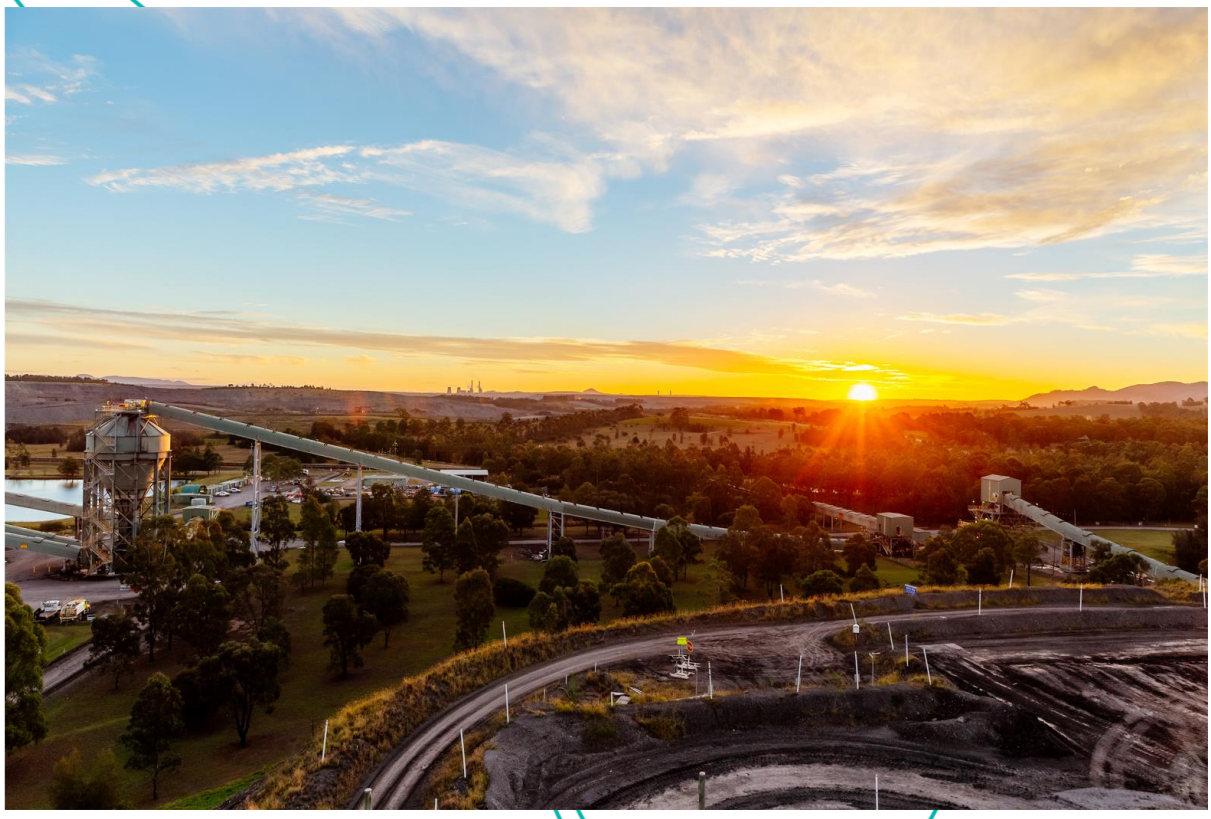
MGO
MT OWEN / GLENDELL
GLENCORE

ANNUAL REVIEW

1 January 2021 – 31 December 2021



Number:	MGO 2021 Annual Review	**Status:**	Pending Approval	**Effective:**	31/3/2022
Owner:	Environment & Community Manager	**Version:**	1	**Review:**	1/1/2023

Title Block

Name of operation	Mt Owen Glendell Operations
Name of operator	Mt Owen, Ravensworth East and Glendell Mines
Development consent/ project approval	MGO Mining Operations Plan (Mt Owen, Glendell and Ravensworth East), DA SSD-5850 (Mt Owen and Ravensworth East) and DA 80/952 (Glendell).
Name of holder of development consent/ project approval	Mt Owen Pty Limited
Mining lease and exploration lease #	Mt Owen & Rav East – CCL715, CL383, ML1355, ML1415, ML1419, ML1453, ML1475, ML1561, ML1608, ML1629, ML1673, ML1694, ML1741, ML1802, MLA512, MLA513, EL6254, EL5824, A268, A423, A429, AL08 Glendell – ML1629, ML1673
Name of holder of mining lease	Mt Owen Pty Limited
Mining lease and Exploration Lease #	Glendell – CL358, MPL343, ML1410, ML1476, EL6594, EL8184
Name of holder of mining lease	Glendell Tenements Pty Ltd
Water licence #	Refer list provided in Table 31
Name of holder of water licences	Mt Owen Pty Limited
MOP/ RMP start date	January 2020
MOP/ RMP end date	June 2024
Annual Review start date	01/01/2021
Annual review end date	31/12/2021
I, Jason Desmond, certify that this audit report is a true and accurate record of the compliance status of Mt Owen Glendell Operations for the period 01/01/2021 to 31/12/2021 and that I am authorised to make this statement on behalf of Mt Owen Glendell Operations. *Note.* *a) The Annual Review is an 'environmental audit' for the purposes of section 122B (2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.* *b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).*	
Name of authorised reporting officer	Sebastien Moreno
Title of authorised reporting officer	Environment and Community Manager
Signature of authorised reporting officer	
Date	22 July 2022

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1. Executive Summary and Statement of Compliance

1.1 Executive Summary

This Annual Review ('the report') is for the period of 01 January 2021 to 31 December 2021. It is required under:

- Schedule 5, Condition 5, of Development Approval SSD-5850 (Mount Owen (MTO) and Ravensworth East)
- Schedule 5, Condition 5, of Development Approval 80/952 (Glendell).

The report has been prepared in accordance with the NSW Department of Planning and Environment *Annual Review Guideline*, dated October 2015. Mt Owen Glendell Operations (MGO) produced a total of 12.07 Million tonnes (Mt) of Run of Mine (ROM) coal during the reporting period. In 2021, product coal totalled 7.08 Mt (see ***Table 1***).

A total of 804 trains were loaded during the reporting period, with 7.11 Mt of product coal railed from site.

On 15 January 2021 DPIE approved Mt Owen Continued Operations Modification 5 (SSD-5850) and on 3 June 2021 DPIE approved Mt Owen Continued Operations Modification 6 (SSD-5850).

Table 1: Summary of ROM and Product Coal

Site	2021 ROM Coal (Mt)	ROM Consent Limit (Mt)	2021 Product Coal (Mt)
Mt Owen	7.78	10	4.59
Glendell	3.33	4.5	2.01
Ravensworth East	0.96	4	0.48
Total	12.07	17*	7.08

**17 million tonnes of ROM coal limit approved to be processed via CHPP in a calendar year as per SSD-5850*

Air Quality

Measurements of PM_{10}, $PM_{2.5}$, Total Suspended Particulates (TSP) and deposited dust were compared to the short and long-term impact assessment criteria from the MTO and Glendell development consents (DA 80/952 and SSD-5850). Monitoring completed during 2021 determined that MGO was in compliance with its development consent criteria in terms of air quality impacts.

Predictions of air quality impacts made in the latest environmental assessment of the approved operation were compared to the measurement results. The comparisons showed that modelled PM_{10}, TSP and deposited dust levels for MGO were generally greater than the 2021 monitoring results.

Water

The Surface Water Management and Monitoring Plan (SWMMP), Groundwater Management and Monitoring Plan (GWMMP) and Surface Water and Groundwater Response Plan (SWGWRP) were all

reviewed during 2021 in consultation with relevant government agencies. MGO will seek approval for the revised water management plans in 2022 following MOCO SSD-5850 Mod 6 approval.

2021 monitoring data for all creeks was generally in line with baseline conditions. There were a number of monitoring results that exceeded baseline trigger levels for Bowmans Creek and Swamp Creek in 2021. All of these results were within the historical range. The sites that triggered SWMMP criteria in 2021 were internally reviewed in accordance with the 2020 SWGWRP. These reviews confirmed that external reporting of these results was not required in line with the SWGWRP. These sites were mainly sampled under "no flow" conditions during 2021.

Stream condition at Bowmans Creek and York's Creek has remained stable to that of 2020. There was either no change or a slight increase in stream condition at Swamp Creek from 2020. At Bettys Creek and Main Creek, stream condition remained constant compared to 2020. Creek diversions onsite undergo bi-annual condition monitoring and annual stream stability and stream condition assessments. Outcomes of Creek monitoring show mixed results, with generally improved conditions, or no change.

MGO monitor groundwater level and quality for over 90 groundwater monitoring bores as per the MGO GWMMP. Monitoring results for a number of bores exceeded the decline in level (drawdown) during 2021 Review of water quality results and comparison to trigger levels for EC and pH identified several trigger exceedances in 2021. Generally, these exceedances were either in line with historical trends or correlated with rainfall events.

Biodiversity

MGO completed its fourth round of monitoring on its Conservation Agreements (CAs) Offsets with overall good composite value scored throughout the offsets, the report also provided recommended actions to be completed in 2022. The main actions being continued primary weed control.

In addition, comprehensive fauna and flora monitoring surveys were conducted at MGO offsets in 2021, identifying the improved ecological state following several years of drought like conditions prior with natural recruitment evident throughout. In 2021, 10 threatened species were recorded, including 4 bird species, 3 non-flying mammals and 3 microbat species. A total of 26 threatened species have been detected at MGO since the commencement of fauna monitoring.

A total of 69 new habitat structures were installed across MGO in 2021.

Noise

The noise monitoring program for MGO incorporates both continuous noise monitors and attended noise monitoring. During attended noise monitoring, one non-compliance was recorded in August 2021, where Glendell exceeded the nominated criteria during applicable meteorological conditions. This exceedance was reported to the relevant regulatory agencies. The applicable noise criteria and the predicted noise levels are the same for each of the monitoring locations and therefore the comparison with the criteria also demonstrates a comparison with the predicted noise levels. Results do not appear to indicate any trends in the data.

Blasting

A total of 187 blasts occurred at MGO in 2021, compared to 238 blasts in 2020. The 187 blasts that occurred during the reporting period consisted of 70 blasts at Glendell, 31 blasts at Ravensworth East and 86 blasts at MTO. No non-compliances with MGO blast impact criteria occurred during 2021.

Heritage

Inspections were carried out during the 2021 reporting period for Aboriginal and European cultural heritage sites in accordance with the Ground Disturbance Permit process. In 2021 MGO continued the monitoring of Aboriginal heritage sites, in conjunction with Registered Aboriginal Parties (RAPs) and an OzArk archaeologist. Monitoring of Aboriginal heritages sites occurred quarterly and artefacts were found to be well preserved. No artefacts were salvaged and there were no environmental incidents relating to Aboriginal heritage in 2021.

During the reporting period MGO conducted quarterly monitoring and ongoing maintenance of European heritage sites. MGO continued to care for Ravensworth Homestead and actively managed the Hebden and Ravensworth Public School ruin sites.

Rehabilitation

Rehabilitation continued across the MGO during 2021 generally in line with the *Rehabilitation Management Plan (RMP) / Mining Operations Plan (MOP).* Glendell completed 75 ha of rehabilitation during 2021 including 32 ha of open grassland or pasture areas and 28 ha of open woodland areas. In 2021 Mt Owen prepared and seeded a total of 15 ha of open forest rehabilitation which was natural landform design technique being incorporated at Mt Owen North Pit.

Rehabilitation across MGO was generally stable and no critical erosion features were identified. Weed incursion has been identified as the main issue at MGO. Weed populations are widespread and threaten the ecological integrity of the rehabilitated communities.

Environmental Incidents

MGO recorded 94 environmental incidents during the reporting period, compared to 56 environmental incidents in 2020. Four Incidents were classified as category 2, 56 as category 1 and 34 were classified as nil category. Of the 56 category 1 incidents, there were 50 hydrocarbon spills less than 1,000L, two noise exceedances, one blast fume related event, one Ground Disturbance Permit breach and two water incidents.

Community Complaints and Consultation

During 2021, one community complaint was recorded at MTO. The complaint related to noise and air quality. Glendell received three community complaints consisting of two relating to noise and one relating to air quality. All complaints were addressed promptly with complainants that requested further correspondence being contacted by MGO. Two Community Consultive Committee (CCC) meetings and three community gatherings were held in 2021. The October 2021 CCC meeting was held via Zoom due to COVID-19 restrictions.

Visual Impact

MGO undertook direct seeding and tube stock planting works in 2021 to further develop the Middle Falbrook Tree Screening along Glennies Creek Road. Seeding works utilised a mix of species endemic to the local area. Weed control, ripping and fencing works were conducted prior to planting.

Demolition Works

No demolition works were undertaken onsite at MGO during 2021.

1.2 Statement of Compliance

During the reporting period, MTO and Glendell functioned under their own development consents and Environment Protection Licence (EPL), together with Mining Leases (MLs) and secondary approvals, such as management plans and water licences.

MGO holds over 100 approvals, containing more than 2,000 conditions. ***Table 2*** summarises the state of compliance against the major approvals for MGO during 2021. Non-compliances are listed in ***Table 3*** and detailed in later sections of this report, with a definition of risk levels for each provided in ***Table 4***.

Table 2: Statement of Compliance 2021

Relevant Approvals	Compliance
MGO Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	Yes
DA SSD-5850 (Mt Owen / Ravensworth East)	Yes
DA 80/952 (Glendell)	No
EPBC 2013/6978	Yes
Mt Owen EPL 4460	Yes
Glendell EPL12840	No
CCL0715	Yes
CL0358	Yes
CL0382	Yes
CL0383	Yes
ML 1355	Yes
ML 1419	Yes
ML 1453	Yes
ML 1561	Yes
ML 1475	Yes
ML 1608	Yes
ML 1410	Yes
ML 1415	Yes
ML 1476	Yes
ML 1694	Yes
ML 1629	Yes
ML 1741	Yes

Relevant Approvals	Compliance
ML 1794	Yes
MPL 343	Yes
EL5824	Yes
EL6594	Yes
EL8184	Yes
Water Licences	Yes

Table 3: Non-Compliances.

Relevant Approval	Condition #	Condition Description	2021 Compliance Status	Comment	Annual Review Section(s)
DA 80/952	Schedule 3, Condition 2	Breach of Operational Noise conditions.	Non-Compliant	10 August 2021: N9 noise exceedance. DPIE and EPA notified.	**Section 6.1** and **Section 10**
EPL 12840	L3.3	Noise generated at the premises must not exceed the noise limits presented in the table below.	Non-Compliant	10 August 2021: N9 Noise exceedance. DPIE and EPA notified.	**Section 6.1** and **Section 10**

Table 4: Compliance Status Key

Risk Level	Colour Code	Description
High	Non-Compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-Compliant	Non-compliance with: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low	Non-Compliant	Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non-Compliant	Only to be applied where the non-compliance does not result in any risk of environmental

1.3 Statutory Requirements

Various statutory approvals stipulate the requirements related to this Annual Review. These requirements are summarised in ***Table 5***.

Table 5: Statutory Requirements.

Approval	Condition	Relevant Section of Document
Development Consents SSD-5850 (Mt Owen and Ravensworth) and 80/952 (Glendell), **Schedule 5, Condition 5**	By the end of March each year, or as otherwise agreed with the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must: (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against the: • relevant statutory requirements, limits or performance measures/criteria; • monitoring results of previous years; and • relevant predictions in the documents listed in condition 2(a) of Schedule 2 or 3; (c) identify any non-compliance or incident over the past year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence; (d) identify any trends in the monitoring data over the life of the development; (e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and (f) describe what measures will be implemented over the next year to improve the environmental performance of the development.	(a) 4, 6, 7, 8 (b) 6, 7, 8, 9 (c) 1, 10 (d) Various (e) Various (f) Various
Development Consent 80/952 (Glendell), **Schedule 4, Condition 7**	Continuous Improvement 7. The Applicant must: (a) implement all reasonable and feasible best practice noise mitigation measures; (b) investigate ways to reduce the noise generated by the development, including maximum noise levels which may result in sleep disturbance; and (c) report on these investigations and the implementation and effectiveness of these measures in the Annual Review.	6
Development Consent 80/952 (Glendell), **Schedule 4, Condition 46**	Monitoring of Coal Transport 46. The Applicant must keep records of the amount of coal transported from the site each year, and include these records in the Annual Review.	4.3.1 and Appendix B
Development Consent 80/952 (Glendell), **Schedule 4, Condition 52**	The Applicant must … (e) report on waste management and minimisation in the Annual Review, …	4.3.2

Approval	Condition	Relevant Section of Document
Development Consent SSD-5850 (Mt Owen and Ravensworth) **Schedule 3, Condition 41**	The Applicant must … (d) monitor and report on the effectiveness of the waste minimisation and management measures in the annual review referred to in condition 5 of Schedule 5.	
Development Consent SSD-5850 (Mt Owen and Ravensworth) **Schedule 3, Condition 26**	Water Management Plan The Applicant must … (vii) a protocol to report on the measures, monitoring results and performance criteria identified above, in the annual review referred to in condition 5 of Schedule 5.	
Development Consent SSD-5850 (Mt Owen and Ravensworth) **Schedule 3, Condition 18**	Air Quality Operating Conditions The Applicant must: … (h) carry out regular monitoring to determine whether the development is complying with the relevant conditions of this consent, and report on this in the annual review referred to in condition 5 of Schedule 5.	6.3 and Appendix F
Development Consent SSD-5850 (Mt Owen and Ravensworth) **Schedule 3, Condition 31**	Biodiversity Management Plan The Applicant must … report on the effectiveness of the above measures against the periodic performance and completion criteria, as part of the annual review referred to in condition 5 of Schedule 5	6.4
Development Consent SSD-5850 (Mt Owen and Ravensworth) **Schedule 3, Condition 45**	Rehabilitation Management Plan The Applicant must … include a program to monitor, independently audit and report on the effectiveness of the measures in paragraph (h) above, and progress against the detailed performance and completion criteria in paragraph (g) above (at a minimum these reporting requirements must be included as part of the annual review referred to in condition 5 of Schedule 5)	8
Exploration Licence EL8184, Conditions 043 and 044	043. The licence holder must submit an Environmental Management Report to the Department in the following circumstances: a) where the licence holder is seeking to renew this exploration licence, an Environmental Management Report must accompany an exploration licence renewal application; or b) where the licence holder is seeking to cancel or part cancel this exploration licence, an Environmental Management Report must accompany an exploration licence cancellation application; c) where the licence holder is not seeking to renew or cancel this exploration licence, and Environmental Management Report must be submitted prior to the expiry of this exploration licence. 044. The report must be prepared in accordance with any Director-General's requirements for environmental and rehabilitation reporting on exploration licences and include information on all disturbance resulting from prospecting operations and rehabilitation carried out within the exploration licence area. The report must be prepared to the satisfaction of the Direction-General.	043. Entire document 044. Entire document

Approval	Condition	Relevant Section of Document
Mining Tenement CCL0715, Schedule 00 Conditions 004 and 005	004. The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. 005. The EMR must: a) report against compliance with the MOP; b) report on progress in respect of rehabilitation completion criteria; c) report on the extent of compliance with regulatory requirements; and d) have regard to any relevant guidelines adopted by the Director-General.	004. Entire document 005. a) 8 b) 8 c) Entire document d) Entire document
Mining Tenement CL0358, Schedule 00 Condition 004	The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. The EMR must: i) report against compliance with the MOP; ii) report on progress n respect of rehabilitation completion criteria; iii) report on the extent of compliance with regulatory requirements; and iv) have regard to any relevant guidelines adopted by the Director-General.	i) 8 ii) 8 iii) Entire document iv) Entire document
Mining Tenements ML1410, ML1415, ML1453, ML1475, ML1476, ML1561, **Schedule 00 Conditions 003.01 and 003.02**	003.01. Within 12 months of the commencement of mining operations and thereafter annually or, at such other times as may be allowed by the Director-General, the lease holder must lodge an Annual Environmental Management Report (AEMR) with the Director-General. 003.02. The AEMR must be prepared in accordance with the Director-General's guidelines current at the time of reporting and contain a review and forecast of performance for the preceding and ensuing twelve months in terms of:- a) the accepted Mining Operations Plan; b) development consent requirements and conditions; c) Environment Protection Authority and Department of Land and Water Conservation licences and approvals; d) any other statutory environmental requirements; e) details of any variations to environmental approvals applicable to the lease area. and f) where relevant, progress towards final rehabilitation objectives.	003.01 Entire document 003.02 a) 8 b) Various c) Various d) Various e) 4.2 f) 8
Mining Tenements ML1608 and ML1629, **Schedule 00 Conditions 04 and 05**	04. The lease holder must lodge Environmental Management Reports (EMR) with The Director-General annually or at dates otherwise directed by the Director- General. 05. The EMR must: - report against compliance with the MOP; - report on progress in respect of rehabilitation completion criteria; - report on the extent of compliance with regulatory requirements; and - have regard to any relevant guidelines adopted by the Director-General.	04. Whole document 05. - 8 - 18 - Entire document - Entire document
Mining Tenements ML1694 and MP0343, **Schedule 00 Condition 04**	The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. The EMR must: (i) report against compliance with the MOP; (ii) report on progress in respect of rehabilitation completion criteria; (iii) report on the extent of compliance with regulatory requirements; and (iv) have regard to any relevant guidelines adopted by the Director-General.	i) 8 ii) 18 iii) Entire document iv) Entire document

2. Introduction

Mt. Owen/Glendell Operations (MGO) comprises (see ***Figure 1*** and ***Figure 2***):

- Mt Owen Open Cut Mine (MTO), including the MGO Coal Handling and Preparation Plant (CHPP)
- Glendell Open Cut Mine (Glendell)
- Ravensworth East Open Cut Mine (Ravensworth East)

This Annual Review ('the report') is prepared for the period 01 January 2021 to 31 December 2021 (the reporting period). The report has been prepared in accordance with the NSW Department of Planning, Industry and Environment (DPIE) Annual Review Guideline, dated October 2015. It covers the reporting requirements of:

- Development consent SSD-5850 for MTO and Ravensworth East
- Development consent (DA) 80/952 for Glendell
- Associated approvals, mining and exploration leases, and environmental management plans (see **Section 3**).

Mt. Owen/Glendell Operations (MGO)

MGO is located on Hebden Road at Ravensworth, approximately 20 km north-west of Singleton, NSW. MGO is owned and managed by Mt Owen Pty Limited (Mt Owen), which is a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore). MTO is operated by Thiess Proprietary (Pty) Limited (Ltd) (Thiess).

Mt Owen Open Cut Coal Mine (MTO)

Mining operations at MTO began in 1993 under the management of Hunter Valley Coal Corporation Pty Limited (HVCC). Xstrata (now Glencore) acquired MTO in 2003. MTO was granted DA 14-01-2004 in December 2004, which was supported by the MTO Environmental Impact Statement (EIS), December 2003 (Umwelt, 2003).

A modification to DA 14-1-2004 was approved in December 2010. This allowed for the construction and operation of a rail facility on the MTO rail loop. Further modification was approved in 2014 to increase the CHPP to 17 Million tonnes per annum (Mtpa) run-of-mine (ROM) coal equivalent from MTO, Glendell and Ravensworth East.

In January 2018 an application was made to DPIE to surrender DA 14-01-2004 as it was replaced by SSD-5850. Approval to surrender DA 14-01-2004 was received from DPIE on 29 May 2018.

Mount Owen Continued Operations (MOCO)

Mount Owen Continued Operations (MOCO) was granted SSD-5850 in November 2016 for the continued operation of both MTO and Ravensworth East. The approval was supported by the MOCO EIS dated January 2015 (Umwelt, 2015).

SSD-5850 has been modified on five occasions:

- Mod 1 was approved in September 2017 and allowed for the construction of a water pipeline and ancillary infrastructure to convey mine water from Integra Underground Mine to MGO
- Mod 2 was approved on 4 September 2019 and allowed for the optimisation of the North Pit mine plan to access an additional 35 Mt Run of Mine (ROM) coal from the mining tenements

obtained by Glencore through its acquisition of the Integra Underground Mine. Mod 2 extended the approved mine life through to 2037

- Mod 3 was approved on 30 January 2020, which was an Administrative Modification to change one land parcel in the Schedule of Lands
- Mod 5 was approved 15 January 2021 and involved the modification of Condition 27 of Schedule 3 of SSD-5850 to remove the requirement to establish the Travelling Stock Reserve (TSR) Offset site as a biodiversity offset and instead nominate the number of biodiversity credits required to be retired in accordance with the *Biodiversity Conservation Act 2016*
- Mod 6 was approved 3 June 2021 for the construction of a water transfer pipeline between MGO and Ravensworth under the existing Greater Ravensworth Area Water and Tailings Sharing System (GRAWTS). Mod 6 also allowed for the installation of a new asset registration at the Western Rail Dam (WRD), and amendment of the SSD-5850 Project Boundary.

Glendell Open Cut Coal Mine

Glendell was granted DA 80/952 in May 1993.

The DA was modified in 1997 to enable the extraction of coal from an undeveloped coal reserve, totalling 3.6 Mtpa of ROM coal. The modification allowed for the construction of a CHPP and the MTO rail loop, and for Glendell to be integrated into the Mt Owen Complex (MOC). A further modification of DA 80/952 was undertaken in February 2008 for mining operations to continue until the end of June 2024, and to permit extraction of up to 4.5 Mt of ROM coal on an annual basis. Modification 3 of DA 80/952 was approved in late 2016. The modification permits the relocation of a section of the 132 kilovolt (kV) powerlines, to allow for the continuation of mining in the Barrett Pit.

A fourth modification to DA80/952 was approved in March 2020 for an extension to the approved Barrett Pit shell, to access additional ROM coal and to install a western haul road.

Ravensworth East Open Cut Coal Mine

Enex Resources (now Glencore) purchased Ravensworth Operations Pty Ltd in March 2002. The operation included the Ravensworth East and Narama mines.

Modification 6 to DA 52-03-99 was approved in 2016. This allowed an integrated tailings management strategy between MOC and the neighbouring Liddell Mine and Ravensworth Mine (see ***Figure 2***).

In January 2018, an application was made to DPIE to surrender DA 52-03-99 as Ravensworth East had been included in MGO under the approval of MOCO SSD-5850. Approval to surrender DA 52-03-99 was received from DPIE on 29 May 2018.

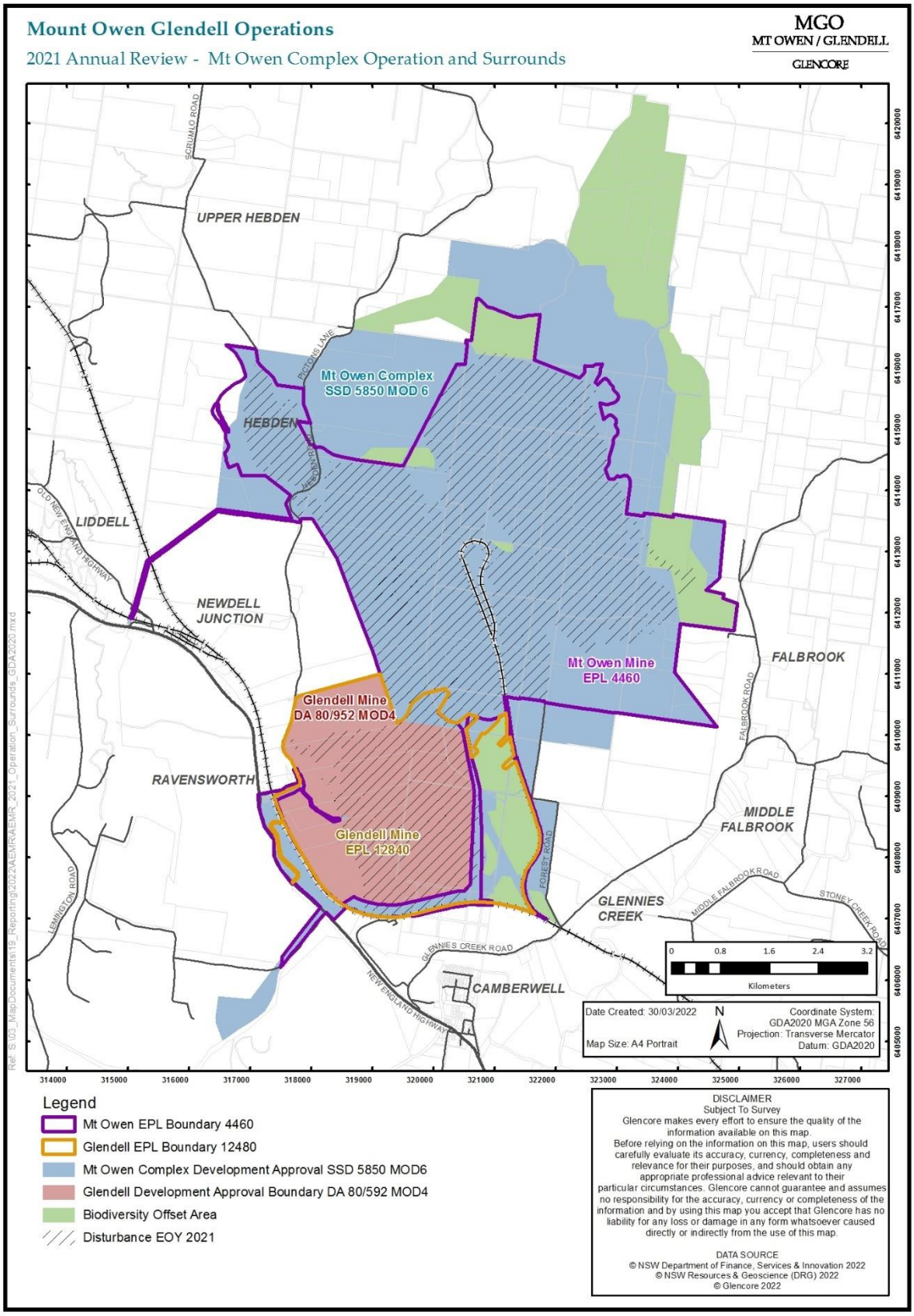

Figure 1: Mt Owen/Glendell Operations Overview and Disturbance as of 31 December 2021.

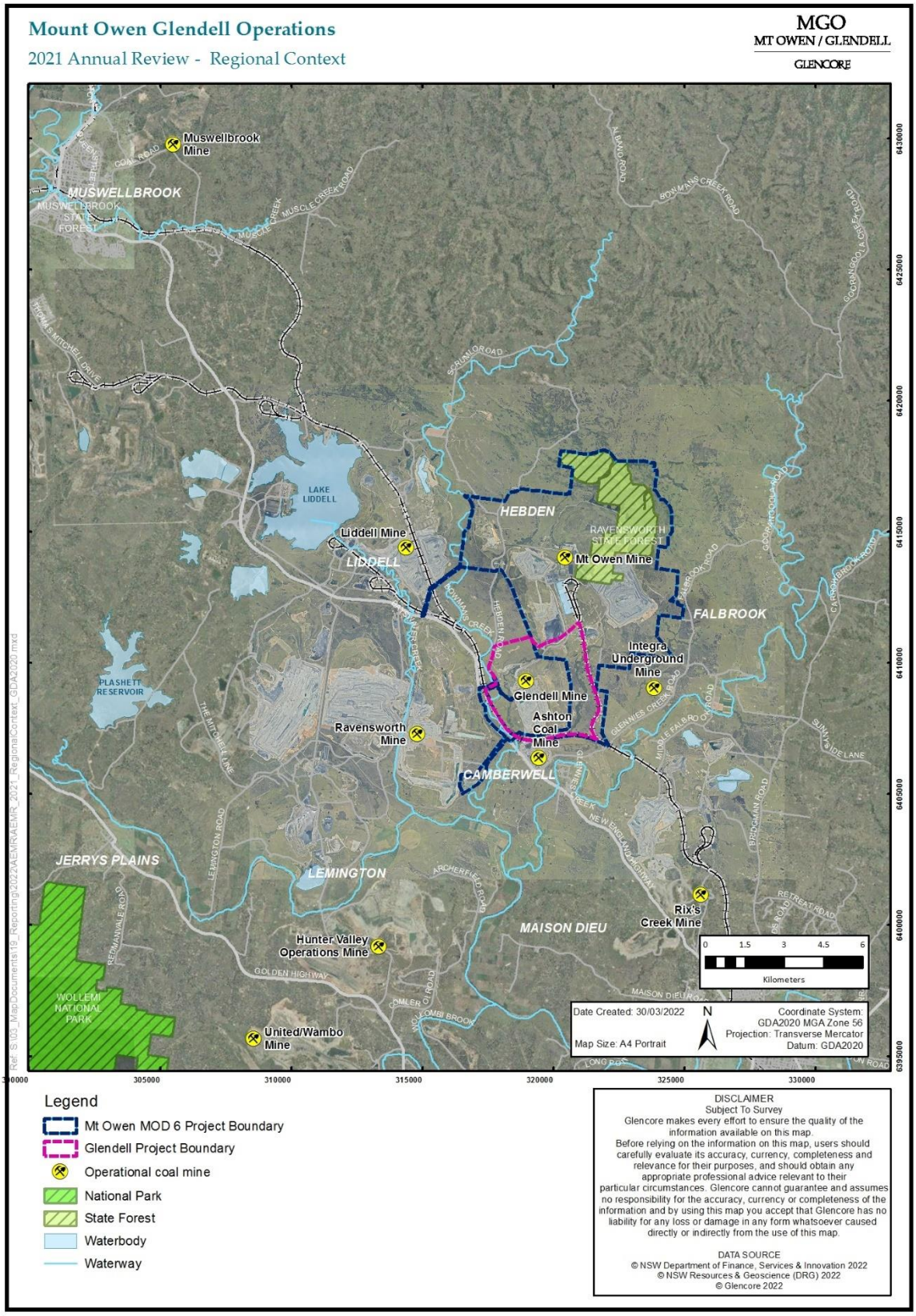

Figure 2: MGO Overview – Regional Context.

Mine Contacts

Mine contacts are provided in ***Table 6***.

Table 6: MGO Contact Details.

Name	Position Held	Contact Details	
Mount Owen Complex Management			
Christopher Gerard	Mt Owen / Glendell Operations – Operations Manager	(02) 6520 2601	
Jeroen Hendricks	Thiess Operations Manager	(02) 6570 0811	
Mount Owen Complex Environment and Community			
Jason Desmond	Environment and Community Manager	(02) 6520 2693	
Julie Crawford	Environment and Community Coordinator	(02) 6520 2633	
Anthony Billings	Environment and Community Officer	(02) 6520 2677	
Stuart Fredericks	Environment and Community Officer	(02) 6520 2622	
General Contact Details			
Mt Owen / Glendell Operations		Street Address:	158 Hebden Road Ravensworth NSW 2330
		Postal Address:	PO Box 320, Singleton NSW 2330
		Phone:	02 6570 0800
		Facsimile:	02 6576 1643
		24-hour Community Hotline:	1800 730 883
		24-hour Blasting Hotline:	1800 319 566
		Emergency Response Line:	1800 248 745
		Website:	*www.glencore.com.au/operations-and-projects/coal/current-operations/mt-owen-glendell-open-cut*

3. Approvals

MGO operates under a number of approvals and licences which are summarised in ***Table 7*** and illustrated in ***Figure 3***.

Updates to MGO approvals throughout the reporting period included:

- 15 January 2021 – SSD-5850 Mod 5 was approved by DPIE. Mod 5 involved the modification of Condition 27 of Schedule 3 of SSD-5850 to remove the requirement to establish the TSR Offset site as a biodiversity offset and instead nominate the number of biodiversity credits required to be retired in accordance with the *Biodiversity Conservation Act 2016*
- 3 June 2021 – MOCO Mod 6 was approved by DPIE. Mod 6 allows for the construction of a water transfer pipeline between MGO and Ravensworth Operations under the existing GRAWTS. Mod 6 also allowed for the installation of a new asset registration at the WRD, and amendment of the SSD-5850 Project Boundary (see ***Figure 1***).

As at 31 December 2021, MGO are awaiting determination on the Glendell SSD-9349 application known as Glendell Continued Operations Project (GCOP). GCOP determination expected in 2022, with the project to be referred to the NSW Independent Planning Commission (IPC). The project seeks to extend the current Glendell approval DA80/952 out until 2044 and extract an additional coal resource of approximately 140 million tonnes.

Environmental management plans developed for MGO are outlined in ***Table 8***, along with the date of the most recent review for each document.

Table 7: MGO Approval Documents

Approval Number	Approval Description	Date Granted	Expiry Date
MGO MOP (Mt Owen, Glendell and Ravensworth East) – Amendment C	Mt Owen Complex Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	15/10/2021	02/07/2022
DA SSD-5850 (Mt Owen and Ravensworth East)	Development Approval SSD-5850	03/11/2016	31/12/2037
EPBC 2013/6978	Environment Protection and Biodiversity Conservation (EPBC) Act approval 2013/6978	19/01/2017	31/12/2037
WA 20WA210940	Water Supply Works	01/08/2009	31/07/2029
WA 20WA211430	Water Approval (Water Supply Works) – Swamp Creek Lower Diversion	01/05/2008	31/07/2022
WA 20WA211425	Water Supply Works – Swamp Creek Middle Diversion	01/08/2009	31/07/2022
WA 20WA211429	Water Supply Works – Yorks Creek Diversion	16/05/2007	15/05/2023
WA 20WA212660	Water Approval (Water Supply Works) – Bettys Creek Lower Diversion	11/02/2013	07/02/2023

Approval Number	Approval Description	Date Granted	Expiry Date
WA 20WA212187	Water Supply Works – Bettys Creek Upper and Middle Diversion	01/08/2009	17/10/2022
ML 1355	Mining Lease	30/06/2014	23/07/2036
ML 1419	Mining Lease	02/02/2015	12/11/2033
ML 1561	Mining Lease	16/02/2005	16/02/2026
ML 1608	Mining Lease	18/12/2007	19/12/2028
ML 1794	Mining Lease	16/07/2019	31/12/2031
ML 1802	Mining Lease	-	30/03/2041
CL 383	Coal Lease	26/06/2014	12/11/2033
CL 358	Coal Lease	26/03/1990	27/03/2032
A 268	Exploration Authorisation	13/09/2017	25/08/2022
EL5824	Exploration Licence	14/11/2016	Perpetuity
EL 6254	Exploration Licence	06/07/2020	04/06/2021
EL8916	Exploration Licence	02/12/2019	05/12/2022
Section 126 (Stages 1 and 2)	Emplacement Approval	7/11/1996	N/A
Section 126 (Stages 3 and 4)	Emplacement Approval	23/12/2003	N/A
EPL 4460	Environment Protection Licence 4460 (Mt Owen and Ravensworth East)	29/08/2019	29/08/2024 (Review Date)
WAL7823	Water Licence (Domestic and Stock)	17/05/2010	Perpetuity
WAL7826	Water Licence (Domestic and Stock)	-	Perpetuity
WAL754	Water Licence (Domestic and Stock)	01/07/2004	Perpetuity
WAL7817	Water Licence (Domestic and Stock)	17/10/2011	Perpetuity
WAL13324	Water Licence (Domestic and Stock)	20/08/2019	Perpetuity
WAL11084	Water Licence (Domestic and Stock)	01/07/2004	30/06/2027
WAL7814	Water Licence (High Security)	15/03/2011	Perpetuity
WAL41542	Water Licence (General Security)	-	Perpetuity
WAL41540	Water Licence (General Security)	-	Perpetuity
20BL168116	Groundwater Licence – Monitoring Bore	15/06/2001	Perpetuity

Approval Number	Approval Description	Date Granted	Expiry Date
20BL169332	Groundwater Licence – Monitoring Bore	24/08/2004	Perpetuity
20BL169333	Groundwater Licence – Monitoring Bore	24/08/2004	Perpetuity
20BL169334	Groundwater Licence – Monitoring Bore	24/08/2004	Perpetuity
20BL169335	Groundwater Licence – Monitoring Bore	24/08/2004	Perpetuity
20BL169336	Groundwater Licence – Monitoring Bore	24/08/2004	Perpetuity
20BL171536	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171538	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171539	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171540	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171541	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171544	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171546	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171542	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171534	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171707	Groundwater Licence – Monitoring Bore	17/08/2007	Perpetuity
20BL171543	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171545	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL169544	Saline Water Excavation Bore	24/02/2005	Perpetuity
DA 80/952	Development Approval 80/952	01/12/2016	30/06/2024
WA 20WA201228	Water Approval (Water Supply Works)	01/07/2004	30/06/2027
WA 20WA201868	Water Approval (Water Supply Works)	01/07/2004	05/01/2028
WA 20WA210993	Water Supply Works – Swamp Creek Upper Diversion	01/08/2009	31/07/2022
WA 20WA215076	Water Approval (Water Supply Works)	01/07/2016	Perpetuity
WA 20WA201499	Water Approval (Water Supply Works)	01/06/2004	30/06/2027
WA 20WA201677	Water Supply Works	01/07/2004	28/06/2028
WA 20WA200727	Water Supply Works	01/07/2004	08/10/2028
MPL 343	Mining Purposes Lease	16/06/1996	04/01/2026

Approval Number	Approval Description	Date Granted	Expiry Date
ML 1629	Mining Lease	08/03/2009	09/03/2030
ML 1673	Mining Lease	-	11/11/2033
ML 1741	Mining Lease	-	Perpetuity
ML 1475	Mining Lease	23/11/2000	23/11/2021 (renewal sought)
ML 1476	Mining Lease	23/11/2000	23/11/2021 (renewal sought)
ML 1694	Mining Lease	21/10/2013	22/10/2034
EL 8916	Exploration Licence	4/12/2019	2/12/2022
EPL 12840	Environment Protection Licence 12840	11/11/2019	11/11/2024 (Review Date)
WAL704	Water Licence (High Security)	02/05/2008	Perpetuity
WAL1118	Water Licence (High Security)	02/05/2008	Perpetuity
WAL9521	Water Licence (High Security)	22/05/2008	Perpetuity
WAL612	Water Licence (General Security)	02/05/2008	06/02/2029
WAL637	Water Licence (General Security)	02/05/2008	Perpetuity
WAL613	Water Licence (General Security)	01/07/2004	Perpetuity
WAL705	Water Licence (General Security)	02/05/2008	Perpetuity
WAL1119	Water Licence (General Security)	02/05/2008	Perpetuity
WAL1215	Water Licence (General Security)	02/05/2008	Perpetuity
WAL1420	Water Licence (Supplementary Water)	02/05/2008	Perpetuity
WAL706	Water Licence (Domestic and Stock)	23/03/2005	Perpetuity
WAL1218	Water Licence (Domestic and Stock)	31/03/2005	Perpetuity
WAL41521	Water Licence (General Security)	-	Perpetuity
WAL13750	Water Licence (General Security)	20/10/2006	19/10/2026
WAL41526	Water Licence (General Security)	01/07/2016	30/06/2029
WAL18000	Water Licence (General Security)	20/08/2019	Perpetuity
WAL18310	Water Licence (Unregulated)	16/05/2014	Perpetuity

Approval Number	Approval Description	Date Granted	Expiry Date
20CA200608	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027
20CA200382	Water Licence (Water Supply Works and Water Use)	01/07/2004	06/02/2029
20CA200445	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027
20CA210976	Water Licence (Water Supply Works and Water Use)	01/08/2009	31/07/2022
20CA201623	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027
20BL171535	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity
20BL171547	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity

Table 8: MGO Environmental Management Plans

Environmental Management Plans	Revision Date
MGO Environmental Management Strategy	September 2021
MGO Pollution Incident Response Management Plan	June 2020
MGO Noise Management Plan	January 2020
MGO Blast Management Plan	October 2021
MGO Air Quality and Greenhouse Gas Management Plan	October 2021
MGO Aboriginal Cultural Heritage Management Plan	October 2021
MGO Historic Heritage Management Plan	October 2021
MGO Water Management Plan	October 2020
MGO Surface Water Management and Monitoring Plan	October 2020
MGO Groundwater Management and Monitoring Plan	October 2020
MGO Erosion and Sediment Control Plan	October 2020
MGO Surface Water and Groundwater Response Plan	October 2020
MGO Creek Diversion Plan	May 2020
MGO Biodiversity Offset Management Plan	September 2021
MGO MOP / Rehabilitation Management Plan	October 2021
MGO Rehabilitation Strategy	November 2021

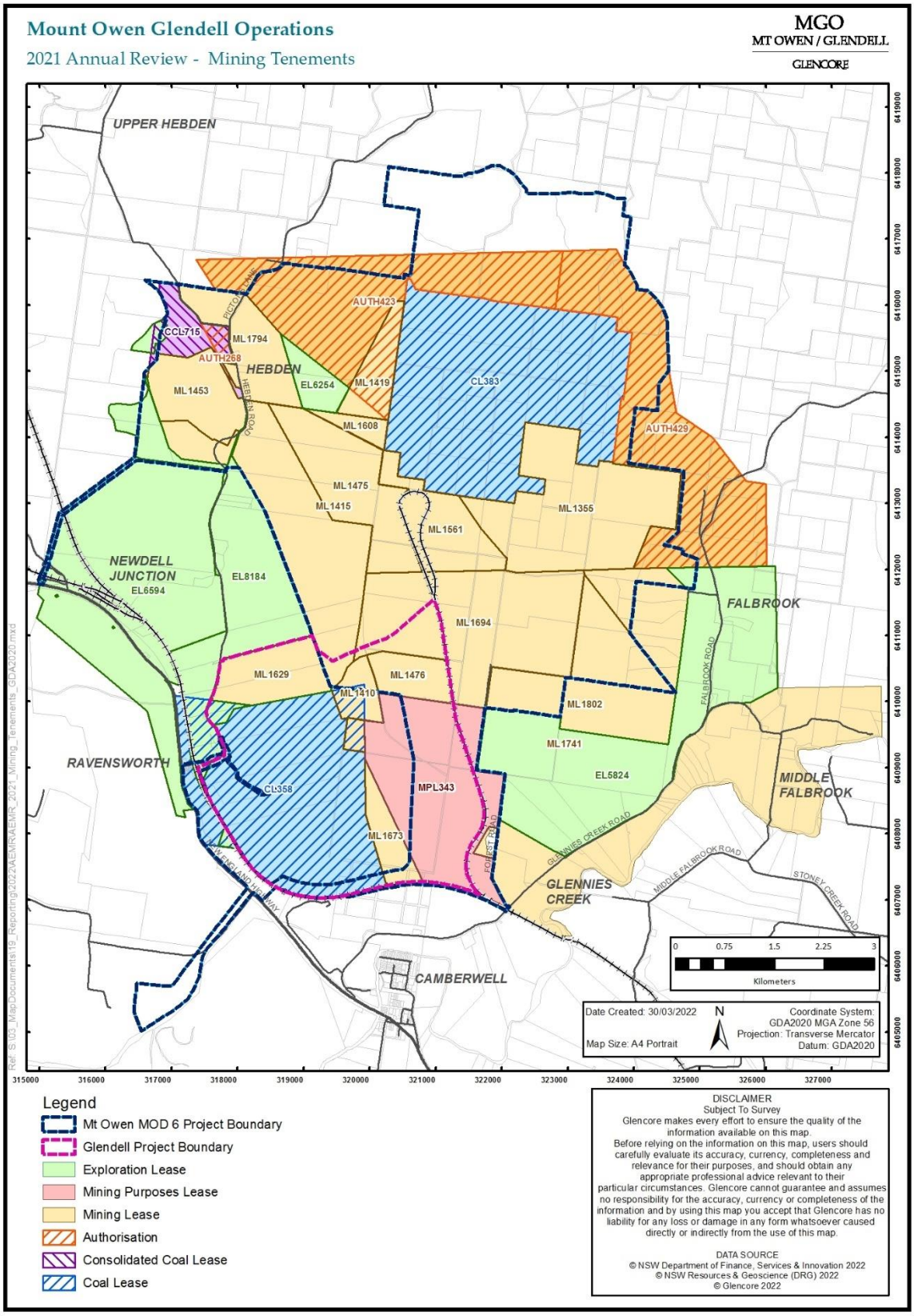

Figure 3. MGO Mining Tenements.

4. Operations Summary

4.1 Mining Operations

In 2021, MGO produced a total of 12.07 Mt of ROM coal, consisting of:

- 7.78 Mt ROM coal from MTO
- 0.96 Mt for Ravensworth East Mine
- 3.33 Mt ROM Coal from Glendell.

The annual ROM coal extraction limits for MGO are 10 Mtpa for MTO, 4 Mtpa for Ravensworth East Mine, and 4.5 Mtpa for Glendell Mine. Details of the amount of ROM coal mined from each area and the total amount of product coal mined at MGO is provided in ***Table 9***. A total of 7.08 Mt product coal was produced, with 4.59 Mt, 0.48 Mt and 2.01 Mt from MTO, Ravensworth East and Glendell, respectively.

In 2021, approximately 240 people were employed at Glendell and 363 were employed at MTO (61 Glencore and 302 Thiess).

Table 9: MGO Production Summary

Material	Approved limit (specify source)	2021 Reporting Period (Forecast)	2021 Reporting Period (Actual)	2022 Reporting Period (Forecast)
MTO				
Prime Overburden (Million bank cubic metres (Mbcm))	-	36.18	36.18	39.59
ROM Coal Mined (Mt)	10 (Development Consent)	8.17	7.78	8.45
Saleable Product (Mt)	-	4.89	4.59	4.79
ROM Coal Fed (Mt)	-	8.74	8.17	8.45
Glendell				
Prime Overburden (Mbcm)	-	14.68	15.75	9.41
ROM mined (Mt)	4.5 (Development Consent)	3.44	3.33	2.57
Saleable Product (Mt)	-	2.16	2.01	1.71
ROM Coal Fed (Mt)	-	3.47	3.34	2.57
Ravensworth East				

Material	Approved limit (specify source)	2021 Reporting Period (Forecast)	2021 Reporting Period (Actual)	2022 Reporting Period (Forecast)
Prime Overburden (Mbcm)	-	2.69	4.50	9.35
ROM mined (Mt)	4 (Development Consent)	1.36	0.96	2.54
Saleable Product (Mt)	-	0.84	0.48	1.46
ROM Coal Fed (Mt)	-	1.40	0.82	2.53
CHPP				
ROM Coal Fed (Mt)	17 (Development Consent)	12.96	12.33[1]	13.56
Coarse Waste Reject (Mt)	-	2.86	2.93	3.99
Total MGO Saleable Product (Mt)	-	7.44	7.08	7.96
Fine Waste Reject (Mt)	-	2.66	2.32	1.61

1. ROM coal fed for the reporting period is greater than the total ROM coal mined due to the processing of coal stockpiles remaining at the end of 2020.

4.2 Project Approvals

4.2.1 Mt Owen Continued Operations

Mt Owen Continued Operation (MOCO) received approval in November 2016, under SSD-5850. The approval combined the existing development consents for Mt Owen and Ravensworth East, extending the operation until 2031.

In August 2017, MGO modified SSD-5850 ('Mod 1') to allow for the construction of a mine water pipeline from Integra Underground Mine to MGO. In September 2019, Modification 2 (Mod 2) to SSD-5850 was approved. This allows the additional mining of 35 Mt of ROM coal and extends the life of mine to 31 December 2037. During January 2020, Modification 3 (Mod 3), an administrative mod, was approved by DPIE for the inclusion of one land parcel within the 'Schedule of Land'. Modification 5 (Mod 5) was approved by DPIE in January 2021. This allowed the modification of Condition 27 of Schedule 3 of SSD-5850 to remove the requirement to establish the TSR Offset site as a biodiversity offset and instead nominate the number of biodiversity credits required to be retired in accordance with the Biodiversity Conservation Act 2016. Modification 6 (Mod 6) was approved in June 2021. Mod 6 allows for the construction of a water transfer pipeline between MGO and Ravensworth under the existing GRAWTS. Mod 6 also approved the installation of a new asset registration at the WRD, and amendment of the SSD-5850 Project Boundary.

At the end of the reporting period, MGO is awaiting regulatory determination of:

- MOCO Mod 4, relating to the amalgamation of SSD-5850 with GCOP (see **Section 4.2.2**)

- MOCO Mod 7, seeking the ongoing use of the West Pit tailings at MTO to receive tailings material via pipeline from the adjacent Liddell and Ravensworth open cut operations.

4.2.2 Glendell Continued Operations Project

Under the GCOP proposal (SSD-9349), Glencore is seeking approval to extend the open cut mining operations at Glendell, north from the existing Barrett Pit. The GCOP proposal would extract an additional 140 Mt of ROM coal, down to the Hebden coal seam and extend the period of mining operations at Glendell to approximately 2044.

During 2018, a Preliminary Environmental Assessment for the project was prepared and submitted to DPIE. The Secretary's Environmental Assessment Requirements (SEARs) were received by Glencore in July 2018. A development application, accompanied by a detailed Environmental Impact Statement (EIS), was submitted to DPIE during 2019. DPIE placed the EIS on Public exhibition from 11 December 2019 until 14 February 2020. 359 submissions were received during public exhibition, including 16 from Government agencies, 16 from Special Interest Groups and 327 from community members. Of the 327 community submissions received 200 were supportive of GCOP, 117 objected and 10 provided comment.

The Response to Submissions report for GCOP was submitted to DPIE in two parts during May and October 2020. A separate response to the Federal Government's Independent Expert Scientific Committee (IESC) was submitted in August 2020. During the end of 2020 and throughout the reporting period, Glencore continued to respond to Government departments and complete further consultation with the Heritage Council and Singleton Council regarding the proposed Ravensworth Homestead relocation options.

Draft preliminary conditions were received from DPIE in November 2021 for site to review, with a response completed in December 2021. It is anticipated DPIE will refer the project to the IPC in early 2022.

A project-specific website for GCOP was established in 2020 and was regularly maintained during the reporting period: www.glendell.com.au. There is also a Facebook page 'Glencore Glendell Continued Operations Project' which was established in 2021 and is accessible to the public.

4.3 Other Operations

4.3.1 Train and Conveyor Movements

Table 10 summarises the train and conveyor movements undertaken at the MGO during 2021. Daily train movements are provided in ***Appendix B***.

Coal Transport Rate and Sales

ROM coal from MGO is transported for processing at the CHPP. Product coal is conveyed to the product coal stockpile where it is stored according to coal quality and loaded onto trains for transport to Newcastle Port. During the reporting period, total sales of 7.11 Mt of product coal from MGO was loaded onto 804 trains (see **Appendix B**) and railed from site. This included:

- 4.64 Mt from MTO
- 2.5 Mt from Glendell and Ravensworth East.

A 600,000 tonne (t) product stockpile is located at the CHPP. The stockpile currently has five product types:

- Semi-soft
- High Ash Thermal
- Mid Ash Thermal
- Low Ash Thermal (<0.6% sulphur)
- Low Ash Thermal (>0.6% sulphur).

As per Schedule 2 Condition 8 of SSD 5850 for Mount Owen and Ravensworth, no more than 2Mtpa of ROM coal/crushed gravel can be transported via conveyor to Liddell Coal Mine and/or Ravensworth Coal Terminal. During the 2021 reporting period no ROM coal/crushed gravel was transported to Liddell Coal Mine or Ravensworth Coal Terminal demonstrating compliance with this condition.

4.3.2 Waste and Other Hazardous Materials Management

Recycling and disposal of waste at MGO focuses on the correct handling, storage, segregation and reuse of materials. MGO recycles waste wherever possible, to reduce the amount of waste destined for landfill.

Waste facilities at MGO are located between the CHPP and the Main Dump. During the reporting period approximately 1,296 tonnes of material was recycled at Glendell and Ravensworth East. This is slightly less than volumes recycled in 2020 (1,373 tonnes). There was more scrap steel recycled in 2021 compared to 2020 (by approximately 36 tonnes). The recycling rate at Glendell and Ravensworth East in 2021 (91.6 %) was higher than the rate during 2020 (86.2 %). At MTO approximately 2,048 tonnes were recycled in 2021. This volume is greater than in 2020 (1,426 tonnes). The MTO recycling rate for 2021 (89.8 %) was slightly higher than 2020 (82.9%).

Waste oil, scrap steel, timber, paper and cardboard, oil filters and batteries were the major waste streams recycled during 2020 (***Table 11***).

Table 10: MGO Train and Conveyor Movements 2021

Train Movements	Total
Annual Average Daily Train Movements	2.63 Trains Per Day
Total Train Movements 2021	804 Trains
Annual Average Daily Train Tonnage	23,228.01 Tonnes Per Day
Annual Average Monthly Train Tonnage	592,314.2 Tonnes Per Month
Total Product Coal Loaded from CHPP	7.11 Million Tonnes
Average Train Loading Time	126 Mins
Average Load Rate (Tonnes per hour)	4,283.52 Tonnes Per Hour
Compliance Limit	May process up to 17 Mt ROM coal per year

Note: Product coal can be stockpiled when not required, hence the product coal sales total will differ from product coal railed to port total.

Table 11: MGO Recycled Materials (2020 and 2021)

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2020	2021	2020	2021
Paper and Cardboard (t)	15.6 (CHPP: 0.1)	22.8 (CHPP: 1.9)	12.8	11.4
Waste Oil (Hazardous) (t)	515.4 (CHPP: 1.6)	673 (CHPP: 1.0)	656.8	558.5
Grease (t)	8.7	13.8	1.4	0.0
Oil filters (t)	24.2	34.3	26.2	24.7
Batteries (Hazardous) (t)	18.1	21.4	8.2	10.9
Scrap Steel (t)	214.6 (CHPP: 140.8)	550.8 (CHPP: 248.7)	153.1	188.9
Timber (t)	55.2	123.6 (CHPP: 36.2)	45.1	13.0

** Co-mingled recycling at MTO includes paper and cardboard, and also glass, aluminium, and plastic.*

MGO disposes of waste heavy vehicle tyres through deep burial in overburden dumps; the location of all tyres is tracked by using spatial data. During 2021, 275 tyres at Glendell and 218 at Mt Owen were buried, compared to 127 tyres at Glendell and 225 at Mt Owen in 2020 (see ***Table 12***).

Table 12: MGO Waste Tyre Burial (2020 and 2021)

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2020	2021	2020	2021
Waste Tyres	225	218	127	275

Bulk fuel facilities at the MGO are bunded and designed to hold at least 110 percent (%) of the largest fuel storage tank. This is as per *Australian Standard (AS) 1940-2004 – The Storage and Handling of Flammable and Combustible Liquids*. Emergency measures and safeguards are in place in the event of a spill. There is low potential for off-site contamination once fuel is received on-site, as all handling and transport of fuel is within the contained water management system.

Monthly housekeeping inspections are undertaken across MGO, to monitor implementation of the Waste and Hydrocarbon Management Plans.

MGO implemented several waste management improvement actions during 2021, including:

- MTO
  - Increase in amount of effluent being recycled at Mt Owen CHPP. Effluent from Mt Owen crib huts and portable toilets was being taken from site and treated at a third-party sewage treatment plant. This effluent is now being redirected into the CHPP sewage treatment plant and the treated water is being recycled back into the MGO water management system
- Glendell

- An additional empty drum was placed at the Ravensworth East hardstand area. This allows the bin to be utilised while conducting maintenance activities at the Ravensworth East hardstand area.

During the reporting period, there were a number of hydrocarbon spills reported at MGO (refer to ***Section 4.3.3***). Contaminated soil from these spills was either transported to the onsite bioremediation area at the Glendell mine or treated in situ.

4.3.3 Environmental Incidents

Environmental incidents at MGO are classified into six categories (based on Glencore's Internal Incident Reporting):

- **Nil Category**
- **Category 1**: Negligible - An incident that causes negligible, reversible environmental impact, requiring very minor or no remediation
- **Category 2**: Minor – An incident that causes minor, reversible environmental impacts, require minor remediation
- **Category 3**: Significant – An incident that has caused moderate, reversible environmental impact with short-term effect, requiring moderate remediation
- **Category 4**: Serious – An incident that has caused significant environmental impact, with medium-term effect, requiring significant remediation
- **Category 5**: Disastrous – An incident that has caused disastrous environmental impact, with long-term effect, requiring major remediation.

MGO recorded 94 environmental incidents during the reporting period. This is higher than 2020, where 57 environmental incidents were recorded (see ***Table 13***).

Table 13: MGO Environmental Incidents

Incident Category	Mt Owen Incidents		Glendell and Rav. East Incidents		Total Glendell/Mt Owen	
	2020	2021	2020	2021	2020	2021
Nil Category	6	10	13	24	19	34
Category 1	19	20	17	36	36	56
Category 2	1	3	0	1	1	4
Category 3	0	0	0	0	0	0
Total	26	34	30	60	56	94

In 2021 there were four Catergory 2, 56 Category 1 and 34 Nil Category Incidents. Increases occurred in all three categories from 2020.

The four Category 2 Incidents included:

- ~ 4,990L hydrolic and diesel oil spill,
- ~ 10,350L diesel spill

- ~ 1,600L diesel spill
- ~ 1,325L diesel spill.

The 56 Category 1 incidents included:

- 50 hydrocarbon spills of less than 1,000L;
- Two noise exceedences;
- One blast fume related event;
- One Ground Disturbance Permit breach; and
- Two water-related incidents.

The 34 Category 0 (Nil Category) incidents related to a noise exceedence, incorrect waste disposal, small hydrocarbon splls (<20 L), power loss and water incidents.

A breakdown of these incidents is provided in ***Appendix C***.

4.3.4 Land Ownership

MGO landholdings total over 9,000 hectares. The landholdings cover the immediate and surrounding areas of the MGO, excluding the Ravensworth State Forest (RSF), which is situated north-east of MTO. The RSF consists of approximately 880 ha and is owned by the Forestry Corporation of NSW. Land not actively used for mining purposes is managed for either grazing or biodiversity offsets.

During 2021, two properties were acquired by MTO from private landowners. Both properties are located in Middle Falbrook. Total land ownership for MGO is summarised in ***Table 14***.

Table 14: Land Ownership

Operation	Land Owned (ha)	Land Leased (ha)
Mt Owen	6,744.6	331*
Glendell	2,733.1	15.3
Total	9,447.7	346.9

** Incorporates the leased crown roads associated with offset properties.*

4.3.5 Exploration

No exploration activities were undertaken at MGO during the reporting period.

4.3.6 Next Reporting Period

During the 2022 reporting period, it is projected that the following activities will occur at MGO:

MTO

- Mining and dumping will continue in a south-easterly direction
- Mt Owen has 22.5 hectares of rehabilitation planned, consisting of woodland areas
- Capping and rehabilitation will continue to progress at North Void. There is 7 hectares of rehabilitation planned, consisting of pasture and woodland areas.

Glendell

- Mining and dumping will continue to the north. Mining has reached it's scheduled extent under the existing approval.
- Glendell has no planned rehabilitation for Barrett Pit as the dump sequence continues to be built in line with the existing approval. Next rehabilitation is scheduled for 2023.
- Liaison with regulatory agencies over determination of the GCOP application.

Ravensworth East

- Mining within the Bayswater North Pit continues within the existing pit shell.
- 8ha of rehabilitaiton is planned, consisting of pasture and woodland areas.

5. Actions Required from Previous Annual Review

The 2020 Annual Review for MGO was submitted to DPIE on 31 March 2021 in accordance with Schedule 5 Condition 5 of SSD-5850 (as modified) and Schedule 5 Condition 5 of DA 80/952. DPIE acknowledged their satisfaction of the 2020 Annual Review on 20 May 2021 and did not identify additional actions to be completed. No formal notification has been received by the DPIE-Resources Regulator at the submission date of this report.

Table 15 summarises the improvement actions from the 2020 Annual Review and their status at 31 December 2021.

Table 15: Actions Required from 2020 Annual Review

Actions Required from Previous Annual Review	Action Taken	Section Discussed in 2021 Annual Review	Completion Date
Ongoing MGO Improvements from 2020 Annual Review			
Implement maintenance activities in line with 2020 Annual rehabilitation monitoring report recommendations. Consider implementation of recommendations from Centre for Mined Land Rehabilitation (University of Queensland) Monitoring review completed in 2019.	Rehabilitation maintenance activities were ongoing throughout 2021. Recommendations from 2019 review completed in line with other GCAA sites.	Rehabilitation	December 2021
Further implement the actions from the Upper Bettys Creek Diversion Remediation Plan and add to 2018 and 2019 remediation works. Further works such as infill planting to be completed at Lower Bettys Creek Diversion in 2020.	Additional erosion repairs and seeding completed in Q2 2021 and reported in bi-annual stream condition reports.	Water	May 2021
Complete recommendations from 2019 annual groundwater review.	Groundwater bore repairs completed	Water	May 2021

Actions Required from Previous Annual Review	Action Taken	Section Discussed in 2021 Annual Review	Completion Date
	across all sites. This included new concrete support and casings where required. Groundwater bore signage installed at all sites.		
MGO Improvements from 2020 Annual Review			
Use of Petrotac (or alternative) around LV/Infrastructure (Non-HV roads) at Mt Owen.	Trial completed in Q1 2021. Trial was completed during summer period.	Air Quality	March 2021
North ROM hopper sprays (high-pressure) trial.	North ROM hopper sprays deemed effective and to remain in use.	Air Quality	August 2021.
Complete required actions from Q4 2020 Audit.	Audit actions scheduled and completed.	Independent Environmental Audit	June 2021 (see ***Section 11***)
On-site and off-site seed nursery to be created for site seed production.	Seed nursery established and planted.	Land Management	November 2021
Review all management plans in line with approvals received in 2021.	Review and update MGO management plans to reflect 2021 approval modifications.	Management Plans	December 2021 (see ***Section 3***)
Implementation of 3D Noise Model at Mt Owen	3D Noise Model Implemented for MTO	Noise	January 2021
3 year plan for rehabilitation certification to be developed	Plan completed and areas assessed for certification at Mt Owen North Pit rehab. Likely ESF2 for for approximately 50ha in 2022.	Rehabiliation	December 2021
Increased focus on capping – North Void progressive rehab	Approximately half of North Void tailings surface area had initial capping material placed in 2021 in line with specialists advice.	Tailings Dam	December 2021

Actions Required from Previous Annual Review	Action Taken	Section Discussed in 2021 Annual Review	Completion Date
	Ongoing monitoring and surface drainage works completed during H2 2021.		

6. Environmental Performance

6.1 Operational Noise

MGO has a range of management strategies in place to limit the generation of noise and noise associated impacts. During 2021, the following activities were undertaken:

- Regular attended noise monitoring in accordance with the program described in the approved Noise Management Plan
- Noise monitoring supplementary to the regular noise monitoring to ensure periods of potential adverse weather were represented by monitoring data
- Continued use of directional real-time noise units integrated to MGO Noise Monitoring Network
- Maintenance of the real-time noise monitoring Sentinex (Sx) network
- Ongoing measurement of machine sound power levels to monitor equipment performance and the potential for degradation of the noise attenuation equipment
- Continue to use the Air Quality Control System environmental forecast summary report to identify periods of potential adverse weather that could affect the propagation of noise
- Ongoing MGO employee education on noise management
- Development and implementation of MGO-specific noise training packages delivered to key site personnel
- Review of MGO Noise Management Plan following approval of SSD-5850 Mod 6
- Implementation of daily a forecasting tool that identifies areas of the mine that may have an increased influence on noise propagation.

6.1.1 Attended Noise Monitoring Program

The noise monitoring program includes both continuous noise monitors and attended noise monitoring. It is designed to measure the contribution that MTO, Ravensworth East and Glendell Mines make to the environmental noise levels in the region surrounding MGO.

Compliance with the development consents and regulatory requirements is determined from routine attended noise monitoring. Unattended Sx noise monitors provide supporting information to the compliance assessment process when high noise levels are recorded during the attended noise monitoring program.

Both attended and real-time noise monitoring locations are detailed in ***Figure 4*** and ***Appendix D***, Table 3. Continuous and attended locations were selected as being representative of the nearest and/or most affected residences to the east, south and south-east of MGO. Monitoring locations are reviewed and where necessary, revised over the life of operations.

6.1.2 MGO Sound Power Level Assessment

MGO is required to undertake an assessment of the equipment fleet against the indicative equipment listed in DA 80/952 every 5 years to confirm that noise impacts have not significantly changed. Global Acoustics were engaged to determine sound power data for mobile equipment at Glendell. A total of

19 plant items were tested during the 2021 sound power survey. A copy of the assessment report is included in ***Appendix D***.

Under the MOCO (SSD-5850) development approval, a minimum of 20% of the mobile fleet requires sound power testing per year. Thearle Engineering were engaged to complete the sound power testing of the MTO fleet. The assessment results were compared with the sound power levels for the operating fleets nominated in Appendix E of the Noise Impact Assessment in the Mt Owen Continued Operations Environmental Assessment (2014). The assessment results are also compared against the Glencore Coal Assets Australia (GCAA) protocol GCAA 11.11 Noise Management as a secondary reference. A total of 10 plant items were tested at MTO in 2021. A copy of the assessment report developed by Thearle Engineering is included in ***Appendix D***.

6.1.3 Noise Monitoring Performance

Attended noise monitoring was undertaken monthly during the night-time periods in accordance with the Noise Management Plan and the EMS. Additional monitoring of day and evening periods occurred seasonally at MTO in accordance with EPL 4460 during the reporting period.

Results of the 2021 attended noise monitoring program are summarised in ***Table 16*** and ***Table 17***, for Mt Owen and ***Table 18*** and ***Table 19***, for Glendell. During the attended noise monitoring, there was one non-compliance recorded at location N9 (see ***Figure 4***), where the Glendell mine exceeded the nominated criteria during applicable meteorological conditions. The exceedance occurred in August and was reported to the relevant agencies. No further action on the exceedance was requested from regulatory agencies during the reporting period. A summary of the event is provided in ***Section 10***.

Night time monitoring results are displayed in ***Appendix D***. Detailed seasonal noise reports are also available on the Glencore website at *https://www.glencore.com.au/*. The results presented in ***Appendix D*** and in the seasonal reports do not appear to indicate any trends in the data.

Generally, the applicable noise criteria and the predicted noise levels are the same for each of the monitoring locations and therefore the comparison with the criteria also demonstrates a comparison with predicted noise levels in the relevant MGO approvals.

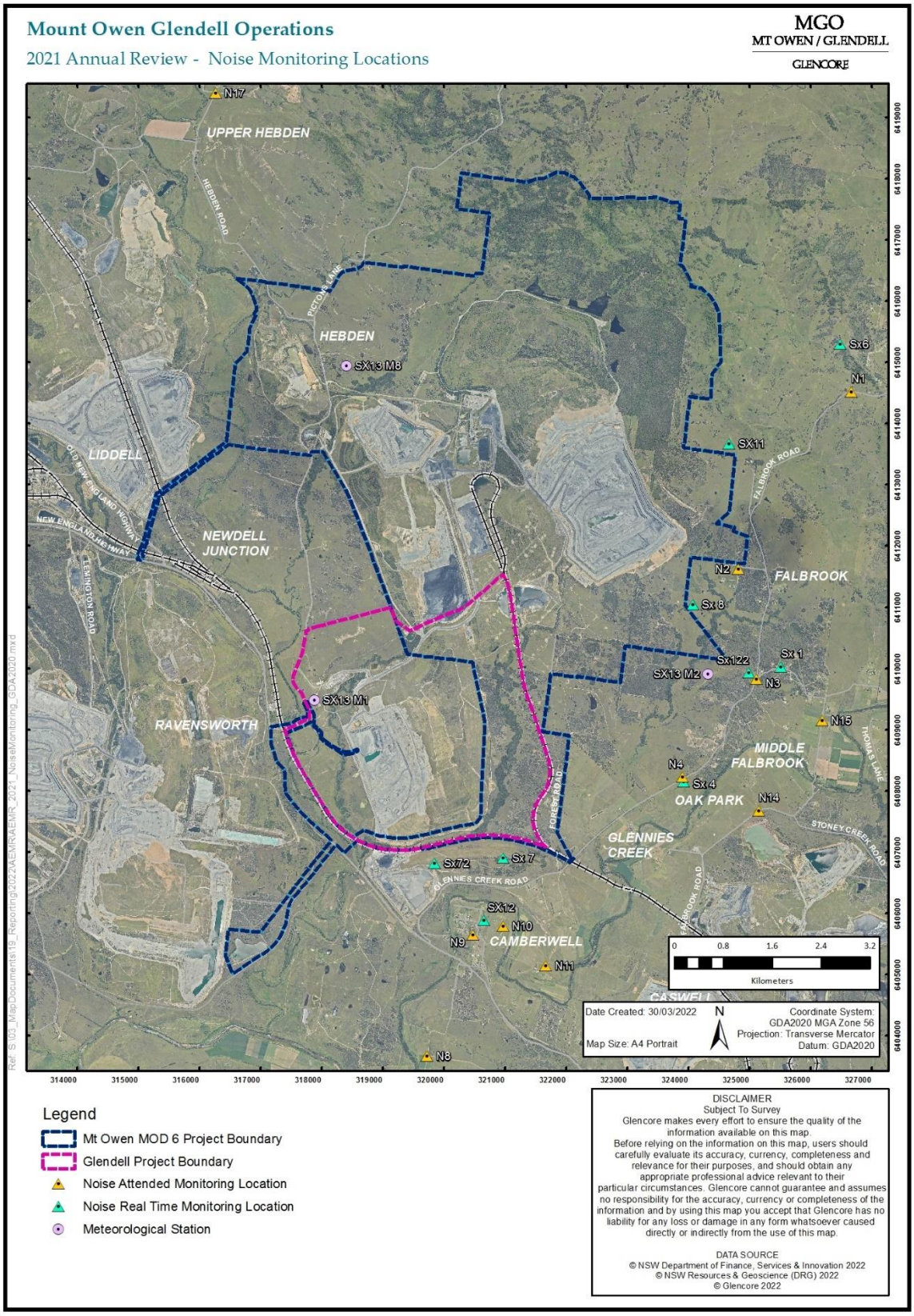

Figure 4: MGO Noise Monitoring Locations.

Table 16: Summary of Mt Owen's 2021 Environmental Noise Level (dB(A)) Contribution (LAeq, 15min)

Monitoring Location	Monitoring Period	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
N1	Day	35	<30	N/A[2]	N/A[2]	IA	N/A[2]	N/A[2]	<30	N/A[2]	N/A[2]	<25	N/A[2]	N/A[2]
	Evening	35	IA	N/A[2]	N/A[2]	21	N/A[2]	N/A[2]	<25	N/A[2]	N/A[2]	IA	N/A[2]	N/A[2]
	Night	35	25	IA	IA	IA	26	<25	<30	30	33	34	28	<30
N2[1]	Day	N/A	37	N/A[2]	N/A[2]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	Evening	N/A	<25	N/A[2]	N/A[2]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	Night	N/A	25	IA	IA	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
N3	Day	41	<35	N/A[2]	N/A[2]	<40	N/A[2]	N/A[2]	IA	N/A[2]	N/A[2]	<35	N/A[2]	N/A[2]
	Evening	41	IA	N/A[2]	N/A[2]	<25	N/A[2]	N/A[2]	IA	N/A[2]	N/A[2]	33	N/A[2]	N/A[2]
	Night	41	<35	IA	IA	**40** 38[3]	<30	IA	35	37	<35	36	38	38
N4	Night	42	<35	IA	IA	<30	IA	<35	39	<40	<35	<35	37	35
N8[1]	Night	N/A	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N9[1]	Night	N/A	<35	IA	IA	<35	IA	<35	IA	IA	IA	<30	IA	IA
N10	Night	35	<35	IA	IA	IA	IA	<30	IA	IA	IA	<35	IA	<35
N11	Night	35	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	<35

Note:
[1] There is no noise criteria for this monitoring location.
[2] Day and evening monitoring is only required once every quarter and was not required for this monthly monitoring round.
[3] Re-measure undertaken following an initial exceedance at N3 as per the NMP
IA = Inaudible.

Table 17: Summary of MTO's 2021 Environmental Noise Level (dB(A)) Contribution (LA1, 1min) – Night

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
N1	45	35	IA	IA	IA	34	<25	<35	36	41	40	<45	<35
N2[1]	N/A	<30	IA	IA	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
N3	45	41	IA	IA	**50** 42[2]	<35	IA	<44	41	44	44	43	42
N4	50	<40	IA	IA	<35	IA	36	44	43	<35	40	<45	40

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
N8[1]	N/A	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N9[1]	N/A	<35	IA	IA	37	IA	<35	IA	IA	IA	<30	IA	IA
N10	45	<40	IA	IA	IA	IA	<35	IA	IA	IA	<35	IA	<35
N11	45	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	<35

Note:
[1] There is no noise criteria for this monitoring location.
[2] Re-measure undertaken following an initial exceedance at N3 as per the NMP
IA = Inaudible.

Table 18: Summary of Glendell's Environmental Noise Level (dB(A)) Contribution (LAeq, 15min) – Night

Monitoring Location	Monitoring Period	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
N1[1]	Night	N/A	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N2[1]	Night	N/A	IA	IA	IA	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
N3	Night	38	<35	IA	IA	<35	<30	IA	IA	IA	IA	<35	IA	<35
N4	Night	38	IA	IA	IA	<30	<35	IA	IA	IA	<35	<35	IA	IA
N8	Night	35	IA	IA	IA	<30	IA	IA	33	<35	IA	30	37	34
N9	Night	42	<30	IA	IA	IA	<40	<35	<35	**43** **42[2]** <35[3]	<35	36	38	<35
N10	Night	40	IA	IA	IA	IA	<35	IA	IA	38	<35	<35	37	IA
N11	Night	38	35	IA	IA	<38	<35	IA	36	<38	<35	<35	<40	<38

Note:
[1] There is no noise criteria for this monitoring location.
[2] Re-measure undertaken following an initial exceedance at N9 as per the NMP
[3] Follow-up measurement undertaken after an initial exceedance at N9 as per the NMP
IA = Inaudible.

Table 19: Summary of Glendell's Environmental Noise Level (dB(A)) Contribution (LA1, 1min) – Night

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
N1[1]	N/A	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N2[1]	N/A	IA	IA	IA	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
N3	45	<35	IA	IA	<35	<35	IA	IA	IA	IA	40	IA	<35
N4	45	IA	IA	IA	36	43	IA	IA	IA	<35	41	IA	IA
N8	45	IA	IA	IA	<40	IA	IA	<35	41	IA	<35	<45	44
N9	45	<35	IA	IA	IA	<45	<35	40	**50** **46[2]** <43[3]	<35	<44	45	<40
N10	45	IA	IA	IA	IA	42	IA	IA	44	39	<42	44	IA
N11	45	39	IA	IA	<40	38	IA	<40	40	<25	<35	<45	43

Note:
[1] There is no noise criteria for this monitoring location.
[2] Re-measure undertaken following an initial exceedance at N9 as per the NMP
[3] Follow-up measurement undertaken after an initial exceedance at N9 as per the NMP
IA = Inaudible.

6.1.4 Continuous Improvement

As a part of the ongoing commitment to the management of noise impacts from MGO, a range of continuous improvement activities have been undertaken during 2021, including:

- Dust & Noise Analysis Tool (DNAT) smart alarm improvements and noise roses – Allows enhanced separation of noise contributions (e.g. trains, neighbouring mine noise, community)
- The continued implementation of the web-based tool assists in managing operational noise across MGO
- Implementation of the 3D Noise Model for MGO
- Implementation of the updated MGO Noise Management Plan
- Modifications and improvement of real-time monitoring network
- Review and simplification of noise alarm response.

Improvement activities to be undertaken in 2022 include:

- Continuous assessment and improvement of the real-time monitoring network and management alarms
- Incorporate plant equipment into the DNAT to identify areas of increased noise propagation.

6.2 Blasting

6.2.1 Blast Management and Monitoring

MGO blast management practices are managed in accordance with the MGO Blast Management Plan. Blast monitoring locations are shown in ***Figure 5***.

6.2.2 Blast Performance

Table 20 summarises MGO's performance for 2021 against the approved blasting hours and frequencies. ***Table 21*** summarises MGO's blasting criteria and performance for 2021. All blasts were fired within approved blasting hours. One (1) blast was fired at Mt Owen between 7am and 9am (Monday to Saturday inclusive). No blasts were fired at Ravensworth East or Glendell between 7am and 9am (Monday to Saturday inclusive) during 2021.

All blasting results from MGO are available on the website at:

https://www.glencore.com.au/operations-and-projects/coal/current-operations/mt-owen-glendell-open-cut.

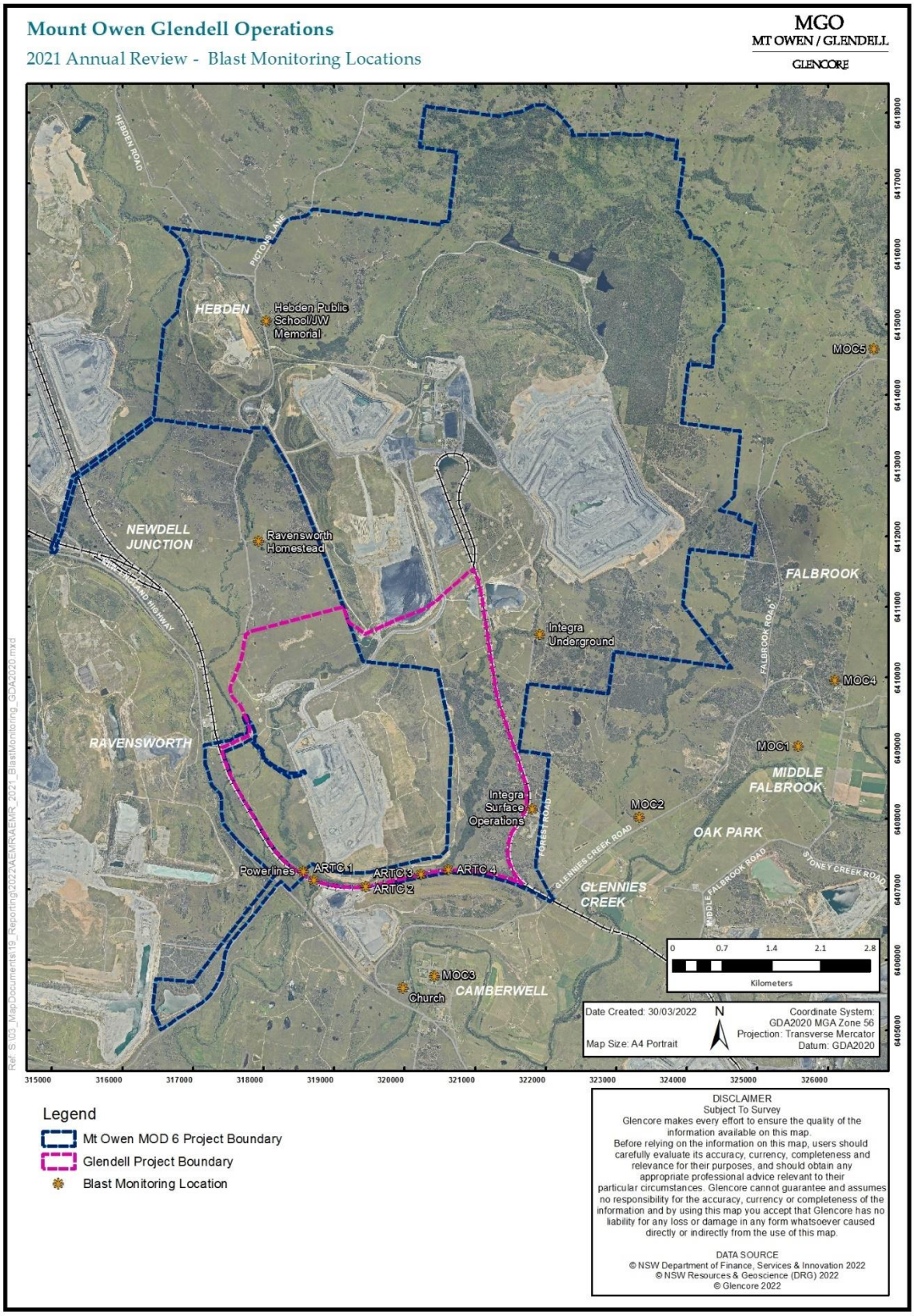

Figure 5: MGO Blast Monitoring Locations.

Table 20: MGO Blasting Hours and Frequencies for 2021

Approval	Operation	Compliant?	Approved Blasting Hours	Approved Blast Frequencies[1]		Actual Blast Frequencies (2021)		
				Maximum number of blasts per day	Average number of blasts per week	Total number of blasts recorded	Maximum number of blasts per day	Average number of blasts per week
DA 80/952	Glendell	Yes	9am – 5pm Monday to Saturday (EST) 9am – 6pm Monday to Saturday (DST)	2	5[3]	70	2	1.3[5]
SSD-5840	Ravensworth East	Yes	9am – 5pm Monday to Saturday[2]	2	5[4]	31	2	0.6[5]
SSD-5850	Mt Owen	Yes		2	8[4]	86	2	1.7[5]

1. Does not apply to blasts that generate ground vibration of 0.5mm/s or less at any residence on privately-owned land, or to blast misfires required to ensure the safety of the mine, its workers or the general public.
2. With the exception of an allowable maximum of 12 blasts in a calendar year which may be undertaken between 7am and 9am (Monday to Saturday inclusive).
3. Averaged over a 12-month period
4. Averaged over a calendar year
5. Averaged over the 2021 calendar year i.e., 1 Jan 2021 – 31 Dec 2021
EST – Eastern Standard Time
DST – Daylight Savings Time

Table 21: MGO Blasting Criteria and Performance for 2021

Location	Operation	Approval Criteria			Environmental Performance	Key Trends	Implemented/ Proposed Management Actions
		Airblast Over Pressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance			
Residents on Privately-Owned Land	Mt Owen Ravensworth East Glendell	120	10	0%	Compliant	Nil	Nil
		115	5	5% of the total number of blasts over a period of 12 months	Compliant		
Ravensworth Homestead	Ravensworth East	126	5	0%	Compliant	Nil	Nil

Location	Operation	Approval Criteria			Environmental Performance	Key Trends	Implemented/ Proposed Management Actions
		Airblast Over Pressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance			
Chain of Ponds Inn	Mt Owen	133	10	0%	Compliant	Nil	Nil
Kangory (Dulwich) Homestead	Mt Owen	126	5	0%	Compliant	Nil	Nil
Former Hebden Public School	Mt Owen	n/a	16	0%	Compliant	Nil	Nil
John Winter Memorial	Mt Owen	n/a	250	0%	Compliant	Nil	Nil
St Clements Church	Glendell	120	5	0 %	Compliant	Nil	Nil
	Glendell	115	2	5% of the total number of blasts over a period of 12 months	Compliant	Nil	Nil
Main Northern Railway Culverts and Bridges	Glendell	120	25	Negotiated Agreement	Compliant	Nil	Nil
Powerlines	Glendell	n/a	25	Negotiated Agreement	Compliant	Nil	Nil
Integra Underground Surface	Mt Owen	n/a	25 or 100	0%	Compliant	Nil	Nil
Integra Underground Workings	Mt Owen	n/a	10 or 250	0%	Compliant	Nil	Nil

Mt Owen

Overpressure and vibration compliance results for MTO are detailed in ***Appendix E*.**

There were 86 blasts fired at MTO during the reporting period, averaging less than 2 blasts fired per week. No blasting non-compliances were identified at MTO during the report period.

Glendell

Overpressure and vibration compliance results for Glendell are detailed in ***Appendix E***.

There were a total of 70 blasts fired at Glendell during the reporting period averaging less than 2 blasts fired per week. No blasting non-compliances were identified at Glendell during the report period.

Ravensworth East

Overpressure and vibration compliance results for Ravensworth East are detailed in **Appendix E**.

There were a total of 31 blasts fired at Ravensworth East during the reporting period averaging less than 1 blast fired per week. No blasting non-compliances were identified at Ravensworth East during the report period.

6.3 Air Quality

6.3.1 Air Quality Management and Monitoring

Air quality is managed in accordance with the approved MGO Air Quality Management Plan. Monitoring locations are shown in ***Figure 6***. Results of air quality monitoring are presented in ***Appendix F***.

Air quality conditions can be characterised by various substances and by various measurement techniques. Airborne particulate matter is typically the key air quality issue for open cut mining and the monitoring in the vicinity of MGO includes the measurement of:

- Particulate matter (as PM10 (particulate matter less than 10 microns))
- Particulate matter (as PM2.5 (particulate matter less than 2.5 microns))
- Particulate matter (as TSP (total suspended particulates))
- Dust deposition.

Appendix F, Tables 17 - 18 present the monitoring results for 2021 and for recent years. It should be noted that the measurement data represents the contributions from all sources that have at some stage been upwind of each monitor. In the case of particulate matter (e.g. PM10), the background concentration may contain emissions from many sources such as from mining activities, construction works, bushfires and 'burning off', industry, vehicles, roads, wind-blown dust from nearby and remote areas, fragments of pollens, moulds etc.

6.3.2 Meteorological Conditions

Meteorological monitoring is undertaken at MGO in accordance with SSD-5850 and DA 80/952 at the locations shown in ***Figure 6***. MGO operates a continuous meteorological monitoring network which includes three (3) weather stations, Sx13 M1, Sx13 M2 and Sx13 M8, located to the west and south-east of the active mining areas respectively.

The wind-roses in ***Figure 7*** show the frequency of wind speeds and wind directions during the reporting period, based on hourly records for the three MGO weather stations. The circular format of the wind rose shows the direction from which the wind blew and the length of each "spoke" around the circle shows how often the wind blew from that direction. The different colours of each spoke provide details on the speed of the wind from each direction.

Rainfall data for Singleton Army Base (the closest Bureau of Meteorology monitoring station), confirms that 2021 was much wetter than average. A total of 1,026.6 mm was recorded at the Singleton Army Base monitoring site in 2021, which was well above the long-term annual average rainfall of 689.8 mm for that site.

Approximately 1,195.80 mm of rainfall was recorded at MGO at Sx13 M1 during the reporting period. In the previous reporting period, approximately 841 mm of rainfall was recorded at that location, confirming that 2021 was wetter than previous years.

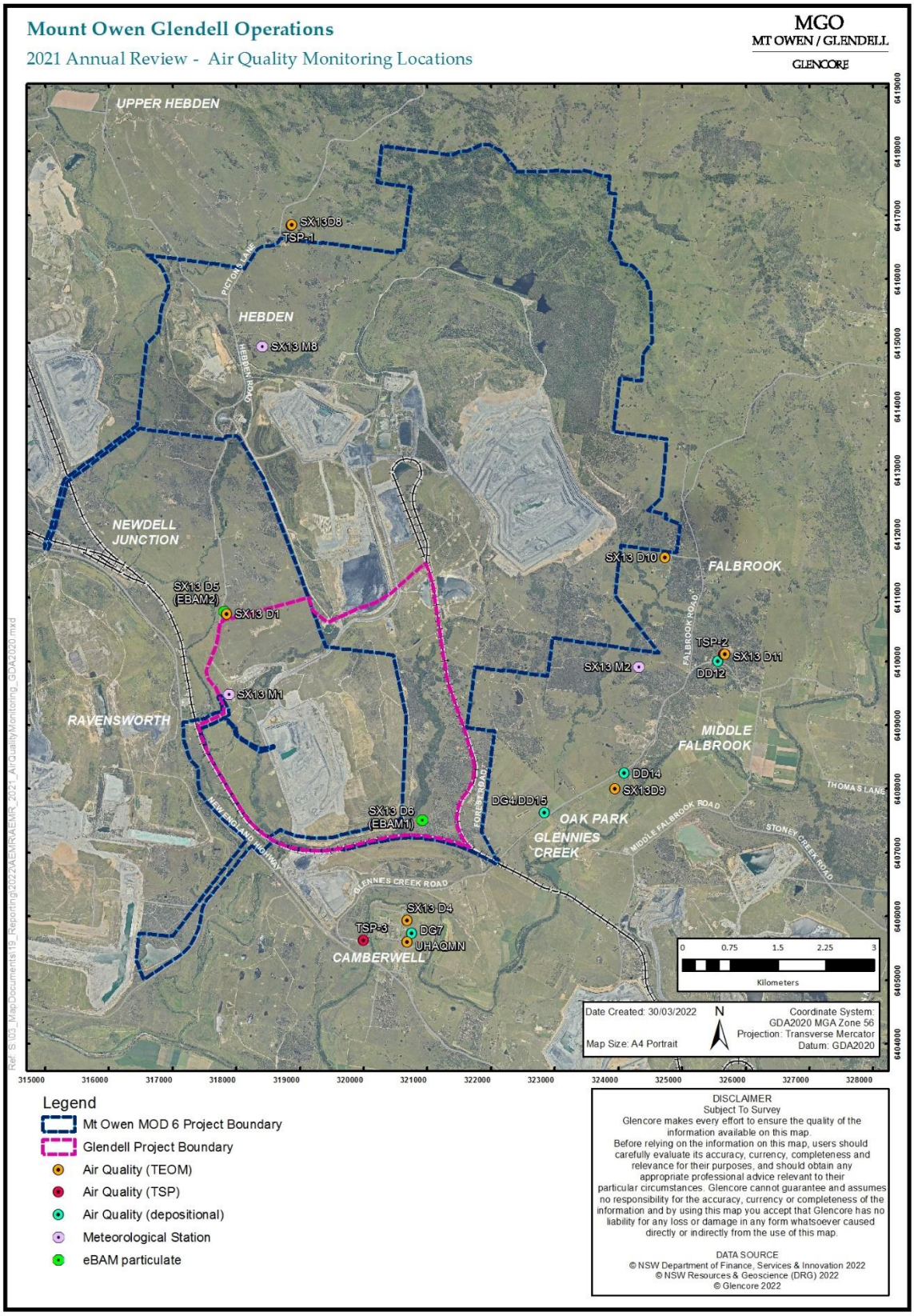

Figure 6: MGO Air Quality Monitoring Locations.

