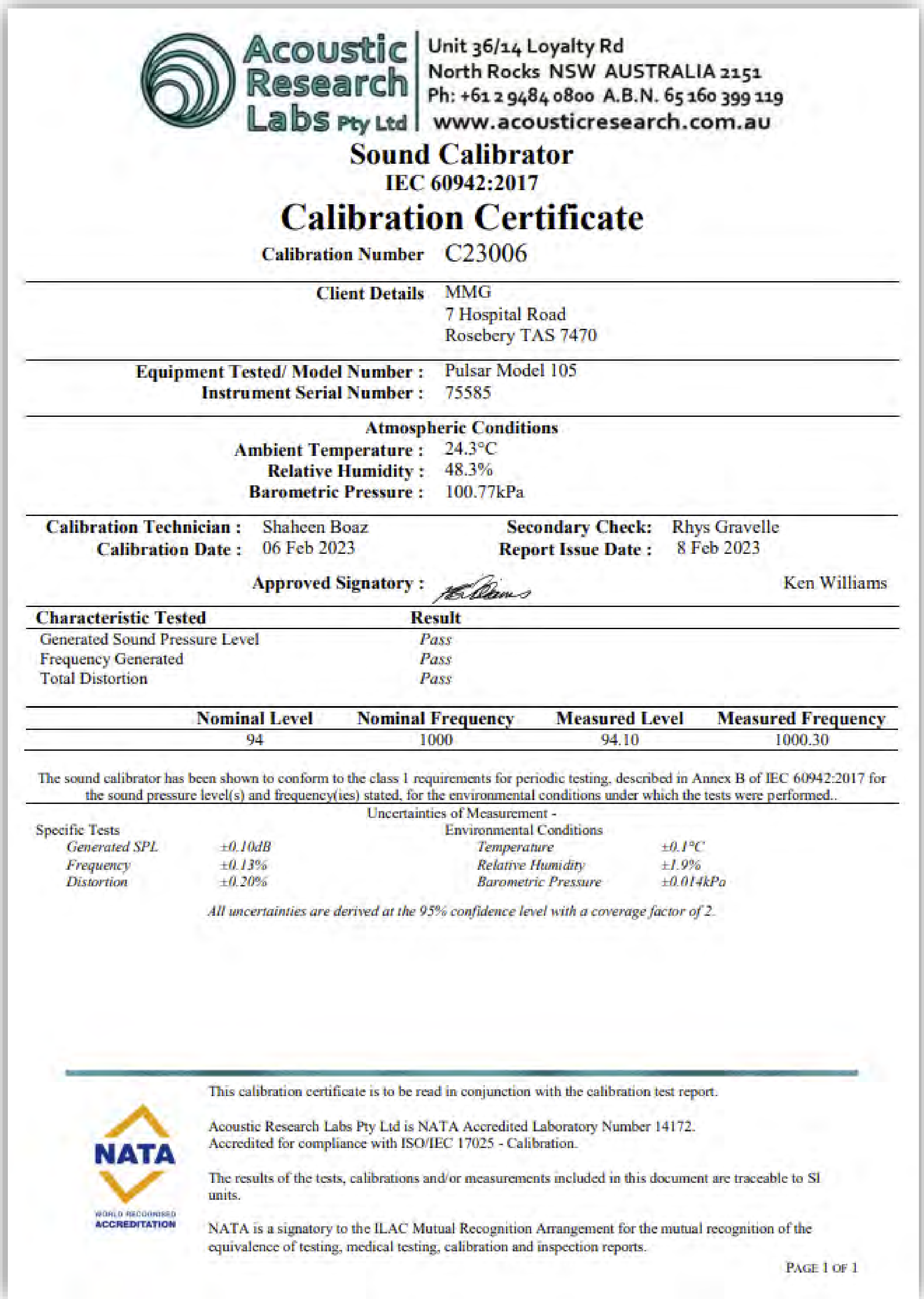
The following reminders are provided based on issues seen in previous years:

- Care is taken in handling the microphones at each monitoring station as these are delicate and easily damaged during calibration.
- Ensuring that the field calibrator is activated prior to calibration being initiated and that care is taken during calibration.
- Check of connection points (i.e. cable connections to preamp and sound level meter unit) to ensure no water ingress, corrosion or other damage has occurred.

