




MGO
MT OWEN/GLENDELL OPERATIONS
GLENCORE

ANNUAL REVIEW
1 January 2019 – 31 December 2019

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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, ML1694, ML1741, 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	01/01/2019
Annual review end date	31/12/2019
<p>I, Jason Desmond, certify that this audit report is a true and accurate record of the compliance status of Mt Owen Complex for the period 01/01/2019 to 31/12/2019 and that I am authorised to make this statement on behalf of Mt Owen Complex.</p> <p><i>Note.</i></p> <p>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.</p> <p>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).</p>	
Name of authorised reporting officer	Jason Desmond
Title of authorised reporting officer	Environment and Community Manager
Signature of authorised reporting officer	
Date	31/03/2020

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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 2019 to 31 December 2019. It is required under:

- Schedule 5, Condition 5, of Development Approval SSD-5850 (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 Primary and Environment (DP&E) Annual Review Guideline, dated October 2015.

Mt Owen Complex (MOC) produced a total of 14.14 Million tonnes of run of mine (ROM) coal during the reporting period. Product coal railed from site totalled 7.65 Million tonnes (see [Table 1](#)).

Table 1: Summary of ROM and Product Coal

Site	2019 ROM Coal (Mt)	ROM Consent Limit (Mt)	2019 Product Coal (Mt)
Mt Owen	8.93	10	5.10
Glendell	4.24	4.5	2.59
Ravensworth East	1.49	4	0.80
Total	14.66	17*	8.49

*Only 17 million tonnes of ROM Coal allowed to be processed via CHPP in a calendar year as per SSD-5850

A total of 971 trains were loaded during the reporting period.

On 4 September 2019 DPIE approved Mt Owen Continued Operations Modification 2 (SSD-5850) and on 12 September 2019 EPA approved the surrender of EPL 10860 (Ravensworth East) and activities within this EPL has now been amalgamated with EPL 4460 (Mt Owen).

Air Quality

No short term impact exceedances were recorded during the reporting period. PM₁₀ and TSP concentrations in 2019 did not exceed the criteria at any of the monitoring locations. All depositional dust records were below the annual criteria of 4.0 g/m²/month except for DG8 which presented an annual average of 4.7 g/m²/month, the increased results were linked to the busfires in NSW (further information presented in the [Appendix F](#)).

MOCO EIS predictions of air quality in the vicinity of MOC were generally higher than the measurement data, indicating the background levels may have been over-estimated. Glendell EIS predictions of air quality in the vicinity of MOC were generally lower than the measurement data. There is no clear trend in maximum historical PM₁₀ or TSP concentrations. Three locations have experienced depositional dust levels above the criterion in the past five years. Neither PM₁₀ or TSP monitors recorded above the annual criterion in 2019 or in the past four years.

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 2019 in consultation with relevant government agencies. MGO will seek approval for the revised water management plans in 2020.

2019 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 2019. All of these results were within the historical range. The sites that triggered SWMMP criteria in 2019 were internally reviewed in accordance with the 2019 SWGWRP. These reviews confirmed that external reporting of these results was not required in line with the SWGWRP. These sites were all sampled under “no flow” conditions during 2019.

Stream condition at Bowmans Creek and York’s Creek has remained stable to that of 2018. There was either no change or a slight decrease in stream health at Swamp Creek from 2018. At Bettys Creek and Main Creek, stream health remained constant compared to 2018. Creek diversions onsite undergo quarterly condition monitoring and annual stream stability and stream health assessments. Outcomes of Creek monitoring show mixed results, with decreased conditions, improved conditions, or no change.

MGO monitor groundwater level and quality for 98 groundwater monitoring bores as per the MGO GWMMP. Monitoring results for a number of bores exceeded the decline in level (drawdown) during 2019. Review of water quality results and comparison to trigger levels for EC and pH identified several trigger exceedances in 2019. Generally, these exceedances were either in line with historical trends or correlated with rainfall events.

Biodiversity

MGO completed its second 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 2020.

In addition, comprehensive fauna and flora monitoring surveys were conducted at MGO offsets in 2019, identifying a critically endangered tree *Rhodamnia rubescens* (Scrub Turpentine) on Mitchell Hills Offset, field cameras deployed in 2019 also revealed presence of the threatened Spotted-tail Quoll at a number of locations throughout MGO. 12 threatened species were recorded during the report period which included 6 bird species, 3 non-flying mammals and 3 microbat species.

A total of 163 new habitat structures were installed at MGO in 2019 (87 throughout the biodiversity offsets and 76 on rehabilitation areas) with a usage rate of 6.5% as most of those boxes were installed at the start of 2019.

Monitoring of the River Oak compensatory planting program undertaken in 2016/2017 showed that less than 10% survived. A further 2000 trees were planted in April 2019 and the planted area fenced to avoid further animal disturbance, MGO will report the germination rate success in next report period. The weed action plan implemented in 2018 continued in 2019, with targeted weed control continuing across MGO offsets and rehabilitation areas.

During 2019 MGO became aware of one non-compliance with the EPBC Approval, EPBC 2013/6978. The non-compliance relates to MGO's failure to notify the Commonwealth Department of Environment and Energy (DoEE) of the modification (2) of DA SSD-5850 within 14 days of its approval. MGO has since notified DoEE as soon as it became aware of the non-compliance.

Noise

The noise monitoring program for MGO incorporates both continuous noise monitors and attended noise monitoring. During 2019 Mt Owen complied with all noise limits. Similarly Glendell complied with all noise limits as specified in the EPL and Development Consent. 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.

During 2019 MGO acquired a new Sentinex unidirectional noise monitoring unit (Sx11). This unit was installed in the Greeland area to allow for improved understanding of noise contributions from the Mt Owen operation in this area. MGO also continued to develop the Noise Analysis Tool (NAT), to assist Mining Supervisors to plan and modify operational controls in adverse noise conditions.

Blasting

There was an increase in the number of blasts during 2019, a total of 248 blasts occurred at MGO compared to 219 in 2018. 2019 blasting consisted of 103 at Mt Owen, 104 at Glendell and 41 at Ravensworth East. No blasting was undertaken in the North Void. MGO recorded no non-compliances with the Blast Management Plan during 2019.

Heritage

Inspections were carried out during the 2019 reporting period for Aboriginal and European cultural heritage sites, in accordance with the Ground Disturbance Permit process. In 2019 MGO, in conjunction with two Registered Aboriginal Parties (RAPs) and an OzArk archaeologist, continued the monitoring of Aboriginal heritage sites across both MGO and Integra Underground. During 2019, no Aboriginal or European heritage sites were salvaged. Artefacts salvaged are under the care of MGO and will be housed in the storage facility at the Wollombi Brook Conservation Agreement Area in the future. There were no environmental incidents relating to Aboriginal heritage in 2019.

During the reporting period MGO continued to care for Ravensworth Homestead and undertake quarterly monitoring of European sites. Unfortunately, on Saturday evening the 18th May, the original Ravensworth Public School was subject to a suspected arson attack resulting in severe fire damage. The property described as Lot 11, DP 825904, owned by Glendell Tenements Pty Ltd is now under Development Consent 8.2019.152.1 as a result of the damage sustained. The former Ravensworth Public School will be reduced to a managed ruin during 2020.