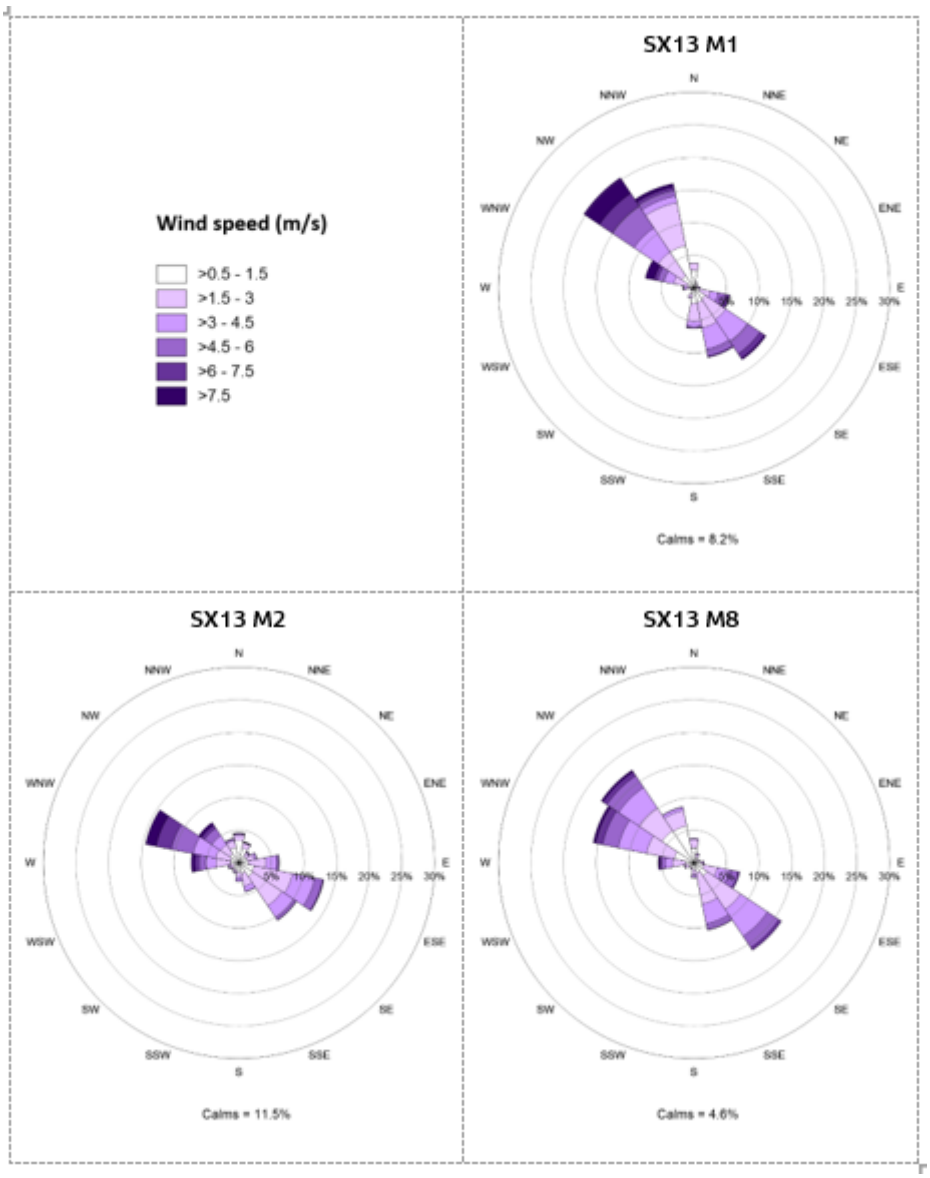

Figure 7: 2021 Annual Wind Roses for MGO Weather Stations.

6.3.3 Air Quality Performance

Overview

As noted in the development consents (DA 80/952 and SSD-5850) determination of compliance against MGO air quality impact assessment criteria is to exclude *"…extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the Secretary"*. The Department of Planning and Environment did not record any extraordinary events during the reporting period.

Particulate Matter as PM_{10}

Figure 6 shows the location of monitors which are used to measure PM10 concentrations. The concentrations are measured by a variety of instruments including Tapered Element Oscillating Microbalance (TEOM) and High Volume Air Samplers (HVAS).

Table 22 summarises the measured PM10 concentrations recorded at MGO during the reporting period. The data in ***Table 22*** show that the PM10 concentrations at all five monitors (bold text) were below the 24-hour and annual average criteria. Consequently, the monitoring demonstrates compliance with DA 80/952 and SSD-5850 in terms of PM10 emissions. Appendix F provides a more detailed analysis of the monitoring data, including a description of the method used to determine contributions from the direction of MGO.

Table 22: Summary of PM_{10} concentration from MGO monitors in 2021

Statistic	SX13 D1	SX13 D4	SX13 D8	SX13 D9	SX13 D11	Criterion	Environmental Performance this Reporting Period	Implemented/ Proposed Management Actions
Maximum 24-hour average in µg/m3								
Measurement (all data)	66.7	68.1	39	43.5	56.2	NA	NA	NA
Calculated contribution from direction of MGO	**32.4**	**34.8**	**4.8**	**21.0**	**26.0**	**50 (SSD-5850)** **50 (DA 80/952)**	**50 (Both Consents)**	N/A
Annual average in µg/m3								
Measurement (all data)	**18.5**	**19.8**	**12.4**	**15.4**	**14.1**	**25 (SSD-5850)** **30 (DA 80/952)**	**25 (SSD-5850)** **30 (DA 80/952)**	Continuation of existing management and mitigation measures
Calculated contribution from direction of MGO	18.5	19.8	12.5	15.4	14.1	NA	NA	NA

Particulate Matter as $PM_{2.5}$

Figure 6 shows the location of monitors which are used to measure $PM_{2.5}$ concentrations. ***Table 23*** summarises the measured $PM_{2.5}$ concentrations. The contribution from the direction of MGO could not be determined as monitoring to carry out an upwind-downwind calculation was not available. However, the data in ***Table 23*** shows that the $PM_{2.5}$ concentrations were below the 24-hour and annual average criteria. Consequently, 2021 monitoring demonstrates compliance with SSD-5850 in terms of $PM_{2.5}$ emissions. ***Appendix F*** provides a more detailed analysis of the monitoring data.

Particulate Matter as TSP

TSP concentrations have been measured at three locations by HVAS. ***Figure 6*** shows the location of the monitoring sites. It should be noted that TSP 1 and TSP 2 are on mine owned land. ***Table 24*** shows the measured annual average TSP concentrations from each monitor for data collected in 2021.

The data shows that the TSP concentrations at TSP 1, TSP 2 and TSP 3 were below the 90 µg/m3 annual average criteria. Consequently, the monitoring demonstrates compliance with the development consents in terms of TSP emissions.

Haul Road Dust Monitoring

Haul Road Control Efficiency Monitoring was completed in November 2021 using a TSI DustTrak. One control site (using watercarts) and one un-controlled site were monitored for each of North Pit, Barrett Pit and Bayswater Pit (six locations in total, as outlined in ***Table 25***). During this monitoring it was observed that the un-controlled site at North Pit had some visible moisture and may have been influenced by the adjacent high wall, causing winds to be obstructed. As a result, when North Pit control site is compared to its uncontrolled site the results show a 46% control efficiency. However, when the un-controlled site at North Pit is compared to the uncontrolled sites at Barrett Pit and Bayswater Pit, the control efficiency is 92% and 98% respectively. The full Haul Road Control Efficiency Monitoring report is provided in ***Appendix F***.

Table 23: Summary of $PM_{2.5}$ Concentrations from MGO Monitors in 2021

Statistic	SX13 D8	SX13 D11	Criterion	Implemented/ Proposed Management Actions
Maximum 24-hour average in µg/m³				
Measurement (all data)	21.4	16.2	NA	Continuation of existing management and mitigation measures
Measurement (without extraordinary events)	21.4	16.2	NA	Continuation of existing management and mitigation measures
Calculated contribution from direction of MGO (without extraordinary events)	4.9	6.6	**25 (SSD-5850)**	Continuation of existing management and mitigation measures
Annual average in µg/m³				
Measurement (all data)	4.0	5.5	NA	Continuation of existing management and mitigation measures
Measurement (without extraordinary events)	4.0	5.5	**8 (SSD-5850)**	Continuation of existing management and mitigation measures
Calculated contribution from direction of MGO (without extraordinary events)	0.1	0.8	NA	Continuation of existing management and mitigation measures

Table 24: Summary of TSP Concentrations from MGO Monitors in 2021

Statistic	TSP 1	TSP 2	TSP 3	Criterion	Environmental Performance this Reporting Period	Implemented/ Proposed Management Actions
Annual average in µg/m³	30	57	57	**90 (SSD-5850)** **90 (DA 80/952)**	Compliant	Continuation of existing management and mitigation measures

Table 25: Haul Road Dust Monitoring Control Efficiency Results.

Location	Controlled Road, average measured PM10 concentration (µg/m³)	Uncontrolled Road, average measured PM10 concentration (µg/m³)	Control Efficiency (%)
Barrett Pit	15.0 µg/m³	130.1 µg/m³	88%
Bayswater Pit	100.4 µg/m³	660.3 µg/m³	85%
North Pit	11.0 µg/m³	20.2 µg/m³	46%

Depositional Dust

MGOs deposition dust gauge network was reviewed in 2021 to determine if any redundant gauges existed. As a result of the findings (see Appendix F) several depositional dust gauges were removed from the network in 2021. In the future, MGO will only be monitoring at four depositional dust gauges in accordance with Air Quality and Greenhouse Gas Management Plan (approved by the DPIE on 29 September 2021). ***Figure 6*** shows the location of the four monitoring sites. ***Table 26*** shows the measured annual average deposited dust levels from each monitor during 2021. The annual averages presented in ***Table 26*** excluded monthly results marked as contaminated by the monitoring contractor. The deposited dust levels recorded during the reporting period were below 4 g/m2/month at all monitoring sites (refer ***Table 26***). The calculations also show that the MGO did not exceed the "incremental impact" criteria from the development consents (i.e, 2 g/m2/month increase on the previous year).

Table 26: Summary of Deposited Dust Levels from MGO Monitors in 2021

Statistic	DD12	DD14	DD15/DG4	DG7	Criterion	Implemented/Proposed Management Action
Annual average in g/m²/month						
Annual average	3.1	1.5	2.3	1.7	**4 (SSD-5850)** **4 (DA 80/952)**	Continuation of existing management and mitigation measures
Estimated MGO contribution to annual average	1.1	0.8	1.2	0.7	**2 (SSD-5850)** **2 (DA 80/952)**	Continuation of existing management and mitigation measures

EIS Predictions

The measured annual average PM_{10}, TSP and deposited dust levels have been compared to the predictions made in the latest environmental assessment of the approved operation, that is, the Statement of Environmental Effects (SEE) for Mount Owen Continued Operations Modification 2 (Jacobs, 2018). The SEE air quality predictions for Year 2 (approximately 2020) were used for the comparison, as the most representative of current MGO operations.

Table 27 shows the comparisons, which confirm that SEE predictions were:

- Between 1.2 and 2.4 times higher than the measured results for annual average PM_{10} concentrations, depending on the location
- Between 1.2 and 1.8 times higher than the measured results for annual average TSP concentrations, depending on the location
- Between 0.8 lower and 1.8 times higher than the measured annual average deposited dust levels, depending on the location.

The comparisons confirm that air quality impacts from MGO in 2021 were generally in accordance with, or less than with EIS predictions. The results are also generally within the factor-of-two accuracy that has been recognised for comparisons against these types of models (US EPA, 2005).

Table 27: Comparison between EIS Predictions and Air Quality Measurements in 2021.

Location	Prediction (Mt Owen Mod 2 for Year 2)	Measurement (2021 excluding extraordinary events)
Annual average PM_{10} in µg/m^3		
SX13 D1	41	18.45
SX13 D4	35	19.82
SX13 D8	21	12.45
SX13 D9	30	15.44
SX13 D11	25	14.12
Annual average TSP in µg/m^3		
TSP 1	74	30
TSP 2	76	57
TSP 3	79	54.3
Annual average deposited dust in g/m^2/month		
DD12	3.1	3.1
DD14	3.0	1.5
DD15/DG4	3.0	2.3
DG7	3.1	1.7

Summary

Late 2019 coincided with a period of unprecedented bushfires in Australia that continued into January and February of 2020. These conditions adversely affected air quality across many parts of NSW and a total of 24 days in 2020 were subsequently declared as extraordinary events. 2021 saw an easing of these extraordinary events with no extraordinary events being recorded. Measurements of PM_{10}, $PM_{2.5}$, TSP and deposited dust were compared to the short and long-term impact assessment criteria from the Mt Owen and Glendell development consents. It was determined that MGO was in compliance with its development consents (DA 80/952 and SSD-5850) in terms of air quality impacts at all reportable monitoring sites for data collected in 2021.

Further information on the air quality data can be found in the independent air quality report, prepared by a suitably qualified air quality specialist, in ***Appendix F***.

6.3.4 Continuous Improvement

As a part of the ongoing commitment to the management of dust impacts from MGO, a range of activities have been undertaken during 2021 that fall within the continuous improvement program. The most important being:

- Implementation of two $PM_{2.5}$ TEOMs monitors to be part of MGO Real Time Dust Monitoring Network for Mt Owen following the approval of the Air Quality and Greenhouse Gas Management Plan in early 2021
- Review and simplification of dust alarm response
- New water fill point to be installed near WOOP dump closer to Mount Owen North Pit active operations
- Further DNAT development to incorporate site specific contribution dust contribution.

A number of activities to be undertaken in 2022 include:

- Upgrade MGOs real-time monitoring network to 4G
- Continuous assessment and improvement of the real-time monitoring network and management alarms
- Review and simplification of dust alarm response
- Additional haul road dust efficiency monitoring.

6.3.5 Greenhouse Gas

Energy consumption at MGO is monitored and reported in accordance with Glencore requirements and with the reporting requirements of the National Greenhouse & Energy Reporting (NGER) system. In the 2020/21 financial year, the total Scope 1 and Scope 2 emissions produced by MGO were estimated to be:

- 121,454.4 t CO2-e from Glendell
- 193,949.2 t CO2-e from MTO.

A summary of greenhouse gas emissions for 2020/21 is provided in ***Table 28***.

Table 28: Greenhouse Gas Emissions at MGO during the 2020/21 Financial Year

Emission Source	Glendell (t CO2-e)	Mt Owen (t CO2-e)	Mt Owen Complex (t CO2-e)
Scope 1 Emissions			
Fossil Fuel	92,660.48	118,504.48	211,164.96
Fugitive emissions	26,440.05	41,379.76	67,819.81
Scope 2 Emissions			
Electricity	1,944.84	34,064.91	36,009.74
Total Emissions	119,100.53	159,884.24	278,984.77

6.4 Biodiversity and Land Management

The Biodiversity Offset Management Plan (BOMP) at MGO forms part of the MGO EMS. The BOMP is used to describe the controls and monitoring implemented for the management of flora and fauna. The objectives for land management at MGO are based on land management principles, including:

- Erosion prevention
- Pasture diversity
- Weed and feral animal control.

Natural regeneration is promoted where practical to enhance biodiversity and landscape amenity.

6.4.1 Biodiversity Offset Areas

MGO were required to secure a number of Biodiversity Offset Areas (BOAs) in accordance with conditions of SSD-5850 and DA 80/952. In 2018, five Conservation Agreements (CAs) were gazetted in consultation with the NSW Environment, Energy and Science Group (then Office of Environment and Heritage OEH) and the Biodiversity Conservation Trust (BCT). These CAs were implemented for the following:

- Bettys Creek (Enex Foydell) Conservation Area.
- Bettys Creek (Glendell) Conservation Area.
- Mount Owen Offsets Conservation Area, represented by a cluster of four smaller offset areas, being;
    - North East Offset;
    - Forest East Offset;
    - South East Offset;
    - South East Corridor Offset.
- Southern Remnant Conservation Area.
- North West Offset Conservation Area.

MGO is in the process of long term securing the remaining BOAs through Stewardship Agreements under the BioBanking Biodiversity and Offset Scheme, therefore, BOAs are current managed under the BOMP, and those include the following properties:

- Cross Creek Offset Site.
- Stringybark Habitat Corridor Offset Site.
- Esparanga Offset Site.
- Mitchell Hills Offset Site.

Details of the MGO CAs and BOAs are provided in ***Table 29*** with their locations shown in ***Figure 9***.

Table 29: Biodiversity Offset Areas

Offset Area	Plant Community Type	Size (ha)
DA 80/952		
Bettys Creek Habitat Management Area (HMA) incorporating*: - **Bettys Creek (Enex Foydell)** - **Bettys Creek (Glendell)**	1691 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter	174.0
	1692 - Bull Oak Grassy Woodland of the Central Hunter Valley	
	1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley	
	Derived Native Grassland	
DA SSD-5850		
Northwest Offset*	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	71.4
	1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (1213 Decommissioned and merged with 1590)	
	Derived Native Grassland	
Northeast Offset*	1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (1213 Decommissioned and merged with 1590	83.6
	1614 - Grey Gum - Grey Myrtle - Narrow-leaved Stringybark - Rusty Fig open forest on ranges of the Upper Hunter	
	Derived Native Grassland	
Southeast Offset*	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	58.3
	Derived Native Grassland	
Southeast Corridor Offset*	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	74.1
	Derived Native Grassland	
	1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley	
Forest East Offset*	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	110.9
	Derived Native Grassland	
	1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (1213 Decommissioned and merged with 1590)	
Southern Remnant Offset*	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	4.0

Offset Area	Plant Community Type	Size (ha)
Cross Creek Offset Site	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	367.0
	Derived Native Grassland	
Stringybark Habitat Corridor Offset Site	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (Including planted variant)	97.5
	1598 Forest Red Gum grassy open forest on floodplains of the lower Hunter	
	Dry Rainforest	
	1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley	
	Derived Native Grassland	
	African Olive Infestation	
Esparanga Offset Site	618 White Box x Grey Box - Red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	303.0
	281 Rough-Barked Apple - Red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
	618 White Box x Grey Box - Red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Shrubby variant)	
	1607 Blakelys Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	
	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	
	Derived Native Grassland	
Mitchell Hills North Offset Site	1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (1213 Decommissioned and merged with 1590)	143.7
	1543 Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley	
	624 Large-fruited Grey Gum - Narrow-leaved Stringybark open forest on sheltered sandstone hillslopes in the Scone region of the upper Hunter Valley	
	Derived Native Grassland	
Rehabilitation Woodland	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	518.0

** CA's gazetted in consultation with the Biodiversity and Conservation Division (BCD) of DPIE and the Biodiversity Conservation Trust (BCT) and as administered by the Minister administering the Biodiversity Conservation Act 2016 (BC Act).*

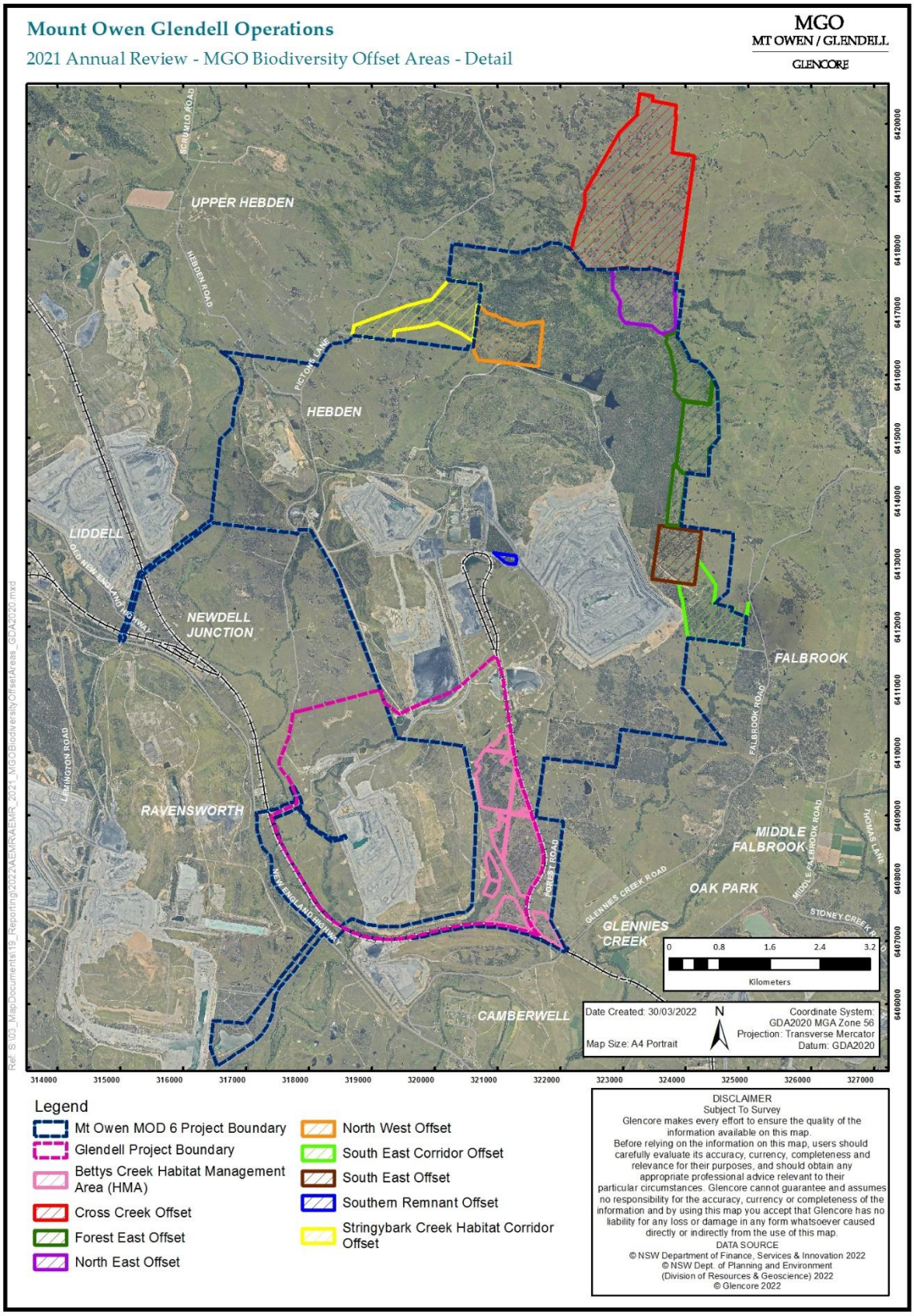

Figure 8: MGO Biodiversity Offset Areas

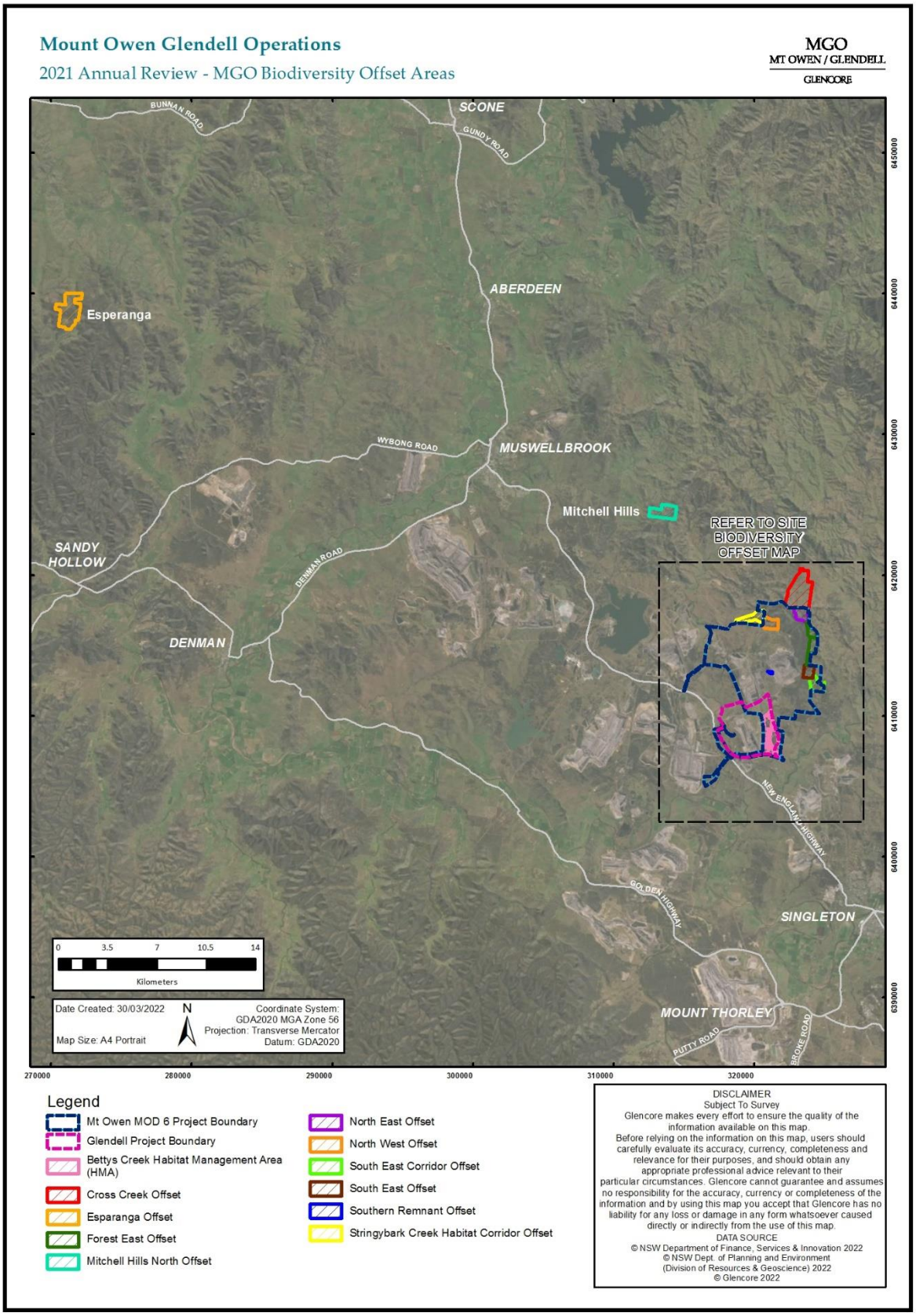

Figure 9: MGO Site Boundary Offset Areas – Detail

6.4.2 Rehabilitation Woodland Offset

MGO is required to identify 518 hectares of mine rehabilitation to commit as a BOA within five years of commencement of operations. This area is to be restored to Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC under the BC Act. The long-term conservation of this offset will be determined in accordance with Condition 29, Schedule 3 of SSD-5850 (MOD2).

Details of the rehabilitation to be undertaken in the Rehabilitation Woodland Offset Area are included in the MOP as well as the Rehabilitation Strategy. Due to the rehabilitation not yet being complete the Department of Planning, Industry and Environment have granted an extension until 6 February 2023 to identify the area to commit as a BOA.

6.4.3 Flora Monitoring

6.4.3.1 Conservation Areas Monitoring Methods

Conservation area monitoring requirements are outlined in Annexure D of the Conservation Agreements (CAs) and further detailed in MGOs Biodiversity and Offset Management Plan (BOMP). As specified within Annexure D of the Conservation Agreements (CAs) and the BOMP, annual monitoring of each Conservation Area must include:

- Photo monitoring for comparison to baseline photos taken between 2015 and 2017 (undertaken at the exact location and from the exact bearings as baseline photos)
- Quadrat monitoring, to compare data to benchmark data provided in Annexure D, Table 2 of each CA
- Walkthrough assessment of opportunistic sightings, including:
    - Fire events or impacts of fire management
    - Weeds (including compilation of list of exotic species and recording new weed infestations including location and extent)
    - Pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance)
    - Visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access trails or tracks)
    - Rubbish dumping
    - Natural regeneration of previously disturbed areas
    - Sightings of threatened species.

The above monitoring methods were utilised during the 2021 monitoring period. All monitoring works were undertaken by qualified ecologists at the locations required in Annexure D, Table 1 of each CA (reproduced in ***Table 30***). Photo monitoring locations are shown in ***Figure 10***.

Table 30: Conservation Agreement Monitoring Locations 2021

Site Name	Plant Community Type	Monitoring Type
Bettys Creek (Enex Foydell) CA*		
P07	Derived Native Grassland (proposed for 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley)	Photo & Quadrat
P08	1691 - Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter	Photo & Quadrat
P09	1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley	Photo & Quadrat
GHMA05	1691 - Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter	Photo & Quadrat
GHMA08	Derived Native Grassland (proposed for 1691 - Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter)	Photo & Quadrat
GHMA09	1691 - Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter	Photo & Quadrat
GHMA11	Derived Native Grassland (proposed for 1691 - Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter)	Photo & Quadrat
GHMA13	Derived Native Grassland (proposed for 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley)	Photo & Quadrat
Bettys Creek (Glendell) CA*		
BCCA-A	Derived Native Grassland (proposed for 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley)	Photo & Quadrat^
Mount Owen Offsets CA*		
P01	1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley	Photo & Quadrat
P02	Derived Native Grassland (Proposed for Plant Community Type (PCT) 1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter)	Photo & Quadrat
P05	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Photo & Quadrat
Photo 3	1614 - Grey Gum - Grey Myrtle - Narrow-leaved Stringybark - Rusty Fig open forest on ranges of the Upper Hunter	Photo & Quadrat^
Photo 4	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Photo & Quadrat^
Southern Remnant CA		
Photo 6	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Photo & Quadrat^

Site Name	Plant Community Type	Monitoring Type
Northwest Offset CA		
P06	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Photo & Quadrat
Photo 5	Derived Native Grassland (Proposed for PCT 1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter)	Photo & Quadrat^

** The CA naming conventions differ slightly from the BOAs (due to ownership/cadastral issues) in the following ways: Bettys Creek HMA is split into the Bettys Creek (Enex Foydell) and Bettys Creek (Glendell) CAs (see **Table 31**); and Northeast Offset, Southeast Offset, Southeast Corridor and Forest East Offset are amalgamated into the collective Mount Owen Offsets CA.*

^ Additional quadrat monitoring sites were established at previously photo monitoring sites to track vegetation change over time and allow comparisons against benchmarks

6.4.3.2 Flora Monitoring Results

Table 31 summarises biodiversity management performance in the Conservation Areas for 2021 and includes recommended management actions for 2022.

Table 31: Conservation Area Biodiversity Management Summary 2021

Conservation Area	2021 Management Actions	Key Trends	Actions for 2022
Bettys Creek (Enex Foydell) CA	• Seed Collection • 6 ha of direct seeding (see ***Figure 11***) • Primary weed control • Vertebrate pest control • Waste removal • Annual reporting	• From 2020 to 2021 there was generally continued recovery in vegetation condition across the CA. This was particularly evident in the midstorey foliage and ground-coverage. • Exotic coverage remains higher in areas of former grassland when compared to remnant vegetation, particularly in areas which have been subject to revegetation works (with scalping allowing for rapid colonisation of opportunistic species). • Natural recruitment continues to occur in this CA, with gradual in-filling of gaps in the canopy observable.	• Continue primary weed control
Bettys Creek (Glendell) CA	• Seed collection • Primary weed control • Vertebrate pest control • Waste removal	• The condition of this CA remains generally consistent with previous monitoring. A relatively dense canopy of swamp oak (*Casuarina glauca*) is present. The midstorey is sparse and where present comprises regenerating canopy species. The ground cover density and height has improved	• Continued primary weed control

Conservation Area	2021 Management Actions	Key Trends	Actions for 2022
	• Annual reporting	since baseline and is dominated by barbed wire grass (*Cymbopogon refractus*), speargrass (*Austrostipa scabra*) and Aristida sp.. • Exotic vegetation has a cover of approximately 50 per cent (being higher in grassland areas). Exotic species of concern are sharp rush (*Juncus acutus*), fireweed (*Senecio madagascariensis*), prickly pear (*Opuntia stricta*), spear thistle (*Cirsium vulgare*) and Coolatai grass (*Hyparrhenia hirta*).	
Mount Owen Offsets CA	• Seed collection • Primary weed control • Vertebrate pest control • Annual reporting	• From 2020 to 2021 there was generally continued recovery in vegetation condition across the CA, likely correlating to the drought breaking in spring 2020. This was particularly evident in the midstorey foliage and ground-coverage of photo monitoring. • Exotic coverage remains much higher in areas of former grassland when compared to remnant vegetation, particularly in areas which have been subject to revegetation works (with scalping allowing for rapid colonisation of opportunistic species). • Natural recruitment, assisted by revegetation continues to occur in this CA, with the gradual in-filling of gaps in the canopy observable in comparative aerial imagery. This is particularly evident in the far south, and central areas of this CA. • Natural recruitment appears to be limited in the far north.	• Continue primary and follow up weed control. • Investigate direct seeding options in the north-most grassland.
North West Offset CA	• Seed collection • Primary weed control • Vertebrate pest control	• The remnant areas of this PCT were initially in good condition, however African olive (*Olea europaea* subsp. *cuspidata*) was quite dense in the northern slopes. Minor canopy defoliation occurred during the drought;	• Continue primary weed control

Conservation Area	2021 Management Actions	Key Trends	Actions for 2022
	• Annual reporting	however, it appears to be improving. Floristic diversity has remained relatively consistent. • Areas of revegetation and regeneration have shown moderate success; however, it may be several years before the ultimate success of this revegetation can be determined. Areas of revegetation are observable in comparison aerial imagery. Although the condition of revegetation areas has substantially improved, it will likely be some time before their parameters are at similar levels to target remnant or benchmark vegetation.	
Southern Remnant Offset CA	• Seed collection • Primary weed control • Annual reporting	• The condition of vegetation within the Southern Remnant CA remains consistent with previous monitoring. A relatively dense canopy is present, consisting grey box (*Eucalyptus moluccana*), red ironbark (*Eucalyptus fibrosa*) and spotted gum (*Corymbia maculata*). The sparse midstorey consists of bulloak (*Allocasuarina luehmannii*) and regenerating grey box (*Eucalyptus moluccana*). Groundcover is dominated by grasses including barbed wire grass (*Cymbopogon refractus*), threeawn speargrass (*Aristida vagans*) and tall chloris (*Chloris ventricosa*), as well as sparse fan wattle (*Acacia amblygona*). • Exotic vegetation has a cover of between 5 and 10 per cent (being lower in the central areas subject to less edge effects). Narrow-leaved cotton bush (*Gomphocarpus fruticosus*) and galenia (*Galenia pubescens*) were recorded in high densities near the access road. • Pest activity in this area remains low. • Natural recruitment continues to occur in this CA, with the gradual	• Continue primary weed control

Conservation Area	2021 Management Actions	Key Trends	Actions for 2022
		in-filling of gaps in the canopy observable in comparative monitoring.	

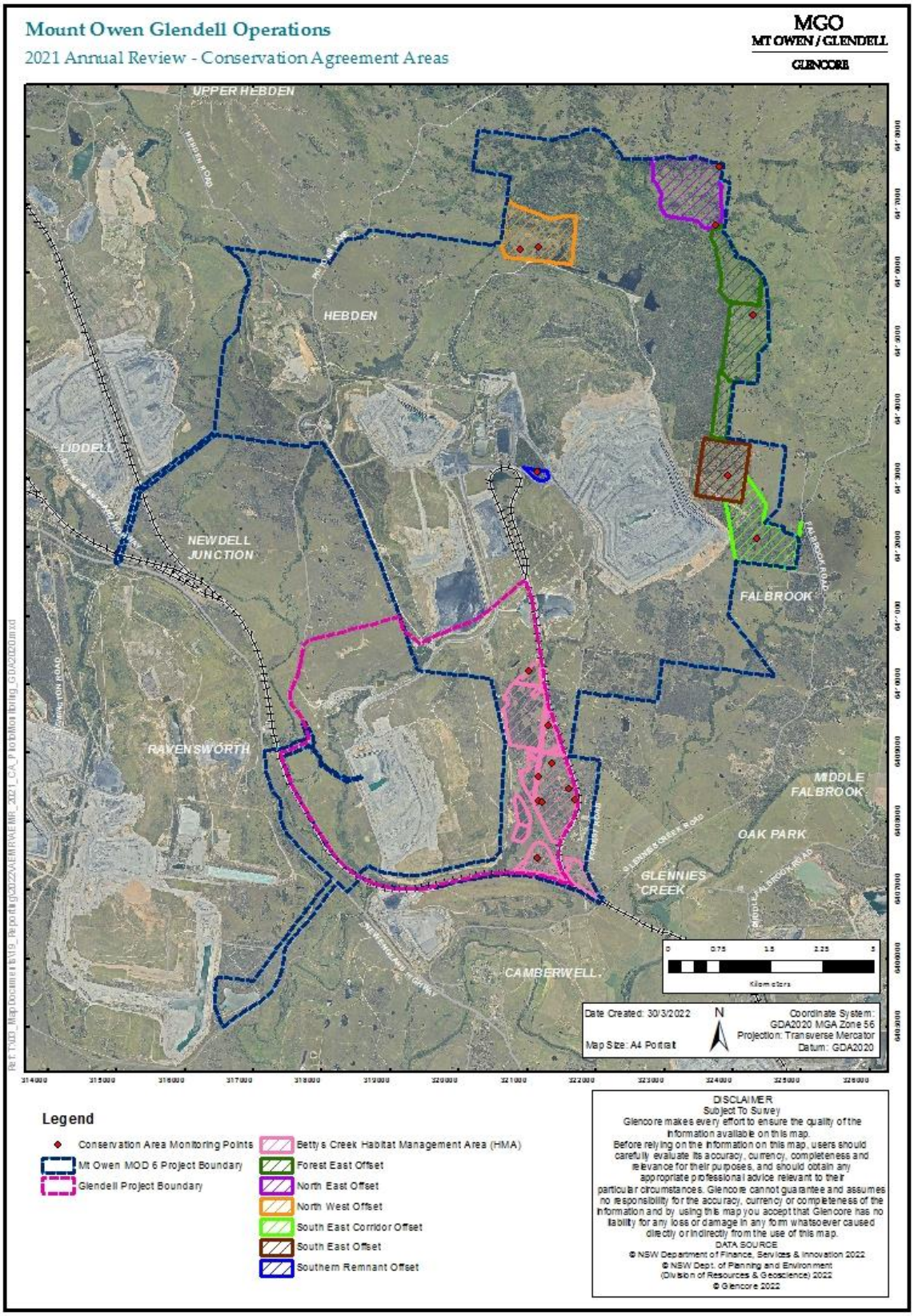

Figure 10: Photo Monitoring Locations for Conservation Areas

Figure 11: Eucalyptus species germinating in Bettys Creek (Enex Foydell) CA seeding area

6.4.3.3 Biodiversity Offset Areas

In 2021, flora monitoring was conducted within MGO BOAs (see ***Table 32*** and ***Figure 9***). Flora monitoring in the BOAs is conducted seasonally, every two to three years in accordance with the MGO BOMP. BOA flora monitoring was last conducted in 2019. 2021 was the third monitoring event to occur in the BOAs, with baseline monitoring taking place in 2017. Cross Creek BOA was not monitored until February 2022 due to high rainfall preventing access to the site during spring 2021.

Table 32: Biodiversity Offset Area Monitoring Locations 2021

Site Name	Plant Community Type	Monitoring Type
Cross Creek BOA		
CC1	1602 - Spotted Gum - Narrow - leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Flora
CC2	1602 - Spotted Gum - Narrow - leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Flora
CC3	Derived Native Grassland 1602 - Spotted Gum - Narrow - leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Flora
Esparanga BOA		
EBB1	281 Rough-Barked Apple - Red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Flora
E1	1607 Blakelys Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Flora
E2	281 Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Flora

Site Name	Plant Community Type	Monitoring Type
E3	618 White Box x Grey Box - Red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Flora
E5	618 White Box x Grey Box - Red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Flora
E6	1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter Valley	Flora
E8	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	Flora
E9	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	Flora
E10	618 White Box x Grey Box - Red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Flora
Mitchell Hills BOA		
MH1	1213 Decommissioned. PCT 1213 merged with 1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Flora
MH2	1213 Decommissioned. PCT 1213 merged with 1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Flora
MH3	1213 Decommissioned. PCT 1213 merged with 1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Flora
MH4	1543 Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley	Flora
MH5	624 Large-fruited Grey Gum - Narrow-leaved Stringybark open forest on sheltered sandstone hillslopes in the Scone region of the upper Hunter Valley	Flora
Stringybark Creek BOA		
S1	1598 Forest Red Gum grassy open forest on floodplains of the lower Hunter	Flora
S2	1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Flora
S3	1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Flora
S4	1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Flora
S5	1614 Grey Gum - Grey Myrtle - Narrow-leaved Stringybark - Rusty Fig open forest on ranges of the Upper Hunter	Flora
S6	1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	Flora

Table 33 summarises biodiversity management performance in the BOAs for 2021 and includes recommended management actions for 2022.

Table 33: Biodiversity Offset Area Management Summary 2021

BOA	2021 Management Actions	Key Trends	Actions for 2022
Cross Creek	• Seed collection • Primary weed control • Direct seeding • Vertebrate pest management • Annual reporting • Development of burn plans and regime	• Monitoring not completed until February 2022 due to high rainfall preventing access to site during Spring 2021.	• Continue primary weed control • Investigate additional seeding options • Vertebrate pest control • Habitat augmentation
Stringybark Creek	• Seed collection • Primary weed control • Direct seeding • Vertebrate pest management • Annual reporting • Development of burn plans and regime	• General recovery of groundcover vegetation – very little exposed bare ground. • Previously controlled areas of African olive (*Olea europaea subsp. cuspidata*) infestation are returning to former levels and follow-up treatment is required. • Observed introduced species diversity and cover fluctuate more in areas of revegetation when compared to remnant areas, indicating that these areas are more resilient. • Remnant vegetation at PCT 1602 is generally stable and considered resilient to change. • While the overall value of derived native grasslands has improved, they lack natural recruitment of canopy species and require improvement in order to meet target vegetation. • Overall floristic value of remnant sites S5 (PCT 1614) and S6 (PCT 1731) are on a negative trajectory. This appears primarily a result of: increased coverage of High Threat Weeds and defoliation that has yet to fully	• Continue primary and follow up weed control • Investigate additional seeding options • Vertebrate pest control • Habitat augmentation •

BOA	2021 Management Actions	Key Trends	Actions for 2022
		recover following drought conditions. • Whilst induvial areas of remnant vegetation have slightly increased in size, no areas of vegetation that were formerly unconnected have become connected as a result of revegetation or natural recruitment.	
Esparanga	• Weed control • Vertebrate pest management • Annual reporting • Development of burn plans and regime	• Remnant vegetation in good condition • All PCTs within Esparanga are either improving or remaining stable since they were last monitored • Annual weeds were highly abundant in the grassland areas	• Weed Control • Vertebrate pest Control • Track maintenance • Habitat Augmentation • Fence line maintenance
Mitchell Hills	• Weed control • Vertebrate pest control • Annual reporting • Development of burn plans and regime	• There has been an increase in weed diversity and abundance since the last monitoring event. This may correspond to the breaking of the drought resulting in increased growth and spread of these species. • As a result, there has been a corresponding decrease in some native cover an abundance in these areas.	• Weed control • Vertebrate pest control • Habitat Augmentation • Track maintenance
Bettys Creek (Enex Foydell) CA	• Seed Collection • 6 ha of direct seeding • Primary weed control • Vertebrate pest control • Waste removal • Annual reporting	• From 2020 to 2021 there was generally continued recovery in vegetation condition across the CA. This was particularly evident in the midstorey foliage and ground-coverage. • Exotic coverage remains higher in areas of former grassland when compared to remnant vegetation, particularly in areas which have been subject to revegetation works (with scalping allowing for rapid colonisation of opportunistic species). • Natural recruitment continues to occur in this CA, with gradual in-	• Continue primary weed control

BOA	2021 Management Actions	Key Trends	Actions for 2022
		filling of gaps in the canopy observable.	
Bettys Creek (Glendell) CA	• Seed collection • Primary weed control • Vertebrate pest control • Waste removal • Annual reporting	• The condition of this CA remains generally consistent with previous monitoring. A relatively dense canopy of swamp oak (*Casuarina glauca*) is present. The midstorey is sparse and where present comprises regenerating canopy species. The ground cover density and height has improved since baseline and is dominated by barbed wire grass (*Cymbopogon refractus*), speargrass (*Austrostipa scabra*) and Aristida sp. • Exotic vegetation has a cover of approximately 50 per cent (being higher in grassland areas). Exotic species of concern are sharp rush (*Juncus acutus*), fireweed (*Senecio madagascariensis*), prickly pear (*Opuntia stricta*), spear thistle (*Cirsium vulgare*) and Coolatai grass (*Hyparrhenia hirta*).	• Continued primary weed control
Mount Owen Offsets CA	• Seed collection • Primary weed control • Vertebrate pest control • Annual reporting	• From 2020 to 2021 there was generally continued recovery in vegetation condition across the CA, likely correlating to the drought breaking in spring 2020. This was particularly evident in the midstorey foliage and ground-coverage of photo monitoring. • Exotic coverage remains much higher in areas of former grassland when compared to remnant vegetation, particularly in areas which have been subject to revegetation works (with scalping allowing for rapid colonisation of opportunistic species). • Natural recruitment, assisted by revegetation continues to occur in this CA, with the gradual in-filling of gaps in the canopy observable in comparative aerial imagery. This is particularly	• Continue primary and follow up weed control. • Investigate direct seeding options in the north-most grassland.

BOA	2021 Management Actions	Key Trends	Actions for 2022
		evident in the far south, and central areas of this CA. • Natural recruitment appears to be limited in the far north.	
North West Offset CA	• Seed collection • Primary weed control • Vertebrate pest control • Annual reporting	• The remnant areas of this PCT were initially in good condition, however African olive (*Olea europaea* subsp. *cuspidata*) was quite dense in the northern slopes. Minor canopy defoliation occurred during the drought; however, it appears to be improving. Floristic diversity has remained relatively consistent. • Areas of revegetation and regeneration have shown moderate success; however, it may be several years before the ultimate success of this revegetation can be determined. Areas of revegetation are observable in comparison aerial imagery. Although the condition of revegetation areas has substantially improved, it will likely be some time before their parameters are at similar levels to target remnant or benchmark vegetation.	• Continue primary weed control
Southern Remnant Offset CA	• Seed collection • Primary weed control • Annual reporting	• The condition of vegetation within the Southern Remnant CA remains consistent with previous monitoring. A relatively dense canopy is present, consisting grey box (*Eucalyptus moluccana*), red ironbark (*Eucalyptus fibrosa*) and spotted gum (*Corymbia maculata*). The sparse midstorey consists of bulloak (*Allocasuarina luehmannii*) and regenerating grey box (*Eucalyptus moluccana*). Groundcover is dominated by grasses including barbed wire grass (*Cymbopogon refractus*), threeawn speargrass (*Aristida vagans*) and tall chloris (*Chloris ventricosa*), as well as sparse fan wattle (*Acacia amblygona*).	• Continue primary weed control

BOA	2021 Management Actions	Key Trends	Actions for 2022
		• Exotic vegetation has a cover of between 5 and 10 per cent (being lower in the central areas subject to less edge effects). Narrow-leaved cotton bush (*Gomphocarpus fruticosus*) and galenia (*Galenia pubescens*) were recorded in high densities near the access road. • Pest activity in this area remains low. • Natural recruitment continues to occur in this CA, with the gradual in-filling of gaps in the canopy observable in comparative monitoring.	

6.4.4 Fauna Monitoring

6.4.4.1 Fauna Monitoring Methods

As per Version 2 of MGO's Biodiversity Offset Management Plan, which was the current version during most of 2021, no fauna monitoring was required within the BOAs in 2021 as fauna monitoring was conducted in 2020 and is only required every 2-3 years. Annual fauna monitoring within the BOAs will commence in 2022 as per Version 3 of Biodiversity Offset Management Plan.

Fauna monitoring methods undertaken at MGO fauna monitoring sites in 2021 included the following methods:

- Diurnal woodland bird surveys
- Targeted winter bird surveys
- Pitfall trapping
- Nest box monitoring
- Microbat echolocation call surveys
- Diurnal herpetofauna surveys
- Call playback surveys
- Remote camera surveys.

6.4.4.2 Fauna Monitoring Results (MGO Sites)

Climatic conditions experienced in 2021 contrasted with 2020, with slightly lower than average rainfall recorded across most months. March 2021 recorded very high monthly rainfall, with above average totals recorded. The majority of smaller farm dams and larger water bodies were full throughout the reporting period.

No new bird species were recorded in 2021, with a cumulative total for MGO of 172 bird species. During the 2021 monitoring year, a total of 89 bird species were recorded, of which 67 were detected by census surveys, and the remaining 22 species observed or heard opportunistically. Analysis of the bird species diversity indices for each monitoring site recorded above average scores in 2021 compared to the long-term annual average. The remnant forest site For1 recorded the highest overall bird species diversity across the 3 habitat treatments. However, the revegetation (Reg1) and rehabilitation sites (Reh1, Reh2, Reh3) all scored above long-term average for bird species in 2021. Possible factors responsible for the higher values at the rehabilitation sites is the improvement in habitat value as this vegetation community increases in age. At present, the oldest rehabilitation site (Reh1) is now 23 years old.

Pitfall trapping was used for the monitoring for smaller mammals in 2021. Small mammals recorded include the native Common Dunnart and Yellow-footed Antechinus, and introduced Black Rat. Field cameras deployed in 2021 revealed the presence of both native and introduced pest species. Notable was the abundance of introduced Fallow Deer in the rehabilitation areas, which were also regularly observed during field surveys.

Nest boxes revealed the presence of two threatened species, the Brush-tailed Phascogale and Squirrel Glider. The Squirrel Glider utilises nest boxes across a large area of MGO, with many boxes containing their characteristic leaf nest. 69 new nest boxes were installed in 2021 within the MGO area. Notable in 2021 was the abundance of Gould's Wattled Bat utilising bat roost boxes, in addition to Eastern Coastal Free-tailed-bat. Echolocation call recordings detected 12 species of microbats in 2021, with comparable number of calls recorded to previous years.

In 2021, 10 threatened species were recorded, including 4 bird species, 3 non-flying mammals and 3 microbat species. A total of 26 threatened species have been detected at MGO since the commencement of fauna monitoring. For several threatened species, their occurrence at the MGO is irregular, being present during favourable environmental conditions and absent outside of those periods. No evidence of the nationally endangered Swift Parrot was recorded at MGO in 2021.

Flowering of eucalypts mistletoe was considered to be relatively low in 2021, which may have influenced the absence of the Swift Parrot. Previously, this species has been periodically recorded at MGO, including the years 2005, 2007 and 2014. Flowering of eucalypt trees was relatively restricted in 2021, with only scattered individual trees or small stands in flower. However, the Spotted Gum trees were found to be in very heavy in bud, and will likely flower very prolifically in late autumn and winter 2022.

Only a small area of clearing was undertaken in 2021 in Strip 12 east of MTO North Pit, with two habitat trees located in the clearing area. Inspection of tree hollows following the felling of each tree did not locate any hollow-dependent resident fauna.

6.4.4.3 Fauna Monitoring Results (Cumulative)

Fauna Monitoring Results Summary

Overall, the fauna monitoring for MGO undertaken over the period 1996 – 2021 has recorded a total of:

- 169 native and 3 introduced bird species
- 41 native and 11 introduced mammal species
- 29 reptiles
- 16 amphibian species.

In the 2021 monitoring period, a total of 89 bird species, 9 native terrestrial and arboreal mammals, 12 microbat species, 4 introduced terrestrial mammals, 7 reptile and 6 amphibian species were recorded (see ***Figure 12***).

Cumulative Threatened Fauna Results

MGO carries out seasonal fauna monitoring across site rehabilitation areas and onsite BOAs. This includes monitoring of birds, reptiles, mammals, and frogs. ***Table 34*** lists the threatened species observed since 1996 at MGO.

A: Squirrel Gliders located in nest box, MTO Rehabilitation

B: Lace Monitor in nest box, MGO

C: Breeding pair of White-bellied Sea Eagles, MGO

D: Southern rainbow skink, MTO Rehabilitation

Figure 12 Opportunistic photos of fauna identified at MGO, 2021

Table 34: Threatened Species Observed at MGO 1996-2021

Common Name	EPBC	BC Act	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Swift Parrot	E	E										√		√							√							
Green & Golden Bell Frog	E	CE	√	√		√						√ *																
Little Eagle		V	√	√		√		√																				
White-bellied Sea Eagle		V				√	√		√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Little Lorikeet		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√			√			√	√	√		√		
Powerful Owl		V									√	√	√	√														
Masked Owl		V		√		√		√	√	√	√	√	√		√	√		√		√	√					√		
Brown Treecreeper		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√
Speckled Warbler		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Black-chinned Honeyeater		V	√	√						√	√																	
Scarlet Robin		V		√														√										
Flame Robin		V				√	√																					
Hooded Robin		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√			√	√		√						
Grey-crowned Babbler		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Varied Sittella		V		√	√	√	√		√	√	√	√	√	√	√											√	√	

Common Name	EPBC	BC Act	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Dusky Woodswallow		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√		√	
Diamond Firetail		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√									
Spotted-tail Quoll	V	V					√	√	√	√	√		√	√	√	√	√	√	√	√	√			√		√	√	√
Brush-tailed Phascogale		V																√					√	√		√	√	√
Koala		V	√ *																							√ *		
Squirrel Glider		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√			√	√
New Holland Mouse	V									√	√	√	√	√									√					
Grey-headed Flying-fox	V	V		√			√				√		√	√			√						√			√	√	
Yellow-bellied Sheathtail-bat		V												√ *		√ *	√ *		√ *	√ *								
Eastern-Coastal Freetail-bat		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√
Large-eared Pied Bat	V	V				√ *		√ *					√ *		√ *						√ *	√ *						
Eastern Bentwing-bat		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√			√	√	√
Little Bentwing-bat		V						√ *							√ *	√											√	√

Common Name	EPBC	BC Act	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Large-footed Myotis		V				√		√				√		√	?	?						√						
Greater Broad-nosed Bat		V					√	√	√		√				?	?	√		√	√								

E = Endangered
V = Vulnerable
√ Unconfirmed sighting*

6.4.5 Comparison to BOMP Performance Indicators and Completion Criteria

The Biodiversity Offset Management Plan details short term performance indicators for the 2021 reporting period. Performance against these indicators and completion criteria are listed in Table 35.

Table 35: 2021 Biodiversity Performance Indicator and Completion Criteria Comparison

Short Term Performance Indicators (Year 5 2021)	Status	Comments
General		
Pre-clearance surveys and tree-felling supervision is undertaken in accordance with procedure. Outcomes of pre-clearing process are recorded and recommendations are implemented.	Complete	Pre-clearance surveys completed in 2021
Suitable habitat features identified during the pre-clearing process are salvaged. Salvaged features are stockpiled appropriately for later use.	Complete	Habitat features salvage for later use in 2021
Salvaged resources and nest boxes are re-instated into surrounding areas with low levels of habitat features. Inspected, maintained, and replaced if required.	Complete	Salvaged resources and habitat features installed in 2021
Progressive installation and monitoring of habitat features and nest boxes.	Complete	Nest boxes installed and monitored in 2021
River oak trees are planted at a 10:1 ratio for the tailings management infrastructure and the realignment of the transmission line.	Complete	An additional 2,000 River Oak trees were planted in 2021
New England Tree Screen - Tree screen assessed for heath, density and condition during Annual Walkover Inspections.	Not complete	Not completed in 2021
East-West Corridor Management Area - Passive regeneration is evident by the presence of dominant canopy species saplings.	Not complete	Monitoring of East-West Corridor not conducted in 2021
Delineation and signage of disturbance footprints is undertaken. Gates are locked and in good structural condition.	Complete	Gates locked and signs in position
Weed management actions are undertaken for noxious weed species if present within 6 months of disturbance works.	Complete	Extensive weed control conducted in 2021
Pest animal actions are undertaken for targeted pest species within 6 months of identification and reporting.	Complete	Targeted pest control activities conducted in 2021
Fire breaks and access roads are maintained. Strategic grazing or controlled burning in consultation with RFS is	Complete	Track maintenance conducted where possible considering weather and safety.

investigated if required following identification of high fuel loads.		Strategic Burn Plans established for four BOAs
Seeds are collected, stored, handled and propagated according to Florabank Guidelines.	Complete	Ongoing in 2021
Data is collected and reported from seed propagation programs (including seed germination success rates).	Partially complete	Seed propagation data is collected and reported but does not include seed germination success rates
Seeding and planting of tubestock and habitat feature emplacement is ongoing.	Complete	Ongoing in 2021
Seeding and planting of tubestock and habitat feature emplacement is ongoing, as well as any other required measures for erosion and bank stability	Complete	Habitat features installed in Bettys Creek Riparian Zone and River Oak trees planted in Bowmans Creek Riparian Zone.
Proposed activities at MGO (such as revegetation and regeneration) are undertaken in accordance with the ACHMP and legislation.	Complete	Works completed in accordance with ACHMP and legislation
Annual monitoring program completed as per BOMP	Complete	All required monitoring completed in 2021
GDE monitoring program undertaken	Not complete	Monitoring not completed in 2021
Specific BOMPS training package is included in the Site Familiarisation and Generic Surface Induction.	Complete	Included in site familiarisation
AR completed as required annually.	Complete	Completed for 2021
Conservation Bond remains in place and is revised if necessary.	Complete	Conservation Bond remained in place in 2021
Salvaged features are reinstated into BOAs with low levels of habitat features.	Complete	Salvaged resources installed in BOAs in 2021
Progressive installation of nest boxes in the BOAs. Nest boxes inspected, maintained and replaced, if required.	Complete	Nest boxes installed and monitored in 2021
Progressive installation and monitoring of nest boxes.	Complete	Nest boxes installed and monitored in 2021

Weed management actions are undertaken for weed species if present as per annual plan targeting identified high risk infestation.	Complete	Targeted weed control activities conducted in 2021
Pest animal actions are undertaken for targeted pest species as per annual plan targeting identified high risk population.	Complete	Targeted pest control activities conducted in 2021
Grazing excluded from BOAs (unless required for strategic weed or fuel load management)	Complete	No grazing conducted in BOAs in 2021
Inspect and maintain fencing and signage.	Complete	Inspections and fence maintenance conducted in 2021
Fire breaks and access roads are maintained. Strategic grazing or controlled burning in consultation with RFS is investigated if required following identification of high fuel loads	Complete	Track maintenance conducted where possible considering weather and safety. Strategic Burn Plans established for four BOAs
Proposed activities at the BOAs (such as revegetation and regeneration) are undertaken in accordance with the ACHMP and legislation.	Complete	Works completed in accordance with ACHMP and legislation
Location of Rehabilitation Woodland Offset Area investigated or determined.	Complete	Investigation completed to determine location
Annual monitoring program completed	Complete	All required monitoring completed in 2021
AR completed as required annually	Complete	Completed for 2021
Weed control works are completed, as required.		Targeted weed control activities conducted in 2021
Seeds are collected, stored, handled and propagated according to Florabank Guidelines.	Complete	Ongoing in 2021
Monitoring indicates that planted or regenerating canopy, mid storey and/or ground cover species are healthy and established.	Complete	Monitoring complete in 2021. Some areas still require establishment
Revegetation/ regeneration works undertaken.	Complete	Works undertaken in 2021
Fauna monitoring undertaken to provide comparable data.	Complete	Fauna monitoring completed in 2021

Cross Creek Offset Area		
Ongoing passive and active regeneration (direct seeding or tubestock) using characteristic species, as required.	Complete	Passive and active (seeding) regeneration undertaken in Cross Creek in 2021
Stringybark Creek Habitat Corridor		
Ongoing passive and active regeneration (direct seeding or tubestock) using characteristic species, as required.	Complete	Passive regeneration ongoing in 2021
Salvaged features are placed into BOA as denning habitat.	Not completed in 2021	No Salvaged features placed in Stringybark Creek Habitat Corridor in 2021
African Olive Management - Monitoring of effectiveness of initial control measures. Further control to be undertaken if required.	Complete	Monitoring shows further control still required
Esparanga Offset Area		
Passive regeneration continues	Complete	Ongoing in 2021
Mitchell Hills Offset Area		
Flora monitoring undertaken	Complete	Flora monitoring undertaken in 2021
Southeast Corridor Offset		
Further supplementary planting of canopy and shrub species if monitoring shows planting failure.	Complete	Direct seeding undertaken to supplement regeneration in 2021
Bettys Creek Habitat Management Area		
Ongoing active regeneration (direct seeding or tubestock) using characteristic species, as required.	Complete	Direct seeding undertaken in 2021

6.4.6 Biodiversity Offset Areas Management

6.4.6.1 Direct Seeding

In 2021 MGO carried out direct seeding works across its BOAs. A total of 45.3 hectares were direct seeded within the Bettys Creek HMA, Cross Creek BOA and South East Corridor BOA. A photo showing the preparation of the Bettys Creek HMA seeding areas is included in ***Figure 13***. Overall, 9 ha were seeded in Bettys Creek HMA, 35 ha in Cross Creek BOA and, 1.3 ha in South East Corridor BOA. Further direct seeding works are planned for 2022.

Figure 13: Seeding area preparation in the Bettys Creek HMA Offset Area

6.4.6.2 Compensatory Planting

In accordance with DA 80/952 and SSD-5850, a compensatory planting ratio of 10:1 is required for every Hunter River Oak removed or severely damaged as a result of works associated with the relocation of the transmission line at Glendell and the installation of the Greater Ravensworth Area Tailing Pipeline Infrastructure during the 2017 reporting period. While clearing activities were minimised during the relocation, these works removed or severely damaged 198 mature Hunter River Oaks. In accordance with DA 80/952 and SSD-5850, MGO planted approximately 2,000 Hunter River Oak tubestock within the Bowmans Creek Riparian Corridor during the 2017 reporting period. Portable solar panel electric fencing was also installed at the time of planting to deter livestock and other animals from entering the planting areas.

MGO monitored the development of the Hunter River Oak plantings during the 2018 reporting period and noted that less than 10% of the original plantings has survived. It was identified this was largely due to:

- Below average rainfall experienced during the two previous reporting periods
- Presence of livestock within planting area i.e. failure to contain livestock with portable solar powered electric fence
- Planting of tubestock undertaken during winter.

In the 2020 reporting period, as a result of the low survival rate, MGO planted an additional 2,000 Hunter River Oak using the direct seeding technique. Additional fencing was installed to protect plantings from grazing activities. There was no strike of seedlings in 2019 due to unfavourable drought conditions.

A further 2,000 Hunter River Oak tubestock were planted in April 2021. The 2021 planting area has been fenced to exclude cattle and a rabbit cull was conducted to reduce grazing pressure on the plants. MGO will continue to monitor survival rates and planting progress in 2022.

6.4.6.3 South East Corridor Offset – Tree Planting

As per BOMP requirements a total of 13,200 tubes were planted on South East Corridor Offset, with a canopy to shrub ration of 1.66. These activities were completed from 2017 - 2019 to enhance corridor function of this area. In 2021, this area maintained moderate survival and growth rates, with the density of canopy and mid story species appropriate for the target vegetation type. Planting areas impacted by drought conditions may be infilled via direct seeding in 2022. ***Table 36*** shows the species planted in the South East Corridor Offset.

Table 36: South East Corridor Offset Tree Planting Species.

Species	Common Name	Number
Eucalyptus fibrosa	Broad leaf ironbark	1,000
Eucalyptus crebra	Narrow leaf ironbark	1,060
Corymbia maculata	Spotted gum	340
Eucalyptus moluccana	Grey Box	400
Allocasuarina luehmannii	Bull oak	400
Casuarina glauca	Swamp oak	200
Angophora floribunda	Rough bark apple	120
Eucalyptus tereticornis	Forest red gum	1,000
Melaleuca styphelioides	Prickly leaf paperbark	120
M. decora	White feather honey myrtle	120
M. nodosa	Ball honey myrtle	200
TOTAL overstorey		**4,960**
Acacia decora	Western golden wattle	880
Acacia decurrens	Green Wattle	640
Acacia falcata	Falcate wattle	800
Acacia parvipinnula	Silver stem wattle	780
Acacia implexa	Hickory	880
Daviesia ulicifolia	Gorse bitter pea	400
Acacia amblygona	Fan wattle	540
Acacia paradoxa	Kangaroo thorn	80
Dodonaea viscosa	Hop bush	800
Indigofera australis	Indigo	600

Species	Common Name	Number
Bursaria spinosa	Blackthorn	800
Breynia oblongifolia	Coffee bush	600
Kunzea occidentalis	Tick bush	440
	TOTAL shrubs	**8,240**
	TOTAL plantings	**13,200**

6.4.6.4 Habitat Augmentation

A total of 69 additional nest box structures were installed across MGO in 2021 (see ***Figure 14***). This included 20 Glider Boxes, 2 Duck Boxes, 10 Large Parrot/Possum Boxes, 22 Microbat Boxes, 13 Small Parrot Boxes, 1 Quoll Box and 1 Owl Box. A further 40 nest box structures will be installed within BOAs in 2022.

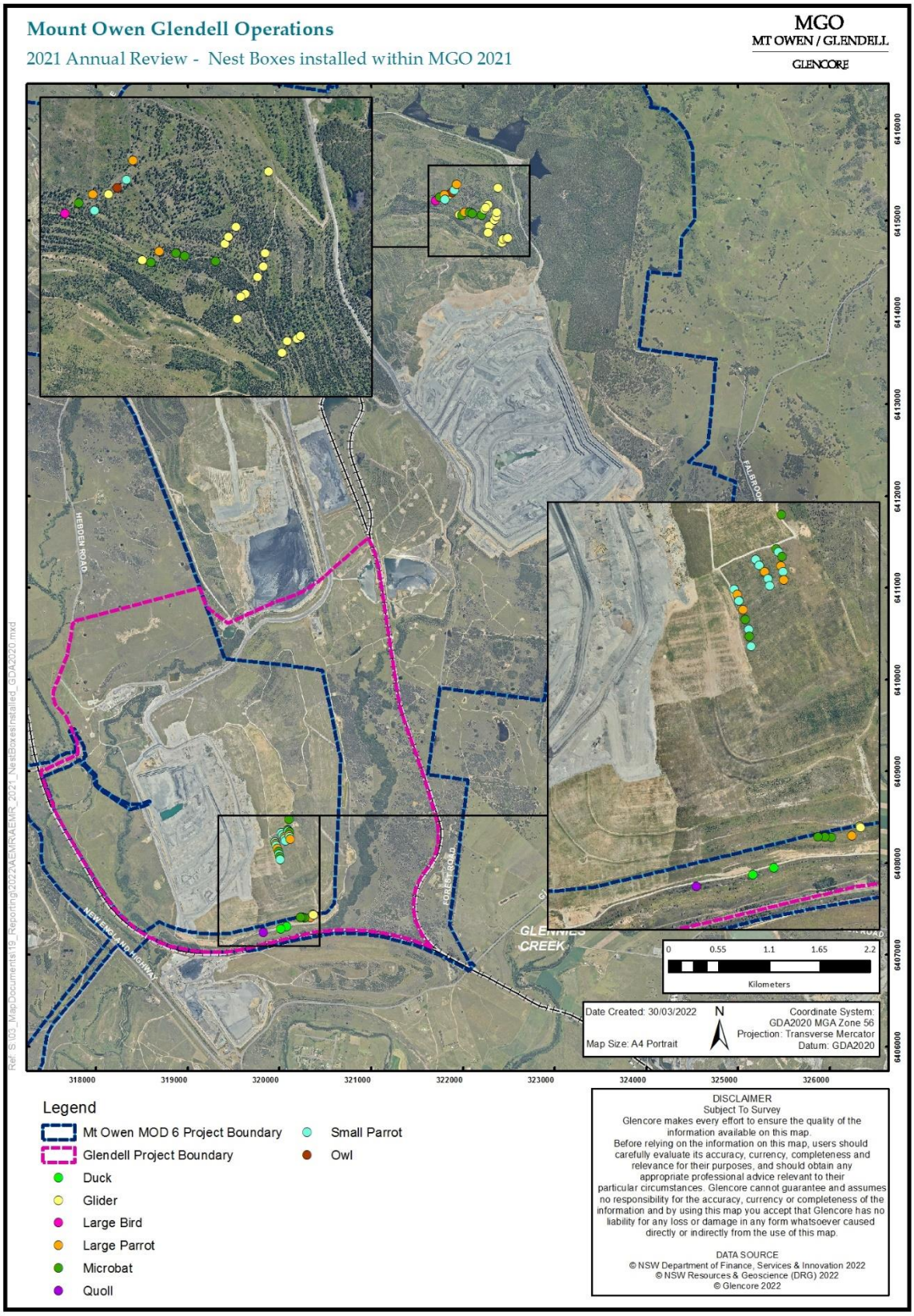

Figure 14: Nest Boxes Installed at MGO in 2021

6.4.6.5 Weed Management

A Weed Action Plan was developed to identify all targeted weed control activities at the MGO. The plan was implemented during the reporting period, continuing the active programs of control that have been implemented since 1996. During 2021, weeds targeted in MGO rehabilitation included:

- Galenia
- Lantana
- Coolatai Grass
- Prickly Pear
- Acacia Saligna.

Weeds were also treated across the MGO buffer land and BOAs, targeting species including (but not limited to):

- African Boxthorn - *Lycium ferocissimum*
- African Olive - *Olea europaea subsp. Cuspidate*
- African Lovegrass - *E. curvula*
- Acacia Saligna
- Bathurst Burr - *Xanthium spinosum*
- Blackberry - *Rubus fruticosus species aggregate*
- Coolatai Grass - *Hyparrhenia hirta*
- Cotton Bush – *Gomphocarpus fructicous*
- Inkweed - *Phytolacca octandra L.*
- Lantana - *Lantana camara*
- Pampass Grass – *Cortaderia spp.*
- *P*rickly Pear - *Opuntia spp.*
- Saffron Thistle – *Carthamus lanatus*
- Scotch Thistle - *Onopordum acanthium*
- Tiger Pear - *Opuntia aurantiaca*
- Spear Thistle - *Cirsium vulgare*.

A summary of weed management works undertaken in MGO BOAs during the reporting period is included in Table 33. During 2021, successful campaigns were carried out on abundant high threat weeds African Olive and Coolatai grass within MGO's BOAs. Before and after images can be viewed below in ***Figure 15*** and ***Figure 16***.

Figure 15: African Olive control in Stringybark BOA

Figure 16: Before and after treatment of Coolatai grass in Bettys Creek HMA

Table 37: MGO Weed Works Completed in Biodiversity Offsets 2021

Offset Area	Weed Control Applied to Area	Weeds Targeted
Northwest Offset	Woody, herbaceous	• Cut and paint targeting African Olive • High volume spray application targeting Coolatai grass. • Slashing and follow up spray of Coolatai grass • Low volume spray targeting Juncus grass
Northeast Offset	Woody	• Cut and paint targeting African Olive • Cut and paint targeting Lantana

Offset Area	Weed Control Applied to Area	Weeds Targeted
Southeast Offset	Woody	• Cut and paint targeting African Olive • Cut and paint targeting Lantana
Forest East Offset	Woody	• Cut and paint targeting African Olive • Cut and paint targeting Lantana
Southeast Corridor Offset	Herbaceous	• Low volume spray application of African Lovegrass and Coolatai grass • High volume spray application targeting Coolatai grass
Southern Remnant Offset	Herbaceous	• Low volume spray application of Prickly Pear, Juncus grass and Stinking Roger
Stringybark Creek Habitat Corridor	Woody, herbaceous	• Cut and paint targeting African Olive • Cut and paint targeting Lantana • High volume spray application targeting Coolatai grass. • Low volume spray application targeting Coolatai grass
Esparanga Offset	Herbaceous	• Low volume spray application of Coolatai grass, Prickly Pear and Inkweed
Mitchell Hills Offset	Herbaceous	• Low volume foliar application of Coolatai grass, Prickly Pear.
Bettys Creek Habitat Management Area (HMA)	Woody, herbaceous	• High volume spray application targeting Coolatai grass and African Lovegrass. • Low volume spray application of Prickly Pear. • Low volume spray application of Coolatai grass • Cut and paint application targeting African Boxthorn.

6.4.6.6 Pest Control

A Vertebrate Pest Monitoring Program (VPMP) was implemented across MGO BOAs and buffer lands during the report period, utilising a range of temporary and permanently installed motion detection cameras. The VPMP detected a range of pests, including deer, wild dogs, pigs, foxes and humans (as a result of unauthorised access).

Offset Pest Control

A targeted wild dog and fox baiting program was conducted across MGO offsets during the report period. The program consisted of a seasonal '1080' baiting program undertaken in Autumn (May) and Spring (October) across on-site BOAs.

Trained personnel placed '1080' poison baits across all areas. Results of the 2021 offset baiting program are summarised in ***Table 38***, and photos in ***Figure 17***. Soft-jaw dog trapping was also implemented in the BOAs in 2021, however, no dogs or foxes were trapped.

A pig trapping program was also conducted across the BOAs in 2021. A total of 6 pigs were trapped as a result of this program.

Buffer Land Pest Control

During 2021, 88 baits were taken by non-target species, including 16 goannas, 38 Crows and 34 miscellaneous. The poison is not lethal to goannas. Goannas tend to be problematic in the warmer months when they are more active and, as such, baiting in summer is not recommended. Of the baits taken by goannas, all were taken during the spring program. Trapping was not conducted in Spring 2021 due to high rainfall (see ***Table 39*** and photos in ***Figure 18***).

Table 38: Wild Dog and Fox Biodiversity Offset Baiting Program – 2021 Results

Program	Number of bait locations	Total number of baits made available to targeted species	Number of baits taken by targeted species	Targeted species success rate
1080 Baiting Program				
Autumn	101	303	107	35.3%
Spring	101	303	95	31.4%

Table 39: Wild Dog and Fox Buffer Land Baiting Program – 2021 Results

Program	Number of locations	Total number of baits made available to targeted species	Number of targeted species culled	Targeted species success rate
1080 Baiting Program				
Autumn	84	252	56	22%
Spring	84	252	41	16%
Trapping				
Autumn	27	N/A	5	N/A
Spring	-	-	-	-

Figure 17: Images captured on motion cameras in Offset Areas during 2021

Figure 18: Images captured on motion cameras in buffer lands during 2021

Combined Program Results

A number of combined firearm culls were undertaken during 2021 across buffer lands and offsets. This resulted in the culling of the target species listed in ***Table 40***.

Table 40: Offset and Buffer Land firearm cull - 2021 Results.

Target Species	Number
Deer	1
Rabbit	30

6.5 Heritage

6.5.1 Aboriginal Heritage

MGO has implemented an Aboriginal Cultural Heritage Management Plan (ACHMP). The ACHMP provides strategies for the management of remaining registered Aboriginal sites. It also provides for the management of the Bettys Creek, Swamp Creek, Yorks Creek and Bowmans Creek areas that fall outside the approved MGO disturbance boundaries. These areas retain Aboriginal heritage and archaeological values that require management, despite being salvaged.

MGO utilises ground disturbance permits (GDPs) to prevent damage to known valid Aboriginal sites. Alternatively, a due diligence assessment is conducted, and any necessary controls implemented. This is completed prior to authorisation of ground disturbance work.

A meeting between MGO and the Aboriginal Cultural Heritage Working Group community was scheduled to be held in June 2021, however a lack of attendance from the community stakeholders resulted in it being cancelled.

A general MGO update to Aboriginal community representatives was presented at the opening of the Minimbah Teaching and Keeping Place. This presentation outlined the status of MGO operations, environmental performance, approvals, Aboriginal cultural heritage and the York's Creek voluntary conservation area.

2021 Monitoring Program

Quarterly monitoring of Aboriginal heritage sites across MGO continued in 2021, in conjunction with RAPs and an archaeologist from OzArk Environment & Heritage (see ***Figure 19*** and ***Figure 20***). This monitoring includes:

- Site condition monitoring - previously recorded sites are inspected to evaluate the condition of the site
- Management recommendations may be made to improve the condition of a site, should it be required.

65 artefact sites visited during quarterly monitoring in 2021. Quadrant 1 monitoring was monitored along with Quadrant 2 in Quarter 4 of 2021 due to Covid-19 restrictions impacting access to MGO during Quarter 3 of 2021. Artefacts were found to be well-preserved with only minor management actions identified, such as maintenance or removal of site fencing.

Salvages During 2021

No artefacts were salvaged at MGO during 2021.

Figure 19: Knapped Glass Artefact Monitored in 2021 in MGO's Buffer Lands.

Figure 20: Mudstone Scraper Artefact Monitored in 2021 in MGO's Buffer Lands.

6.5.2 European Heritage

MGO manages European heritage through the implementation of the Historic Heritage Management Plan (HHMP). MGO demonstrates a varied historical pattern of European habitation. Prior European land use in the area has included a range of activities, from dairying to mixed farming, cropping, and mining.

MGO has committed to continual historical heritage management initiatives. These include:

- Implementing a quarterly monitoring program for European heritage sites
- Ongoing maintenance of sites.

Monitoring during the reporting period found that sites are well-preserved with minimal management recommendations required, such as the Hebden and Ravensworth Public School managed ruin sites pictured in ***Figure 21*** and ***Figure 22***.

Figure 21: Hebden Public School Remains.

Figure 22: Ravensworth Public School Managed Ruin.

6.6 Visual Amenity

MGO undertook direct seeding and tube stock planting works in 2021 as part of the development of the Middle Falbrook Tree Screen adjacent Glennies Creek Road. Seeding works utilised a mix of species endemic to the local area. Preparatory weed control, ripping and fencing works were also undertaken during the reporting period prior to planting of the screen.

6.7 Demolition Works

No demolition works were undertaken on-site during the reporting period.

7. Water Management

7.1 Water Balance

MGO operates a water management system designed to ensure efficient operation of the site through the control of water inflow and the ready provision for onsite demands. Appendix G, Figure 1 details the water flow path throughout the complex. In average to dry rainfall periods, MGO is predicted to operate with a water deficit in absence of water imports from either the GRAWTS or from licensed surface water allocations.

Table 41: MGO Water Balance for 2021

Aspect	*Volume (ML)*
INFLOWS	
Runoff	*8,949*
Glennies Creek Extraction	*411*
Transfers from other sites	*1,070*
Tailings Bleed Water to West Pit[1]	*5,577*
CHPP Feed ROM Moisture	*740*
Groundwater Inflow	*1,383*
Total	*18,130*
OUTFLOWS	
Evaporation	*2,414*
Exported to Other Sites	*7,853*
Entrainment[2]	*2,157*
Dust Suppression	*1,369*
Off-site Discharge	*-*
Total	*13,793*
BALANCE	
Inflow-outflow	*4,337*
Inflow – Outflow – Change in Storage	*98*
Error	*12.6%*

1. Tailings bleed from Ravensworth and Liddell tailings
2. Includes water entrained in tailings, product coal and coarse rejects

7.2 Hunter River Salinity Trading Scheme (HRSTS)

MGO has a total of 5 credits as a non-discharging participant of the scheme. MGO has no licensed discharge point. MGO transfers excess water to other sites as part of the GRAWTS. Other sites able to discharge are limited by the HRSTS. Mt Owen credits would be transferred to the relevant discharge site if discharge was to occur.

7.3 Surface Water

Over the last several years MGO has received highly variable rainfall. In the years prior to 2021, MGO experienced lower than average rainfall resulting in long periods of no flow conditions within MGO's creek systems. For both 2020 and 2021 above average rainfall was received, resulting in an increase in flow rates at most surface water monitoring sites. Samples collected in the 2021 reporting period were collected under variable flow conditions. MGO was unable to obtain water samples from Swamp Creek (SC3) during the reporting period due to low water levels and dry conditions (***Figure 23***).

Figure 23: Regional Rainfall Data (Bowmans Creek BoM Station (0612270))

7.3.1 Surface Water Monitoring Program and Triggers

7.3.1.1 Surface Water Monitoring Performance

MGO monitors surface water quality at 19 creek locations surrounding the site (***Figure 24***). These include:

- Bowmans Creek (5 sites: BMC1-BMC5)
- York's Creek (3 sites: YC1-YC3)
- Swamp Creek (4 sites: SC1-SC4)
- Betty's Creek (4 sites: BC1-BC4)
- Main Creek (3 sites: MC1-MC3).

Sites are monitored for pH, electrical conductivity (EC) and total suspended solids (TSS). Results are recorded in the site Environmental Monitoring Database. Results are assessed against baseline trigger levels outlined in the MGO Surface Water Monitoring and Management Plan (SWMMP).

A summary of 2021 surface water monitoring results is presented in ***Table 43***, with a copy all monitoring results included in ***Appendix G***. A comparison of 2021 data against historical data for the last five years is also provided in ***Appendix G***.

Bowmans Creek

Monitoring data collected for Bowmans Creek in 2021 generally aligned with baseline conditions (refer to **Appendix G**). Exceedances of the SWMMP trigger levels for Bowmans Creek are outlined in ***Table 44***. All trigger level exceedances were within the historical range (highest and lowest measurements) recorded throughout the entire monitoring period. The sites that triggered SWMMP criteria in 2021 were internally reviewed in accordance with the 2020 Surface Water and Groundwater Response Plan (SWGWRP).

Table 42: Surface Water Quality Triggers

Water Quality Variable	Bowmans Creek	York's Creek	Swamp Creek	Bettys Creek	Main Creek
pH	7.5 – 8.1	7.0 – 7.9	7.1 – 8.6	7.1 – 8.3	7.1 – 8.4
EC (µS/cm)[1]	1,288 - 2,430	5,286 - 8,852	824 - 8,824	1,882 - 6,680	1,191 – 5,440
TSS (mg/L)[1]	Oct-26	20 - 33	21 - 35	16 - 52	10 - 140

[1] 80th percentile range for EC and TSS. Sites have specific triggers as per MGO's approved SWMMP.

MGO has defined 80th percentile trigger values for EC and TSS, and 20th percentile (acidic) and 80th percentile (alkaline) triggers for pH. Triggers are specific to each individual creek monitoring site. These values are based on historical datasets for each site. The Specific triggers are contained within MGO's approved SWMMP.

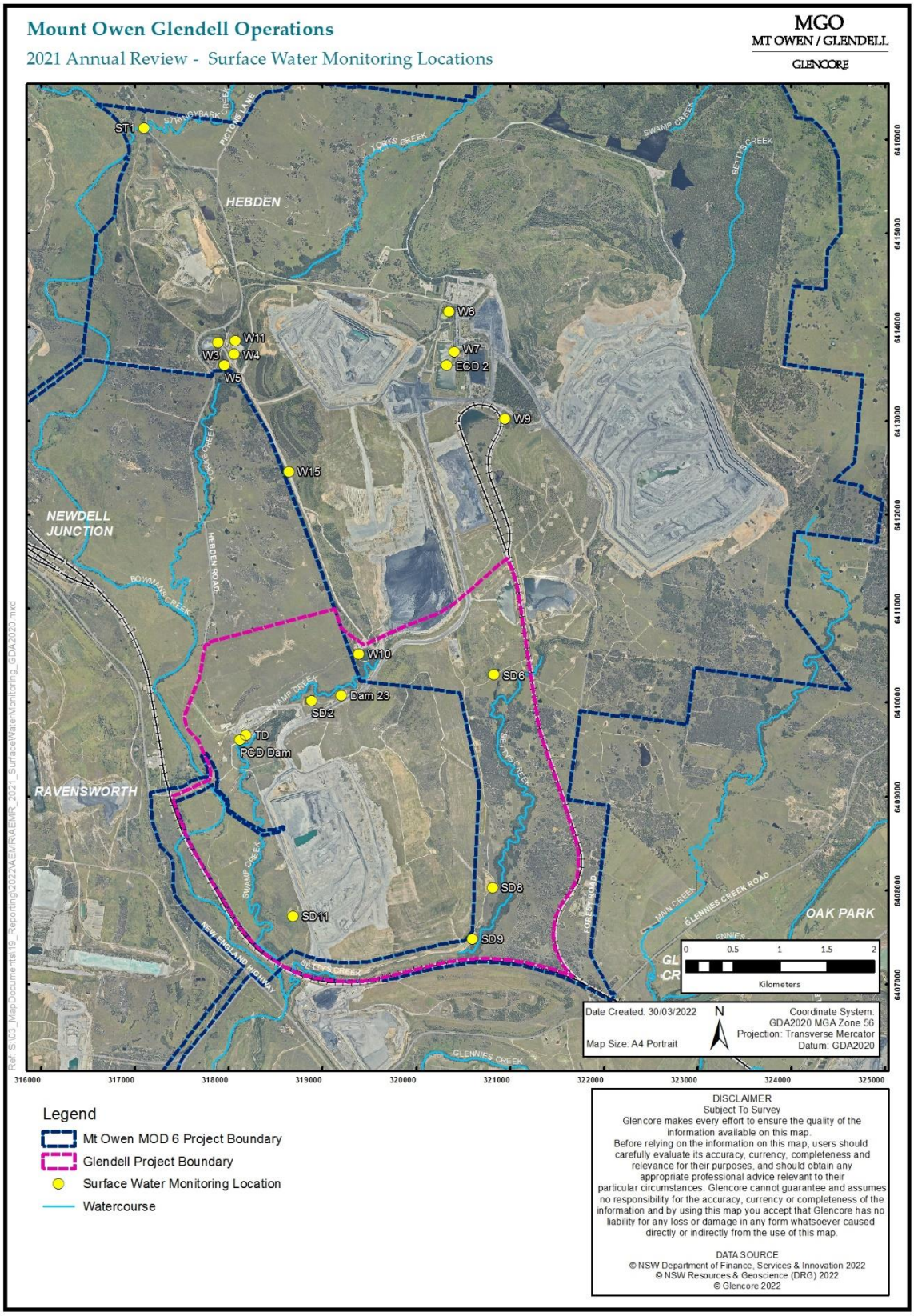

Figure 24: MGO Surface Water Monitoring Locations

Table 43: Summary of Surface Water Monitoring Results 2021

Site	pH (units)			EC (µS/cm)			TSS (mg/L)			Comment	Scheduled monitoring events	Actual sampling events
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg		Monthly	%
Betty's Creek												
BC1	7.19	7.51	7.39	375	633	500.5	<5	7	6.5	Samples collected under still water conditions Mar-Apr; Nov-Dec	12	33%
BC2	7.21	7.64	7.4	167	250	208.25	16	21	17.75			
BC3	6.8	6.8	6.8	218	218	218	<5	10	10			
Bowmans Creek												
BMC1	7.6	8.01	7.91	495	1900	883.92	<5	28	13.5	Samples collected under steady flow conditions	12	100%
BMC2	7.6	8.06	7.89	500	944	775.92	<5	18	11	Samples collected under slow/trickle conditions		
BMC3	7.7	8.15	7.96	515	922	776.25	<5	24	11.71			
BMC4	7.5	7.96	7.79	561	1030	822.83	<5	29	12.17			
BMC5	7.13	7.82	7.65	393	1090	827.33	<5	24	13.33	Samples collected under fast flow conditions		
Glennies Creek												
GC2/W4	7.66	8	7.83	286	845	629.33	<5	52	18.17	Samples collected under steady flow conditions	12	100%
GC3	7.55	8.09	7.82	350	868	653.09	<5	41	15.56	Unsafe access to collect Feb sample		92%
Main Creek												
MC1	6.52	7.97	7.03	324	828	536.71	<5	33	19.83	Samples collected under cease -to - flow/trickle conditions	12	58%
MC2	7	7.64	7.31	320	968	573.14	6	20	13.71	Samples collected under No flow conditions		58%
MC3	6.8	7.51	7.22	385	1520	918.33	<5	27	14.57	Samples collected under No flow conditions		100%
Swamp Creek												
SC1	7.34	9.3	7.91	228	586	412.25	<5	15	9.57	Samples collected under No flow conditions	12	100%
SC2	6.82	7.95	7.43	125	386	267.5	5	63	22.75	Samples collected under No flow conditions		100%
SC3	-	-	-	-	-	-	-	-	-	DRY		0%
SC4	6.68	7.06	6.82	195	280	250.33	18	19	18.33	DRY except samples collected Mar; Nov-Dec		25%
York's Creek												
YC1	6.78	7.65	7.26	246	4270	1642	<5	18	12	Samples collected under No flow conditions	12	75%
YC2	6.86	7.62	7.44	347	1083	552.08	<5	17	11		12	100%
YC3	7.3	7.77	7.51	745	1580	1055.13	<5	16	9.5		12	67%

Table 44: Bowmans Creek Surface Water Analyses Exceeding SWMMP Trigger Levels

Sample Site	Date	Analyte	Result (2021)	Trigger Level	Historical Range (pre 2021)	Comments	Flow
BMC1	21/01/2021	pH	7.6	<7.7 - >8.1	6.75 - 8.2	Result within the historical range and also within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Samples collected under no flow conditions
BMC1	15/07/2021	EC	1,900	1,288	360 - 7,880	Result within the historical range.	
BMC1	21/01/2021	TSS	16	10	1 - 1,620	The result was within the historical range and below the historical average (21.87 mg/L). Increased rainfall may have contributed to elevated TSS results.	Samples collected under steady flow conditions
BMC1	22/02/2021	TSS	28				
BMC1	29/03/2021	TSS	16			The result was within the historical range and below the historical average (21.87 mg/L). Increased rainfall over the previous three months may have contributed to elevated TSS results.	
BMC1	26/05/2021	TSS	11			The result was within the historical range and below the historical average (21.87 mg/L). Increased rainfall may have contributed to elevated TSS results.	
BMC2	21/01/2021	pH	7.6	<7.8 - >8.1	6.0 - 8.8	Result within the historical range and also within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Sample collected under slow/trickle conditions
BMC3	21/01/2021	pH	7.7	<7.8 - >8.1	7.2-8.4	Result within the historical range and also within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Sample collected under steady flow conditions
BMC3	17/08/2021	pH	8.15				Sample collected under slow/trickle conditions
BMC3	17/12/2021	pH	8.02				Sample collected under steady flow conditions
BMC4	22/02/2021	TSS	29	17	1 - 201	Result within the historical range	Sample collected under slow/trickle conditions
BMC5	22/02/2021	TSS	24	14	1-64	Result within the historical range	Samples collected under slow flow conditions
BMC5	17/11/2021	TSS	22				
BMC5	21/01/2021	pH	7.5	<7.7 - >8.0	7.1 - 8.6	Result within the historical range, circum-neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Sample collected under fast flow conditions
BMC5	22/02/2021	pH	7.66	<7.7 - >8.0	7.1 - 8.6	Result within the historical range and also within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Samples collected under steady flow conditions
BMC5	29/03/2021	pH	7.66				
BMC5	22/04/2021	pH	7.13			Result within the historical range, circum-neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
BMC5	17/08/2021	pH	7.58				
BMC5	17/09/2021	pH	7.54				Samples collected under slow/trickle conditions
BMC5	18/10/2021	pH	7.63				

Main Creek

Main Creek exhibited variable flow conditions during 2021. Samples from Main Creek sample site MC3 were collected under no flow conditions during January and February, and from April to October. The exceedances at this location during the monitoring period can be seen in ***Table 45.*** The exceedances that were outside the historical range were reviewed and deemed to be not attributable to MGO. Monitoring data for Main Creek is included in ***Appendix G***.

Swamp Creek

Swamp Creek sample site SC3 was unable to be sampled during the 2021 reporting period due to low water levels and dry conditions. Swamp Creek site SC4 was sampled in March, November and December but was too low to sample/dry for the remainder of 2021.

The exceedances of SWMMP trigger levels at Swamp Creek during the reporting period are detailed in Table 46***5*** The exceedances were reviewed in accordance with the SWGWRP. These reviews confirmed that external reporting of the results was not required in line with the SWGWRP. Monitoring data for Swamp Creek is included in ***Appendix G***.

York's Creek

Exceedances of York's Creek SWMMP trigger levels are outlined in Table 47. 2021 monitoring results for York's Creek in exceedance of SWMMP trigger levels were internally reviewed in accordance with the SWGWRP. These reviews confirmed that external reporting of the results was not required in line with the SWGWRP.

Monitoring data collected for York's Creek during the 2021 reporting period aligned with baseline conditions (refer ***Appendix G***).

Betty's Creek

Bettys Creek exhibited variable flow conditions during 2021. Monitoring at all sites was only possible in select months due to water levels being too low to sample and dry conditions. Monitoring data for Betty's Creek is included in ***Appendix G.*** 2021 monitoring results for Bettys Creek sites in exceedance of SWMMP trigger levels (see Table 48) were internally reviewed in accordance with the SWGWRP. These reviews confirmed that external reporting of the results was not required in line with the SWGWRP.