7.2 GV and ABO monitoring

As discussed in section 4 of this report, the current measurement location does not fully comply with the provisions of Appendix J sections J3.2 and J3.3 of *AS 2187.2-2006*. Tarkarri Engineering recommends that the monitoring equipment be relocated to a more suitable position. An investigation was conducted in March 2021 and detailed in Tarkarri Engineering report 5514_VIB_R which provides recommendations regarding new monitoring location options. MMG has requested approval to change the location of the microphone and is awaiting EPA response. Changing data recording to 10 minutes, along with noise recording, would help to more accurately correlate with weather data. It is also recommended to record only during blasting times.

8 Appendix



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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23006

Client Details MMG
7 Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 75585

Atmospheric Conditions
Ambient Temperature : 24.3°C
Relative Humidity : 48.3%
Barometric Pressure : 100.77kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 06 Feb 2023
Secondary Check: Rhys Gravelle
Report Issue Date : 8 Feb 2023

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.10	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10dB*	*Temperature*	*±0.1°C*
Frequency	*±0.13%*	*Relative Humidity*	*±1.9%*
Distortion	*±0.20%*	*Barometric Pressure*	*±0.014kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - Calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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Sound Level Meter
IEC 61672-3:2013

Calibration Certificate

Calibration Number C23060

Client Details MMG - Rosebery Mine
7 Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878139
Microphone Serial Number : 22403
Pre-amplifier Serial Number : 28142
Firmware Version : 12.6

Pre-Test Atmospheric Conditions
Ambient Temperature : 24.8°C
Relative Humidity : 52.6%
Barometric Pressure : 100.76kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 25.3°C
Relative Humidity : 52.6%
Barometric Pressure : 100.76kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 14 Mar 2023
Secondary Check: Rhys Gravelle
Report Issue Date : 14 Mar 2023

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014kPa*
Electrical Tests	*±0.13dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
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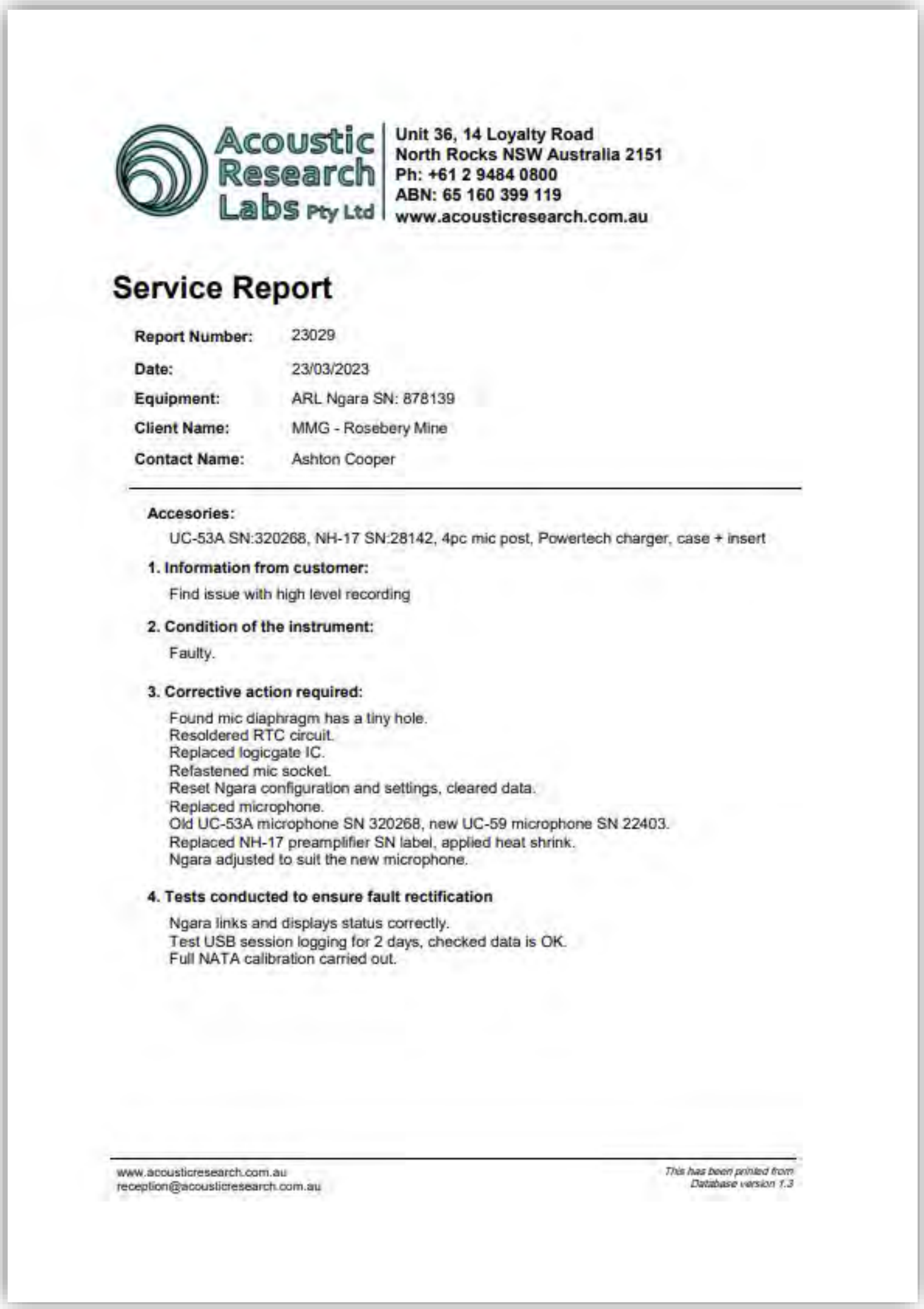