Rehabilitation

Rehabilitation continued across the MGO during 2019 generally in line with the Rehabilitation Management Plan (RMP) / Mining Operations Plan (MOP). Glendell completed 54 ha of rehabilitation during 2019 including 10 ha of open grassland or pasture areas and 44 ha of open woodland areas. In 2019 Mt Owen prepared and seeded a total of 50 ha of open forest rehabilitation. This included 27.5 ha of the natural landform design technique being incorporated at Mt Owen North Pit.

Rehabilitation across MGO was generally stable and no critical erosion features were identified. There is however localised active erosion in one area located near the West Pit tailing's dam which exceeded the relevant MOP completion criteria. This includes several areas with low severity tunnel erosion and/or moderately severe rill erosion which requires maintenance. Repairs to this area is planned in 2020. 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 44 environmental incidents during the reporting period, compared to 43 environmental incidents in 2018. Thirty seven incidents were classified as category 1, zero was classified as category 2, and seven were classified as category 0. Of the 37 Category 1 incidents, 35 were hydrocarbon spills less than 1000 L, two related to coolant spills. Contaminated material was collected and taken to the bioremediation area at Glendell and Mt Owen for treatment.

Community Complaints and Consultation

During 2019, one community complaint was recorded at MTO. The complaint was in relation to dust emissions, a response was provided to DPIE. Glendell and Ravensworth East received a total of 43 community complaints consisting of 24 relating to noise, one for lighting and 9 relating to air quality. Two Community Consultative Committee (CCC) meetings and two Community Gathering were held during 2019.

Visual Impact

During the reporting period a dilapidated dairy on Glennies Creek Rd and fire damaged building at 140 Picton Lane were demolished. Further fence replacement and farm waste removal were undertaken to improve visual amenity in the local area.

In accordance with MOCO MOD 2 Schedule 3 Condition 39A a visual tree screen was planted adjacent to Falbrook Rd. As a result of the extremely dry conditions in 2019 there was a low survival rate further inspections, maintenance and planting is planned for 2020.

Demolition Works

During the reporting period the fire damaged former property at 140 Picton Lane was dismantled and disposed of to improve local visual amenity and farming land. Approximately 188 tonnes of waste was removed from the site including 84.62 tonnes of mixed waste, 101.14 tonnes of concrete waste and 2.4 tonnes of steel.

To improve visual amenity on Glennies Creek Rd a dilapidated dairy was demolished and disposed of. Approximately 107 tonnes of waste was removed from the site including 71.36 tonnes of mixed waste, 33.76 tonnes of concrete waste and 2.2 of asbestos material.

Independent Audit

MGO continued to implement recommendations from the 2017 Independent Environmental Audit during the reporting period. The next Independent Audit is to be scheduled for Q4 2020.

1.2 Statement of Compliance

Mt Owen/Glendell Operations (MGO)) incorporates:

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

During the reporting period, each operation functioned under their own development consent and Environmental Protection Licence (EPL), together with mining licences (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 site's major approvals during 2019. Non-compliances are listed in **Table 3** and detailed in later sections of this report.

Table 2: Statement of Compliance for 2019

Relevant Approvals	Compliance
MOC Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	Yes
DA SSD-5850 (Mt Owen / Ravensworth East)	No
DA 80/952 (Glendell)	No
EPBC 2013/6978	No
Mt Owen EPL 4460	No
Glendell EPL12840	No
Ravensworth East EPL10860 – surrendered on 19 th of September 2019	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

Relevant Approvals	Compliance
ML 1629	Yes
ML 1741	Yes
ML 1794	No
MPL 343	Yes
Water Licences	Yes

Table 3: Non-Compliances

Relevant Approval	Condition #	Condition Description	2019 Compliance Status	Comment	Annual Review Section
DA SSD-5850	Schedule 3, Condition 18	Air Quality Operating Conditions	Non-Compliant	\$15,000 Penalty Notice was received due to an event on 16 August 2019.	Section 10
DA 80/952	Schedule 3, Condition 20 Table 10	Depositional Dust outside of the Long Term Impact Assessment criteria	Non-Compliant	DPIE was notified upon receipt of December 2019 monitoring results	Section 6.3
EPL 4460	M 2.2 Point 8	24 hour average PM10 results not captured by SX13 D8	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPL 4460	M 2.2 Point 9	24 hour average PM10 results not captured by SX13 D10	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPL 4460	M 2.2 Point 10	24 hour average PM10 results not captured by SX13 D9	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPL 10860	M 2.2 Point 6	24 hour average PM10 results not captured by SX13 D8	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPL 12840	M 2.2 Point 12	24 hour average PM10 results not captured by EBAM 1	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPL 12840	M 2.2 Point 13	24 hour average PM10 results not captured by EBAM 2	Non-Compliant	No continuous air quality monitor due to a technical fault, planned maintenance and Telstra outage.	Appendix F
EPBC 2013/6978	1(d)	Notification to DoEE	Non-Compliant	DoEE was not notified within 14 days of MOCO MOD 2 Approval	Section 11
ML 1794	1 (a)	Notification to landholders within 3 months	Non-Compliant	Landholders were not notified within the 3 month window.	Section 4.3

Compliance status key for Table 2:

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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 harm (e.g. submitting a report to government later than required under approval conditions)

1.3 Statutory Requirements

Various statutory approvals stipulate the requirements related to this Annual Review. These requirements are summarised in [Table 4](#).

Table 4: 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: <ul style="list-style-type: none"> 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, 11 (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
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

Approval	Condition	Relevant Section of Document
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	6.5
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)	6.6
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 Director-General.	043. Entire document 044. Entire 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 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) 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,	04. The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General.	04. Whole document 05.

Approval	Condition	Relevant Section of Document
Schedule 00 Conditions 04 and 05	05. The EMR must: <ul style="list-style-type: none"> - 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. 	<ul style="list-style-type: none"> - 8 - 18 - Entire document - Entire document
Mining Tenements ML1694 and MP0343, Schedule 00 Condition 04	<p>The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General.</p> <p>The EMR must:</p> <ul style="list-style-type: none"> (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. 	<ul style="list-style-type: none"> i) 8 ii) 18 iii) Entire document iv) Entire document

2 Introduction

The Mt. Owen/Glendell Operations (MGO) comprises of (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 reporting period 01 January 2019 to 31 December 2019. The report has been prepared in accordance with the NSW Department of Primary and Environment (DP&E) Annual Review Guideline, dated October 2015. It covers the reporting requirements of:

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

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, Ravensworth East and Glendell.

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

Mount Owen Continued Operations (MOCO)

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

A modification to DA SSD-5850 was approved in August 2017 to allow for the inclusion of the Greater Ravensworth Water Sharing Scheme (GRAWTS), and the construction of a water pipeline from Integra Underground Mine to MGO.

A second modification to DA SSD-5850 was approved September 2019 to allow an increased disturbance area and extend mining operations to 31 December 2037.