Table 45: 2021 Main Creek Surface Water Analyses Exceeding SWMMP Trigger Levels

Sample Site	Date	Analyte	Result (2021)	Trigger Level	Historical Range (pre 2021)	Comments	Flow
MC1	22/02/2021	pH	6.82	<7.1 - >7.6	6.3 - 8.0	Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH))	Sample collected under no flow conditions
MC1	29/03/2021	pH	7				Sample collected under slow/trickle conditions
MC1	22/04/2021	pH	7.97				Samples collected under no flow conditions
MC1	29/06/2021	pH	6.52				
MC1	15/07/2021	pH	6.82				
MC1	17/11/2021	pH	6.87				
MC2	21/01/2021	pH	7	<7.3 - >8.4	6.1 - 8.9		
MC2	22/02/2021	pH	7.19				
MC2	17/11/2021	pH	7.18				
MC3	21/01/2021	pH	6.8	<7.3 - >7.6	6.9 - 7.9		
MC3	22/02/2021	pH	7.08				
MC3	29/03/2021	pH	7.15				Samples collected under slow/trickle conditions
MC3	22/04/2021	pH	7.29				Samples collected under no flow conditions
MC3	26/05/2021	pH	7.29				
MC3	17/11/2021	pH	6.87				Samples collected under slow/trickle conditions
MC3	17/12/2021	pH	7.21				
MC3	22/04/2021	EC	1,480	1,191	304 - 1,247	Result within the historical range.	Samples collected under no flow conditions
MC3	26/05/2021	EC	1,520				
MC3	29/06/2021	EC	1,320			Result within the historical range with the maximum recorded result occurring in May 2021. The result was greater than the historical average as well as the 80th percentile of results. The June result also follows a trend of elevated EC results recorded at MC3 since April 2021	
MC3	17/08/2021	EC	1,310				
MC3	17/09/2021	EC	1,200				
MC3	21/01/2021	TSS	27	10	2-38	Result within the historical range	Samples collected under no flow conditions
MC3	22/02/2021	TSS	17				
MC3	29/03/2021	TSS	17			Result within the historical range however greater than the historical average. increased rainfall following an extended dry period may have contributed to the elevated results.	Samples collected under slow/trickle conditions
MC3	18/10/2021	TSS	13			Result within the historical range	Sample collected under now flow conditions

Table 46: 2021 Swamp Creek Surface Water Analyses Exceeding SWMMP Trigger Levels

Sample Site	Date	Analyte	Result (2021)	Trigger Level	Historical Range (pre 2021)	Comments	Flow
SC1	21/01/2021	pH	9.3	<7.7 - >8.6	6.4 - 10.1	Result within the historical range however was higher than the historical average. However equivalent to the lowest result obtained at SC1 since August 2020	Samples collected under no flow conditions
SC1	22/02/2021	pH	9.3			Result within the historical range however was higher than the historical average. The pH result recorded during January (9.3) was the equal-lowest result obtained at SC1 since August 2020	
SC1	29/03/2021	pH	7.43			Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
SC1	22/04/2021	pH	7.41				
SC1	26/05/2021	pH	7.34				
SC1	29/06/2021	pH	7.58			Result within the historical range and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
SC1	15/07/2021	pH	7.63				
SC1	17/08/2021	pH	7.64				
SC1	17/12/2021	pH	7.42			Result within the historical range and circum-neutral. The result was also within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
SC2	21/01/2021	pH	7	<7.4 - >8.2	6.6 - 9.7	Result was neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Samples collected under no flow conditions
SC2	29/03/2021	pH	6.82			Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
SC2	22/04/2021	pH	7.34			Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
SC2	26/05/2021	pH	7.32				
SC2	17/11/2021	pH	7.22				
SC2	17/12/2021	pH	7.21				
SC2	21/01/2021	TSS	39	35	2 - 290	TSS levels recorded at SC2 in January exceeded the trigger level (35 mg/L. The result was within the historical range and is the lowest TSS result since July 2020.	Samples collected under no flow conditions
SC2	22/02/2021	TSS	56			Levels recorded exceeded the trigger level (35 mg/L) for the nineth consecutive month. The result was within the historical range	
SC2	29/03/2021	TSS	63				

Table 47: 2021 York's Creek Surface Water Analyses Exceeding SWMMP Trigger Levels

Sample Site	Date	Analyte	Result (2021)	Trigger Level	Historical Range (pre 2021)	Comments	Flow
YC1	29/06/2021	pH	6.89	<7.1 - >7.7	6.0 - 8.3	Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Samples collected under no flow conditions
YC1	15/07/2021	pH	6.78				
YC1	17/11/2021	pH	7.05				
YC2	17/11/2021	pH	6.86	<7.0 - >7.8	6.0 - 8.6	Result within the historical range, circum- neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Sample collected under no flow conditions

Table 48: 2021 Betty's Creek Surface Water Analyses Exceeding SWMMP Trigger Levels

Sample Site	Date	Analyte	Result (2021)	Trigger Level	Historical Range (pre 2021)	Comments	Flow
BC2	29/03/2021	pH	7.2	<7.4 - >8.3	6.2 - 9.4	Result within the historical range, circum-neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	Samples collected under no flow conditions
BC2	17/12/2021	pH	7.3				
BC3	21/01/2021	pH	6.8	<7.1 - >7.9	5.0 - 8.4		
BC3	22/02/2021	pH	6.9				
BC3	29/03/2021	pH	7				Sample collected under slow/trickle conditions
BC3	17/11/2021	pH	6.9				Samples collected under no flow conditions
BC3	29/06/2021	EC	2,880	2,686	4 - 7,090	Result within the historical range.	
BC3	15/07/2021	EC	2,800				
BC3	17/12/2021	EC	2,760				
BC4	21/01/2021	pH	6.6	<7.1 - >7.8	6.4 - 8.3	Result within the historical range, circum-neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH))	
BC4	22/02/2021	pH	6.9				
BC4	22/04/2021	pH	7.8			Result within the historical range and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
BC4	26/05/2021	pH	7.9				
BC4	17/11/2021	pH	7			Result within the historical range, neutral and within the ANZECC Guidelines criteria (6.5 – 8.0 pH)	
BC4	29/03/2021	EC	2,500	2,176	178 - 7,390	Result within the historical range of results (max 7,390 µS/cm) however greater than the 80th percentile of results.	
BC4	22/04/2021	EC	4,560				
BC4	26/05/2021	EC	4,200				
BC4	29/06/2021	EC	2,540				
BC4	15/07/2021	EC	2,750				
BC4	21/01/2021	TSS	101	52	5 - 912	Result within the historical range	
BC4	26/05/2021	TSS	116				

7.3.2 Stream Stability and Condition Monitoring

7.3.2.1 Location

Annual channel stability assessment is also carried out across both existing creeks and creek diversions at the site. MGO monitors channel stability at 43 locations (***Figure 28***). These include:

- Reference waterway sites
  - Bowmans Creek (2 sites: BMC1-BMC2)
  - Yorks Creek (3 sites: YC1-YC3)
- Main Creek (2 sites: MC1-MC2), Swamp Creek (4 sites: SC1-SC4)
- Bettys Creek (2 sites: BC1-BC2
- Bettys Creek Diversion (25 sites: UBD1-UBD6, MBD1-MBD6 and LBD1-LBD13)
- Swamp Creek Diversion (3 sites: SC1A-SC1C).

7.3.2.2 Methodology

Channel stability is assessed using the CSIRO Ephemeral Stream Assessment (2011) (refer to ***Table 49*** and ***Table 50***) and the Rapid Appraisal of Riparian Condition (RARC) (Jansen et al., 2005) methodologies and scoring system (refer to ***Table 51***).

Table 49: CSIRO Ephemeral Stream Assessment Stability Classifications

Activity Rating (%)	Classification	Discussion of Classification
> 80	Very Stable	Drainage line is very stable and likely to be in original form. It is able to withstand all flow velocities that have previously occurred in this area and only minimal monitoring is required, predominantly after high flow events, to ensure condition does not deteriorate.
70-80	Stable	Drainage line is stable. It is important to assess this zone in relation to the other classifications and define whether this zone is moving from potentially stabilising to a more stable form, or if it is deteriorating from a very stable form. The nature of this relationship will identify the type of monitoring required.
60-69	Potentially Stabilising	Drainage line is potentially stabilising. Ongoing monitoring is required while rehabilitation works are not needed in the immediate future.
50-59	Active	Drainage line is actively eroding and remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.
<50	Very Active	Drainage line is very actively eroding and immediate remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.

Table 50: Summary Table of Indicators, Functions and Components Assessed in the RARC Index

Functions of the riparian zone at different levels of organisation	Components of the riparian ecosystem that perform those functions	Indicators of the functions used in the RARC
Physical		
Reduction of erosion of banks	Roots, groundcover	Vegetation cover*
Sediment trapping	Roots, fallen logs, ground cover	Canopy cover, fallen log, ground cover vegetation, leaf litter cover
Controlling stream,	Riparian Forest	Canopy Cover
Microclimate/discharge/water temperatures		
Filtering of nutrients from upslope	Vegetation, leaf litter	Ground cover vegetation, leaf litter cover
Community		
Provision of organic matter to aquatic food chains	Vegetation	Vegetation cover*, leaf litter cover
Retention of plant propagules	Fallen logs, leaf litter	Fallen logs, litter cover
Maintenance of plant diversity	Regeneration of dominant species, presence of important species, dominance of natives versus exotics	Native canopy and shrub regeneration, grazing damage to regeneration, reeds, native vegetation cover*
Provision of habitat for aquatic and terrestrial fauna	Fallen logs, leaf litter, standing dead trees/hollows, riparian forest, habitat complexity	Fallen logs, leaf litter cover, standing dead trees, hollows, vegetation cover*, number of vegetation layers
Landscape		
Provision of biological connections in the landscape	Riparian forest (cover, width, connectedness)	Vegetation cover*, width of riparian vegetation, longitudinal continuity of riparian vegetation, proximity to another habitat
Provision of biological connections in the landscape	Riparian forest (cover, width, connectedness)	Vegetation cover*, width of riparian vegetation, longitudinal continuity of riparian vegetation, proximity to another habitat

Table 51: Summary RARC Classification System

RARC Total Score	Classification
40-50	*Excellent*
35-39	*Good*
30-34	*Average*
25-29	*Poor*
< 25	*Very Poor*

7.3.2.3 Reference Sites

Bowmans Creek

Bowmans Creek was assessed for stream stability and condition at two locations and results are presented in ***Table 52***. In 2021, the stream trajectory has remained static at both monitoring points. There has also been no overall change in stream condition classification. The stream condition classification for Bowmans Creek has remained 'Very Poor' since 2014 and is generally a reflection of past land use and management.

Table 52: Bowmans Creek Stream Stability & Condition Assessment 2021

Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
	2021	Trajectory	2021	Trend 2014-2021
Bowmans Creek 1 (BMC1)	63% (Potentially Stabilising)	Static	Very Poor	Stable
Bowmans Creek 2 (BMC2)	72% (Stable)	Static	Very Poor	Stable

York's Creek

York's Creek was assessed for stream stability and stream condition at three locations and results are included in ***Table 53***. Stream stability has remained on a static trajectory and potentially stabilising since 2017. The stream condition of monitoring site YC1 continues improve since 2014. However, monitoring sites YC2 and YC3 are classified as 'Stable' and 'Very Poor' stream condition. Fireweed (*Senecio madagarascariensis)* is reported to be present at all three monitoring sites.

Table 53: York's Creek Stream Stability & Condition Assessment 2021

Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
	2021	Trajectory	2021	Trend 2014-2021
York's Creek 1 (YC1)	56% (Active)	Static	Average	Improved
York's Creek 2 (YC2)	69% (Potentially Stabilising)	Static	Very Poor	Declined
York's Creek 3 (YC3)	63% (Potentially Stabilising)	Static	Very Poor	Stable

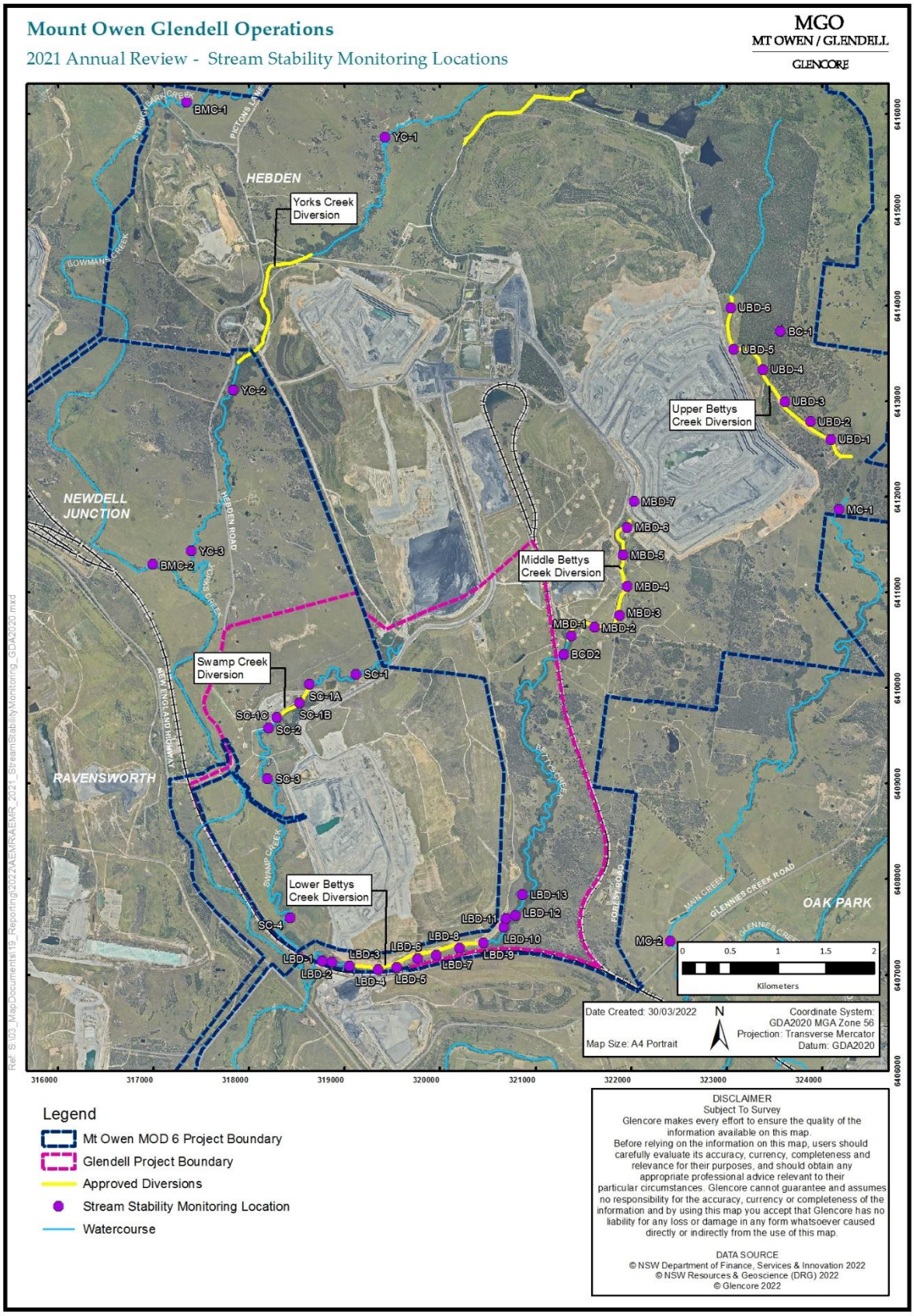

Figure 25: Stream Stability and Condition Monitoring Locations

Main Creek

Main Creek was assessed for stream stability and stream health at two locations, with results included in ***Table 54.*** Stream stability for both sites has remained static since 2018. One site (MC1) progressed from 'Active' to 'Potentially stabilising' between 2017-2018, however the other site (MC2) has been classified as "Active' since 2014. Stream condition has remained constant, and generally classified as 'Very Poor'. Main Creek has been cleared in the past prior to mining activities and has minimal riparian vegetation. This is the main reason for the low health score.

Table 54: Main Creek's Stream Stability & Condition Assessment 2021

Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
	2021	Trajectory	2021	Trend 2014-2021
Main Creek 1 (MC1)	63% (Potentially Stabilising)	Static	Very Poor	Stable
Main Creek 2 (MC2)	59% (Active)	Static	Very Poor	Stable

Bettys Creek

Bettys Creek natural waterway was assessed for stream stability and condition at two locations. Results are included in ***Table 55***. Stream condition at BC1 declined in the assessment conducted in November 2021 which is likely to have been a results of high rainfall events.

Table 55: Bettys Creek Stream Stability and Condition Assessment 2021

Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
	2021	Trajectory	2021	Trend 2014-2021
BC1	66% (Potentially Stabilising)	Static	Poor	Declined
BCD2	72% (Stable)	Static	Poor	Stable

7.3.2.4 Creek Diversions

Creek diversions onsite undergo biannual monitoring of stream stability and condition assessments, targeted at identifying areas requiring maintenance such as erosion and weed control. Annual stream stability and condition assessments follow the same methodology as that carried out for local creek reference sites (Ephemeral Stream Assessment and RARC) and results can be compared to existing creek lines to assess the performance of diversions.

Bettys Creek Diversion

Stream stability trajectory across Bettys Creek diversion monitoring sites remains static, with stability ranging between 63%- 81% among and between the Upper, Middle and Lower groupings (refer to ***Table 56*** and ***Figure 25***). African Boxthorn (*Lycium ferocissimum*) is present on the Lower Betty's Diversion, with ongoing weed treatment and control undertaken.

Table 56: Betty's Creek Diversion Stream Stability & Conditions Assessment 2021

Creek Diversion	Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
		2021	Trajectory	2021	Trend 2014-2021
Upper Betty's Diversion	UBD1	63% (Potentially Stabilising)	Static	Very Poor	Stable
	UBD2	63% (Potentially Stabilising)	Static	Very Poor	Stable

Creek Diversion	Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
		2021	Trajectory	2021	Trend 2014-2021
	UBD3	66% (Potentially Stabilising)	Static	Very Poor	Stable
	UBD4	64% (Potentially Stabilising)	Static	Poor	Improved
	UBD5	66% (Potentially Stabilising)	Static	Very Poor	Stable
	UBD6	75% (Stable)	Static	Very Poor	Stable
Middle Bettys Diversion	MBD1	81% (Very Stable)	Static	Average	Improved
	MBD2	63% (Potentially Stabilising)	Static	Average	Improved
	MBD3	66% (Potentially Stabilising)	Static	Poor	Stable
	MBD4	66% (Potentially Stabilising)	Static	Poor	Improved
	MBD5	81% (Very Stable)	Static	Poor	Improved
	MBD6	69% (Potentially Stabilising)	Static	Very Poor	Stable
Lower Bettys Diversion	LBD1	66% (Potentially Stabilising)	Static	Poor	Improved
	LBD2	66% (Potentially Stabilising)	Static	Average	Improved
	LBD3	69% (Potentially Stabilising)	Static	Average	Improved
	LBD4	75% (Stable)	Static	Very Poor	Stable
	LBD5	69% (Potentially Stabilising)	Static	Very Poor	Stable
	LBD6	75% (Stable)	Static	Very Poor	Stable
	LBD7	75% (Stable)	Static	Very Poor	Stable
	LBD8	75% (Stable)	Static	Very Poor	Stable
	LBD9	69% (Potentially Stabilising)	Static	Very Poor	Stable
	LBD10	72% (Stable)	Static	Average	Stable
	LBD11	72% (Stable)	Static	Average	Improved
	LBD12	72% (Stable)	Static	Average	Stable
	LBD13	72% (Stable)	Static	Average	Stable

Swamp Creek

Swamp Creek was assessed for stream stability and condition at four natural waterway locations and three diversion locations (refer to ***Figure 25***). Stream stability remained relatively consistent across all sites. Comparison to previous monitoring shows that stream condition at the upstream natural waterway site SC1 has declined and classified as 'Very Poor', whilst diversion site SC1B and downstream site SC2 have improved. Like other creeks in the area, the low health scores are a result of past land use and management where cattle were not excluded from riparian areas. Results are included in the Table 57. Fencing inspections are completed bi-annually to ensure cattle are excluded from these areas.

Table 57: Swamp Creek Natural Waterway and Diversion Stability & Condition Assessment 2021

Monitoring Point	Stream Stability (CSIRO)		Stream Condition (RARC)	
	2021	Trajectory	2021	Trend 2014-2021
Swamp Creek 1 (SC1) Natural upstream	66% (Potentially Stabilising)	Static	Very Poor	Declined
Swamp Creek 1A (SC1A) Diversion	66% (Potentially Stabilising)	Static	Very Poor	Stable
Swamp Creek 1B (SC1B) Diversion	78% (Stable)	Static	Poor	Improved
Swamp Creek 1C (SC1C) Diversion	78% (Stable)	Static	Very Poor	Stable
Swamp Creek 2 (SC2) Natural downstream	63% (Potentially Stabilising)	Static	Poor	Improved
Swamp Creek 3 (SC3) Natural downstream	63% (Potentially Stabilising)	Static	Very Poor	Stable
Swamp Creek 4 (SC4 Natural downstream)	66% (Potentially Stabilising)	Static	Very Poor	Stable

7.3.3 Erosion and Sediment Control

MGO engages an erosion and sediment controls specialist to conduct quarterly inspections. These inspections aim to identify issues that require maintenance, and where possible these issues are scheduled for rectification prior to the next inspection.

As a result of ongoing monitoring and management, MGO did not have any instances where sediment dams overflowed during 2021. There were also no environmental incidents or complaints relating to erosion and sediment control management.

7.4 Groundwater

7.4.1 Groundwater Monitoring Program and Triggers

Groundwater monitoring is undertaken in accordance with the approved MGO Groundwater Management and Monitoring Plan (GWMMP) and includes recording of depth to water (to calculate drawdown), pH and Electrical Conductivity (EC). Groundwater performance criteria is provided in ***Table 58***.

The location of groundwater monitoring sites is shown on ***Figure 26***.

Table 58: Groundwater Performance Criteria

Aspect	Performance Measures	Performance Indicator/Trigger
Alluvial aquifers	Groundwater levels (depth to water)	Drawdown greater than historical average plus 1 standard deviation.
	Groundwater quality (pH and EC)	pH or EC outside of 80th percentile of historical data for specific bore locations. Groundwater quality concentrations outside of trigger value for at least one parameter for 2 or more consecutive (quarterly) monitoring rounds.
Hardrock aquifers	Groundwater levels (depth to water)	Drawdown greater than historical average plus 1 standard deviation.
	Groundwater quality (pH and EC)	pH or EC outside of 80th percentile of historical data for specific bore locations. Groundwater quality concentrations outside of trigger value for at least one parameter for 2 or more consecutive (quarterly) monitoring rounds.
Groundwater inflows to mining pits	Calculated inflows to mining pits	Groundwater inflow to mining pits is >10% higher than predicted for three consecutive months. Groundwater inflows exceed WAL limits.
Seepage/leachate	Presence of seepage/leachate from water storages	Visual inspections of water storages (as per the MGO Erosion and Sediment Control Plan) shows seepage zones and reporting water balance indicates seepage is greater than negligible (i.e: >5% of inflows to water storages).
	Seepage/leachate from emplacement areas	Visual inspections of water storages (as per the MGO Erosion and Sediment Control Plan) indicates seepage areas and confirms location of drainage pathways outside of water management system.
	Seepage/leachate from backfilled voids	No increasing trends in water quality parameters in monitoring bores surrounding backfilled voids. An increasing trend would be indicated by 4 consecutive water quality readings showing continual increases in analyte concentrations.

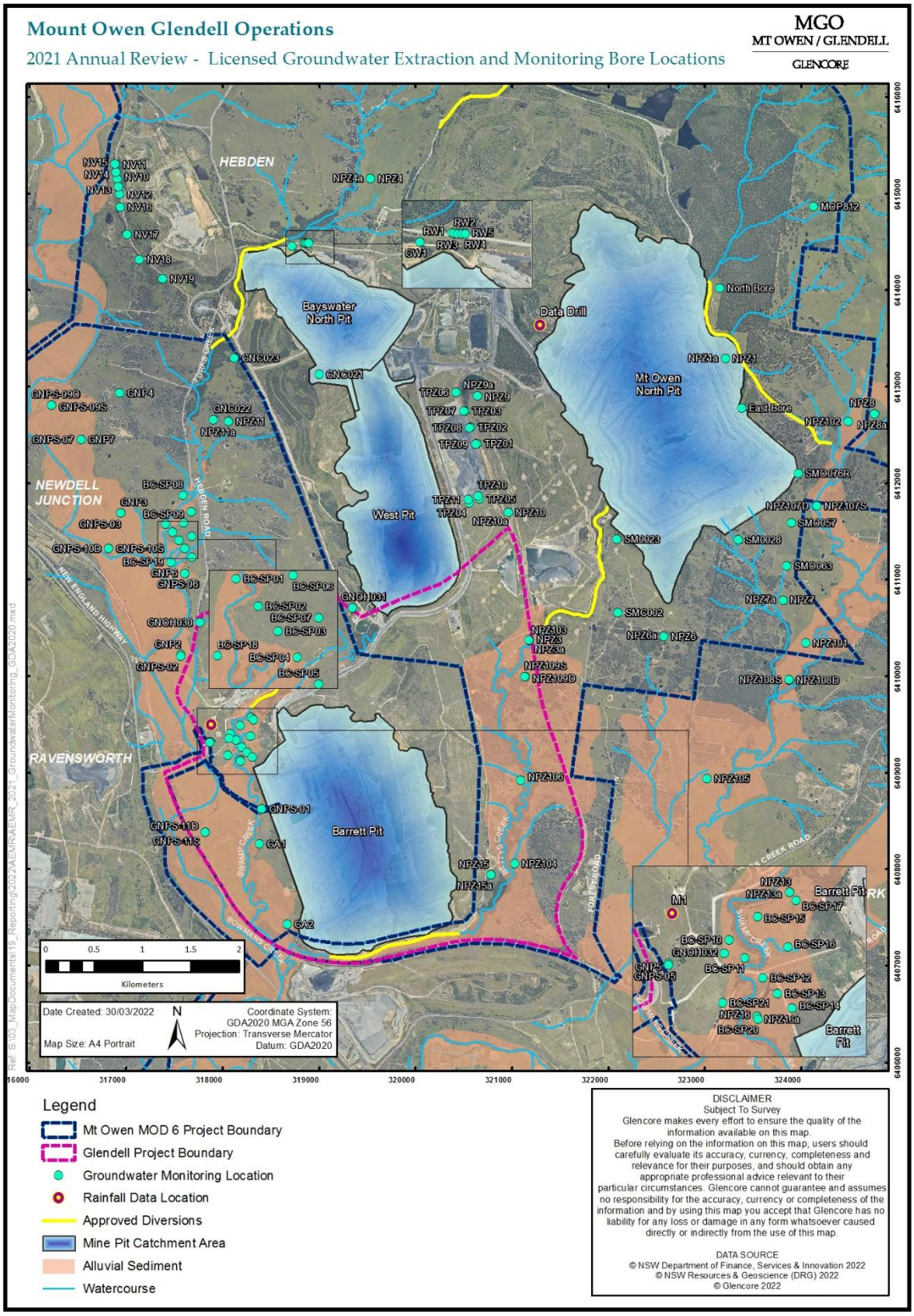

Figure 26: MGO Groundwater Extraction and Monitoring Bores

7.4.2 Groundwater Monitoring Performance

MGO experienced above average rainfall during most of 2021. The greatest monthly rainfall (> 50 mm) was recorded in January to March and October to December of 2021. During the reporting period streamflow was also observed within Bowmans Creek/Foy Brook and Glennies Creek, with significant flow events in March and November 2021. The above-average rainfall and streamflow for the reporting period would have resulted in recharge to the alluvium and Permian coal measures where they occur at outcrop, as well as within backfilled MGO mining areas.

The annual groundwater review for the 2021 monitoring period (Umwelt, 2021) identified several GWMMP trigger exceedances as summarised below:

- Water Level drawdown:
  - Bores BC-SP04, BC-SP05, BC-SP06, BC-SP08, BC-SP07, BC-SP09, BC-SP10, BC-SP11, BC-SP20, BC-SP22, NPZ1a. NPZ1, NPZ4, NPZ4a, NPZ8, NPZ11, NPZ13 and NPZ13a, NPZ16, NPZ101, NPZ107S, NPZ108S, NPZ108D, NPZ107D, NPZ13, NPZ13a, NPZ16, NPZ101, NPZ107S and NPZ108S
- Electrical Conductivity:
  - Bores BC-SP04, BC-SP05, BC-SP07, BC-SP09, BC-SP10, NPZ1, NPZ4, NPZ4a, NPZ8, NPZ11, NPZ BC-SP06, BC-SP08, NPZ13, NPZ1a.13a, NPZ16, NPZ101, NPZ107S and NPZ108S
- pH:
  - Bores NPZ3a, GNPS-02, BC-SP11, BC-SP20, BC-SP22, NPZ108D and NPZ107D.

A summary of the findings from the investigations of 2021 GWMMP trigger exceedances are included below:

- Alluvial bores:
  - Bettys Creek:
    - All alluvial bores were recorded as dry or with levels at the base of the bore
    - The lack of recharge to the alluvium is potentially influenced by the reduction in the catchment area and reduced flows along Bettys Creek.
  - Main Creek:
    - Water quality in the Main Creek alluvium is brackish to saline, with the lowest salinity water within upgradient bore NPZ102. Bores NPZ101, NPZ107S and NPZ108S all recorded trigger exceedances for EC over the reporting period
    - Bore BC-SP10 also recorded elevated EC of 12,900 µS/cm in August 2021; however, this concentration reduced to 11,630 µS/cm (below the trigger level) in November 2021. No other exceedances for EC were recorded over the reporting period.
  - Swamp Creek:
    - During 2021, all alluvial bores in Swamp Creek and in the regolith recorded a water level trigger exceedance. The Swamp Creek alluvial bores are largely dry or recorded water levels near the base of the bore

- Yorks Creek:
  - Full water quality analysis undertaken in August for the bore indicates a high concentration of sulphate (674 mg/L), but a higher concentration (and proportion) of chloride of 3,840 mg/L. These results are consistent with water quality results collected since 2017
- Bowmans Creek:
  - Groundwater level triggers were recorded for four alluvial bores (BC-SP18, BC- SP19, GNPS-03 and GNPS-07) as well as a regolith bore (and GNPS-05), which were recorded as dry for the duration of 2021
  - No trigger exceedances for water level were recorded for bores BC-SP22, GNP09S, GNP10S, GNP11S, GNPS02 and GNPS-06.

- Permian Coal Measures:
  - Three of the shallow overburden bores recorded a water level trigger exceedance (NPZ1, NPZ11 and North). Bores NPZ1 and NPZ11 also recorded an EC trigger exceedance. Bore NPZ9 also recorded a water level and pH trigger exceedance.

A summary of the groundwater bore monitoring parameters that exceeded respective GWMMP trigger levels is provided in ***Table 59***. A copy of the monitoring results for individual groundwater monitoring locations is included in ***Appendix G***, along with a summary of the 2021 results for all bores and historical trends.

Table 59: Summary of Groundwater Bore Trigger Level Exceedances

Bore ID	EC average	Field pH average	pH Min	pH Max	Average water level (mbgl)	Comment
BC-SP02	9540	6.7	6.5	6.9	8.3	Dry in Q1 but rise in Q3 in response to above average rainfall
BC-SP04	14120	6.9	6.8	7.2	7.7	Rise in Q3 in response to above average rainfall
BC-SP05	14120	6.8	5.6	7.5	7.1	EC likely to be influenced by stagnant water at base of bore
BC-SP06	12840	7.1	7	7.3	9.2	Dry in Q1. EC & pH exceedance Q3 below trigger in Q4
BC-SP07	11000	7	7	7	10.3	Dry in Q1, Q3, Q4. EC high In Dec'22 only
BC-SP08	16690	6.7	6.5	7	6.8	Historically high EC. pH below trigger in Q2 only
BC-SP09	13930	7	7	7.1	8.3	Bore monitored but dry in Q1 and Q4 Elevated EC likely to be stagnant water at bore base
BC-SP10	12900	7.1	6.9	7.3	6.1	Dry in or at near dry since September 2018. Dry in Q1 and Q4 slight increase Q2 '22
BC-SP14	11710	7.2	7	7.4	5.9	Bore dry Q1 and Q4
BC-SP21	10000	7.1	7	7.1	6.7	Bore dry Q1 and low water levels Q2 and Q3
BC-SP22	8400	6.9	6.3	7.2	5.4	Historically displaying fluctuating pH
GNP09D	1691	6.6	6.4	6.8	6.1	Historically displaying fluctuating pH
GNPS-02	11100	6.5	6.2	6.9	4.5	Historically displaying fluctuating pH

Bore ID	EC average	Field pH average	pH Min	pH Max	Average water level (mbgl)	Comment
GNPS-06	923	6	5.7	6.3	4.1	Level too low to sample in Q3, roots in bore. pH within historical range
NPZ1	20940	6.9	6.8	6.9	16.4	No observable water level or EC trends
NPZ101	17760	7	7	7.1	5.9	Water level now stabilised.EC has been historically above trigger level
NPZ107D	9050	10.5	7.3	11.9	21.2	Declining water level trend since 2018
NPZ107S	16020	6.8	6.7	6.9	8.4	Declining water level trend since 2018. EC has been historically above trigger level
NPZ108S	18170	7	6.8	7.2	8	Declining water level trend since 2018. EC has been historically above trigger level
NPZ11	13980	6.8	6.6	7	29.2	Gradual declining trend until early 2018 stabilisation to slight rise in Q1 '22 in response to rainfall. EC close to or above the trigger level have been historically observed
NPZ11a	12530	8.2	7.9	8.3	62	Gradual declining trend to rise in Q12 – Q3 in response to above average rainfall.
NPZ13	12800	6.9	6.5	7.1	26.6	Gradual declining trend until early 2018 stabilisation to slight rise in Q1 '22 in response to rainfall. EC trigger in Q3 only. pH trigger only in in Q2
NPZ13a	14700	7	6.7	7.3	55.5	Decline trend similar to Vane Subgroup. EC close to above trigger values
NPZ16	15280	7	6.7	7.1	23.3	
NPZ1a	15400	8.5	8.4	8.7	47.4	No observable trend in water levels. Historically EC has been above the trigger level since 2011
NPZ3a	20610	6.7	6.5	6.8	11	
NPZ4	29800	7	6.9	7.1	6.5	Low water levels potential blockage and measurement of stagnant water
NPZ4a	26300	6.9	6.9	7	7	
NPZ6a	-	-	-	-	105.2	Bore blocked and dry
NPZ7	10430	7.3	7.1	7.4	17.5	Decline trend similar to Vane Subgroup
NPZ7a	8780	7.3	7.3	7.5	44.4	Decline trend similar to Vane Subgroup
NPZ8	21900	7.4	7.3	7.4	10.1	Bore has historically reported EC above trigger levels – no adverse trend currently identifiable
NPZ8a	4270	7.1	7	7.2	36.9	Slightly declining to relatively stable levels
NPZ9	10370	6.6	6	6.8	4.6	Levels relatively stable since 2019 rise 2022 in response to above average rainfall

7.4.3 Groundwater Take

The approved site activities include the direct interception of groundwater from the Permian coal measures, as well as direct and indirect interception of groundwater from alluvium. The alluvium falls under the Hunter Unregulated and Alluvial Water Source Water Sharing Plan, while groundwater in the Permian coal measures is under the North Coast Fractured and Porous Rock Groundwater Source.

Mining was active within MTO North Pit and Glendell Barrett Pit. Drawdown in the Permian coal measures is observed. Over the reporting period, the local area also experienced above average rainfall that had the potential to influence inflows to active mining areas. However, no pumping of water reporting to Barrett Pit occurred in the reporting period.

The groundwater impacts for approved operations have been assessed and predicted progressively over time, which includes modelling by MER (2003), Jacobs (2015) and AGE (2018 and 2019). The assessment by AGE (2019) in the EIS had limited context relating to the annualised take for the approved operations across site (direct and indirect take) so the numbers are based on the Water Management Plan details for prior studies.

The groundwater level and quality trends reported for 2021 have been reviewed in consideration of the previously predicted impacts for the approved operations and are shown in **Appendix G**. Even though, the modelled and predicted impacts for 2021 included drawdown and depressurisation of the Permian Coal Measures, observed water levels and trends appear to remain steady overtime.

The most recent modelling of the approved operations was undertaken by AGE (2019) for the proposed Glendell Continued Operations Project. The groundwater model developed by AGE (2019) replicated actual mining and was calibrated to observe water levels and mine inflows to 2019. As per the consent conditions, the performance of the model is to be undertaken every three years and is therefore planned for 2022 and may include:

- Review of groundwater level and quality trends compared to triggers and previously predicted impacts and discussion on compliance with approved conditions.
- Comparison and verification of the predicted change in groundwater levels to observed water levels as well as comparison between observed and predicted mine inflows and the modelled and actual mine progression timing.

The total water take for water 'year 2021' was 1,794ML which is well below the total water licence allocation held by MGO as show in the table 60:***60*** presents the relevant water sources, units licensed by Glencore and predicted take for the previous water year (1 July 2020 to 30 June 2021).

*Table 60: Mine Inflows 2021Between 1 July 2020 and 30 June 2021*Water Source	*[ML]*
Groundwater Withdrawn	*1,383*
Surface water withdrawn	*411*
Total used	*1,794*
Total Entitlement	*6,160*

7.4.4 Continuous Improvement

The following summarises the recommendations made by the 2021 Annual Groundwater review (Umwelt, 2021):

- Measure the total depth of bores to verify that existing bore depth information is correct and to help identify where there may be blockages, and to inform GWMMP trigger reviews
- Revise the groundwater triggers to account for natural variability and predicted drawdown impacts for the coal measures. Water quality triggers should also be revised based on the updated bore network information and calculated for the different groundwater units building on baseline data. Update the GWMMP to reflect these changes.

8. Rehabilitation

During the reporting period MGO submitted one amendment to the titled Mt. Owen Glendell Operations Mining Operations Plan Amendment C Report No. 630.301641 for the period January to 30 June 2024 Plan to Resources Regulator for approval. The revised MOP included updated text and plans to reflect current, mining operations and rehabilitation.

In 2021, rehabilitation at MGO was carried out in accordance with:

- Glencore Standard 11.16 Rehabilitation Management
- MGO MOP/ Rehabilitation Management Plan
- MGO Biodiversity and Offset Strategy
- MGO Rehabilitation Strategy
- Mt Owen and Glendell Annual Rehabilitation and Closure Management Plan (ARLCP, an internal MGO document).

Rehabilitation is designed to achieve a stable final landform compatible with the surrounding environment and to meet the landform commitments presented in the MOP/Rehabilitation Management Plan as well as the Rehabilitation Strategy.

Table 61 provides a summary of rehabilitation activities at MGO for 2020 and 2021 and the rehabilitation forecast to be undertaken in 2022. All values presented are in hectares.

Table 61: MGO Rehabilitation Summary.

Mine Area Type	Previous Reporting Period (2020)	This Reporting Period – Forecast (2021)	This Reporting Period – Actual (2021)	Next Reporting Period – Forecast (2022)
Total Mine Footprint	2928.2	3056.2	3053.1	3116.1
Total Active Disturbance	1442.6	1479.9	1511.48	1596.5
Land being prepared for rehabilitation	0	0	0	0
Land under active rehabilitation	1509.2	1573.4	1634.3	1664.55
Completed Rehabilitation	96.5	67.1	75.0	30.25

*Forecasts based on MOP Amendment C approved to July 2021.

Rehabilitation continued across MGO during 2021 in line with the ARCP / MOP (***Table 62***). 75.0 ha of rehabilitation was completed across MGO, made up of 53.6ha at Glendell and 21.4ha at Mt Owen. A total of 15ha was completed at Mt Owen North Pit in line with the natural landform design.

Table 62: 2021 Rehabilitation Works Compared to MOP.

Mine Area Type	2021 Actual Data (Mt Owen Complex)	MOP Predication
Rehabilitation (ha)	75.0	67.1
Disturbance (ha)	11.48	37.3

Glendell

GLD completed 53.6 ha of rehabilitation during 2021 including 46.93 ha of open grassland or pasture areas and 6.67 ha of open woodland areas. In woodland areas, GLD continued to use a species mix which incorporates several shrub and understorey species, characteristic of the Central Hunter Ironbark-Spotted Gum-Grey Box Forest. GLD including improvements to the rehabilitation process, deep ripping directly prior to seeding. This change in the rehabilitation process provides a rougher surface finish improving infiltration, limiting surface runoff, and therefore reducing any potential erosion issues.

Mt Owen

MTO rehabilitated 21.1ha of open forest rehabilitation. Rehabilitation methodology remains largely unchanged at MTO with past success an indicator that processes are suitable for the conditions. Focus is placed on the use of direct place topsoil from pre-strip areas and the majority of 2021 rehabilitation was able to utilise this resource. The rest of the area was rehabilitated using subsoil with the addition of gypsum to counter any soil dispersion. Natural landform design continued to be incorporated into the rehabilitation process during 2021, with ha completed on the North Pit rehabilitation area.

Figure 27: Newly Completed Natural Landform Rehabilitation at Mt Owen.

8.1 Rehabilitation Monitoring

The objective of rehabilitation monitoring is to assess the progression of rehabilitation areas towards relevant criteria and commitments and to facilitate continuous improvements in rehabilitation practices.

Commencing in 2020, GCAA implemented across its NSW operations common templates for rehabilitation monitoring, performance indicators and completion criteria. This standardised approach adopts monitoring according based on the establishment age of the rehabilitation areas.

These are defined by two distinct groups known as Initial Establishment Monitoring (IEM) and Long-Term Monitoring (LTM).

Initial Establishment Monitoring focuses on rehabilitation which is 1 to 3 years of age since establishment. Monitoring of these areas evaluates native species germination success, landform stability and early identification of problematic weeds.

Long Term Monitoring focuses of rehabilitation which is 4 years or greater in age since establishment and evaluates and tracks progress towards completion criteria using detailed scientific monitoring methods.

The 2021 monitoring program included a combination of:

- High resolution imagery – identification of mapping areas of recalcitrant bare ground >1,000m2 in size;
- Walkover inspection – high level assessment of rehabilitation condition and ground-truthing the findings of remote sensing; and
- Long term monitoring – plot/transect based monitoring collecting scientific data and trends on vegetation community establishment.

The 2021 monitoring campaign included the assessment of 23 rehabilitation blocks covering a cumulative area of ~470.2 ha, comprising of 20 IEM blocks and 3 LTM blocks for areas being returned to Open Grassland, Corridors/Shelter Belts and Open Woodland/ Forest. In addition, one native reference site was also monitoring in 2021 under the GCAA reference site sharing program. The monitoring program is designed to assess all rehabilitation block areas at least once every three years. As this monitoring methodology was introduced in 2020 data presented here presents the current trends for the blocks monitored, over the next several years all blocks will be monitored under this methodology which will then allow for more direct comparison of trends over time. ***Table 63*** rehabilitation performance categories are based on field assessments, observations and criteria to determine the status of rehabilitation. ***Table 64*** provides details of the rehabilitation blocks monitored in 2021 and ***Figure 28*** shows the locations.

Performance against key rehabilitation metrics was assessed for each rehabilitation polygon. A summary of this data is presented in ***Table 64***. Each polygon is assigned one of four performance rankings as per the criteria below.

Table 63: Rehabilitation Performance Categories.

Category	Criteria
Rework	• Does not meet completion criteria. • Extensive rework required that would not typically form part of a rehabilitation maintenance program; e.g. slopes do not comply with approval requirements, large bare areas >0.1ha, very severe and widespread erosion, etc. • TARP condition red
Maintenance	• Does not meet completion criteria. • Routine rehabilitation maintenance works required (e.g. weed control, infill seeding/plantings, repair of minor erosion, fertiliser application). • TARP Condition Amber
Monitor	• Trajecting towards completion criteria but does not meet all criteria. • No intervention required other than ongoing routine land management, but continued monitoring required (e.g. ecologically young areas, variable results). • TARP Condition Green.
Acceptable	• Rehabilitation objectives and completion criteria are generally met and the area is ready for sign off by regulators. • Routine management and monitoring should be continued to maintain status until relinquishment process is sought. • TARP Condition Green.

Table 64: 2021 Rehabilitation Monitoring Scope of Works.

Type	Mine Site	Mining Area	Block Code	Domain	Area (ha)	Sites	2021 Performance Condition Status
IEM	Rav East	Bayswater north	PAS-BN-2020	Open Grassland	37.7	0	Monitor
IEM	Rav East	North void	PAS-NV-2020	Open Grassland	3.6	0	Maintenance
IEM	Glendell	Barrett pit	PAS-BP-2019	Open Grassland	2.4	1	Maintenance
IEM	Rav East	Tailings pond 01	PAS-TP1-2018	Open Grassland	8.4	2	Maintenance
IEM	Glendell	Barrett pit	NSNV-BP-2020	Corridors/Shelter Belts	11.3	0	Monitor
IEM	Glendell	Barrett pit	NSNV-BP-2019	Corridors/Shelter Belts	33.7	4	Maintenance
IEM	Glendell	Barrett pit	NSNV-BP-2018	Corridors/Shelter Belts	11.7	3	Maintenance

Type	Mine Site	Mining Area	Block Code	Domain	Area (ha)	Sites	2021 Performance Condition Status
IEM	Mt Owen	WOOP Dump	GBIW-WD-2020	CHGBIW	13.7	0	Maintenance
IEM	Rav East	North void	GBIW-NV-2020	CHGBIW	2.4	0	Rework
IEM	Rav East	Bayswater north	GBIW-BN-2020-1	CHGBIW	4.6	0	Monitor
IEM	Rav East	Bayswater north	GBIW-BN-2020-2	CHGBIW	5.4	0	Monitor
IEM	Rav East	North void	GBIW-NV-2019	CHGBIW	21.6	4	Maintenance
IEM	Rav East	Bayswater north	GBIW-BN-2019-1	CHGBIW	12.9	3	Maintenance
IEM	Rav East	Bayswater north	GBIW-BN-2019-2	CHGBIW	1.8	1	Maintenance
IEM	Rav East	North void	GBIW-NV-2018-1	CHGBIW	14.7	4	Maintenance
IEM	Rav East	North void	GBIW-NV-2018-2	CHGBIW	13.3	3	Maintenance
IEM	Mt Owen	North pit	SGIGBF-NP-2020-1	CHSGIGBF	5.1	0	Maintenance
IEM	Mt Owen	North pit	SGIGBF-NP-2020-2	CHSGIGBF	5.2	0	Monitor
IEM	Mt Owen	North pit	SGIGBF-NP-2020-3	CHSGIGBF	3.8	0	Monitor
IEM	Mt Owen	North pit	SGIGBF-NP-2019	CHSGIGBF	36.5	5	Maintenance
LTM	Glendell	Barrett pit	PAS-BP-B1	Open Grassland	88.9	5	Maintenance
LTM	Mt Owen	North pit	SGIGBF-NP-B4	CHSGIGBF	42.5	4	Maintenance
LTM	Mt Owen	North pit	SGIGBF-NP-B5	CHSGIGBF	89.0	8	Maintenance
				Total	**470.2**	**47**	

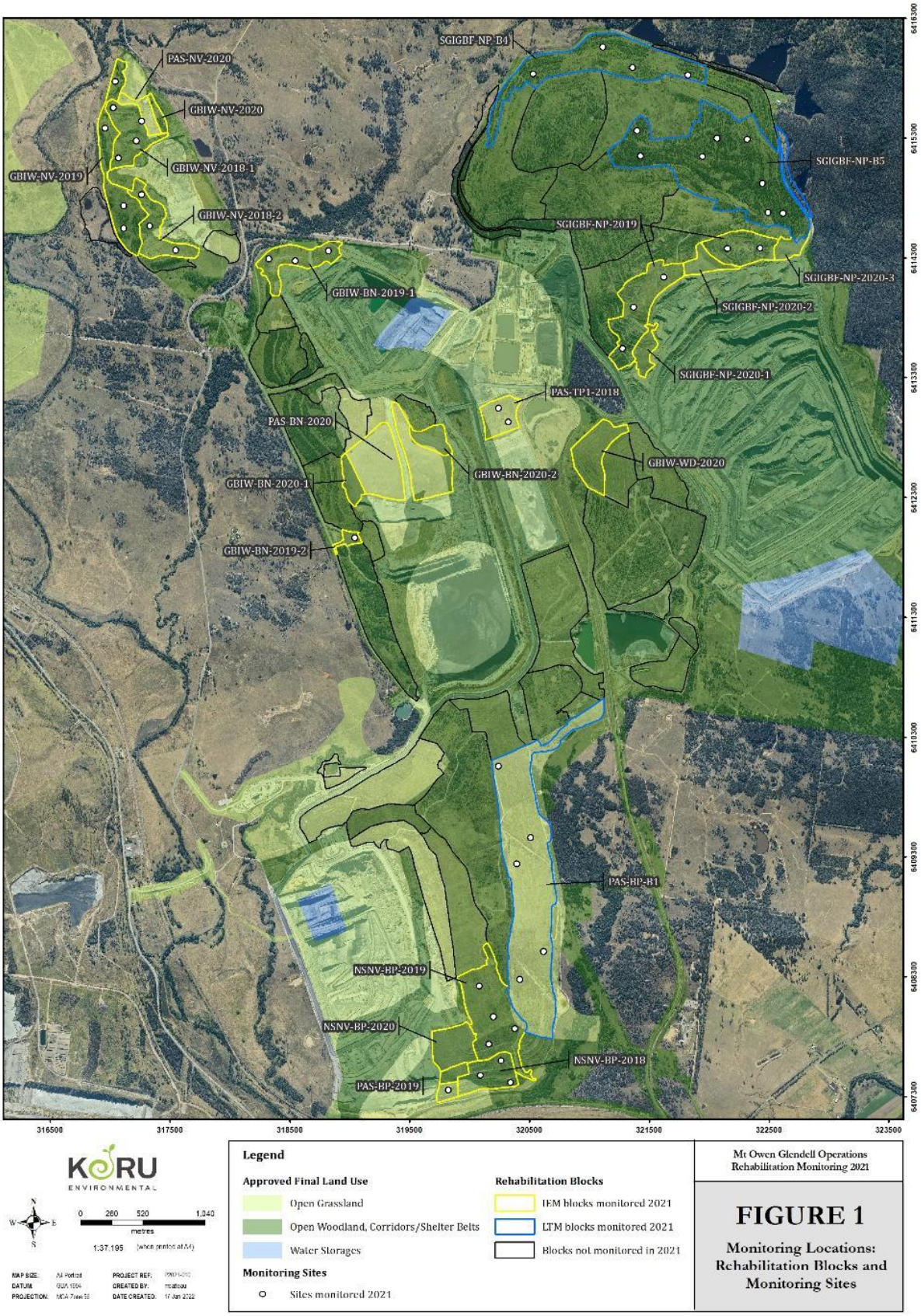

Figure 28: 2021 Monitoring Locations – Rehabilitation Blocks and Monitoring Sites.

8.1.1 Results

8.1.1.1 Long-term Monitoring

Open Grassland

- Block PAS-BP-BI (88.9 ha)
  - established between 2012 and 2014.
  - Excellent soil slope and stability was generally observed throughout with two residual erosion channels noted, however both appeared fully stabilised.
  - Erosion features are unlikely to warrant repairs at present.
  - Groundcover and pasture establishment remained satisfactory across the area; however routine control is required for priority weeds.

Based on the observations and results from the 2021 walkover inspection and transect-based monitoring an assessment of rehabilitation progress against the relevant MOP (including TARP) and Rehabilitation Strategy criteria is provided in ***Table 65*** for the LTM Open Grassland block.

Table 65: 2021 Rehabilitation Progress Summary – Open Grassland Rehabilitation LTM Block.

Monitoring Block	LTM-BN-GP-B1	
MOP / Rehabilitation Strategy Criteria	**Compliant**	**TARP**
Slopes generally <14 degrees (Glendell)	Yes	Acceptable
No drainage issues threating to cause rehabilitation failure	Yes	Acceptable
Land capability classification criteria met	Yes	Acceptable
No large bare patches indicating poor soil/spoil quality	Yes	Acceptable
No evidence of spontaneous combustion	Yes	Acceptable
No gully or tunnel erosion features, or rill erosion >200mm deep	Yes	Acceptable
Protective ground cover is at least 80%	Yes	Acceptable
Weed presence does not present a risk to the intended land use	No	Maintenance
Pasture establishment is in good health and provides adequate cover	Yes	Acceptable
>75% of herbage cover provided by grasses and legumes suitable for grazing	Yes	Acceptable
Pasture production is comparable to similarly managed pastures	Yes	Acceptable

Corridors/Shelter Belts

Blocks of Corridors/Shelter Belts rehabilitation at the LTM stage were not monitored during the 2021 monitoring campaign.

Open Woodland

- Block SGIGBF-NP-B4
  - Established between 2004 and 2007.
  - Excellent soil and slope stability were observed throughout, and no evidence of active (or residual) erosion features or drainage was recorded.
  - Most areas showed excellent woodland vegetation establishment and growth with nor large (>1000m2) recalcitrant bare patches.
- Block SGIGBF-NP-B5
  - Established between 2007-2012.
  - Landform stability and drainage were satisfactory with some localised issues requiring remediation.
  - Overall excellent woodland vegetation establishment showing good landscape heterogeneity and diversity.
  - Treatment of priority weed grass infestations were in progress at the time of monitoring and it noted as successful where completed.

Results of natural regeneration across both sites highlighted an overall good potential for the established communities to be self-sustainable.

Based on observations and results from the 2021 walkover inspection and transect-based monitoring an assessment of rehabilitation progress against the relevant MOP (including TARP) and Rehabilitation Strategy criteria is presented in ***Table 66*** for the LTM Open Woodland blocks being returned to CHGBIW.

Table 66: 2021 Rehabilitation Progress Summary – Open Woodland (CHGBW) LTM Blocks

Monitoring Block	LTM-SGIGBF-NP-B4		LTM-SGIGBF-NP-B5	
MOP / Rehabilitation Strategy Criteria	**Compliant**	**TARP**	**Compliant**	**TARP**
Slopes generally <10 degrees (MTO/Rav East)	Yes	Acceptable	Yes	Acceptable
Overburden emplacements include informal undulations	No	n/a	Yes	n/a
Artificial habitat features incorporated in the landform	Yes	Acceptable	Yes	Acceptable

Landforms are free draining to local watercourses	Yes	Acceptable	Yes	Acceptable
No drainage issues threatening to cause potential rehabilitation failure	Yes	Acceptable	Yes	Acceptable
No gully or tunnel erosion features, or rill erosion >200mm deep	Yes	Acceptable	No	Rework
No large bare patches (>1,0002) indicating poor soil/spoil quality	Yes	Acceptable	Yes	Acceptable
No evidence of spontaneous combustion	Yes	Acceptable	Yes	Acceptable
Soil pH in the range of reference sites	Not assessed	Not assessed	Not assessed	Not assessed
The rehabilitation surface is a suitable growing medium (as evidenced by vegetation establishment)	Yes	Acceptable	Yes	Acceptable
Protective ground cover is at least 70%	Yes	Acceptable	Yes	Acceptable
Cover of priority weeds is within range of reference sites	No	Maintenance	No	Maintenance
No significant weed infestations within the Blocks	No	Rework	No	Rework
Evidence of nutrient cycling processes (litter cover) within benchmarks	Yes	n/a	Yes	n/a
Species composition and assemblages characteristic of target community	Partially	Maintenance	Partially	Maintenance
Native tree diversity >75% of reference sites or published community benchmarks	Yes	Acceptable	Yes	Acceptable
Native shrub diversity >75% of reference sites or published community benchmarks	Yes	Acceptable	Yes	Acceptable
Native ground cover diversity >75% of reference sites or published community benchmarks	No	Rework	Yes	Acceptable
Trees FPC trending towards target community	No	Maintenance	Yes	Acceptable
Shrubs FPC trending towards target community	Yes	Acceptable	No	Maintenance
Ground cover FPC trending towards target community	Yes	Acceptable	Yes	Acceptable
>75 percent of trees are healthy and growing	Trending	n/a	Trending	n/a

Evidence of flowering, seeds for trees and shrubs	Yes	n/a	Yes	n/a
At least one second-generation seedling present per plot	Yes	n/a	Yes	n/a
Rehabilitation provides a range of structural features (e.g. trees, shrubs, ground cover, litter layer, etc.)	Yes	n/a	Yes	n/a

8.1.1.2 Initial Establishment Monitoring (IEM – Year 1)

The condition of Year 1 rehabilitation is limited to a high walkover inspection and summarised below:

Open Grassland

- Block PAS-BN-2020 (37.7 ha)
  - Landform is relatively flat topography with small depression and rock piles incorporated
  - Good soil and slope stability
  - Germination of pasture grasses dominated by cloves, medics and Hexham Scent (*Melilotus indicus*) with Rhodes Grass (*Chloris gayana*) and Setaria (*Setaria spp*.) starting to establish
- Block PAS-NV=2020 (3.6 ha)
  - Low lying area at the toes of the North Void high wall
  - Gully channel will require remediation
  - Ground layer is generally established and dominated by Common Couch (*Cyndodon dactylon*) , Rhodes Grass (*C. gayana*) and Kikuyu (*Cenchrus clandestinus*)
  - Golden Wreath Wattle (*Acacia saligna*) present and control is ongoing

Corridors Shelter Belts

- Block NSNV-BP-2020 (11.3 ha)
  - No erosion or drainage issues
  - Germination of native shrubs and trees variable but generally satisfactory throughout with excellent strike rates noted on the upper slopes
  - Exotic grasses were present and require treatment

Open Woodland

Four blocks of IEM Open Woodland were monitored in 2021.

- Block SGIGBF-NP-2020 (14.1 ha) comprises of three small blocks
    - Constructed landforms include a mix of conventional linear slope, contour banks and micro-relief(s)
    - Good densities of artifical habitat features incorporated into the landform
    - Germination and establishment of native ground covers; shrubs and trees remain limited at the time of monitoring
- Block GBIW-WD-2020 (13.7 ha)
    - Area was reworked in 2020 to change open grassland pasture established in 2012 to final landuse of Open Woodland
    - No drainage issues were noted and all water management structures were assessed as very stable and well functioning
    - The block has been rapidly recolonised by the exotic pasture species occurring in the area prior to the reworks
- Block GB1W-NV-2020 (2.4 ha)
    - The block consists of the shaped high wall of the north void with localised area of excellent woodland establishment however will likely require reworking to adresss channels of erosion
- Block GBIW-BN-2020-1 (10.0 ha)
    - Area reworked to accommodate the revised final landfrm design i.e. increased dump height post monitoring event

8.1.1.3 Initial Establishment Monitoring (IEM – Year 2 and 3)

Open Grassland

- Block PAS-BP-2019 (2.4 ha)
    - Successful repair completed for contour bank failure noted in 2020 walkover with satisfactory ground cover
    - Good pasture establishment
- Block PAS-TPI- 2018 (8.4)
    - Established in 2018 on capped tailings pond
    - Some ephemeral water ponding
    - Successful treatment of Galena (*Galena pubescens*) infestation reported in 2020

Corridors/Shelter Belts

- Block NSNV-BP-2019 (33.7)
    - Localised erosion repairs undetaken since 2020 now stablising following excellent vegetation establishment
    - Establishment of native woody species excellent throughout with very high tree densities and growth
- Block NSNV-BP-2018 (11.7)
    - Overall slope stability and surface drainage is satisfactory
    - Shrub and tree establishment remains satisfactory
    - Treatmentof Galenia (*G.pubescens*) and localised presence of African Boxthorn (*Eragrostis curvula*) recommended

Open Woodland

- Block GBIW-BN-2019- 1 & 2 (14.7 ha)
    - Relaltively flat topography with north facing slopes
    - Artificial habitat features incorporated comprising of rock piles and piles of coarse woody debris
    - No surface drainage issues and water management structure are generally well functioning
    - Woodland vegetation generally satisfactory with maintenance and treatment of some exotic grasses
- Block GBIW-BN-2019- (21.6 ha)
    - All areas were overall stable and no erosion issues requiring remediation were detected
    - Minimal establishment of trees and shrubs of native woodland species seeded in 2020
    - Priority weed infestation have established since 2020
- Block SGIGBF-NP-2019 (36.5 ha)
    - No drainage issues, all contour banks stable and well-functioning and no evidence of overtopping, scouring or tunnelling
    - Erosion repair not currently deemed necessary except a gully channel at the intersection of 2017-2019 works
    - Excellent native vegetation, germination, establishment and growth including good species diversity

  - Excellent densities of artificial habitat features
  - Localised occurrences of Galenia (*G. pubescens*)
- Block SGIGBF-NP-2019 (36.5 ha)
  - Previously reported rill erosion on south-western slope previously reported has stablised and is unlikely to warrant repair
  - Weed incursion issues remain
  - Establishment of native shrubs and trees remain viable but overall satisfactory
- Block GBI-NV-2018-2 9 (13.3 ha)
  - No surface drainage issues and all contour banks were assessed as stable and well functioning
  - Weed control works of *A. saligna* and *G. pubescens* mapped in 2020 at the south eastern section were successfully removed, however, infestations have increased throughout the remainder of the block
  - Establishment of woodland vegetation overall remained limited. Additional revegetation works will likely be needed in this area.

8.1.1.4 Rehabilitation Monitoring Results Summary

A summary of rehabilitation performance as determined through rehabilitation monitoring during 2021 is shown in ***Figure 29***.

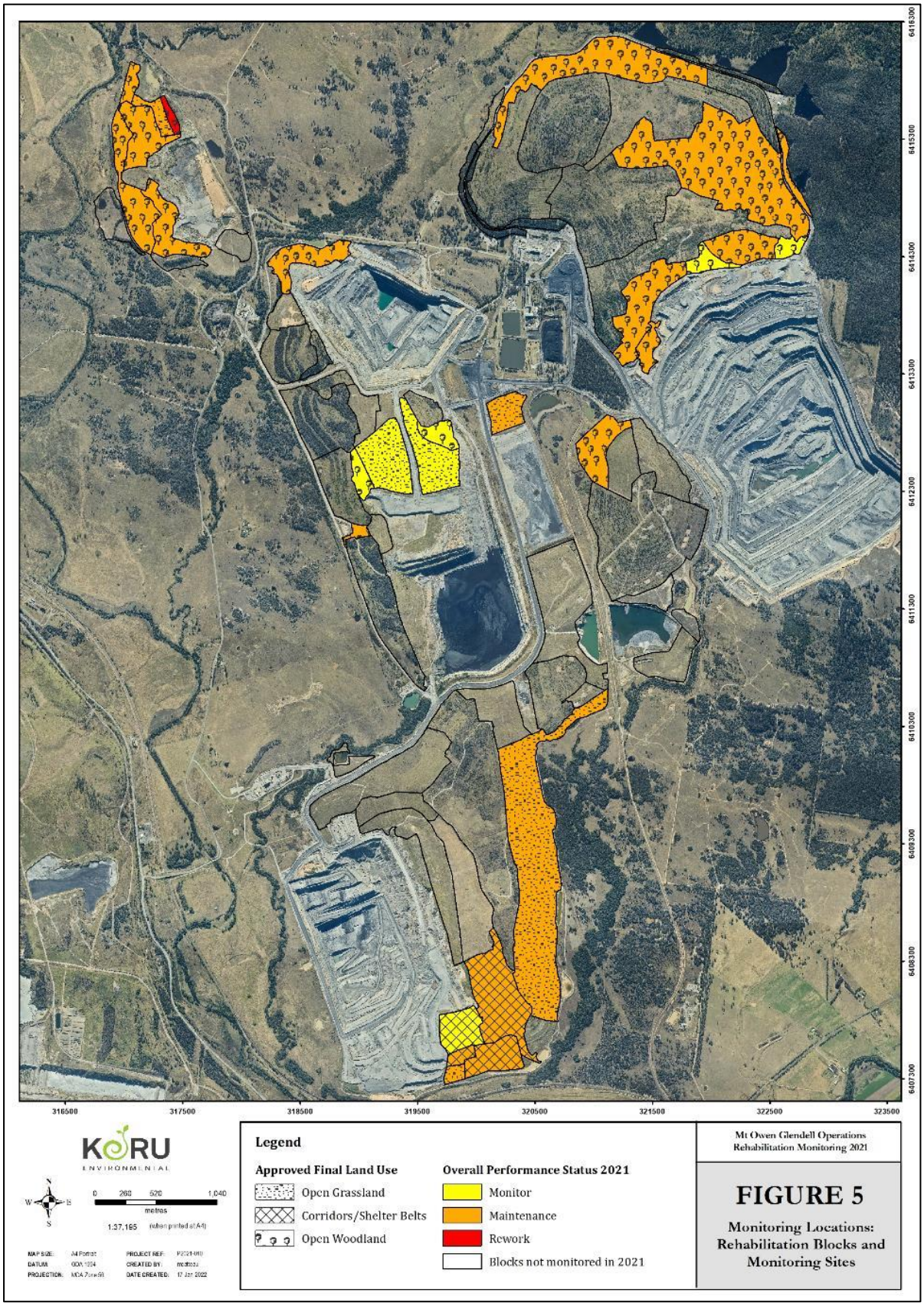

Figure 29: Summary of Rehabilitation Performance for 2021 Monitoring.

In areas currently showing an unsatisfactory performance in 2021, it was identified that the key issues and factors impeding the successful establishment of stable and self-sustaining vegetation communities include:

- erosion
- weed incursion

Rehabilitation across MGO was generally stable and no critical erosion features were identified. One block located in North Void requires rework to remediate gully erosion.

Weed incursion has been identified as the main issue for rehabilitation impacts at MGO. The main species of concern at the time of the 2021 monitoring included Galenia (*G. pubescens*), Golden Wreath Wattle *(A. saligna)* and exotic grasses. The management of these species is ongoing using a targeted approached based on annual monitoring recommendations.

The results from the 2021 monitoring also identified the requirement in some areas for increases and decreases in existing stem densities. Species composition and assemblages characteristic of target communities were variable between and among some sites.

The management of these requirements is also ongoing and targeted based on the outcomes of annual monitoring recommendations so that improvement trends can be monitored overtime.

While there are localised issues with rehabilitation performance identified across the site (which in most cases could be successfully controlled/ treated in the next reporting period), established rehabilitation at MGO generally showed good performance in 2021 following improved rainfall conditions compared to the drought conditions of the previous several years. Going forward, the continued monitoring of rehabilitation performance will allow MGO to build a robust database of relevant and scientific data. This dataset will allow an accurate and reliable assessment of rehabilitation performance to be made against regulatory requirements and assist in presenting a strong case for successful land relinquishment in the future.

8.2 Further Improvements and Research

- Remediation of rehabilitated areas to meet trajectory towards success include:
  - North Void: ~13Ha rip and infill seeding rework of prior rehabilitation
  - Barrett Pit: ~ 27 Ha rip an infill seeding and create habitat assemblies by scattering timber piles within older woodland rehabilitation
  - WOOP Dump: Deep rip pasture vegetation and re-seed the area to establish an open woodland as the final community type
- Betty's Creek: minor erosion repair and additional aquatic and bank stability plantings

- Installation of additional habitat nest boxes in woodland corridors and offset areas: 30 nest boxes were installed in the Mt Owen North Pit rehabilitation area and 40 boxes in the Glendell rehabilitation and Lower Betty's Creek diversion areas. The boxes will cater for a mix of hollow dependent fauna species, including Squirrel Glider, Brush-tailed Phascogale, East-coast Freetail-bat, Southern Myotis, Little Lorikeet, Masked Owl. Additional structures and boxes were also installed to cater for the Spotted-tail Quoll.

- Aerial Seeding: Utilisation of helicopter and high- tech drone seeding equipped with advanced mapping equipment for accuracy of spread.

Figure 30: Aerial seeding activities 2021

- Application of biosolids for soil amelioration: The soils consist of yellow-grey and orange grey sandy clay subsoils. These soils were highly alkaline, with high salinity levels and low contaminant levels. Major plant nutrient levels were considered low and deficient. These soils require major amelioration provide effective growing conditions for plants. The application of biosolids at maximum allowable rates, gypsum, starter fertiliser and the use of sodic, saline and drought tolerant plant species are recommended. The application of biosolids provide a significant benefit by boosting soil organic matter and plant nutrient levels, stimulating microbial activity, ameliorating sodic property, and promoting rapid vegetation growth and groundcover.

- Seed collection and nursery production of EEC species: MGO developed a program to address the absence of difficult to establish EEC species within the rehabilitation. Work began late in 2017 on seed collection and propagation of these species. During 2020 native seed was collected from existing established rehabilitation as well as buffer land areas. The aims of this program are to:
    - Supplement the existing rehabilitation areas with missing or underrepresented EEC species and important missing secondary species through targeted planting;
    - Establish patches of plants from which seed can be harvested in the future for use on new rehabilitation; and

- Establish of patches of plants which will self-seed and increase in population size, increasing the resilience and sustainability of plant communities within rehabilitation.
- Establish an offsite nursery facility for the propagation of EEC stock plants to increase the availability of seed to sow in rehabilitation and offset areas.

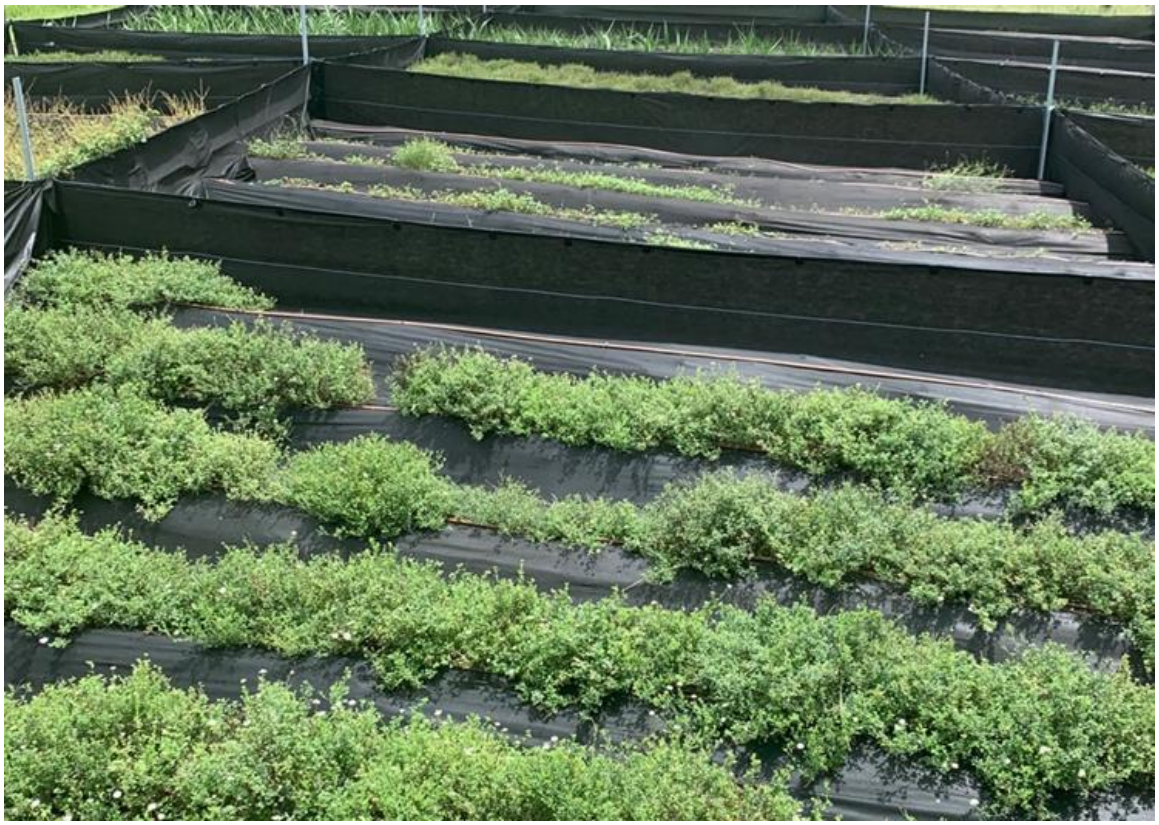

Figure 31: EEC Stock plant production for seed collection at specialised nursery

It is envisaged that this program will be ongoing and the success of this targeted and innovative approach to EEC rehabilitation at MGO will be reported on in future Annual Reviews.

In 2021, MGO commissioned a baseline study with the objective to inform future rehabilitation strategy targeting areas of insufficient information (or deemed outdated) and identify additional studies necessary to meet progressive certification and rehabilitation closure criteria. The study area is entirely being returned to a native ecosystem final land use, specifically targeting the Central Hunter Spotted Gum-Ironbark-Grey Box Forest (CHSGIGBF) local vegetation community. Criteria deemed relevant to this study is focussed on ecological criteria and slope stability.

Although not necessarily 'mature' based on ecological timescales standards, rehabilitation ≥10 years old meeting certain benchmarks hence the project will continue to inform areas requiring early intervention as necessary and those areas that can be confidently demonstrate the rehabilitation is on a trajectory towards a fully functioning community, and thus be a considered suitable for progressive certification (with long term potential for relinquishment).

Additional research in 2021 was delayed due to Covid -19 related constraints. However, the ACARP study "Optimising Plant Growths and Flood Preconditioning for Tailings Dams", commenced in 2022 with the objectives to optimize plant survival on tailings by testing growth medium mixes, pot size, and pre-conditioning to flooding and to expand the number of primary species under study to reflect those native to other regions containing coal fields.

8.3 Rehabilitation Activities for the Next Reporting Period (2022)

Rehabilitation activities will be carried out in line with the MGO Rehabilitation Management Plan (RMP) / Mining Operations Plan (MOP). A total of approximately 30.5 ha rehabilitation is planned for MGO in 2022. This includes approximately 22.5 ha across the Mt Owen site whilst 8 ha at Ravensworth East.

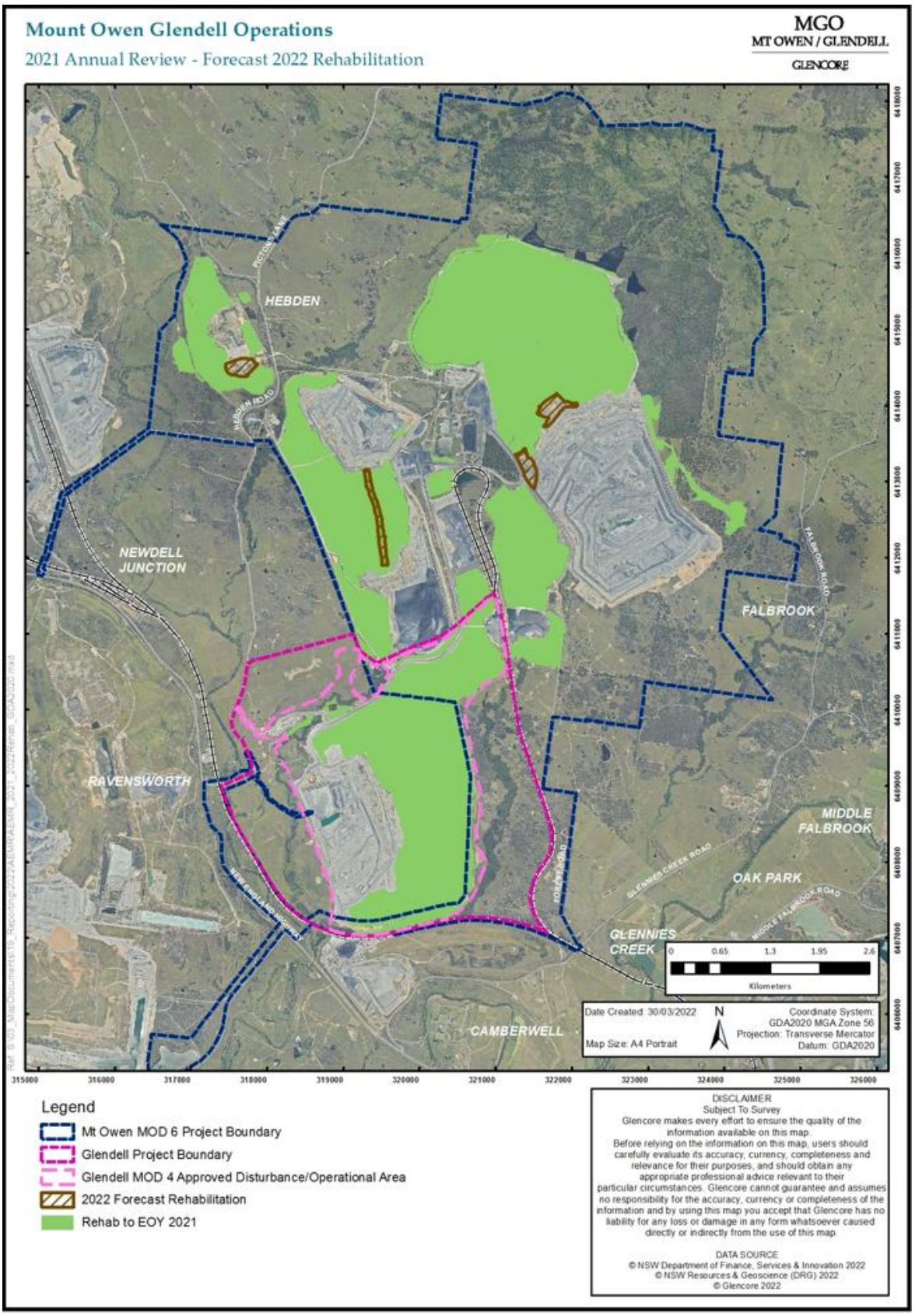

Figure 32: Mt Owen Complex Proposed Rehabilitation for 2022

9. Community

9.1 Community Engagement and Activities 2021

During the reporting period, informal discussions continued with local landowners, regulatory authorities and other stakeholders on the status of operational activities within MGO.

MGO implemented the community engagement program, consisting of:

- One-on-one meetings with:
  - community neighbours
  - regulators
  - non-governmental organisations
- Distribution of Community Newsletters
- Community Consultative Committee (CCC) meetings.
- Informal community gatherings

Topics of discussion included:

- Progress of development applications
- Progress of MOP / RMP
- Current operational environmental performance
- Environmental monitoring results
- Rehabilitation progress.

Details of community engagement activities undertaken at MGO during 2021 are included in ***Table 67***.

Table 67: Community Engagement Activities for 2021

Date	Community Group	Community Activity	Topics Covered
29 April 2021	CCC	Community Consultative Committee Meeting	General overview of MGO operations, environmental performance, approvals update, exploration activities update and Integra Mine update.
31 May 2021	Glennies Creek Community	Coffee and a Chat	General overview of MGO operations and environmental performance.
18 June 2021	Aboriginal Cultural Heritage Working Group Meeting	Biannual Meeting	Meeting prepared and not held due to lack of stakeholder turnout.
28 October 2021	CCC	Community Consultative Committee Meeting	General overview of MGO operations, environmental performance, approvals update, exploration activities update and Integra Mine update. Meeting was held via Zoom due to Covid-19 restrictions.

Date	Community Group	Community Activity	Topics Covered
8 December 2021	Hebden Community	Coffee and a Chat	General overview of MGO operations and Environmental performance followed by Working Bee at Hebden Hall.
15 December 2021	Aboriginal Community	Opening of Minimbah Teaching and Keeping Place	General overview of MGO operations, environmental performance, approvals update, aboriginal cultural heritage update, Integra Mine update and York's Creek Voluntary Conservation Area update. Meeting was held in conjunction with United Wambo Joint Venture and Bulga Coal.
20 December 2021	Singleton Neighbourhood Centre	Donation drop off and delivery	MGO donations were delivered to the neighbourhood centre.

MGO organised community coffee events at Hebden and Glennies Creek for the residents of the Goorangoola, Falbrook, and Hebden areas, as well as the CCC representatives. These events provided an opportunity to discuss topics such as:

- Post-mining land use
- Rehabilitation
- Updates on the MGO projects
- Feral animal control
- Air quality, blast and noise management.

9.2 Community Contributions

Table 68 summarises the community contributions made by MGO during 2021.

Table 68: MGO Community Contributions 2021

Date	Organisation	Reason for Contribution	Amount
February 2021	Singleton Council	Local historic heritage documentary production	$3,028
February 2021	Police Citizens Youth Club	Friday Afternoon Fun Program	$5,250
June 2021	Darlington Rural Fire Brigade	Supply of industrial fridge to brigade shed	$2,524
June 2021	Wildlife Aid	Food and medical supplies for injured animals	$2,017.63
July 2021	RSPCA	Supply of washing machine for use at the Rutherford facility	$2,300

Date	Organisation	Reason for Contribution	Amount
August 2021	Upper Hunter Community Services	Books in Homes program	$462.88
November 2021	Westpac Rescue Helicopter Service (see ***Figure 33***)	Contribution to the service to continue Glencore's support	$10,000
December 2021	Samaritans Foundation Diocese of Newcastle	Samaritans Christmas Lunch - Singleton	$3,000
December 2021	Singleton Fire Station	Singleton Lolly Run	$2,000
December 2021	Hebden Community Hall	Working bee upgrades and maintenance to the Hall	$2,552
December 2021	Mt Pleasant Public School	Supply of laptops to assist in remote learning	$6,228.5
December 2021	Mt Olive Community Centre	Construction of a carpark barrier fence at the Hall	$6,501
MGO Total Community Contributions			**$45,860**

Figure 33: Westpac Rescue Helicopter Contribution.

9.3 Summary of MGO Community Complaints

MTO received 1 community complaint during 2021 related to:

- Noise and air quality.

Glendell and Ravensworth East received a total of 3 community complaints during 2021 consisting of:

- 2 for noise, and
- 1 for air quality.

MGO responded and investigated to all complaints received during 2021. All complaints are contained within the Community Complaints Register which is available on the Glencore website: https://www.glencore.com.au/. Further information can be found in ***Appendix H***.

9.4 Complaint Trends and Actions

In 2021 Mt Owen received one community complaint, compared to four received in 2020 (see ***Figure 34***). Glendell received three community complaints in 2021, a large decrease on 12 complaints received in 2020 (see ***Figure 34***).

Each complaint is investigated individually for compliance.

During 2021, noise-related complaints made up the majority. However, complaints often aligned with unsuitable meteorological conditions such as temperature inversions. Temperature inversions are monitored across MGO daily to reduce these noise impacts. Furthermore, MGO operates a real time noise monitoring system (with alarms) to assist Supervisors in adjusting operations, which ultimately reduces noise during periods of increased risk.

Air Quality across MGO is continually monitored through a system of meteorological predictions, modelling and reactive alarming systems. As operations progress, these systems are reviewed and revised to ensure air quality is appropriately managed.

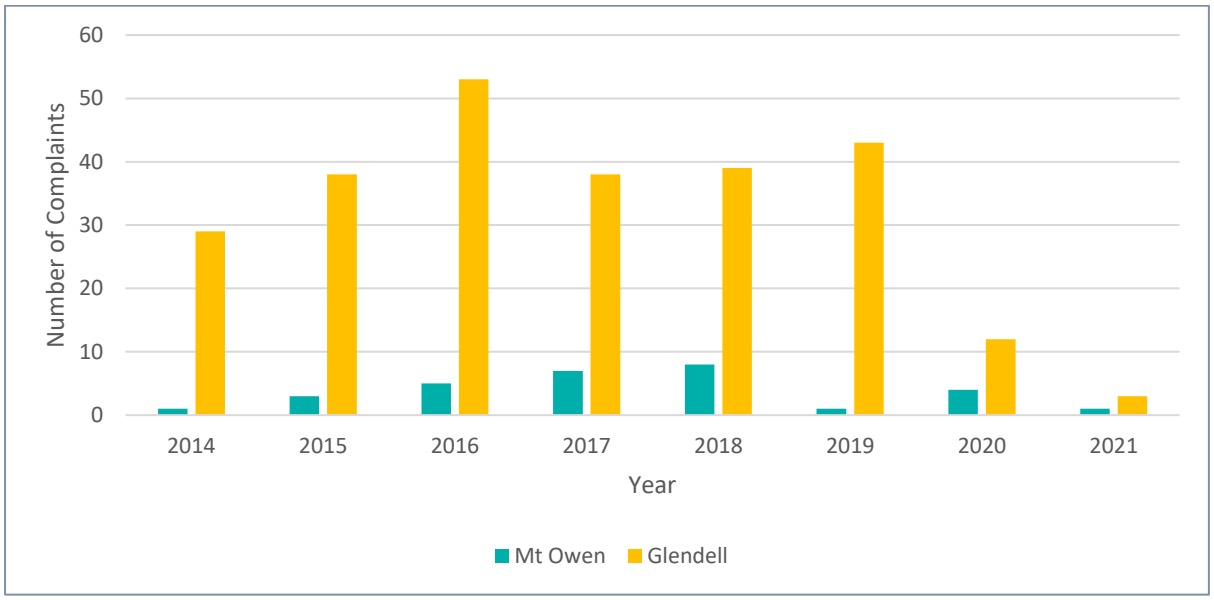

Figure 34: Comparison of Complaints Received at Mt Owen and Glendell from 2014 to 2021

10. Incidents and Non-Compliances

MGO reported one (1) non-compliance during 2021, as detailed in ***Table 69***.

Table 69: Non-Compliance Reported in 2021

Agency	Approval	Description	Follow up/ Action taken
NSW DPIE, EPA	DA 80/952, Schedule 3, Condition 2 and EPL-12480 Condition L3.3	Breach of Operational Noise conditions at location N9 on 10 August 2021.	– Exceedance at monitoring location N9 on 10 August 2021 was investigated and corrective actions were implemented. – DPIE & the EPA were notified via email 11 August 2021. – An additional noise monitoring test was scheduled at location N9 within one week of the exceedance (on 14 August 2021) in accordance with the approved Noise Management Plan. – Noise exceedance report developed – submitted to DPIE 20 August 2021. – Corrective Action Plan was submitted within the noise exceedance report to decrease likelihood of recurrence. – No additional remediation measures directed by the DPIE. – MGO provided written notification to all affected landowners regarding exceedance of noise criteria as well as results of the retest which were found to be back within compliance criteria. – DPIE provided correspondence noting that the management actions implemented in response to the exceedance were consistent with the approved Noise Management Plan (6 September 2021). – MGO reviewed approved Noise Management Plan as per Schedule 5, Condition 6(b) of DA 80/952 with no revision of the plan required.

11. Independent Environmental Audit

An independent environmental audit (IEA) is required for MGO every three years and was conducted by Jacobs during December 2020. The audit covered the period 31 October 2017 to 2 December 2020, and consisted of a desktop review of documentation, interviews with key MGO personnel, and a field inspection.

The IEA was conducted generally in accordance with the *State Significant Developments Independent Audit Guideline, October 2015* (DPIE), *ISO 14001:2015 Environmental management systems* and *ISO 19011:2018 Guidelines for auditing management systems* and was submitted to DPIE in February 2021.

The audit identified seven non-compliance recommendations. All seven issues were classified as administrative in nature and no 'high-risk' non-compliances were identified.

Table 70 summarises MGO's response to the findings of the audit IEA findings and the associated action plan as submitted to DPIE on the 19 February 2021. All actions relating to the audit recommendations are now complete.

The 2020 IEA report and MGO response to audit recommendations are located on the MGO website: *https://www.mtowencomplex.com.au/en/Pages/home.aspx*.

Table 70: MGO Response and Action Plan for 2020 IEA Recommendations

Ref	Requirement	Auditors Recommendation	Risk Level	MGO Response and Action Plan	Timing
SSD 5850 Non-compliance Recommendations					
1	Schedule 2, Condition 17	Ensure all required consultation is documented in CMO	**Administrative**	Following finalisation of the Planning Agreement (PA) with Singleton Council, MGO will maintain record of consultation as required by the condition.	Completed July 2021
2	Schedule 3, Condition 5	Conduct an internal review of the NMP and operating procedures relating to noise to determine if any improvements can be made and communication to those with responsibility for noise control	**Administrative**	Since the incident relating the noise exceedance on 17 June 2020, MGO has reviewed the Noise Management Plan and associated management processes which did not identify the need for any further action. A record of this review was submitted to DPIE on 4 August 2020. No further action is required to address this recommendation.	Completed in 2020
3	Schedule 3, Condition 15	Ensure Preblast procedures are complaint with the Blast Management Plan and the approvals and reinforce with training the timing requirements of the BMP and approvals.	**Administrative**	Since the blast miscapture incident on 5 September 2018, MGO implemented improved communication methods to ensure that personnel servicing blast monitoring equipment and their respective task coordinators were aware of blasting activities at both	Completed in 2020

Ref	Requirement	Auditors Recommendation	Risk Level	MGO Response and Action Plan	Timing
				Glendell and Mt Owen mining areas. Pre-blast assessments now also require review of monitor status prior to blasting. No further action is required to address this recommendation.	
4	Schedule 3, Condition 15 (c)	Condition is explicit in requiring a Road Closure plan however mine plans indicate that this will not be required in life of mine. MGO should seek permission from DPIE to forego the requirement for a road closure plan.	**Administrative**	MGO views the requirement for this plan to not have been triggered as mining is not anticipated to be within 500m of a public road. Section 3.5 of the approved MGO Blast Management Plan details that this plan will be developed should mining be planned within 500m of a public road. Nonetheless, MGO will seek clarification from DPIE that the Road Closure Management Plan is not required unless mining with 500m of a public road.	Completed June 2021
5	Schedule 3, Condition 16 & 18	Ensure compliance with the Air Quality Management Plan and approvals requirements when managing air quality. Review training needs and retrain if required.	**Administrative**	MGO continues to implement the controls identified in the Air Quality Management Plan to maintain compliance with approval conditions. This includes the provision of training in management of air quality for mine personnel. MGO will review for adequacy air quality training needs and reassess if required.	Completed June 2021
DA 80/952 Non - compliance Recommendations					
6	Schedule 3, Condition 4	Revise the quarterly noise monitoring summary report by inclusion of a statement of compliance for cumulative noise.	**Administrative**	MGO's Noise Management Plan describes the processes in place for reasonable and feasible management of cumulative noise impacts with neighbouring mines. This includes a process for monitoring all noise sources from the real time monitoring system, regular interaction meetings with neighbouring mines, a protocol for triggering detailed cumulative noise assessments and a process for notifying neighbouring mines if attended noise monitoring identifies other	Completed June 2021

Ref	Requirement	Auditors Recommendation	Risk Level	MGO Response and Action Plan	Timing
				mines noise to be of concern. MGO believes that these measures satisfy the requirement of the approval condition however, MGO will undertake a review of existing processes in relation to management of cumulative noise including options for assessment of compliance.	
7	Schedule 3, Condition 20	Ensure compliance with the Air Quality Management Plan and approvals requirements when managing air quality. Review training needs and retrain if required.	**Administrative**	This recommendation is a duplicate to that of recommendation number 5. As MOC is operated as a complex, no additional action is required to address this separately to that already list above.	N/A

12. Activities to Improve Environmental Management in 2022

Table 71 lists activities that aim to improve the overall environmental performance at MGO and are scheduled to be undertaken during 2022.

Table 71: Performance Improvement for 2022

Aspect	Implementation Timeframe	Effect on Management Plans	Improvement Action
Biodiversity Offset Strategy	Q4 2022	Biodiversity Offset Management Plan will require update.	Remaining biodiversity credit retirement to be sought for Glendell DA80/952 Mod 4, Mt Owen SSD-5850 Mod 2, Mt Owen SSD-5850 Mod 5 and Mt Owen SSD-5850 Mod 6 via land-based offsets with security mechanism via Biodiversity Stewardship Agreement. Four land-based offsets include mine owned land being Esparanga, Mitchell Hills, Stringybark and Cross Creek offset areas.
Mt Owen North Pit owner-operate	Q4 2022	Nil.	Glencore to take over day to day operations of Mt Owen North Pit from 1 January 2023. Although existing Management Plans and external website managed by Glencore, Mt Owen North Pit procedures and forms to be developed which integrate existing Thiess documents.
Groundwater Management	Q4 2022	Ground Water Management and Monitoring Plan will require update.	As per recommendations made during the 2021 Annual Groundwater Review, MGO will measure the total depth of bores to verify that existing bore depth information is correct and to help identify where there may be blockages, and to inform GWMMP trigger reviews
Groundwater Management	Q4 2022	Ground Water Management and Monitoring Plan will require update.	As per recommendations made during the 2021 Annual Groundwater Review, MGO will revise groundwater triggers to account for natural variability and predicted drawdown impacts for the coal measures. Water quality triggers will also be revised based on the updated bore network information and calculated for the different groundwater units building on baseline data. Update the GWMMP to reflect these changes.

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APPENDIX A – Correspondence

Department of Planning and Environment

Jason Desmond
Environment and Community Manager
Mt Owen / Glendell Operations – Glencore
Wonnarua Country
Hebden NSW 2330

20/06/2022

Dear Mr Desmond

Mt Owen / Glendell Operations (SSD-5850 and DA 80/952)
2021 Annual Review - Request for Additional Information

I refer to the 2021 Annual Review submitted to the Department of Planning and Environment (the department) as required under Schedule 5 condition 5 of SSD-5850 as modified for Mt Owen and Ravensworth East operations and Schedule 5 condition 5 of DA 80/952 as modified for Glendell operations.