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Service Report

Report Number:	23029
Date:	23/03/2023
Equipment:	ARL Ngara SN: 878139
Client Name:	MMG - Rosebery Mine
Contact Name:	Ashton Cooper

Accesories:

UC-53A SN:320268, NH-17 SN:28142, 4pc mic post, Powertech charger, case + insert

1. Information from customer:

Find issue with high level recording

2. Condition of the instrument:

Faulty.

3. Corrective action required:

Found mic diaphragm has a tiny hole.
Resoldered RTC circuit.
Replaced logicgate IC.
Refastened mic socket.
Reset Ngara configuration and settings, cleared data.
Replaced microphone.
Old UC-53A microphone SN 320268, new UC-59 microphone SN 22403.
Replaced NH-17 preamplifier SN label, applied heat shrink.
Ngara adjusted to suit the new microphone.

4. Tests conducted to ensure fault rectification

Ngara links and displays status correctly.
Test USB session logging for 2 days, checked data is OK.
Full NATA calibration carried out.

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reception@acousticresearch.com.au

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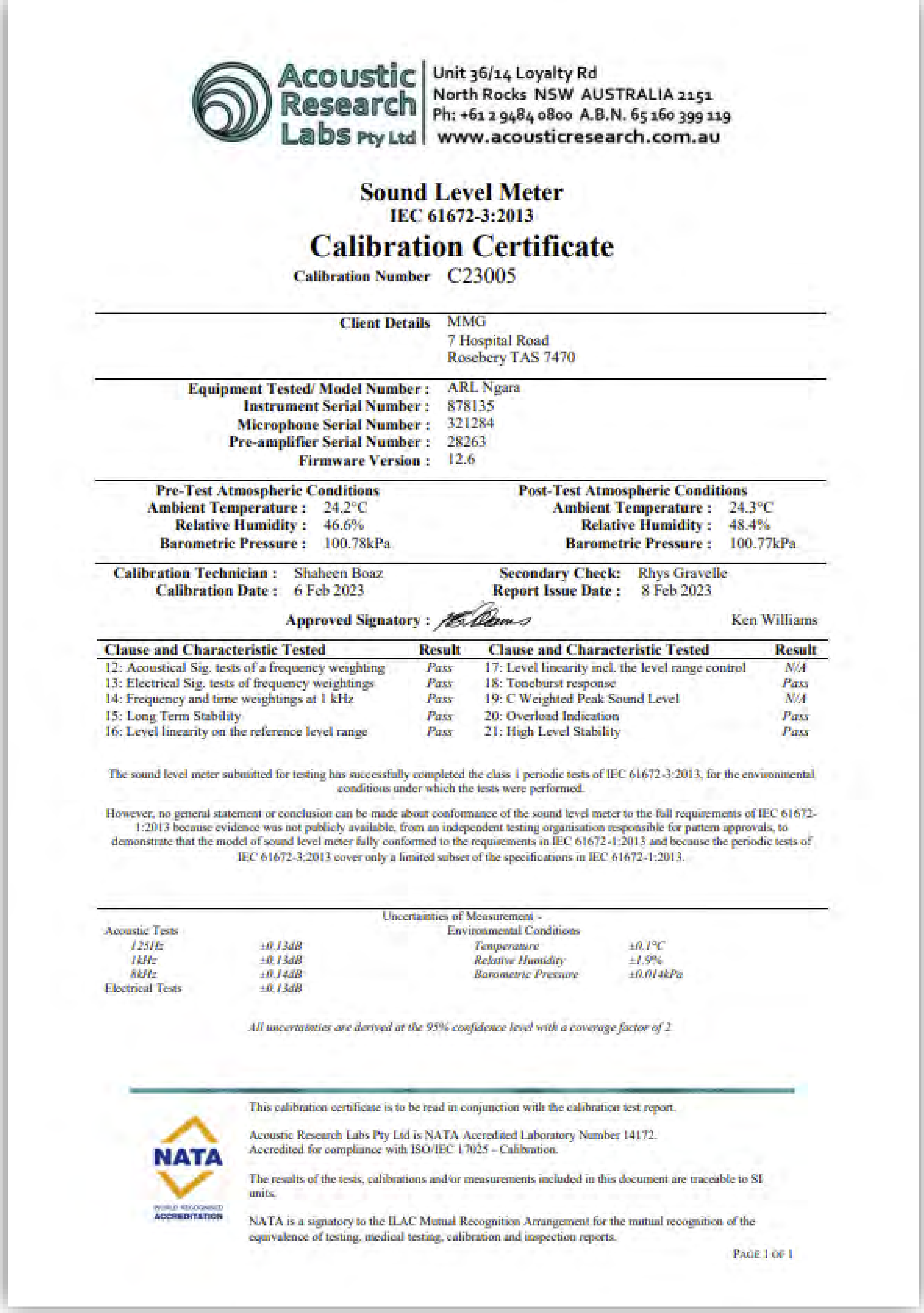