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 MOC. A further modification of the DA 80/952 was undertaken in February 2008. This was to allow for mining operations to continue until the end of June 2024, and to permit extraction of up to 4.5 Mt of ROM coal annually. 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.

Ravensworth East Open Cut Coal Mine

Ravensworth East was acquired in 1997 by Peabody Resources Ltd. In March 2000, DA 52-03-99 was granted. This was to enable production of up to 4 Mtpa. This allowed mining operations to commence in August 2000 and continue for up to 21 years.

Enx Resources (now Glencore) purchased Ravensworth Operations Pty Ltd in March 2002. The operation included the Ravensworth East and Narama mines. A mining operations plan (MOP) was granted in December 2002, which allowed for the transport and processing of coal from Ravensworth East to the MTO CHPP. Modification to the DA in 2005 allowed the integration of Ravensworth East with MTO.

In 2016, Modification 6 to the DA was approved. This allowed an integrated tailings management strategy between Liddell Operations, Ravensworth Operations and the MOC.

In January 2018 an application was made to DP&E to surrender DA 52-03-99 as Ravensworth East has been included in SSD-5850. Approval to surrender DA 52-03-99 was received from DP&E on 29 May 2018.

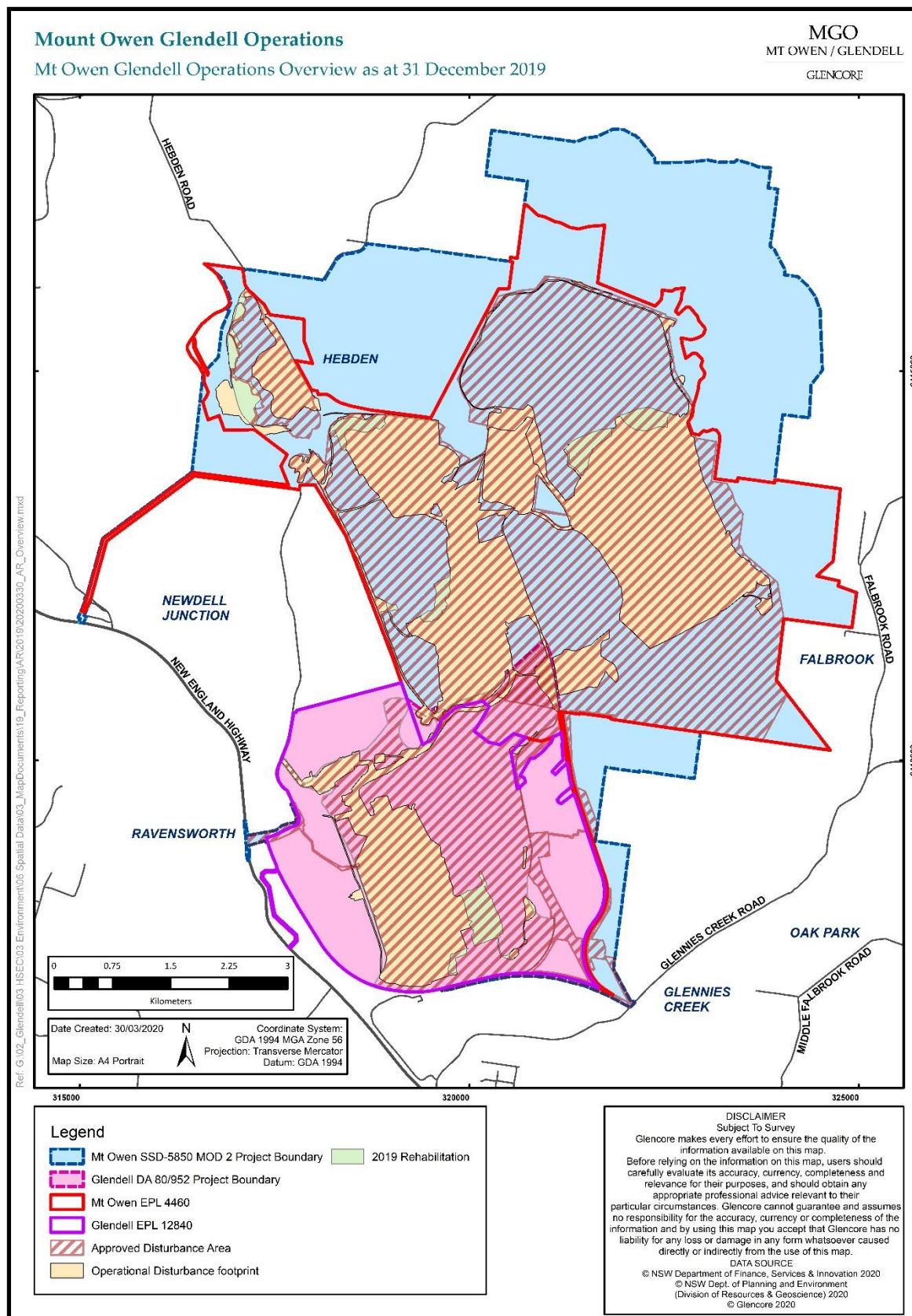


Figure 1: Mt Owen/Glendell Operations Overview and Disturbance as of 31 December 2019