After careful consideration, the department requests that you submit a revised document that addresses the following –

- Transport rates – please provide details of ROM coal and/or crushed gravel transported by conveyor to the Liddell Coal Mine and/or Ravensworth Coal Terminal to allow confirmation of compliance with Schedule 2 Condition 8 of SSD 5850.
- Noise monitoring –
  - Section 6.1.3 states 'A copy of the assessment report developed by Thearle Engineering is included in Appendix D'. However sound power level results are not in Appendix D.
  - Section 6.1.3 refers to noise monitoring results in Appendix D. However, there are no noise monitoring results in Appendix D.
- Air Quality
  - Section 6.3.3 states that the full Haul Road Control Efficiency Monitoring report is provided in Appendix F. Road Control Efficiency Monitoring report is not provided in Appendix F.
  - Section 6.3.3 states 'Further information on the air quality data can be found in the independent air quality report, prepared by a suitably qualified air quality specialist, in Appendix F.' The independent air quality report is not included in Appendix F.
  - Section 6.3.1 states 'Appendix F Tables 32 - 36 present the monitoring results for 2021 and for recent years'. Please revise the table number references.
- Groundwater
  - No groundwater trend data has been presented.
  - No comparison to EIS predictions for groundwater has been presented.
  - include water taken in the previous 'water year' (1 July to 30 June) not 2021 Annual Review reporting period.
  - Section 7.4.4 describes recommendations made by the 2021 Annual Groundwater Review. Please update the report (Section 12) to include recommendations as firm commitments for 2022.
- Biodiversity
  - Section 6.4.3.1 refers to monitoring methods in Annexure D of the Conservation Agreements, however the Conservation Agreements are not publicly available so monitoring method and performance indicators cannot be checked. The Biodiversity and Offset Management Plan and Strategy version 3 dated 13/9/2021 (available on website)

describes monitoring commitments for monitoring of the Conservation Agreements offset areas. Please update the AR to clarify which MGO document has the latest monitoring requirements and performance criteria for the Conservation Agreements Offsets.
    - The AR does not include a comprehensive review of biodiversity area flora and fauna monitoring results that includes a comparison of these results against the relevant statutory requirements, limits or performance measures/criteria.
    - The performance indicators and completion criteria in the BOMP largely comprise completion of actions (e.g. installation of nest boxes and river oak tree planting). The AR does not provide a clear review of whether these performance indicators for 2021 have been met (i.e. specific actions undertaken). The summary of rehabilitation compliance against MOP completion criteria and whether TARP was triggered for each rehab area (in Section 8.1.1) would be an appropriate summary for monitoring and management of offset areas.
- Rehabilitation – update Section 8.2 to clarify trials and research and their outcomes
- Typographic errors –
    - Bookmark errors in List of Tables
    - Section 6.1.2 cross references to Table 19 in text

You are requested to provide an amended Annual Review report, or notification that the report will not be provided, to the department by close of business Tuesday 5 July 2022. If you are unable to provide the requested revision within this timeframe, you are required to provide, and commit to, a timeframe detailing the provision of this information. Such an extension can be requested through the Major Projects portal.

If you have any questions, please contact Jennifer Sage, Compliance Officer who can be contacted on 0400 245 170 or email to compliance@planning.nsw.gov.au.

Yours sincerely

HWatters

Heidi Watters
Team Leader Northern
Compliance

APPENDIX B – Daily Train Movements

Table 1: Daily Train Movements and Tonnes Loaded 2021

Date	Number of Trains Per Day	Tonnes Loaded
1/01/2021	4	36895
2/01/2021	2	18590
3/01/2021	4	37104
4/01/2021	4	37215
5/01/2021	1	9300
6/01/2021	4	37210
7/01/2021	1	9256
8/01/2021	2	18560
9/01/2021	1	9305
10/01/2021	3	27960
13/01/2021	2	13198
14/01/2021	1	4123
15/01/2021	3	17606
16/01/2021	8	58759
17/01/2021	3	17757
18/02/2021	4	37193
19/01/2021	1	9232
20/01/2021	2	18476
21/01/2021	2	18636
22/01/2021	2	18608
23/01/2021	3	27701
24/01/2021	1	9312
25/01/2021	2	18460
26/01/2021	1	9334
27/01/2021	5	46800
28/01/2021	2	18631
29/01/2021	3	24304
30/01/2021	2	18524
31/01/2021	3	28030
1/02/2021	1	9337
2/02/2021	1	9358
3/02/2021	1	9355
4/02/2021	3	27955
5/02/2021	4	37311
6/02/2021	5	46507
7/02/2021	6	55978
8/02/2021	1	9375
13/02/2021	1	9365
14/02/2021	5	46575

Date	Number of Trains Per Day	Tonnes Loaded
15/02/2021	2	18637
17/02/2021	1	9363
19/02/2021	1	8979
20/02/2021	1	9234
21/02/2021	4	36920
22/02/2021	3	28055
24/02/2021	2	18677
25/02/2021	4	37327
26/02/2021	4	36761
27/02/2021	5	46193
28/02/2021	5	45629
1/03/2021	5	45948
2/03/2021	4	36825
3/03/2021	5	46692
4/03/2021	6	55944
5/03/2021	1	9050
6/03/2021	4	36986
7/03/2021	3	27947
8/03/2021	2	10083
9/03/2021	2	18689
10/03/2021	1	9363
11/03/2021	4	36617
12/03/2021	4	36936
13/03/2021	4	37173
14/03/2021	1	8888
15/03/2021	3	27760
16/03/2021	2	18355
17/03/2021	1	9160
18/03/2021	1	9312
24/03/2021	1	9133
25/03/2021	2	18590
26/03/2021	2	18534
27/03/2021	2	18650
28/03/2021	2	18608
29/03/2021	2	18570
30/03/2021	3	27200
31/03/2021	1	9371
1/04/2021	1	9248
2/04/2021	3	28021
3/04/2021	6	55524
4/04/2021	3	27740
7/04/2021	1	9074
9/04/2021	1	9319

Date	Number of Trains Per Day	Tonnes Loaded
10/04/2021	2	18557
11/04/2021	1	9223
12/04/2021	3	27173
13/04/2021	1	9336
14/04/2021	4	37195
15/04/2021	1	9206
16/04/2021	4	36867
17/04/2021	1	9313
18/04/2021	3	27989
19/04/2021	2	18670
20/04/2021	5	46528
21/04/2021	1	9311
22/04/2021	1	9200
23/04/2021	1	9265
25/04/2021	1	9378
26/04/2021	1	9352
27/04/2021	1	9370
30/04/2021	5	45886
1/05/2021	7	65136
2/05/2021	6	55800
3/05/2021	5	46115
4/05/2021	2	18544
5/05/2021	1	9341
6/05/2021	3	27999
7/05/2021	3	27531
9/05/2021	1	9232
10/05/2021	1	9185
11/05/2021	1	9147
12/05/2021	1	9336
13/05/2021	3	27948
14/05/2021	1	9118
15/05/2021	1	9320
16/05/2021	2	18666
17/05/2021	3	27325
19/05/2021	2	18254
20/05/2021	4	37097
21/05/2021	2	18705
22/05/2021	4	37221
23/05/2021	7	65048
24/05/2021	1	9343
28/05/2021	5	46697
29/05/2021	4	36992
30/05/2021	4	37226

Date	Number of Trains Per Day	Tonnes Loaded
31/05/2021	1	9291
1/06/2021	1	9087
2/06/2021	1	9334
3/06/2021	1	9307
5/06/2021	1	9270
6/06/2021	1	9199
7/06/2021	1	9283
8/06/2021	1	9108
9/06/2021	2	18518
10/06/2021	1	9119
11/06/2021	1	9144
13/06/2021	2	18699
14/06/2021	1	9384
16/06/2021	2	18123
17/06/2021	2	18056
18/06/2021	2	17958
19/06/2021	5	46019
20/06/2021	2	18599
22/06/2021	1	9165
24/06/2021	1	9071
25/06/2021	1	9291
26/06/2021	3	27705
27/06/2021	2	18481
28/06/2021	2	18656
29/06/2021	2	18642
30/06/2021	1	9330
1/07/2021	2	18312
2/07/2021	2	18512
3/07/2021	1	9006
7/07/2021	3	28056
8/07/2021	2	18632
9/07/2021	5	46505
10/07/2021	6	55702
11/07/2021	6	55302
12/07/2021	4	36942
13/07/2021	4	36987
14/07/2021	4	36312
15/07/2021	4	36644
16/07/2021	1	9274
17/07/2021	4	37375
18/07/2021	4	37134
19/07/2021	3	27895
20/07/2021	6	55551

Date	Number of Trains Per Day	Tonnes Loaded
21/07/2021	2	18357
22/07/2021	2	18349
23/07/2021	4	37007
25/07/2021	2	18352
26/07/2021	3	27355
27/07/2021	2	18382
28/07/2021	1	9211
30/07/2021	2	18595
31/07/2021	2	18306
1/08/2021	4	37162
2/08/2021	2	18567
3/08/2021	1	9189
4/08/2021	2	18237
5/08/2021	6	55423
6/08/2021	3	27780
7/08/2021	4	36791
8/08/2021	4	36606
13/08/2021	1	9307
14/08/2021	6	55267
15/08/2021	5	41090
16/08/2021	3	17480
17/08/2021	3	27560
18/08/2021	2	13243
19/08/2021	2	13250
20/08/2021	1	9296
21/08/2021	2	18321
22/08/2021	3	27164
23/08/2021	4	36653
24/08/2021	3	27541
25/08/2021	4	31712
26/08/2021	2	18359
27/08/2021	2	13129
28/08/2021	3	17364
29/08/2021	2	18475
30/08/2021	3	22707
31/08/2021	4	27025
1/09/2021	1	5518
2/09/2021	3	27604
3/09/2021	3	27372
6/09/2021	2	17391
7/09/2021	1	9018
8/09/2021	5	44935
9/09/2021	3	26879

Date	Number of Trains Per Day	Tonnes Loaded
10/09/2021	3	22479
11/09/2021	4	26585
12/09/2021	3	17604
13/09/2021	2	13429
15/09/2021	1	4184
16/09/2021	2	17926
17/09/2021	3	27054
18/09/2021	1	9076
19/09/2021	3	26633
20/09/2021	1	9182
21/09/2021	3	22604
22/09/2021	3	17428
23/09/2021	5	35514
24/09/2021	1	9233
25/09/2021	2	18528
26/09/2021	4	37012
27/09/2021	4	35636
28/09/2021	3	27373
29/09/2021	1	8975
1/10/2021	1	9086
2/10/2021	3	22324
3/10/2021	4	21506
7/10/2021	2	18537
8/10/2021	1	9086
9/10/2021	4	36878
10/10/2021	3	27562
11/10/2021	4	36821
12/10/2021	2	18267
13/10/2021	2	18378
14/10/2021	3	27762
15/10/2021	1	9323
16/10/2021	3	27427
17/10/2021	2	18318
18/10/2021	1	9275
19/10/2021	1	9094
20/10/2021	3	27843
21/10/2021	3	27906
22/10/2021	2	18703
23/10/2021	4	37307
24/10/2021	3	27837
25/10/2021	1	8970
27/10/2021	2	18464
28/10/2021	3	27297

Date	Number of Trains Per Day	Tonnes Loaded
29/10/2021	3	27881
30/10/2021	1	9330
31/10/2021	2	18704
1/11/2021	2	18572
2/11/2021	3	27861
3/11/2021	5	46158
4/11/2021	5	46487
5/11/2021	3	27754
6/11/2021	4	36006
7/11/2021	6	54873
8/11/2021	2	18280
9/11/2021	2	18532
10/11/2021	3	27420
12/11/2021	1	9154
13/11/2021	1	9286
14/11/2021	3	17617
15/11/2021	2	13392
16/11/2021	4	26923
17/11/2021	3	22551
18/11/2021	4	36960
19/11/2021	3	27604
20/11/2021	3	27808
21/11/2021	2	18541
29/11/2021	1	9267
30/11/2021	4	36930
1/12/2021	3	17713
2/12/2021	5	35927
3/12/2021	3	22543
4/12/2021	5	40968
5/12/2021	3	13750
6/12/2021	4	31790
7/12/2021	5	35898
8/12/2021	4	31542
9/12/2021	3	22496
10/12/2021	1	9123
11/12/2021	2	13266
12/12/2021	2	13282
13/12/2021	5	45698
14/12/2021	2	18303
15/12/2021	4	36659
17/12/2021	1	9319
18/12/2021	2	18611
20/12/2021	5	46489

Date	Number of Trains Per Day	Tonnes Loaded
21/12/2021	1	9282
22/12/2021	1	9268
23/12/2021	2	18647
24/12/2021	1	9314
27/12/2021	2	18631
28/12/2021	1	9346
29/12/2021	1	9335
30/12/2021	3	27930
31/12/2021	2	18602
Total	**804**	**7,107,770**

APPENDIX C - Environmental Incidents

Environmental incidents at MGO are classified into six categories (based on Glencore's Internal Incident Reporting):

- Nil Category: below category 1.
- Category 1: Negligible - An incident that causes negligible, reversible environmental impact, requiring very minor or no remediation.
- Category 2: Minor – An incident that causes minor, reversible environmental impacts, require minor remediation.
- Category 3: Significant – An incident that has caused moderate, reversible environmental impact with short-term effect, requiring moderate remediation.
- Category 4: Serious – An incident that has caused significant environmental impact, with medium-term effect, requiring significant remediation.
- Category 5: Disastrous – An incident that has caused disastrous environmental impact, with long-term effect, requiring major remediation.

A summary of environmental incidents at MGO during the reporting period is provided in Table 2.

Table 2: Environmental Incidents 2021

No.	Incident Date	Incident Category	Incident Type	Response
Glendell and Ravenworth East				
1	12-Jan-21	1	Hydraulic oil spill	Spill was contained and cleaned up; a new hose was fitted to prevent the incident reoccurring.
2	14-Jan-21	Nil	Oil spill	Machine shutdown and spill was contained and cleaned up.
3	21-Jan-21	Nil	Pipe leak	Damaged pipe was drained and replaced.
4	09-Feb-21	Nil	Coolant spill	Spill was contained and cleaned up.
5	11-Feb-21	Nil	Oil spill	Spill was contained and cleaned up.
6	12-Feb-21	Nil	Water spill	Damaged pipe was drained and replaced.
7	13-Feb-21	1	Diesel spill	Fuel tank of the rail locomotive was drained to prevent further spillage. Spill was contained and cleaned up.
8	17-Feb-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
9	15-Mar-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up. Faulty tube replaced to prevent further issues.
10	21-Mar-21	1	Hydraulic oil spill	Spill was contained and cleaned up.
11	27-Mar-21	1	Hydraulic oil spill	Spill was contained and cleaned up.
12	31-Mar-21	1	Oil spill	Spill was contained and cleaned up.
13	14-Apr-21	Nil	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.

No.	Incident Date	Incident Category	Incident Type	Response
14	27-Apr-21	2	Hydrocarbon spill	Machine shutdown and spill was contained and cleaned up.
15	01-May-21	1	Hydrocarbon spill	Machine shutdown and spill was contained and cleaned up.
16	06-May-21	1	Hydrocarbon spill	Machine shutdown and spill was contained and cleaned up.
17	18-May-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
18	25-May-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
19	27-May-21	1	Coolant spill	Machine shutdown and spill was contained and cleaned up.
20	29-May-21	1	Oil spill	Spill was contained and cleaned up.
21	09-Jun-21	Nil	Oil spill	Spill was contained and cleaned up.
22	21-Jun-21	1	Elevated level of fume emitted from blast in Bayswater North NO4	Fume trace was monitored via video. MGO Environment and Community personnel investigated the issue.
23	22-Jun-21	Nil	Diesel spill	Spill was contained and cleaned up.
24	23-Jun-21	Nil	Diesel spill	Spill was contained and cleaned up.
25	28-Jun-21	1	Oil spill	Spill was contained and cleaned up.
26	30-Jun-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
27	01-Jul-21	1	Coolant spill	Machine shutdown and spill was contained and cleaned up.
28	01-Jul-21	1	Coolant spill	Machine shutdown and spill was contained and cleaned up.
29	08-Jul-21	1	Coolant spill	Spill was contained and cleaned up.
30	09-Jul-21	Nil	Oil spill	Machine shutdown and spill was contained and cleaned up.
31	09-Jul-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
32	12-Jul-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
33	28-Jul-21	Nil	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
34	29-Jul-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
35	02-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
36	02-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
37	02-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
38	03-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
39	03-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
40	03-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.

No.	Incident Date	Incident Category	Incident Type	Response
41	03-Aug-21	Nil	Q1 Ground water monitoring triggers as per GWMMP	Results reviewed as per MGO ground water monitoring result investigation form.
42	18-Aug-21	1	Diesel spill	Spill contained and cleaned up.
43	24-Aug-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
44	28-Aug-21	1	Oil spill	Machine was shut down and spill was contained and cleaned up.
45	10-Sep-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
46	14-Sep-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
47	17-Sep-21	Nil	Sediment dam 7 poly pipe leak	Area was inspected and it was confirmed that water did not leave the premises. Pump was isolated.
48	19-Sep-21	1	Hydrocarbon spill	Machine shutdown and spill was contained and cleaned up.
49	23-Sep-21	1	Hydrocarbon spill	Machine shutdown and spill was contained and cleaned up.
50	01-Oct-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
51	14-Oct-21	Nil	Q2 Ground water monitoring triggers as per GWMMP	Results reviewed as per MGO ground water monitoring result investigation form.
52	24-Oct-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
53	26-Oct-21	1	Oil spill	Spill was contained and cleaned up.
54	04-Nov-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
55	13-Nov-21	1	Oil spill	Spill was contained and cleaned up.
56	18-Nov-21	Nil	Surface water monitoring triggers as per SWMMP	Results reviewed as per MGO surface water monitoring result investigation form.
57	18-Nov-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
58	22-Nov-21	1	Oil spill	Spill was contained and cleaned up.
59	29-Nov-21	Nil	Q3 Ground water monitoring triggers as per GWMMP	Results reviewed by Umwelt Environmental consultants as per MGO ground water monitoring results investigation form.
60	15-Dec-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up.
Mount Owen				
1	07-Jan-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
2	11-Jan-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
3	18-Jan-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
4	19-Jan-21	Nil	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up.
5	19-Jan-21	Nil	Hydrauilc oil spill	Machine shutdown and spill was contained and cleaned up.

No.	Incident Date	Incident Category	Incident Type	Response
6	21-Jan-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
7	04-Feb-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
8	09-Feb-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
9	09-Feb-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
10	18-Feb-21	1	Procedural breach of C12E ground disturbance permit	MGO Environment and Community personnel were notified and the issue was investigated.
11	23-Feb-21	1	Hydraulic oil spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
12	11-Mar-21	2	Diesel and hydraulic oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
13	08-Apr-21	2	Diesel spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
14	13-Apr-21	Nil	Noise exceedance at N3 during attended noise monitoring	Mt Owen OCE and MGO Environment and Community personnel were notified.
15	23-Apr-21	Nil	Mine Water Spill into SD11	Environment and Community manager was notified, and area was remediated.
16	23-Apr-21	1	Overpressure above 115dB at MOC2 and procedural breach of Mt Owen Explosives Pre-Blasting Activities Procedure	Overpressure and vibration results of shot were reviewed, dust emissions were monitored. MGO Environment and Community personnel investigated the issue.
17	27-Apr-21	1	Hydraulic oil spill	Spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
18	28-Apr-21	1	Hydraulic oil spill	Spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
19	04-May-21	Nil	Zero filter left on Sx13 D5 from 29 April to 3 May 2021	A technician was sent to remove the filter immediately.
20	13-May-21	1	Dirty water spill from pump truck	The spill was contained and recovered using a vacuum truck.
21	17-May-21	1	Oil spill	Spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
22	01-Jun-21	Nil	Suspected asbestos dumping off-site (buffer lands)	The site was inspected, and the discovery was reported to the EPA via the hotline.
23	26-Jul-21	1	Water supply pipeline leak	Pump was stopped. The area was inspected to determine the extent of the leak and the leak was contained. Pipe was repaired.
24	13-Aug-21	1	Noise exceedance at N9 during	Possible source of the noise was identified as dover DZ454 and the machine was shut down. Noise continued to be managed via the Dust and Noise Analysis Tool and truck

No.	Incident Date	Incident Category	Incident Type	Response
			attended noise monitoring	speeds were reduced. The EPA and DPIE were informed of the incident.
25	24-Aug-21	2	Diesel spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
26	31-Aug-21	Nil	Hydraulic oil leak	Spill was contained and cleaned up.
27	31-Aug-21	Nil	Diesel spill	Spill was contained and cleaned up; contaminated material was taken to the bioremediation area.
28	03-Sep-21	Nil	Power loss to air quality monitor SX13D10 due to vandalism	Area was made safe and power was re-established.
29	12-Oct-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
30	12-Oct-21	1	Oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
31	20-Oct-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
32	28-Oct-21	1	Hydraulic oil spill	Machine shutdown and spill was contained and cleaned up. Contaminated material taken to the bioremediation area.
33	18-Nov-21	1	Hydraulic oil spill	Spill was contained and cleaned up.
34	24-Nov-21	Nil	Hydraulic oil leak	Machine shutdown and spill was contained and cleaned up.

APPENDIX D – Noise

Table 3: MOC Noise Monitoring Locations

Monitoring Location	Description of Monitoring Location	Property Location Reference
Sx1	Continuous noise unit located on Property 86	Mt Owen EIS
Sx4	Continuous noise unit located on Property 109	Mt Owen EIS
Sx8	Mt Owen reference continuous noise unit located south east of Mt Owen Mine on Property 66	Mt Owen EIS
Sx6	Mobile Continuous Noise unit – used for targeted monitoring	-
Sx7	Continuous noise unit located to the south of the Glendell Pit	-
Sx11	Refurbished Mobile Continuous Noise unit – used for targeted monitoring	-
Sx12	Continuous noise unit located near Property 31	Glendell EA
Sx122	Mobile Continuous Noise unit – used for targeted monitoring	-
Sx13 M8	Meteorological station located to the west of Mt Owen Mine	-
Sx13 M1	Meteorological station located to the west of Glendell Mine	-
Sx13 M2	Meteorological station located to the east of Glendell Mine	-
N1	Greenlands, to the west of Property 54	Mt Owen EIS
N3	Corner of Falbrook and Middle Falbrook Road	-
N4	Glennies Creek Road adjacent to Property 109	Mt Owen EIS
N8	South of Camberwell Village at Property 7a	Glendell EA
N9	Camberwell Village (central section) adjacent to Property R47	Glendell EA
N10	Camberwell Village (western section) adjacent to Property R27	Glendell EA
N11	Glennies Creek Road adjacent to Property R37a	Glendell EA
N17	Representative of the rural residence on Scrumlo Road, Hebden near property R134	Mt Owen EIS

Inspired People.
Dedicated Team.
Quality Outcomes.

Our Ref: 22219_R01_MGO_NoiseSummary_ltr.docx

8 February 2022

Anthony Billings
Environment and Community Officer
Mount Owen Glendell Operations, Glencore

E| Anthony.Billings@glencore.com.au

Dear Anthony

RE: 2021 Annual Environmental Monitoring Review – Environmental Noise Monitoring Mount Owen Glendell Operations

Umwelt is pleased to provide this letter which summarises the 2021 attended noise monitoring results of the Mount Owen Glendell Operations (MGO) operations, for your inclusion in the 2021 Annual Review.

Attended Noise Monitoring Program Performance

Throughout the reporting period, January 2021 to December 2021, attended noise monitoring was carried out at monthly intervals by Umwelt in accordance with the MGO Noise Management Plan (MGOOC-1779562647-10975, Version 4) (referred to hereafter as the NMP) and in accordance with the additional requirements in Mount Owen Mine's Environment Protection Licence 4460 (EPL4460). At the time of its development, the NMP incorporated the requirements of the Mount Owen EPL4460, the Glendell EPL12840 and consents SSD-5850 and DA 80/952.

However, for some of the reporting period, the noise monitoring requirements of EPL4460 and the NMP did not align. Specifically, EPL4460 has fewer noise assessment groups (i.e. noise monitoring locations) and also required the duration of monitoring undertaken at each location to be 30 minutes, increased from 15 minutes. A revision to EPL4460 in September 2021, returning measurement durations to 15 minutes, re-aligned monitoring requirements with the NMP.

To satisfy the NMP and EPL4460 noise monitoring obligations, Mount Owen undertook parallel but separate noise monitoring programs during 2021. These are referred to as the NMP and EPL noise monitoring programs. The results from both noise monitoring programs have been provided for the January 2021 to December 2021 reporting period. There are also different $L_{A1,1minute}$ criteria at N3 and N4 between EPL4460 and the NMP, which will be made consistent in a future version of the NMP.

Umwelt (Australia) Pty Limited

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Monitoring location N2 was removed from the monitoring program from March 2021, as it was removed from the NMP.

Attended Noise Monitoring Performance Summary

Mount Owen Mine

During the reporting period a total of 162 measurements were undertaken across 10 monitoring locations during the day, evening and night-time periods for Mount Owen Mine. Of these measurements, 86 were reported in the EPL monitoring program and 105 were reported in the NMP monitoring program, noting that some measurements are included in both the EPL and NMP reports.

Table 1 provides an overall monthly compliance summary of the 2021 attended NMP and EPL noise monitoring rounds for the Mount Owen Mine. As shown in **Table 1**, an exceedance of the noise criteria occurred in April 2021 in both monitoring programs.

The exceedance relates to a single $L_{A1,1minute}$ measurement at N3 which is reported in both the EPL and NMP reports and has been reported to the relevant agencies with no further action being requested or undertaken. The measured $L_{A1,1minute}$ during April EPL monitoring at N3 triggered monitoring at supplementary monitoring location N15, where Mount Owen Mine levels were determined to be in compliance. During the NMP monitoring program, a re-measure was undertaken at N3 and Mount Owen Mine noise levels were determined to be in compliance.

Further details regarding the monthly Mount Owen Mine NMP and EPL monitoring results for each location and corresponding noise criteria can be found in **Appendix A** and **Appendix B** respectively.

The monitoring results show that Mount Owen Mine achieved a high level of compliance with 100% of $L_{Aeq,15minute}$ noise levels and 99% of $L_{A1,1minute}$ noise levels complying with the applicable criteria in both the EPL and NMP noise monitoring programs (see **Table 3**).

Glendell Mine

During this reporting period a total of 88 measurements were undertaken across 8 locations during the night period for Glendell Mine.

Table 2 provides an overall monthly compliance summary of the attended NMP noise monitoring results for Glendell Mine. As shown in **Table 2** an exceedance of the $L_{Aeq,15minute}$ and $L_{A1,1minute}$ noise criteria occurred in August 2021. A re-measure and follow-up monitoring was undertaken at N9 in accordance with the NMP. This exceedance at the N9 monitoring location has been reported to the relevant agencies and no further action has been requested or undertaken. Further details regarding the monthly NMP monitoring results for each location and corresponding noise criteria can be found in **Appendix C**.

The monitoring results show that Glendell Mine achieved a high level of compliance with 99% of $L_{Aeq,15minute}$ noise levels and 98% of $L_{A1,1minute}$ noise levels complying with the applicable NMP noise criteria (see **Table 3**).

Table 1 - Summary Compliance Statement for Mount Owen Mine

Monitoring Program / Month in which monitoring was undertaken	All monitoring locations comply with $L_{Aeq,15minute}$ criteria (Yes/No)	All monitoring locations comply with $L_{A1,1minute}$ criteria (Yes/No)
NMP / January 2021	Yes	Yes
EPL / January 2021	Yes	Yes
NMP / February 2021	Yes	Yes
EPL / February 2021	Yes	Yes
NMP / March 2021	Yes	Yes
EPL / March 2021	Yes	Yes
NMP / April 2021	Yes	No
EPL / April 2021	Yes	No
NMP / May 2021	Yes	Yes
EPL / May 2021	Yes	Yes
NMP / June 2021	Yes	Yes
EPL / June 2021	Yes	Yes
NMP / July 2021	Yes	Yes
EPL / July 2021	Yes	Yes
NMP / August 2021	Yes	Yes
EPL / August 2021	Yes	Yes
NMP / September 2021	Yes	Yes
EPL / September 2021	Yes	Yes
NMP / October 2021	Yes	Yes
EPL / October 2021	Yes	Yes
NMP / November 2021	Yes	Yes
EPL / November 2021	Yes	Yes
NMP / December 2021	Yes	Yes
EPL / December 2021	Yes	Yes

Table 2 - Summary Compliance Statement for Glendell

Monitoring Program / Month in which monitoring was undertaken	All monitoring locations comply with $L_{Aeq,15minute}$ criteria (Yes/No)	All monitoring locations comply with $L_{A1,1minute}$ criteria (Yes/No)
NMP / January 2021	Yes	Yes
NMP / February 2021	Yes	Yes
NMP / March 2021	Yes	Yes
NMP / April 2021	Yes	Yes
NMP / May 2021	Yes	Yes
NMP / June 2021	Yes	Yes
NMP / July 2021	Yes	Yes
NMP / August 2021	No	No
NMP / September 2021	Yes	Yes
NMP / October 2021	Yes	Yes
NMP / November 2021	Yes	Yes
NMP / December 2021	Yes	Yes

Table 3 - January 2021 to December 2021 percentage level of compliance with noise criteria for NMP and EPL noise monitoring programs

Mine / Noise monitoring program	Percentage compliance with $L_{Aeq,15minute}$ criteria	Percentage compliance with $L_{A1,1minute}$ criteria
Mount Owen / NMP	100	99
Mount Owen / EPL	100	99
Glendell / NMP	99	98

We trust this information meets with your current requirements. Please do not hesitate to contact the undersigned on 1300 793 267 should you require clarification or further information.

Yours sincerely

Tim Procter
Practice Lead – Acoustic Environment

E | tprocter@umwelt.com.au

APPENDIX A

2021 Mount Owen Mine
NMP Noise Monitoring
Result Tables

Mount Owen Mine 2021 NMP Program, Noise Monitoring Summary – $L_{Aeq,15minute}$ contribution in dB(A)[1,2]

Monitoring Location	Monitoring period	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1	Day	35	<30	N/A	N/A	IA	N/A	N/A	<30	N/A	N/A	<25	N/A	N/A
	Evening	35	IA	N/A	N/A	21	N/A	N/A	<25	N/A	N/A	IA	N/A	N/A
	Night	35	25	IA	IA	IA	26	<25	<30	30	33	34	28	<30
N2[3]	Day	No criteria	37	N/A	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]
	Evening	No criteria	<25	N/A	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]
	Night	No criteria	25	IA	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]	NM[4]
N3	Day	45	<35	N/A	N/A	<40	N/A	N/A	IA	N/A	N/A	<35	N/A	N/A
	Evening	45	IA	N/A	N/A	<25	N/A	N/A	IA	N/A	N/A	33	N/A	N/A
	Night	42	<35	IA	IA	40[5] 38[5]	<30	IA	35	37	<35	36	38	38[5]
N4	Night	42	<35	IA	IA	<30	IA	<35	39	<40	<35	<35	37	35
N8	Night	No criteria	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N9	Night	No criteria	<35	IA	IA	<35	IA	<35	IA	IA	IA	<30	IA	IA
N10	Night	35	<35	IA	IA	IA	IA	<30	IA	IA	IA	<35	IA	<35
N11	Night	35	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	<35

Notes:

1. *"N/A" indicates that day and evening monitoring is not undertaken at this location during these months, as it is only undertaken one month per season (January, April, July and October).*
2. *"IA" indicates that Mount Owen Mine was not audible at this location.*
3. *There is no Mount Owen Mine LAeq,15minute noise criterion for this location.*
4. *"NM" indicates that monitoring at this location was discontinued, as N2 had been removed from V4 of the MGO NMP (from December 2020).*
5. *The Mount Owen Mine LAeq result includes a 2 dB low frequency modifying factor in accordance with Fact Sheet C of the NPfI.*

Mount Owen Mine 2021 NMP Program, Noise Monitoring Summary – $L_{A1,1minute}$ contribution in dB(A)[1]

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1	45	35	IA	IA	IA	34	<25	<35	36	41	40	<45	<35
N2[2,3]	No criteria	<30	IA	IA	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]
N3	45	41	IA	IA	**50**[4] 42[5]	<35	IA	<44	41	44	44	43	42
N4	50	<40	IA	IA	<35	IA	36	44	43	<35	40	<45	40
N8[2]	No criteria	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N9[2]	No criteria	<35	IA	IA	37	IA	<35	IA	IA	IA	<30	IA	IA
N10	45	<40	IA	IA	IA	IA	<35	IA	IA	IA	<35	IA	<35
N11	45	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	<35

Notes:

1. *"IA" indicates that Mount Owen Mine was not audible at this location.*
2. *There is no Mount Owen Mine LA1,1minute noise criterion for this location.*
3. *"NM" indicates that monitoring at this location was discontinued, as N2 had been removed from V4 of the MGO NMP (from December 2020).*
4. *Exceedances of the Mount Owen Mine LA1,1minute noise criterion are shown in bold.*
5. *Re-measure undertaken following an initial exceedance at N3 in April, as per the NMP.*

APPENDIX B

2021 Mount Owen Mine
EPL Noise Monitoring
Result Tables

Mount Owen Mine 2021 EPL Program, Noise Monitoring Summary – $L_{Aeq,15minute}$ contribution in dB(A)[1]

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1	35	25	IA	IA	IA	26	<25	<30	30	33	34	28	<30
N1	35	25	IA	IA	<25	25	<25	<30	31	31	-[2]	-[2]	-[2]
N3	42	<35	IA	IA	40	<30	IA	35	37	<35	36	38	38[3]
N3	42	<35	IA	IA	38	32	IA	36	40	<35	-[2]	-[2]	-[2]
N4	42	<35	IA	IA	<30	IA	IA	<30	<38	<40	<35	37	35
N4	42	<35	IA	IA	<30	<30	IA	<30	35	39	-[2]	-[2]	-[2]
N17	35	IA	28	28	IA	<25	<30	<30	IA	IA	IA	<30	IA
N17	35	IA	28	27	IA	<30	<30	<30	IA	<35	-[2]	-[2]	-[2]
N15	37	-[2]	-[2]	-[2]	<35	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]
N15	37	-[2]	-[2]	-[2]	IA	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]

Notes:

1. *"IA" indicates that Mount Owen Mine was not audible at this location.*
2. *"-" indicates that monitoring was not required at this location, due to it being a secondary location or no longer being required after changes were made to EPL4460 in September 2021.*
3. *The Mount Owen Mine LAeq result includes a 2 dB low frequency modifying factor in accordance with Fact Sheet C of the NPfI.*

Mount Owen Mine 2021 EPL Program, Noise Monitoring Summary – $L_{A1,1minute}$ contribution in dB(A)[1]

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1	45	35	IA	IA	IA	34	<25	<35	36	41	40	<45	<35
N1	45	<30	IA	IA	27	29	<25	35	37	37	-[2]	-[2]	-[2]
N3	49	41	IA	IA	50[3]	<35	IA	<44	41	44	44	43	42
N3	49	42	IA	IA	42	37	IA	<45	44	45	-[2]	-[2]	-[2]
N4	52	<40	IA	IA	<35	IA	IA	<35	42	47	40	<45	40
N4	52	38	IA	IA	<35	<35	IA	<35	40	46	-[2]	-[2]	-[2]
N17	45	IA	33	38	IA	<30	39	<35	IA	IA	IA	<45	IA
N17	45	IA	35	45	IA	35	<30	<35	IA	<40	-[2]	-[2]	-[2]
N15	45	-[2]	-[2]	-[2]	<40	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]
N15	45	-[2]	-[2]	-[2]	IA	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]

Notes:

1. *"IA" indicates that Mount Owen Mine was not audible at this location.*
2. *"-" indicates that monitoring was not required at this location, due to it being a secondary location or no longer being required after changes in monitoring duration were made to EPL4460 in September 2021.*
3. *Exceedances of the Mount Owen Mine LA1,1minute noise criterion are shown in bold. This noise level triggered monitoring at supplementary monitoring location N15.*

APPENDIX C

2021 Glendell Mine
NMP Noise Monitoring
Result Tables

Glendell Mine 2021 Noise Monitoring Summary – Night period $L_{Aeq,15minute}$ contribution in dB(A)[1]

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1[2]	No criteria	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N2[2]	No criteria	IA	IA	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]
N3	38	<35	IA	IA	<35	<30	IA	IA	IA	IA	<35	IA	<35
N4	38	IA	IA	IA	<30	<35	IA	IA	IA	<35	<35	IA	IA
N8	35	IA	IA	IA	<30	IA	IA	33	<35	IA	30	37	34
N9	42	<30	IA	IA	IA	<40	<35	<35	**43**[4] 42 <35	<35	36	38	<35
N10	40	IA	IA	IA	IA	<35	IA	IA	38	<35	<35	37	IA
N11	38	35	IA	IA	<38	<35	IA	36	<38	<35	<35	<40	<38

Notes:

1. *"IA" indicates that Glendell Mine was not audible at this location.*
2. *There is no Glendell Mine LAeq,15minute noise criterion for this location.*
3. *"NM" indicates that monitoring at this location was discontinued, as N2 had been removed from V4 of the MGO NMP (from December 2020).*
4. *Exceedances of the Glendell Mine LAeq,15minute noise criterion are shown in bold.*
5. *Re-measure undertaken following an initial exceedance at N9 in August, as per the NMP.*
6. *Follow-up measurement undertaken within seven days of the re-measure at N9 in August, as per the NMP (as a result of an exceedance of the LA1,1minute criterion during the re-measure).*

Glendell Mine Noise Monitoring Summary – Night period $L_{A1,1minute}$ contribution in dB(A)[1]

Monitoring Location	Criteria	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
N1[2]	No criteria	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
N2[2]	No criteria	IA	IA	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]	NM[3]
N3	45	<35	IA	IA	<35	<35	IA	IA	IA	IA	40	IA	<35
N4	45	IA	IA	IA	36	43	IA	IA	IA	<35	41	IA	IA
N8	45	IA	IA	IA	<40	IA	IA	<35	41	IA	<35	<45	44
N9	45	<35	IA	IA	IA	<45	<35	40	**50**[4] **46**[4,5] <43[6]	<35	<44	45	<40
N10	45	IA	IA	IA	IA	42	IA	IA		39	<42	44	IA
N11	45	39	IA	IA	<40	38	IA	<40		<35	<35	<45	43

Notes:

1. *"IA" indicates that Glendell Mine was not audible at this location.*
2. *There is no Glendell Mine LA1,1minute noise criterion for this location.*
3. *"NM" indicates that monitoring at this location was discontinued, as N2 had been removed from V4 of the MGO NMP (from December 2020).*
4. *Exceedances of the Glendell Mine LA1,1minute noise criterion are shown in bold.*
5. *Re-measure undertaken following an initial exceedance at N9 in August, as per the NMP.*
6. *Follow-up measurement undertaken within seven days of the re-measure at N9 in August, as per the NMP (as a result of an exceedance of the LA1,1minute criterion during the re-measure).*

Glendell Mine

Mobile Plant Sound Power Screening 2021

Prepared for

Mt Owen Pty Ltd

Global Acoustics

Noise and Vibration Analysis and Solutions

Global Acoustics Pty Ltd
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ABN 94 094 985 734

Glendell Mine

Sound Power Screening 2021

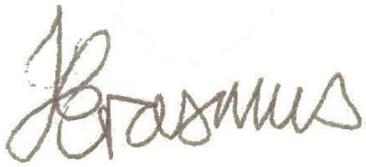
Reference: 21160_R01
Report date: 7 January 2022

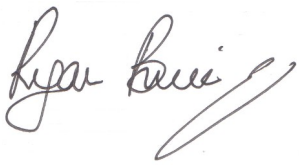
Prepared for

Mt Owen Pty Ltd
Locked Bag 6015
Hunter Regional MC NSW 2310

Prepared by

Global Acoustics Pty Ltd
PO Box 3115
Thornton NSW 2322





Prepared: Jonathan Erasmus
Consultant

QA Review: Ryan Bruniges
Consultant

Global Acoustics Pty Ltd ~ Environmental noise modelling and impact assessment ~ Sound power testing ~ Noise control advice ~ Noise and vibration monitoring ~ OHS noise monitoring and advice ~ Expert evidence in Land and Environment and Compensation Courts ~ Architectural acoustics ~ Blasting assessments and monitoring ~ Noise management plans (NMP) ~ Sound level meter and noise logger sales and hire

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Appendices

1 INTRODUCTION

Global Acoustics was engaged by Mt Owen Pty Ltd (Mt Owen) to determine sound power (L_W) data for mobile equipment operated at Glendell Mine (Glendell)

Mt Owen has a commitment in the Mt Owen Complex (MOC) Noise Management Plan (NMP) to monitor the condition of the mobile plant operating at Glendell. '*Section 3.2.2 - Operational Performance Assessment*' states that "*In order to manage noise impacts as a result of significant variations to equipment fleet over time, MOC will undertake an assessment of their equipment fleet against the indicative equipment list outlined in...DA 80/952 (Glendell Mine) every 5 years to confirm that noise impacts have not significantly changed. If the equipment list has substantially changed the change management process will be triggered.*"

Sound power noise level measurements were made on 19, 29, and 30 November 2021. A total of 19 plant items were tested during the 2021 sound power survey. All units were tested to the reduced scope screening methodology. More detail is provided in Section 2.

1.1 Terminology

Some definitions of terminology, which may be used in this report, are provided in Table 1.1.

Table 1.1: TERMINOLOGY & ABBREVIATIONS

Descriptor	Definition
dB	Decibels. For sound pressure level this is 10 times the logarithm to the base 10 of the ratio of the mean-square sound pressure to the square of the reference sound pressure (20 micro-pascals)
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise.
SPL	Sound pressure level (SPL), fluctuations in pressure measured as 10 times a logarithmic scale, the reference pressure being 20 micro-pascals.
L_W	Linear sound power level, expressed in decibels, is the logarithmic ratio of the sound power of a source in watts (W) relative to the sound power reference base of 10-12W
L_{WA}	A-weighted sound power level.
L_{Aeq}	The average A-weighted noise energy during a measurement period, in dB

2 METHODOLOGY

2.1 Test Standards

Measurement and calculation was conducted using a reduced scope version of the following:

- AS 2012.1-1990 'Acoustics – Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors – Stationary test condition – Determination of Compliance With Limits for External Noise';
- ISO 3744-2010 'Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane';
- ISO 6393:2008(E) 'Earth-moving machinery – Determination of sound power level – Stationary test conditions'; and
- ISO 6395:2008(E) 'Earth-moving machinery – Determination of sound power level noise emissions – Dynamic test conditions'.

The reduced scope uses fewer microphone positions than specified in the standards, with only ground positions used. The rationale being to increase mobility of the testing team, provide flexibility in choice of testing location, and to minimise disruption to mining production.

The test is mainly used as a screening tool. A more accurate equipment sound power result obtained from full adherence to the above standards was not required. A minimum of two test runs were recorded for each plant item with the aim to have less than 1.5 dB difference between results. It is considered that the results are of sufficient accuracy and repeatability for the purpose of this survey.

Typical test areas are present in Figure 1 and Figure 2. The majority of tests for mobile plant were undertaken using a dynamic test only, where the plant item passes through the test area shown in Figure 1 under full power on level ground. The measurement is commenced and completed when the plant item (centre of) passes between microphone positions 2 & 3 and 1 & 4 respectively.

Typically for mobile plant items the test area radius ("R" in Figure 1 and 2) was 16-20m depending on equipment size and test area limitations. For stationary tests on drills, excavators, and shovels, the alternate stationary microphone positions were used as presented in Figure 2. In some cases, not all four microphone positions could safely be reached due to proximity of high walls, low walls or other mining operations.

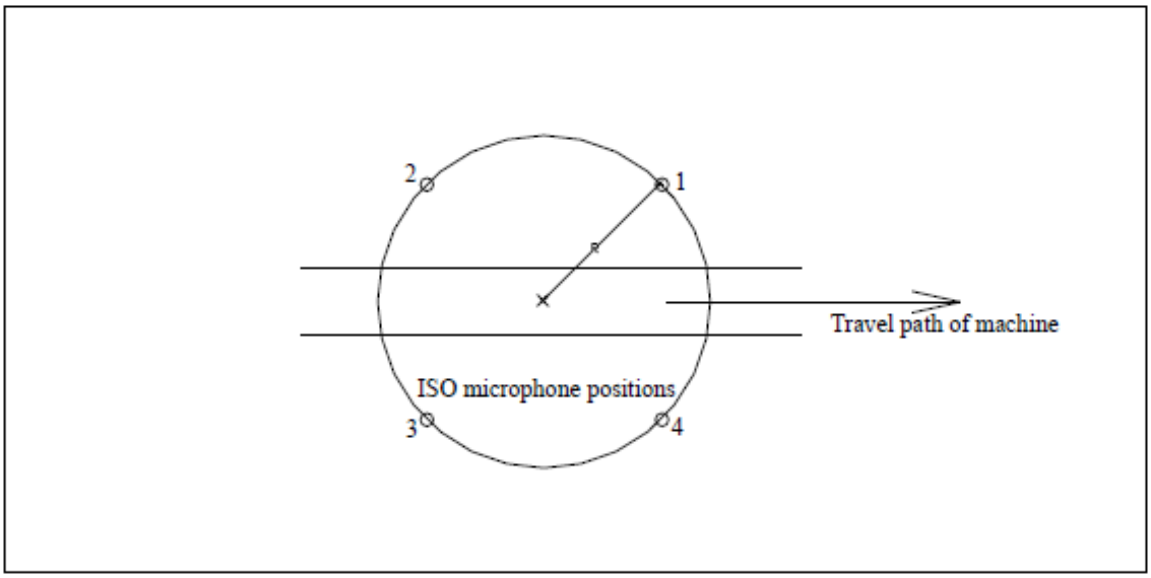

Figure 1 Sound Power Microphone Positions

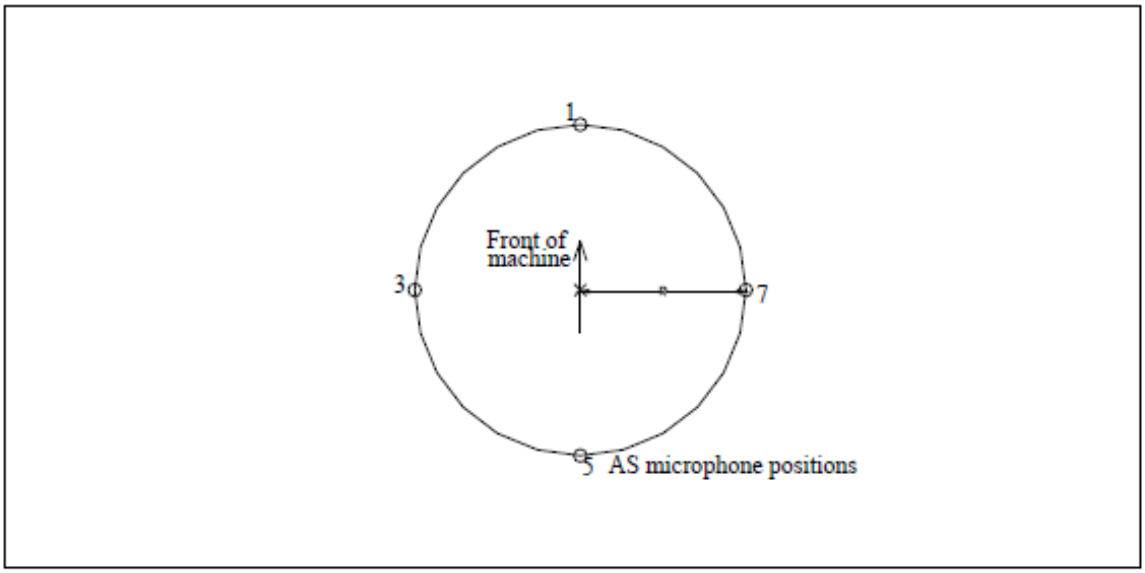

Figure 2 Alternate Stationary Sound Power Microphone Positions

2.2 Equipment Used

Equipment used to measure and record noise levels are listed in Table 2.1. Calibration certificates are provided in Appendix A.

Table 2.1: SOUND LEVEL MEASUREMENT EQUIPMENT

Model	Serial Number	Calibration Due Date
SVAN 958A noise and vibration analyser	69814	14/09/2023
SVAN 958 noise and vibration analyser	20880	14/04/2022
Rion NC74 sound level calibrator	34483783	11/03/2022
Pulsar 105 sound level calibrator	96080	07/10/2023

2.3 Weather Conditions

Weather conditions at the time of testing, presented in Table 2.2.

Table 2.2: ATMOSPHERIC CONDITIONS

Date	Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)
19/11/2021	23	0 – 1	50
29/11/2021	22	1 – 2	62
30/11/2021	22	0 – 1	68

2.4 Sound Power Criteria

During this sound power testing survey, 19 plant items were tested. Where applicable, results have been compared to criteria sourced from "Environmental Assessment for Modification of Glendell Mine Operations Volume 2 August 2007". A table extracted from this source listing the criteria is presented in Appendix B.

2.5 Tonality

The NPfI states that a noise is determined to be tonal when the level of an individual one-third octave band exceeds the level of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is above 400Hz;
- 8 dB or more if the centre frequency of the band containing the tone is 160 Hz to 400 Hz inclusive;
- 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.

The tonality assessment is by itself not an actionable trigger for remedial work on any specific piece of mobile plant failing the assessment. A single plant item with tonal noise content does not necessarily indicate potential off site noise issues. Individual results must be viewed in relation to the whole mining fleet and the potential for tonal noise to be noted off site. Any plant failing this tonality requirement has been listed in Table 3.2.

2.6 Overall Sound Power

Overall A-weighted sound power levels determined from measured SPL are shown in Table 3.1. Overall sound power results which exceeded the relevant criterion by 2 dB or less are considered minor and not significant enough to require additional investigation. Overall sound power results which exceeded the relevant criterion by 3 dB or more (presented in bold red type) are considered significant and require additional investigation.

This approach has been developed in consideration of a number of uncertainty factors and has been adopted and approved by the Department of Planning and Environment (DPE) in other annual noise testing regimes of mobile plant in NSW. These factors include, but are not limited to:

- As described in Section Methodology section of this report, the acceptable repeatability for screening is up to 1.5 dB between measured results;
- Due to the mobile nature of screening testing, additional variables such as other mobile plant operating nearby, hard-packed and/or uneven testing surfaces, varying skill of operators, and certain modes of operations being undertaken during testing (in the case of excavators and drills)

can result in measured noise levels that are slightly different than they would be under full scope noise testing;

Single and one-third-octave graphs for equipment tested can be useful in identifying noise sources or differences between like machines. These graphs have not been included in this report but are available upon request.

Note that overall linear sound power levels are a better indicator of low frequency noise content of plant than overall A-weighted sound power levels. Low frequency noise can propagate further than high frequency noise, and so can indicate items with higher potential for off-site noise impacts.

3 Results

3.1 Overall sound power

Overall 2021 sound powers determined from measured SPL are provided in Table 3.1. These results are compared with sound power limits specified in Appendix B

Table 3.1: OVERALL SOUND POWER RESULTS (dB)

SOUND POWER RESULTS 2021								
Plant No	**Date**	**Make/Model**	**Test Type**	**L_W (dB)**	**L_{WA} (dB)**	**Glendell EIS Target L_{WA} (dB)**	**Exceedance (dB)**	**Tonal (Hz)**
				Trucks				
201	2021-11-30	Caterpillar 793D	Dynamic, 1st Gear Forward	123	116	115	1	
202	2021-11-30	Caterpillar 793D	Dynamic, 1st Gear Forward	121	115	115	0	
203	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	122	115	115	0	
206	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	124	117	115	2	2000
207	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	122	116	115	1	
208	2021-11-30	Caterpillar 793D	Dynamic, 1st Gear Forward	124	116	115	1	
209	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	123	114	115	Nil	
210	2021-11-30	Caterpillar 793D	Dynamic, 1st Gear Forward	123	116	115	1	
211	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	127	119	115	**4**	
213	2021-11-29	Caterpillar 793D	Dynamic, 1st Gear Forward	125	116	115	1	
214	2021-11-30	Caterpillar 793D	Dynamic, 1st Gear Forward	123	116	115	1	
253	2021-11-29	Caterpillar 789C	Dynamic, 1st Gear Forward	123	116	115	1	
258	2021-11-29	Caterpillar 789C	Dynamic, 1st Gear Forward	122	115	115	Nil	

SOUND POWER RESULTS 2021

Plant No	Date	Make/Model	Test Type	L_W (dB)	L_{WA} (dB)	Glendell EIS Target L_{WA} (dB)	Exceedance (dB)	Tonal (Hz)
			Water Cart					
642	2021-11-30	Caterpillar 777F	Dynamic, 1st Gear Forward	130	117	114	**3**	100
			Dozers					
452	2021-11-30	Caterpillar D11R	Dynamic, 1st Gear Forward	125	116	110	**6**	
452	2021-11-30	Caterpillar D11R	Dynamic, 1st Gear Reverse	126	119	122	Nil	
452	2021-11-30	Caterpillar D11R	Stationary	121	108	110	Nil	
			Loader					
6002	2021-11-30	Caterpillar 992K	Stationary	119	110	110	Nil	
			Grader					
602	2021-11-29	Caterpillar 16M	Dynamic, 1st Gear Forward	114	107	104	**3**	
			Drills					
501	2021-11-19	Reedrill SKF	Stationary	120	118	114	**4**	
502	2021-11-19	Reedrill SKF	Stationary	122	120	114	**6**	

Notes:

1. *Bolded results in red indicate an exceedance of Glendell EIS Target;*
2. *"-" denotes item not tested or information not available; and*
3. *"NA" denotes that criterion for this plant was not provided.*

4 SUMMARY

Global Acoustics was engaged by Glendell Coal Mine to undertake annual noise testing of mobile plant. Plant items identified with elevated sound power levels should come under additional investigation.

We trust this information is per your requirements. Please contact us if you require further details or advice.

Global Acoustics Pty Ltd

APPENDIX

A CALIBRATION CERTIFICATES

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM30558

EQUIPMENT TESTED: Sound & Vibration Analyser

Manufacturer:	Svantek		
Type No:	Svan-958A	**Serial No:**	69814
Mic. Type:	NA	**Serial No:**	NA
Pre-Amp. Type:	N/A	**Serial No:**	N/A
Filter Type:	1/3 Octave	**Test No:**	FILT 6659

Owner: Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton, NSW 2322

Tests Performed: IEC 61672-3:2013, IEC 1260:1995, & AS/NZS 4476:1997

Comments: All Test passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1008	hPa ±1 hPa	**Date of Receipt :**	14/09/2021
Temperature	23	°C ±1° C	**Date of Calibration :**	14/09/2021
Relative Humidity	37	% ±5%	**Date of Issue :**	14/09/2021

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION
Accredited Lab No. 9262
Acoustic and Vibration Measurements

Acu-Vib Electronics
CALIBRATIONS SALES RENTALS REPAIRS

Head Office & Calibration Laboratory
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
(02) 9680 8133
www.acu-vib.com.au

Page 1 of 2 Calibration Certificate
AVCERT10.15 Rev.2.0 14/04/2021

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C20218

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/ Model Number : SVANTEK 958
Instrument Serial Number : 20880
Microphone Serial Number : 16894
Pre-amplifier Serial Number : 24298

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23.5°C	**Ambient Temperature :**	24.6°C
Relative Humidity :	47.3%	**Relative Humidity :**	46.6%
Barometric Pressure :	101.2kPa	**Barometric Pressure :**	101.1kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 14 Apr 2020
Secondary Check: Max Moore
Report Issue Date : 17 Apr 2020

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	*Pass*
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	*Pass*
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.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.2°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

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.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Calibrator

IEC 60942-2017

Calibration Certificate

Calibration Number C20154

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Dr
Thornton NSW 2322

Equipment Tested/ Model Number : Rion NC-74
Instrument Serial Number : 34483783

Atmospheric Conditions
Ambient Temperature : 23.3°C
Relative Humidity : 53.8%
Barometric Pressure : 101.2kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 11 Mar 2020
Secondary Check: Alannah Squires
Report Issue Date : 12 Mar 2020

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	93.99	1002.13

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.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.14dB*	*Temperature*	*±0.2°C*
Frequency	*±0.09%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.09%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Calibrator

IEC 60942-2017

Calibration Certificate

Calibration Number C21661

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton, NSW, 2322

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 96080

Atmospheric Conditions
Ambient Temperature : 22.7°C
Relative Humidity : 40.4%
Barometric Pressure : 99.8kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 07 Oct 2021
Secondary Check: Matthew Calleja
Report Issue Date : 7 Oct 2021

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	93.85	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..

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.11dB*	*Temperature*	*±0.2°C*
Frequency	*±0.18%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.50%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

NATA
WORLD RECOGNISED ACCREDITATION

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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The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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B CRITERIA

Criteria taken from "Environmental Assessment for Modification of Glendell Mine Operations Volume 2 August 2007".

Table A3.1: Proposed Fleet Specification (all noise levels in dB(A))

Equipment	Year 1.5 Standard	Year 1.5 Attenuated	Year 3	Year 6	Year 9	Year 12
Excavator (Overburden)	123 - Average (125 - Exhaust Side) (130 - Fan Side)	117	117	117	117	117
Excavator (Coal)	114 to 116	114	114	114	114	114
Trucks (240t)	117 to 119 - Up 8% Grade 113 to 116 - Down 8% Grade	115	115	115	115	115
Trucks (150t and Watercart)	119 - Up 8% Grade 114 to 120 - Down 8% Grade	114	114	114	114	114
Dozers - D10 (Pushing/Reversing)	110/122	110/122	110/122	110/118	110/118	110/118
Grader	104 - Cat 16H Grader 112 - Cat 24H Grader	104	104	104	104	104
Drills	116 to 119	114	114	114	114	114

Notes

1. *All dozers, including rubber tyre dozers, have been assessed against the Dozer D10 Year 1.5 Attenuated criteria as advised by Glendell Mine; and*
2. *Criteria for dozers is for first gear only, as advised by Glendell Mine.*

Sound Power Determination

Mt Owen Complex Mobile Machinery

2021

Prepared By:	Michael Thearle
Date:	09 December 2021
Telephone:	0437 345 297
Email:	michael@thearle.net.au
Address:	Branxton NSW 2335

Report - Sound Power Determination - 2020

This report has been prepared within the specific requirements agreed between Thearle Engineering and Thiess Mt Owen. This report was prepared with background information, terms of reference and assumptions agreed with the Thiess Mt Owen. The report is not intended for use by any other individual or organisation. Thearle Engineering will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

Summary:

Machines tested generally represent a cross section of the mobile mining fleet at Thiess Mt Owen. Individual machine results and recommendations are presented on the following pages. Equipment such as the EH4500 haul trucks represent the best level of attenuation currently achieved on these models.

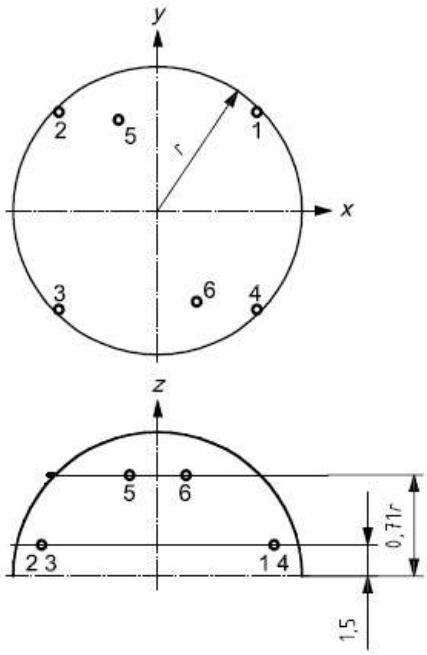
Referenced Standards:

ISO 3744:2010	Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane
ISO 6393:2008	Earth-moving machinery – Determination of sound power level Stationary test conditions
ISO 6395:2008	Earth-moving machinery – Determination of sound power level Dynamic test conditions
MDG15	Guideline for mobile and transportable equipment for use in mines
MGOOC-1779562647-10975	MGO Noise Management Plan
3109/R11/FINAL	Appendix 7 – Noise Impact Assessment, Mt Owen Continued Operations Project
GCAA-625378177-10238	GCCA 11.11 Noise Management

Test Setup Parameters:

The test area was setup as per ISO 6393:2008 with microphones positioned at the locations in Figure 1.

Dimensions in metres



Key

1 to 6 microphone positions

r hemisphere radius

Figure 1 — Microphone array on the hemisphere

Table 1 — Co-ordinates of microphone positions

Microphone position	x/r	y/r	z
1	0,7	0,7	1,5 m
2	–0,7	0,7	1,5 m
3	–0,7	–0,7	1,5 m
4	0,7	–0,7	1,5 m
5	–0,27	0,65	0,71 r
6	0,27	–0,65	0,71 r

Figure 1 – ISO 6393:2008 Microphone Positions (1, 5 and 2 are on the left side of the machine)

Test Configuration:

Haul Trucks:

Stationary Test	Engine Rated Power RPM, Park Brake Applied.
Dynamic Test Uphill	Nominal Rated Load, Rated Power RPM, 1st Gear Mechanical Drive Trucks, Maximum Speed Electric Drive Trucks.
Dynamic Test Downhill	Machine Unloaded, 23-25 km/hr, Speed Controlled on Retarder

Water Carts:

Stationary Test	Engine Rated Power RPM, Park Brake Applied.
Dynamic Test Uphill	Nominal Rated Load, Rated Power RPM, 1st Gear.
Dynamic Test Downhill	Nominal Rated Load, 23-25 km/hr, Speed Controlled on Retarder

Dozers and Loaders:

Stationary Test	Engine Rated RPM, Park Brake Applied.
Dynamic Test Forwards	First Gear Forwards, Engine Rated RPM.
Dynamic Test Reverse	First Gear Reverse, Engine Rated RPM.

Graders and Scrapers:

Stationary Test	Engine Rated RPM, Park Brake Applied.
Dynamic Test Forwards	First Gear Forwards, Engine Rated RPM.

Diggers and Drills:

Stationary Test	Engines High Idle
Dynamic Test	Engines High Idle, Drills - Hoist Force Set to Maximum, Diggers - Full Pretend to Dig Cycle

Testing Equipment:

Class 1 Sound Meters Pattern Approved to IEC 61672:2013 and IEC 61260:2014.

	Serial Number	Microphone and Preamp Serial Number	Calibration Date	Calibration Expiry
NTI XL2-TA	A2A-18907-E0	A20339 / 9696	09/02/2021	09/02/2023
NTI XL2-TA	A2A-18632-E0	A19795 / 9593	09/02/2021	09/02/2023
NTI XL2-TA	A2A-18906-E0	A19796 / 9592	09/02/2021	09/02/2023
NTI XL2-TA	A2A-18591-E0	A19789 / 9599	08/02/2021	08/02/2023
NTI XL2-TA	A2A-18699-E0	A20326 / 9691	09/02/2021	09/02/2023
NTI XL2-TA	A2A-19615-E0	A19781 / 9601	08/02/2021	08/02/2023
Precision Calibrator CAL200	18292		11/12/2020	11/12/2021

Calibration Certificates are supplied separately on request.

Results:

Machinery has been tested and assessed as per the requirements of Glencore document GCAA 11.11. All machines tested were existing machines onsite. As such, Sound power levels have been assessed according to the in-service target and tonality requirement only. In-service target and tonal requirements are applicable to all tests as described in the following tables. The Glencore in-service target consists of a linear noise level only. A-weighted and linear noise levels of each machine have been reported. A-weighted levels have been included for historical purposes only due to this being the previous method for assessing compliance onsite.

Unit Number	Model	Static	Uphill Loaded	Downhill Loaded	Tonal	GCAA In-Service Target	Compliant
2737	CAT 793F Haul Truck	114 dBA / 121 dB	115 dBA / 121 dB	112 dBA / 120 dB	No	- dBA / 123 dB	Yes
212	CAT 793D Haul Truck	115 dBA / 121 dB	119 dBA / 123 dB	116 dBA / 121 dB	No	- dBA / 123 dB	Yes
1574	Hitachi EH4500	113 dBA / **127 dB**	116 dBA / **125 dB**	114 dBA / **129 dB**	No	- dBA / 123 dB	**No**
4373	CAT 785C Water Cart	118 dBA / 123 dB	118 dBA / 124 dB	115 dBA / 120 dB	No	- dBA / 125 dB	Yes

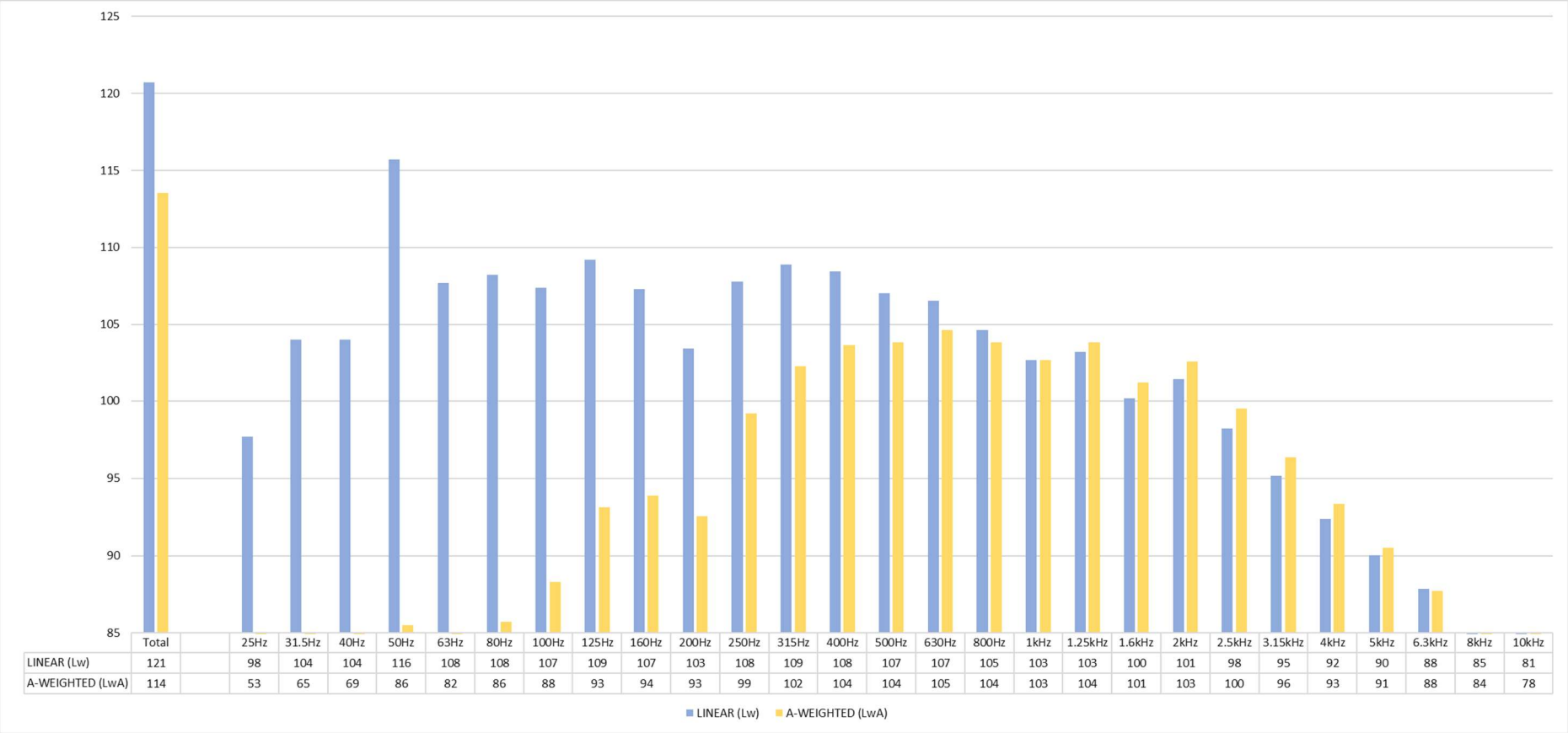
Unit Number	Model	Static	Forwards	Reverse	Tonal	GCAA In-Service Target	Compliant
8054	CAT D11T Dozer	110 dBA / 121 dB	114 dBA / 123 dB	115 dBA / 123 dB	No	- dBA / 123 dB	Yes
RJG04249	CAT D10T Dozer	111 dBA / 120 dB	112 dBA / 120 dB	114 dBA / 122 dB	No	- dBA / 123 dB	Yes
2222	CAT D10T-2 Dozer	108 dBA / 119 dB	111 dBA / 120 dB	113 dBA / 121 dB	No	- dBA / 123 dB	Yes
2223	CAT D10T-2 Dozer	108 dBA / 119 dB	111 dBA / 120 dB	114 dBA / 121 dB	No	- dBA / 123 dB	Yes

Unit Number	Model	Static	Dynamic		Tonal	GCAA In-Service Target	Compliant
1849	Liebherr 996 Excavator	116 dBA / 121 dB	118 dBA / 123 dB		No	- dBA / 125 dB	Yes
1850	Liebherr 966 Excavator	117 dBA / 121 dB	118 dBA / 123 dB		No	- dBA / 125 dB	Yes

Comments and Recommendations:

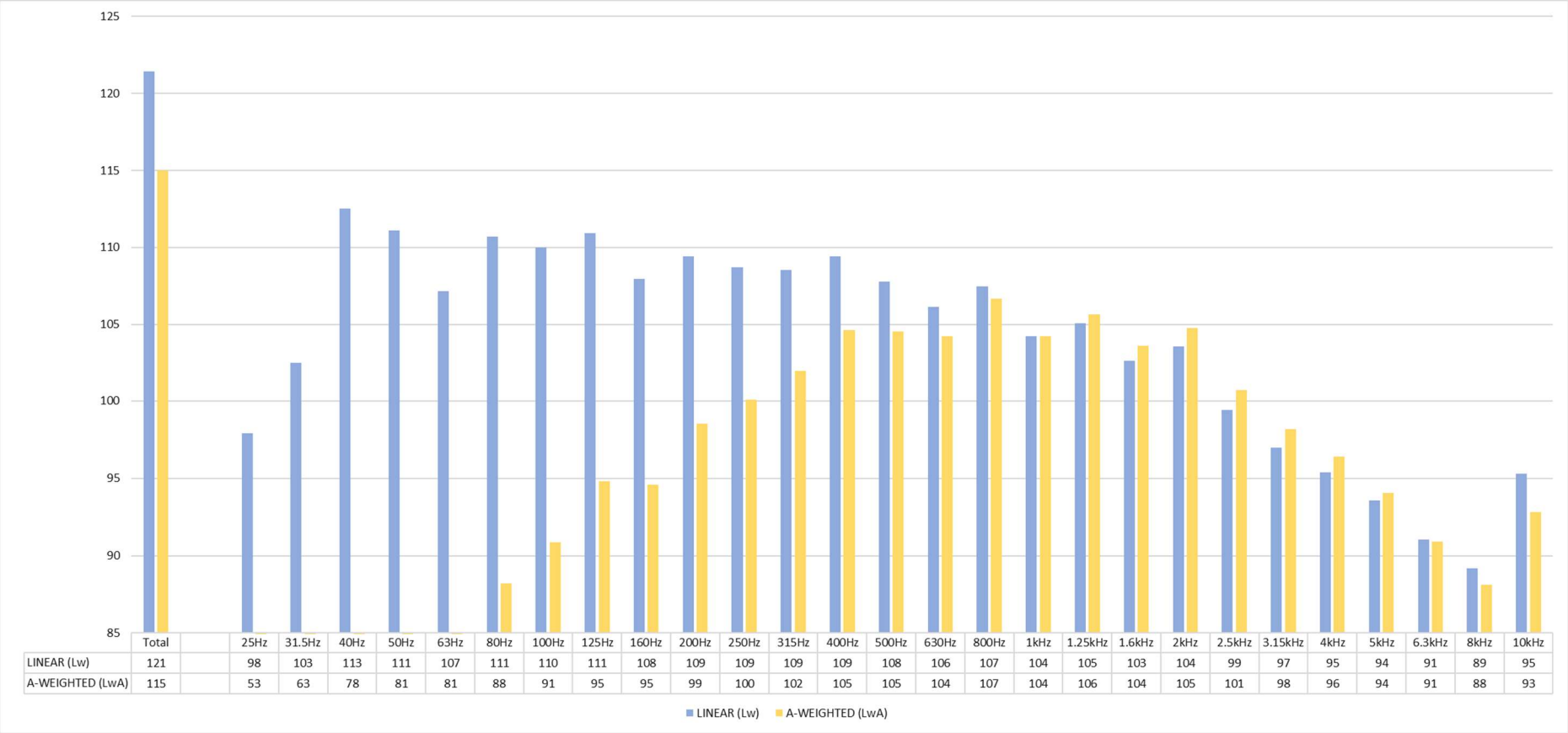
Unit Number	Model	Recommendation for Further Treatment
1574	Hitachi EH4500 Haul Truck	Machine setup consistent with previous A-weighted Target. Review performance of exhaust system and replace as appropriate to suit current Linear Target.

Appendix A



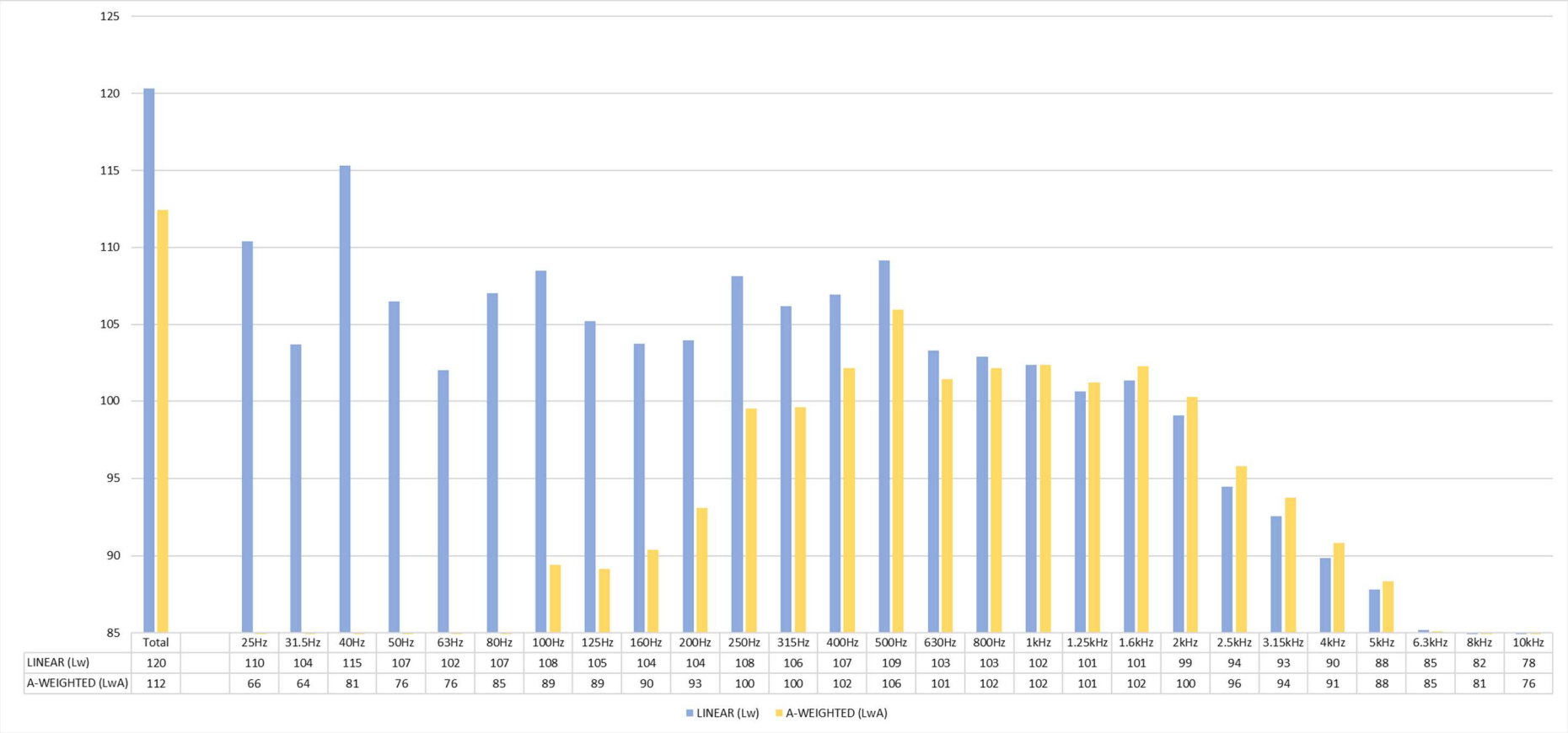
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	98	104	104	116	108	108	107	109	107	103	108	109	108	107	107	105	103	103	100	101	98	95	92	90	88	85	81
A-WEIGHTED (LwA)	114	53	65	69	86	82	86	88	93	94	93	99	102	104	104	105	104	103	104	101	103	100	96	93	91	88	84	78

2737 Haul Truck Stationary Test



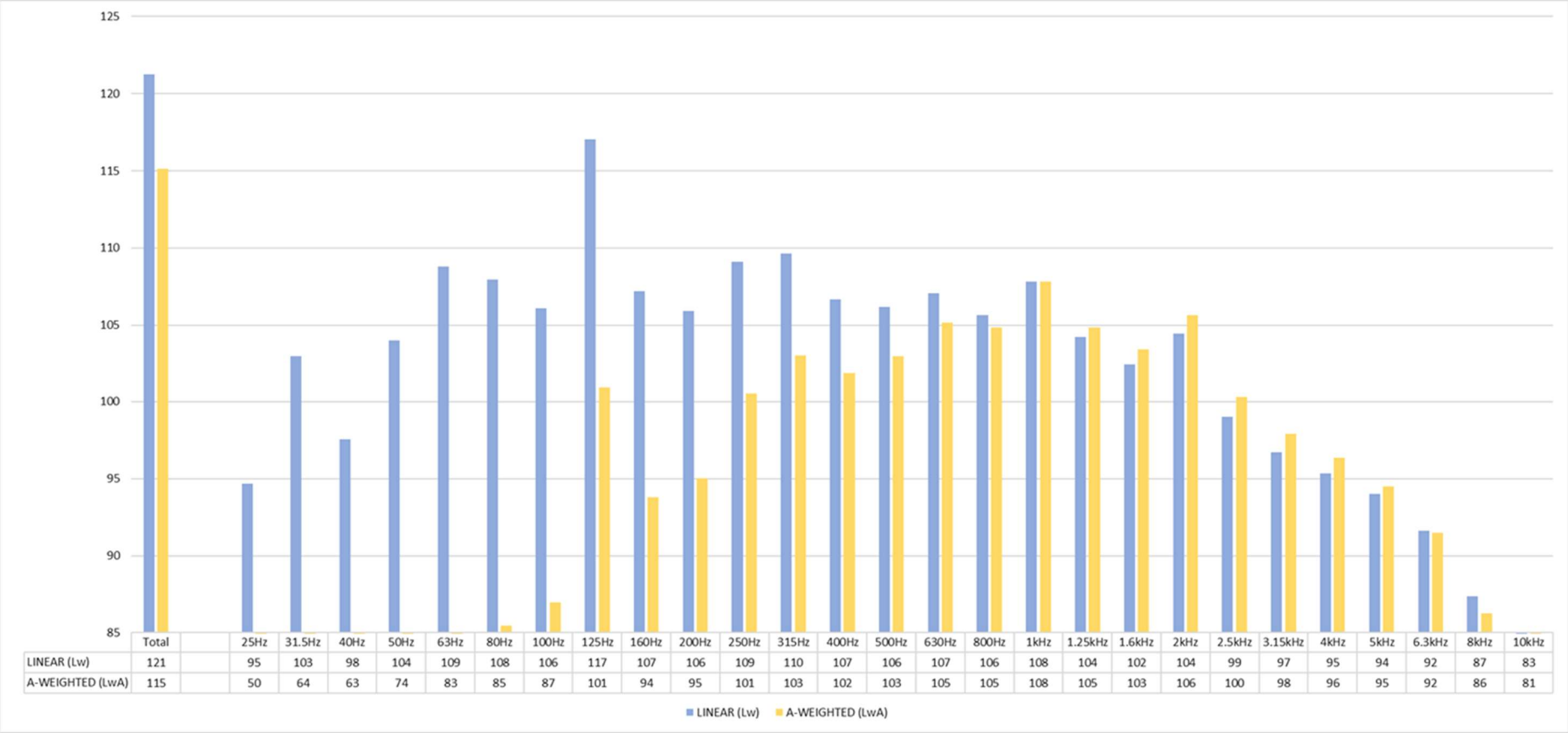
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	98	103	113	111	107	111	110	111	108	109	109	109	109	108	106	107	104	105	103	104	99	97	95	94	91	89	95
A-WEIGHTED (LwA)	115	53	63	78	81	81	88	91	95	95	99	100	102	105	105	104	107	104	106	104	105	101	98	96	94	91	88	93

2737 Haul Truck Dynamic Test Uphill



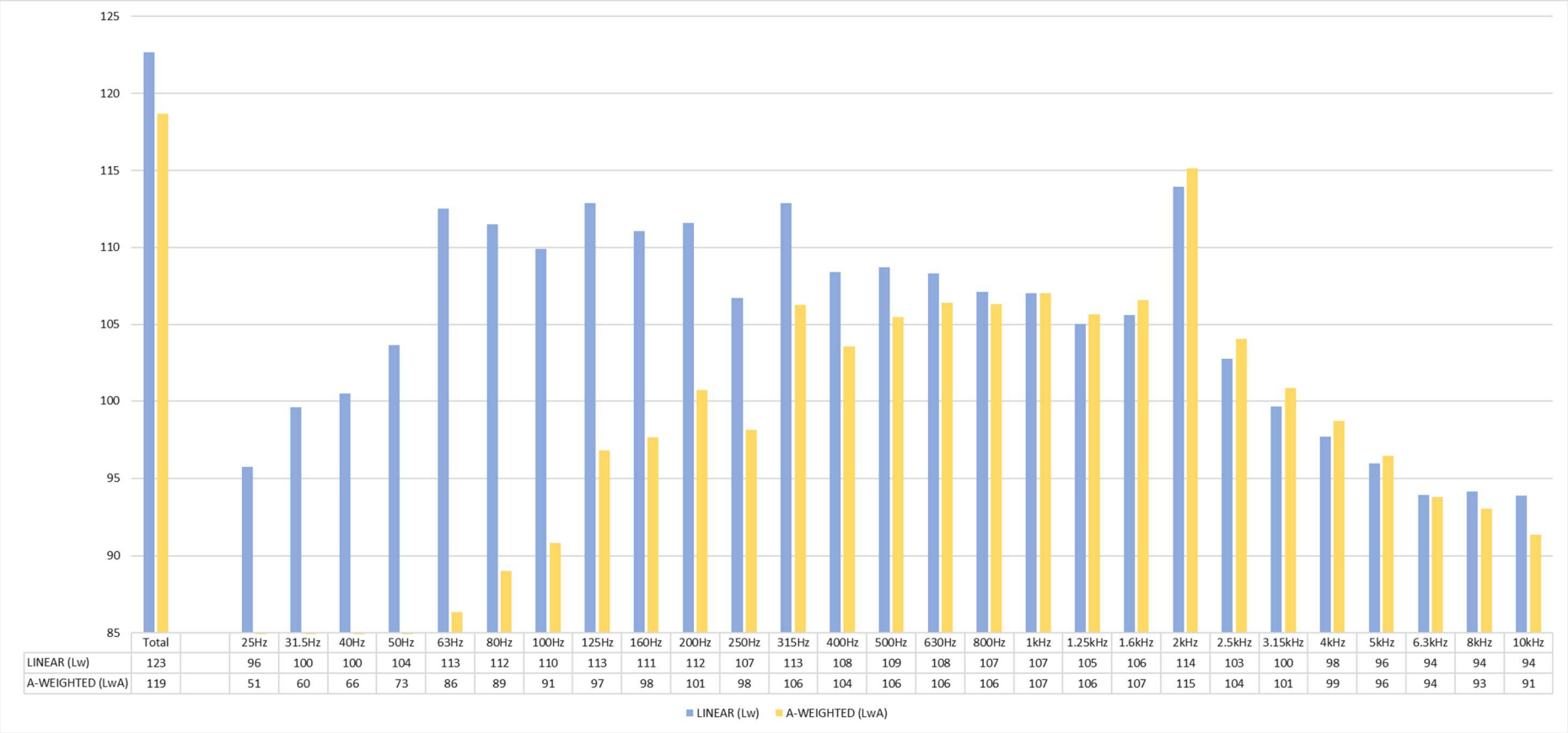
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	110	104	115	107	102	107	108	105	104	104	108	106	107	109	103	103	102	101	101	99	94	93	90	88	85	82	78
A-WEIGHTED (LwA)	112	66	64	81	76	76	85	89	89	90	93	100	100	102	106	101	102	102	101	102	100	96	94	91	88	85	81	76

2737 Haul Truck Dynamic Test Downhill



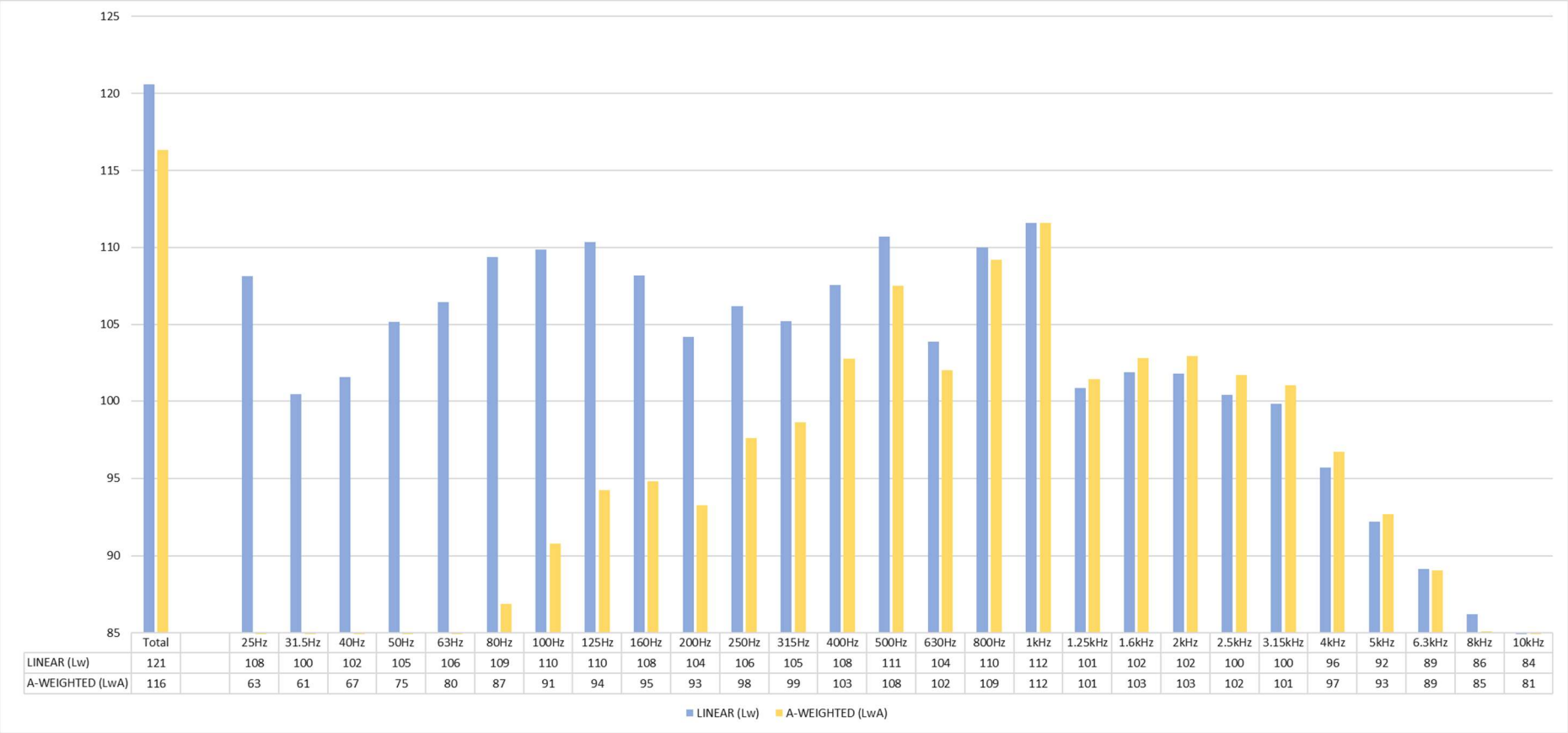
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	95	103	98	104	109	108	106	117	107	106	109	110	107	106	107	106	108	104	102	104	99	97	95	94	92	87	83
A-WEIGHTED (LwA)	115	50	64	63	74	83	85	87	101	94	95	101	103	102	103	105	105	108	105	103	106	100	98	96	95	92	86	81

212 Haul Truck Stationary Test



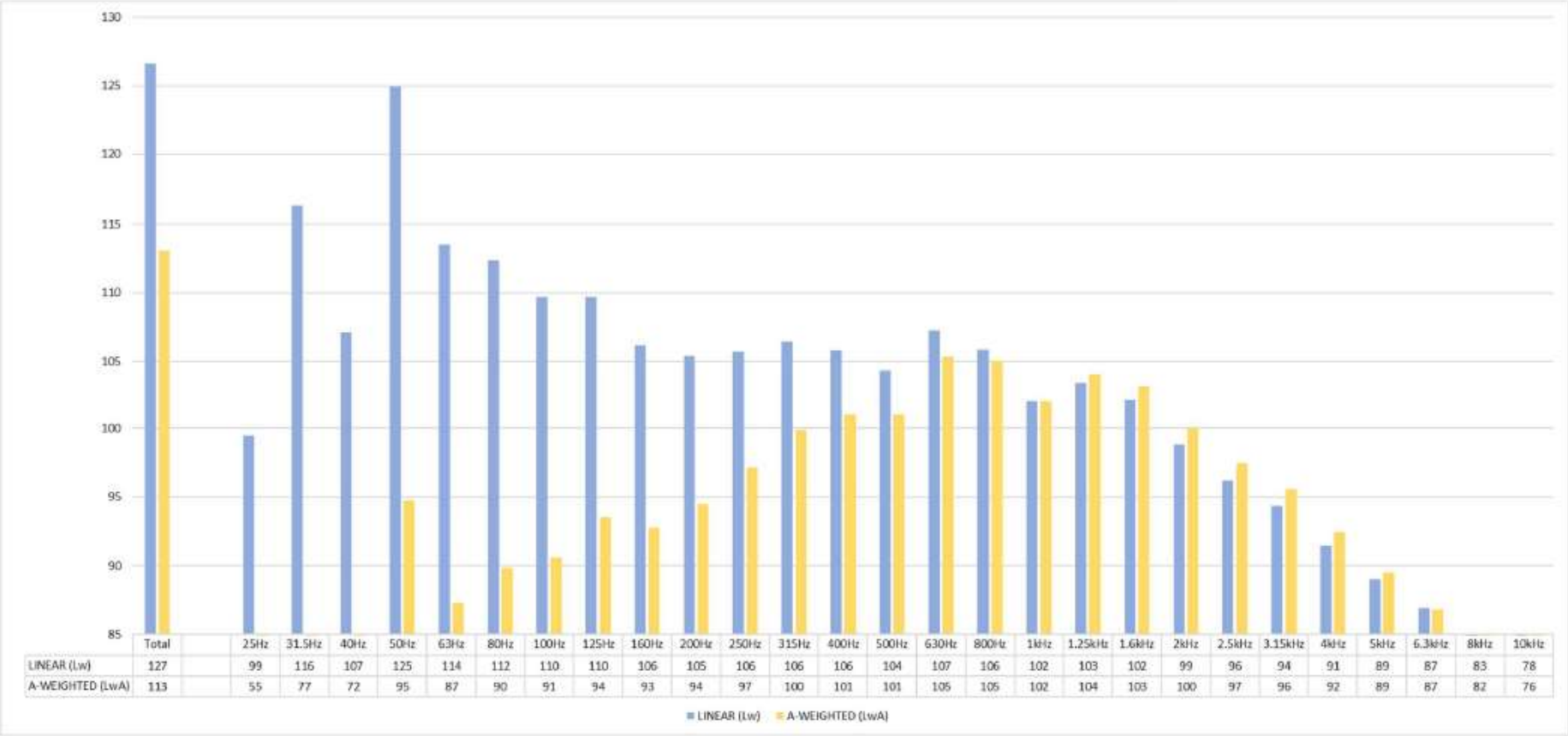
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	96	100	100	104	113	112	110	113	111	112	107	113	108	109	108	107	107	105	106	114	103	100	98	96	94	94	94
A-WEIGHTED (LwA)	119	51	60	66	73	86	89	91	97	98	101	98	106	104	106	106	106	107	106	107	115	104	101	99	96	94	93	91