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Sound Level Meter

IEC 61672-3:2013

Calibration Certificate

Calibration Number C23005

Client Details MMG
7 Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878135
Microphone Serial Number : 321284
Pre-amplifier Serial Number : 28263
Firmware Version : 12.6

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	24.2°C	**Ambient Temperature :**	24.3°C
Relative Humidity :	46.6%	**Relative Humidity :**	48.4%
Barometric Pressure :	100.78kPa	**Barometric Pressure :**	100.77kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 6 Feb 2023
Secondary Check: Rhys Gravelle
Report Issue Date : 8 Feb 2023

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014kPa*
Electrical Tests	*±0.13dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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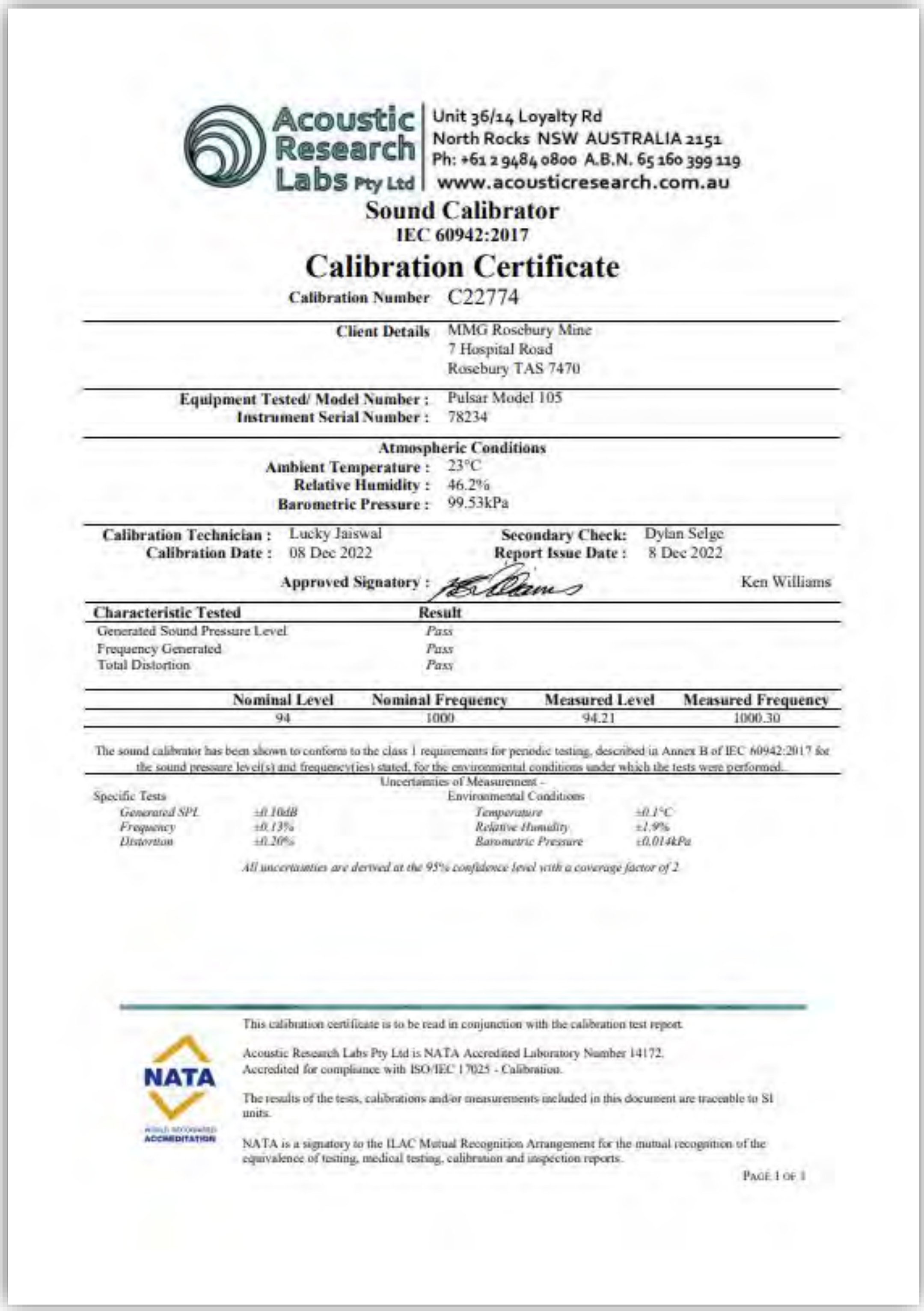