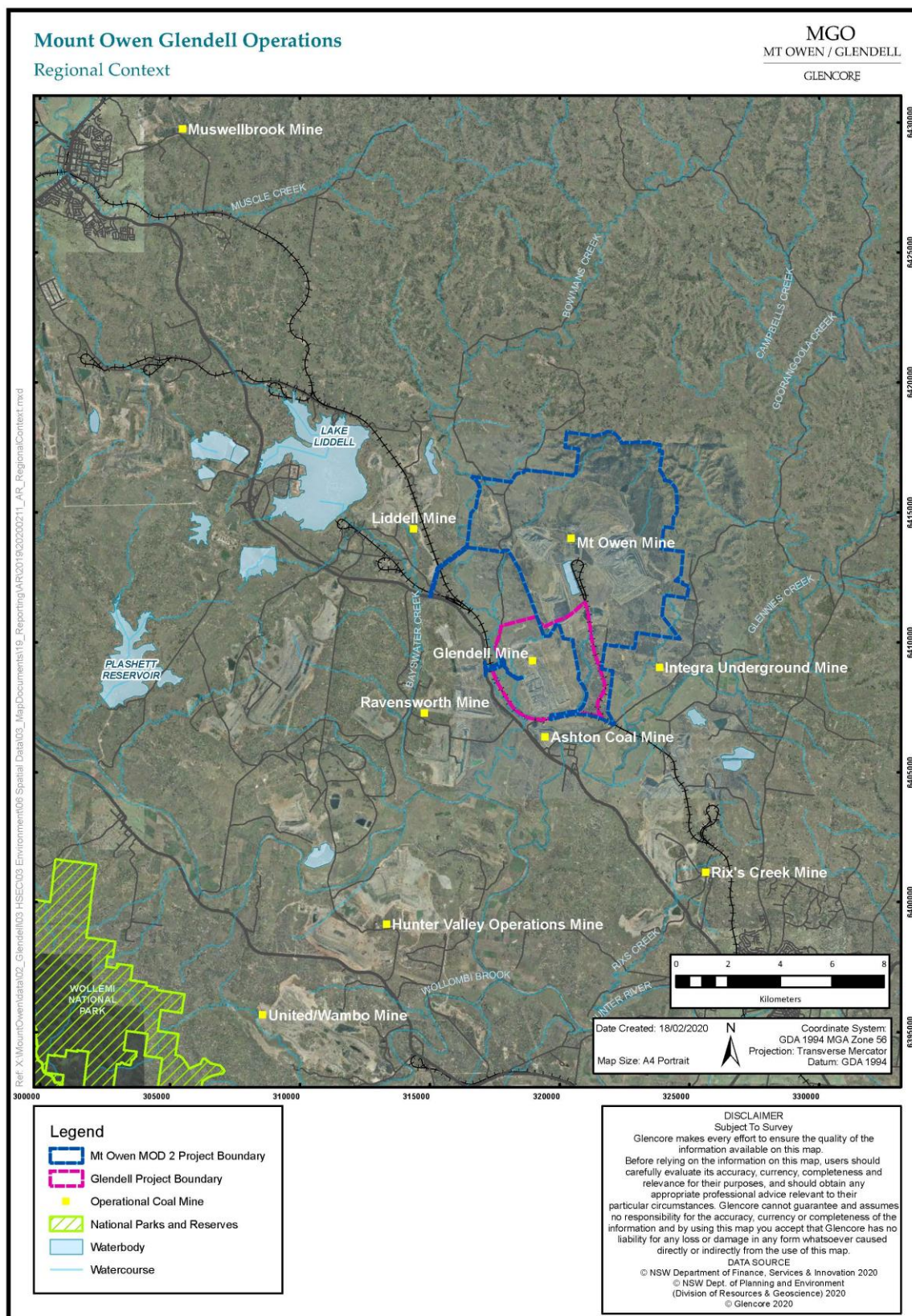


Figure 2: MGO Overview – Regional Context

Mine Contacts

Mine contacts are provided in [Table 5](#).

Table 5: MGO Contact Details

Name	Position Held	Contact Details
Mount Owen Complex Management		
Geoff Kelly	Mt Owen 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 (Acting)	(02) 6520 2693
Jason Desmond	Environment and Community Coordinator	(02) 6520 2693
Mike Pereira	Environment and Community Officer	(02) 6520 2677
Mel Dillon	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.mtowencomplex.com.au

3 Approvals

MGO operates under a number of approvals and licences which are summarised in [Table 6](#) and illustrated in [Figure 3](#).

Updates to MGO approvals throughout the year as follows:

- 4 September 2019 - Mt Owen SSD-5850 Modification 2 was approved by DPIE. This approval provides an extension to the mining area at North Pit to enable access to an additional approximately 35Mt of ROM coal extending the Mount Owen Mine life by an additional 6 years to 2037.
- 19 of September 2019 - EPL License No. 10860 was surrendered and amalgamated with EPL 4460.
- 20 December 2019 - MGO MOP for the period 2020-June 2024 was approved by DPIE RR until 31 December 2020.

As at 31 December 2019 MGO approvals awaiting determination:

- Mt Owen SSD-5850 Modification 3 awaiting DPIE approval. This modification relates to an additional land parcel being included within SSD-5850 Appendix 1 'Schedule of Land'.
- Glendell DA 80/952 Modification 4 referred to the IPC. This modification would allow for an additional 1.97Mt ROM coal and the construction of a western haul road within the current approval which expires 31 June 2024.

Table 6: MGO Approval Conditions

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
Mt Owen and Ravensworth East				
Approvals				
MGO MOP (Mt Owen, Glendell and Ravensworth East)	Mt Owen Complex Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	20/12/2019	31/12/2020	2020-June 2024 period
DA SSD-5850 (Mt Owen and Ravensworth East)	Development Approval SSD-5850	03/11/2016	31/12/2037	Mod 2 approved 4 September 2019
DA 14-1-2004 (Mt Owen)	Development Approval 14-1-2004	08/12/2004	08/12/2025	Surrendered 29 May 2018
DA 52-03-99 (Ravensworth East)	Development Approval 52-03-99	02/03/2000	02/03/2021	Surrendered 29 May 2018
EPBC 2013/6978	Environment Protection and Biodiversity Conservation (EPBC) Act approval 2013/6978	19/01/2017	31/12/2037	
WA 20CA200390	Water Supply Works and Water Use	01/07/2004	30/06/2027	
WA 20CA200779	Water Supply Works and Water Use	01/07/2004	29/12/2027	
WA 20WA200723	Water Supply Works	01/07/2004	03/01/2029	
WA 20WA201677	Water Supply Works	01/07/2004	28/06/2028	
WA 20WA200727	Water Supply Works	01/07/2004	08/10/2028	
WA 20WA210993	Water Supply Works – Swamp Creek Upper Diversion	01/08/2009	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 20WA212187	Water Supply Works – Bettys Creek Upper and Middle Diversion	01/08/2009	17/10/2022	

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
Leases and Exploration Authorisation				
ML 1355	Mining Lease	30/06/2014	23/07/2036	
ML 1419	Mining Lease	02/02/2015	12/11/2033	
ML 1453	Mining Lease	07/05/2001	04/07/2020	
ML 1561	Mining Lease	16/02/2005	16/02/2026	
ML 1475	Mining Lease	23/11/2000	23/11/2021	
ML 1608	Mining Lease	18/12/2007	19/12/2028	
ML 1410	Mining Lease	11/05/1997	04/07/2020	
ML 1415	Mining Lease	06/08/1997	04/07/2020	
ML 1476	Mining Lease	23/11/2000	23/11/2021	
ML 1694	Mining Lease	21/10/2013	22/10/2034	
CCL 715	Consolidated Coal Lease	25/04/1989	12/09/2019	Renewal sought
AL 8	Assessment Lease	11/07/2003	Awaiting reissue	
CL 383	Coal Lease	26/06/2014	12/11/2033	
A 423	Exploration Authorisation	11/01/2017	21/12/2018	Renewal sought
A 429	Exploration Authorisation	10/01/2017	27/07/2019	
A 268	Exploration Authorisation	13/09/2017	25/08/2022	
EL5824	Exploration Licence	18/06/2013	Awaiting reissue	Renewal sought
EL 6254	Exploration Licence	11/01/2010	03/06/2019	
EL6594	Exploration Licence	30/09/2016	06/07/2020	
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	
Section 100 (West Pit)	Emplacement Approval		08/08/2021	Tailings emplacement commenced in August 2015.
Licences				
EPL 4460	Environment Protection Licence 4460 (Mt Owen and Ravensworth East)	17/08/2017	02/09/2019 (Review Date)	
WAL704	Water Licence (High Security)	02/05/2008	Perpetuity	
WAL613	Water Licence (General Security)	01/07/2004	Perpetuity	
WAL7823	Water Licence (Domestic and Stock)	17/05/2010	Perpetuity	
WAL754	Water Licence (Domestic and Stock)	01/07/2004	Perpetuity	
WAL7817	Water Licence (Domestic and Stock)	17/10/2011	Perpetuity	