212 Haul Truck Dynamic Test Uphill



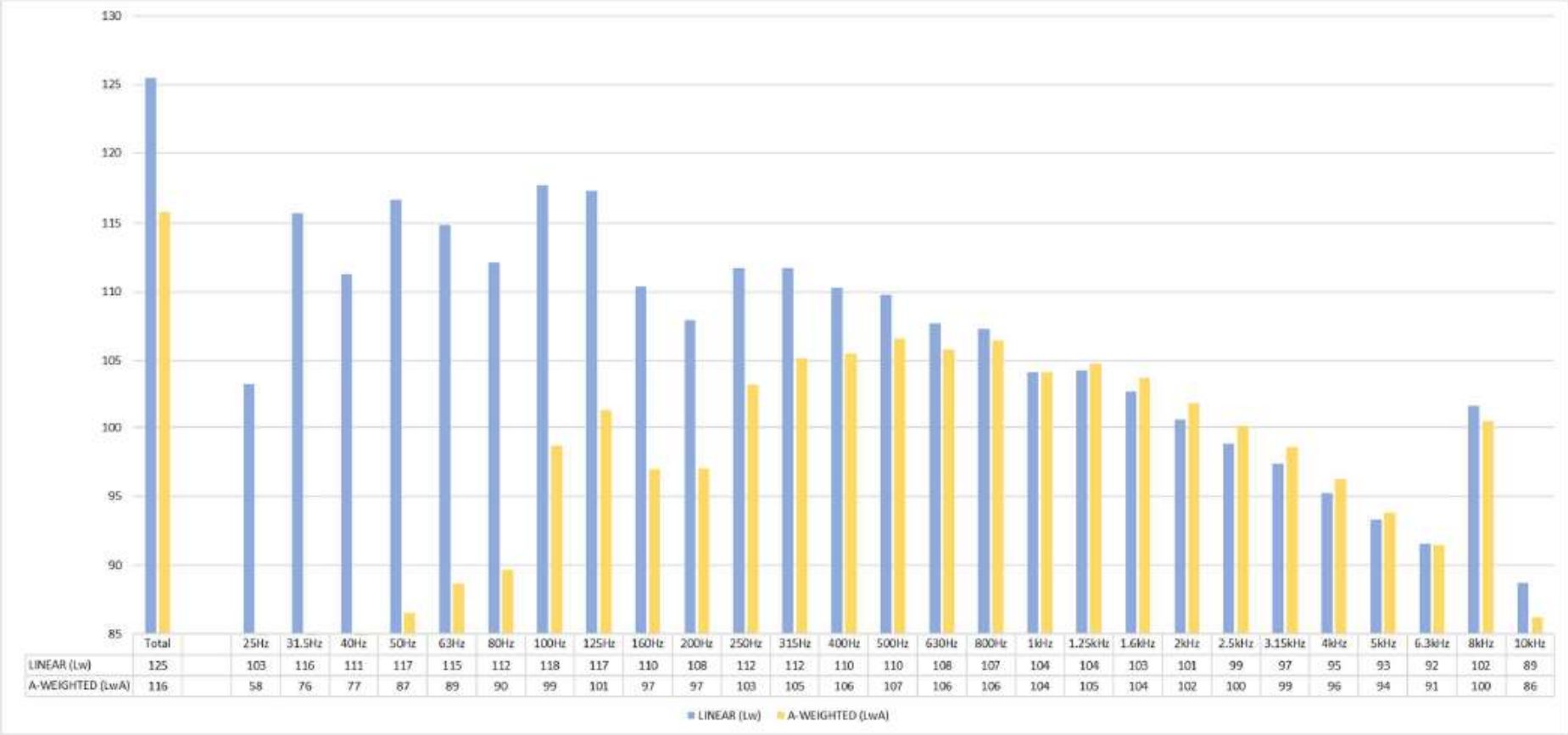
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	108	100	102	105	106	109	110	110	108	104	106	105	108	111	104	110	112	101	102	102	100	100	96	92	89	86	84
A-WEIGHTED (LwA)	116	63	61	67	75	80	87	91	94	95	93	98	99	103	108	102	109	112	101	103	103	102	101	97	93	89	85	81

212 Haul Truck Dynamic Test Downhill



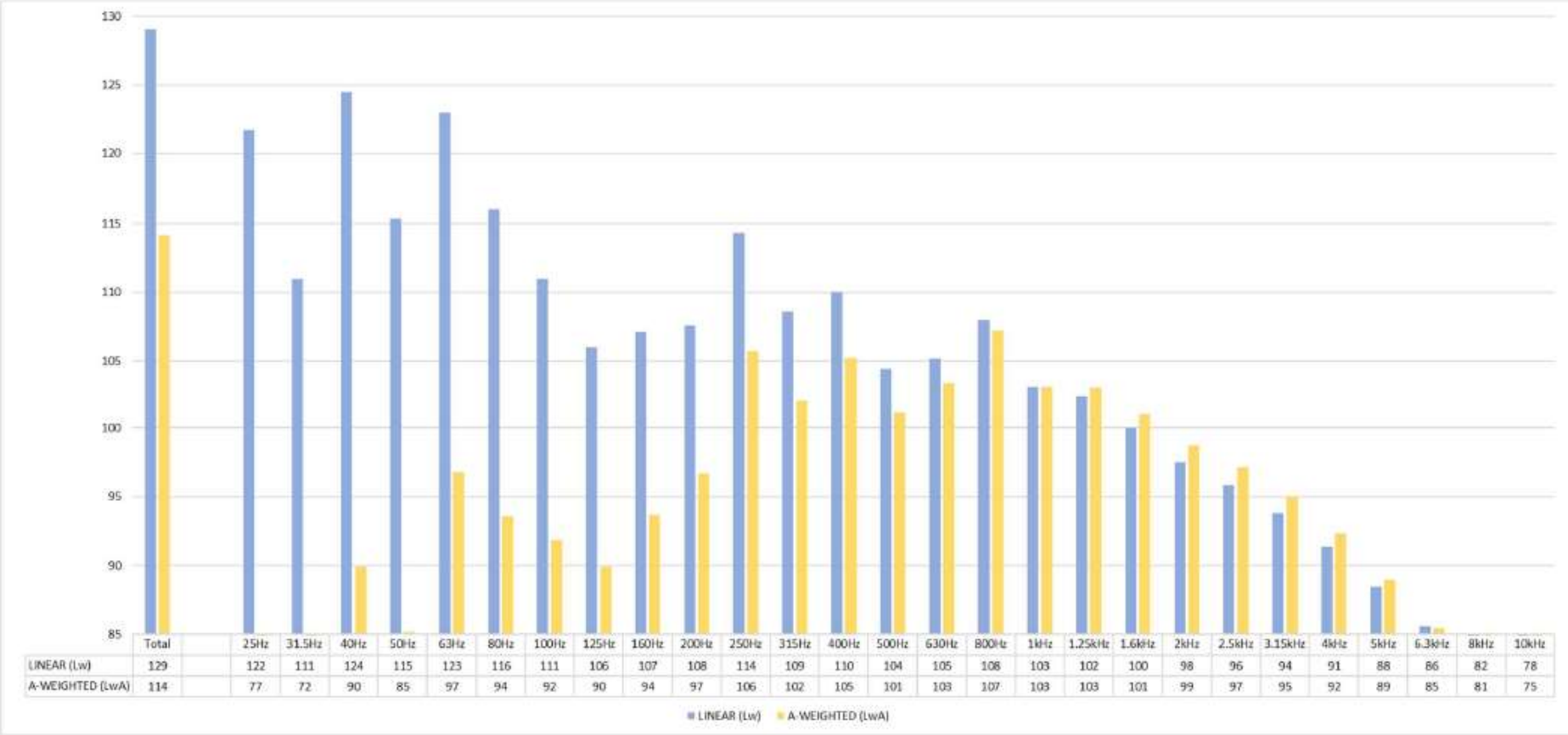
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	127	99	116	107	125	114	112	110	110	106	105	106	106	106	104	107	106	102	103	102	99	96	94	91	89	87	83	78
A-WEIGHTED (LwA)	113	55	77	72	95	87	90	91	94	93	94	97	100	101	101	105	105	102	104	103	100	97	96	92	89	87	82	76

1574 Haul Truck Stationary Test



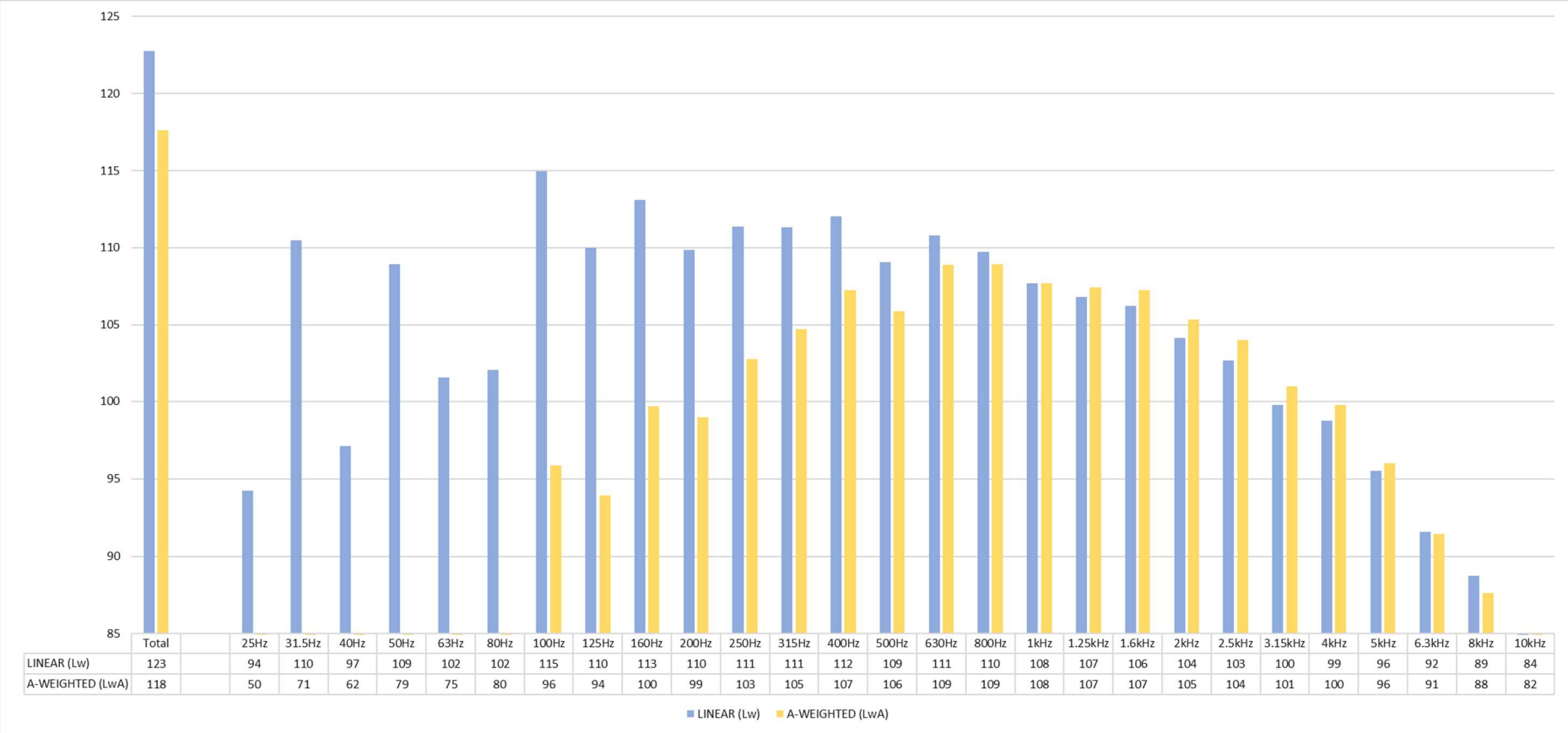
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	125	103	116	111	117	115	112	118	117	110	108	112	112	110	110	108	107	104	104	103	101	99	97	95	93	92	102	89
A-WEIGHTED (LwA)	116	58	76	77	87	89	90	99	101	97	97	103	105	106	107	106	106	104	105	104	102	100	99	96	94	91	100	86

1574 Haul Truck Dynamic Test Uphill



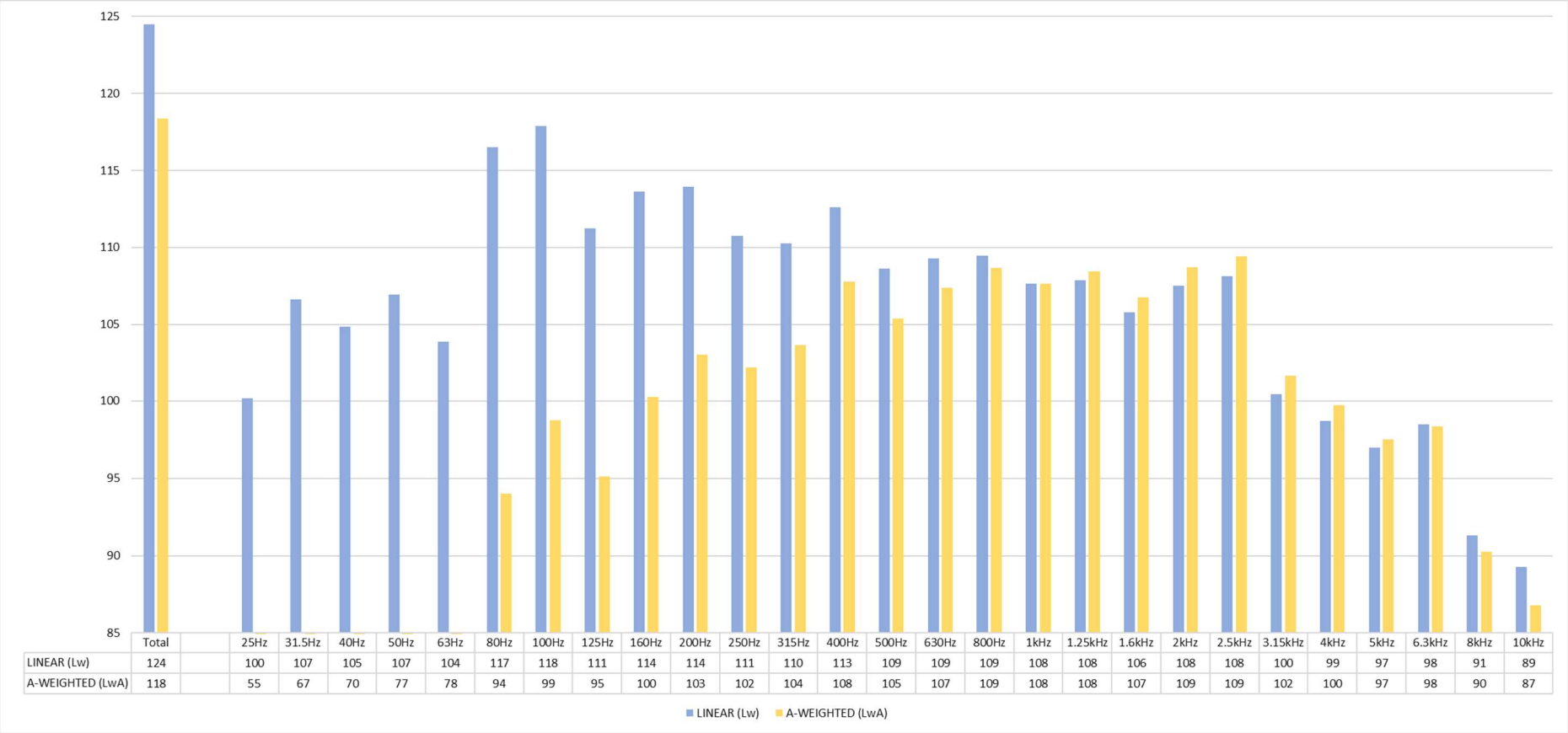
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	129	122	111	124	115	123	116	111	106	107	108	114	109	110	104	105	108	103	102	100	98	96	94	91	88	86	82	78
A-WEIGHTED (LwA)	114	77	72	90	85	97	94	92	90	94	97	106	102	105	101	103	107	103	103	101	99	97	95	92	89	85	81	75

1574 Haul Truck Dynamic Test Downhill



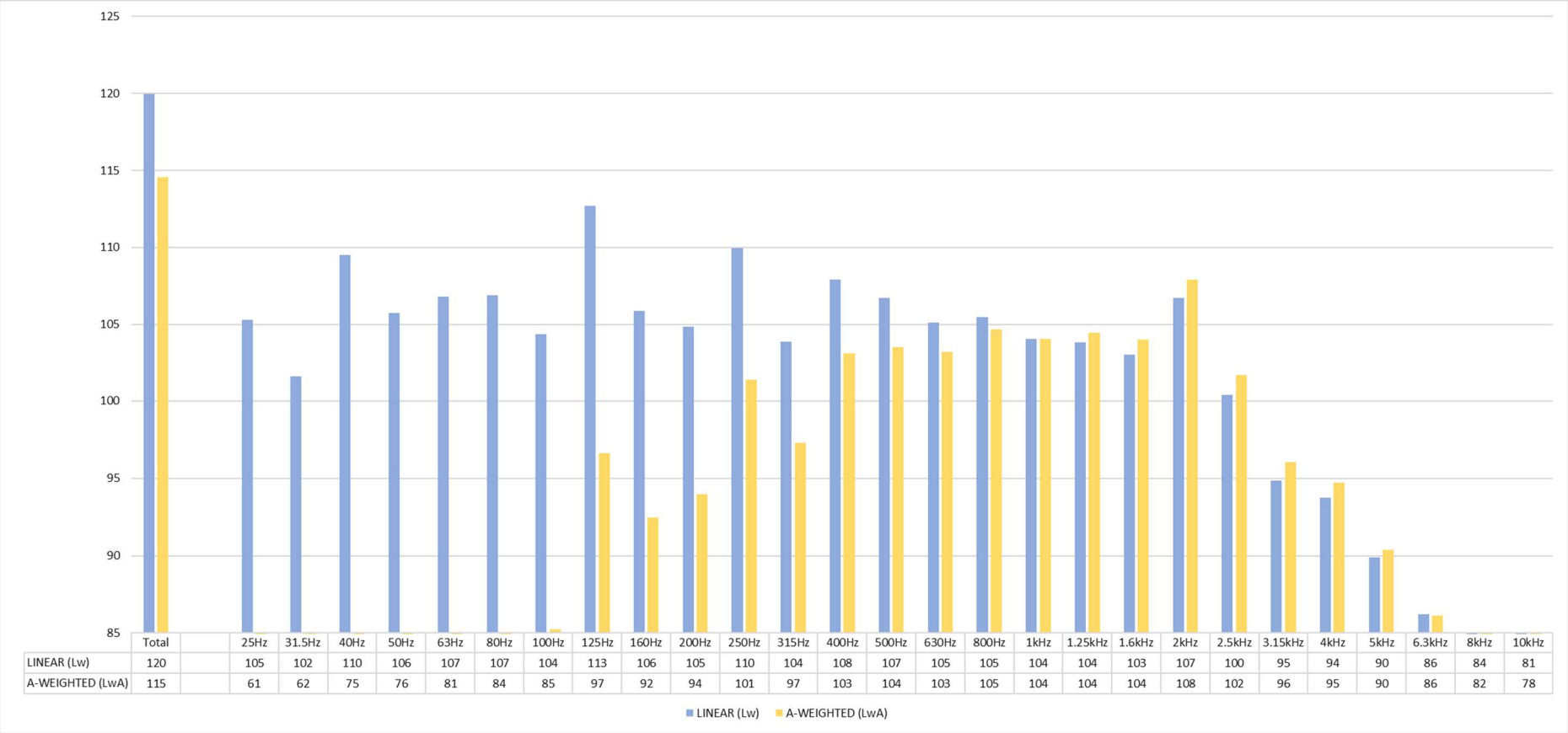
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	94	110	97	109	102	102	115	110	113	110	111	111	112	109	111	110	108	107	106	104	103	100	99	96	92	89	84
A-WEIGHTED (LwA)	118	50	71	62	79	75	80	96	94	100	99	103	105	107	106	109	109	108	107	107	105	104	101	100	96	91	88	82

4373 Water Cart Stationary Test



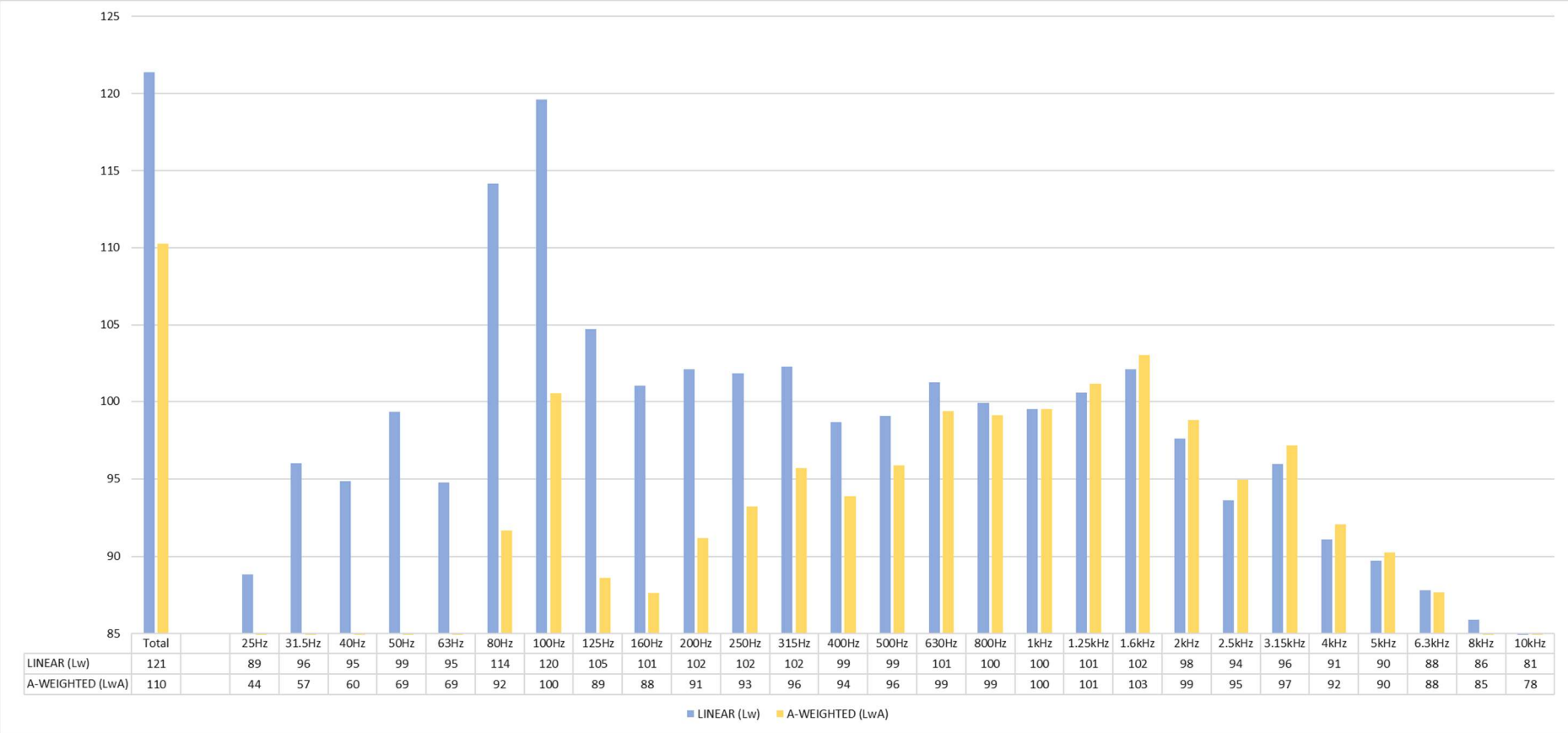
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	124	100	107	105	107	104	117	118	111	114	114	111	110	113	109	109	109	108	108	106	108	108	100	99	97	98	91	89
A-WEIGHTED (LwA)	118	55	67	70	77	78	94	99	95	100	103	102	104	108	105	107	109	108	108	107	109	109	102	100	97	98	90	87

4373 Water Cart Dynamic Test Uphill



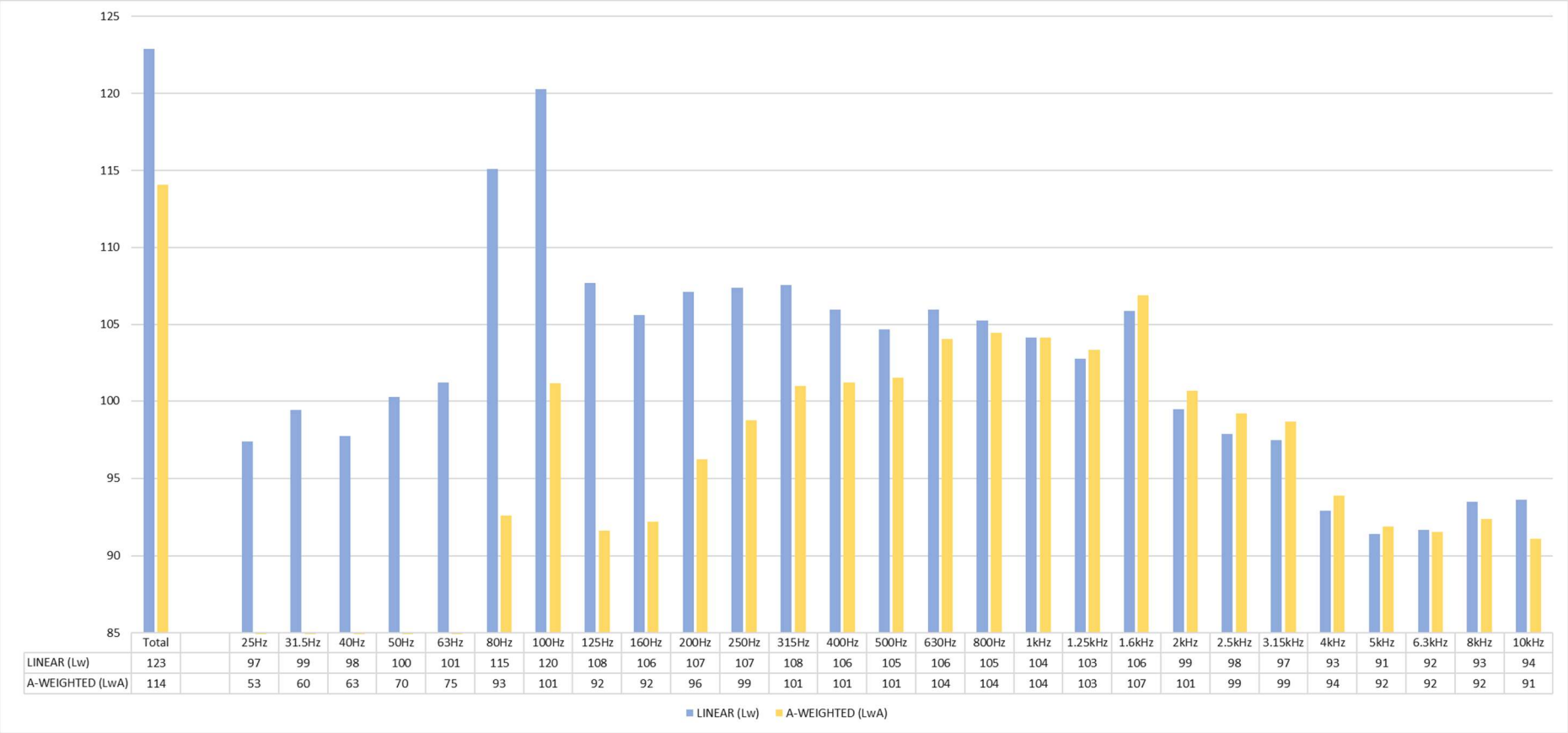
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	105	102	110	106	107	107	104	113	106	105	110	104	108	107	105	105	104	104	103	107	100	95	94	90	86	84	81
A-WEIGHTED (LwA)	115	61	62	75	76	81	84	85	97	92	94	101	97	103	104	103	105	104	104	104	108	102	96	95	90	86	82	78

4373 Water Cart Dynamic Test Downhill



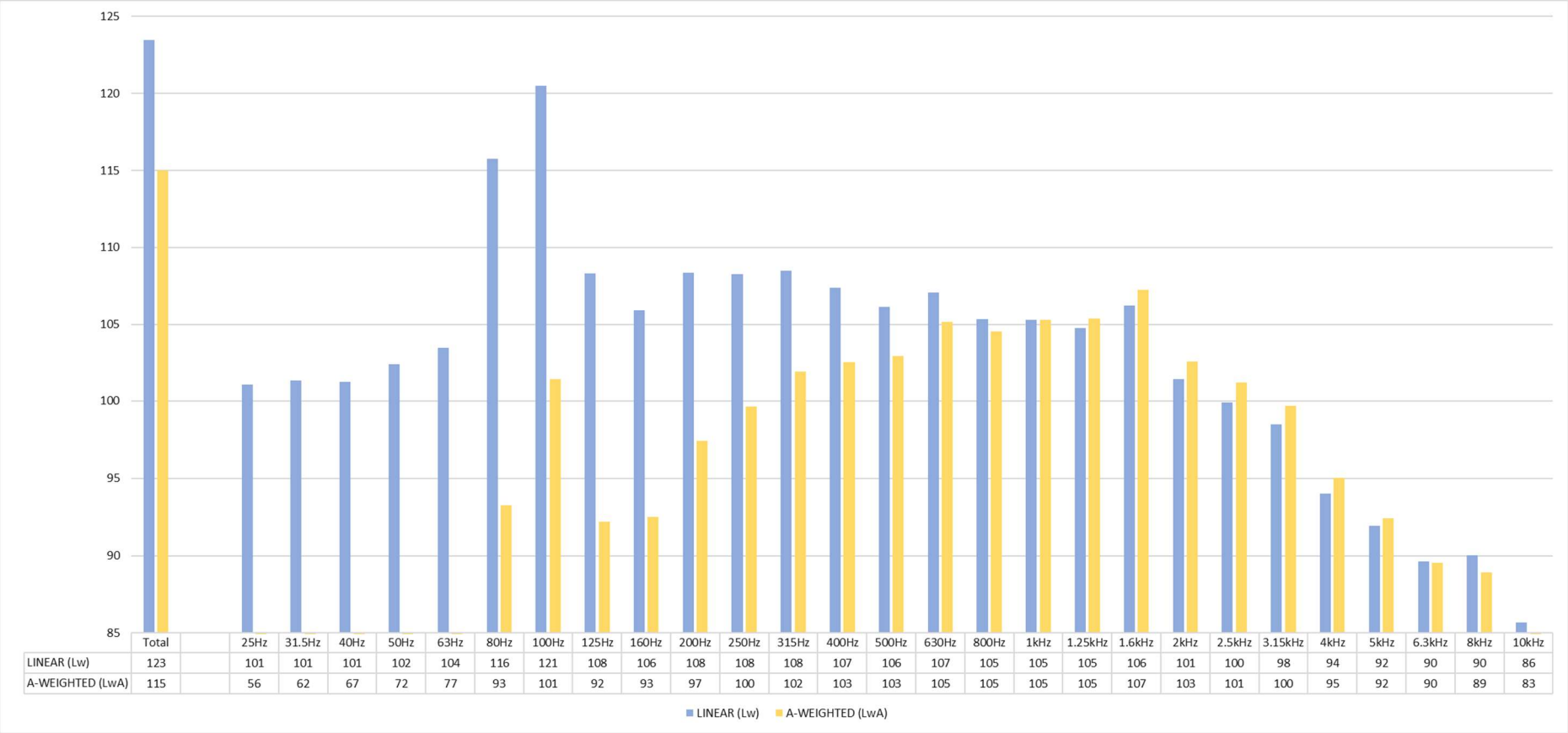
	Total		25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121		89	96	95	99	95	114	120	105	101	102	102	102	99	99	101	100	100	101	102	98	94	96	91	90	88	86	81
A-WEIGHTED (LwA)	110		44	57	60	69	69	92	100	89	88	91	93	96	94	96	99	99	100	101	103	99	95	97	92	90	88	85	78

8054 Dozer Stationary Test



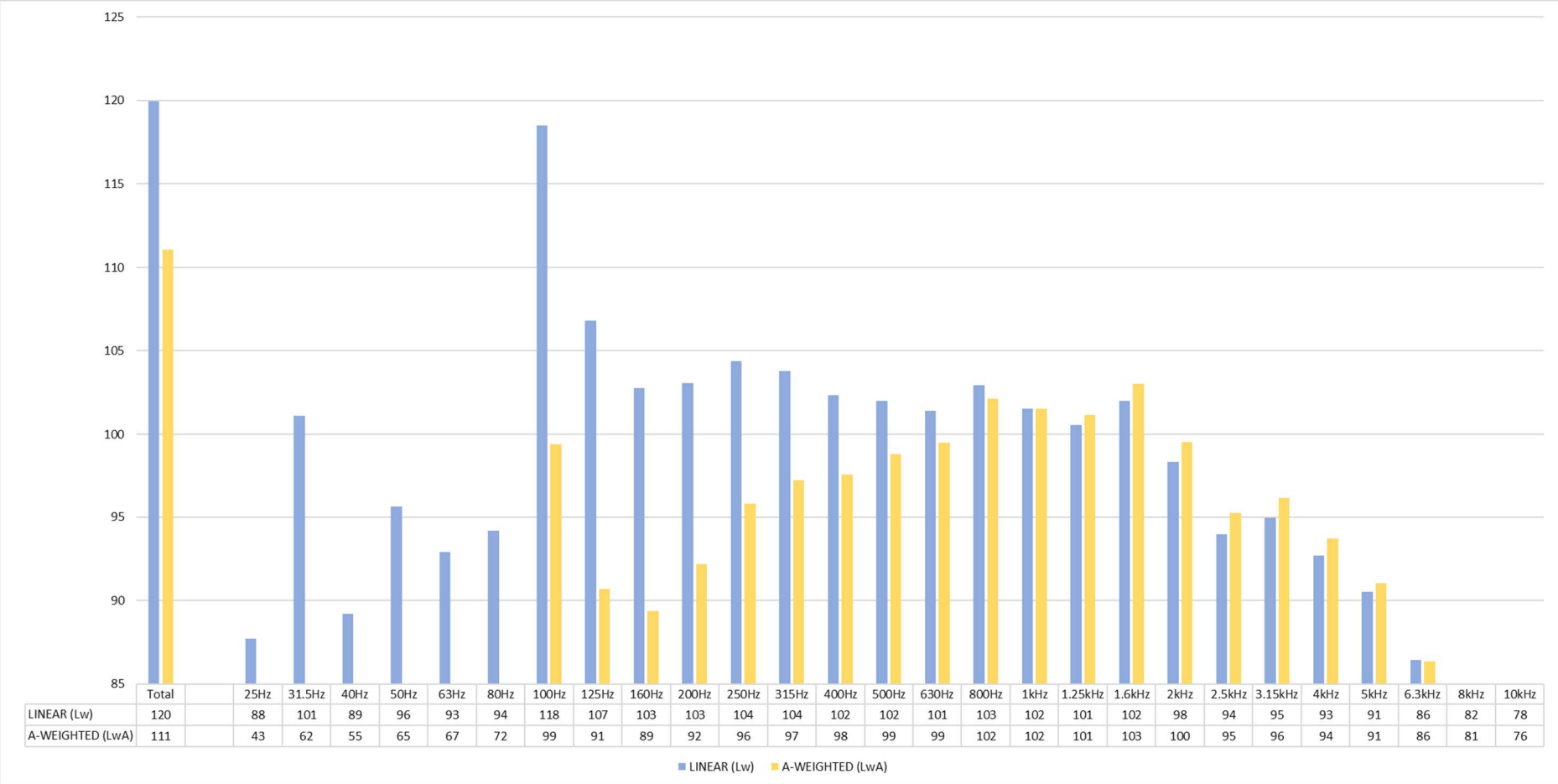
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	97	99	98	100	101	115	120	108	106	107	107	108	106	105	106	105	104	103	106	99	98	97	93	91	92	93	94
A-WEIGHTED (LwA)	114	53	60	63	70	75	93	101	92	92	96	99	101	101	101	104	104	104	103	107	101	99	99	94	92	92	92	91

8054 Dozer Dynamic Test Forwards



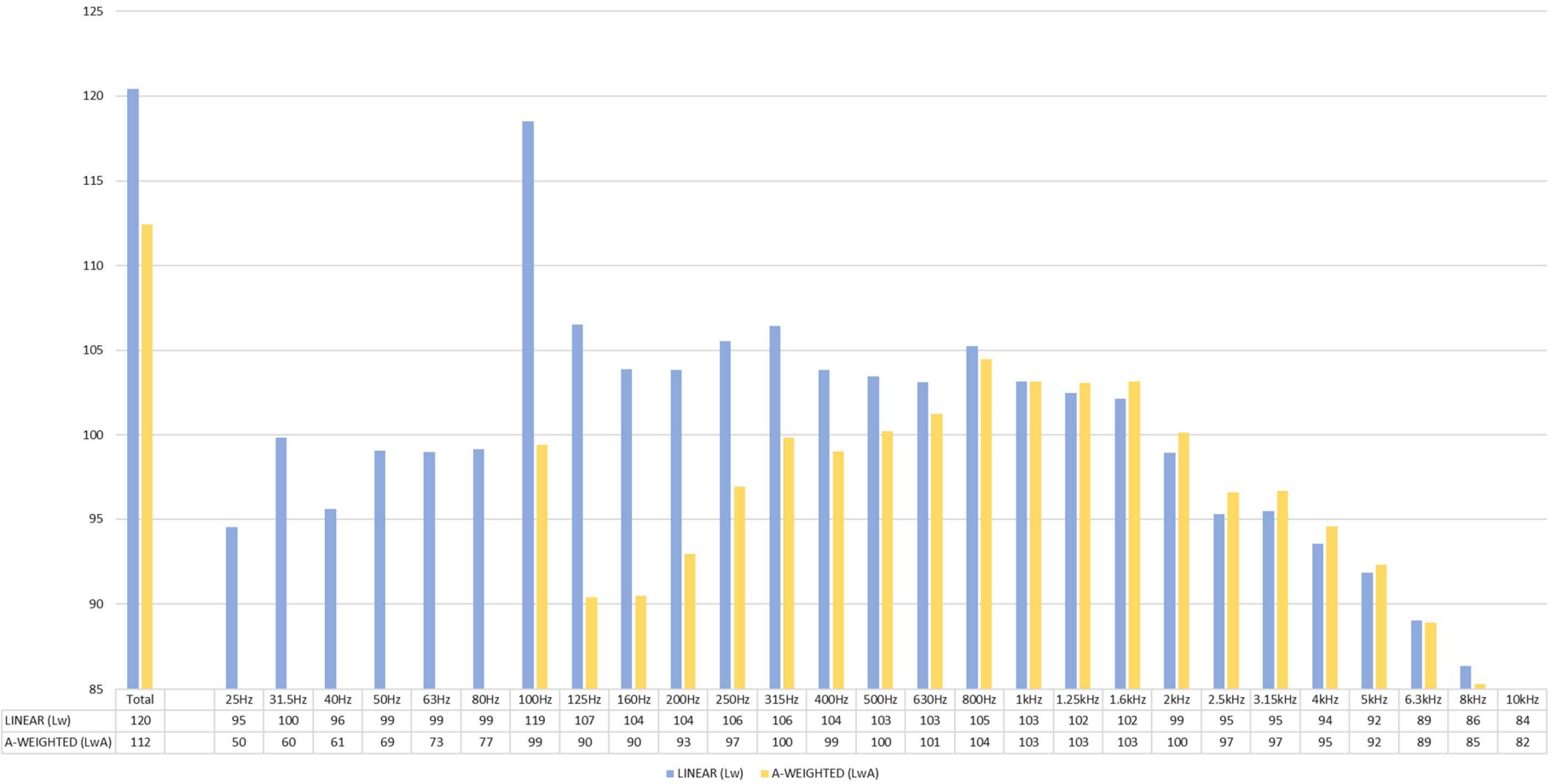
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	101	101	101	102	104	116	121	108	106	108	108	108	107	106	107	105	105	105	106	101	100	98	94	92	90	90	86
A-WEIGHTED (LwA)	115	56	62	67	72	77	93	101	92	93	97	100	102	103	103	105	105	105	105	107	103	101	100	95	92	90	89	83

8054 Dozer Dynamic Test Reverse



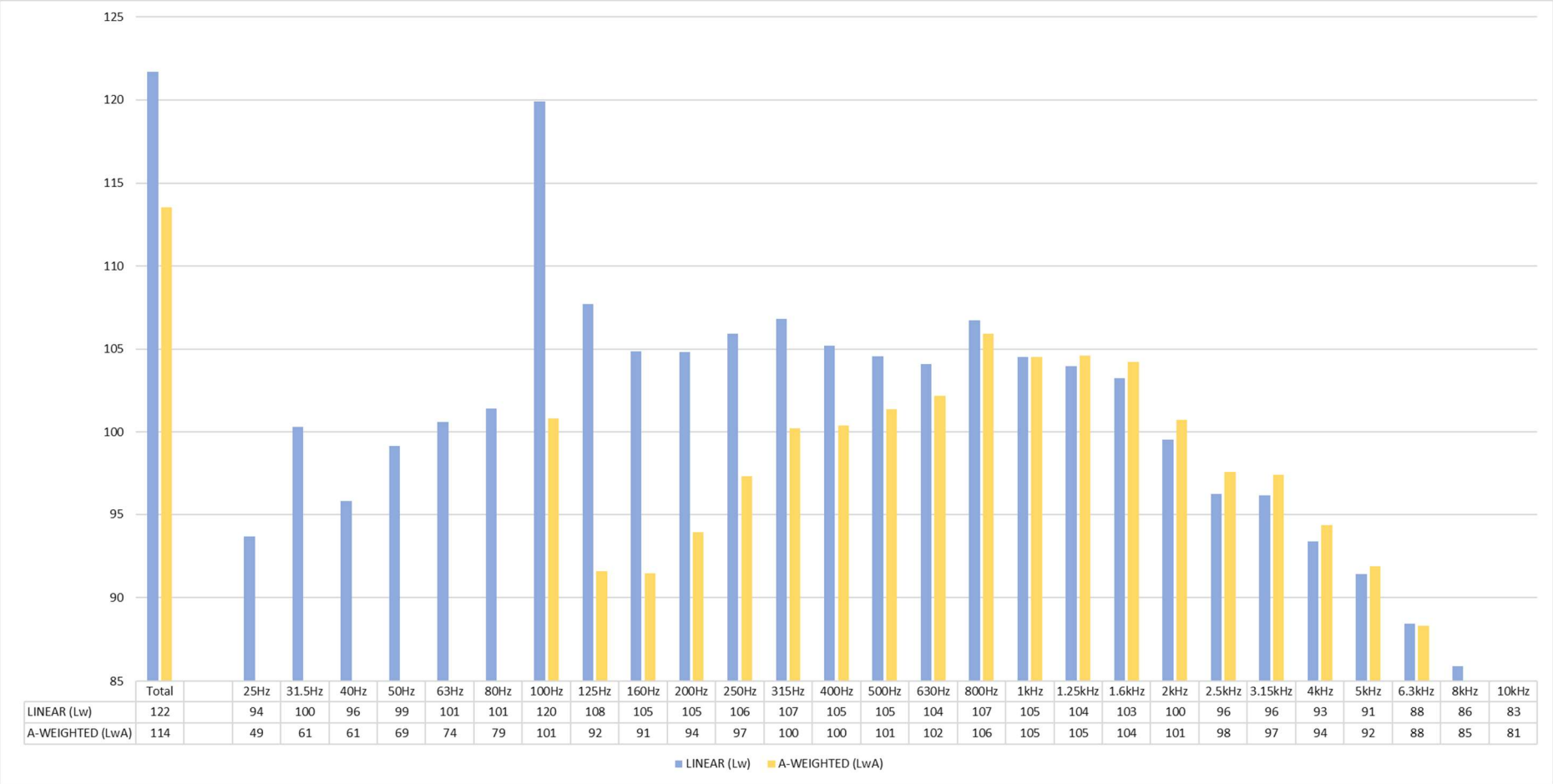
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	88	101	89	96	93	94	118	107	103	103	104	104	102	102	101	103	102	101	102	98	94	95	93	91	86	82	78
A-WEIGHTED (LwA)	111	43	62	55	65	67	72	99	91	89	92	96	97	98	99	99	102	102	101	103	100	95	96	94	91	86	81	76

RJG04249 Dozer Stationary Test



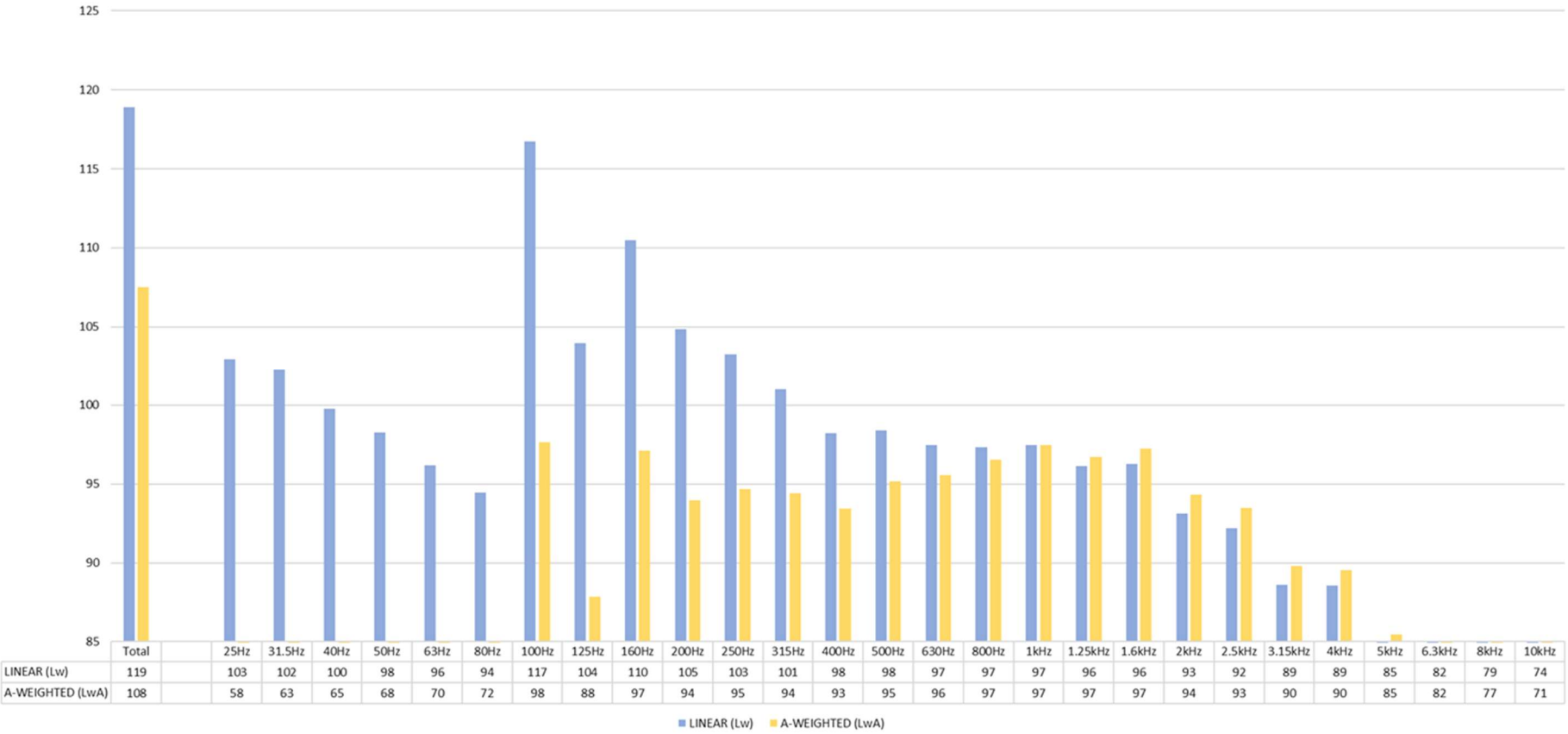
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	95	100	96	99	99	99	119	107	104	104	106	106	104	103	103	105	103	102	102	99	95	95	94	92	89	86	84
A-WEIGHTED (LwA)	112	50	60	61	69	73	77	99	90	90	93	97	100	99	100	101	104	103	103	103	100	97	97	95	92	89	85	82

RJG04249 Dozer Dynamic Test Forwards



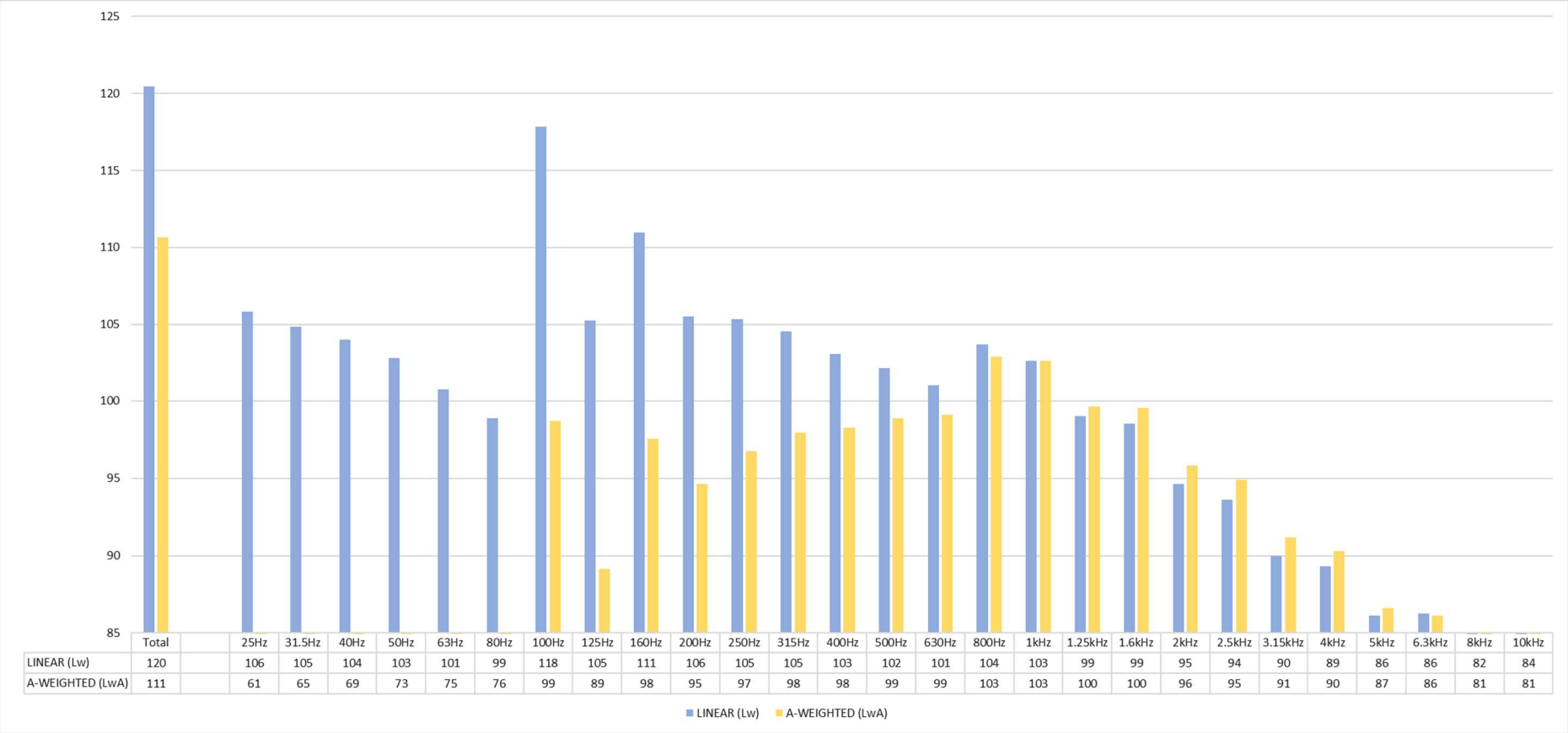
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	122	94	100	96	99	101	101	120	108	105	105	106	107	105	105	104	107	105	104	103	100	96	96	93	91	88	86	83
A-WEIGHTED (LwA)	114	49	61	61	69	74	79	101	92	91	94	97	100	100	101	102	106	105	105	104	101	98	97	94	92	88	85	81

RJG04249 Dozer Dynamic Test Reverse



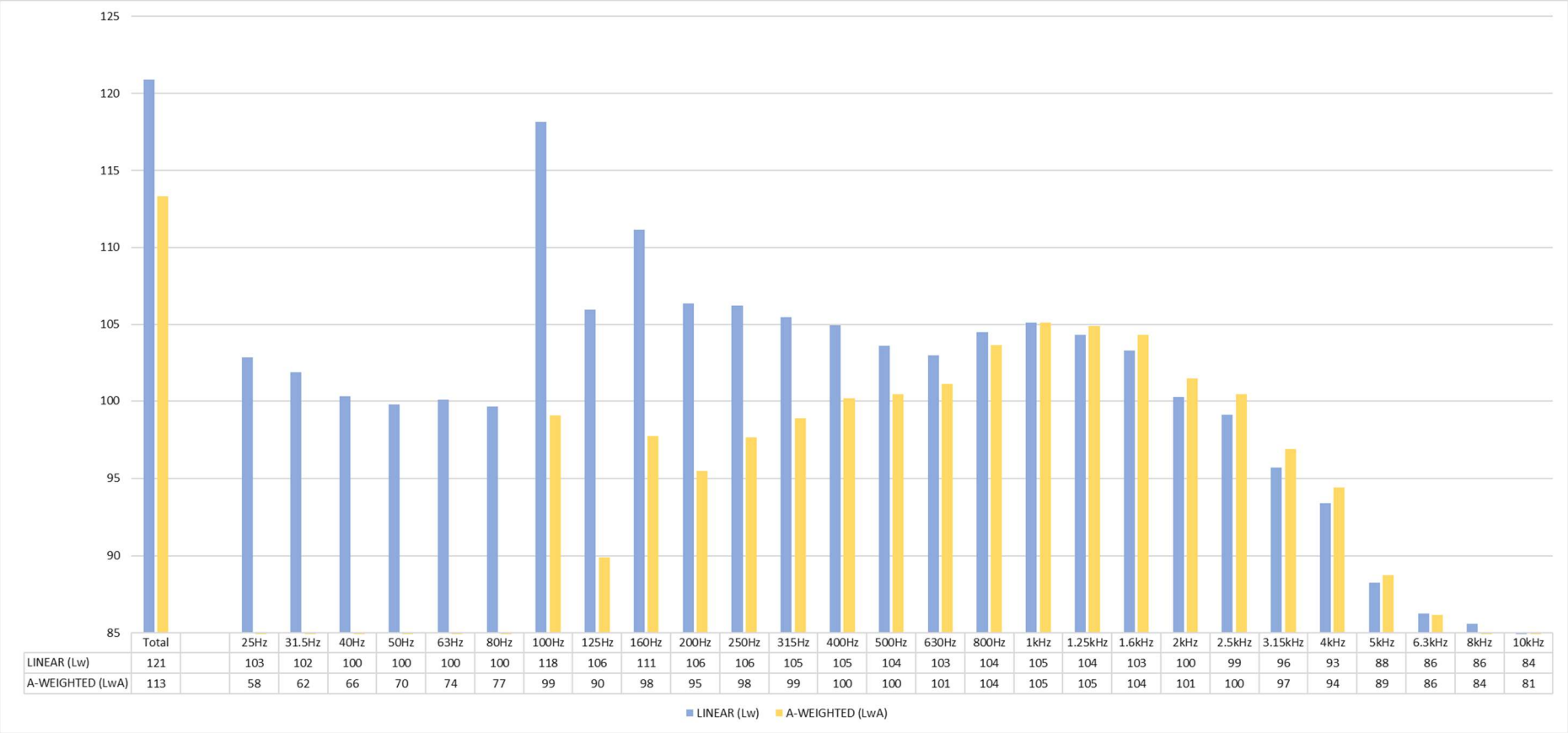
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	119	103	102	100	98	96	94	117	104	110	105	103	101	98	98	97	97	97	96	96	93	92	89	89	85	82	79	74
A-WEIGHTED (LwA)	108	58	63	65	68	70	72	98	88	97	94	95	94	93	95	96	97	97	97	97	94	93	90	90	85	82	77	71

2222 Dozer Stationary Test



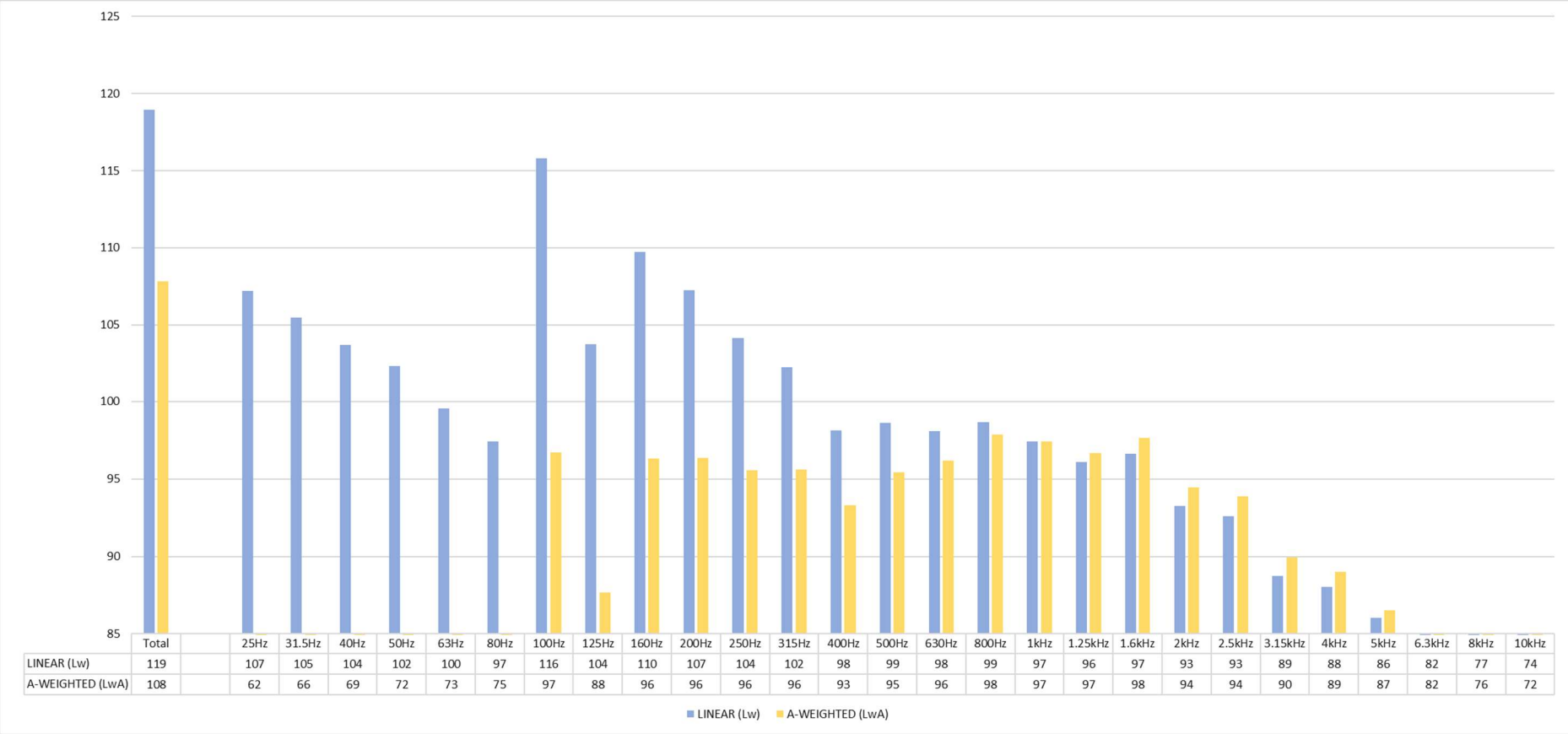
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	106	105	104	103	101	99	118	105	111	106	105	105	103	102	101	104	103	99	99	95	94	90	89	86	86	82	84
A-WEIGHTED (LwA)	111	61	65	69	73	75	76	99	89	98	95	97	98	98	99	99	103	103	100	100	96	95	91	90	87	86	81	81

2222 Dozer Dynamic Test Forwards



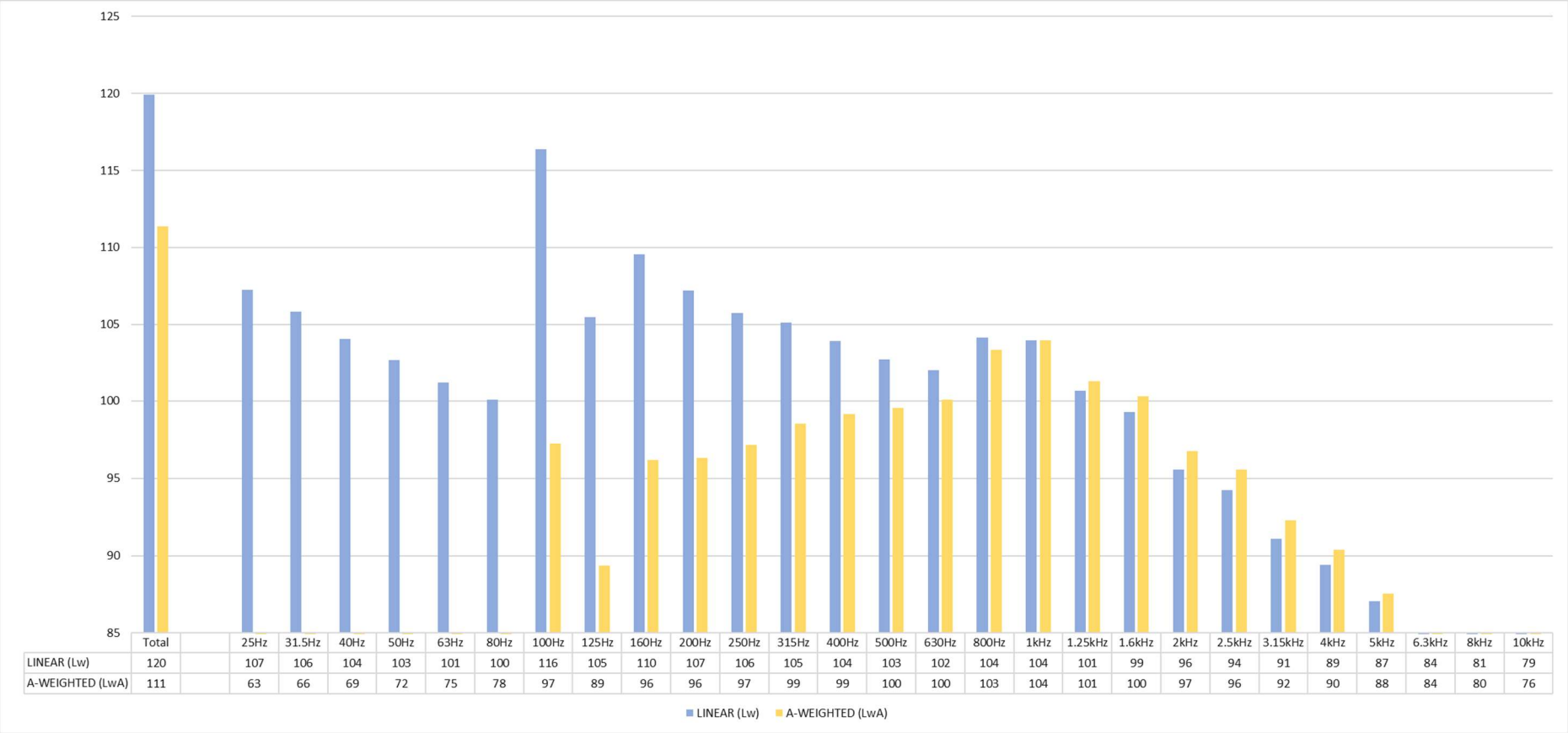
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	103	102	100	100	100	100	118	106	111	106	106	105	105	104	103	104	105	104	103	100	99	96	93	88	86	86	84
A-WEIGHTED (LwA)	113	58	62	66	70	74	77	99	90	98	95	98	99	100	100	101	104	105	105	104	101	100	97	94	89	86	84	81

2222 Dozer Dynamic Test Reverse



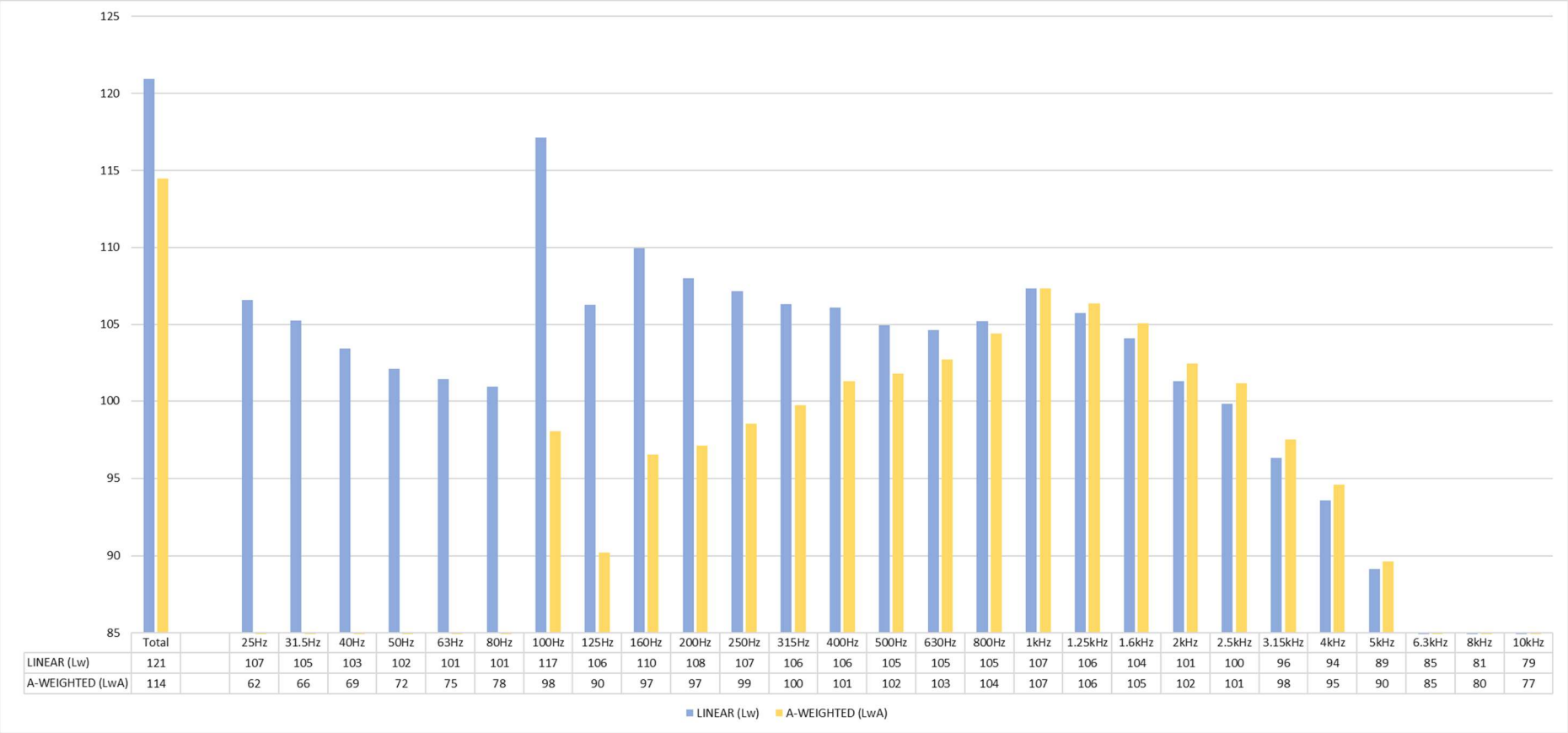
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	119	107	105	104	102	100	97	116	104	110	107	104	102	98	99	98	99	97	96	97	93	93	89	88	86	82	77	74
A-WEIGHTED (LwA)	108	62	66	69	72	73	75	97	88	96	96	96	96	93	95	96	98	97	97	98	94	94	90	89	87	82	76	72

2223 Dozer Stationary Test



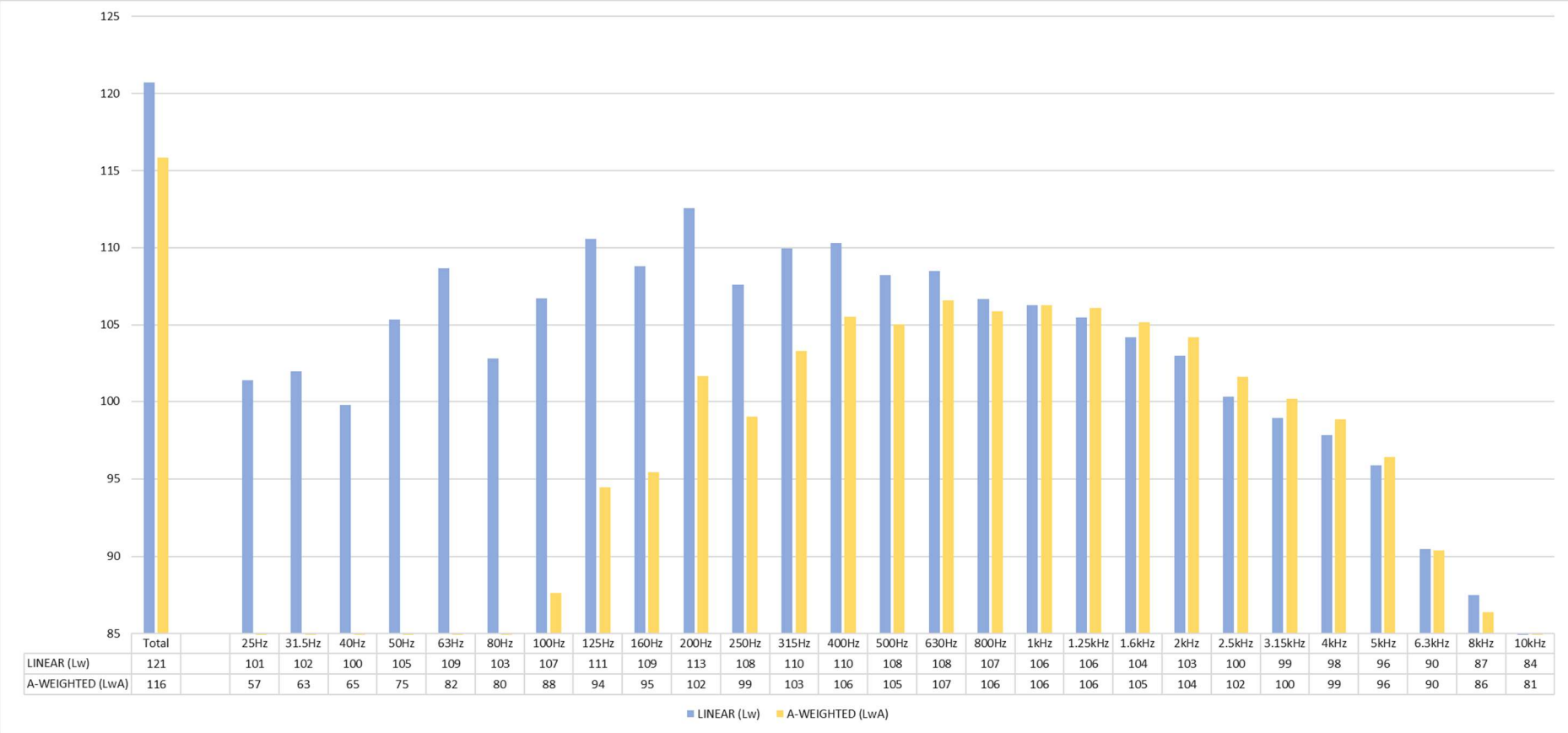
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	120	107	106	104	103	101	100	116	105	110	107	106	105	104	103	102	104	104	101	99	96	94	91	89	87	84	81	79
A-WEIGHTED (LwA)	111	63	66	69	72	75	78	97	89	96	96	97	99	99	100	100	103	104	101	100	97	96	92	90	88	84	80	76

2223 Dozer Dynamic Test Forwards



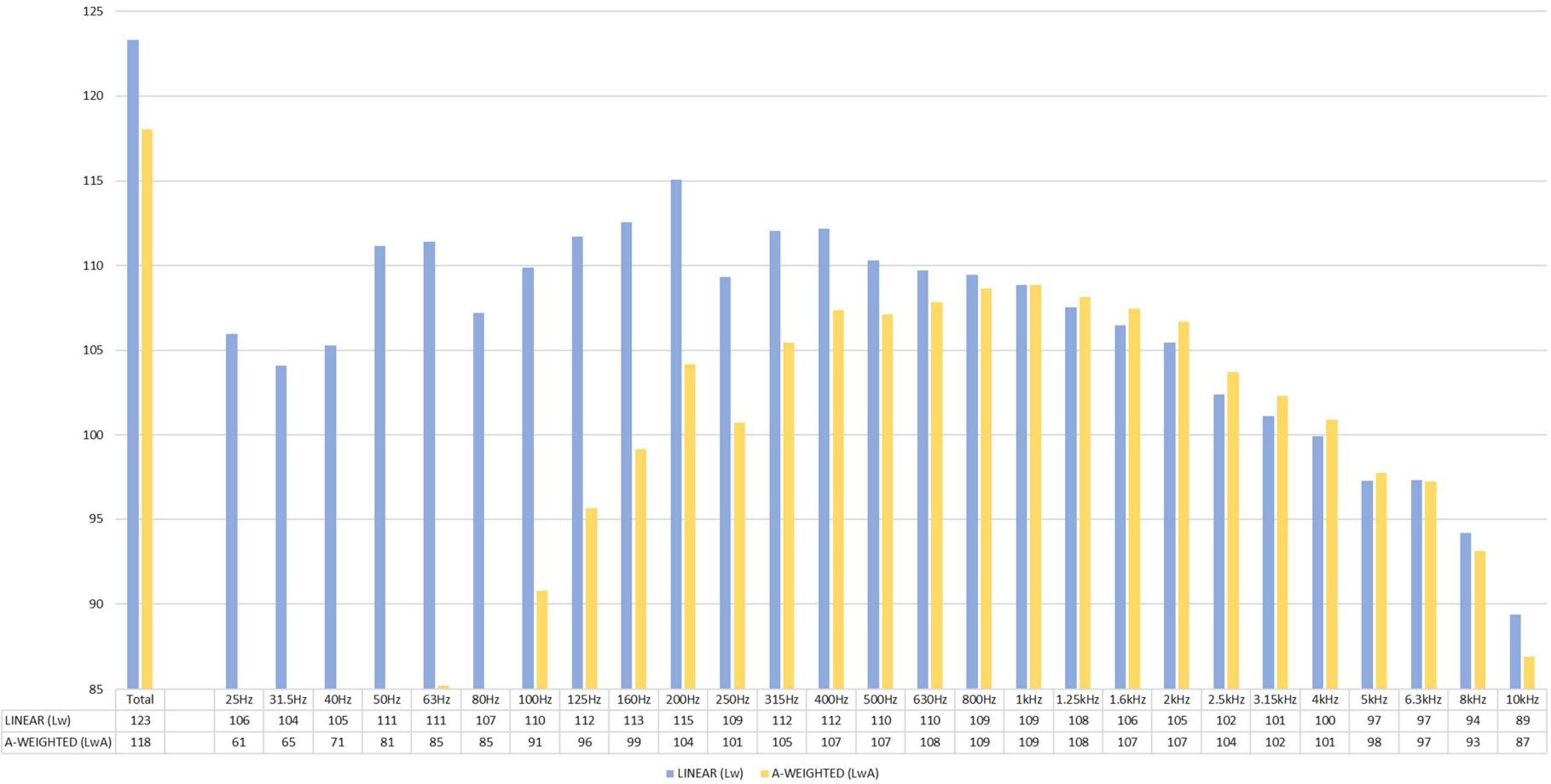
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	107	105	103	102	101	101	117	106	110	108	107	106	106	105	105	105	107	106	104	101	100	96	94	89	85	81	79
A-WEIGHTED (LwA)	114	62	66	69	72	75	78	98	90	97	97	99	100	101	102	103	104	107	106	105	102	101	98	95	90	85	80	77

2223 Dozer Dynamic Test Reverse



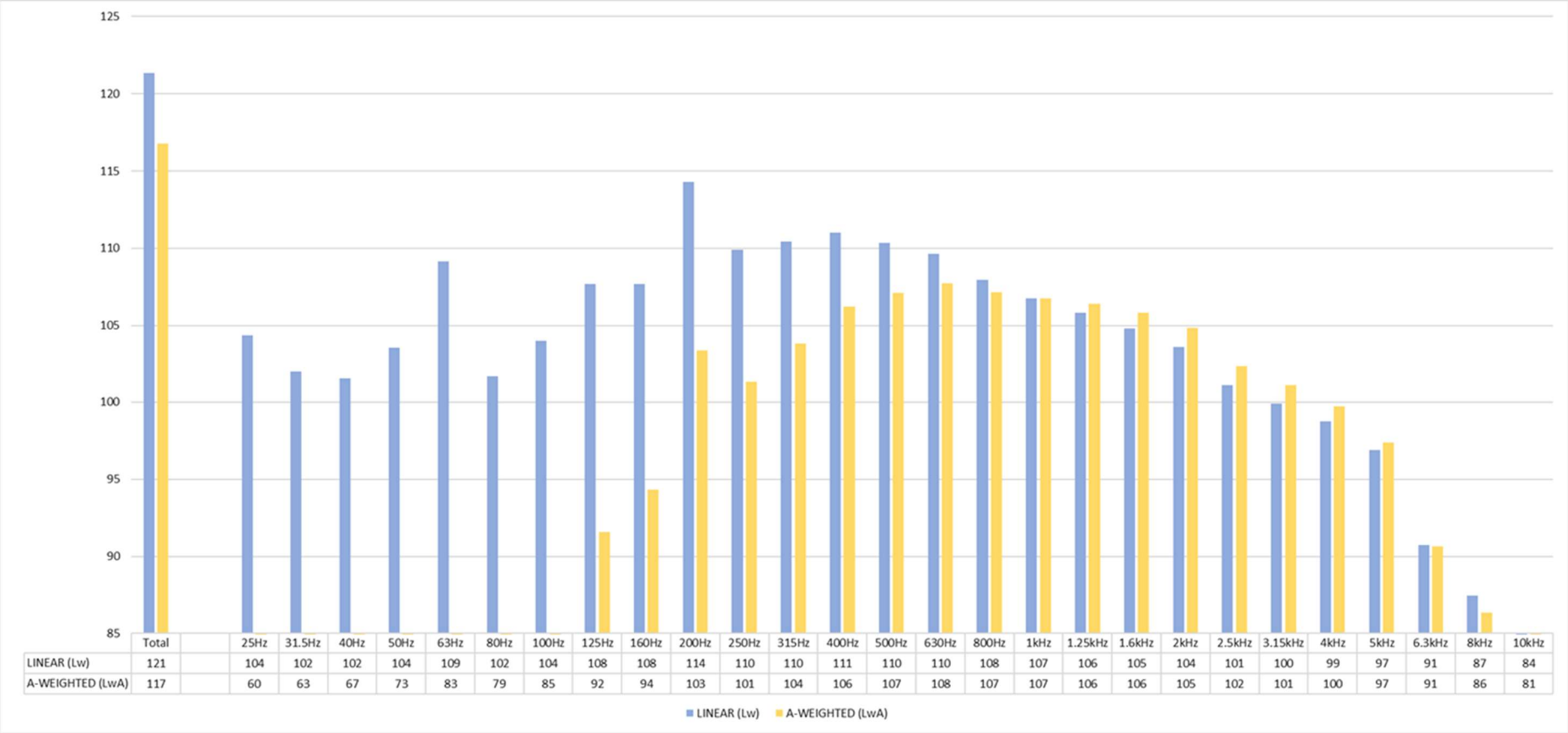
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	101	102	100	105	109	103	107	111	109	113	108	110	110	108	108	107	106	106	104	103	100	99	98	96	90	87	84
A-WEIGHTED (LwA)	116	57	63	65	75	82	80	88	94	95	102	99	103	106	105	107	106	106	106	105	104	102	100	99	96	90	86	81

1849 Excavator Stationary Test



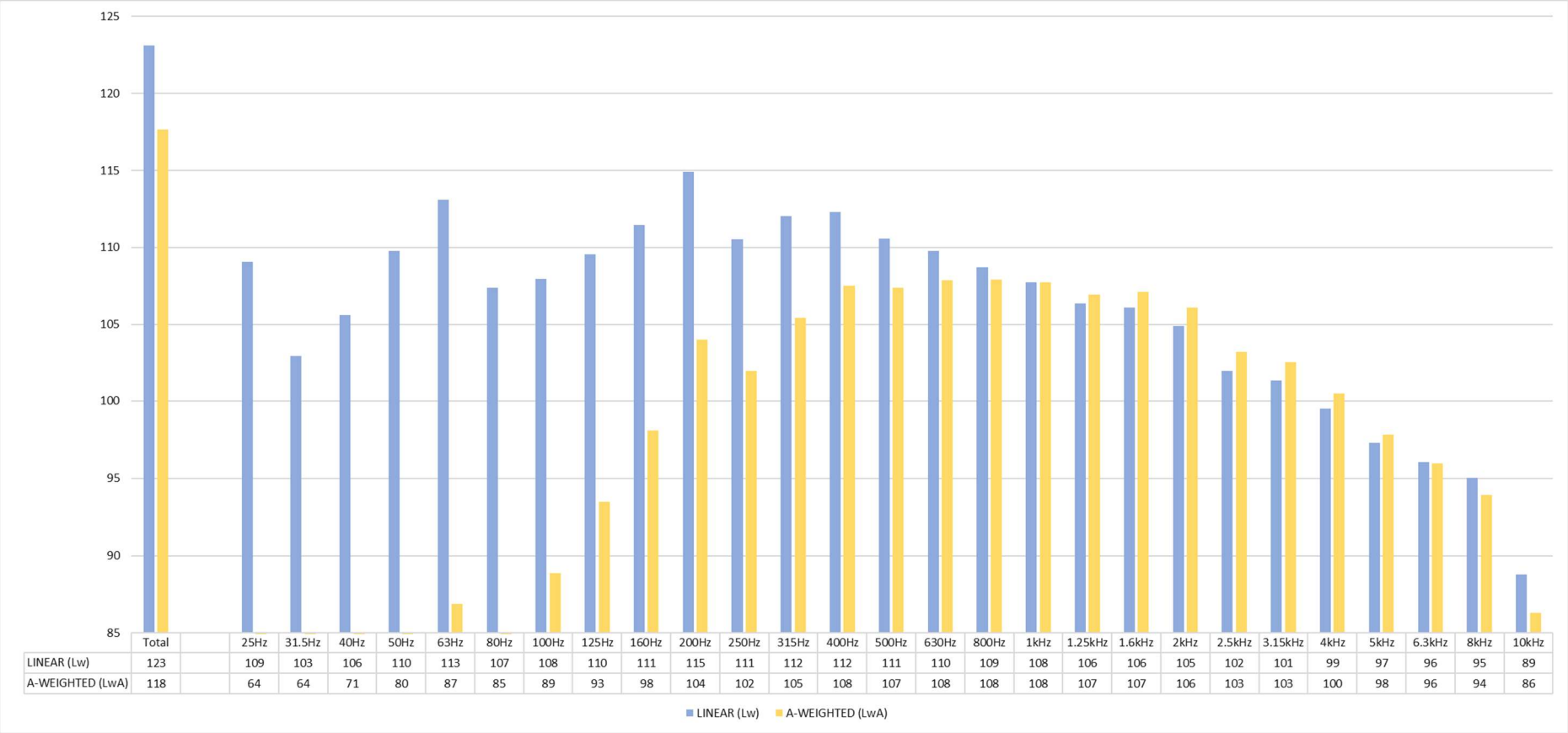
	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	106	104	105	111	111	107	110	112	113	115	109	112	112	110	110	109	109	108	106	105	102	101	100	97	97	94	89
A-WEIGHTED (LwA)	118	61	65	71	81	85	85	91	96	99	104	101	105	107	107	108	109	109	108	107	107	104	102	101	98	97	93	87

1849 Excavator Dynamic Test



	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	121	104	102	102	104	109	102	104	108	108	114	110	110	111	110	110	108	107	106	105	104	101	100	99	97	91	87	84
A-WEIGHTED (LwA)	117	60	63	67	73	83	79	85	92	94	103	101	104	106	107	108	107	107	106	106	105	102	101	100	97	91	86	81

1850 Excavator Stationary Test



	Total	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
LINEAR (Lw)	123	109	103	106	110	113	107	108	110	111	115	111	112	112	111	110	109	108	106	106	105	102	101	99	97	96	95	89
A-WEIGHTED (LwA)	118	64	64	71	80	87	85	89	93	98	104	102	105	108	107	108	108	108	107	107	106	103	103	100	98	96	94	86

1850 Excavator Dynamic Test

APPENDIX E - Blasting

Table 4: MGO Overpressure Blasting Compliance Summary

Blast Monitor	Location	Maximum Airblast (dB(L))	Average Airblast (dB(L))
Mt Owen and Ravensworth			
MOC1	Glennies Ck Road	114.9	97.4
MOC2	Glennies Ck Road	117.2	93.9
MOC3	Glennie St Camberwell Village	107.1	89.5
MOC4	Middle Falbrook Area	113.8	92.1
MOC5	Goorangoola Area	110.3	87.1
Ravensworth Homestead	Ravensworth Homestead	111	95.9
Chain of Ponds Inn	Chain of Ponds Inn	106.8	91.8
Former Hebden Public School	Former Hebden Public School	110.2	95.4
Church	Camberwell Church	106.7	92.4
Integra Surface	Integra Surface	136.9	107.0
Integra Underground Workings	Integra Underground Workings	111.8	96.4
Glendell			
Ravensworth Homestead	Ravensworth Homestead	112.5	97.7
MOC3	Glennie St Camberwell Village	106	93.6
Church	Camberwell Church	114.7	95.1
Powerlines	Powerlines	113.8	101.9
ARTC 1	Main Northern Railway	112.4	101.6
ARTC 2	Main Northern Railway	112.2	101.8
ARTC 3	Main Northern Railway	109.2	98.6
ARTC 4	Main Northern Railway	111.9	97.6
MOC2	Glennies Creek Road	113.1	93.1
Integra Surface	Integra Surface	110.7	96.9

Table 5: MGO Vibration Blasting Compliance Summary

Blast Monitor	Location	Maximum Vibration (mm/s)	Average Vibration (mm/s)
Mt Owen and Ravensworth East			
MOC1	Glennies Ck Road	0.95	0.3

Blast Monitor	Location	Maximum Vibration (mm/s)	Average Vibration (mm/s)
MOC2	Glennies Ck Road	1.19	0.3
MOC3	Glennie St Camberwell Village	0.27	0.1
MOC4	Middle Falbrook Area	0.85	0.3
MOC5	Goorangoola Area	0.77	0.2
Ravensworth Homestead	Ravensworth Homestead	1.87	0.3
Chain of Ponds Inn	Chain of Ponds Inn	0.43	0.1
Former Hebden Public School	Former Hebden Public School	2.05	0.3
Church	Camberwell Church	0.17	0.1
Integra Surface	Integra Surface	9.4	1.8
Integra Underground Workings	Integra Underground Workings	0.71	0.3
Glendell			
Ravensworth Homestead	Ravensworth Homestead	1.3	0.4
MOC3	Glennie St Camberwell Village	1.19	0.3
Church	Camberwell Church	1.12	0.2
MOC2	Glennies Creek Road	1.58	0.2
Powerlines	Powerlines	3.61	1.2
ARTC 1	Main Northern Railway	2.83	0.9
ARTC 2	Main Northern Railway	1.6	0.6
ARTC 3	Main Northern Railway	2.55	0.5
ARTC 4	Main Northern Railway	1.42	0.4
Integra Surface	Integra Surface	1.07	0.3

Table 6: Mount Owen Blast Monitoring Results – MOC 1 and MOC 2

Date Fired	Time Fired	Site	MOC 1		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	12:14	Mt Owen	109.3	0.46	97.9	0.29
13/01/2021	13:46	Mt Owen	108.7	0.32	93.3	0.22
13/01/2021	13:46	Mt Owen	108.7	0.15	93.3	0.13
15/01/2021	12:24	Ravensworth East	99.1	0.03	85.3	0.06
18/01/2021	12:29	Mt Owen	101.2	0.24	97.0	0.23
21/01/2021	13:10	Mt Owen	101.5	0.37	105.1	0.47

Date Fired	Time Fired	Site	MOC 1		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
27/01/2021	12:09	Mt Owen	106.0	0.79	99.8	0.76
03/02/2021	12:13	Mt Owen	98.4	0.29	98.8	0.21
05/02/2021	12:08	Mt Owen	101.9	0.28	93.9	0.33
11/02/2021	12:27	Mt Owen	90.0	0.42	91.6	0.27
17/02/2021	12:18	Mt Owen	110.4	0.49	107.0	0.35
18/02/2021	16:12	Mt Owen	86.0	0.18	82.6	0.19
23/02/2021	12:14	Mt Owen	91.2	0.12	97.0	0.25
25/02/2021	12:11	Mt Owen	93.4	0.31	91.2	0.30
01/03/2021	12:41	Ravensworth East	94.3	0.06	96.5	0.18
02/03/2021	13:18	Mt Owen	96.2	0.22	90.6	0.29
04/03/2021	13:04	Mt Owen	99.5	0.21	87.3	0.27
10/03/2021	12:12	Mt Owen	105.3	0.38	99.0	0.30
10/03/2021	12:16	Ravensworth East	109.3	0.10	90.8	0.16
11/03/2021	12:46	Ravensworth East	93.6	0.36	91.1	0.25
12/03/2021	13:31	Mt Owen	87.2	0.09	82.8	0.21
18/03/2021	12:22	Mt Owen	101.0	0.39	107.9	0.34
29/03/2021	13:18	Mt Owen	100.1	0.56	94.4	0.37
31/03/2021	13:16	Mt Owen	99.9	0.66	102.9	0.81
8/04/2021	16:06	Mt Owen	96.1	0.28	95.3	0.26
8/04/2021	16:08	Mt Owen	92.9	0.36	102.5	0.45
14/04/2021	10:29	Ravensworth East	103.6	0.02	91.0	0.04
15/04/2021	12:28	Mt Owen	108.2	0.95	100.1	0.44
20/04/2021	16:00	Mt Owen	99.9	0.31	93.6	0.24
23/04/2021	7:09	Mt Owen	114.9	0.46	117.2	0.70
26/04/2021	13:30	Ravensworth East	77.8	0.10	79.3	0.15
27/04/2021	12:16	Mt Owen	96.4	0.20	94.8	0.19
28/04/2021	12:12	Mt Owen	100.1	0.25	93.6	0.21
30/04/2021	12:12	Mt Owen	94.5	0.29	90.0	0.24
4/05/2021	13:47	Ravensworth East	90.2	0.06	92.0	0.09
5/05/2021	13:14	Mt Owen	87.4	0.67	91.2	0.59
11/05/2021	12:23	Mt Owen	98.1	0.35	100.2	0.27
17/05/2021	15:58	Mt Owen	98.6	0.08	95.7	0.10
17/05/2021	16:02	Mt Owen	98.3	0.40	96.3	0.27
18/05/2021	13:26	Ravensworth East	98.3	0.03	82.4	0.10
19/05/2021	13:16	Mt Owen	101.3	0.38	95.2	0.28
21/05/2021	12:32	Mt Owen	94.8	0.48	89.4	0.45
28/05/2021	12:12	Mt Owen	104.4	0.40	97.6	0.31
31/05/2021	13:17	Mt Owen	102.1	0.31	98.8	0.28
2/06/2021	12:14	Mt Owen	94.3	0.29	95.4	0.32
7/06/2021	12:33	Mt Owen	98.3	0.21	96.2	0.38

Date Fired	Time Fired	Site	MOC 1		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/06/2021	13:32	Ravensworth East	88.4	0.04	96.6	0.08
15/06/2021	15:28	Mt Owen	100.5	0.29	98.0	0.36
21/06/2021	12:19	Ravensworth East	81.8	0.16	84.9	0.47
22/06/2021	12:01	Mt Owen	100.5	0.36	96.1	0.30
24/06/2021	12:37	Ravensworth East	101.1	0.03	101.4	0.05
24/06/2021	12:40	Ravensworth East	91.3	0.03	103.7	0.04
25/06/2021	09:39	Mt Owen	96.1	0.31	93.0	0.38
1/07/2021	12:14	Mt Owen	94.6	0.41	91.3	0.56
6/07/2021	12:09	Mt Owen	103.1	0.45	106.5	0.40
8/07/2021	12:17	Mt Owen	97.1	0.13	96.7	0.08
9/07/2021	12:30	Ravensworth East	89.4	0.05	87.5	0.13
13/07/2021	12:53	Mt Owen	100.6	0.49	95.5	0.47
15/07/2021	13:22	Mt Owen	95.8	0.42	91.8	0.34
21/07/2021	14:22	Ravensworth East	91.5	0.08	95.2	0.14
22/07/2021	16:24	Mt Owen	99.6	0.40	102.4	0.55
29/07/2021	13:23	Mt Owen	99.4	0.49	102.6	0.32
29/07/2021	13:27	Ravensworth East	99.6	0.05	104.2	0.10
29/07/2021	13:37	Mt Owen	96.3	0.40	95.1	0.44
30/07/2021	12:38	Ravensworth East	97.5	0.04	91.0	0.07
5/08/2021	11:28	Ravensworth East	108.6	0.05	93.0	0.08
5/08/2021	13:38	Mt Owen	102.7	0.37	98.9	0.48
9/08/2021	12:16	Mt Owen	89.0	0.28	83.8	0.24
12/08/2021	13:39	Mt Owen	106.3	0.61	103.8	0.40
12/08/2021	13:47	Mt Owen	102.7	0.35	98.5	0.32
17/08/2021	12:24	Ravensworth East	97.5	0.06	83.8	0.06
17/08/2021	13:30	Mt Owen	91.6	0.20	85.9	0.17
19/08/2021	12:21	Mt Owen	99.3	0.36	93.5	0.31
25/08/2021	13:28	Ravensworth East	105.8	0.07	88.3	0.17
26/08/2021	13:19	Mt Owen	102.9	0.30	94.5	0.46
26/08/2021	13:22	Mt Owen	102.6	0.17	88.3	0.22
31/08/2021	12:30	Ravensworth East	97.1	0.05	88.8	0.05
2/09/2021	13:42	Mt Owen	95.1	0.45	97.3	0.56
2/09/2021	13:45	Mt Owen	95.7	0.36	95.3	0.52
3/09/2021	12:56	Ravensworth East	98.4	0.06	86.9	0.10
9/09/2021	12:57	Mt Owen	109.3	0.46	91.0	0.30
9/09/2021	12:59	Mt Owen	100.8	0.18	97.5	0.14
16/09/2021	12:27	Mt Owen	96.2	0.46	93.1	0.47
16/09/2021	12:29	Mt Owen	97.5	0.29	91.5	0.41
21/09/2021	9:11	Mt Owen	98.9	0.25	92.9	0.31
22/09/2021	12:01	Mt Owen	85.9	0.01	81.0	0.01

Date Fired	Time Fired	Site	MOC 1		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
27/09/2021	13:32	Ravensworth East	95.2	0.04	96.1	0.09
28/09/2021	13:22	Mt Owen	94.3	0.36	95.0	0.28
28/09/2021	13:25	Mt Owen	97.0	0.09	95.2	0.09
30/09/2021	12:27	Ravensworth East	104.7	0.05	91.0	0.10
6/10/2021	12:01	Ravensworth East	90	0.04	88.3	0.1
6/10/2021	13:08	Mt Owen	92.1	0.07	91.7	0.06
6/10/2021	13:10	Mt Owen	99.8	0.67	97.4	0.37
8/10/2021	12:09	Ravensworth East	95	0.17	95.9	0.37
14/10/2021	12:49	Mt Owen	93.6	0.26	92.1	0.31
15/10/2021	10:00	Ravensworth East	94	0	98.8	0.02
19/10/2021	12:31	Mt Owen	91.4	0.59	90.7	0.52
20/10/2021	12:08	Mt Owen	103.3	0.65	92.6	1.19
20/10/2021	12:32	Ravensworth East	106.9	0.11	110	0.21
26/10/2021	12:17	Mt Owen	98	0.23	95.4	0.38
26/10/2021	12:33	Ravensworth East	82.6	0.03	81.2	0.08
28/10/2021	9:12	Mt Owen	89	0.23	88.2	0.32
1/11/2021	13:19	Mt Owen	87.9	0.36	86.2	0.56
3/11/2021	13:15	Mt Owen	89.3	0.18	86.1	0.31
4/11/2021	12:29	Mt Owen	87.0	0.11	85.4	0.11
10/11/2021	12:16	Mt Owen	90.4	0.75	91.8	0.59
16/11/2021	12:34	Mt Owen	97.0	0.30	96.2	0.34
18/11/2021	13:06	Ravensworth East	91.4	0.12	88.6	0.24
25/11/2021	12:30	Mt Owen	89.7	0.69	95.2	0.4
30/11/2021	12:49	Mt Owen	88.8	0.24	86.9	0.31
7/12/2021	12:16	Mt Owen	96.1	0.58	85.6	0.63
14/12/2021	12:37	Ravensworth East	98.2	0.10	84.1	0.29
17/12/2021	13:40	Ravensworth East	106.1	0.17	91.4	0.41
30/12/2021	12:16	Mt Owen	100.8	0.50	101.1	0.57

Table 7: Mount Owen Blast Monitoring Results MOC 3 and MOC 4

Date Fired	Time Fired	Site	MOC 3 Camberwell		MOC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	12:14	Mt Owen	95.4	0.10	103.3	0.34
13/01/2021	13:46	Mt Owen	93.5	0.09	91.6	0.48
13/01/2021	13:46	Mt Owen	93.5	0.04	91.6	0.20
15/01/2021	12:24	Ravensworth East	86.3	0.03	82.4	0.03
18/01/2021	12:29	Mt Owen	90.1	0.06	104.9	0.26

Date Fired	Time Fired	Site	MOC 3 Camberwell		MOC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
21/01/2021	13:10	Mt Owen	101.6	0.22	98.9	0.29
27/01/2021	12:09	Mt Owen	106.0	0.20	96.4	0.48
03/02/2021	12:13	Mt Owen	88.9	0.06	92.1	0.35
05/02/2021	12:08	Mt Owen	82.5	0.09	89.4	0.24
11/02/2021	12:27	Mt Owen	91.5	0.09	90.6	0.48
17/02/2021	12:18	Mt Owen	94.4	0.13	92.5	0.53
18/02/2021	16:12	Mt Owen	81.2	0.06	84.0	0.21
23/02/2021	12:14	Mt Owen	85.8	0.05	87.1	0.21
25/02/2021	12:11	Mt Owen	94.7	0.07	92.0	0.37
01/03/2021	12:41	Ravensworth East	86.3	0.04	83.4	0.07
02/03/2021	13:18	Mt Owen	86.7	0.08	91.3	0.35
04/03/2021	13:04	Mt Owen	84.5	0.07	88.8	0.29
10/03/2021	12:12	Mt Owen	91.1	0.09	104.7	0.37
10/03/2021	12:16	Ravensworth East	89.9	0.04	90.8	0.09
11/03/2021	12:46	Ravensworth East	87.7	0.15	91.6	0.30
12/03/2021	13:31	Mt Owen	87	0.06	82.8	0.09
18/03/2021	12:22	Mt Owen	90.5	0.09	93.2	0.43
29/03/2021	13:18	Mt Owen	91.7	0.08	92.4	0.85
31/03/2021	13:16	Mt Owen	100.8	0.18	98.3	0.47
8/04/2021	16:06	Mt Owen	96	0.08	90.9	0.18
8/04/2021	16:08	Mt Owen	97	0.15	89.1	0.41
14/04/2021	10:29	Ravensworth East	86.4	0.02	86.9	0.03
15/04/2021	12:28	Mt Owen	84.7	0.14	99.1	0.52
20/04/2021	16:00	Mt Owen	88.4	0.06	94.0	0.25
23/04/2021	7:09	Mt Owen	104.4	0.17	113.8	0.34
26/04/2021	13:30	Ravensworth East	80.7	0.07	79.6	0.07
27/04/2021	12:16	Mt Owen	90.2	0.05	96.0	0.25
28/04/2021	12:12	Mt Owen	88.5	0.06	95.8	0.24
30/04/2021	12:12	Mt Owen	88.6	0.11	95.7	0.31
4/05/2021	13:47	Ravensworth East	84.3	0.04	98.5	0.07
5/05/2021	13:14	Mt Owen	85	0.12	88.0	0.61
11/05/2021	12:23	Mt Owen	93	0.11	92.1	0.44
17/05/2021	15:58	Mt Owen	92.4	0.03	95.6	0.07
17/05/2021	16:02	Mt Owen	92.7	0.07	98.5	0.36
18/05/2021	13:26	Ravensworth East	78.1	0.02	75.9	0.04
19/05/2021	13:16	Mt Owen	90.3	0.1	103.1	0.47
21/05/2021	12:32	Mt Owen	89.9	0.09	90.6	0.64
28/05/2021	12:12	Mt Owen	91	0.09	95.1	0.41
31/05/2021	13:17	Mt Owen	96	0.09	98.4	0.41
2/06/2021	12:14	Mt Owen	87.7	0.1	92.3	0.63

Date Fired	Time Fired	Site	MOC 3 Camberwell		MOC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
7/06/2021	12:33	Mt Owen	90.3	0.11	99.4	0.21
8/06/2021	13:32	Ravensworth East	89.2	0.03	87.1	0.03
15/06/2021	15:28	Mt Owen	96.7	0.16	100.8	0.40
21/06/2021	12:19	Ravensworth East	76.9	0.08	78.7	0.13
22/06/2021	12:01	Mt Owen	92	0.08	96.9	0.35
24/06/2021	12:37	Ravensworth East	88	0.03	90.5	0.03
24/06/2021	12:40	Ravensworth East	88.8	0.02	85.6	0.05
25/06/2021	09:39	Mt Owen	87.5	0.15	102.6	0.33
1/07/2021	12:14	Mt Owen	89	0.12	91.0	0.44
6/07/2021	12:09	Mt Owen	99	0.16	103.6	0.68
8/07/2021	12:17	Mt Owen	94.3	0.04	96.9	0.15
9/07/2021	12:30	Ravensworth East	90.4	0.04	88.0	0.06
13/07/2021	12:53	Mt Owen	92.9	0.08	101.3	0.79
15/07/2021	13:22	Mt Owen	88.1	0.09	94.0	0.41
21/07/2021	14:22	Ravensworth East	88.6	0.06	85.6	0.14
22/07/2021	16:24	Mt Owen	103	0.12	100.0	0.36
29/07/2021	13:23	Mt Owen	92.5	0.12	93.2	0.53
29/07/2021	13:27	Ravensworth East	83.9	0.03	80.5	0.05
29/07/2021	13:37	Mt Owen	84.5	0.09	99.4	0.53
30/07/2021	12:38	Ravensworth East	89.2	0.02	83.2	0.04
5/08/2021	11:28	Ravensworth East	82.7	0.03	102.2	0.07
5/08/2021	13:38	Mt Owen	88.5	0.12	94.4	0.47
9/08/2021	12:16	Mt Owen	84.7	0.06	87.6	0.38
12/08/2021	13:39	Mt Owen	90	0.14	103.1	0.33
12/08/2021	13:47	Mt Owen	99.5	0.11	100.5	0.62
17/08/2021	12:24	Ravensworth East	88	0.03	85.9	0.05
17/08/2021	13:30	Mt Owen	90.9	0.06	88.3	0.21
19/08/2021	12:21	Mt Owen	91.1	0.06	99.3	0.53
25/08/2021	13:28	Ravensworth East	86.4	0.04	98.7	0.07
26/08/2021	13:19	Mt Owen	91.1	0.13	99.3	0.22
26/08/2021	13:22	Mt Owen	79.8	0.06	85.9	0.20
31/08/2021	12:30	Ravensworth East	78.1	0.02	76.4	0.03
2/09/2021	13:42	Mt Owen	89.2	0.15	92.7	0.54
2/09/2021	13:45	Mt Owen	81	0.12	97.4	0.36
3/09/2021	12:56	Ravensworth East	86.6	0.04	84.0	0.06
9/09/2021	12:57	Mt Owen	95.4	0.08	90.7	0.49
9/09/2021	12:59	Mt Owen	86.9	0.04	90.7	0.22
16/09/2021	12:27	Mt Owen	90.5	0.09	90.5	0.38
16/09/2021	12:29	Mt Owen	87.1	0.17	93.8	0.33
21/09/2021	9:11	Mt Owen	86.4	0.07	100.3	0.32

Date Fired	Time Fired	Site	MOC 3 Camberwell		MOC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
22/09/2021	12:01	Mt Owen	86.7	0.01	79.3	0.01
27/09/2021	13:32	Ravensworth East	89.5	0.02	96.1	0.04
28/09/2021	13:22	Mt Owen	85.7	0.12	92.5	0.40
28/09/2021	13:25	Mt Owen	91	0.03	94.3	0.09
30/09/2021	12:27	Ravensworth East	107.1	0.04	100.8	0.06
6/10/2021	12:01	Ravensworth East	90.2	0.03	86.6	0.06
6/10/2021	13:08	Mt Owen	87.7	0.02	94.3	0.08
6/10/2021	13:10	Mt Owen	93.9	0.13	96.8	0.56
8/10/2021	12:09	Ravensworth East	84.3	0.1	83	0.14
14/10/2021	12:49	Mt Owen	90	0.07	91.6	0.24
15/10/2021	10:00	Ravensworth East	78.8	0.01	76.4	0.01
19/10/2021	12:31	Mt Owen	87.1	0.14	92.4	0.7
20/10/2021	12:08	Mt Owen	102.6	0.27	94.3	0.78
20/10/2021	12:32	Ravensworth East	98.5	0.06	78.7	0.09
26/10/2021	12:17	Mt Owen	93.2	0.12	98.6	0.19
26/10/2021	12:33	Ravensworth East	83.5	0.02	79	0.04
28/10/2021	9:12	Mt Owen	85.5	0.07	89.1	0.24
1/11/2021	13:19	Mt Owen	85	0.15	88.1	0.39
3/11/2021	13:15	Mt Owen	86.7	0.07	87.6	0.24
4/11/2021	12:29	Mt Owen	80.7	0.05	86.1	0.13
10/11/2021	12:16	Mt Owen	87.5	0.12	88.6	0.58
16/11/2021	12:34	Mt Owen	92.8	0.1	98.7	0.26
18/11/2021	13:06	Ravensworth East	88.4	0.07	83.2	0.13
25/11/2021	12:30	Mt Owen	85.7	0.11	89.2	0.32
30/11/2021	12:49	Mt Owen	87.5	0.1	87.3	0.22
7/12/2021	12:16	Mt Owen	84.7	0.11	92.2	0.55
14/12/2021	12:37	Ravensworth East	84.1	0.08	88.7	0.15
17/12/2021	13:40	Ravensworth East	84.5	0.09	88.3	0.16
30/12/2021	12:16	Mt Owen	95.5	0.19	95.1	0.37

Table 8:Mount Owen Blast Monitoring Results – MOC 5 and Homestead.