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C22774

Client Details MMG Rosebury Mine
7 Hospital Road
Rosebury TAS 7470

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 78234

Atmospheric Conditions
Ambient Temperature : 23°C
Relative Humidity : 46.2%
Barometric Pressure : 99.53kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 08 Dec 2022
Secondary Check: Dylan Selge
Report Issue Date : 8 Dec 2022

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.21	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10dB*	*Temperature*	*±0.1°C*
Frequency	*±0.13%*	*Relative Humidity*	*±1.9%*
Distortion	*±0.20%*	*Barometric Pressure*	*±0.014kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2

This calibration certificate is to be read in conjunction with the calibration test report.

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: G35019

EQUIPMENT TESTED : Ground Vibration Monitor

Manufacturer: Instantel
Meter Type: Minimate Pro **Serial No:** MP14225
Transducers A: 720A2004 **Serial No:** SE14095

Owner: MMG Rosebery Mine
8 River Road
Wivenhoe, TAS 7320

Tests Performed: Measured Frequency response, Correct level display, Linearity display
Comments: Detailed overleaf.

CONDITION OF TEST:

Temperature	23	°C ±1° C
Relative Humidity	59	% ±5%

Date of Receipt : 03/02/2023
Date of Calibration : 07/02/2023
Date of Issue : 08/02/2023

Acu-Vib Test Procedure: AVP15 (Ground vibration Monitor & Low Frequency Transducer) based on AS2187.2 & DIN45669-1

CHECKED BY: .... **AUTHORISED SIGNATURE:** ....

Jack Kielt

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Unit 14, 22 Hudson Ave, Castle Hill NSW 2154
(02) 9680 8133

Page 1 of 2 Calibration Certificate
AVCERT15 Rev 2.0 14.04.2021

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: M35020

EQUIPMENT TESTED : Microphone

Manufacturer: Instantel
Type No: 720A1801 **Serial No:** SL13220

Owner: MMG Rosebery Mine
8 River Road
Wivenhoe, TAS 7320

Tests Performed: Minimate Low Frequency Microphone Response

Comments: Detailed Overleaf.

CONDITION OF TEST:

Ambient Pressure	999	hPa ±1 hPa	**Date of Receipt :**	03/02/2023
Temperature	23	°C ±1° C	**Date of Calibration :**	07/02/2023
Relative Humidity	57	% ±5%	**Date of Issue :**	08/02/2023

Acu-Vib Test Procedure: AVP18 (Low Frequency Microphone Calibration with Monitor)

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Page 1 of 2 Calibration Certificate
AVCERT18 Rev.2.0 14.04.2021