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
WAL7814	Water Licence (High Security)	15/03/2011	Perpetuity	
WAL18310	Water Licence (Unregulated)	16/05/2014	Perpetuity	
20BL168116	Groundwater Licence – Monitoring Bore	15/06/2001	Perpetuity	
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	
20BL171537	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	
20BL171544	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	
20BL171546	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	
20BL171547	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	
20BL169337	Groundwater excavation	15/03/2015	14/03/2020	
20BL169544	Saline Water Excavation Bore	24/02/2005	Perpetuity	
20BL170294	Groundwater Excavation	17/05/2012	14/3/2020	
20BL170295	Groundwater Excavation	17/05/2012	14/3/2020	
20BL168209	Groundwater Excavation	13/02/2012	Perpetuity	
Glendell				
Approvals				
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 20WA211430	Water Approval (Water Supply Works) – Swamp Creek Lower Diversion	01/05/2008	31/07/2022	
WA 20WA212660	Water Approval (Water Supply Works) – Bettys Creek Lower Diversion	11/02/2013	07/02/2023	
Leases and Exploration Authorisation				
CL 358	Coal Lease	26/03/1990	27/03/2032	

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
MPL 343	Mining Purposes Lease	16/06/1996	04/01/2026	
ML 1629	Mining Lease	08/03/2009	09/03/2030	
ML 1475	Mining Lease	23/11/2000	23/11/2021	
ML 1476	Mining Lease	23/11/2000	23/11/2021	
CL 382	Coal Lease	11/11/1991	11/11/2033	
EL 8916	Exploration Licence	4/12/2019	2/12/2022	
Licences				
EPL 12840	Environment Protection Licence 12840	17/08/2017	18/11/2019 (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	Perpetuity	
WAL637	Water Licence (General Security)	02/05/2008	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	
WAL1364	Water Licence (Supplementary Water)	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	
20CA200608	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027	
20CA201623	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	06/02/2019	Under renewal
20CA200445	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027	
20CA201862	Water Licence (Water Supply Works and Water Use)	01/07/2004	30/06/2027	
20BL171534	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	
20BL171535	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	
20BL171542	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	

MT OWEN GLENDELL OPERATIONS

Annual Review 2019

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
20BL171543	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	
20BL171545	Groundwater Licence – Monitoring Bore	03/10/2007	Perpetuity	

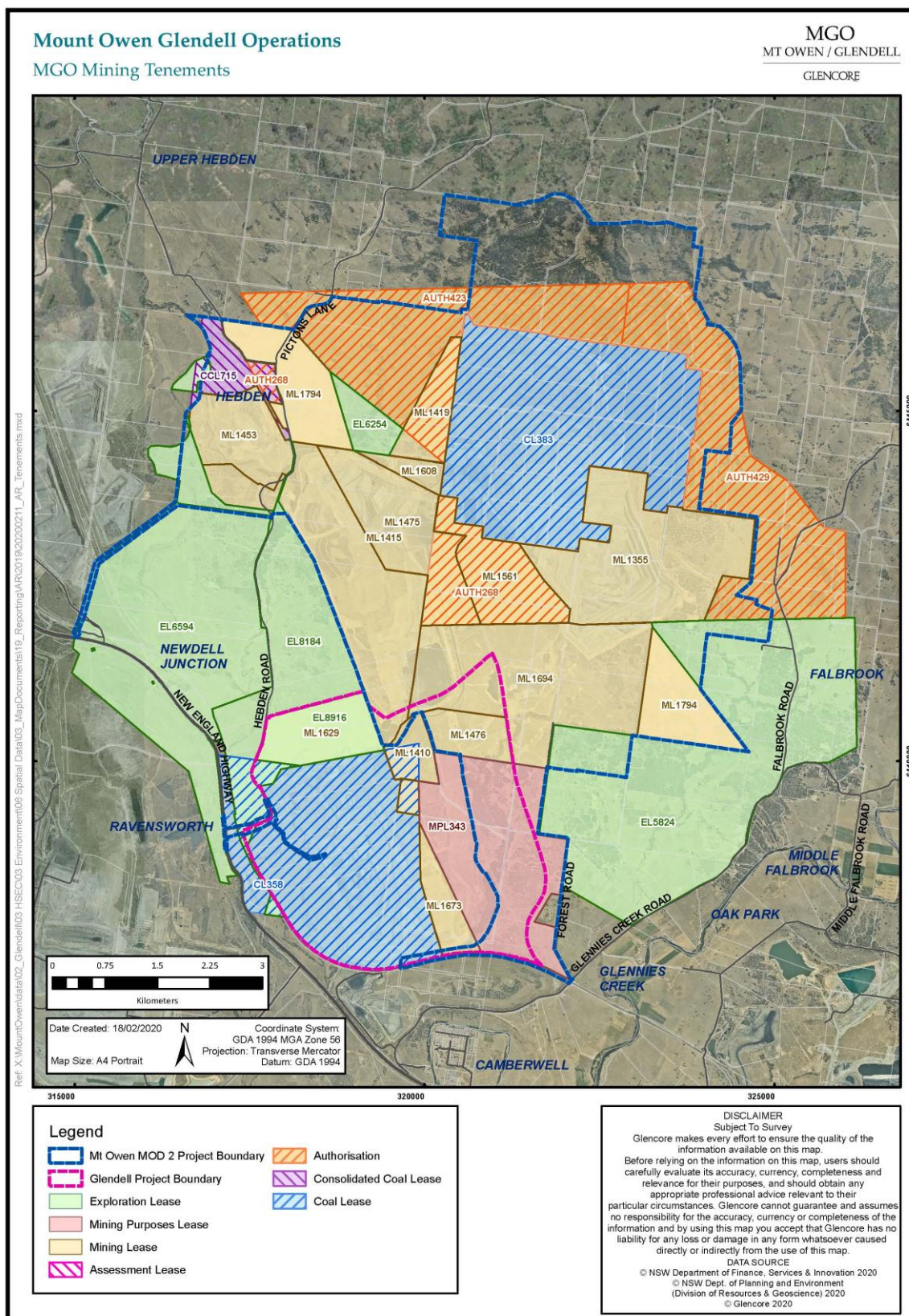


Figure 3: MGO Mining Tenements

Environmental management plans have been developed for MGO and are outlined in [Table 7](#). The date of the most recent review is provided below.