Date Fired	Time Fired	Site	MOC 5		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	12:14	Mt Owen	104.4	0.19	111.0	0.26
13/01/2021	13:46	Mt Owen	102.7	0.19	97.7	0.17
13/01/2021	13:46	Mt Owen	97.8	0.08	97.7	0.17
15/01/2021	12:24	Ravensworth East	80.6	0.03	95.6	0.19

Date Fired	Time Fired	Site	MOC 5		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
18/01/2021	12:29	Mt Owen	94.5	0.15	95.0	0.09
21/01/2021	13:10	Mt Owen	101.9	0.19	94.3	0.35
27/01/2021	12:09	Mt Owen	104.5	0.22	109.1	0.22
03/02/2021	12:13	Mt Owen	108.1	0.15	89.4	0.10
05/02/2021	12:08	Mt Owen	87.5	0.17	88.1	0.33
11/02/2021	12:27	Mt Owen	91.6	0.16	97.4	0.23
17/02/2021	12:18	Mt Owen	104.6	0.21	91.8	0.20
18/02/2021	16:12	Mt Owen	83.8	0.13	88.4	0.13
23/02/2021	12:14	Mt Owen	96.5	0.14	97.3	0.18
25/02/2021	12:11	Mt Owen	90.4	0.24	92.1	0.12
01/03/2021	12:41	Ravensworth East	88.0	0.07	102.4	1.12
02/03/2021	13:18	Mt Owen	94.5	0.10	86.6	0.11
04/03/2021	13:04	Mt Owen	83.4	0.15	86.1	0.13
10/03/2021	12:12	Mt Owen	102.3	0.20	106.8	0.13
10/03/2021	12:16	Ravensworth East	96.8	0.10	100.1	0.92
11/03/2021	12:46	Ravensworth East	96.4	0.18	95.6	0.27
12/03/2021	13:31	Mt Owen	88.0	0.08	97.8	0.41
18/03/2021	12:22	Mt Owen	97.3	0.30	98.6	0.19
29/03/2021	13:18	Mt Owen	97.7	0.22	92.1	0.22
31/03/2021	13:16	Mt Owen	104.9	0.26	96.6	0.41
8/04/2021	16:06	Mt Owen	95.6	0.07	95.1	0.21
8/04/2021	16:08	Mt Owen	93.3	0.08	93.7	0.18
14/04/2021	10:29	Ravensworth East	110.3	0.02	96.2	0.31
15/04/2021	12:28	Mt Owen	93.0	0.19	100.7	0.11
20/04/2021	16:00	Mt Owen	94.0	0.15	92.5	0.22
23/04/2021	7:09	Mt Owen	107.5	0.17	91.0	0.20
26/04/2021	13:30	Ravensworth East	95.1	0.06	99.0	1.18
27/04/2021	12:16	Mt Owen	94.4	0.25	92.3	0.07
28/04/2021	12:12	Mt Owen	96.6	0.18	90.6	0.12
30/04/2021	12:12	Mt Owen	90.7	0.13	94.4	0.10
4/05/2021	13:47	Ravensworth East	87.1	0.07	99.2	0.83
5/05/2021	13:14	Mt Owen	88.9	0.47	91.4	0.28
11/05/2021	12:23	Mt Owen	97.1	0.23	94.4	0.10
17/05/2021	15:58	Mt Owen	92.9	0.05	89.8	0.03
17/05/2021	16:02	Mt Owen	92.5	0.18	93.9	0.10
18/05/2021	13:26	Ravensworth East	76.7	0.03	94.2	0.31
19/05/2021	13:16	Mt Owen	94.5	0.19	99.2	0.13
21/05/2021	12:32	Mt Owen	95.0	0.44	98.0	0.14
28/05/2021	12:12	Mt Owen	98.8	0.22	98.8	0.09
31/05/2021	13:17	Mt Owen	99.2	0.13	92.4	0.25

Date Fired	Time Fired	Site	MOC 5		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
2/06/2021	12:14	Mt Owen	92.5	0.15	84.7	0.18
7/06/2021	12:33	Mt Owen	96.1	0.11	91.4	0.22
8/06/2021	13:32	Ravensworth East	98.6	0.03	104.3	0.22
15/06/2021	15:28	Mt Owen	96.1	0.24	90.9	0.30
21/06/2021	12:19	Ravensworth East	80.8	0.17	95.6	1.13
22/06/2021	12:01	Mt Owen	96.2	0.10	89.8	0.13
24/06/2021	12:37	Ravensworth East	95.2	0.01	96.9	0.27
24/06/2021	12:40	Ravensworth East	94.5	0.05	98.4	0.57
25/06/2021	09:39	Mt Owen	95.8	0.22	94.7	0.26
1/07/2021	12:14	Mt Owen	95.4	0.50	92.9	0.16
6/07/2021	12:09	Mt Owen	101.9	0.17	94.6	0.14
8/07/2021	12:17	Mt Owen	98.1	0.06	90.9	0.05
9/07/2021	12:30	Ravensworth East	89.6	0.10	106.0	0.61
13/07/2021	12:53	Mt Owen	100.3	0.36	98.0	0.15
15/07/2021	13:22	Mt Owen	98.7	0.28	86.1	0.13
21/07/2021	14:22	Ravensworth East	86.3	0.08	96.9	1.14
22/07/2021	16:24	Mt Owen	102.1	0.20	103.3	0.51
29/07/2021	13:23	Mt Owen	102.8	0.17	98.6	0.27
29/07/2021	13:27	Ravensworth East	95.8	0.05	99.6	0.62
29/07/2021	13:37	Mt Owen	98.4	0.30	98.2	0.15
30/07/2021	12:38	Ravensworth East	93.3	0.03	97.5	0.35
5/08/2021	11:28	Ravensworth East	96.9	0.05	109.3	0.52
5/08/2021	13:38	Mt Owen	101.0	0.25	109.3	0.14
9/08/2021	12:16	Mt Owen	89.3	0.16	86.6	0.25
12/08/2021	13:39	Mt Owen	94.0	0.18	104.4	0.20
12/08/2021	13:47	Mt Owen	95.0	0.28	103.0	0.14
17/08/2021	12:24	Ravensworth East	89.0	0.05	101.7	0.27
17/08/2021	13:30	Mt Owen	94.3	0.12	95.2	0.17
19/08/2021	12:21	Mt Owen	96.3	0.21	89.9	0.13
25/08/2021	13:28	Ravensworth East	99.9	0.07	102.0	0.47
26/08/2021	13:19	Mt Owen	96.4	0.15	86.6	0.13
26/08/2021	13:22	Mt Owen	88.7	0.22	94.7	0.13
31/08/2021	12:30	Ravensworth East	79.0	0.02	88.0	0.46
2/09/2021	13:42	Mt Owen	91.1	0.38	93.2	0.24
2/09/2021	13:45	Mt Owen	91.3	0.22	89.9	0.18
3/09/2021	12:56	Ravensworth East	92.2	0.05	104.4	0.69
9/09/2021	12:57	Mt Owen	70.3	0.31	104.3	0.23
9/09/2021	12:59	Mt Owen	69.4	0.12	104.5	0.09
16/09/2021	12:27	Mt Owen	68.5	0.38	94.1	0.17
16/09/2021	12:29	Mt Owen	65.0	0.17	90.4	0.21

Date Fired	Time Fired	Site	MOC 5		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
21/09/2021	9:11	Mt Owen	67.5	0.14	98.1	0.14
22/09/2021	12:01	Mt Owen	67.5	0.01	85.5	0.01
27/09/2021	13:32	Ravensworth East	65.0	0.04	100.1	0.34
28/09/2021	13:22	Mt Owen	66.3	0.14	88.0	0.15
28/09/2021	13:25	Mt Owen	66.3	0.03	88.7	0.02
30/09/2021	12:27	Ravensworth East	73.5	0.04	104.2	1.30
6/10/2021	12:01	Ravensworth East	66.3	0.05	102.6	0.33
6/10/2021	13:08	Mt Owen	66.3	0.04	101.7	0.02
6/10/2021	13:10	Mt Owen	71	0.2	105.4	0.19
8/10/2021	12:09	Ravensworth East	66.3	0.13	95.1	1.48
14/10/2021	12:49	Mt Owen	66.3	0.15	97.2	0.22
15/10/2021	10:00	Ravensworth East	66.3	0.01	105.3	0.01
19/10/2021	12:31	Mt Owen	67.5	0.45	89.7	0.2
20/10/2021	12:08	Mt Owen	67.5	0.77	110.4	0.41
20/10/2021	12:32	Ravensworth East	67.5	0.09	100.8	0.86
26/10/2021	12:17	Mt Owen	70.3	0.12	95.9	0.2
26/10/2021	12:33	Ravensworth East	66.3	0.04	97.3	0.43
28/10/2021	9:12	Mt Owen	66.3	0.2	84.1	0.14
1/11/2021	13:19	Mt Owen	65	0.24	96	0.14
3/11/2021	13:15	Mt Owen	66.3	0.09	98.5	0.17
4/11/2021	12:29	Mt Owen	63.4	0.07	84.6	0.09
10/11/2021	12:16	Mt Owen	67.5	0.15	85.5	0.18
16/11/2021	12:34	Mt Owen	73	0.15	98.8	0.14
18/11/2021	13:06	Ravensworth East	67.5	0.13	98.5	1.87
25/11/2021	12:30	Mt Owen	65	0.18	88.1	0.16
30/11/2021	12:49	Mt Owen	63.4	0.14	92.5	0.28
7/12/2021	12:16	Mt Owen	66.3	0.36	89	0.2
14/12/2021	12:37	Ravensworth East	70.3	0.13	98.1	1.23
17/12/2021	13:40	Ravensworth East	84.6	0.18	103.5	1.19
30/12/2021	12:16	Mt Owen	96.4	0.21	94.3	0.33

Table 9: Mount Owen Blast Monitoring Results – Chain of Ponds, Hebden School and Church

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	12:14	Mt Owen	103.0	0.14	105.2	0.16	101.0	0.07
13/01/2021	13:46	Mt Owen	86.1	0.10	92.3	0.21	94.5	0.09

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
13/01/2021	13:46	Mt Owen	86.1	0.10	92.3	0.09	94.5	0.05
15/01/2021	12:24	Ravensworth East	96.9	0.11	98.4	0.35	83.6	0.01
18/01/2021	12:29	Mt Owen	90.9	0.10	94.6	0.09	92.0	0.07
21/01/2021	13:10	Mt Owen	91.5	0.16	94.5	0.24	100.1	0.15
27/01/2021	12:09	Mt Owen	100.7	0.14	96.4	0.11	95.3	0.11
03/02/2021	12:13	Mt Owen	96.1	0.13	95.6	0.10	91.0	0.07
05/02/2021	12:08	Mt Owen	87.5	0.13	91.6	0.21	86.8	0.06
11/02/2021	12:27	Mt Owen	90.3	0.11	100.4	0.29	93.5	0.06
17/02/2021	12:18	Mt Owen	88.0	0.14	91.6	0.10	99.5	0.10
18/02/2021	16:12	Mt Owen	85.5	0.12	96.0	0.11	81.4	0.06
23/02/2021	12:14	Mt Owen	96.1	0.12	99.8	0.14	86.4	0.03
25/02/2021	12:11	Mt Owen	89.2	0.12	91.5	0.15	95.6	0.10
01/03/2021	12:41	Ravensworth East	91.5	0.23	103.9	1.86	87.4	0.03
02/03/2021	13:18	Mt Owen	85.5	0.10	90.9	0.08	85.3	0.06
04/03/2021	13:04	Mt Owen	95.0	0.11	87.3	0.13	102.2	0.09
10/03/2021	12:12	Mt Owen	88.4	0.12	91	0.10	96.5	0.06
10/03/2021	12:16	Ravensworth East	94.6	0.16	104.3	0.61	87.4	0.03
11/03/2021	12:46	Ravensworth East	86.1	0.22	95.5	0.16	85.6	0.13
12/03/2021	13:31	Mt Owen	89.9	0.16	103.8	0.52	86.2	0.03
18/03/2021	12:22	Mt Owen	93.8	0.11	102.3	0.10	91.8	0.08
29/03/2021	13:18	Mt Owen	90.3	0.11	93.9	0.24	91.3	0.04
31/03/2021	13:16	Mt Owen	95.8	0.15	99.4	0.31	100.4	0.15
8/04/2021	16:06	Mt Owen	89.9	0.11	89.7	0.33	90.0	0.05
8/04/2021	16:08	Mt Owen	87.1	0.13	92.4	0.09	94.5	0.10
14/04/2021	10:29	Ravensworth East	98.0	0.10	96.6	0.35	100.4	0.01
15/04/2021	12:28	Mt Owen	87.5	0.17	91.4	0.08	86.7	0.09
20/04/2021	16:00	Mt Owen	90.6	0.11	86.5	0.28	98.3	0.05

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
23/04/2021	7:09	Mt Owen	90.9	0.17	88	0.10	103.1	0.11
26/04/2021	13:30	Ravensworth East	90.3	0.17	107.4	0.59	82.7	0.04
27/04/2021	12:16	Mt Owen	88.4	0.10	95.3	0.10	89.6	0.05
28/04/2021	12:12	Mt Owen	84.9	0.11	88.8	0.12	89.3	0.06
30/04/2021	12:12	Mt Owen	87.1	0.12	91	0.09	89.8	0.08
4/05/2021	13:47	Ravensworth East	93.3	0.16	102.2	0.39	85.7	0.03
5/05/2021	13:14	Mt Owen	90.6	0.13	97.8	0.18	85.6	0.12
11/05/2021	12:23	Mt Owen	93.1	0.13	95.3	0.15	93.9	0.09
17/05/2021	15:58	Mt Owen	87.1	0.10	85.7	0.02	91.8	0.02
17/05/2021	16:02	Mt Owen	88.0	0.14	93.2	0.12	92.9	0.08
18/05/2021	13:26	Ravensworth East	87.1	0.11	102.4	0.25	83.7	0.01
19/05/2021	13:16	Mt Owen	88.4	0.13	90.5	0.14	91.3	0.06
21/05/2021	12:32	Mt Owen	96.1	0.13	103.3	0.16	92.4	0.09
28/05/2021	12:12	Mt Owen	88.4	0.13	97.3	0.07	89.1	0.07
31/05/2021	13:17	Mt Owen	88.8	0.12	92.7	0.17	96.6	0.05
2/06/2021	12:14	Mt Owen	86.1	0.15	87.2	0.09	88.7	0.07
7/06/2021	12:33	Mt Owen	91.2	0.15	91.7	0.11	94.3	0.07
8/06/2021	13:32	Ravensworth East	90.3	0.13	99.9	0.19	85.8	0.01
15/06/2021	15:28	Mt Owen	89.2	0.18	91.8	0.24	96.5	0.08
21/06/2021	12:19	Ravensworth East	89.9	0.31	106.4	0.89	86.4	0.05
22/06/2021	12:01	Mt Owen	86.6	0.13	92.6	0.09	92.3	0.06
24/06/2021	12:37	Ravensworth East	90.9	0.11	89.4	0.26	99.7	0.02
24/06/2021	12:40	Ravensworth East	94.8	0.11	103.3	0.82	94.7	0.01
25/06/2021	09:39	Mt Owen	99.0	0.16	88	0.15	92.3	0.08
1/07/2021	12:14	Mt Owen	87.1	0.14	96.5	0.15	89.5	0.15
6/07/2021	12:09	Mt Owen	89.9	0.19	95.5	0.13	98.3	0.12
8/07/2021	12:17	Mt Owen	89.2	0.09	87.6	0.05	94.4	0.02

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
9/07/2021	12:30	Ravensworth East	93.8	0.17	109.8	0.62	90.1	0.03
13/07/2021	12:53	Mt Owen	96.6	0.13	93.9	0.16	97.4	0.09
15/07/2021	13:22	Mt Owen	88.4	0.13	89.2	0.14	88.2	0.07
21/07/2021	14:22	Ravensworth East	93.1	0.18	106.7	1.04	104.9	0.04
22/07/2021	16:24	Mt Owen	94.4	0.15	108.5	0.35	103.5	0.09
29/07/2021	13:23	Mt Owen	101.5	0.12	92.6	0.20	95.7	0.07
29/07/2021	13:27	Ravensworth East	89.9	0.18	100.3	0.85	92.0	0.02
29/07/2021	13:37	Mt Owen	99.4	0.13	88.2	0.14	101.3	0.17
30/07/2021	12:38	Ravensworth East	93.6	0.13	99.8	0.50	90.4	0.01
5/08/2021	11:28	Ravensworth East	103.3	0.14	99.1	0.73	100.8	0.02
5/08/2021	13:38	Mt Owen	97.7	0.13	93	0.12	99.1	0.08
9/08/2021	12:16	Mt Owen	86.6	0.13	89.1	0.15	85.8	0.06
12/08/2021	13:39	Mt Owen	95.4	0.20	86.9	0.13	87.1	0.12
12/08/2021	13:47	Mt Owen	94.2	0.13	89.7	0.19	94.4	0.11
17/08/2021	12:24	Ravensworth East	92.8	0.12	103.2	1.49	102.2	0.02
17/08/2021	13:30	Mt Owen	86.6	0.11	93.6	0.15	97.6	0.06
19/08/2021	12:21	Mt Owen	87.5	0.13	93.5	0.10	99.0	0.09
25/08/2021	13:28	Ravensworth East	106.8	0.13	98.1	0.55	102.8	0.03
26/08/2021	13:19	Mt Owen	94.0	0.15	100	0.08	89.1	0.08
26/08/2021	13:22	Mt Owen	89.9	0.10	83.4	0.12	82.7	0.04
31/08/2021	12:30	Ravensworth East	88.8	0.14	86.4	0.40	94.3	0.03
2/09/2021	13:42	Mt Owen	88.0	0.18	98.2	0.34	89.0	0.16
2/09/2021	13:45	Mt Owen	86.6	0.14	93	0.10	83.9	0.08
3/09/2021	12:56	Ravensworth East	92.8	0.14	102.4	0.42	85.7	0.02
9/09/2021	12:57	Mt Owen	97.2	0.13	87.8	0.12	103.9	0.08
9/09/2021	12:59	Mt Owen	97.1	0.09	85.3	0.11	106.7	0.05
16/09/2021	12:27	Mt Owen	88.8	0.18	100.7	0.20	89.4	0.07

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
16/09/2021	12:29	Mt Owen	88.0	0.24	92.1	0.15	87.1	0.12
21/09/2021	9:11	Mt Owen	103.5	0.13	93.3	0.14	98.7	0.06
22/09/2021	12:01	Mt Owen	92.3	0.10	94.5	0.05	94.9	0.01
27/09/2021	13:32	Ravensworth East	93.1	0.13	104.1	0.54	97.9	0.02
28/09/2021	13:22	Mt Owen	85.5	0.19	93.6	0.10	85.6	0.09
28/09/2021	13:25	Mt Owen	88.4	0.09	91	0.02	91.7	0.03
30/09/2021	12:27	Ravensworth East	100.2	0.18	103.3	0.67	100.3	0.03
6/10/2021	12:01	Ravensworth East	95.2	0.14	106.8	0.85	100.2	0.03
6/10/2021	13:08	Mt Owen	90.9	0.09	88.3	0.02	96.5	0.02
6/10/2021	13:10	Mt Owen	103	0.18	101.1	0.12	95.9	0.09
8/10/2021	12:09	Ravensworth East	90.3	0.29	110	0.91	86.2	0.06
14/10/2021	12:49	Mt Owen	86.6	0.15	92.9	0.25	89.8	0.05
15/10/2021	10:00	Ravensworth East	101.9	0.1	81.6	0.03	102.6	0
19/10/2021	12:31	Mt Owen	92.8	0.21	95.5	0.23	87.2	0.12
20/10/2021	12:08	Mt Owen	103.8	0.43	108.3	0.82	103.6	0.15
20/10/2021	12:32	Ravensworth East	95	0.2	110.2	0.64	89.8	0.06
26/10/2021	12:17	Mt Owen	92.8	0.16	90.6	0.12	94.1	0.09
26/10/2021	12:33	Ravensworth East	88.4	0.15	104.1	0.46	81.8	0.02
28/10/2021	9:12	Mt Owen	91.8	0.12	89	0.15	90.9	0.05
1/11/2021	13:19	Mt Owen	86.1	0.14	88.2	0.13	84.9	0.08
3/11/2021	13:15	Mt Owen	89.2	0.11	85.1	0.08	88.2	0.05
4/11/2021	12:29	Mt Owen	86.1	0.12	86.2	0.07	79.8	0.03
10/11/2021	12:16	Mt Owen	88	0.18	86	0.11	88.5	0.09
16/11/2021	12:34	Mt Owen	89.2	0.15	91.6	0.14	94.3	0.1
18/11/2021	13:06	Ravensworth East	97.1	0.28	102.9	2.05	90.7	0.07
25/11/2021	12:30	Mt Owen	91.2	0.14	88.4	0.16	85.8	0.08
30/11/2021	12:49	Mt Owen	89.6	0.17	95.7	0.22	87.1	0.06

Date Fired	Time Fired	Site	Chain of Ponds		Hebden School		Church	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
7/12/2021	12:16	Mt Owen	87.5	0.14	86	0.25	91.8	0.08
14/12/2021	12:37	Ravensworth East	91.5	0.28	105.4	0.95	84.6	0.05
17/12/2021	13:40	Ravensworth East	91.2	0.25	108.6	0.86	83.2	0.05
30/12/2021	12:16	Mt Owen	89.6	0.24	96.2	0.16	97.5	0.1

Table 10: Mount Owen Blast Monitoring Results – Integra Underground and Integra Surface

Date Fired	Time Fired	Site	Integra Underground		Integra Surface	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	12:14	Mt Owen	136.9	1.67	99.8	0.27
13/01/2021	13:46	Mt Owen	106.4	1.17	98.1	0.17
13/01/2021	13:46	Mt Owen	101.9	1.10	99.1	0.15
15/01/2021	12:24	Ravensworth East	101.8	0.19	98.4	0.09
18/01/2021	12:29	Mt Owen	110.6	0.59	103.7	0.23
21/01/2021	13:10	Mt Owen	136.9	6.35	110.9	0.38
27/01/2021	12:09	Mt Owen	136.9	9.26	101.1	0.49
03/02/2021	12:13	Mt Owen	118.7	0.92	99.5	0.19
05/02/2021	12:08	Mt Owen	136.9	2.04	92.4	0.23
11/02/2021	12:27	Mt Owen	112.9	1.38	98.6	0.18
17/02/2021	12:18	Mt Owen	112.2	5.47	101.0	0.48
18/02/2021	16:12	Mt Owen	103.2	1.32	90.5	0.23
23/02/2021	12:14	Mt Owen	105.7	0.66	92.2	0.16
25/02/2021	12:11	Mt Owen	108.3	0.69	97.9	0.21
01/03/2021	12:41	Ravensworth East	97.3	0.41	93.7	0.15
02/03/2021	13:18	Mt Owen	109.1	2.54	96.8	0.29
04/03/2021	13:04	Mt Owen	103.8	1.78	88.7	0.23
10/03/2021	12:12	Mt Owen	107.2	1.32	89.7	0.29
10/03/2021	12:16	Ravensworth East	102	0.31	85.6	0.25
11/03/2021	12:46	Ravensworth East	107.2	1.86	88.3	0.71
12/03/2021	13:31	Mt Owen	97.6	0.32	90.8	0.33
18/03/2021	12:22	Mt Owen	109.4	1.83	98.5	0.27
29/03/2021	13:18	Mt Owen	114	2.53	98.3	0.22
31/03/2021	13:16	Mt Owen	121.3	9.40	106.7	0.65
8/04/2021	16:06	Mt Owen	106.3	2.12	96.8	0.23
8/04/2021	16:08	Mt Owen	114.3	7.16	97.9	0.64
14/04/2021	10:29	Ravensworth East	105.7	0.07	86.6	0.05

Date Fired	Time Fired	Site	Integra Underground		Integra Surface	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
15/04/2021	12:28	Mt Owen	107.2	1.35	93.7	0.52
20/04/2021	16:00	Mt Owen	107.4	1.67	92.8	0.17
23/04/2021	7:09	Mt Owen	116.8	7.12	111.1	0.45
26/04/2021	13:30	Ravensworth East	91.5	0.83	82.3	0.21
27/04/2021	12:16	Mt Owen	105.6	0.32	98.3	0.17
28/04/2021	12:12	Mt Owen	107.1	1.58	94.1	0.22
30/04/2021	12:12	Mt Owen	110.4	2.80	93.9	0.33
4/05/2021	13:47	Ravensworth East	98.6	0.48	98.6	0.16
5/05/2021	13:14	Mt Owen	105.2	1.13	96.1	0.44
11/05/2021	12:23	Mt Owen	112.4	1.93	97.9	0.29
17/05/2021	15:58	Mt Owen	105.8	0.36	97.3	0.07
17/05/2021	16:02	Mt Owen	108.3	1.43	99.1	0.28
18/05/2021	13:26	Ravensworth East	91.5	0.22	82.8	0.08
19/05/2021	13:16	Mt Owen	108.7	1.75	96.2	0.31
21/05/2021	12:32	Mt Owen	113.6	0.88	100.2	0.41
28/05/2021	12:12	Mt Owen	103.7	1.52	97.7	0.34
31/05/2021	13:17	Mt Owen	117.1	3.16	104.6	0.22
2/06/2021	12:14	Mt Owen	108.4	1.35	106.4	0.39
7/06/2021	12:33	Mt Owen	114.9	7.05	111.8	0.47
8/06/2021	13:32	Ravensworth East	108.3	0.15	96.4	0.07
15/06/2021	15:28	Mt Owen	117.1	3.00	104.2	0.42
21/06/2021	12:19	Ravensworth East	92.7	0.83	102	0.52
22/06/2021	12:01	Mt Owen	110.3	6.30	98.8	0.32
24/06/2021	12:37	Ravensworth East	103.6	0.15	99.3	0.07
24/06/2021	12:40	Ravensworth East	97.6	0.17	99	0.07
25/06/2021	09:39	Mt Owen	109.2	4.39	99.5	0.31
1/07/2021	12:14	Mt Owen	107.4	0.79	94.8	0.39
6/07/2021	12:09	Mt Owen	115.3	1.94	106.8	0.56
8/07/2021	12:17	Mt Owen	105.4	0.39	102.7	0.08
9/07/2021	12:30	Ravensworth East	97.8	0.47	98.3	0.14
13/07/2021	12:53	Mt Owen	108.3	0.81	99.8	0.35
15/07/2021	13:22	Mt Owen	101.8	1.04	101	0.30
21/07/2021	14:22	Ravensworth East	100.3	0.33	99.9	0.15
22/07/2021	16:24	Mt Owen	123.7	5.22	107.4	0.58
29/07/2021	13:23	Mt Owen	115.6	4.86	98	0.30
29/07/2021	13:27	Ravensworth East	99.8	0.25	96	0.14
29/07/2021	13:37	Mt Owen	106.3	2.05	96.1	0.63
30/07/2021	12:38	Ravensworth East	97.8	0.12	94.5	0.09
5/08/2021	11:28	Ravensworth East	107.2	0.23	99.1	0.13
5/08/2021	13:38	Mt Owen	111.9	1.62	95.4	0.28

Date Fired	Time Fired	Site	Integra Underground		Integra Surface	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
9/08/2021	12:16	Mt Owen	106.3	1.64	98.4	0.28
12/08/2021	13:39	Mt Owen	112.6	7.14	102.3	0.47
12/08/2021	13:47	Mt Owen	107.2	1.02	101	0.24
17/08/2021	12:24	Ravensworth East	98.1	0.36	96.3	0.10
17/08/2021	13:30	Mt Owen	103.3	1.64	96.8	0.19
19/08/2021	12:21	Mt Owen	109.1	0.89	100.1	0.24
25/08/2021	13:28	Ravensworth East	111.5	0.30	95.5	0.22
26/08/2021	13:19	Mt Owen	108.4	3.02	98.1	0.32
26/08/2021	13:22	Mt Owen	102.2	1.31	97.6	0.17
31/08/2021	12:30	Ravensworth East	86.5	0.11	98.4	0.07
2/09/2021	13:42	Mt Owen	111.2	1.68	93.7	0.41
2/09/2021	13:45	Mt Owen	103.5	1.52	88.4	0.42
3/09/2021	12:56	Ravensworth East	103.9	0.54	97.2	0.15
9/09/2021	12:57	Mt Owen	109.1	0.96	102.7	0.28
9/09/2021	12:59	Mt Owen	106.6	1.46	104.1	0.21
16/09/2021	12:27	Mt Owen	108.7	0.69	98.8	0.39
16/09/2021	12:29	Mt Owen	108.4	1.73	95.4	0.45
21/09/2021	9:11	Mt Owen	107.7	0.90	95.2	0.25
22/09/2021	12:01	Mt Owen	78.6	0.02	95.7	0.02
27/09/2021	13:32	Ravensworth East	103.9	0.13	95.9	0.10
28/09/2021	13:22	Mt Owen	103.8	1.80	91.8	0.39
28/09/2021	13:25	Mt Owen	105.9	0.35	97.2	0.09
30/09/2021	12:27	Ravensworth East	102.3	0.24	98.4	0.14
6/10/2021	12:01	Ravensworth East	101.2	0.18	90.1	0.14
6/10/2021	13:08	Mt Owen	103.3	0.19	109.1	0.06
6/10/2021	13:10	Mt Owen	112.4	1.39	99.6	0.37
8/10/2021	12:09	Ravensworth East	95.8	1	84.9	0.3
14/10/2021	12:49	Mt Owen	107.6	1.8	93.7	0.26
15/10/2021	10:00	Ravensworth East	99.8	0.03	81.2	0.01
19/10/2021	12:31	Mt Owen	104.7	1.2	90.5	0.51
20/10/2021	12:08	Mt Owen	111.2	0.85	98.2	0.7
20/10/2021	12:32	Ravensworth East	109.4	0.68	90.6	0.26
26/10/2021	12:17	Mt Owen	118.9	7.34	100.2	0.35
26/10/2021	12:33	Ravensworth East	99.2	0.15	84.1	0.08
28/10/2021	9:12	Mt Owen	103.6	2.51	88.6	0.32
1/11/2021	13:19	Mt Owen	103.8	1.1	89.6	0.4
3/11/2021	13:15	Mt Owen	104.5	4.75	87.9	0.23
4/11/2021	12:29	Mt Owen	99.9	0.61	87.7	0.13
10/11/2021	12:16	Mt Owen	102.1	1.25	91.4	0.37
16/11/2021	12:34	Mt Owen	115.1	1.13	98.2	0.31

Date Fired	Time Fired	Site	Integra Underground		Integra Surface	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
18/11/2021	13:06	Ravensworth East	95.5	0.62	89.4	0.39
25/11/2021	12:30	Mt Owen	104	1.54	92.1	0.38
30/11/2021	12:49	Mt Owen	104.3	3.28	89.8	0.29
7/12/2021	12:16	Mt Owen	101.4	1.23	87.9	0.42
14/12/2021	12:37	Ravensworth East	95.5	1.14	91.3	0.3
17/12/2021	13:40	Ravensworth East	94.8	1.06	86.8	0.42
30/12/2021	12:16	Mt Owen	118.6	8.78	97.2	0.45

Table 11: Glendell Blast Monitoring Results – MOC3, Church and MOC 2

Date Fired	Time Fired	Site	MOC 3 Camberwell		Church		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	13:42	Glendell	90.2	0.29	98.7	0.18	93.6	0.19
12/01/2021	13:34	Glendell	93.9	0.26	89.5	0.22	88.5	0.16
14/01/2021	12:33	Glendell	102.9	0.51	100.5	0.29	101.6	0.25
20/01/2021	13:32	Glendell	91.1	0.24	99.1	0.21	103.1	0.12
27/01/2021	13:30	Glendell	92.2	0.51	89.8	0.27	104.6	0.21
1/02/2021	13:36	Glendell	90.2	0.28	89.8	0.18	99.3	0.16
3/02/2021	13:32	Glendell	92.1	0.39	93.3	0.19	90.7	0.14
5/02/2021	13:38	Glendell	87.8	0.38	96.6	0.21	82.6	0.15
9/02/2021	13:28	Glendell	103.7	0.38	95	0.23	99.3	0.25
11/02/2021	13:19	Glendell	96.5	0.32	96.6	0.22	90.3	0.19
15/02/2021	13:44	Glendell	81.8	0.31	94.5	0.25	92.1	0.11
20/02/2021	10:06	Glendell	91.9	0.37	89.3	0.21	90.5	0.21
26/02/2021	11:34	Glendell	92.9	0.16	95.6	0.08	101	0.07
26/02/2021	11:50	Glendell	98.8	0.43	99.2	0.31	95	0.25
3/03/2021	15:31	Glendell	88.3	0.33	92.3	0.15	96.6	0.1
11/03/2021	9:24	Glendell	94.2	0.47	92.1	0.27	88	0.24
17/03/2021	11:01	Glendell	90.9	0.58	89.1	0.25	88	0.27
29/03/2021	13:42	Glendell	93.3	0.25	94.4	0.19	87.7	0.17
1/04/2021	11:52	Glendell	95.7	0.39	96.2	0.21	90.3	0.13
8/04/2021	13:49	Glendell	90.8	0.15	92	0.15	86.7	0.12

Date Fired	Time Fired	Site	MOC 3 Camberwell		Church		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
12/04/2021	15:36	Glendell	92.3	0.65	92	0.39	86.1	0.74
16/04/2021	13:21	Glendell	92.1	0.36	92.5	0.28	96.2	0.26
21/04/2021	13:42	Glendell	93.7	0.26	95.4	0.16	99.4	0.17
23/04/2021	13:27	Glendell	94.3	0.16	95.3	0.11	94.8	0.12
28/04/2021	13:25	Glendell	86	0.22	87.2	0.15	92.8	0.1
30/04/2021	13:28	Glendell	92.7	0.11	95.4	0.07	87	0.07
5/05/2021	13:25	Glendell	83.5	0.18	86.7	0.12	79	0.08
12/05/2021	12:31	Glendell	92.4	0.63	93.8	0.36	89.5	0.58
14/05/2021	13:04	Glendell	102.5	0.56	104.5	0.28	93.4	0.31
17/05/2021	9:33	Glendell	88.6	0.22	87.5	0.14	106.2	0.06
24/05/2021	16:45	Glendell	90.5	0.51	90.9	0.35	97.9	0.22
25/05/2021	13:31	Glendell	86.7	0.1	90.4	0.1	84.6	0.05
28/05/2021	13:39	Glendell	87.8	0.3	108	0.23	98.7	0.23
31/05/2021	13:43	Glendell	96.2	0.23	94.4	0.25	90	0.14
2/06/2021	13:26	Glendell	90.6	0.19	89.9	0.13	86.6	0.24
7/06/2021	13:41	Glendell	94.3	0.16	93.9	0.21	95.3	0.15
15/06/2021	13:34	Glendell	98.6	0.25	100.5	0.2	93.6	0.11
21/06/2021	13:43	Glendell	93.8	0.12	93.9	0.1	91.4	0.06
21/06/2021	13:46	Glendell	96	0.2	94.5	0.16	85.6	0.07
29/06/2021	13:26	Glendell	92.2	0.48	91.7	0.23	84	0.17
2/07/2021	13:39	Glendell	95.8	0.26	95.8	0.16	96	0.18
7/07/2021	13:49	Glendell	87.8	0.29	87.8	0.15	93.3	0.13
7/07/2021	13:51	Glendell	93.5	0.31	95.3	0.19	90.1	0.12
16/07/2021	09:51	Glendell	106	0.29	105.1	0.27	98.5	0.12
16/07/2021	09:53	Glendell	100.3	0.04	100.5	0.02	89.3	0.04
2/08/2021	13:27	Glendell	99.2	0.15	96	0.08	96.9	0.05
9/08/2021	13:29	Glendell	93.4	0.48	91.2	0.29	89.7	0.19
13/08/2021	13:32	Glendell	98.7	0.14	98.1	0.1	90	0.11
19/08/2021	13:32	Glendell	92.1	0.2	95.8	0.12	91.4	0.14
1/09/2021	14:45	Glendell	94	0.25	90.9	0.1	87.3	0.12
6/09/2021	13:24	Glendell	91.5	0.11	103.7	0.08	92.6	0.06

Date Fired	Time Fired	Site	MOC 3 Camberwell		Church		MOC 2 Green Acres	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
9/09/2021	13:30	Glendell	94.6	0.37	103.6	0.38	98.4	0.29
10/09/2021	13:28	Glendell	92.1	0.17	107.3	0.08	93.6	0.07
13/09/2021	14:29	Glendell	85.8	0.25	93.1	0.17	87.7	0.1
16/09/2021	12:38	Glendell	99.5	0.29	93.5	0.18	90.3	0.18
17/09/2021	14:26	Glendell	92	0.12	89.9	0.08	90.6	0.05
25/09/2021	9:46	Glendell	95	0.32	94.1	0.22	102.1	0.13
14/10/2021	12:28	Glendell	94.6	0.15	92.2	0.1	86.6	0.13
22/10/2021	13:40	Glendell	94	0.14	94.1	0.11	90.3	0.09
28/10/2021	13:43	Glendell	94.9	0.14	95.4	0.09	92	0.08
29/10/2021	13:26	Glendell	104.3	0.14	114.7	0.07	113.1	0.03
5/11/2021	13:28	Glendell	97.5	0.38	98.8	0.29	93	0.22
11/11/2021	14:42	Glendell	90.6	0.36	95.3	0.16	98.9	0.2
20/11/2021	11:46	Glendell	87.5	0.01	104.3	0.01	99	0.01
25/11/2021	13:51	Glendell	88.1	0.15	89.1	0.1	85.7	0.03
3/12/2021	13:38	Glendell	95.1	0.59	97.5	0.35	91.4	0.34
7/12/2021	13:42	Glendell	105.9	0.17	97.8	0.12	104.4	0.21
17/12/2021	13:40	Glendell	103.5	1.19	84.5	0.09	83.2	0.05
23/12/2021	12:31	Glendell	92	0.26	102	1.12	101.2	1.58
24/12/2021	10:26	Glendell	88.1	0.33	85.3	0.11	101.6	0.1

Table 12: Glendell Blast Monitoring Results – Powerlines and Railway/ARTC 1

Date Fired	Time Fired	Site	Powerlines		Railway/ARTC 1	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	13:42	Glendell	106.5	1.36	104.6	0.82
12/01/2021	13:34	Glendell	102.3	1.06	103.2	0.89
14/01/2021	12:33	Glendell	107.9	1.85	107.3	1.63
20/01/2021	13:32	Glendell	107.6	1.83	108.3	1.65
27/01/2021	13:30	Glendell	105.2	1.09	107.6	1.06
1/02/2021	13:36	Glendell	100.8	1.54	98.5	1.06
3/02/2021	13:32	Glendell	101.3	0.84	101.5	0.77

Date Fired	Time Fired	Site	Powerlines		Railway/ARTC 1	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
5/02/2021	13:38	Glendell	102.2	2.28	97.8	1.69
9/02/2021	13:28	Glendell	106.5	0.79	105.9	0.73
11/02/2021	13:19	Glendell	106.1	1.8	107.1	1.52
15/02/2021	13:44	Glendell	92.3	1.07	98.2	0.78
20/02/2021	10:06	Glendell	103.7	1.69	100.6	1.45
26/02/2021	11:34	Glendell	95	0.34	95	0.43
26/02/2021	11:50	Glendell	104.4	3.51	105.5	2.83
3/03/2021	15:31	Glendell	104.5	1.18	103.1	0.8
11/03/2021	9:24	Glendell	104	1.77	104.6	1.85
17/03/2021	11:01	Glendell	101.9	0.85	104.3	0.94
29/03/2021	13:42	Glendell	104.8	1.73	104.2	1.07
1/04/2021	11:52	Glendell	113.5	1.46	110.5	1.26
8/04/2021	13:49	Glendell	100.7	0.82	98.6	0.98
12/04/2021	15:36	Glendell	107.9	1.22	109.6	1.07
16/04/2021	13:21	Glendell	102.8	1.16	105.7	0.86
21/04/2021	13:42	Glendell	99.6	2.05	99.7	1.42
23/04/2021	13:27	Glendell	101.6	0.68	98.3	0.66
28/04/2021	13:25	Glendell	96.4	0.7	96.7	0.47
30/04/2021	13:28	Glendell	99.9	0.42	101.6	0.31
5/05/2021	13:25	Glendell	91.7	0.93	96.8	0.53
12/05/2021	12:31	Glendell	104.3	3.61	102.5	1.77
14/05/2021	13:04	Glendell	103.7	1.55	106.2	1.02
17/05/2021	9:33	Glendell	96.4	1.13	93.3	0.87
24/05/2021	16:45	Glendell	103.3	3.33	103	2.01
25/05/2021	13:31	Glendell	93.9	0.79	95.8	0.44
28/05/2021	13:39	Glendell	103.2	0.93	98.9	0.65
31/05/2021	13:43	Glendell	105.7	1.81	104.6	0.97
2/06/2021	13:26	Glendell	102.3	0.59	99.8	0.56
7/06/2021	13:41	Glendell	107.9	0.91	110.1	0.71
15/06/2021	13:34	Glendell	104.6	0.59	105.3	0.65
21/06/2021	13:43	Glendell	104.2	0.79	103.7	0.53
21/06/2021	13:46	Glendell	110.4	0.7	104.7	0.66
29/06/2021	13:26	Glendell	103.5	1.62	102.2	1.07
2/07/2021	13:39	Glendell	100.8	1.28	101.9	0.79
7/07/2021	13:49	Glendell	95.8	1.42	94	0.73
7/07/2021	13:51	Glendell	100.6	0.86	99.8	0.79
16/07/2021	09:51	Glendell	113.8	1.75	112.4	2.28
16/07/2021	09:53	Glendell	97.4	0.17	96.9	0.13
2/08/2021	13:27	Glendell	92.5	0.64	96	0.35
9/08/2021	13:29	Glendell	102.5	2.81	101.3	1.1

Date Fired	Time Fired	Site	Powerlines		Railway/ARTC 1	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
13/08/2021	13:32	Glendell	106.6	0.83	104.3	0.41
19/08/2021	13:32	Glendell	104.5	0.85	101.3	0.53
1/09/2021	14:45	Glendell	102.2	1.49	101.4	0.8
6/09/2021	13:24	Glendell	96.7	1.04	97.4	0.37
9/09/2021	13:30	Glendell	103.2	1.8	100.2	1.67
10/09/2021	13:28	Glendell	98.5	0.24	96	0.27
13/09/2021	14:29	Glendell	101.3	0.43	99.2	0.34
16/09/2021	12:38	Glendell	101	1.37	103	1.05
17/09/2021	14:26	Glendell	98.7	0.59	96.6	0.71
25/09/2021	9:46	Glendell	104.3	1.29	103.2	1.25
14/10/2021	12:28	Glendell	103.2	0.69	101.2	0.45
22/10/2021	13:40	Glendell	101	0.91	99.1	0.5
28/10/2021	13:43	Glendell	103.5	0.99	102.2	0.66
29/10/2021	13:26	Glendell	101.2	0.61	101.4	0.43
5/11/2021	13:28	Glendell	104.3	2.3	105.9	1.42
11/11/2021	14:42	Glendell	105.5	0.74	100.4	0.67
20/11/2021	11:46	Glendell	111.9	0.19	101.4	0.04
25/11/2021	13:51	Glendell	99.7	0.29	99	0.32
3/12/2021	13:38	Glendell	106.2	1.97	106	1.49
7/12/2021	13:42	Glendell	95.8	0.16	103.5	0.07
17/12/2021	13:40	Glendell	82.6	0.19	86.9	0.14
23/12/2021	12:31	Glendell	92.6	0.43	97	0.9
24/12/2021	10:26	Glendell	92	0.32	95.1	0.34

Table 13: Glendell Blast Monitoring Results – ARTC 2, ARTC 3 and ARTC 4.

Date Fired	Time Fired	Site	ARTC 2		ARTC 3		ARTC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	13:42	Glendell	100.6	0.57	97.1	0.58	92.6	0.32
12/01/2021	13:34	Glendell	99.5	0.56	97.6	0.36	96.4	0.3
14/01/2021	12:33	Glendell	106.7	0.72	109.2	0.32	108.4	0.34
20/01/2021	13:32	Glendell	102.1	0.39	101.7	0.21	100.7	0.19
27/01/2021	13:30	Glendell	103.4	0.75	99.8	0.77	94.6	0.73
1/02/2021	13:36	Glendell	101.3	0.53	96.9	0.6	94	0.46
3/02/2021	13:32	Glendell	101.3	0.75	96.5	0.57	96.2	0.55
5/02/2021	13:38	Glendell	99.9	0.6	94.4	0.51	93.9	0.37
9/02/2021	13:28	Glendell	103.8	0.71	101.6	0.75	107.4	0.46
11/02/2021	13:19	Glendell	106.8	0.54	103.3	0.54	99.7	0.47

Date Fired	Time Fired	Site	ARTC 2		ARTC 3		ARTC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
15/02/2021	13:44	Glendell	91.8	0.41	88	0.41	86.8	0.23
20/02/2021	10:06	Glendell	100.1	0.77	99.7	0.49	102.9	0.34
26/02/2021	11:34	Glendell	99	0.37	98.8	0.27	96	0.19
26/02/2021	11:50	Glendell	106.8	0.99	108.6	0.5	104.9	0.38
3/03/2021	15:31	Glendell	100.7	0.55	98.9	0.84	101.5	0.41
11/03/2021	9:24	Glendell	104.1	0.76	103.5	0.67	99.7	0.5
17/03/2021	11:01	Glendell	99.8	0.72	97.2	0.72	97.9	0.6
29/03/2021	13:42	Glendell	101.6	0.87	101	0.42	98	0.3
1/04/2021	11:52	Glendell	107.1	0.6	103.8	0.51	100.3	0.42
8/04/2021	13:49	Glendell	101.2	0.47	95.1	0.33	93.3	0.2
12/04/2021	15:36	Glendell	104.6	0.74	101.8	1.2	97.5	1.02
16/04/2021	13:21	Glendell	101.9	0.61	97.1	0.66	98.8	0.65
21/04/2021	13:42	Glendell	101.2	0.54	98.7	0.36	98.6	0.28
23/04/2021	13:27	Glendell	100.5	0.55	100.6	0.28	103.2	0.25
28/04/2021	13:25	Glendell	94.3	0.45	92.4	0.22	92.3	0.19
30/04/2021	13:28	Glendell	99.6	0.51	97.9	0.21	92.9	0.2
5/05/2021	13:25	Glendell	92.4	0.34	91.4	0.31	88.6	0.15
12/05/2021	12:31	Glendell	105.6	0.82	100.3	0.63	95.4	0.99
14/05/2021	13:04	Glendell	107.1	0.98	107.1	0.66	111.9	0.59
17/05/2021	9:33	Glendell	98	0.33	92.6	0.24	103.4	0.27
24/05/2021	16:45	Glendell	103	0.98	99.4	0.91	106.2	0.45
25/05/2021	13:31	Glendell	97.6	0.3	88.7	0.23	88.6	0.11
28/05/2021	13:39	Glendell	100.7	0.6	96.1	0.53	95	0.36
31/05/2021	13:43	Glendell	105.7	1.35	101.6	0.39	100.5	0.41
2/06/2021	13:26	Glendell	97.9	0.51	99.9	0.48	94.3	0.45
7/06/2021	13:41	Glendell	103.8	0.84	102.2	0.25	101.2	0.2
15/06/2021	13:34	Glendell	107.6	0.82	103.5	0.23	101.3	0.26
21/06/2021	13:43	Glendell	102.1	0.33	102.1	0.16	97.1	0.16
21/06/2021	13:46	Glendell	100.6	0.51	102.1	0.2	97.1	0.19
29/06/2021	13:26	Glendell	102.9	0.86	98.4	0.71	94.8	0.43
2/07/2021	13:39	Glendell	105.3	0.71	103	0.48	101.4	0.41
7/07/2021	13:49	Glendell	97.7	0.71	93.2	0.44	89.6	0.3
7/07/2021	13:51	Glendell	99.7	0.54	98.8	0.31	97.5	0.31
16/07/2021	09:51	Glendell	112.2	1.01	107.9	0.45	105.8	0.43
16/07/2021	09:53	Glendell	95.3	0.19	96.7	0.09	97.1	0.04
2/08/2021	13:27	Glendell	94.5	0.35	95.5	0.23	92.7	0.14
9/08/2021	13:29	Glendell	105.1	0.87	103.2	0.61	97.8	0.5
13/08/2021	13:32	Glendell	102.9	0.56	100.3	0.26	100.1	0.25
19/08/2021	13:32	Glendell	108.5	0.74	104.8	0.37	101	0.24
1/09/2021	14:45	Glendell	102.1	0.47	99	0.32	96.4	0.23

Date Fired	Time Fired	Site	ARTC 2		ARTC 3		ARTC 4	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
6/09/2021	13:24	Glendell	101.9	0.44	96.9	0.3	98.4	0.23
9/09/2021	13:30	Glendell	102.9	1.19	104	0.68	107.3	0.85
10/09/2021	13:28	Glendell	98.6	0.3	100.2	0.19	106	0.15
13/09/2021	14:29	Glendell	99.2	0.47	88.6	0.4	91.2	0.17
16/09/2021	12:38	Glendell	100.8	0.86	95.9	0.55	91.5	0.51
17/09/2021	14:26	Glendell	100.9	0.64	94.9	0.23	98.9	0.13
25/09/2021	9:46	Glendell	104	0.89	102.1	0.42	100.1	0.43
14/10/2021	12:28	Glendell	101.2	0.63	98.6	0.44	94.8	0.22
22/10/2021	13:40	Glendell	105.2	0.62	98.1	0.25	96.4	0.2
28/10/2021	13:43	Glendell	104.7	0.57	100.5	0.23	99	0.19
29/10/2021	13:26	Glendell	104.3	0.28	95.4	0.17	95.3	0.12
5/11/2021	13:28	Glendell	107	0.93	103.6	0.63	103	0.52
11/11/2021	14:42	Glendell	100.4	0.74	97.6	0.47	92.4	0.42
20/11/2021	11:46	Glendell	100.4	0.15	85.5	0.05	96.2	0.01
25/11/2021	13:51	Glendell	98.3	0.31	94.4	0.25	94.3	0.08
3/12/2021	13:38	Glendell	102.1	0.95	107.1	2.55	96.1	1.42
7/12/2021	13:42	Glendell	111.7	0.3	97.5	0.15	86	0.26
17/12/2021	13:40	Glendell	93.9	0.25	84.9	0.25	94.8	0.32
23/12/2021	12:31	Glendell	101.4	1.6	90.2	0.37	93.3	0.43
24/12/2021	10:26	Glendell	97.9	0.38	96	0.51	91.5	0.73

Table 14: Glendell Blast Monitoring Summary – Integra Surface and Homestead.

Date Fired	Time Fired	Site	Integra Surface		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
8/01/2021	13:42	Glendell	93.9	0.28	102.7	0.26
12/01/2021	13:34	Glendell	93.8	0.3	91.9	0.38
14/01/2021	12:33	Glendell	106.8	0.25	102.9	0.7
20/01/2021	13:32	Glendell	107.1	0.2	109	0.36
27/01/2021	13:30	Glendell	101.3	0.3	107.5	0.51
1/02/2021	13:36	Glendell	97.8	0.28	96.9	0.15
3/02/2021	13:32	Glendell	99.7	0.32	100.8	0.43
5/02/2021	13:38	Glendell	95.4	0.34	96.1	0.4
9/02/2021	13:28	Glendell	94.9	0.36	105.4	0.44
11/02/2021	13:19	Glendell	95.5	0.36	93.9	0.58
15/02/2021	13:44	Glendell	101.4	0.22	99.4	0.47
20/02/2021	10:06	Glendell	95.3	0.3	95.1	0.4
26/02/2021	11:34	Glendell	94.7	0.13	82.2	0.2

Date Fired	Time Fired	Site	Integra Surface		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
26/02/2021	11:50	Glendell	97.2	0.38	96.3	0.55
3/03/2021	15:31	Glendell	92.8	0.27	93.2	0.19
11/03/2021	9:24	Glendell	95	0.41	93	0.71
17/03/2021	11:01	Glendell	93.5	0.4	96.3	0.75
29/03/2021	13:42	Glendell	94.4	0.22	94.5	0.39
1/04/2021	11:52	Glendell	94.9	0.36	90.3	0.34
8/04/2021	13:49	Glendell	88.9	0.27	95.7	0.42
12/04/2021	15:36	Glendell	91.2	0.67	89.5	0.32
16/04/2021	13:21	Glendell	91.6	0.37	99.6	0.67
21/04/2021	13:42	Glendell	96.1	0.34	95.2	0.44
23/04/2021	13:27	Glendell	97.1	0.29	98.5	0.39
28/04/2021	13:25	Glendell	85.6	0.16	88.4	0.33
30/04/2021	13:28	Glendell	92	0.15	95.9	0.22
5/05/2021	13:25	Glendell	95.1	0.19	95.6	0.23
12/05/2021	12:31	Glendell	91.4	1.07	99.5	0.8
14/05/2021	13:04	Glendell	105.8	0.71	112.5	0.5
17/05/2021	9:33	Glendell	98.2	0.14	102.3	0.37
24/05/2021	16:45	Glendell	97.6	0.99	97	1.3
25/05/2021	13:31	Glendell	95.5	0.14	102.3	0.3
28/05/2021	13:39	Glendell	93.3	0.44	101.1	0.3
31/05/2021	13:43	Glendell	99.9	0.26	96.6	0.49
2/06/2021	13:26	Glendell	103.8	0.26	92.1	0.24
7/06/2021	13:41	Glendell	96.8	0.24	92.6	0.46
15/06/2021	13:34	Glendell	102.3	0.14	93.6	0.49
21/06/2021	13:43	Glendell	102.8	0.16	107	0.22
21/06/2021	13:46	Glendell	103.8	0.25	93.2	0.35
29/06/2021	13:26	Glendell	97.7	0.4	94.6	0.31
2/07/2021	13:39	Glendell	103.1	0.36	97.7	0.35
7/07/2021	13:49	Glendell	102.5	0.25	96.7	0.46
7/07/2021	13:51	Glendell	103.2	0.31	92.7	0.33
16/07/2021	09:51	Glendell	103.1	0.34	92.6	0.72
16/07/2021	09:53	Glendell	98.2	0.04	109.3	0.06
2/08/2021	13:27	Glendell	88.8	0.15	100.6	0.25
9/08/2021	13:29	Glendell	99.9	0.55	90.2	0.55
13/08/2021	13:32	Glendell	99.8	0.16	95.1	0.26
19/08/2021	13:32	Glendell	97.9	0.23	95	0.36
1/09/2021	14:45	Glendell	98	0.18	96	0.25
6/09/2021	13:24	Glendell	97	0.19	106.2	0.15
9/09/2021	13:30	Glendell	101	0.35	106.3	1.29
10/09/2021	13:28	Glendell	96.4	0.12	105.3	0.22

Date Fired	Time Fired	Site	Integra Surface		Homestead	
			Peak Overpressure dB(L)	Peak Vibration (mm/s)	Peak Overpressure dB(L)	Peak Vibration (mm/s)
13/09/2021	14:29	Glendell	101.6	0.27	94.1	0.36
16/09/2021	12:38	Glendell	93.7	0.34	94.4	0.59
17/09/2021	14:26	Glendell	95.6	0.15	87	0.25
25/09/2021	9:46	Glendell	102	0.28	98.1	0.48
14/10/2021	12:28	Glendell	90.3	0.17	95.8	0.27
22/10/2021	13:40	Glendell	91.5	0.13	94.2	0.19
28/10/2021	13:43	Glendell	93.9	0.16	97.6	0.2
29/10/2021	13:26	Glendell	105.8	0.1	110.8	0.26
5/11/2021	13:28	Glendell	95.8	0.56	100.1	1.03
11/11/2021	14:42	Glendell	87.5	0.33	106.1	0.58
20/11/2021	11:46	Glendell	98.2	0.01	101.2	0.01
25/11/2021	13:51	Glendell	87.7	0.09	93.2	0.24
3/12/2021	13:38	Glendell	97	0.41	102.1	0.6
7/12/2021	13:42	Glendell	110.7	0.37	108.8	0.35
17/12/2021	13:40	Glendell	86.8	0.42	91.4	0.41
23/12/2021	12:31	Glendell	99.3	0.48	99.3	0.48
24/12/2021	10:26	Glendell	86.4	0.35	91.5	0.43

APPENDIX F - Air Quality

Table 15: MGO Depositional Dust Gauge Results 2021 (g/m²/month)

Gauge Ref.	Insoluble Matter (g/m²/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mt Owen												
DD6[D]	1.0	0.4	2.0	0.6	0.6	0.8	1.8	0.4	0.4	0.6	-	-
DD7 (DG2)[D]	1.9	1.4	2.4	0.9	2.9	3.0	2.3	3.6	4.0	3.6	-	-
DD12	1.9	2.1	2.8	9.6c	3.7	3.8	3.6	9.6c	4.6	3.9	3.1	1.2
DD14	1.3	1.0	1.2	0.6	2.7	1.2	1.3	1.7	2.0	2.3	1.6	1.1
DD16[D]	1.8	3.5	2.0	1.3	8.8c	6.1c	6.4	8.2	9.7	7.4	-	-
Glendell												
DG3[D]	6.8c	1.0	1.3	0.5	4c	2.0	1.2	2.3	1.6	1.6	-	-
DG4 (DD15)	1.6	2.6	2.3	2.8	2.5	2.2	1.5	2.3	2.8	53.1c	10.3c	10.9c
DG5[D]	1.2	3.3	5.5c	1.7	1.0	2.3	5.1c	2.5	1.5	1.5	-	-
DG6[D]	1.2	2.1	2.2	17.9c	1.6	1.1	0.8	1.6	1.6	1.2	-	-
DG7	1.8	2.8	4.2c	0.7	1.6	1.6	1.1	8.8c	2.1	1.8	2.0	1.2
DG8[D]	10.1c	11.2c	5.9	2.2	9.2c	5.0c	2.5	3.6	3.2	2.7	-	-

c - Dust gauge deemed contaminated after analysis of influencing factors. These factors include an ash residue result of <50%, the presence of bird droppings or other contaminants such as insects in the dust gauge and analysis of historical results from the dust gauge.

D – Dust gauge decommissioned as per AQGGMP approved September 2021, final reading in October 2021.

Table 16: MGO Total Suspended Particulate Monitoring Results 2021 (µg/m³ 24hr period/wk)

Date Sampled	TSP 24Hr Mean (µg/m³)		
	TSP1 (Picton)	TSP2 (Middle Falbrook)	TSP3 (Camberwell Village)
03/01/2021	21.0	18.0	23.0
09/01/2021	15.0	9.0	10.0
15/01/2021	65.0	80.0	129.0
21/01/2021	51.0	28.0	38.0
27/01/2021	59.0	39.0	75.0
02/02/2021	20.1	11.2	19.5
08/02/2021	25.3	17.0	26.6
14/02/2021	28.9	19.8	24.9
20/02/2021	16.4	6.8	13.5

Date Sampled	TSP 24Hr Mean (µg/m³)		
	TSP1 (Picton)	TSP2 (Middle Falbrook)	TSP3 (Camberwell Village)
26/02/2021	41.3	42.1	67.7
04/03/2021	47.0	33.1	49.6
10/03/2021	48.1	24.0	38.3
16/03/2021	19.7	10.0	18.8
22/03/2021	10.3	7.0	81.2
28/03/2021	28.4	54.9	45.6
03/04/2021	14.5	7.9	16.7
09/04/2021	31.7	93.0	79.0
15/04/2021	48.9	112.0	120.0
21/04/2021	50.4	84.2	75.4
27/04/2021	24.2	41.6	36.9
03/05/2021	24.6	61.7	70.4
09/05/2021	20.0	39.0	53.4
15/05/2021	25.9	85.9	83.5
21/05/2021	34.4	63.7	32.7
27/05/2021	36.3	106.0	81.6
02/06/2021	8.9	92.7	74.0
08/06/2021	31.6	65.5	61.2
14/06/2021	7.3	64.3	32.9
20/06/2021	25.3	18.6	27.7
26/06/2021	7.5	81.4	49.3
02/07/2021	8.0	30.9	32.0
08/07/2021	39.6	61.2	44.9
14/07/2021	23.2	64.9	68.5
20/07/2021	13.9	85.0	44.5
26/07/2021	22.4	120.0	81.7
01/08/2021	28.9	113.0	93.3
07/08/2021	17.4	62.7	67.3
13/08/2021	52.4	107.0	73.9
19/08/2021	43.8	121.0	83.0
25/08/2021	11.8	69.8	56.1
31/08/2021	39.4	111.0	94.4
06/09/2021	22.6	109.0	39.0
12/09/2021	45.5	119.0	147.0
18/09/2021	38.8	143.0	77.6
24/09/2021	33.8	168.0	123.0
30/09/2021	13.5	38.9	40.3

Date Sampled	TSP 24Hr Mean (µg/m³)		
	TSP1 (Picton)	TSP2 (Middle Falbrook)	TSP3 (Camberwell Village)
06/10/2021	27.7	127.0	116.0
12/10/2021	21.0	19.4	17.6
18/10/2021	36.3	83.3	73.0
24/10/2021	36.0	40.6	45.9
30/10/2021	67.1	79.9	74.3
05/11/2021	45.6	10.5	19.8
11/11/2021	18.7	25.3	18.1
17/11/2021	44.5	21.1	46.2
23/11/2021	16.4	8.2	19.6
29/11/2021	30.2	19.5	26.0
05/12/2021	30.4	18.6	24.3
11/12/2021	17	7.9	21.7
17/12/2021	46	21.7	41.7
23/12/2021	38.4	15.6	35.8
29/12/2021	17.2	9	12.9

Table 17: Continuous PM_{10} (µg/m³) Monitoring Results 2021

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
01/01/2021	6.10	8.40	8.80	9.10	7.80
02/01/2021	7.70	9.80	10.50	10.30	8.20
03/01/2021	10.10	10.10	11.30	10.10	7.80
04/01/2021	9.20	13.80	11.80	12.70	12.50
05/01/2021	8.20	17.00	10.40	14.80	9.20
06/01/2021	14.50	13.90	12.60	13.80	11.20
07/01/2021	9.80	9.90	4.10	10.10	7.30
08/01/2021	12.00	11.50	10.40	12.40	8.20
09/01/2021	5.30	7.40	5.30	7.20	4.70
10/01/2021	6.50	6.60	6.50	6.50	3.80
11/01/2021	8.90	7.10	9.40	7.50	6.00
12/01/2021	23.30	23.00	21.90	18.90	13.10
13/01/2021	9.50	11.90	10.60	10.10	7.70
14/01/2021	16.50	26.00	33.00	20.40	16.50
15/01/2021	25.10	34.10	28.10	28.50	24.70
16/01/2021	26.70	30.80	26.40	28.10	24.10
17/01/2021	23.40	27.30	19.00	27.40	19.00
18/01/2021	26.20	31.10	22.60	22.30	20.90

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
19/01/2021	25.20	30.30	29.40	28.50	19.20
20/01/2021	9.50	6.00	13.90	12.60	10.90
21/01/2021	16.10	12.20	16.60	7.30	10.70
22/01/2021	17.60	32.80	17.50	17.90	15.90
23/01/2021	30.20	37.40	16.90	28.80	25.00
24/01/2021	24.10	30.40	15.40	18.60	19.90
25/01/2021	24.80	31.90	22.10	21.40	19.30
26/01/2021	20.70	28.70	17.80	20.00	17.10
27/01/2021	24.90	22.00	23.40	19.50	12.40
28/01/2021	4.40	4.60	4.60	4.20	3.10
29/01/2021	5.90	5.10	5.80	4.30	2.80
30/01/2021	11.70	14.90	12.70	13.50	10.20
31/01/2021	15.70	16.10	19.30	14.00	8.70
01/02/2021	14.50	15.60	14.70	12.70	10.50
02/02/2021	7.70	11.00	9.80	10.50	8.10
03/02/2021	13.90	18.30	16.70	15.50	11.70
04/02/2021	13.00	15.70	16.80	13.00	10.50
05/02/2021	11.10	14.20	18.60	11.60	9.60
06/02/2021	13.40	15.20	16.00	15.00	9.30
07/02/2021	12.70	15.70	13.60	14.30	11.50
08/02/2021	13.00	17.10	17.10	14.60	10.20
09/02/2021	10.90	14.60	13.20	11.70	6.80
10/02/2021	11.70	13.80	11.00	11.00	7.90
11/02/2021	11.70	13.00	18.70	10.60	8.10
12/02/2021	15.40	30.20	33.80	23.30	15.40
13/02/2021	12.00	20.20	11.20	15.60	12.20
14/02/2021	16.00	17.50	17.10	16.60	11.70
15/02/2021	16.00	12.90	13.90	11.30	6.80
16/02/2021	9.10	9.30	11.00	8.80	5.70
17/02/2021	12.50	14.70	13.60	12.20	8.20
18/02/2021	15.60	17.50	16.80	15.30	10.10
19/02/2021	10.00	11.70	11.90	10.30	6.30
20/02/2021	4.70	10.30	9.90	8.30	6.40
21/02/2021	5.00	8.00	10.40	7.80	7.10
22/02/2021	17.20	22.50	18.20	17.60	13.00
23/02/2021	14.80	17.30	15.80	15.20	12.60
24/02/2021	11.80	13.20	15.50	12.70	9.80

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
25/02/2021	11.20	20.80	17.00	16.20	14.10
26/02/2021	16.70	27.20	20.90	23.10	15.70
27/02/2021	12.90	16.40	17.30	14.10	11.20
28/02/2021	22.00	24.90	22.90	22.00	20.30
01/03/2021	31.00	31.20	23.40	26.60	25.00
02/03/2021	40.10	34.30	32.40	29.80	25.80
03/03/2021	21.90	18.40	20.50	16.40	13.40
04/03/2021	17.40	17.20	18.50	14.80	12.50
05/03/2021	26.90	32.00	31.00	29.40	25.20
06/03/2021	16.70	18.00	17.50	16.30	13.70
07/03/2021	15.70	15.60	16.10	13.40	10.90
08/03/2021	17.10	23.80	23.10	17.50	16.00
09/03/2021	17.10	23.10	17.60	18.90	14.20
10/03/2021	16.70	17.70	20.80	17.50	14.70
11/03/2021	13.00	13.30	17.50	12.50	9.10
12/03/2021	9.80	11.70	11.30	10.70	9.40
13/03/2021	13.70	19.00	10.90	13.90	14.10
14/03/2021	17.30	Power Outage	12.60	7.80	9.80
15/03/2021	12.40	Power Outage	13.90	13.00	9.60
16/03/2021	9.90	6.20	11.40	9.70	6.20
17/03/2021	8.00	6.30	9.60	7.80	6.40
18/03/2021	4.70	4.60	7.50	6.30	3.90
19/03/2021	8.90	7.40	10.30	8.40	5.80
20/03/2021	5.10	5.40	6.40	6.00	4.50
21/03/2021	5.00	5.70	7.30	6.10	5.10
22/03/2021	3.60	4.80	7.00	5.50	4.90
23/03/2021	2.70	4.90	6.40	5.60	3.50
24/03/2021	9.10	13.40	8.90	9.90	8.00
25/03/2021	18.40	23.30	15.00	16.10	13.10
26/03/2021	16.30	17.80	16.60	13.90	11.20
27/03/2021	19.60	25.30	13.00	17.60	19.30
28/03/2021	15.60	17.90	12.50	15.60	14.60
29/03/2021	10.70	11.60	16.20	10.40	7.20
30/03/2021	13.00	15.10	14.90	12.60	9.90
31/03/2021	13.70	13.10	10.70	11.40	8.40
01/04/2021	10.40	12.40	7.50	11.50	8.30
02/04/2021	6.80	9.20	4.80	7.00	5.00

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
03/04/2021	8.40	8.30	5.70	7.20	5.20
04/04/2021	12.40	13.10	6.90	11.30	10.30
05/04/2021	14.20	19.10	15.30	16.50	17.20
06/04/2021	8.10	8.30	7.30	9.70	6.20
07/04/2021	6.60	7.80	11.70	8.30	6.00
08/04/2021	5.10	5.90	10.00	6.20	4.20
09/04/2021	23.50	27.50	8.70	23.80	26.30
10/04/2021	27.20	27.60	20.00	23.90	24.10
11/04/2021	21.00	25.80	14.40	21.60	18.50
12/04/2021	18.10	24.80	15.50	15.50	11.70
13/04/2021	19.40	18.50	12.80	16.40	15.60
14/04/2021	26.60	38.30	19.30	25.20	26.10
15/04/2021	36.60	36.80	25.00	30.90	25.50
16/04/2021	27.00	29.80	39.00	23.50	19.80
17/04/2021	8.80	8.30	7.80	8.90	6.60
18/04/2021	11.40	10.70	7.40	10.20	8.90
19/04/2021	17.10	19.00	13.90	18.10	16.40
20/04/2021	24.60	29.40	19.20	24.60	22.20
21/04/2021	22.40	23.00	19.50	20.80	19.30
22/04/2021	24.70	23.80	15.90	24.40	25.60
23/04/2021	25.80	25.70	15.90	24.80	20.80
24/04/2021	20.80	22.50	14.70	23.20	21.30
25/04/2021	19.70	20.70	12.90	19.30	19.50
26/04/2021	17.80	17.20	16.70	14.30	14.20
27/04/2021	16.10	14.80	12.80	13.10	16.00
28/04/2021	14.20	14.10	13.10	12.00	11.30
29/04/2021	16.90	14.30	9.00	12.30	10.90
30/04/2021	9.00	16.00	9.70	10.20	7.40
01/05/2021	9.00	9.80	11.40	8.20	8.40
02/05/2021	12.10	10.00	7.70	9.30	11.70
03/05/2021	14.20	20.30	12.90	13.90	13.70
04/05/2021	17.60	16.20	12.90	21.50	19.20
05/05/2021	11.60	5.30	9.40	10.50	5.80
06/05/2021	12.90	13.70	7.40	12.60	9.50
07/05/2021	9.30	10.40	8.60	9.60	8.10
08/05/2021	12.90	20.00	12.10	13.50	11.10
09/05/2021	19.40	22.00	12.90	14.90	15.30

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
10/05/2021	23.70	25.60	9.80	19.40	15.70
11/05/2021	19.90	20.90	11.30	14.10	12.60
12/05/2021	18.90	18.40	9.40	16.70	12.20
13/05/2021	28.50	26.60	15.30	16.80	17.90
14/05/2021	35.80	30.80	12.90	17.60	19.10
15/05/2021	36.10	44.70	12.30	15.70	18.00
16/05/2021	34.90	29.70	8.40	19.80	16.60
17/05/2021	24.90	21.70	11.80	16.20	13.10
18/05/2021	15.20	20.80	18.70	15.80	25.70
19/05/2021	18.50	19.50	13.00	16.60	20.40
20/05/2021	20.80	23.40	12.30	20.60	30.20
21/05/2021	18.80	18.30	16.30	15.70	31.80
22/05/2021	15.40	11.90	10.30	9.90	8.40
23/05/2021	13.90	13.10	6.60	11.40	11.60
24/05/2021	15.20	14.70	10.00	9.70	7.40
25/05/2021	14.60	14.70	8.90	12.00	14.20
26/05/2021	25.20	27.90	17.10	20.10	22.80
27/05/2021	23.60	24.40	13.40	17.60	15.70
28/05/2021	19.00	15.50	10.30	11.90	11.10
29/05/2021	16.50	15.10	10.50	10.60	8.20
30/05/2021	16.30	14.70	10.00	10.00	7.10
31/05/2021	13.60	15.10	15.80	11.20	9.60
01/06/2021	22.40	24.70	20.00	18.50	21.90
02/06/2021	22.30	29.50	7.80	23.10	24.60
03/06/2021	21.70	29.40	20.50	22.80	41.20
04/06/2021	11.90	13.80	6.20	11.00	10.70
05/06/2021	15.10	18.40	6.20	13.70	13.30
06/06/2021	13.80	12.90	6.80	12.20	12.40
07/06/2021	14.50	20.60	14.10	19.70	30.90
08/06/2021	25.40	23.80	15.90	24.10	25.70
09/06/2021	6.90	6.90	1.60	5.20	3.30
10/06/2021	5.10	6.20	0.50	5.30	1.70
11/06/2021	10.60	12.00	2.40	7.10	5.30
12/06/2021	11.70	13.70	2.60	8.90	8.40
13/06/2021	14.70	13.00	2.50	8.50	13.20
14/06/2021	9.90	11.00	3.10	11.80	10.10
15/06/2021	13.90	20.80	11.10	22.90	19.90

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
16/06/2021	20.30	20.10	14.70	14.90	21.50
17/06/2021	19.90	23.50	6.60	14.10	12.70
18/06/2021	14.90	15.90	6.60	11.50	10.70
19/06/2021	12.60	16.90	5.10	12.00	7.50
20/06/2021	12.70	10.20	7.00	8.90	4.20
21/06/2021	11.90	10.30	8.60	9.30	6.30
22/06/2021	11.90	14.60	5.80	9.40	6.50
23/06/2021	14.30	12.70	10.10	10.00	7.60
24/06/2021	24.90	25.80	11.00	18.20	15.00
25/06/2021	12.70	16.20	3.70	9.60	7.60
26/06/2021	17.80	19.00	4.40	15.90	13.10
27/06/2021	14.70	18.10	3.60	11.10	9.30
28/06/2021	15.30	15.80	6.50	13.10	16.90
29/06/2021	13.80	10.80	11.10	10.40	7.60
30/06/2021	9.90	10.00	8.10	7.20	5.80
01/07/2021	14.50	11.90	10.40	9.00	8.20
02/07/2021	9.90	10.70	6.70	10.60	8.90
03/07/2021	12.50	12.60	4.20	11.30	14.20
04/07/2021	16.50	17.00	4.10	14.70	14.20
05/07/2021	17.10	18.20	6.80	12.30	15.00
06/07/2021	13.40	16.90	7.80	14.40	14.50
07/07/2021	13.60	17.00	10.40	16.70	29.60
08/07/2021	19.10	20.60	13.10	12.80	21.10
09/07/2021	15.50	21.60	6.50	14.70	14.20
10/07/2021	11.60	11.70	4.80	10.80	7.70
11/07/2021	12.10	10.20	7.40	9.30	7.00
12/07/2021	20.00	16.90	8.90	12.00	13.60
13/07/2021	20.30	17.70	11.00	17.50	13.60
14/07/2021	32.10	30.20	10.70	15.40	15.00
15/07/2021	19.00	17.30	9.10	13.60	11.60
16/07/2021	23.10	26.10	13.30	17.30	15.50
17/07/2021	28.70	35.40	14.80	23.20	17.90
18/07/2021	28.80	23.70	4.90	13.20	12.40
19/07/2021	20.30	22.00	6.40	11.80	11.10
20/07/2021	19.90	19.90	4.70	11.30	12.30
21/07/2021	15.90	14.90	8.40	10.70	8.10
22/07/2021	19.20	22.70	13.10	18.30	25.90

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
23/07/2021	25.50	25.90	11.70	24.20	19.40
24/07/2021	23.20	34.40	4.00	18.20	18.80
25/07/2021	25.70	28.90	7.70	18.20	21.30
26/07/2021	26.70	34.60	9.50	15.80	20.40
27/07/2021	22.60	30.80	17.00	19.30	15.20
28/07/2021	42.80	48.00	19.40	28.60	27.20
29/07/2021	22.20	25.50	8.60	15.50	15.40
30/07/2021	25.30	23.40	6.20	20.50	17.30
31/07/2021	38.30	39.80	13.90	30.10	29.90
01/08/2021	29.90	39.30	12.00	29.00	26.80
02/08/2021	17.50	16.30	11.10	14.50	9.80
03/08/2021	20.20	11.80	9.30	13.90	11.60
04/08/2021	16.80	18.10	9.60	14.10	12.80
05/08/2021	10.40	22.90	6.40	10.60	12.30
06/08/2021	27.40	24.40	7.70	12.60	16.8
07/08/2021	25.60	22.10	6.70	13.70	10.7
08/08/2021	14.50	15.90	7.00	14.50	9.2
09/08/2021	19.50	18.40	15.30	13.70	10.00
10/08/2021	23.00	20.20	15.80	18.20	22.30
11/08/2021	23.00	23.90	17.40	16.70	16.00
12/08/2021	24.90	27.70	13.60	21.50	18.80
13/08/2021	24.90	20.40	20.40	19.50	29.10
14/08/2021	25.90	27.60	21.90	22.20	22.90
15/08/2021	34.60	38.40	16.00	24.40	36.10
16/08/2021	43.10	47.40	12.80	30.90	38.70
17/08/2021	25.60	24.10	14.10	17.70	15.10
18/08/2021	22.60	23.00	22.50	15.00	11.10
19/08/2021	21.70	28.00	21.20	25.00	30.10
20/08/2021	28.40	26.50	19.50	26.00	39.70
21/08/2021	32.40	27.50	6.80	21.00	19.10
22/08/2021	34.60	36.90	10.30	28.60	45.10
23/08/2021	29.90	27.10	9.80	26.30	15.00
24/08/2021	6.80	5.40	0.30	4.80	4.10
25/08/2021	11.70	10.50	2.90	8.80	8.90
26/08/2021	14.60	15.20	4.00	12.10	7.20
27/08/2021	25.90	21.90	7.80	15.80	23.50
28/08/2021	19.30	19.60	5.60	16.80	14.00

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
29/08/2021	29.90	22.20	12.30	20.30	19.20
30/08/2021	26.00	25.80	10.00	20.80	17.50
31/08/2021	26.70	28.40	13.40	23.80	27.50
01/09/2021	28.70	30.70	17.70	25.10	31.50
02/09/2021	22.50	23.00	18.70	17.70	16.70
03/09/2021	17.40	17.60	10.90	10.40	14.60
04/09/2021	35.40	35.30	13.10	25.70	28.60
05/09/2021	11.80	14.10	2.30	8.60	9.00
06/09/2021	20.40	16.20	6.90	9.30	17.70
07/09/2021	25.60	26.40	10.40	18.00	22.80
08/09/2021	20.30	28.40	11.20	23.40	16.60
09/09/2021	34.80	41.50	9.10	25.70	30.00
10/09/2021	40.40	37.60	16.60	25.40	26.10
11/09/2021	29.30	38.20	9.90	28.50	20.50
12/09/2021	66.70	61.00	20.40	35.50	26.70
13/09/2021	21.90	22.40	14.80	15.50	12.00
14/09/2021	8.40	7.50	2.80	7.00	3.50
15/09/2021	10.20	11.80	6.50	9.90	5.70
16/09/2021	13.10	10.40	24.50	9.00	4.20
17/09/2021	17.30	18.30	12.30	12.90	8.60
18/09/2021	44.00	42.60	22.10	30.20	37.30
19/09/2021	29.90	25.90	5.80	18.40	21.50
20/09/2021	35.90	35.00	10.20	26.00	22.40
21/09/2021	17.50	18.20	9.30	15.60	14.90
22/09/2021	15.80	22.50	11.90	17.20	14.90
23/09/2021	28.60	33.70	12.00	23.80	32.00
24/09/2021	29.30	43.10	10.70	25.70	30.40
25/09/2021	26.00	35.60	17.30	25.70	20.40
26/09/2021	8.40	9.10	7.40	7.60	4.50
27/09/2021	10.60	10.90	10.50	8.00	4.30
28/09/2021	19.40	20.50	16.30	15.30	13.00
29/09/2021	31.40	25.80	25.90	18.10	16.00
30/09/2021	15.50	13.80	5.90	11.00	8.90
01/10/2021	16.70	20.60	7.30	13.00	10.10
02/10/2021	16.50	16.60	3.40	11.00	12.00
03/10/2021	19.20	18.80	7.40	15.40	11.60
04/10/2021	32.10	44.40	17.00	26.50	33.50

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
05/10/2021	31.10	40.50	13.40	26.60	30.00
06/10/2021	26.00	32.40	13.30	23.50	20.70
07/10/2021	39.40	54.60	18.00	32.00	42.10
08/10/2021	27.40	30.40	27.50	24.60	18.10
09/10/2021	23.80	30.70	12.70	22.30	20.70
10/10/2021	54.40	53.60	24.50	32.70	43.80
11/10/2021	6.10	4.50	2.50	4.70	4.30
12/10/2021	8.10	7.60	6.10	6.70	4.60
13/10/2021	6.80	6.10	3.10	5.40	2.30
14/10/2021	10.60	13.80	10.70	11.20	5.90
15/10/2021	21.60	25.00	14.90	22.40	14.40
16/10/2021	17.70	20.20	6.80	14.00	13.40
17/10/2021	16.90	16.80	8.00	16.00	12.20
18/10/2021	22.20	24.40	11.20	16.70	15.50
19/10/2021	27.10	26.00	14.40	26.40	27.10
20/10/2021	11.00	10.70	8.30	8.10	5.00
21/10/2021	14.30	13.10	12.30	9.40	4.20
22/10/2021	12.10	12.90	15.70	8.60	5.10
23/10/2021	18.40	24.10	18.30	18.00	11.70
24/10/2021	15.50	18.50	13.00	15.50	11.60
25/10/2021	19.20	21.20	13.90	16.50	13.60
26/10/2021	19.80	18.90	15.40	14.00	8.00
27/10/2021	20.70	25.90	15.20	18.60	12.60
28/10/2021	27.70	43.50	37.20	25.50	30.00
29/10/2021	58.80	68.10	35.10	43.50	56.20
30/10/2021	34.80	34.80	23.10	27.60	22.20
31/10/2021	12.60	15.30	4.70	9.50	4.40
01/11/2021	23.70	27.00	15.50	17.30	12.40
02/11/2021	14.00	10.70	20.10	8.90	4.80
03/11/2021	13.90	11.70	21.20	11.20	5.50
04/11/2021	18.90	13.80	23.30	14.40	9.80
05/11/2021	11.20	6.20	9.10	7.50	5.30
06/11/2021	16.30	10.70	9.40	10.20	8.90
07/11/2021	24.90	19.90	17.80	17.90	18.60
08/11/2021	13.30	10.50	9.10	10.60	11.70
09/11/2021	19.00	15.90	11.60	13.50	10.50
10/11/2021	16.50	10.80	10.00	10.20	7.30

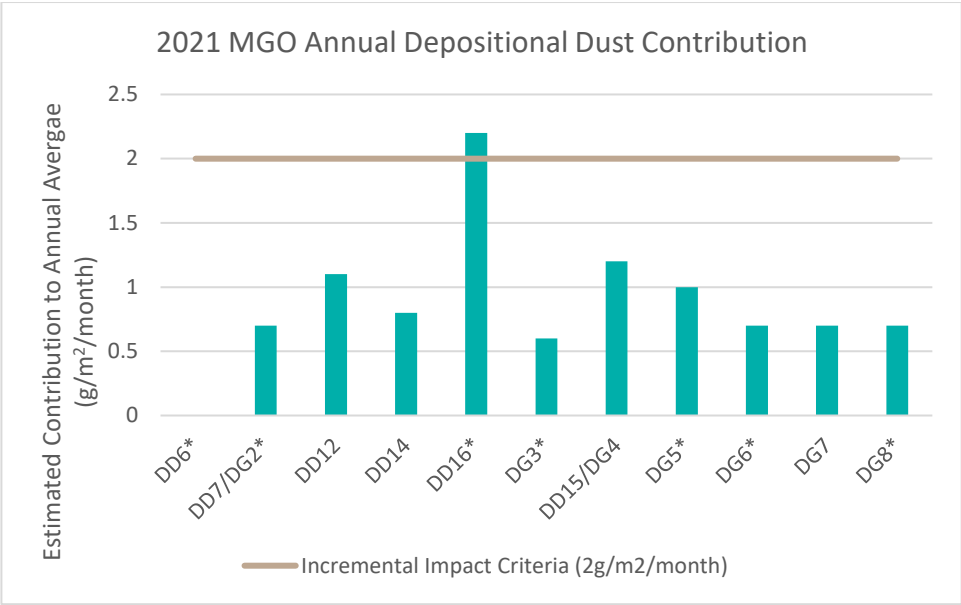
Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
11/11/2021	10.00	9.30	9.30	10.00	8.60
12/11/2021	29.80	32.80	31.50	24.00	23.60
13/11/2021	21.60	21.60	8.90	15.30	13.60
14/11/2021	15.00	18.60	8.00	13.20	12.90
15/11/2021	21.90	32.00	9.80	19.80	15.40
16/11/2021	17.00	19.40	8.80	15.50	11.70
17/11/2021	16.70	15.00	10.70	12.50	7.70
18/11/2021	19.20	22.00	12.10	15.10	11.70
19/11/2021	31.50	35.20	24.00	33.30	28.60
20/11/2021	25.10	23.30	10.00	18.80	16.20
21/11/2021	7.80	6.50	4.40	5.80	3.40
22/11/2021	11.20	Water Damage	4.60	8.80	5.50
23/11/2021	11.40	Water Damage	5.90	8.90	4.60
24/11/2021	13.50	7.80	10.10	10.60	7.20
25/11/2021	13.00	8.30	9.80	9.20	7.20
26/11/2021	8.40	5.50	5.70	4.60	5.20
27/11/2021	10.40	7.00	5.60	6.90	3.10
28/11/2021	17.60	16.20	10.30	14.70	9.80
29/11/2021	21.40	19.80	12.50	17.80	12.70
30/11/2021	15.60	13.10	10.90	12.40	7.50
01/12/2021	9.80	6.50	5.30	6.20	3.60
02/12/2021	9.80	7.60	3.60	6.20	4.30
03/12/2021	24.50	25.20	13.50	23.10	18.50
04/12/2021	24.80	21.70	21.10	20.00	18.30
05/12/2021	16.60	15.70	11.10	12.90	10.90
06/12/2021	20.60	16.70	11.40	14.10	9.70
07/12/2021	17.40	13.00	10.00	11.80	7.70
08/12/2021	13.30	12.30	11.80	10.70	8.20
09/12/2021	9.70	8.40	6.90	8.10	6.60
10/12/2021	17.60	17.60	11.00	15.80	10.00
11/12/2021	11.20	9.20	5.40	6.90	3.40
12/12/2021	15.00	13.90	6.60	11.20	7.60
13/12/2021	22.70	20.10	14.60	16.30	9.90
14/12/2021	22.80	20.50	12.80	16.00	11.30
15/12/2021	31.40	31.00	20.30	21.40	17.70
16/12/2021	23.80	20.00	17.00	17.60	14.70
17/12/2021	20.10	19.70	8.70	15.60	11.80

Date	DPIE PM10 Monitoring 24 Hour Average (µg/m³)				
	Sx13 D1 Project Office	Sx13 D4 McInerney	Sx13 D8 Picton	Sx13 D9 Nobles	Sx13 D11 Middle Falbrook
18/12/2021	23.50	27.20	11.40	22.70	19.00
19/12/2021	35.20	32.30	14.30	22.90	25.70
20/12/2021	22.80	25.30	16.00	21.10	14.70
21/12/2021	27.90	32.00	22.80	24.90	25.60
22/12/2021	27.10	32.90	15.50	22.90	19.00
23/12/2021	21.40	17.50	13.50	14.20	10.80
24/12/2021	12.80	12.10	7.50	10.20	10.00
25/12/2021	15.90	11.30	8.70	11.70	13.00
26/12/2021	12.90	10.00	7.80	9.50	8.60
27/12/2021	10.10	9.10	6.20	8.90	6.70
28/12/2021	10.00	7.50	5.60	7.70	4.90
29/12/2021	10.40	9.70	5.20	8.80	5.50
30/12/2021	11.00	9.10	5.80	7.30	3.30
31/12/2021	11.80	8.80	8.10	8.30	6.00

Table 18: 2016 to 2021 Depositional Dust Air Quality Monitoring Results (g/m²/month)

Dust Gauge Code	Annual Average (g/ m²/month)					
	2016	2017	2018	2019	2020	2021
DD6	1.0	0.9	0.9	1.5	1.2	1.5[1]
DD7	2.3	2.5	2.6	2.9	2.4	1.7[1]
DD12	4.3	2.7	1.0	3.3	3.1	3.1
DD14	2.6	1.8	2.5	1.7	2.6	1.5
DD16	1.8	4.0	2.8	3.5	3.8	5.0[1]
DG3	3.3	1.7	1.4	1.9	1.7	1.4[1]
DG4	1.6	2.4	2.5	3	2	2.3
DG5	1.8	2.5	2.3	3.1	2.4	1.9[1]
DG6	1.6	2.0	1.9	2.4	2	1.5[1]
DG7	2.0	2.2	2.6	2.7	2.5	1.7
DG8	4.0	2.7	3.6	4.7	2.6	3.4[1]

[1] – Dust gauge decommissioned, final reading in October 2021.