Table 7: MGO Environmental Management Plans

Environmental Management Plans	Revision Date
MGO Environmental Management Strategy	October 2017
MGO Pollution Incident Response Management Plan	November 2019
MGO Noise Management Plan	November 2019
MGO Blast Management Plan	October 2018
MGO Air Quality Management Plan	October 2018
MGO Aboriginal Cultural Heritage Management Plan (revised ACHMP submitted to DPIE on 2 December 2019)	May 2018
MGO Historic Heritage Management Plan	February 2020
MGO Water Management Plan (revised WMP submitted to DPIE on 31 December 2018)	November 2018
MGO Surface Water Management and Monitoring Plan (revised SWMMP submitted to DPIE on December 2019)	March 2019
MGO Groundwater Management and Monitoring Plan (revised GWMMP submitted to DPIE on 4 December 2019)	March 2019
MGO Erosion and Sediment Control Plan (revised GWMMP submitted to DPIE on 29 November 2019)	November 2018
MGO Surface Water and Groundwater Response Plan (revised GWMMP submitted to DPIE on 29 November 2019)	March 2019
MGO Creek Diversion Plan	February 2020
MGO Biodiversity Offset Management Plan (Incorporating the Flora and Fauna Management Plan and Offset Management Plan)	December 2018
MGO Mining Operations Plan / Rehabilitation Management Plan	December 2019
Glendell Greenhouse Gas and Energy Efficiency Plan	October 2017
Rehabilitation Strategy	June 2019

4 Operations Summary

4.1 Mining Operations

In 2019, MGO produced a total of 14.67 Mtpa of ROM coal, consisting of:

- 9.04 Mt for MTO
- 4.32 Mt for Ravensworth East Mine
- 1.32 Mt for Glendell Mine.

A total of 8.49 Mt product coal was produced, with MTO, Glendell and Ravensworth East producing 5.10 Mt, 2.59 Mt and 0.80 Mt respectively. The DA limit for ROM coal for MTO is 10 Mtpa, Ravensworth East is 4 Mtpa, and Glendell is 4.5 Mtpa. Details of the amount of ROM coal mined from each site, and the total amount of coal mined at the complex is provided in [Table 8](#).

Table 8: MGO Production Summary

Material	Approved limit (specify source)	2019 Reporting Period (Forecast)	2019 Reporting Period (Actual)	2020 Reporting Period (Forecast)
Mt Owen				
Prime Overburden (Mbcm)	-	39.75	40.36	39.87
ROM Coal Mined (Mt)	10 (Development Consent)	8.78	8.93	8.70
Saleable Product (Mt)	-	4.76	5.10	5.1
ROM Coal Fed (Mt)	-	8.78	9.04	8.42
Glendell				
Prime Overburden (Mbcm)	-	20.36	21.84	19.94
ROM mined (Mt)	4.5 (Development Consent)	4.12	4.24	3.70
Saleable Product (Mt)	-	2.31	2.59	2.00
ROM Coal Fed	-	3.99	4.32	3.48
Ravensworth East				
Prime Overburden (Mbcm)	-	10.73	9.59	9.14
ROM mined (Mt)	4 (Development Consent)	1.71	1.49	1.9
Saleable Product (Mt)	-	0.94	0.80	1.0
ROM Coal Fed	-	1.58	1.32	1.80
CHPP				
Coarse Waste Reject (Mt)	-	4.18	3.71	3.58
Total MGO ROM Coal Fed	17 (Development Consent)	14.35	14.68	13.69
Fine Waste Reject (Mt)	-	2.09	2.55	2.38

During 2019 a new MOP was drafted to include operational changes. The MOP was submitted to DPIE RR and approved 20 December 2019. In 2019, approximately 280 people were employed at Glendell, 45 at Ravensworth East and 528 at Mt Owen (65 Glencore and 463 Thiess).

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 ('Modification 1') to allow for the construction of a mine water pipeline from Integra Underground Mine to the 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 December 2019, Modification 3 (Mod 3), an administrative mod, was submitted to DPIE for the inclusion of one land parcel within the 'Schedule of Land'.

4.2.2 Glendell Continued Operations

Glencore is seeking approval to extend the open cut mining operations at Glendell, north from the existing Barrett Pit (Glendell Continued Operations Project (GCOP)). The extension of the current operations would extract an additional 140 Mt of ROM coal, down to the Hebden coal seam. This would extend the mining operations of 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 the end of the reporting period.

Glencore continued consultation with near neighbours and stakeholders regarding the project during the reporting period.

4.2.3 Glendell Mine – Modification 4 – Minor Extension

In November 2018 Glencore submitted an application to modify DA 80/952 to provide for a minor extension to the Barrett Pit at Glendell Mine in order to access an additional approximately 1.97 Mt ROM Coal (Modification 4). Thirty nine (39) submissions were received on the application, including four from government agencies and thirty five (35) from community members, organisations and special interest groups. A Response to Submissions was prepared and submitted to DPIE in May 2019. DPIE referred the Mod to the IPC during November 2019 for Determination.

4.2.4 Ravensworth East EPL - 10860 – Surrendered

In September 2019, the EPA approved the surrender of the EPL 10860 (Ravensworth East) and activities within this EPL has now been amalgamated with EPL 4460 (Mt Owen). The Mt Owen EPL 4460 was reviewed and approved by the EPA on the 19th of September. This revision included the update of the attended noise monitoring locations, inclusion of sewage treatment and mine water transfer locations.

Mt Owen Glendell Operations now has two approved EPLs, the newly reviewed Mt Owen EPL (4460) and the Glendell EPL (12840).

4.3 Other Operations

4.3.1 Train and Conveyor Movements

Table 9 summarises the train and conveyor movements undertaken at the MGO during 2019. Daily train movements are provided in **Appendix B**.

Table 9: MGO Train and Conveyor Movements

Train Movements	Total
Annual Average Daily Train Movements	2.86 Trains Per Day
Total Train Movements 2019	1039 Trains
Annual Average Daily Train Tonnage	23, 104 Tonnes Per Day
Annual Average Monthly Train Tonnage	698,886.90 Tonnes Per Month
Total Product Coal Loaded from CHPP	8.39 Million Tonnes
Average Train Loading Time	108 Mins
Average Load Rate (Tonnes per hour)	4,562.5 Tonnes Per Hour
Compliance Limit	May Process up to 17 Million Tonnes of 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.

Coal Transport Rates and Sales

ROM coal from MGO is transported for processing to 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 product coal from the MGO was 8.39 Mt. This included:

- 5.092 Mt from MTO
- 3.408 Mt from Glendell and Ravensworth East.

A total of 8.39 Mt of coal was loaded into 1039 trains (Table 9) and railed from site in 2019.

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).

4.3.2 Waste and Other Hazardous Material 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 1,281 tonnes of material was recycled at Glendell and Ravensworth East. This is slightly more than in 2018 (1,211 tonnes). There was more scrap steel recycled in 2019 compared to 2018 (approximately 21 tonnes), a

house and dairy demolition largely account for the difference. The recycling rate for 2019 (80.21 %) was higher than 2018 (75 %). This is likely due to the demolition and removal of waste from fire affected and dilapidated former properties which occurred in August and September 2019 (see [Section 6.9.4](#)). The demolitions produced approximately 292.8 tonnes of non-hazardous waste and 2.2 tonnes of asbestos.

At MTO approximately 1,366 tonnes was recycled in 2019. This is slightly more than in 2018 (1,320 tonnes). The recycling rate for 2019 (83.65%) was higher than 2018 (82%) An increase in MTO production resulted in more grease used on equipment and an increase in delivery of parts resulting in more timber pallets being recycled in 2019.

Waste oil, scrap steel, timber, paper and cardboard, oil filters and batteries were the major waste streams recycled during 2019 ([Table 10](#)).