* Decommissioned on 29 September 2021 as part of a consolidation process. Final samples taken in mid-October 2021.

Figure 1: MGO Estimated Deposit Dust Contribution to Annual Average.

Table 19: 2016 to 2021 Continuous PM_{10} Monitoring Comparison

Year	Sx13 D8 Picton	SX13 D1 Project Office	Sx D11 Middle Falbrook	Sx13 D9 Nobles	Sx13 D4 McInerney	Criterion
Maximum 24-hour average in µg/m³						
2016	51	56	61	76	54	50
2017	111	63	86	66	79	
2018	168	144	163	166	210	
2019	220.6	201	175	191	243	
2019 (**excluding extraordinary events**)	60	70	77	64	69	
2020	99	92	59	87	101	
2020 (**excluding extraordinary events**)	45	52	41	45	58	
2021	39	66.70	56.20	43.50	68.10	
Number of days above 24-hour average criteria						
2016	1	2	1	2	5	N/A
2017	28	6	17	4	20	
2018	15	13	27	11	34	
2019	49	58	62	55	81	

Year	Sx13 D8 Picton	SX13 D1 Project Office	Sx D11 Middle Falbrook	Sx13 D9 Nobles	Sx13 D4 McInerney	Criterion
2019 (**excluding extraordinary events**)	7	11	22	14	28	
2020	10	9	2	9	17	
2020 (**excluding extraordinary events**)	0	1	0	0	2	
2021	0	3	1	0	4	
Annual average in µg/m³						
2016	19	20	14	18	23	30**
2017	24	20	23	19	24	
2018	23	23	25	22	29	
2019*	22	23	27	23	28	
2019 (**1 January 2019 – 3 September 2019 SSD-5850**)*	21	22	26	22	26	
2019 (**4 September 2019 – 31 December 2019 SSD-5850**)*	26	27	28	27	33	
2020	19**	19	15	19	24	25**
2020 (**excluding extraordinary events**)	0**	2***	2**	4****	5***	25** 30***
2021	12	18	14	15	20	

Note: Days have been denoted as 'extraordinary events' as advised by DPIE. As advised by DPIE, days which are identified as 'extraordinary events' are not included in Long term impact assessment criteria.
*** MOCO Mod 2 (SSD-5850) has a criteria of 25 µg/m3*
**** Glendell Mod 4 (DA 80-952) has a criteria of 30 µg/m3*
***** Both approvals*

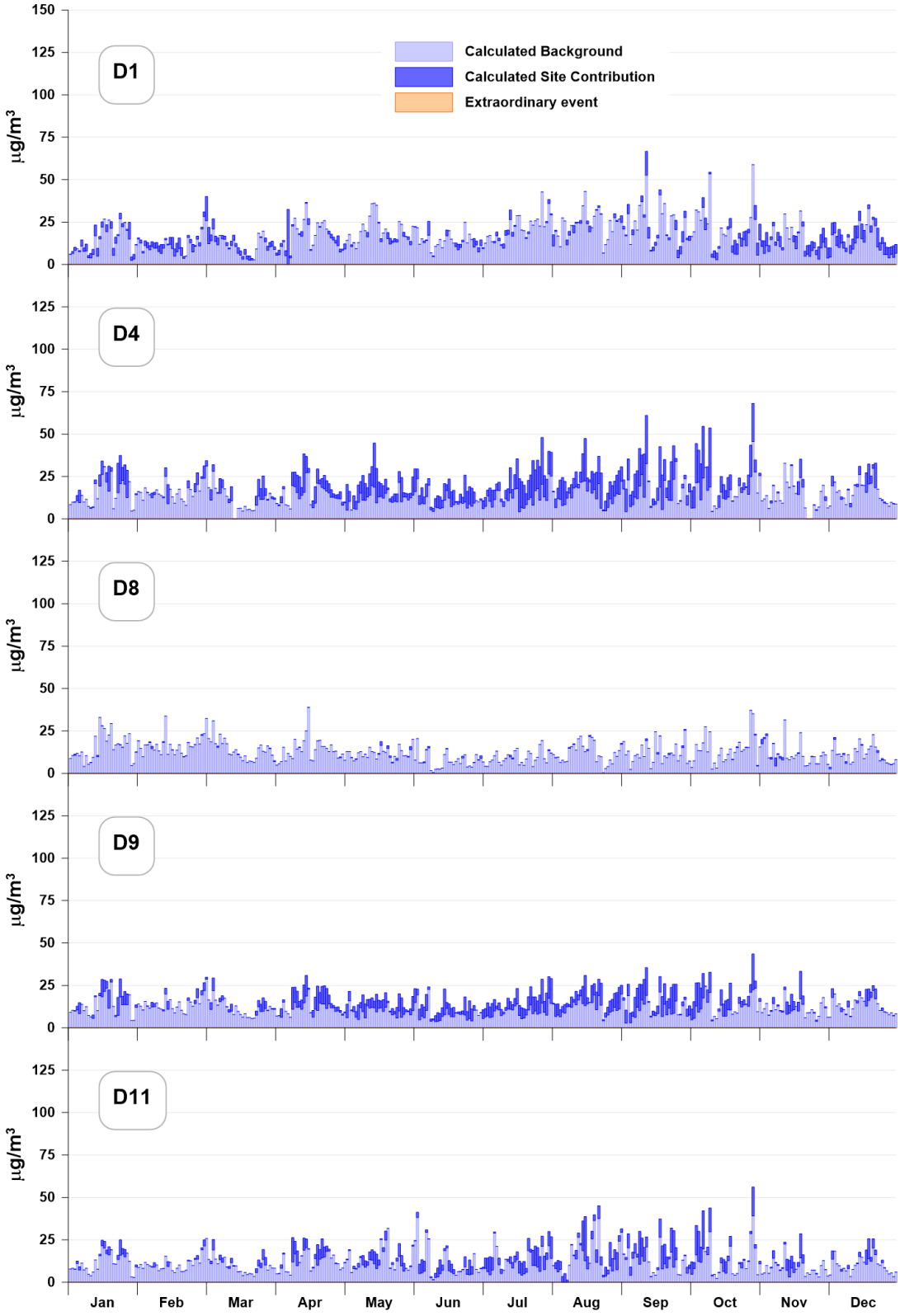


Figure 2: Measured 24-hour PM_{10} Summary 2021

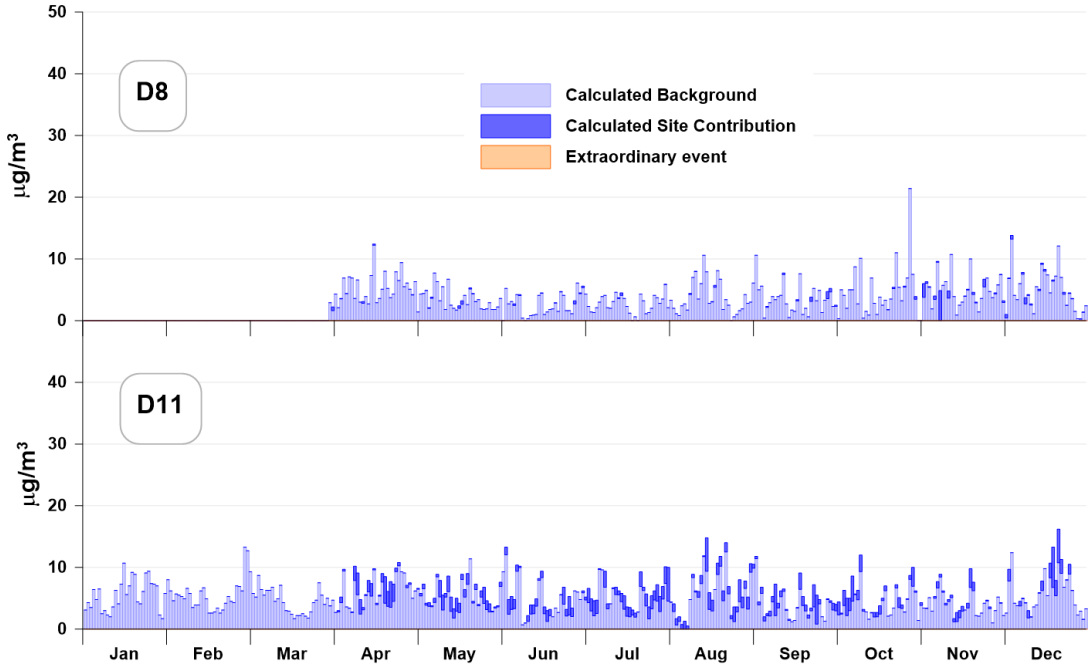


Figure 3: Measured 24-hour average $PM_{2.5}$ Summary 2021

Table 20: 2016 to 2021 HVAS TSP Comparison

HVAS Site	Location	TSP Annual Average (µg/m³)					
		2016	2017	2018	2019	2020	2021
TSP 1	Picton	53	60	59	60	42	30
TSP 2	Falbrook Road	76	73	78	76	62	57
TSP 3	Camberwell Church	62	68	80	79	67	54

ENVIRONMENT
& HEALTH

GLENCORE MOUNT OWEN / GLENDELL
HAUL ROAD CONTROL EFFICIENCY MONITORING 2021

Project name	**MGO Haul Road Control Efficiency Monitoring**
Project no.	**318001240**
Recipient	**Anthony Billings**
Document type	**Report**
Version	**2**
Date	**18/11/2021**
Prepared by	**Greer Laing**
Checked by	**Martin Parsons**
Approved by	**Fiona Robinson**
Description	**Summary of haul road dust monitoring implemented on 3 to 4 November 2021 to quantify control efficiencies as required by the MGO Air Quality and Greenhouse Gas Management Plan**

CONTENTS

1. Overview

Ramboll Australia Pty Ltd (Ramboll) was commissioned by Glencore Australia Pty Ltd (Glencore) Mt Owen/Glendell (MGO) to complete independent monitoring of fugitive haul road dust to quantify relative control efficiencies for the watering regime. MGO is located in the Hunter Valley, approximately 18 km north-northwest of Singleton and 25 km south-west of Muswellbrook, NSW.

Wheel generated dust on unsealed roads is one of the largest sources of dust from open cut mining operations (Katestone, 2011). Road management at MGO to minimise dust emissions is managed primarily through watering the road with watercarts, along with grading/gravel sheeting, construction and maintenance to reduce fine build-up, speed limits and implementation of high-capacity haul trucks to minimise traffic volumes.

This monitoring campaign was designed to measure roadside dust concentrations downwind of representative, active haul routes at each of the three pits: Glendell Barrett Pit; Mt Owen Bayswater North Pit (BNP) and North Pit. Barrett Pit and BNP are operated by Glencore and North Pit operations are contracted to Thiess Pty Ltd (Thiess). The parameter of interest for this study is particulate matter of less than 10 microns in aerodynamic diameter (PM_{10}).

MGO has committed to haul road dust emissions monitoring in their Air Quality and Greenhouse Gas Management Plan (AQGHGMP; Glencore, 2021; refer to Section 4.1). The target control efficiency is 85%. The AQGHGMP requires haul road monitoring be carried out every three years, from 30 June 2017. Monitoring was last completed by Greer Laing (formerly with Jacobs Australia Pty Ltd) in November 2018.

The objective of the monitoring is to determine the control efficiency of dust control measures and provide recommendations for improving controls (if relevant). These results will be reported in the 2021 Annual Environmental Managemental Report (AEMR) by Glencore.

2. Methodology

2.1 Monitoring locations

The objective of the monitoring campaign is to compare relative emissions between controlled and uncontrolled haul roads in the same road network under similar conditions. Monitoring was completed by Greer Laing from Ramboll on 3 and 4 November 2021.

The monitoring locations and timing was planned based on the following criteria:

- Locations selected to be representative of typical conditions and traffic volumes at the operation.
- No rainfall for a week prior to monitoring.
- Road orientated perpendicular to the prevailing wind directions.
- No watering of uncontrolled sections for at least 12 hours prior to commencement of monitoring and for the duration of the monitoring.
- Uncontrolled sections of minimum 100m in length.
- Monitoring locations to be safely accessible for working in an operating environment.

Monitoring locations for controlled and uncontrolled sections are shown in Figure 2-1, along with the location of the meteorological station used to understand rainfall and wind conditions.

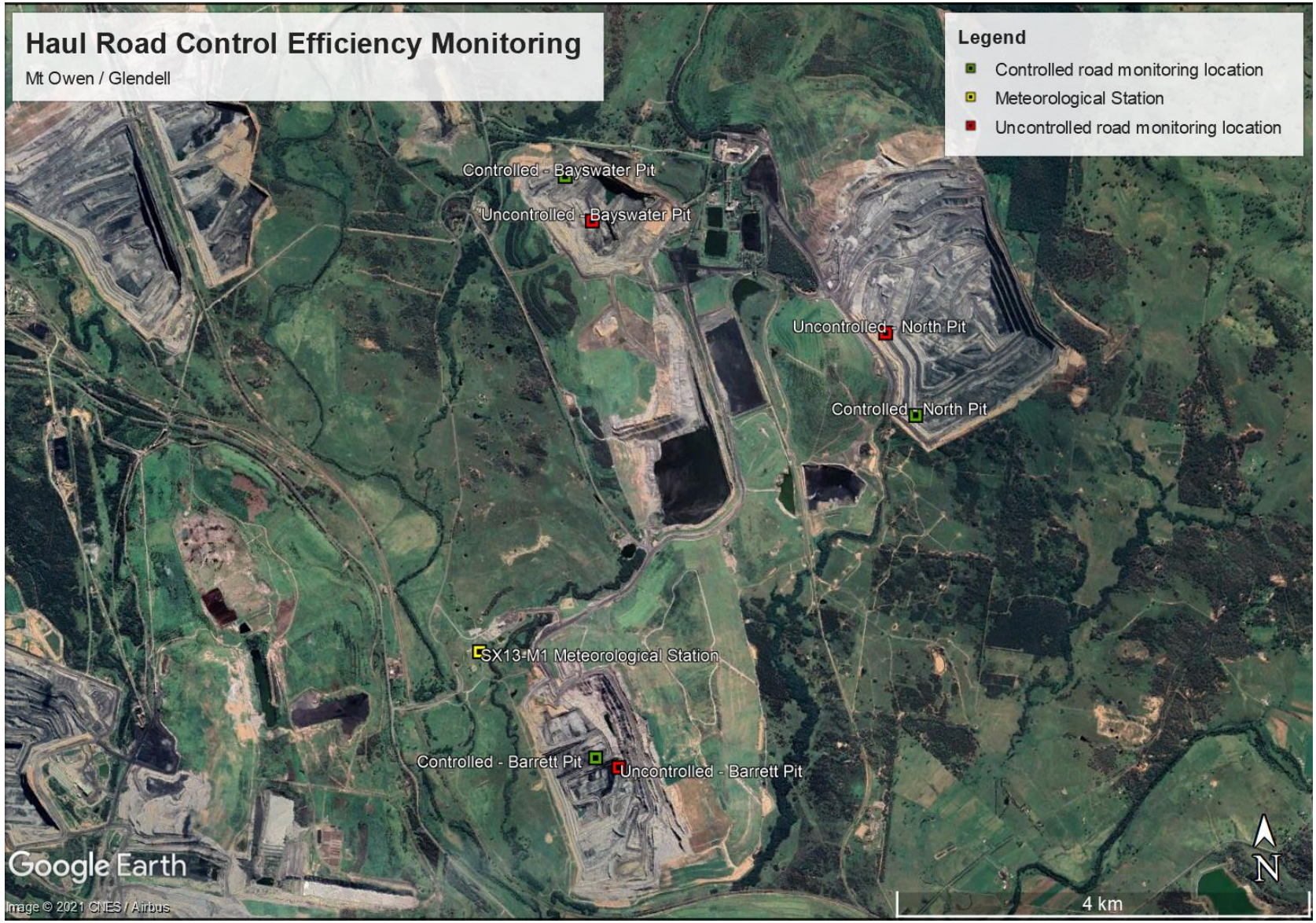


Figure 2-1: Haul road emissions monitoring locations, 3 to 4 November, 2021

2.2 Instrumentation

Dust concentrations were measured using laser photometers (TSI DustTrak 8533) configured to measure continuously at 2-second averages. The instruments were installed in enclosures with solar radiation shields and mounted on tripods with an inlet height of approximately 1.2 m above ground-level. The instruments were factory calibrated against a respirable mass standard (ISO 12103 – AI Test Dust) and zero calibrated at site prior to monitoring. Validation of instrument response was completed prior to attending site, to determine consistency between instruments.

East dataset was validated, which involved the removal of the first and last minutes of data which can be influenced by the instrument checking, installing and decommissioning process. During the Bayswater Pit monitoring campaign, operations ceased while a plant issue was resolved. Data collected during this period were excluded from the analysis as no haul trucks were running.

A summary of the locations and instruments used in the program are provided in Table 2-1. Photos of the instruments in-situ is provided in Figure 2-2.

Table 2-1: Data collected

Mine	Operator	Location	Control type	Instrument serial number	Date/time	Number of data points
Glendell	Glencore	Barrett Pit	Controlled	8533191122	3-11-21, 8:48 – 9:42	3591
			Uncontrolled	8533170303	3-11-21, 8:37 – 10:38	3364
Mt Owen	Glencore	Bayswater Pit	Controlled	8533191122	3-11-21, 11:10 – 14:12	3222
			Uncontrolled	8533170303	3-11-21, 11:17 – 14:22	3254
Mt Owen	Thiess	North Pit	Controlled	8533191122	4-11-21, 8:51 – 11:03	3640
			Uncontrolled	8533170303	4-11-21, 9:01 – 11:07	3871

2.3 Control efficiency determination

For the purposes of this assessment, the concentrations measured throughout the monitoring period were averaged for the length of the monitoring period.

Control efficiency was calculated as:

$$CE = \frac{(E\ (uncontrolled) - E\ (controlled)) * 100}{E\ (uncontrolled)}$$

Where:
CE = Control Efficiency
E = Emission rate of the activity

Controlled haul road, Barrett Pit

Uncontrolled haul road, Barrett Pit

Controlled haul road, Bayswater Pit

Uncontrolled haul road, Bayswater Pit

Controlled haul road, North Pit

Uncontrolled haul road, North Pit

Figure 2-2: Photos of each monitoring station in-situ during the monitoring campaign, 3 and 4 November 2021

3. Results

3.1 Meteorology

Site meteorological data for rainfall and wind conditions measured at SX13-M1, located to the east of the Complex between Bayswater and Barrett Pit (refer to Figure 2-1), were reviewed to understand conditions for the week prior to monitoring and during the monitoring campaign. No rain was recorded from a week prior (29 October 2021) until after the monitoring campaign was completed on 4 November 2021. Wind conditions measured on site show a prevailing south-easterly on 3 November (refer to Figure 3-1) and winds predominately from the south-east and south on 4 November (refer to Figure 3-2).

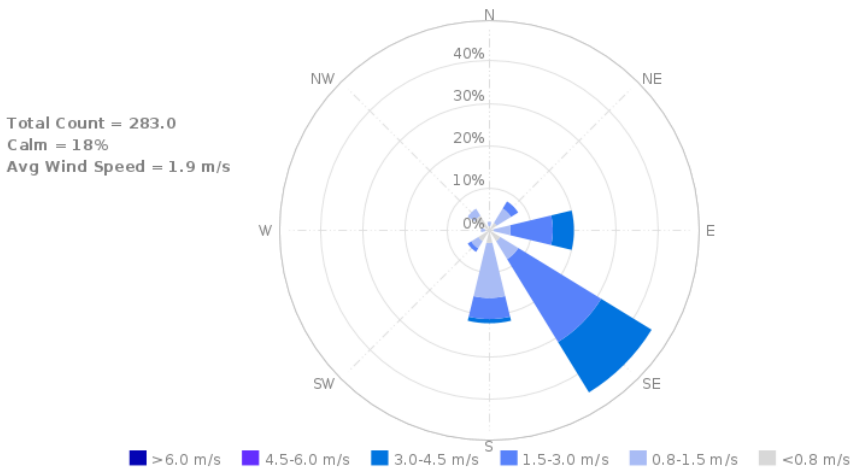


Figure 3-1: Windrose from MGO, Sentinex 13-M1, 3 November 2021

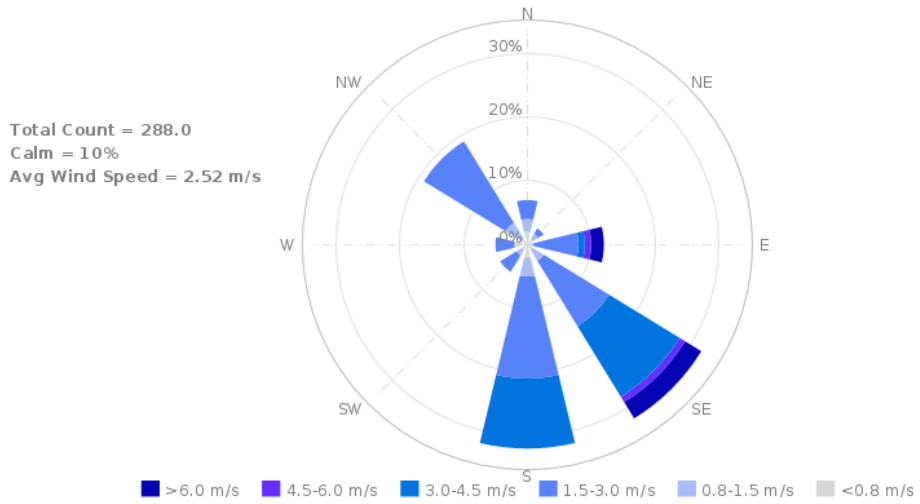


Figure 3-2: Windrose from MGO, Sentinex 13-M1, 4 November 2021

3.2 Measured concentrations and dust control efficiency

The average concentration and derived control efficiency in each location is shown in Table 3-1.

Table 3-1: Control efficiency results

Location	Controlled Road, average measured PM_{10} concentration (µg/m³)	Uncontrolled Road, average measured PM_{10} concentration (µg/m³)	Control Efficiency (%)
Barrett Pit	15.0 µg/m³	130.1 µg/m³	88%
Bayswater Pit	100.4 µg/m³	660.3 µg/m³	85%
North Pit	11.0 µg/m³	20.2 µg/m³	46% [1]

[1] 92% and 98% when North Pit controlled section compared to Barrett Pit and Bayswater Pit uncontrolled section respectively.

The derived control efficiency at North Pit was below the target control efficiency of 85%. A timeseries of the data, shown in Figure 3-3, shows evident peaks in the data likely as a result of trucks passing indicating the controlled road shows improved conditions compared to the uncontrolled road. The baseline emissions from both sections of road are reasonably consistent. On site inherent moisture in the road was observed in the shoulder of the road, while this is not typical of road left to dry for 12+ hours (see photo in Figure 2-2 for reference) and may not be representative of an uncontrolled road, Thiess confirmed the road was left unwatered overnight for the specified duration. The location of the monitoring point at North Pit may also be influenced by the high wall, where winds from the south and south-east during the monitoring period could be obstructed. If the controlled road section is compared to the uncontrolled sections from Barrett and Bayswater Pit, the control efficiency is much higher (92% and 98% respectively).

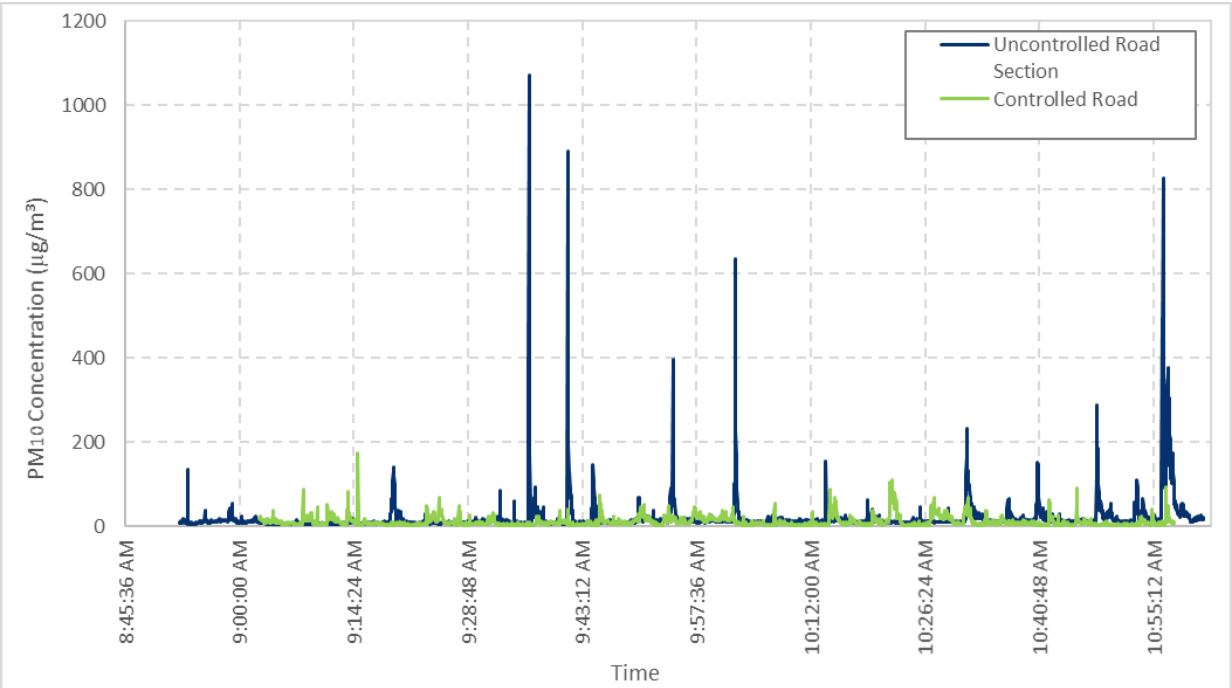


Figure 3-3: North Pit average roadside PM_{10} concentration at controlled and uncontrolled monitoring locations, 4 November 2021

4. Conclusion

The control efficiency achieved by watering haul roads during the monitoring campaign was measured at or above the target control efficiency of 85% at Barrett Pit and Bayswater Pit. The control efficiency for North Pit was below the target, calculated as 46% control. Moisture was observed in the shoulder of the uncontrolled road section at North Pit, which may suggest the road was not representative of an uncontrolled road. The highwall may have obstructed the prevailing southerly and south-easterly during the monitoring program at the North Pit location.

5. References

Katestone (2011). NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particular Matter from Coal Mining. Prepared for Office of Environment and Heritage KE1006953, June 2011.

Glencore (2021). Mt Owen / Glendell Air Quality and Greenhouse Gas Management Plan. MGOOC-1779562647-4392. Version 12, 29 September 2021.

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8 February 2022

Attention: Anthony Billings
Environment and Community Officer
Mt Owen / Glendell Operations, Glencore

Project Name: 2021 Mt Owen Glendell Operations Annual Review
Project Number: IA005400

Dear Anthony,

Review of 2021 Air Quality Monitoring Data

I have completed a review of Mt Owen's air quality monitoring data for 2021. Please see attached for the outcomes.

In summary, it has been concluded that Mt Owen Glendell Operations was in compliance with its development consents in terms of all relevant air quality indicators for data collected in 2021.

Yours sincerely

Shane Lakmaker
Principal (Air Quality)
(02) 4979 2663
shane.lakmaker@jacobs.com

1. Background

Mt Owen Pty Ltd (Mt Owen) has a network of air quality and meteorological monitoring equipment around the Mt Owen Glendell Operations (MGO) which is designed to meet relevant conditions under the development consents for Glendell Mine (DA 80/952) and Mt Owen Mine (SSD-5850).

Figure 1 shows the meteorological and air quality monitoring network. This network includes:

- Three (3) meteorological stations.
- Six (6) tapered element oscillating microbalances (TEOM) measuring PM_{10}. Compliance is determined at five locations; SX13 D1, SX13 D4, SX13 D8, SX13 D9 and SX13 D11.
- Two (2) EBAM units measuring PM_{10}. Data from these units are used for operations management.
- Two (2) tapered element oscillating microbalances (TEOM) measuring $PM_{2.5}$. Compliance is determined at SX13 D8 and SX13 D11.
- Three (3) high volume air samplers (HVAS) measuring TSP. Compliance is determined at two locations; TSP 1 and TSP 2.
- Eleven (11) dust deposition gauges. Seven of the gauges were decommissioned on 29 September 2021 as part of a consolidation process. Compliance is determined at four locations; DD12, DD14, DG4 and DG7.

A review of the air quality monitoring data collected in 2021 has been carried out. The main purpose of the review was to determine whether Mt Owen had complied with the criteria specified in the development consents (DA 80/952 and SSD-5850). Table 1 shows the relevant development consent criteria.

Table 1 Development consent criteria

Substance	Averaging time	[d] Impact assessment criteria from Glendell Consent (DA 80/952)	[d] Impact assessment criteria from Mount Owen Consent (SSD-5850 Mod 6)
Particulate matter (PM_{10})	24 hour	[b] 50 µg/m^3	[b] 50 µg/m^3
	Annual	[a] 30 µg/m^3	[a] 25 µg/m^3
Particulate matter ($PM_{2.5}$)	24 hour	Nil	[b] 25 µg/m^3
	Annual	Nil	[a] 8 µg/m^3
Particulate matter (TSP)	Annual	[a] 90 µg/m^3	[a] 90 µg/m^3
[c] Deposited dust	Annual (maximum increase)	[b] 2 g/m^2/month	[b] 2 g/m^2/month
	Annual (maximum total)	[a] 4 g/m^2/month	[a] 4 g/m^2/month

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own).
[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the Secretary.

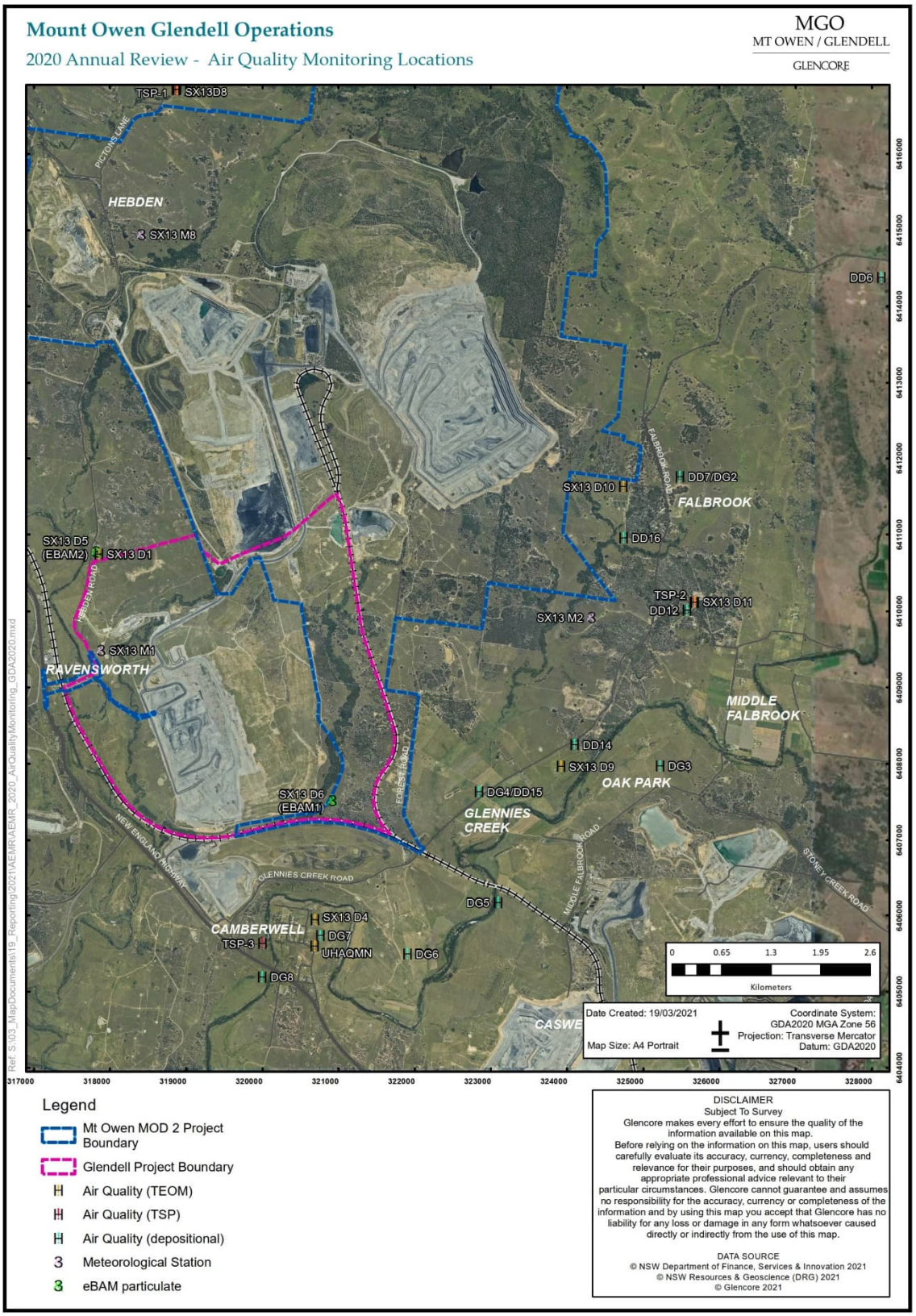


Figure 1 Location of monitoring stations around the MGO

2. Approach to Review

2.1 Extraordinary Events

Historically the Department of Planning Industry and Environment (DPIE) has identified extraordinary events that are relevant to the Hunter Valley based on the Upper Hunter Air Quality Monitoring Network as well as other factors such as bushfires and dust storms. For example, in 2020 the DPIE identified 24 days as extraordinary events. The DPIE did not identify any “extraordinary event” days in 2021.

2.2 Particulate Matter (as PM_{10})

Evaluation of PM_{10} involved:

- Obtaining hourly average PM_{10} concentration data from all monitoring sites for 2021 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from MGO weather stations for 2021 and calculating the contributions from the direction of MGO to each hourly PM_{10} concentration result.
- Summarising of all monitored PM_{10} concentration data and estimated contributions from the direction of MGO, and making comparisons to the consent criteria.

There is no standard prescribed methodology for determining contributions to air quality from mining operations. The methodology described below is based on the use of concurrent hourly meteorological and air quality monitoring data from suitably located monitoring stations around the mine sites to estimate the potential contribution from the direction of the mining operations. This method is referred to as an “upwind / downwind” calculation approach. In this context, “upwind” is a location that collects data representative of background conditions, not influenced by the source of interest, and does not necessarily need to be upwind of the source of interest.

The maximum contributions from the direction of the MGO to each measured hourly average result was calculated by first determining the wind direction ranges which represented a wind from the direction of MGO towards the monitor. Table 2 shows the wind direction ranges that represented the direction to MGO from each monitor. Calculations of contributions from both Glendell mine and Mt Owen mine had been considered however it was determined that there are some wind directions for which the individual contributions could not be calculated due to overlap in the wind direction ranges to some monitors.

Table 2 Wind directions to MGO mining activities for PM_{10} contribution calculations

Monitoring site	Directions to MGO
SX13 D1	Between 10 and 170 degrees from true north
SX13 D4	Between 310 and 40 degrees from true north
SX13 D8	Between 30 and 110 degrees from true north
SX13 D9	Between 250 and 360 degrees from true north
SX13 D11	Between 240 and 330 degrees from true north

The potential contribution from the direction of MGO to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a

"monitor" concentration minus "background" concentration calculation. Table 3 shows the data representing "monitor" and "background" conditions for each monitoring site. The "monitor" concentration minus "background" concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 3 Data for monitor and background PM_{10} calculations

Monitoring site	Data representing "background" conditions
SX13 D1	SX13 D11
SX13 D4	SX13 D8
SX13 D8	SX13 D9
SX13 D9	SX13 D8
SX13 D11	SX13 D8

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.3 Particulate Matter (as $PM_{2.5}$)

Evaluation of $PM_{2.5}$ involved:

- Obtaining hourly average $PM_{2.5}$ concentration data from all monitoring sites for 2021 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from MGO weather stations for 2021 and calculating the contributions from the direction of MGO to each hourly $PM_{2.5}$ concentration result.
- Summarising of all monitored $PM_{2.5}$ concentration data and estimated contributions from the direction of MGO, and making comparisons to the consent criteria.

The maximum contributions from the direction of the MGO to each measured hourly average result was calculated in the same manner as for the calculated PM_{10} contributions, as described in Section 2.2. Table 4 shows the wind direction ranges that represented the direction to MGO from each monitor.

Table 4 Wind directions to MGO mining activities for $PM_{2.5}$ contribution calculations

Monitoring site	Directions to MGO
SX13 D8	Between 30 and 110 degrees from true north
SX13 D11	Between 240 and 330 degrees from true north

The potential contribution from the direction of MGO to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a "monitor" concentration minus "background" concentration calculation. Table 5 shows the data representing "monitor" and "background" conditions for each monitoring site. The "monitor" concentration minus "background" concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 5 Data for monitor and background $PM_{2.5}$ calculations

Monitoring site	Data representing "background" conditions
SX13 D8	SX13 D11
SX13 D11	SX13 D8

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.4 Particulate Matter (as TSP)

Evaluation of TSP involved:

- Obtaining six day records of TSP concentration data from all monitoring sites for 2021 and calculating annual averages.
- Obtaining hourly meteorological data from MGO weather stations for 2021 and calculating the frequency of winds towards each monitor to determine potential maximum contributions from the direction of MGO to each TSP concentration result.
- Summarising of all monitored TSP concentration data and estimated contributions from the direction of MGO, and making comparisons to the consent criteria.

In accordance with AS 3580.9.10, there is only one measurement of TSP concentration every six days, from each monitor. Consequently, it is not possible to determine whether a daily average was being influenced by a single source over a few hours, multiple sources over the entire day, or some other combination. This complicates the process for isolating and determining contributions from a source of interest, such as MGO. In addition, there is no standard prescribed methodology for determining site contributions to air quality for mining operations, so an estimation technique had to be adopted.

The contribution of MGO mining activities to each measured result was calculated by first determining the wind direction ranges which represent a wind direction from the operation towards each monitor. Table 6 shows the wind direction ranges that represented the direction to MGO from each monitor.

Table 6 Wind directions to MGO mining activities for TSP contribution calculations

Monitoring site	Directions to MGO
TSP 1	Between 30 and 110 degrees from true north
TSP 2	Between 240 and 330 degrees from true north
TSP 3	Between 330 and 40 degrees from true north

The potential site contribution to each monitor was then calculated by multiplying the annual average TSP concentration by the percentage of time that winds were in the direction of that monitor. This calculation assumes that MGO was contributing to the measurements at all times when the wind was in the direction of the monitor, which may not necessarily be the case.

2.5 Deposited Dust

Evaluation of deposited dust involved:

- Obtaining monthly dust deposition data from all monitoring sites for 2021 and calculating annual averages.
- Obtaining hourly meteorological data from the MGO weather stations for 2021 and calculating the frequency of winds towards each dust monitor to determine potential maximum contributions from the direction of MGO to each dust deposition result.
- Summarising of all monitored dust deposition data and estimated contributions from the direction of MGO, and making comparisons to the consent criteria.

In accordance with AS 5380.10-1, there is only one measurement of dust deposition each month, from each monitor. Consequently, it is not possible to determine whether a monthly measurement was being influenced by a single source over a few days, multiple sources over the entire month, or some other combination. This complicates the process for isolating and determining contributions from a source of interest, such as the MGO. In addition, there is no standard prescribed methodology for determining site contributions to air quality for mining operations, so an estimation technique had to be adopted.

The contribution from the direction of MGO activities to each measured result was calculated by first determining the wind direction ranges which represent a wind direction from the operation towards each monitor. Table 7 shows the wind direction ranges that represented the direction to the MGO from each monitor.

Table 7 Wind directions to MGO mining activities for deposited dust contribution calculations

Monitoring site	Directions to Mt Owen Complex
DD6*	Between 230 and 280 degrees from true north
DD7/DG2*	Between 230 and 320 degrees from true north
DD12	Between 240 and 330 degrees from true north
DD14	Between 250 and 360 degrees from true north
DD16*	Between 230 and 340 degrees from true north
DG3*	Between 260 and 340 degrees from true north
DD15/DG4	Between 260 and 10 degrees from true north
DG5*	Between 280 and 10 degrees from true north
DG6*	Between 300 and 30 degrees from true north
DG7	Between 310 and 40 degrees from true north
DG8*	Between 330 and 40 degrees from true north

* Decommissioned on 29 September 2021 as part of a consolidation process. Final samples taken in mid-October 2021.

The potential site contribution to each monitor was then calculated by multiplying the annual average dust deposition by the percentage of time that winds were in the direction of that monitor. This calculation assumes that the MGO was contributing to the measurements at all times when the wind was in the direction of the monitor, which may not necessarily be the case.

3. Monitored Results

3.1 Meteorology

Meteorological conditions are important for determining the transport of emissions, and the potential influences on air quality. Rainfall can influence air quality conditions, particularly dust. The Bureau of Meteorology collects rainfall information at many location across Australia and recent data from two nearby monitoring locations are shown in Figure 2 as well as the data collected at MGO. Rainfall was well below the long-term average (688 mm) in 2017, 2018 and 2019, coinciding with drought, but exceeded the long term average in 2020 and 2021.

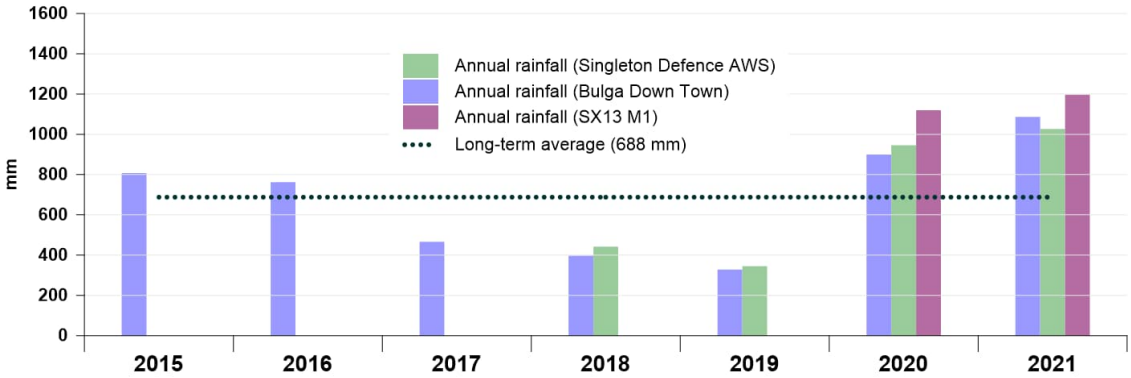


Figure 2 Annual rainfall from the Bureau of Meteorology

MGO operates three meteorological stations, referred to as SX13 M1, SX13 M2 and SX13 M8, and wind-roses have been prepared to summarise the data collected in 2021. The wind-roses (Figure 3) show the frequency of wind speeds and wind directions based on hourly records for each location. The circular format of the wind rose shows the direction from which the wind blew and the length of each "spoke" around the circle shows how often the wind blew from that direction. The different colours of each spoke provide details on the speed of the wind from each direction.

It can be seen from Figure 3 that winds in 2021 were from the southeast and northwest. This pattern of winds is common for many parts of the Hunter Valley and reflects the northwest-southeast alignment of the valley. Wind patterns were similar at all three locations.

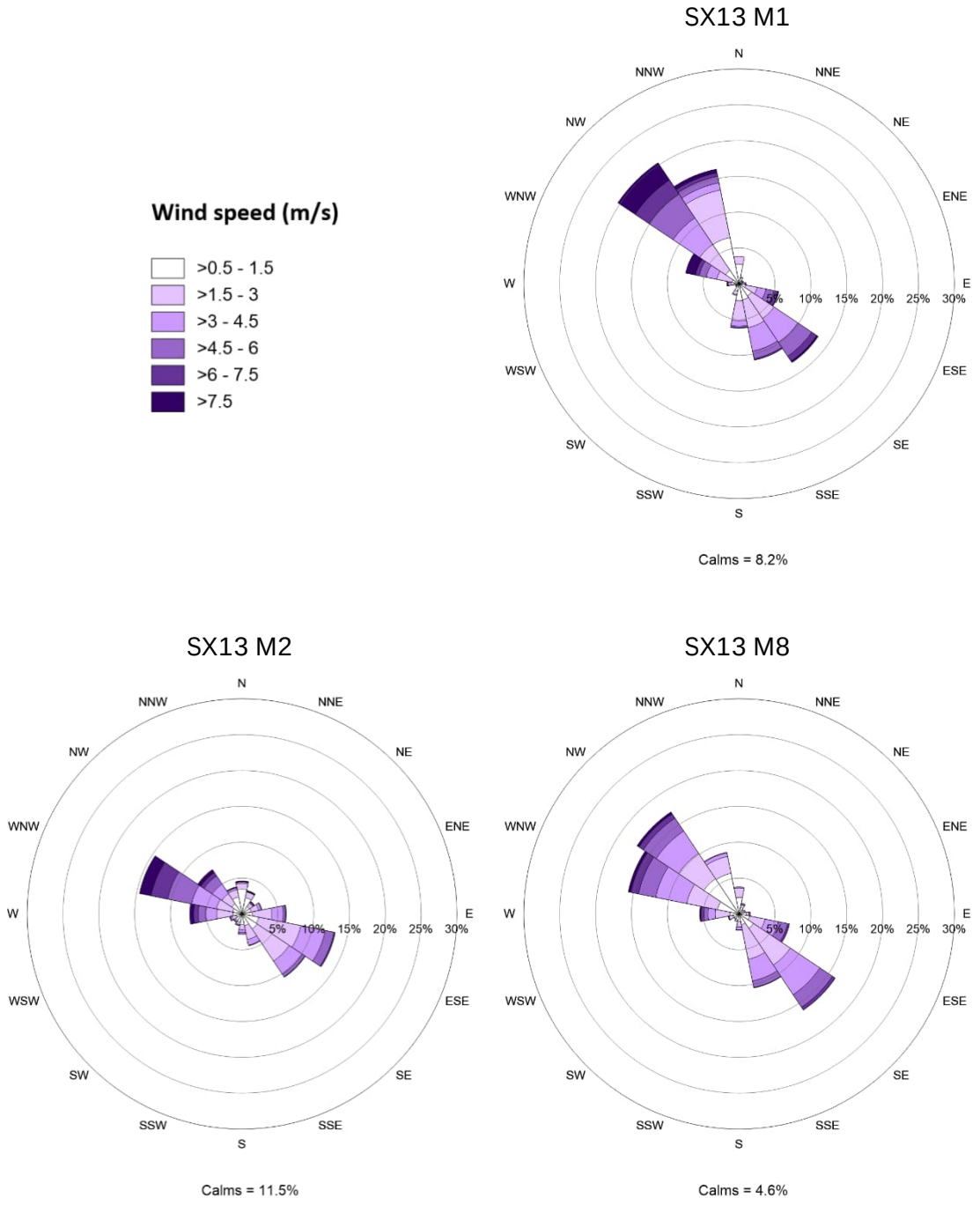


Figure 3 Annual wind-roses from data collected in 2021 at MGO meteorological stations

3.2 Particulate Matter (as PM_{10})

Figure 4 shows the measured 24-hour average PM_{10} concentrations in 2021 from data collected at each compliance monitoring site. The calculated contributions from the direction of MGO to each monitoring location have been identified as per the methodology described in Section 2). The contribution from the direction of MGO is reported in order to assess compliance as the 24-hour average PM_{10} criteria from DA 80/952 and SSD-5850 relate to an "incremental impact".

Table 8 summarises the measured PM_{10} concentrations. The results have been calculated without extraordinary events (although it is noted that no extraordinary events were identified in 2021). The data in Table 8 show that the PM_{10} concentrations at all five monitors (bold text) were below the 24-hour and annual average criteria. Consequently the monitoring demonstrates compliance with DA 80/952 and SSD-5850 in terms of particulate matter as PM_{10}.

Table 8 Summary of PM_{10} concentrations from MGO monitors in 2021

Statistic	SX13 D1	SX13 D4	SX13 D8	SX13 D9	SX13 D11	Criterion
Maximum 24-hour average in µg/m^3						
Measurement (all data)	66.7	68.1	39.0	43.5	56.2	NA
Measurement (without extraordinary events)	66.7	68.1	39.0	43.5	56.2	NA
Calculated maximum contribution from direction of MGO (without extraordinary events)	32.4	34.8	4.8	21.0	26.0	50 (SSD-5850) 50 (DA 80/952)
Annual average in µg/m^3						
Measurement (all data)	18.5	19.8	12.5	15.4	14.1	NA
Measurement (without extraordinary events)	18.5	19.8	12.5	15.4	14.1	25 (SSD-5850) 30 (DA 80/952)
Calculated contribution from direction of MGO (without extraordinary events)	2.4	5.9	0.2	4.2	3.0	NA

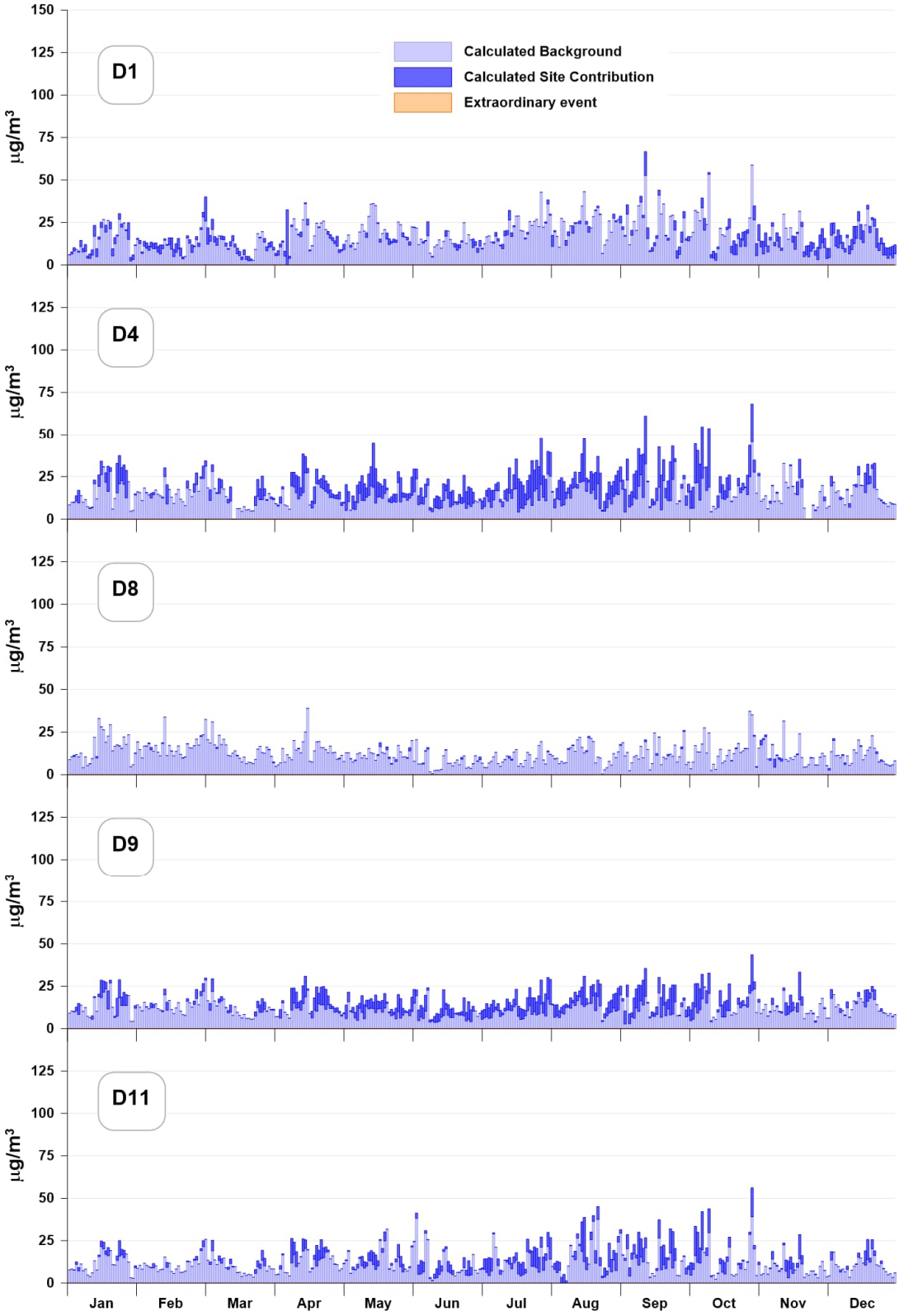


Figure 4 Measured 24-hour average PM_{10} concentrations at MGO monitoring sites in 2021

3.3 Particulate Matter (as $PM_{2.5}$)

Figure 5 shows the measured 24-hour average $PM_{2.5}$ concentrations in 2021 from data collected at each compliance monitoring site. The calculated contribution from the direction of MGO to each monitoring location is also shown as per the methodology described in Section 2. The contribution from the direction of MGO is reported in order to assess compliance as the 24-hour average $PM_{2.5}$ criteria from SSD-5850 relate to an "incremental impact".

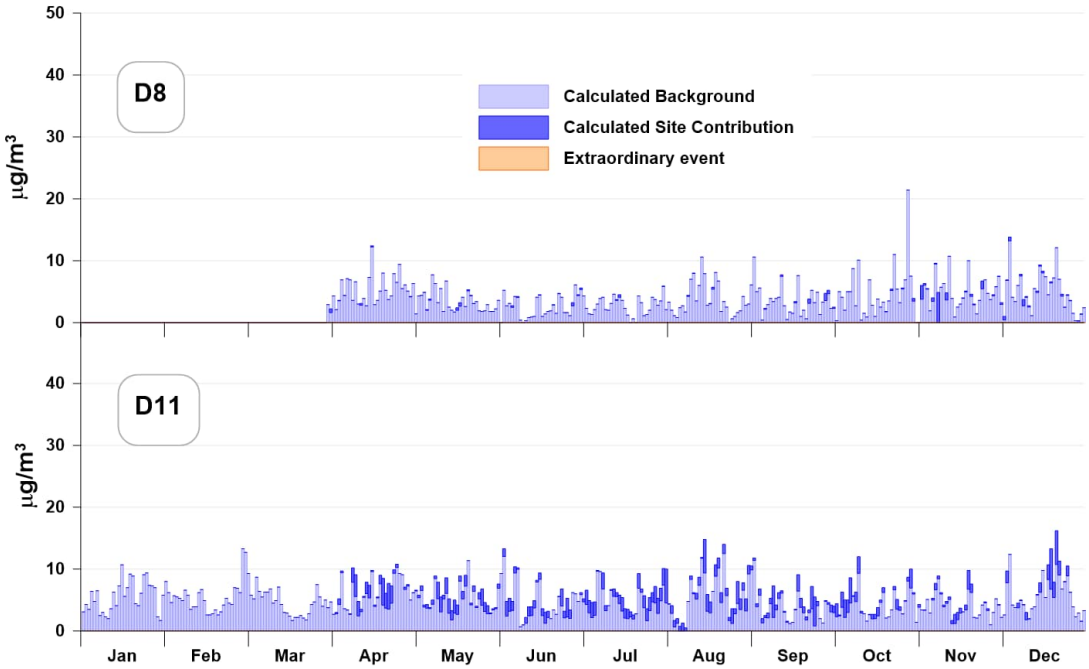


Figure 5 Measured 24-hour average $PM_{2.5}$ concentrations at MGO monitoring sites in 2021

Table 9 summarises the measured $PM_{2.5}$ concentrations. The data in Table 9 show that the $PM_{2.5}$ concentrations were below the 24-hour and annual average criteria. Consequently the monitoring demonstrates compliance with SSD-5850 in terms of particulate matter as $PM_{2.5}$.

Table 9 Summary of $PM_{2.5}$ concentrations from MGO monitors in 2021

Statistic	SX13 D8	SX13 D11	Criterion
Maximum 24-hour average in µg/m³			
Measurement (all data)	21.4	16.2	NA
Measurement (without extraordinary events)	21.4	16.2	NA
Calculated maximum contribution from direction of MGO (without extraordinary events)	4.9	6.6	25 (SSD-5850)
Annual average in µg/m³			
Measurement (all data)	4.0	5.5	NA
Measurement (without extraordinary events)	4.0	5.5	8 (SSD-5850)
Calculated contribution from direction of MGO (without extraordinary events)	0.1	0.8	NA

3.4 Particulate Matter (as TSP)

Table 10 shows the measured annual average TSP concentrations from each monitor for data collected in 2021. Annual averages have been calculated without extraordinary events for comparison with the development consent criteria. The data show that, without extraordinary events, the TSP concentrations at TSP 1, TSP 2 and TSP 3 were below 90 µg/m^3. Consequently the monitoring demonstrates compliance with the development consent in terms of particulate matter as TSP.

Table 10 Summary of TSP concentrations from MGO monitors in 2021

Statistic	TSP 1	TSP 2	TSP 3	Criterion
Annual average in µg/m^3				
Measurement (all data)	30	57	57	NA
Measurement (without extraordinary events)	30	57	57	90 (SSD-5850) 90 (DA 80/952)

Table 11 shows the calculated site contributions to each monitor as per the methodology described in Section 2.

Table 11 Estimated contributions of MGO to measured TSP concentrations

Parameter	TSP 1	TSP 2	TSP 3	Criterion
Lower bound of wind from MGO to monitor (degrees)	30	240	330	-
Upper bound of wind from MGO to monitor (degrees)	110	330	40	-
Percentage of time that wind was from MGO towards monitor (%)	4	35	20	-
Annual average TSP concentration (µg/m^3)	30	57	57	90 (SSD-5850) 90 (DA 80/952)
Estimated MGO contribution to annual average TSP (µg/m^3)	1	20	11	-

The calculations from Table 11 show that the MGO was estimated to have contributed up to 1 µg/m^3 to the measured 30 µg/m^3 at TSP 1, up to 20 µg/m^3 to the measured 57 µg/m^3 at TSP 2, and up to 11 µg/m^3 to the measured 57 µg/m^3 at TSP 3. The higher potential contribution at TSP 2 would be expected since this monitor was located downwind of the MGO for a higher proportion of the year. There are no specific criteria for which to assess a calculated site contribution.

3.5 Deposited Dust

Table 12 shows the measured annual average deposited dust levels from each monitor for data collected in 2021. Seven of the gauges were decommissioned on 29 September 2021 as part of a consolidation process and the final samples were taken in mid-October 2021. Consequently

the data from these gauges did not represent a full year and are not compared to the consent criteria. The annual averages presented in Table 12 excluded monthly results marked as contaminated by the monitoring contractor but did not exclude periods of extraordinary events as per the provisions of the development consents. The deposited dust levels from all monitors measuring for the 12 month period were below 4 g/m^2/month.

Table 12 Summary of deposited dust levels from MGO monitors in 2021

Statistic	g/m^2/month											
	DD6*	DD7/DG2*	DD12	DD14	DD16*	DG3*	DD15/DG4	DG5*	DG6*	DG7	DG8*	Criterion
Annual average	0.9	2.6	3.1	1.5	5.0	1.4	2.3	1.9	1.5	1.7	3.4	4

* Decommissioned on 29 September 2021 as part of a consolidation process. Final samples taken in mid-October 2021.

Table 13 shows the calculated site contributions to each monitor as per the methodology described in Section 2. The calculations show that MGO did not exceed the “incremental impact” criteria from the development consent (that is, 2 g/m^2/month).

Table 13 Estimated contributions of MGO to measured deposited dust

Parameter	DD6*	DD7/DG2*	DD12	DD14	DD16*	DG3*	DD15/DG4	DG5*	DG6*	DG7	DG8*	Criterion
Lower bound of wind from MGO to monitor (degrees)	230	230	240	250	230	260	260	280	300	310	330	-
Upper bound of wind from MGO to monitor (degrees)	280	320	330	360	340	340	10	10	30	40	40	-
Percentage of time that wind was from MGO towards monitor (%)	3	25	35	52	43	42	53	51	46	40	20	-
Annual average dust deposition (g/m^2/month)	0.9	2.6	3.1	1.5	5.0	1.4	2.3	1.9	1.5	1.7	3.4	4
Estimated MGO contribution to annual average (g/m^2/month)	0.0	0.7	1.1	0.8	2.2	0.6	1.2	1.0	0.7	0.7	0.7	2

* Decommissioned on 29 September 2021 as part of a consolidation process. Final samples taken in mid-October 2021.

4. Conclusion

Based on the analysis and it has been concluded that MGO was in compliance with its development consents (DA 80/952 and SSD-5850) in terms of air quality impacts at all reportable monitoring sites for data collected in 2021.

APPENDIX G – Water

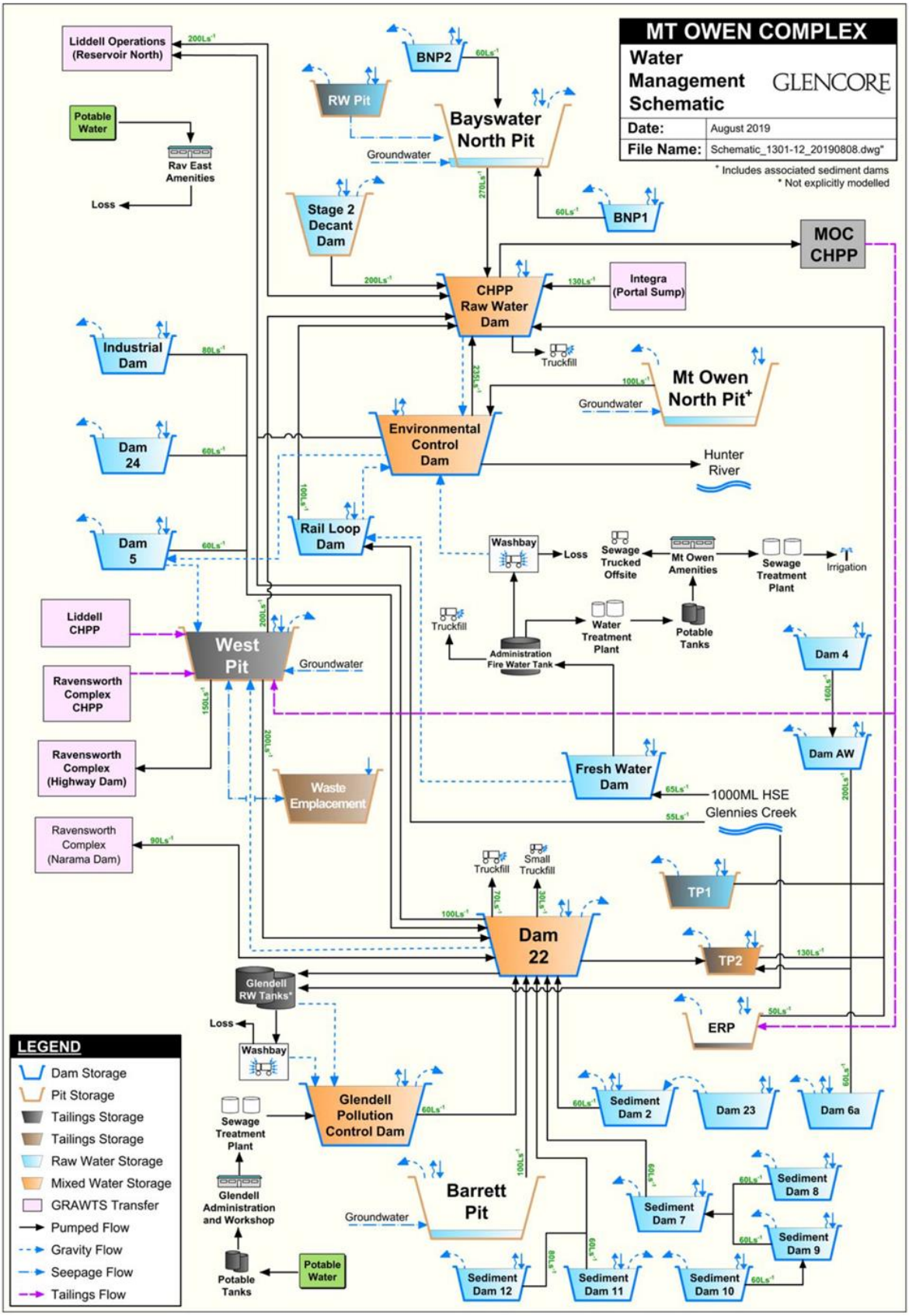


Figure 4: MGO Water Schematic

Surface Water

Table 21: 2021 Surface Water Monitoring Results – Bowmans Creek.

Sampling Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
BMC1 – Bowmans Creek Upstream				
21/01/2021	7.60	827	16	529
18/02/2021	7.91	495	28	291
31/03/2021	7.83	605	16	347
22/04/2021	7.98	834	<5	460
26/05/2021	8.01	876	11	465
18/06/2021	7.88	832	<5	462
15/07/2021	7.97	1,900	<5	1,060
17/08/2021	7.84	910	5	558
17/09/2021	7.98	900	<5	466
18/10/2021	7.99	907	<5	511
17/11/2021	7.91	947	<5	567
17/12/2021	7.96	574	5	440
BMC2 – Bowmans Creek Downstream				
21/01/2021	7.60	826	16	534
18/02/2021	7.92	500	13	306
31/03/2021	7.81	586	18	346
22/04/2021	7.97	833	<5	464
26/05/2021	8.06	878	<5	470
18/06/2021	7.89	853	6	468
15/07/2021	7.88	889	<5	484
17/08/2021	7.99	944	8	551
17/09/2021	7.92	904	<5	487
18/10/2021	7.97	918	<5	508
17/11/2021	7.83	648	7	393
17/12/2021	7.89	532	9	384
BMC3 – Bowmans Creek Downstream				
21/01/2021	7.70	822	16	516
18/02/2021	7.96	515	24	306
31/03/2021	7.81	589	14	355
22/04/2021	7.96	832	<5	448
26/05/2021	7.96	880	<5	477
18/06/2021	7.97	862	6	474
15/07/2021	8.08	884	<5	492
17/08/2021	8.15	922	8	546
17/09/2021	8.00	921	<5	482
18/10/2021	8.05	917	<5	507
17/11/2021	7.87	646	6	392
17/12/2021	8.02	525	8	365

BMC4 – Bowmans Creek (Hebden Road)				
21/01/2021	7.50	857	10	544
18/02/2021	7.96	591	29	337
29/03/2021	7.81	565	13	333
22/04/2021	7.77	872	<5	466
26/05/2021	7.75	921	<5	505
18/06/2021	7.87	893	<5	494
15/07/2021	7.82	938	<5	527
17/08/2021	7.54	993	7	610
17/09/2021	7.90	1,030	<5	526
18/10/2021	7.82	989	<5	550
17/11/2021	7.85	664	6	385
17/12/2021	7.87	561	8	394
BMC5 – Bowmans Creek NEH Bridge				
07/01/2021	7.70	466	10	332
08/02/2021	7.66	719	24	412
08/03/2021	7.66	920	6	521
12/04/2021	7.13	1,040	9	608
12/05/2021	7.75	877	<5	514
17/06/2021	7.80	930	<5	525
14/07/2021	7.82	910	<5	534
11/08/2021	7.58	1,010	<5	562
07/09/2021	7.54	1,070	<5	577
07/10/2021	7.63	1,090	<5	588
25/11/2021	7.80	393	22	257
17/12/2021	7.78	561	8	394

Table 22: 2021 Surface Water Monitoring Results – Yorks Creek

Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
YC1 – Yorks Creek Upstream				
21/01/2021	Water level too low to sample.			
22/02/2021	7.46	665	<5	485
25/03/2021	7.20	246	18	216
22/04/2021	7.65	356	<5	234
26/05/2021	7.62	347	<5	207
22/06/2021	6.89	3,070	<5	1,940
15/07/2021	Water level too low to sample.			
15/07/2021	6.78	3,410	<5	2,050
17/08/2021	Dry			
17/09/2021	Dry			
18/10/2021	7.16	4,270	<5	2,520
17/11/2021	7.05	1700	6	1050
17/12/2021	7.53	714	<5	500

YC2 – Yorks Creek Midstream				
21/01/2021	7.10	1,083	17	710
22/02/2021	7.39	609	<5	475
29/03/2021	7.34	395	<5	273
22/04/2021	7.62	351	<5	228
26/05/2021	7.62	347	<5	205
22/06/2021	7.62	347	<5	219
15/07/2021	7.57	449	<5	267
17/08/2021	7.59	490	<5	303
17/09/2021	7.57	611	<5	317
18/10/2021	7.51	622	11	486
17/11/2021	6.86	896	5	617
17/12/2021	7.53	425	<5	343
YC3 – Yorks Creek Downstream				
21/01/2021	7.30	923	7	614
22/02/2021	7.35	745	16	574
29/03/2021	7.52	971	7	607
22/04/2021	Water level too low to sample.			
26/05/2021	Water level too low to sample.			
18/06/2021	7.74	757	<5	475
15/07/2021	7.77	1,170	<5	691
17/08/2021	7.44	1,440	8	930
17/09/2021	Water level too low to sample.			
18/10/2021	Dry.			
17/11/2021	7.37	1,580	<5	956
17/12/2021	7.62	855	<5	554

Table 23: 2021 Surface Water Monitoring Result – Swamp Creek

Sampling Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
SC1 – Swamp Creek Upstream (Dam 5)				
21/01/2021	9.30	582	7	335
22/02/2021	9.30	586	13	343
25/03/2021	7.43	408	15	261
22/04/2021	7.41	374	10	257
26/05/2021	7.34	390	6	236
22/06/2021	7.58	393	<5	254
15/07/2021	7.63	395	<5	251
17/08/2021	7.64	385	6	269
17/09/2021	7.85	423	<5	250
18/10/2021	8.06	411	<5	266
17/11/2021	7.93	372	<5	266
17/12/2021	7.42	228	10	214

SC2 - Swamp Creek Midstream (Dam 1)				
21/01/2021	7.00	254	39	313
22/02/2021	7.73	232	56	336
25/03/2021	6.82	125	63	194
22/04/2021	7.34	272	5	212
26/05/2021	7.32	293	13	193
22/06/2021	7.54	301	10	213
15/07/2021	7.54	310	9	190
17/08/2021	7.69	319	15	230
17/09/2021	7.79	368	10	194
18/10/2021	7.95	386	8	260
17/11/2021	7.22	133	34	236
17/12/2021	7.21	217	11	156
SC3 – Swamp Creek Downstream				
21/01/2021	Water level too low to sample.			
22/02/2021	Dry.			
29/03/2021	Dry.			
22/04/2021	Dry.			
26/05/2021	Dry.			
18/06/2021	Dry.			
15/07/2021	Dry.			
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	Dry.			
17/12/2021	Dry.			
SC4 – Swamp Creek Prior to Ashton				
21/01/2021	Dry.			
22/02/2021	Dry.			
29/03/2021	6.72	276	19	231
22/04/2021	Water level too low to sample.			
26/05/2021	Water level too low to sample.			
18/06/2021	Dry.			
15/07/2021	Dry.			
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	6.68	195	18	226
17/12/2021	7.06	280	18	282

Table 24: 2021 Surface Water Monitoring Results – Bettys Creek.

Sampling Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
BC1 – Bettys Creek Upstream				
21/01/2021	Dry.			
22/02/2021	Dry.			
25/03/2021	7.51	375	6	277
22/04/2021	7.36	633	<5	380
26/05/2021	Water level too low to sample.			
22/06/2021	Water level too low to sample.			
15/07/2021	Water level too low to sample.			
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	7.19	469	7	358
17/12/2021	7.48	525	<5	416
BC2 – Bettys Creek Downstream				
21/01/2021	Water level too low to sample.			
22/02/2021	7.44	202	21	218
29/03/2021	7.21	250	16	187
22/04/2021	Water level too low to sample.			
26/05/2021	Water level too low to sample.			
18/06/2021	Water level too low to sample.			
15/07/2021	Water level too low to sample.			
17/08/2021	Dry.			
17/09/2021	Water level too low to sample.			
18/10/2021	Dry.			
17/11/2021	7.64	167	17	175
17/12/2021	7.32	214	17	186
BC3 – Bettys Creek Prior to Ashton				
21/01/2021	6.80	269	15	280
22/02/2021	6.92	218	32	237
29/03/2021	6.98	637	11	423
22/04/2021	Water level too low to sample.			
26/05/2021	Water level too low to sample.			
18/06/2021	7.59	2,880	12	1,970
15/07/2021	7.69	2,800	<5	1,850
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	6.86	245	29	280
17/12/2021	7.81	2,760	10	2,020

BC4 – Bettys Creek 4				
21/01/2021	6.60	270	101	246
22/02/2021	6.94	333	11	289
29/03/2021	7.55	2,500	37	1,650
22/04/2021	7.82	4,560	9	3,030
26/05/2021	7.89	4,200	116	2,930
18/06/2021	7.70	2,540	12	1,660
15/07/2021	7.75	2,750	<5	1,820
17/08/2021	Water level too low to sample.			
17/09/2021	Dry.			
18/10/2021	7.24	1,070	9	684
17/11/2021	6.98	210	6	248
17/12/2021	7.49	1,250	7	908

Table 25: 2021 Surface Water Monitoring Results – Main Creek.

Sampling Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
MC1 – Main Creek Upstream				
21/01/2021	Water level too low to sample.			
23/02/2021	6.82	377	32	436
25/03/2021	7.00	324	10	277
22/04/2021	7.97	618	33	390
26/05/2021	Water level too low to sample.			
29/06/2021	6.52	828	<5	520
15/07/2021	6.82	795	14	480
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	6.87	444	14	328
17/12/2021	7.21	371	16	355
MC2 – Main Creek Downstream				
21/01/2021	7.00	373	14	311
23/02/2021	7.19	445	18	512
25/03/2021	7.30	320	18	297
22/04/2021	7.50	968	9	562
26/05/2021	7.64	855	20	497
29/06/2021	Dry.			
15/07/2021	Dry.			
17/08/2021	Dry.			
17/09/2021	Dry.			
18/10/2021	Dry.			
17/11/2021	7.18	489	6	400
17/12/2021	7.37	562	11	414
MC3 – Main Creek Upstream				
21/01/2021	6.80	385	27	310
23/02/2021	7.08	434	17	321
25/03/2021	7.15	411	17	314
22/04/2021	7.29	1,480	<5	825
26/05/2021	7.29	1,520	<5	837
29/06/2021	7.30	1,320	<5	782
15/07/2021	7.51	803	<5	441
17/08/2021	7.38	1,310	10	763
17/09/2021	7.42	1,200	8	595
18/10/2021	7.33	695	13	407
17/11/2021	6.87	650	<5	452
17/12/2021	7.21	812	10	586

Table 26: 2021 Surface Water Monitoring Results – Glennies Creek.

Sampling Date	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
GC2 – Nobles Crossing				
11/01/2021	7.78	538	-	-
08/02/2021	7.75	485	14	296
09/03/2021	7.70	567	14	-
09/04/2021	7.80	286	52	-
10/05/2021	8.00	792	<5	-
08/06/2021	7.97	720	<5	-
15/07/2021	8.00	748	<5	-
03/08/2021	7.90	759	<5	-
06/09/2021	7.94	845	<5	-
11/10/2021	7.74	800	10	-
16/11/2021	7.66	550	10	317
15/12/2021	7.75	462	9	-
GC3 – Glennies Creek				
11/01/2021	7.67	548	16	318
08/02/2021	Unable to access site due to wet conditions.			
09/03/2021	7.66	559	41	304
09/04/2021	7.77	350	20	214
10/05/2021	7.98	793	8	402
08/06/2021	7.90	727	12	390
15/07/2021	8.09	751	<5	427
03/08/2021	7.94	761	5	428
06/09/2021	8.01	868	<5	478
11/10/2021	7.81	823	10	455
16/11/2021	7.55	554	6	307
15/12/2021	7.66	450	22	305

Table 27: MGO Summary Surface Water Monitoring Results

Site	pH			EC (µS/cm)			TSS (mg/L)			Data Capture (%)	Comment
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg		
BMC1	7.6	8.01	7.9	495	1,900	912.09	<5	28	9.64	100%	Samples collected under slow/steady/moderate flow conditions.
BMC2	7.6	8.06	7.89	500	944	798.09	<5	18	8.45	100%	Samples collected under slow/steady/moderate flow conditions.
BMC3	7.7	8.15	7.96	515	922	799.09	<5	24	9	100%	Samples collected under slow/steady/moderate flow conditions.
BMC4	7.5	7.96	7.78	565	1,030	846.64	<5	29	8.64	100%	Samples collected under no flow conditions in April, August, and October.
BMC5	7.13	7.82	7.64	393	1,090	856.82	<5	24	9.18	100%	Samples collected under slow/steady/fast conditions.
YC1	6.78	7.65	7.25	246	4,270	1,766.29	<5	18	6.86	100%	No water samples were collected in January or July due to low water levels. No water samples were collected in August or September as the sample site was too dry. Samples collected under no flow conditions in June and from October to December.
YC2	6.86	7.62	7.44	347	1,083	563.64	<5	17	6.64	100%	Samples were collected under no flow conditions in January, May, and from August to November.
YC3	7.3	7.77	7.50	745	1,580	1,083.71	<5	16	7.57	100%	No water samples were collected in April, May or September due to low water levels. No water samples were collected in October as the sample site was too dry. Samples collected under no flow conditions from January to February, June, August and November.
SC1	7.34	9.3	7.95	372	586	429	<5	15	7.45	100%	-
SC2	6.82	7.95	7.45	125	386	272.09	5	63	23.82	100%	
SC3	-	-	-	-	-	-	-	-	-	100%	No water samples were collected in January due to low water levels. No water samples were collected from February to December as the sample site was too dry.
SC4	6.68	6.72	6.7	195	276	235.5	18	19	18.5	100%	No water samples were collected in April or May due to low water levels. No water samples were collected in January, February or from June to October as the sample

											site was too dry. Water samples collected under no flow conditions in March, November and December.
BC1	7.19	7.51	7.35	375	633	492.33	<5	7	6	100%	No samples were collected from May to July due to low water levels. No water samples were collected in August to October as the sample site was too dry. Samples collected under no flow conditions in April and November.
BC2	7.21	7.64	7.43	167	250	206.33	16	21	18	100%	No samples were collected in January, September or from April to July due to low water levels. No water samples were collected in August or October as the sample site was too dry. Water samples collected under no flow condition in February-March and November-December.
BC3	6.8	7.69	7.14	218	2,880	1,174.83	<5	31	17.33	100%	No samples were collected in April or May due to low water levels. No water samples were collected from August to October as the sample site was too dry. Samples collected under no flow conditions in January-February, June-July and November.
BC4	6.6	7.89	7.39	210	4560	2,048.11	<5	116	34	100%	No sample was collected in August due to low water levels. No water samples were collected in September as the sample site was too dry. All samples (except those collected in March) were collected under no flow conditions.
MC1	6.52	7.97	7	324	828	564.33	<5	33	18	100%	No samples were collected from August to October as the sample site was too dry. No samples were collected in January or May as water levels were too low. All samples (except those collected in March) were collected under no flow conditions.
MC2	7	7.64	7.31	320	968	573.14	6	20	13.71	100%	No samples were collected from June to October as the sample site was too dry. Samples collected under no flow conditions in January-February and April-May.
MC3	6.8	7.51	7.22	385	1,520	918.33	<5	27	10.58	100%	Samples collected in January-February and April-October

											were collected under no flow conditions.
GC2	7.66	8	7.83	286	8445	629.33	<5	51	12.18	100%	Samples collected under slow flow conditions.
GC3	7.55	8.09	7.82	350	868	653.09	<5	41	13.64	100%	No samples were collected for GC3 in February as the site was unable to be accessed in wet conditions. All samples were collected under slow flow conditions.

Table 28: Historical Surface Water Data Comparison – pH

Site Name	Trigger Level		Annual Average						
	Lower	Upper	2015	2016	2017	2018	2019	2020	2021
Bowmans Creek									
BMC1	6.5	8.0	7.8	8.01	7.88	7.69	7.82	7.63	7.9
BMC2	6.5	8.0	7.9	7.99	7.96	7.78	7.77	7.49	7.89
BMC3	6.5	8.0	8	8.05	8.05	7.87	7.90	7.70	7.96
BMC4	6.5	8.0	7.7	7.87	7.63	7.40	7.47	7.40	7.78
BMC5	6.5	8.0	7.9	7.76	7.78	8.11	7.96	7.57	7.64
Yorks Creek									
YC1	6.5	8.6	7.5	7.6	7.25	6.7	N/A	7.08	7.25
YC2	6.5	8.6	7.6	7.77	7.28	N/A	N/A	7.15	7.44
YC3	6.5	8.6	7.5	7.79	7.4	N/A	N/A	7.13	7.50
Swamp Creek									
SC1	6.5	8.6	8	8.16	8.18	9.13	8.69	8.93	7.95
SC2	6.5	8.6	7.7	7.88	7.42	7.64	8.04	7.34	7.45
SC3	6.5	8.6	8.1	8.03	7.3	N/A	N/A	N/A	N/A
SC4	6.5	8.6	7.2	7.27	6.75	N/A	N/A	6.80	6.7
Bettys Creek									
BC1	7.7	6.9	7.5	7.7	6.9	N/A	N/A	7.05	7.35
BC2	7.5	8.2	7.4	7.5	8.2	N/A	N/A	7.57	7.43
BC3	8	8.1	6.97	8	8.1	N/A	N/A	6.84	7.14
BC4	7.9	7.6	7.27	7.9	7.6	6.65	6.97	6.95	7.39
Main Creek									
MC1	N/A	N/A	7.24	N/A	N/A	7.10	6.8	7.15	7
MC2	N/A	N/A	7.55	N/A	N/A	7.00	N/A	6.98	7.31
MC3	N/A	N/A	7.46	N/A	N/A	N/A	N/A	7.10	7.22

Table 29: Historical Surface Water Data Comparison – Electrical Conductivity (µS/cm)

Site Name	Trigger Level	Annual Average						
		2015	2016	2017	2018	2019	2020	2021
Bowmans Creek								
BMC1	2,200	1,026	940	767	1,447	2,056	1,916	912.1
BMC2	2,200	1,114	964	860	1,293	1,948	1,358	798.1
BMC3	2,200	1,337	1,344	1,354	1,656	2,505	1,165	799.1
BMC4	2,200	1,065	1,124	1,115	1,274	1,399	1,330	846.6
BMC5	2,200	1,415	1,179	1,461	3,888	4,306	1,321	856.8
Yorks Creek								
YC1	6,668	3,012	3,818	3,422	4,990	N/A	1,818	1,766.3
YC2	6,668	7,194	5,241	9,002	N/A	N/A	1,200	563.6
YC3	6,668	4,971	2,903	6,739	N/A	N/A	724	1,083.7
Swamp Creek								
SC1	6,668	392	351	393	524	531	562	429
SC2	6,668	265	315	227	469	601	302	272.1
SC3	6,668	4,184	5,075	7,180	N/A	N/A	N/A	N/A
SC4	6,668	898	720	281	N/A	N/A	222	235.5
Bettys Creek								
BC1	6,668	926	1,096	776	N/A	N/A	442	492.3
BC2	6,668	529	696	188	N/A	N/A	419	206.3
BC3	6,668	763	529	288	N/A	N/A	229	1,174.8
BC4	6,668	559	1,227	427	300	403	353	2,048.1
Main Creek								
MC1	6,668	1,253	1,207	872	1,321	207	446	564.3
MC2	6,668	1,634	1,311	1,968	1,720	N/A	515	573.1
MC3	6,668	N/A	N/A	1,103	N/A	N/A	440	918.3

Table 30: Historical Surface Water Data Comparison – TSS (mg/L)

Site Name	Trigger Level	Annual Average						
		2015	2016	2017	2018	2019	2020	2021
Bowmans Creek								
BMC1	21	10.3	9	26	5	7	138	9.6
BMC2	21	47.5	14.1	12	19	116	18	8.5
BMC3	21	13.4	17.3	13	33	69	6	9
BMC4	21	13.5	15.2	6	10	34	8	8.6
BMC5	21	9.4	9.9	14	20	18	13	9.2
Yorks Creek								
YC1	68	48.6	32.7	12	14	N/A	40	6.9
YC2	68	58.5	17.4	9	N/A	N/A	81	6.6
YC3	68	38	35.3	33	N/A	N/A	126	7.6
Swamp Creek								
SC1	68	9.3	8.2	8	7.3	11	7	7.5
SC2	68	13.5	8	19	25.6	24	85	23.8
SC3	68	46.9	53.6	7	N/A	N/A	N/A	N/A
SC4	68	27.3	31	37	N/A	N/A	54	18.5
Bettys Creek								
BC1	68	9.5	64.5	6	N/A	N/A	14	6
BC2	68	41.1	11.5	7	N/A	N/A	348	18
BC3	68	106	37.7	14	N/A	N/A	49	17.3
BC4	68	38	21.6	46	56	24	21	34
Main Creek								
MC1	68	144.8	187.5	252	100	39	35	18
MC2	68	239.6	56.9	153	56	N/A	55	13.7
MC3	68	N/A	N/A	6.8	N/A	N/A	23	10.6

Table 31: Historical Surface Water Data Comparison – TDS (mg/L)

Site Name	Trigger Level	Annual Average						
		2015	2016	2017	2018	2019	2020	2021
Bowmans Creek								
BMC1	890	586.6	529.5	615	964	1,397	1484	513
BMC2	890	649.3	557.7	636	827	1,298	961	449.6
BMC3	890	766.8	779.3	710	1,052	1,625	767	446.7
BMC4	890	575.7	651.4	687	781	908	854	472.6
BMC 5	890	902.9	714.6	721	2,463	2,800	887	485.3
Yorks Creek								
YC1	4,384	1822	2,278.2	2,013	3,240	N/A	1252	1087.8
YC2	4,384	4,797.3	3,375.4	6,476	N/A	N/A	991	370.3
YC3	4,384	3,051.3	1914	4,210	N/A	N/A	492	675.1
Swamp Creek								
SC1	4,384	236.8	218.4	295	344.2	342	356	266.8
SC2	4,384	179	211.1	199	331	388	340	227.3
SC3	4,384	2,204.3.	3,072.9	4,890	N/A	N/A	N/A	N/A
SC4	4,384	618.2	501.33	295	N/A	N/A	214	246.3
Bettys Creek								
BC1	4,384	513	644.8	515	N/A	N/A	358	357.8
BC2	4,384	338.6	473.3	187	N/A	N/A	370	191.5
BC3	4,384	530.4	277.7	293	N/A	N/A	268	1008.6
BC4	4,384	342.3	797.7	322	265	338	300	1346.5
Main Creek								
MC1	4,384	837.9	918.6	739	812	228	331	398
MC2	4,384	986.8	875.1	1,258	1,080	N/A	411	427.6
MC3	4,384	N/A	N/A	678	N/A	N/A	331	552.8

Groundwater

Table 32: 2021 MGO Groundwater Monitoring Results

Sampling Date	BC-SP01			BC-SP02			BC-SP03			BC-SP04			BC-SP05			BC-SP06		
	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)
Feb. 2021	Insufficient water to sample.			8.56	6.60	9,010	Insufficient water to sample.			7.88	6.77	14,120	7.38	6.77	14,120	9.10	6.98	11,690
May 2021				8.29	6.49	9,160				7.44	6.80	14,020	6.38	7.45	2,088	9.16	7.03	12,660
Aug. 2021				8.06	6.67	9,540				7.58	6.90	13,230	7.15	7.26	4,130	9.20	7.17	12,840
Nov. 2021				8.15	6.86	8,940				7.87	7.17	12,760	7.53	5.64	6,400	9.19	7.32	10,910

Sampling Date	BC-SP07			BC-SP08			BC-SP09			BC-SP10			BC-SP11			BC-SP12		
	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Insufficient water to sample.			7.50	6.55	16,690	Insufficient water to sample.			Insufficient water to sample.			5.31	6.32	10,350	3.50	7.06	1,556
May 2021	10.29	7.00	11,000	6.63	6.48	16,440	8.27	6.97	13,390	6.02	6.87	11,130	4.49	6.42	975	2.87	6.70	1,301
Aug. 2021	Insufficient water to sample.			6.47	6.73	16,560	8.25	7.12	13,810	5.95	7.17	12,900	4.67	6.42	7,330	3.14	6.88	1,689
Nov. 2021				6.47	7.04	15,770	Insufficient water to sample.			6.19	7.30	11,630	5.15	6.33	8,120	4.61	7.01	1,791

Sampling Date	BC-SP13			BC-SP14			BC-SP15			BC-SP16			BC-SP17			BC-SP18		
	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Insufficient water to sample.			Insufficient water to sample.			Insufficient water to sample.			Insufficient water to sample.			Insufficient water to sample.			Insufficient water to sample.		
May 2021	Bore obstructed/damaged.			5.63	7.04	11,710				4.20	6.51	2,420						
Aug. 2021				5.73	7.44	11,490				Insufficient water to sample.								