Table 10: MGO Recycled Materials (2018 and 2019)

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2018	2019	2018	2019
Paper and Cardboard (t)	15.6*	14.2 (CHPP: 0.4)	10.5	9.26
Waste Oil (Hazardous) (t)	561.6	588.3	598.3	647.6
Grease (t)	3.3	7.0	0.9	1.18
Oil filters (t)	36.0	38.3	24.6	26.63
Batteries (Hazardous) (t)	15.9	14.9	7.2	5.2
Scrap Steel (t)	272.5	180 (CHPP: 49.3)	99.0	120.23
Timber (t)	24.8	47.9 (CHPP: 0.4)	64.5	8.02

*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 2019, 93 tyres at Glendell and 220 at Mt Owen were buried as compared to 106tyres at Glendell and 166 at Mt Owen in 2018.

Table 10: MGO Waste Tyre Burial 2018 and 2019

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2018	2019	2018	2019
Waste Tyres	166	220	106	93

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 a number of waste management improvement actions during 2019, including:

- MTO: Continued to recycle plastic straws. As a result 17 kg of straws were recycled.
- Glendell:
 - installation of large permanent bin signage was installed at Ravensworth East to ensure waste segregation.
 - introduction of plastic straw recycling in late 2019. Numerous plastic straws have been diverted from landfill.
 - ongoing waste segregation training to reduce contamination.

During the reporting period there were a number of hydrocarbon spills reported at MGO (refer 4.3.3) Contaminated soil from these spills was either transported to the onsite bioremediation area at the Glendell mine for land farming 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.

MOC recorded 42 environmental incidents during the reporting period. This is similar to 2018, where forty three (43) environmental incidents were recorded (see [Table 11](#)).

Table 11: MGO Environmental Incidents

Incident Category	Mt Owen Incidents		Glendell & Rav. East Incidents		Total Glendell/Mt Owen	
	2018	2019	2018	2019	2018	2019
Category 0	0	3	1	4	4	7
Category 1	22	8	7	29	38	37
Category 2	1	0	0	0	1	0
Category 3	0	0	0	0	0	0
Total	23	11	8	33	43	44

At MGO Environmental Incidents have slightly decreased from 2018. In 2019 there was zero Category 2 and 35 Category 1 incidents. However, there was a slight increase of Nil Categories from 4 to 7 which can be attributed to an increased awareness campaign.

Of the 35 Category 1 incidents:

- 32 were hydrocarbon spills less than 1000 L
- one suspected unauthorised sewage dumping into sewage treatment pond

The seven Category 0 (Nil Categories) incidents related to vandalism, and small hydrocarbon spills (<20 L).

A breakdown of the incidents is provided in [Appendix C, Table 2](#).

4.3.4 Land Ownership

MGO landholdings total over 9000 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.

Land ownership for MGO is summarised in [Table 12](#). During 2019, one property was acquired by MTO from a private landowner. The property, Lot 1 DP781057, is 48.2 ha, and adjoins existing MGO landholdings.

Table 12: Land Ownership

Operation	Land Owned (ha)	Land Leased (ha)
Mt Owen	6,634.59	331*
Glendell	2733.1	15.3
Total	9367.69	346.9

* Incorporates the leased crown roads associated with offset properties.

4.3.5 Exploration

During 2019, the following exploration activities were conducted:

- Integra exploration drilling for structure, coal quality and stress testing
- Glendell Continued Operations exploration drilling for structure, coal quality

Details are listed in Table 13.

Table 13: Exploration completed in 2019

Site	No of Holes	Surface Lease	Subsurface Lease 1	Subsurface Lease 2
Integra	5	EL5824	CL382	
Glendell Continued Operations	1	EL8184	CCL708 (Liddell)	
	2	ML1475	ML1415	CCL708 (Liddell)

4.3.6 Next Reporting Period

During the 2020 reporting period, it is projected that the following activities will occur at MGO;

Mt Owen

- Mining and dumping will continue in a south-easterly direction. Mt Owen has 13.4 hectares of rehabilitation planned, consisting of woodland areas.
- Capping and rehabilitation will continue to progress at North Void. There is 25.4 hectares of rehabilitation planned, consisting of pasture and woodland areas.

Glendell

- Mining and dumping will continue to the north. Glendell has several areas planned for rehabilitation; Tailings Pit 1 comprising of 8.5 hectares (Continued capping of tailings dam) and West Pit comprising of 48 hectares. This will consist of mainly pasture.

Ravensworth East

- Mining and dumping will continue in the Bayswater North Pit and will move southeast during 2020. Rehabilitation will focus on areas to the north, where mining is now complete. Rehabilitation at Ravensworth East is predominantly open woodland. No rehabilitation is planned for Ravensworth East in 2020 as the overburden dumps are progressively being dumped to final landform design.

5 Actions Required from Previous Annual Review

The 2018 Annual Review document was submitted to DPIE on 29th March 2019 in accordance with Schedule 5 Condition 5 of SSD-5850 (as modified) and Schedule 5 Condition 5 of DA 80/952.

Minor alterations to the 2018 Annual Review document were made at the request of DPIE and subsequently re-submitted on 27 June 2019. DPIE acknowledged their satisfaction of the 2018 Annual Review on 8 July 2019. The Resources Regulator acknowledged their satisfaction of the 2018 Annual Review on 24 September 2019.

Table 14 summarises the improvement actions from the 2018 Annual Review and their status as at 31 December 2019. DPIE and Resources Regulator did not require additional actions from the previous Annual Review.

Table 14: Actions Required from 2018 Annual Review

Action Required from Previous Annual Review	Action Taken	Section discussed in 2019 AR	Completion Date
MGO Improvements from 2019 Annual Review			
1. Acquisition of two ultrasonic wind sensors to replace the mechanical sensors, currently used for SX13M8.	Completed	Noise	2019 Q1
2. Relocation of older SX5 dust unit to Middle Falbrook (will be used as a spare monitor to better understand Mt Owen and Glendell contributions) and enhance Mt Owen NAT.	Completed	Noise	2019 Q2
3. Installation of two real time dust cameras, at Falbrook and Barrett Pit, to help manage visual dust impacts from Mt Owen and Glendell Operations.	Completed	Air Quality	2019 Q1
4. Review and simplification of dust alarm response.	Completed	Air Quality	2019 Q4
5. Acquisition of refurbished TEOM unit from USA to be used as parts replacement for old units	Completed	Air Quality	2019 Q3
6. Implementation of Glendell and Mt Owen Dust Analysis Tool on the existing Noise Analysis Tool (NAT) web page, to assist mining. Supervisors with the management of dust.	Completed	Air Quality	2019 Q1
7. Review the commitments in all approved management plans to remove duplications across licences.	Ongoing	All	-
8. Installation of 76 nest boxes and 10 chainsaw hollows in existing rehabilitation areas. Installation of rehabilitation track network and rehabilitation viewing platform at North Pit.	Completed	Rehabilitation	2019 Q3

Action Required from Previous Annual Review	Action Taken	Section discussed in 2019 AR	Completion Date
9. Further implement the actions from the Upper Betty's Creek Diversion Remediation Plan and add to 2018 remediation works.	Completed	Water	2019 Q1
10. Complete recommendations from 2018 Annual groundwater review.	Completed	Water	2019 Q4
11. Complete the recommendations in the Hansen Bailey Compliance Audit.	Completed	N/A	Completed in 2019
12. Progress the Wollombi Brook Cultural heritage Keeping & Teaching Place with the Bulga mine	Ongoing consultation with RAPs	-	Expected to be completed 2020 Q4

6 Environmental Performance

MGO environmental performance is measured against the criteria set out in:

- DA SSD-5850 for both MTO and Ravensworth East
- DA 80/952 for Glendell

An Environmental Management Strategy and specific management plans (see [Table 7](#)) have been developed to minimise environmental impacts from the MGO. They provide the strategic context for environmental management across the complex. Performance in the reporting period is discussed in the following sections.