Nov. 2021	Insufficient water to sample.	Insufficient water to sample.				

Sampling Date	BC-SP19			BC-SP20			BC-SP21			BC-SP22			GA1			GA2		
	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Insufficient water to sample.			1.01	6.53	417	Insufficient water to sample.			5.36	7.13	1,448	Insufficient water to sample.			6.06	6.95	3,600
May 2021				3.93	5.92	762	6.70	6.96	8,720	5.25	6.32	457	4.52	7.02	1,592	5.51	6.63	3,690
Aug. 2021				4.20	6.31	1,528	6.63	7.09	10,000	5.49	7.10	8,400	5.13	6.97	2,859	5.45	6.65	4,270
Nov. 2021				Insufficient water to sample.			6.69	7.12	9,410	5.53	7.19	7,470	5.65	7.04	3,260	5.52	6.77	4,040

Sampling Date	GNPS-01			GNPS-02			GNPS-03			GNPS-05			GNPS-06			GNPS-07		
	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Bore destroyed			4.33	6.60	1,401	Insufficient water to sample.			Insufficient water to sample.			3.60	6.12	515	Insufficient water to sample.		
May 2021				4.43	6.18	1,398							2.97	6.32	479			
Aug. 2021				4.56	6.30	1,300							Insufficient water to sample.					
Nov. 2021				4.63	6.91	11,100							4.58	5.68	923			

Sampling Date	GNP09D			GNP09S			GNP10D			GNP10S			GNP11D			GNP11S		
	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)
N/A Annual average	6.1	6.6	1397	5.8	6.9	1354	3.79	6.71	1,379	3.58	6.83	904	4.17	6.97	1,613	4.11	7.00	1,115
							3.79	6.93	1,221	3.62	7.35	443	4.25	6.73	1,532	4.20	6.68	879
							3.90	7.26	1,125	3.71	7.05	1,042	4.39	6.92	1,655	4.35	6.70	1,070
							3.93	7.09	1,261	3.73	7.21	1,061	4.33	6.94	1,474	4.27	7.05	1,024

Sampling Date	GW1			North			NPZ101			NPZ102			NPZ103			NPZ104		
	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl)	pH (field)	EC (field) (µS.cm)	Depth to Water (mbgl	pH (field)	EC (field) (µS.cm)
Feb. 2021	Bore Damaged			11.19	7.22	4,810	6.09	7.07	16,600	3.00	6.99	7,330	Insufficient water to sample.			Insufficient water to sample.		
May 2021				8.73	7.45	4,360	5.88	7.04	16,530	2.39	7.22	3,340	5.19	6.97	8,610			
Aug. 2021				8.87	6.93	5,740	5.76	6.95	17,760	2.37	7.00	6,720	Insufficient water to sample.					
Nov. 2021				9.84	7.30	4,800	5.90	7.01	16,480	2.37	7.14	5,190						

Sampling Date	NPZ105			NPZ106			NPZ107D			NPZ107S			NPZ108D			NPZ108S		
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Insufficient water to sample.			Insufficient water to sample.			20.53	11.85	9,050	8.16	6.93	15,070	8.26	11.03	9,750	8.00	7.15	17,180
May 2021							19.94	7.34	2,890	8.23	6.83	15,210	8.03	10.61	9,630	7.98	7.02	17,190
Aug. 2021							21.49	11.42	8,590	8.39	6.65	16,020	8.02	10.40	10,220	7.90	6.83	18,170
Nov. 2021							22.89	11.37	8,140	8.78	6.79	14,770	8.22	10.43	9,430	8.05	7.06	17,100

Sampling Date	NPZ109D			NPZ109S			NPZ1			NPZ1a			NPZ3			NPZ3a		
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	Bore obstructed.			Insufficient water to sample.			16.23	6.82	20,470	46.91	8.51	13,910	Insufficient water to sample.			12.04	6.76	20,250
May 2021				5.06	6.85	6,380	16.44	6.90	18,570	47.64	8.74	14,070				10.03	6.49	19,390
Aug. 2021				5.48	7.15	7,780	16.55	6.86	20,940	47.24	8.35	15,400				10.81	6.64	20,610
Nov. 2021				Insufficient water to sample.			16.47	6.94	19,210	47.68	8.55	14,020				11.02	6.74	18,160

Sampling Date	NPZ4			NPZ4a			NPZ6			NPZ6a			NPZ7			NPZ7a		
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	6.35	6.92	28,030	7.02	7.00	25,580	Insufficient water to sample.			Bore obstructed/insufficient water to sample.			17.27	7.40	9,740	43.15	7.49	8,360
May 2021	6.44	6.97	28,030	6.97	6.97	24,280							17.28	7.26	9,830	44.58	7.28	8,220
Aug. 2021	6.54	7.05	29,800	6.94	6.85	26,300							17.37	7.09	10,430	44.39	7.25	8,780
Nov. 2021	6.60	7.11	26,210	7.14	6.95	24,120							18.06	7.29	9,550	45.63	7.34	8,360

Sampling Date	NPZ8			NPZ8a			NPZ9			NPZ9a			NPZ10			NPZ10a		
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	10.23	7.34	20,360	36.68	7.14	3,580	4.63	6.80	10,040	Bore obstructed.			23.54	7.15	6,340	Bore obstructed.		
May 2021	10.05	7.43	18,260	36.70	7.21	3,630	4.46	6.03	9,980				23.04	6.68	4,770			
Aug. 2021	9.95	7.30	21,900	36.93	7.03	4,050	4.65	6.79	10,370				25.78	6.96	4,920			
Nov. 2021	10.07	7.38	20,460	37.42	7.10	4,270	4.49	6.79	8,770				24.97	7.13	4,370	Insufficient water to sample.		

Sampling Date	NPZ11			NPZ11a			NPZ13			NPZ13a			NPZ15			NPZ15a		
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	29.66	6.56	12,690	62.36	7.87	12,160	24.88	7.05	12,000	54.76	7.31	14,210	Insufficient water to sample.			126.40	7.25	8,990
May 2021	29.57	6.96	13,540	62.16	8.29	12,220	25.95	6.48	11,800	55.14	6.71	13,160				125.95	6.80	8,810
Aug. 2021	28.30	6.83	13,980	61.20	8.18	12,530	27.12	7.12	12,800	55.70	7.10	14,700				125.88	7.04	9,340
Nov. 2021	29.07	6.91	13,750	62.14	8.32	12,080	28.61	6.84	11,520	56.59	7.06	13,550				120.27	7.03	7,940

Sampling Date	NPZ16			NPZ16a														
	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)	Depth to Water (m)	pH (field)	EC (field) (µS.cm)
Feb. 2021	21.76	7.14	14,290	Bore obstructed.														
May 2021	22.09	6.68	14,020															
Aug. 2021	24.19	6.98	15,280															
Nov. 2021	25.22	7.11	13,410	Insufficient water to sample.														

Figure 5: Historical Depth to Water Monitoring Results for BC-SP Groundwater Bores

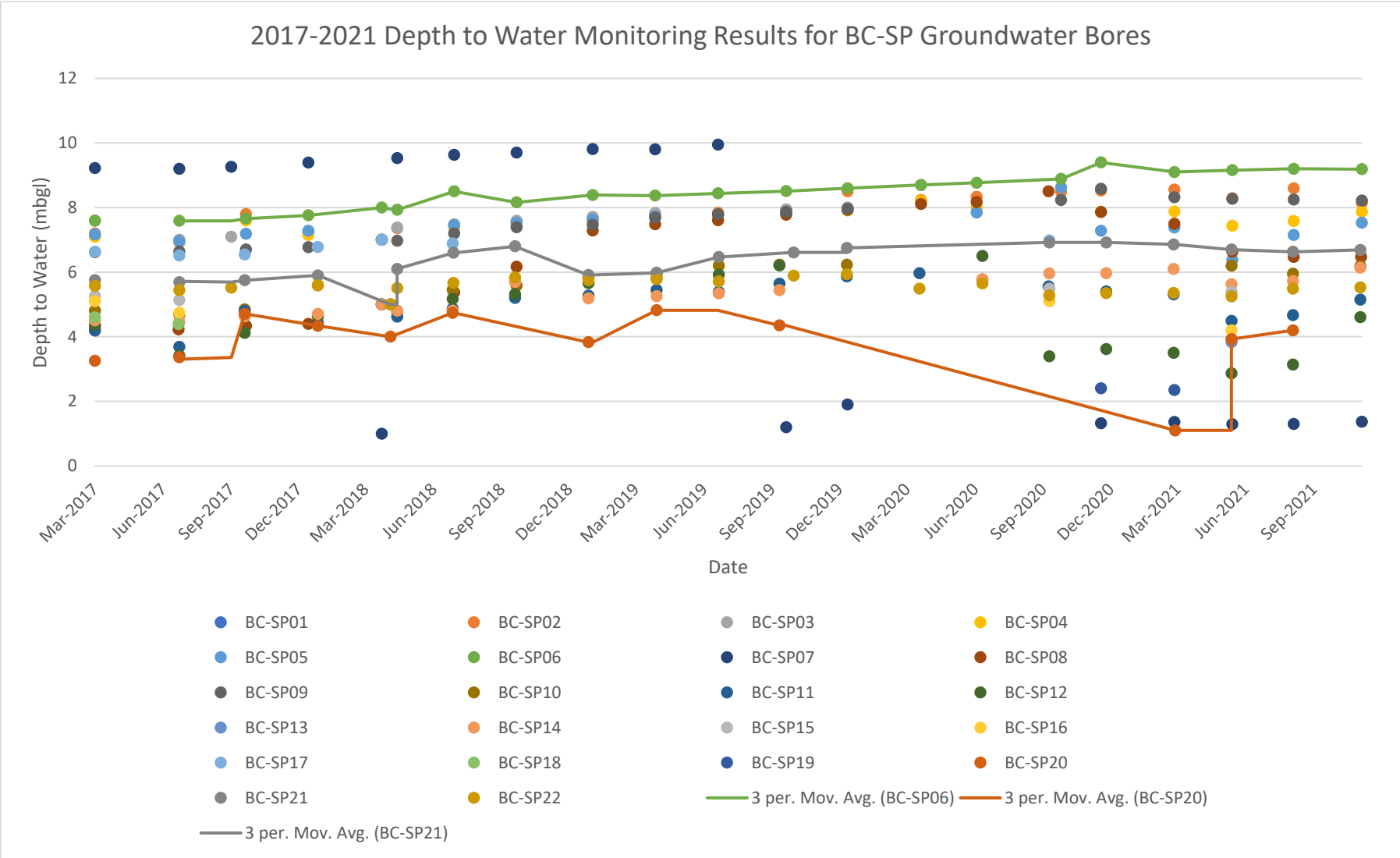


Figure 6: Historical Electrical Conductivity Monitoring Results for BC-SP Groundwater Bores

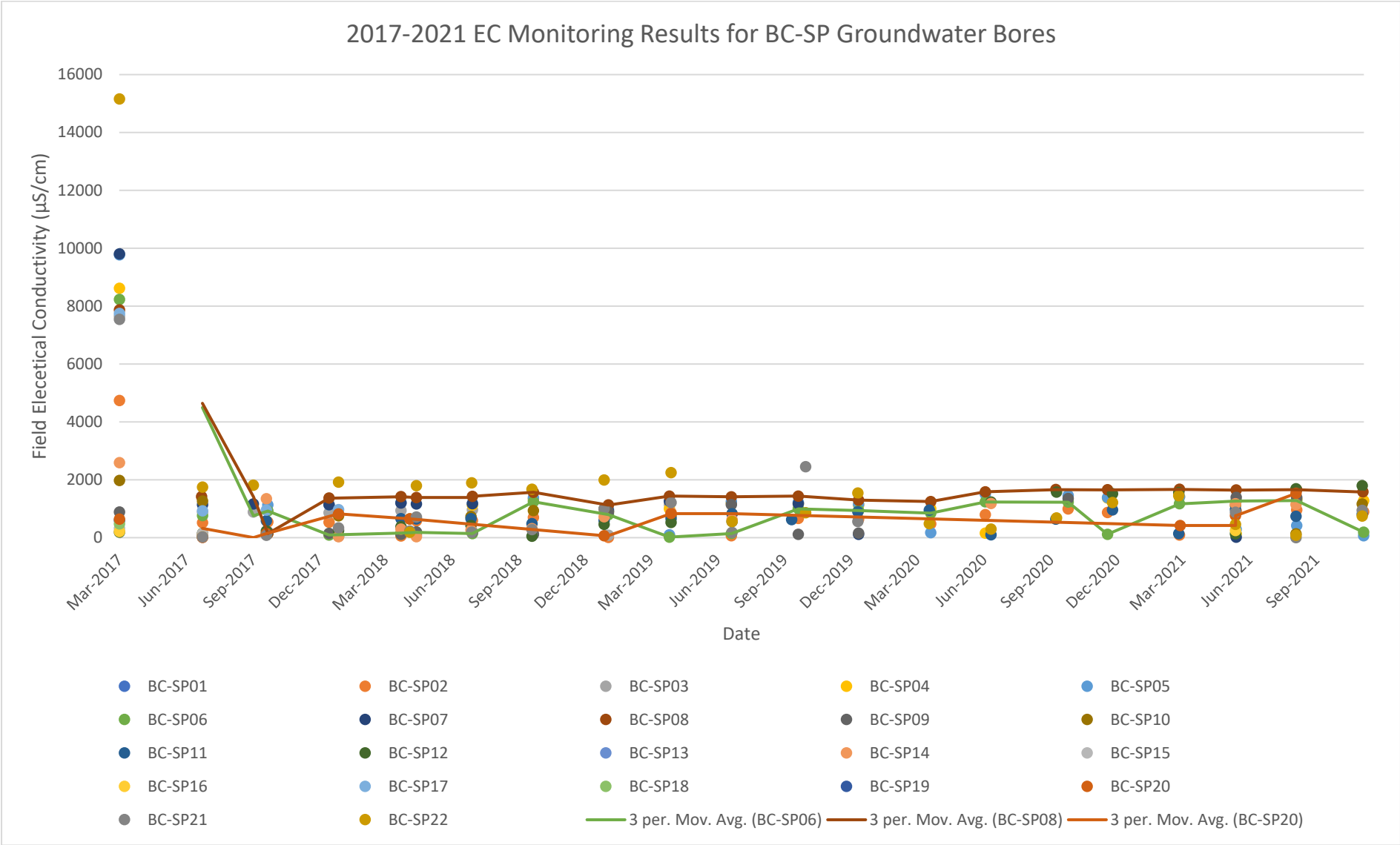


Figure 7: Historical pH Monitoring Results for BC-SP Groundwater Bores

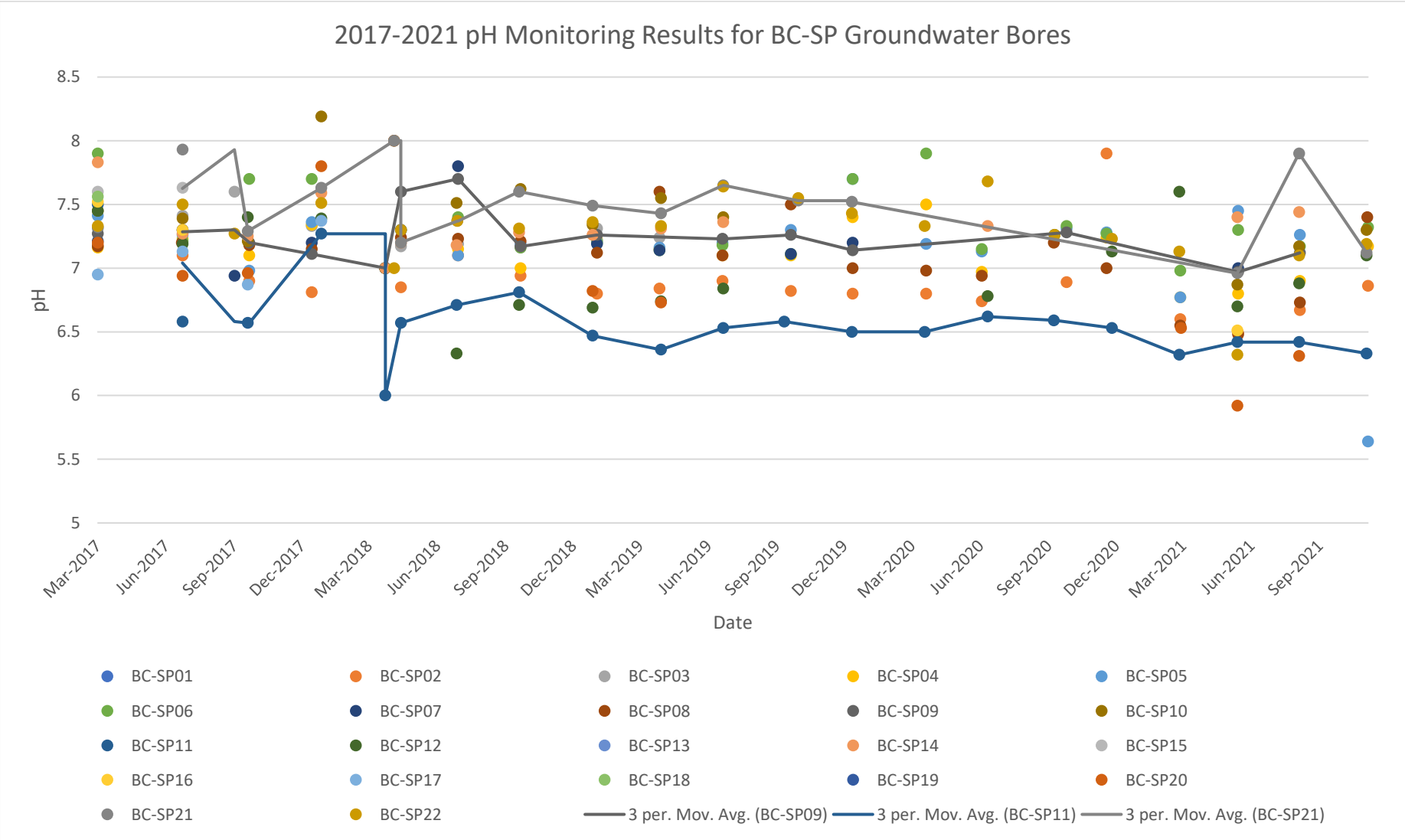


Figure 8: Historical Depth to Water Monitoring Results for GA Groundwater Bores

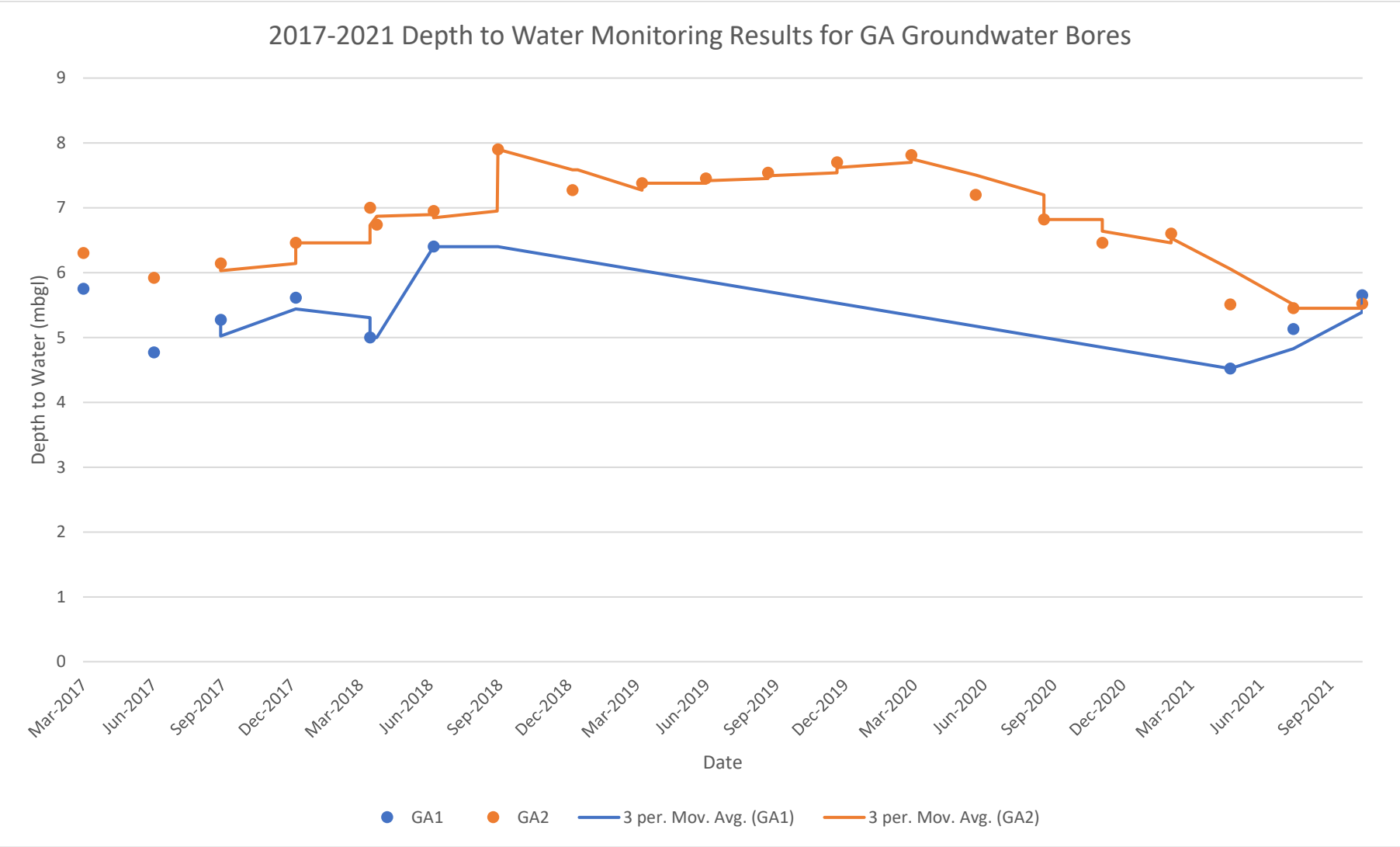


Figure 9: Historical Electrical Conductivity Monitoring Results for GA Groundwater Bores

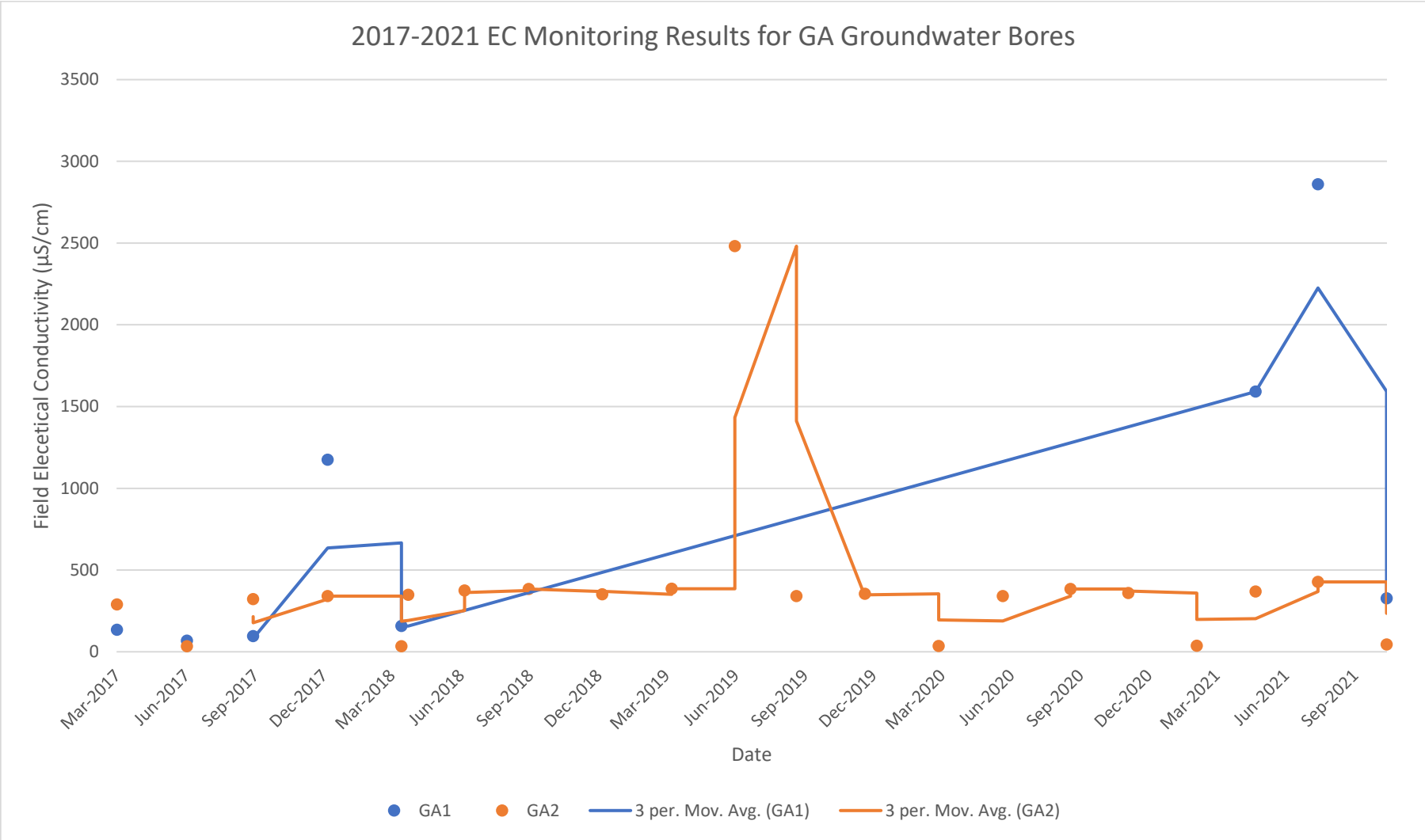


Figure 10: Historical pH Monitoring Results for GA Groundwater Bores

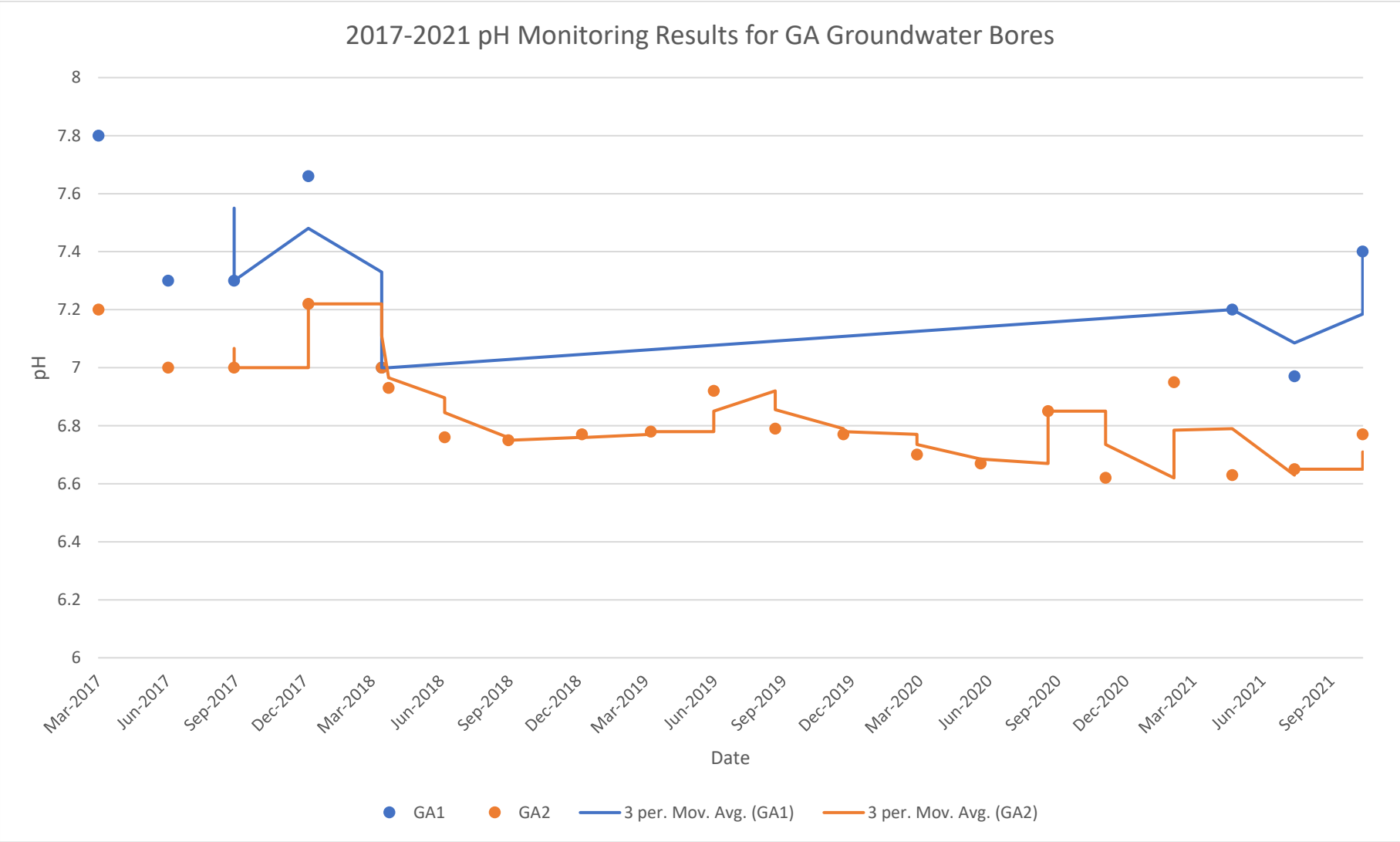


Figure 11: Historical Depth to Water Monitoring Results for GNP Groundwater Bores

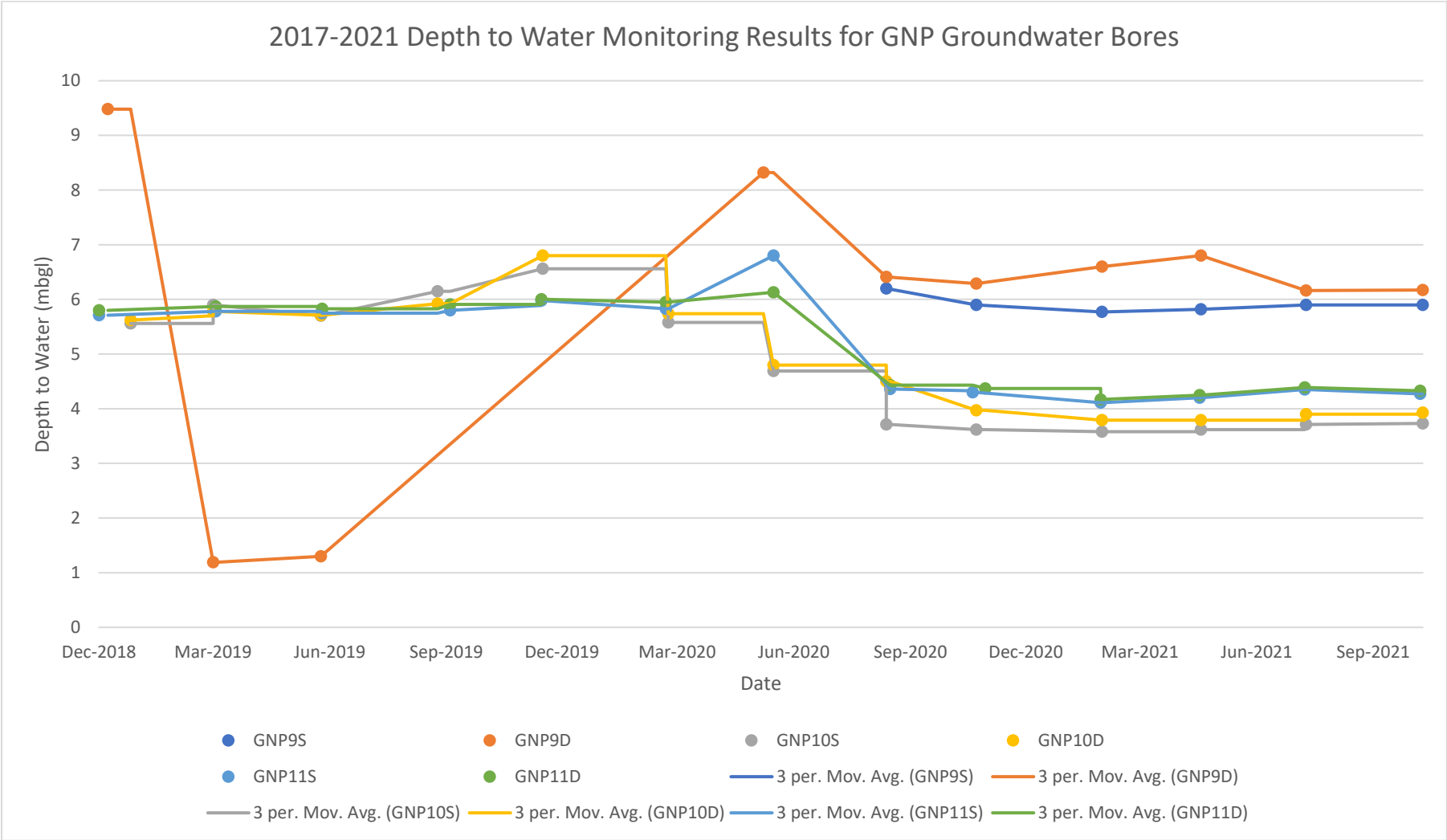


Figure 12: Historical Electrical Conductivity Monitoring Results for GNP Groundwater Bores

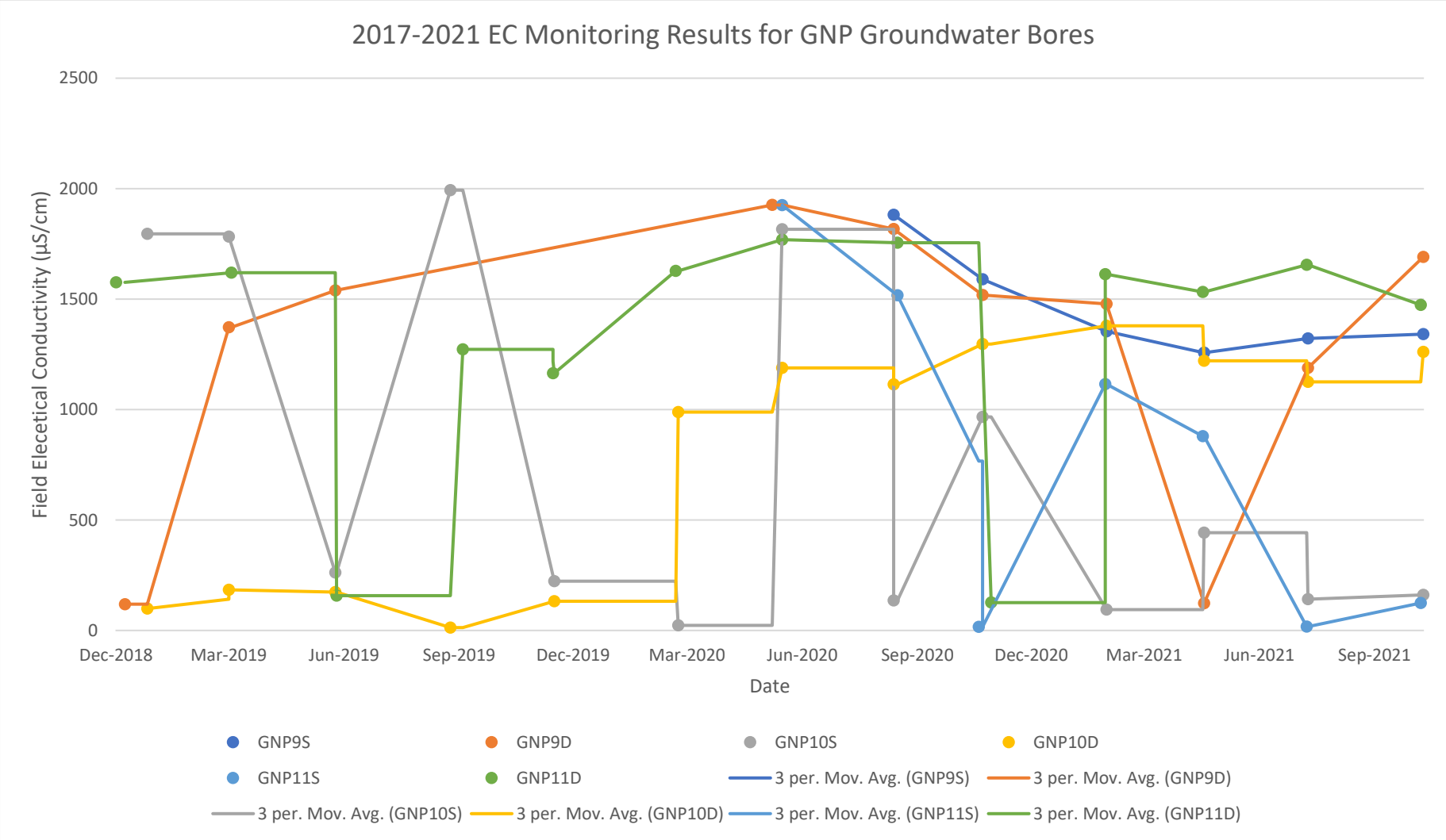


Figure 13: Historical pH Monitoring Results for GNP Groundwater Bores

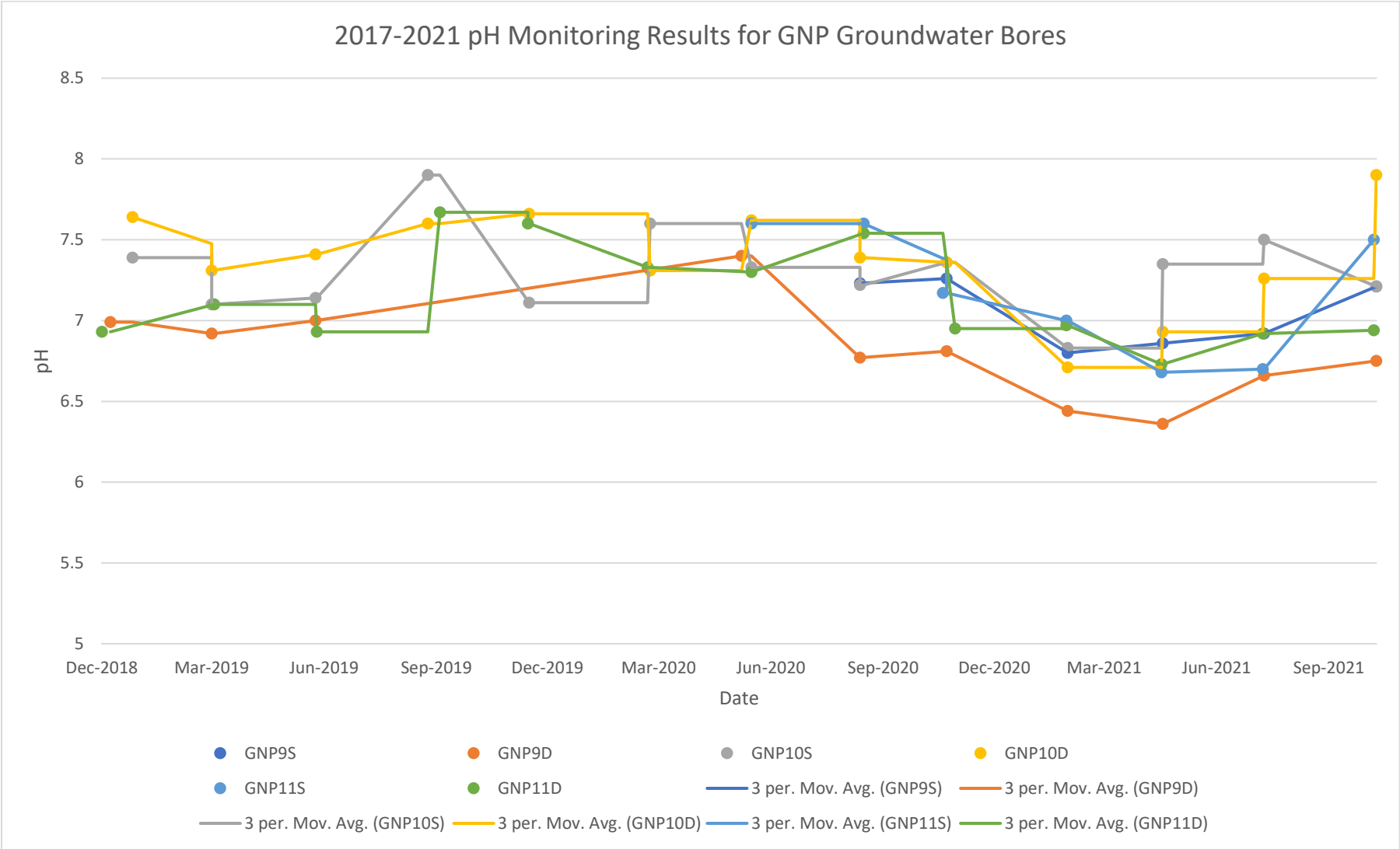


Figure 14: Historical Depth to Water Monitoring Results for GNPS Groundwater Bores

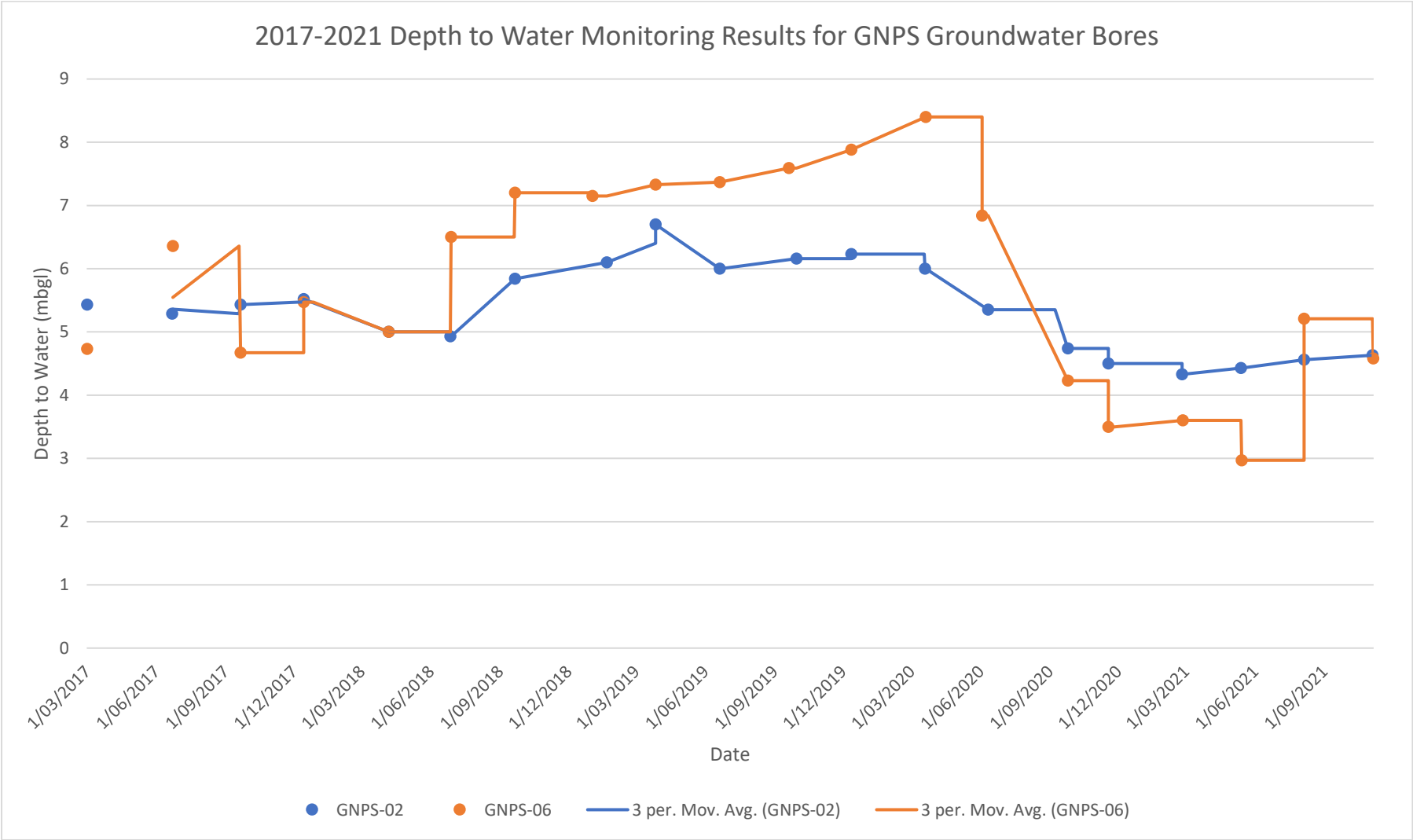


Figure 15: Historical Electrical Conductivity Monitoring Results for GNPS Groundwater Bores

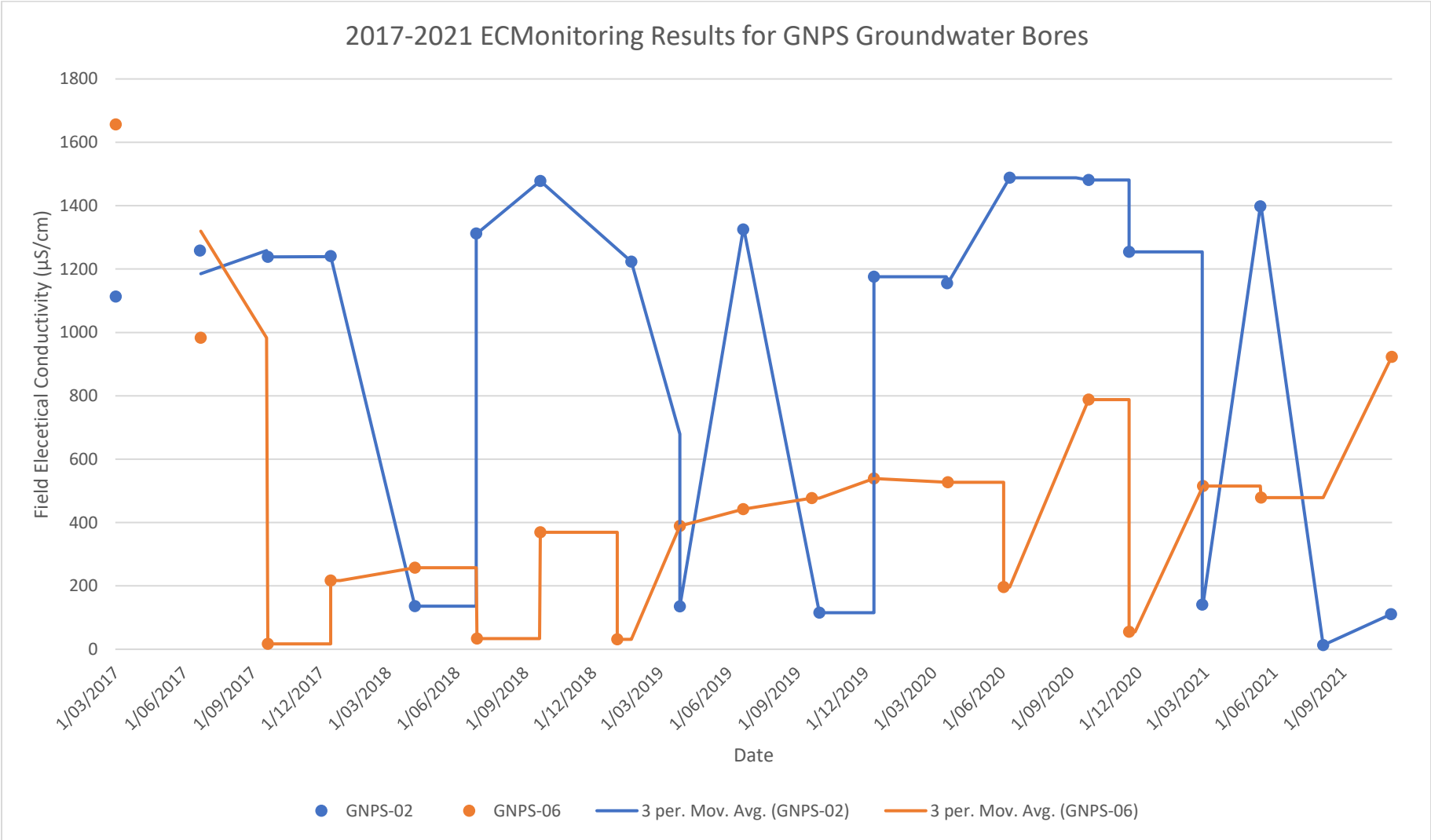


Figure 16: Historical pH Monitoring Results for GNPS Groundwater Bores

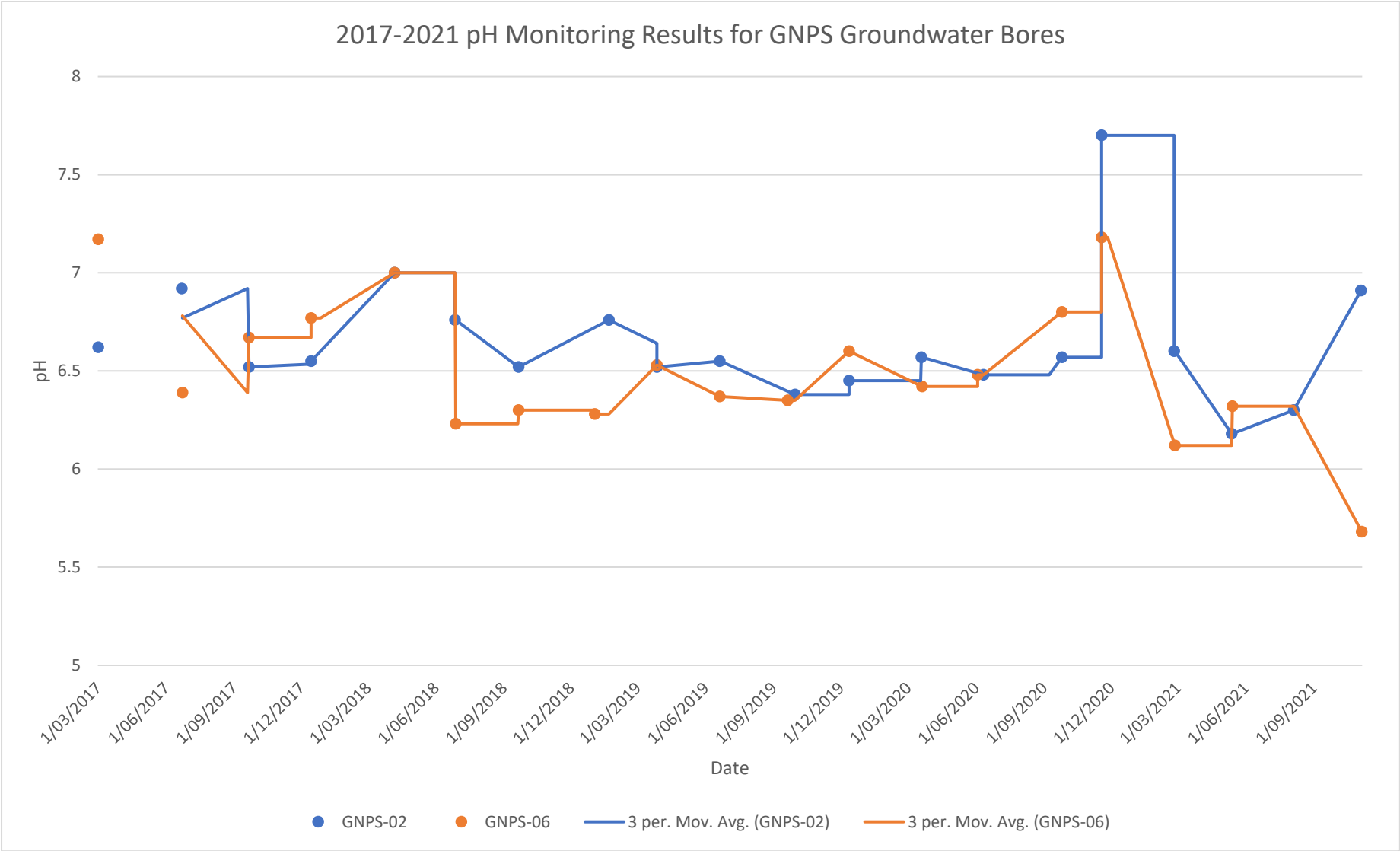


Figure 17: Historical Depth to Water Monitoring Results for North Groundwater Bore

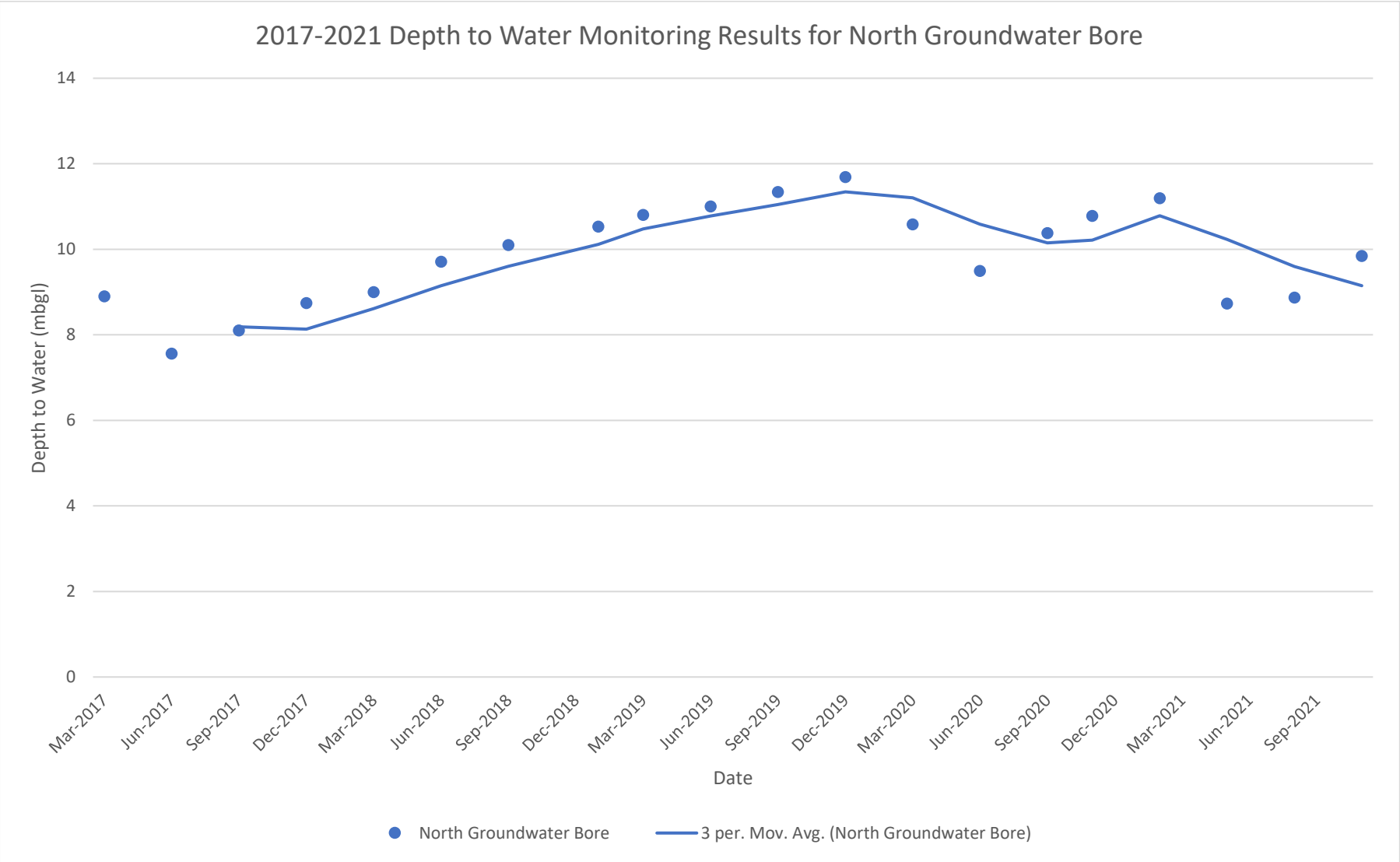


Figure 18: Historical Electrical Conductivity Monitoring Results for North Groundwater Bore

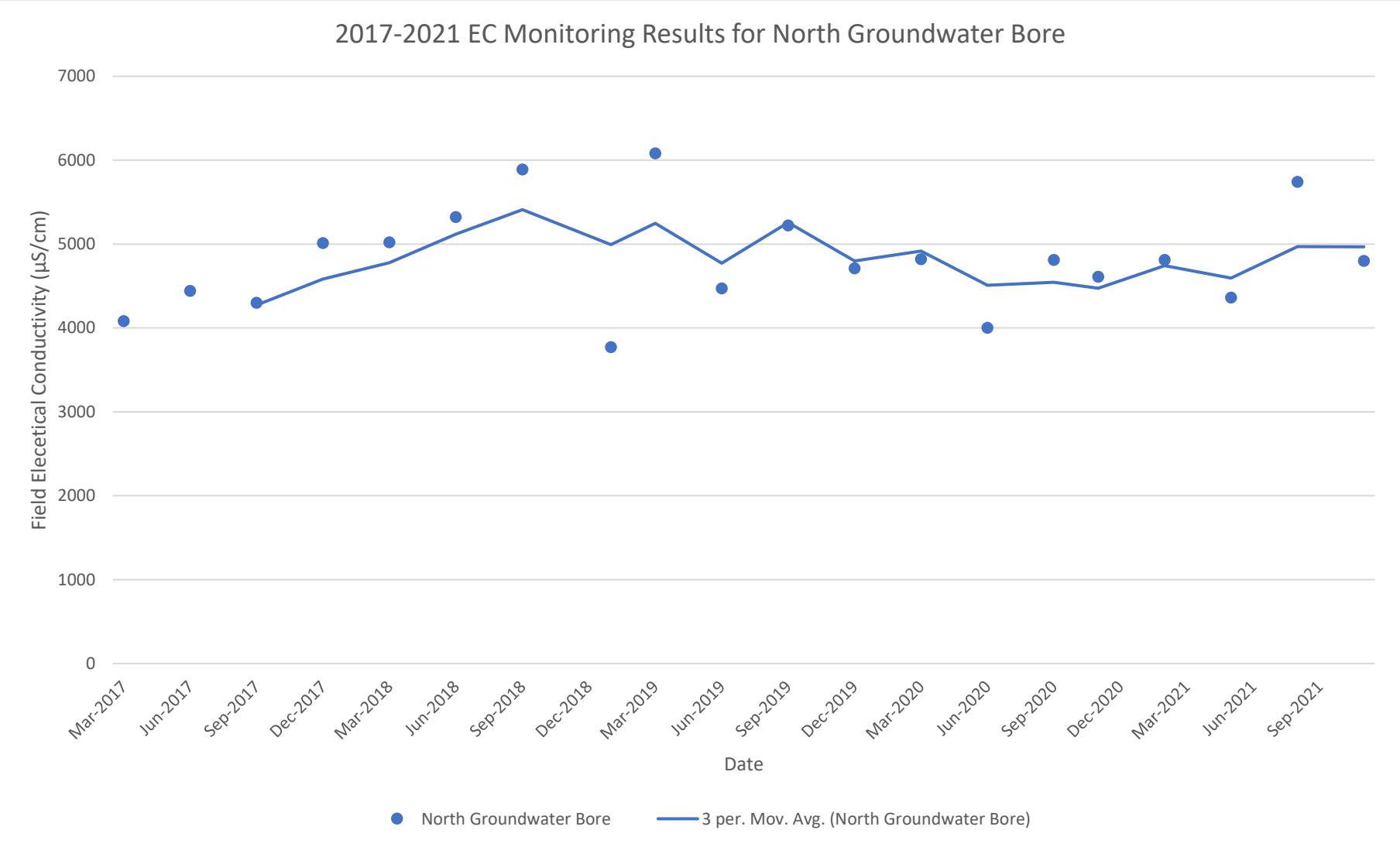


Figure 19: Historical pH Monitoring Results for North Groundwater Bore

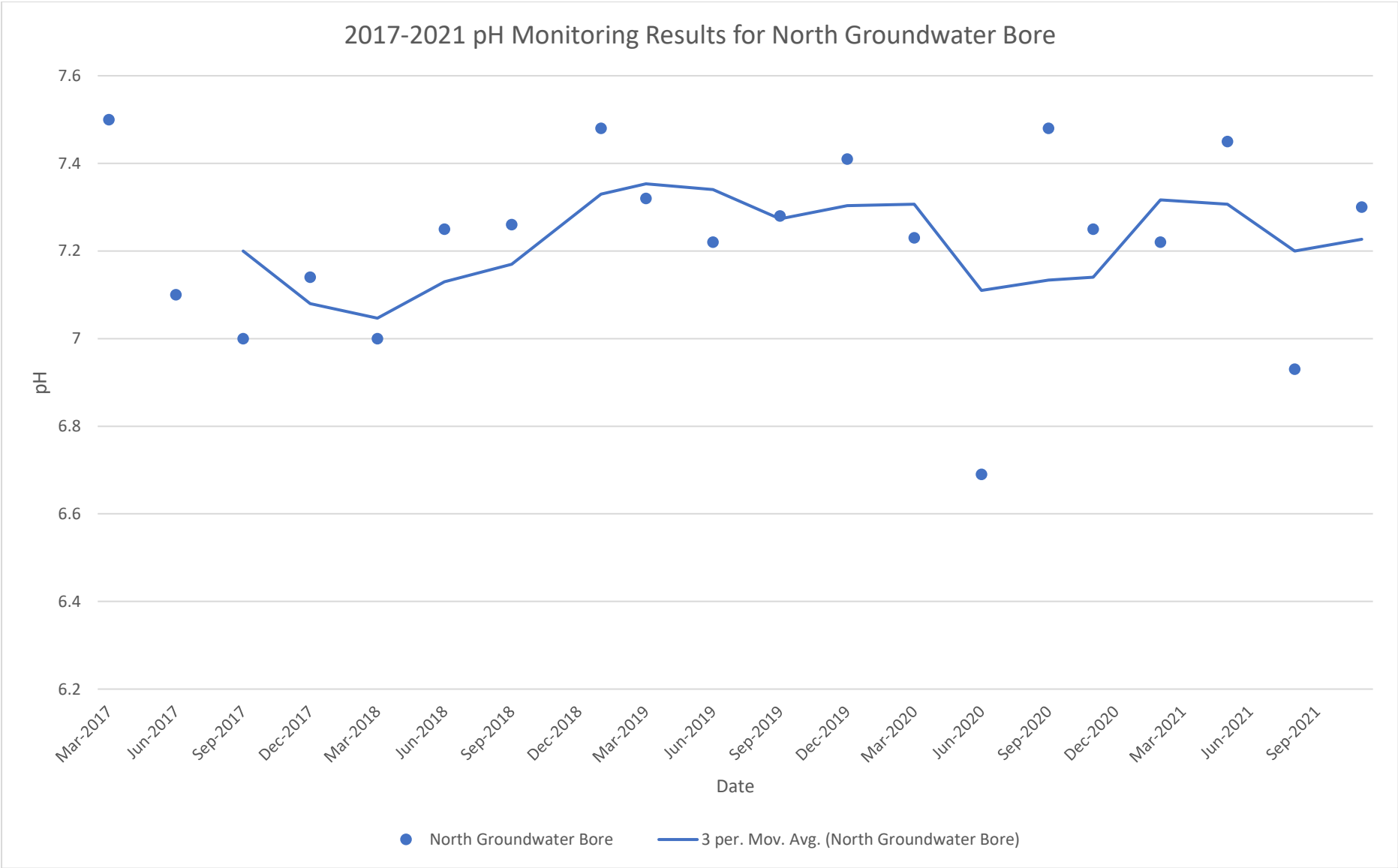

2017-2021 pH Monitoring Results for North Groundwater Bore
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
pH
Mar-2017
Jun-2017
Sep-2017
Dec-2017
Mar-2018
Jun-2018
Sep-2018
Dec-2018
Mar-2019
Jun-2019
Sep-2019
Dec-2019
Mar-2020
Jun-2020
Sep-2020
Dec-2020
Mar-2021
Jun-2021
Sep-2021
Date
North Groundwater Bore
3 per. Mov. Avg. (North Groundwater Bore)

Figure 20: Historical Depth to Water Monitoring Results for Selected NPZ Groundwater Bores (1)

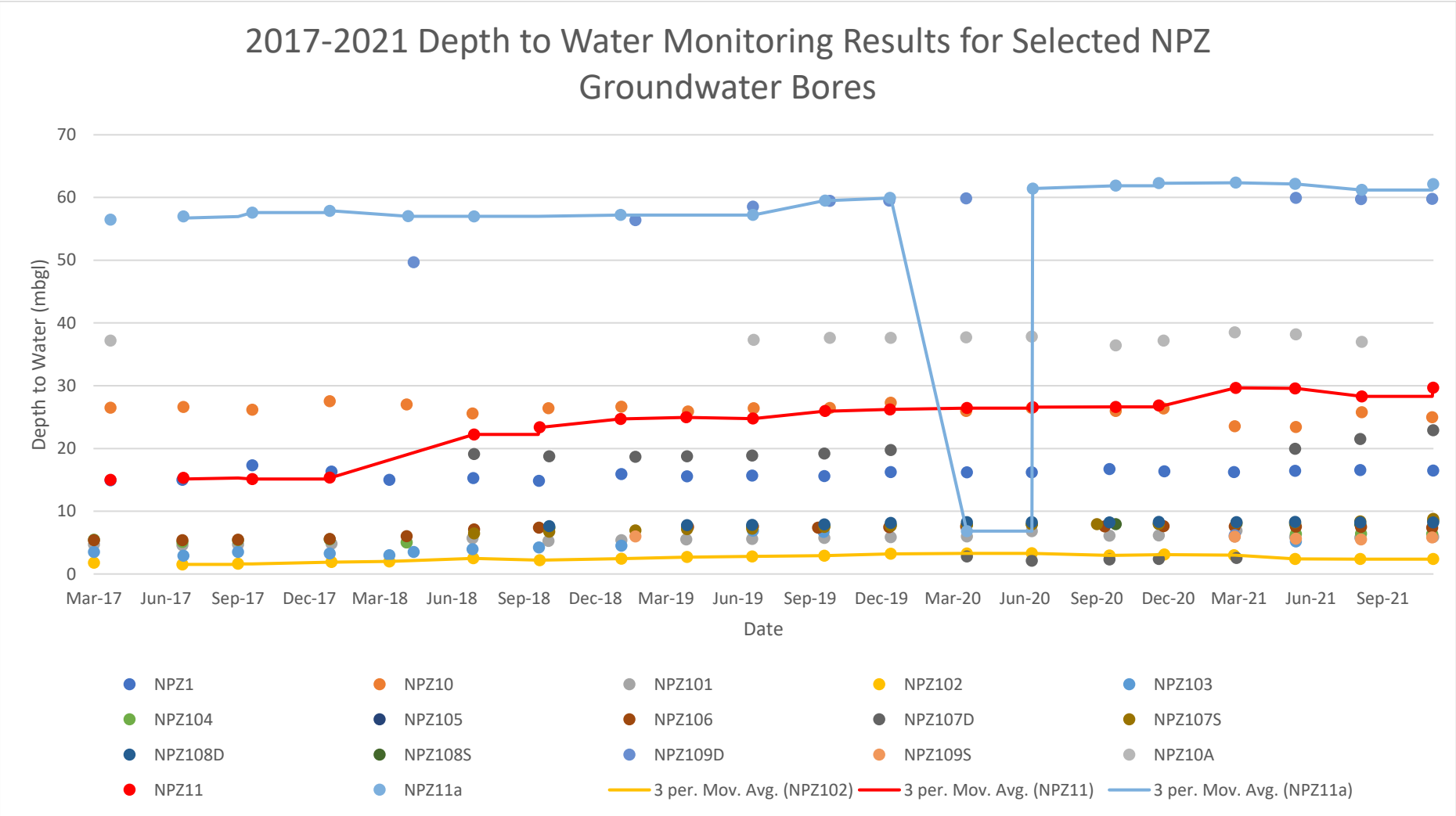


Figure 21: Historical Depth to Water Monitoring Results for Selected NPZ Groundwater Bores (2)

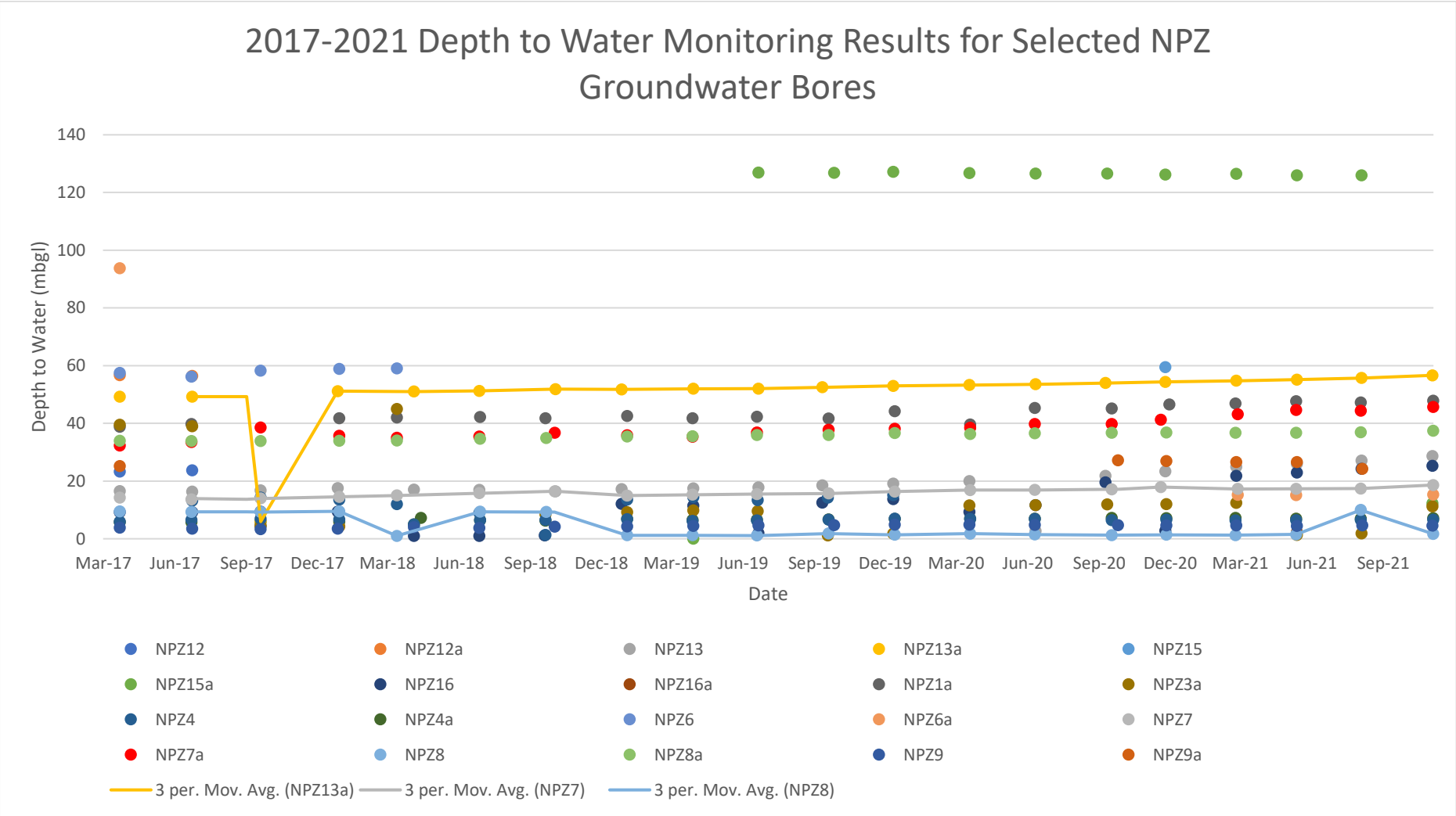


Figure 22: Historical Electrical Conductivity Monitoring Results for Selected NPZ Groundwater Bores (1)

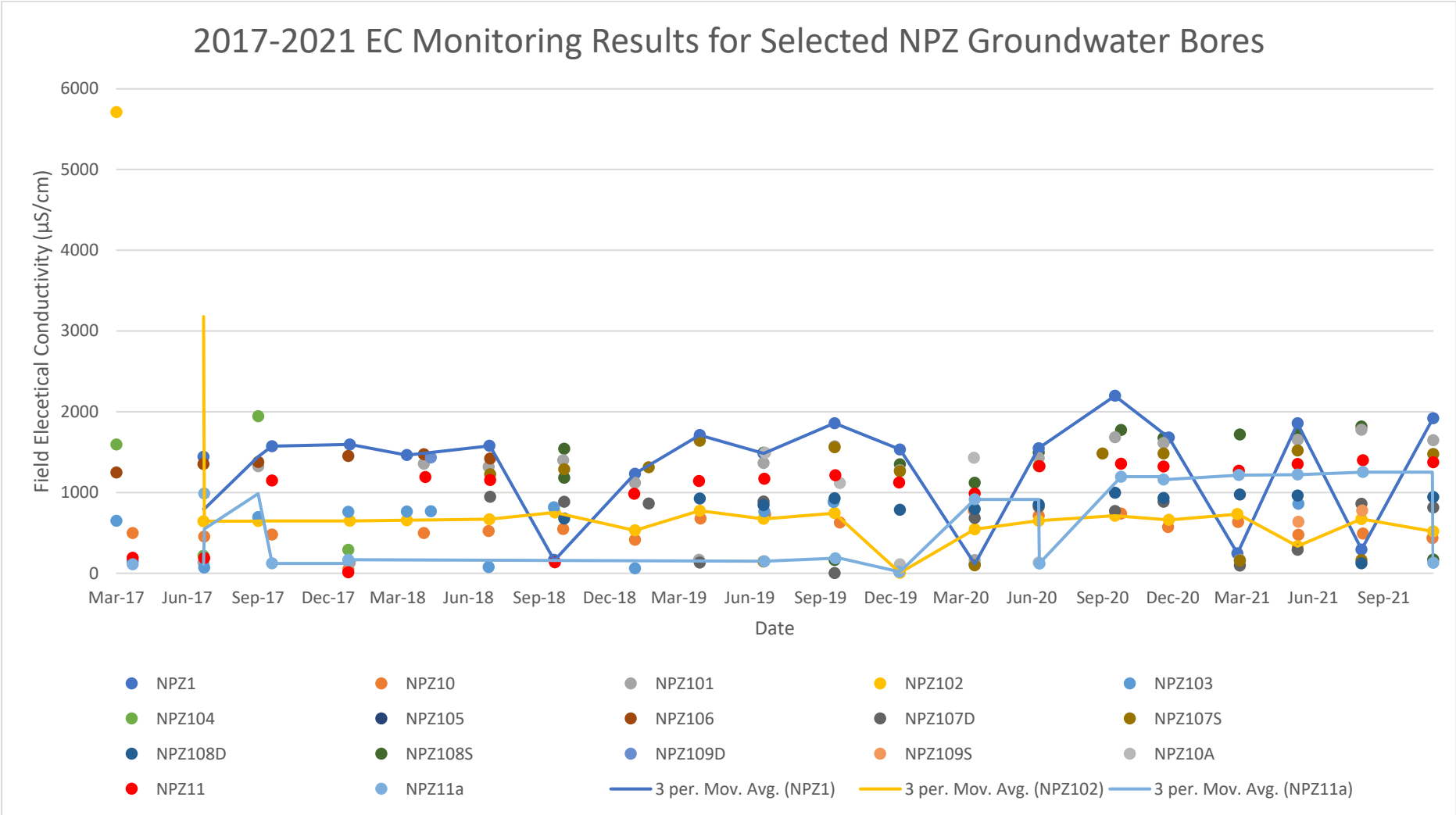


Figure 23: Historical Electrical Conductivity Monitoring Results for Selected NPZ Groundwater Bores (2)

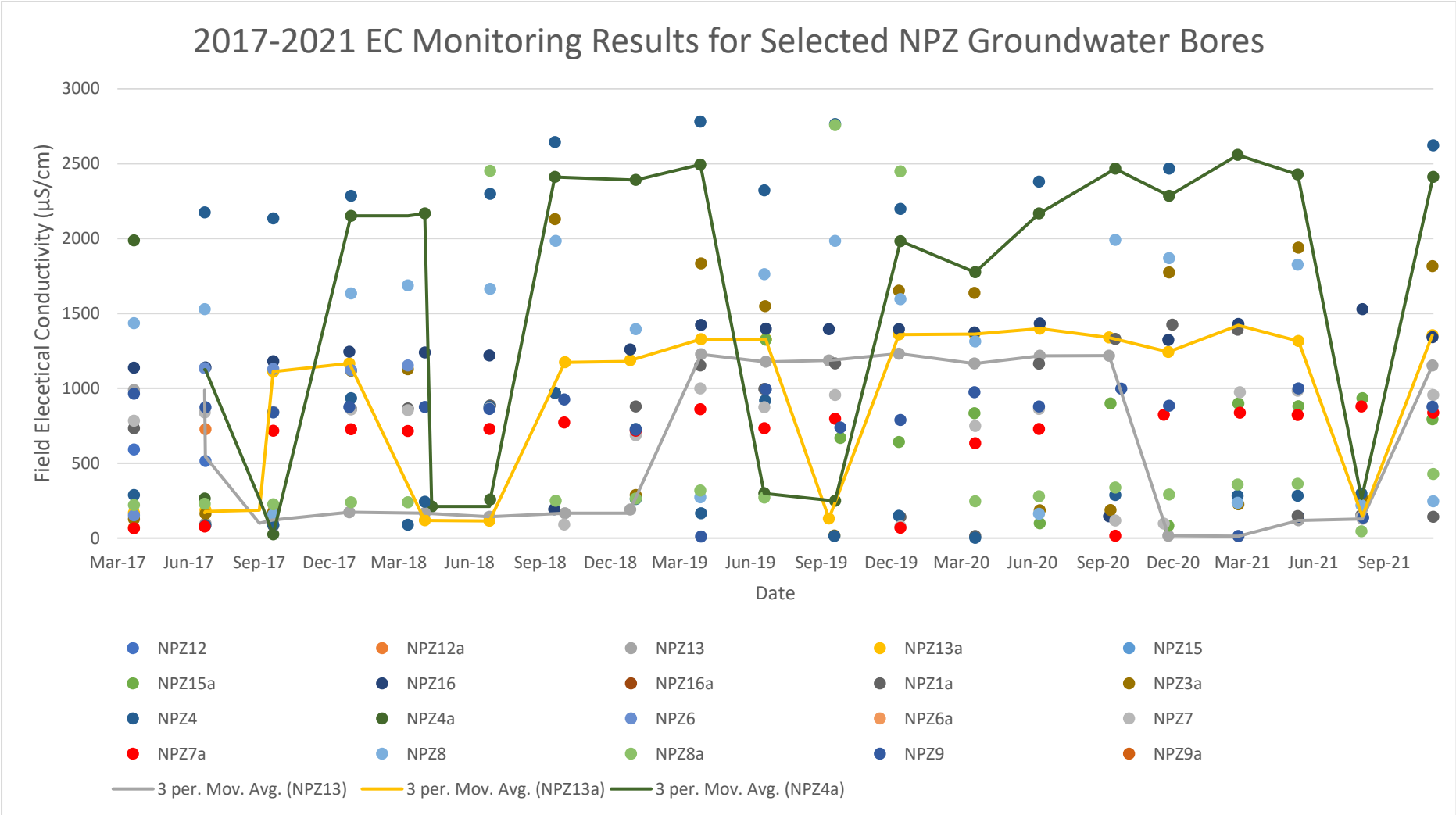


Figure 24: Historical pH Monitoring Results for Selected NPZ Groundwater Bores (1)

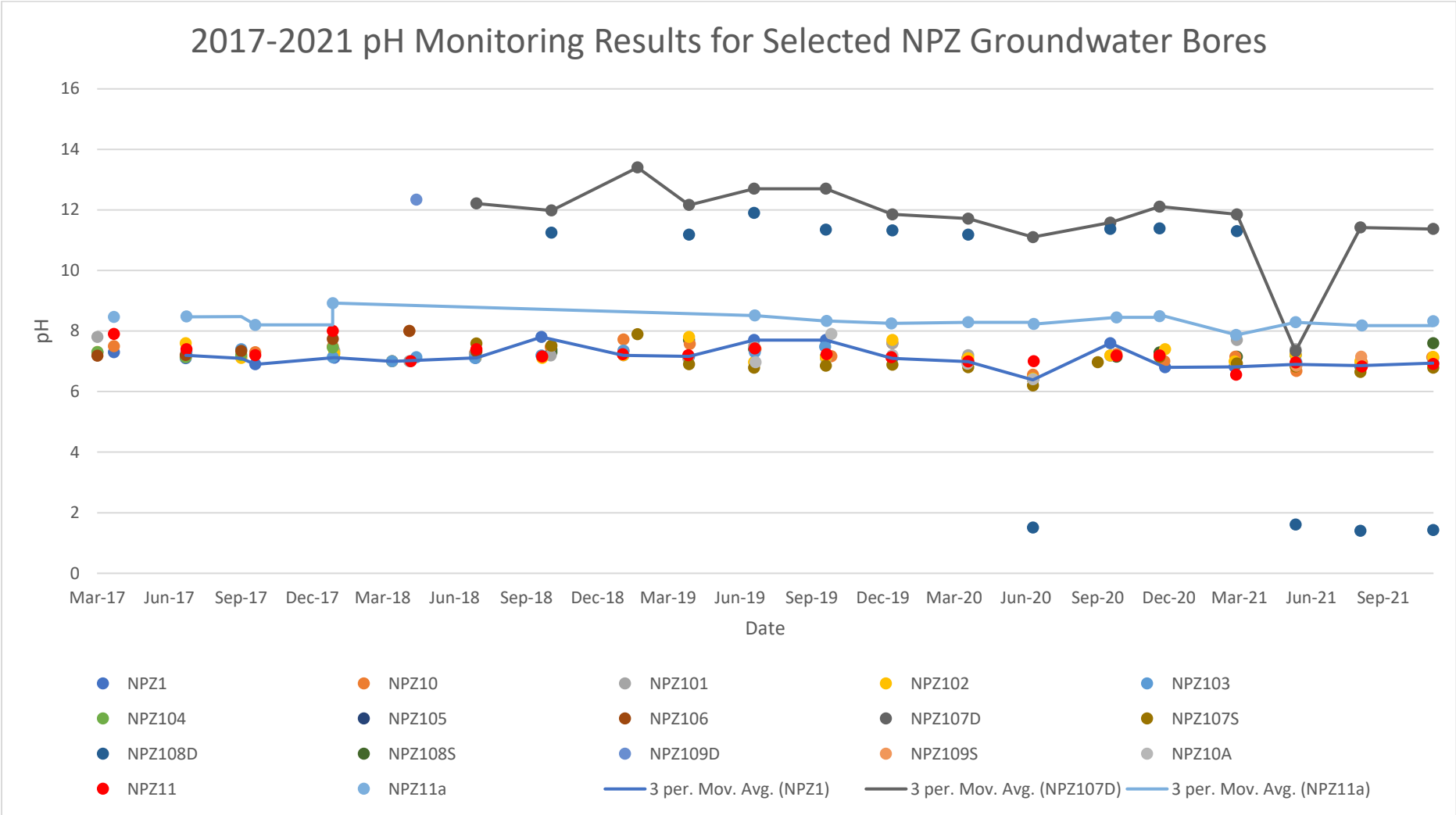
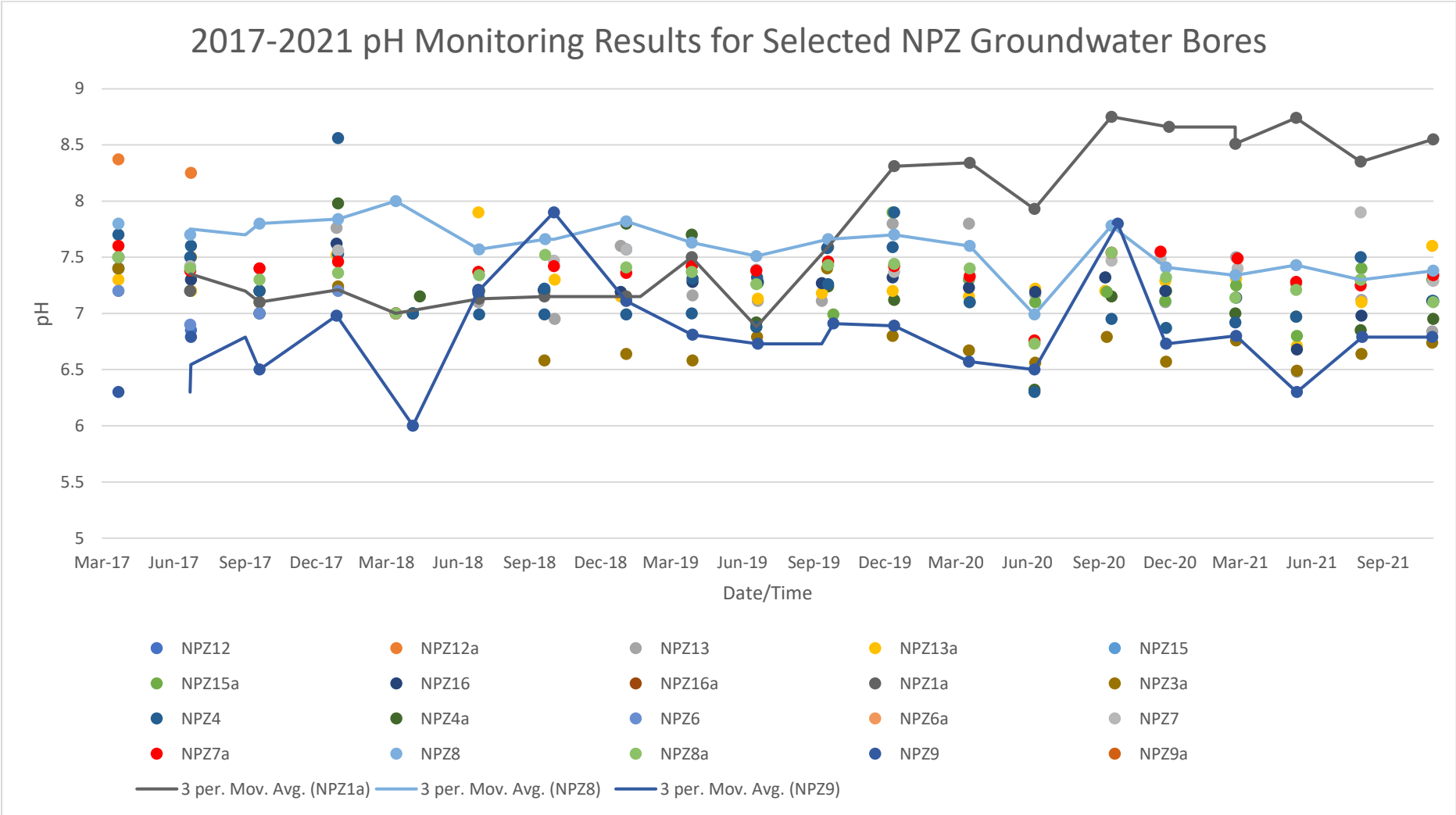


Figure 25: Historical pH Monitoring Results for Selected NPZ Groundwater Bores (2)



APPENDIX H – Community

Table 33: MGO Summary of Community Complaints 2021

Date	Time	Site	Nature of Complaint	Company Response
January				
No community complaints received.				
February				
No community complaints received.				
March				
No community complaints received.				
April				
04/04/2021	7:58am	Glendell	Noise	A complaint was received via the Mt Owen complaints hotline by a Camberwell Village community member. The complaint stated that "it's noisy on a Sunday morning and it is a public holiday." Mt Owen Complex Environment and Community personnel investigated the complaint ultimately finding that no noise alarms had been received during or prior to the complaint being received. Noise levels were below the compliance limit (40dB). Noise levels were measured at 31dB (LAeq) at the time of the complaint. The complainant did not wish to be contacted.
May				
No community complaints received.				
June				
No community complaints received.				
July				
31/07/2021	9:53am	Glendell	Noise	A complaint was received via email by a Camberwell Village community member regarding operational noise. The complainant stated that they had initially called the Mt Owen complaints hotline but were put on hold for an extended period. Between 7am and 9am, prior to the complaint being received, several noise alarms were received via the Dust and Noise Tool (DNAT). Operational changes were made in response to these alarms. All equipment in Glendell Barrett Pit was shut down and noise levels were monitored. Noise levels continued to exceed at Camberwell monitor (Sx 12). Live stream noise recordings were monitored and clearly showed audible highway noise. A soft start-up was commenced to review Glendell Barrett Pits incremental noise impact. Noise alarms continued to be received throughout this time. During this period only two dig units (EX101 and EX152) were operational as per the mine plan, all dumping was completed in-pit, no crushing works were undertaken, and no rehabilitation works were undertaken. No noise alarms were received after 9am during and after the complaint period. Because the complaint was received via email (on a Saturday) and not through the site hotline, Environment and Community personnel were not aware of the complaint at the time. The Environment and Community manager responded to the complainant via email on Monday 02/08/2021.
August				
22/08/2021	9:02am	Mt Owen	Noise and Air Quality	A complaint was received by a community member regarding noise and air quality. Upon receipt of the complaint a dust inspection of the North Pit was carried out. Real time air quality and noise monitoring results were reviewed. Air quality was measured at 64.5µg/m^3 and did not exceed the compliance limit of 80µg/m^3. Noise was measured at 39dB and did not exceed the compliance limit of 42dB. The complainant was

Date	Time	Site	Nature of Complaint	Company Response
				contacted by the Glencore Environment and Community Manager at 10:33am on 22/08/2021.
September				
20/09/2021	12:45pm	Glendell	Air Quality	A complaint was received via direct call from a community member regarding air quality. The complainant informed Mount Owen Complex Environment and Community Personnel that dust from West Pit RL170 dump area could be seen whilst driving along Glennies Creek Road. An air quality inspection was immediately carried out from Glennies Creek road upon receipt of the complaint. Real time air quality data received at the time of the complaint was measured at 29.2µg/m^3 and did not exceed the 50µg/m^3 compliance limit. Operations were modified in response to the complaint with the truck fleet being diverted from RL170 dump area to RL120 dump area within the pit. Video footage was reviewed to identify areas of improvement. The complainant requested that an SMS be sent to them with the review of operations that was carried out, this was completed at 6:36pm on 20/09/2021.
October				
No community complaints received.				
November				
No community complaints received.				
December				
No community complaints received.				

GLENCORE