6.1 Operational Noise

MGO has a range of management strategies in place to limit the generation of noise and noise impacts to the surrounding environment. During 2019, the following activities were undertaken:

- revision and update of the Mt Owen EPL 4460
- regular attended noise monitoring in accordance with the MGO Noise Monitoring Program
- inclusion of a new noise monitoring location (N17) in the Mt Owen EPL Attended Noise Monitoring Program
- noise monitoring supplementary to the regular noise monitoring to ensure periods of potential adverse weather were represented by monitoring data
- maintenance of the real-time noise monitoring Sentinex (Sx) network
- acquisition of directional real-time noise unit integrated to MGO Noise Monitoring 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 site specific personnel
- review and revision of MGO Noise Management Plan (including the Noise Monitoring Program) (NMP)
- continued implementation of a web-based Noise Analysis Tool (NAT) to assist in managing operational noise (refer [Section 6.1.2](#)) across MGO.

6.1.1 Noise Monitoring Program

The noise monitoring program includes both continuous noise monitors and attended noise monitoring. It is designed to measure the contribution that Mt Owen, 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 the routine attended noise monitoring. Unattended Sentinex (Sx) noise monitors provide supporting information to the compliance assessment process when high noise levels are recorded during the attended noise monitoring program.

The details of the noise monitoring locations (attended and real-time units) are provided in [Appendix D Table 3](#) and shown in [Figure 4](#).

Attended noise monitoring locations N1 to N4, N8 to N11 and N17 are shown on [Figure 4](#). 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. Locations are reviewed and where necessary, revised over the life of operations.

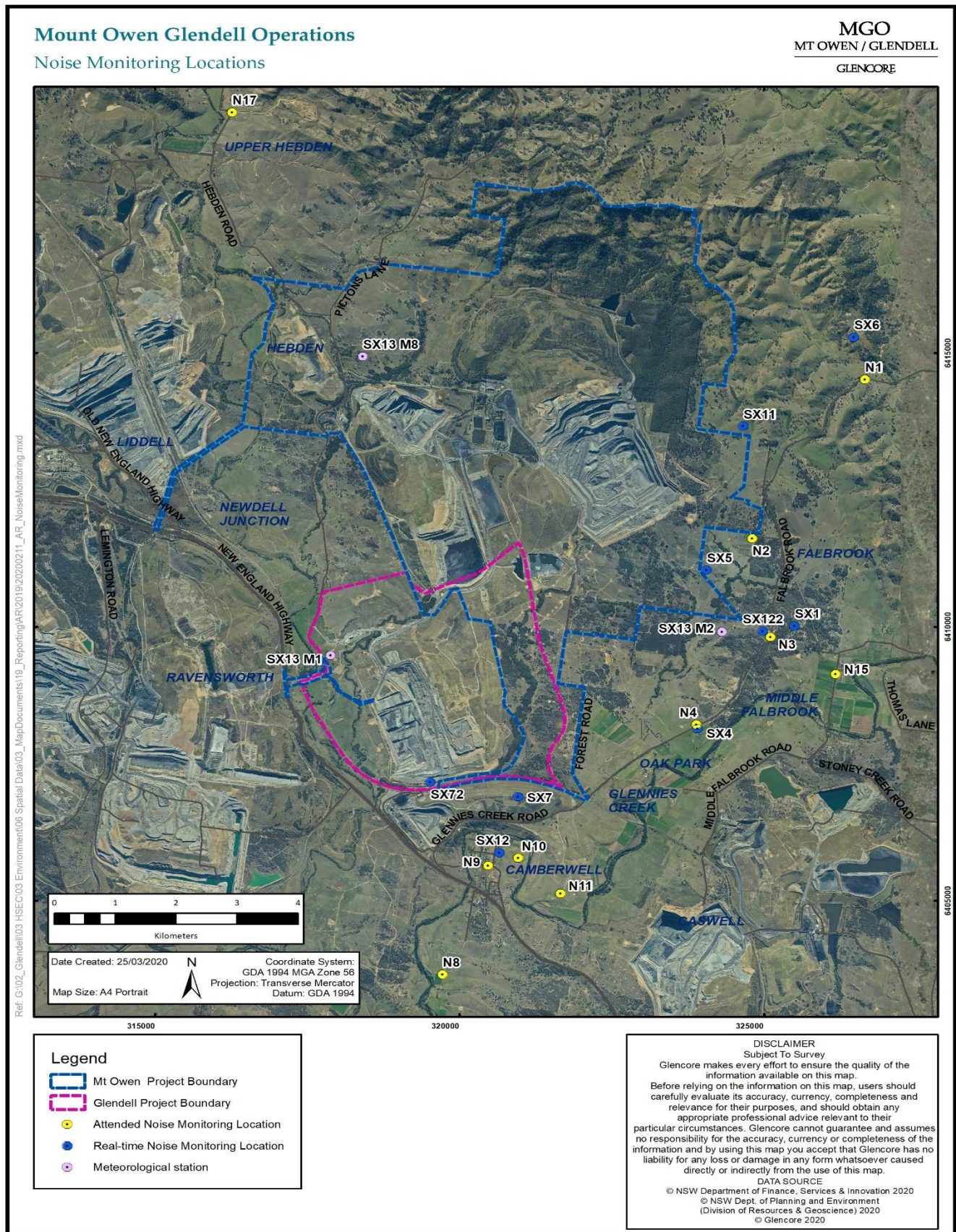


Figure 4: MGO Noise Monitoring Locations

6.1.2 MGO Dust and Noise Analysis Tool – DNAT

The Dust/Noise Analysis Tool (DNAT) continued to be utilised to monitor environmental impacts on the Camberwell, Falbrook and Middle Falbrook areas during the reporting period. The DNAT is a web page based tool that assists Mining Supervisors to plan and modify operational controls in adverse noise conditions. The readings from the Upper Hunter Air Quality Monitor in Camberwell were included in the webpage to assist in the management of dust.

6.1.3 MGO Sound Power Level Assessment

Glendell

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. Umwelt measured the sound power noise level of 12 plant items at the Glendell mine during 2019, inclusive of 5 retest items.

The assessment results are compared with the nominated sound power levels for the operating fleets in the Environmental Assessment for Modification of Glendell Mine Operations (Volume 2, August 2007). The Glencore Coal Assets Australia (GCAA) protocol GCAA 11.11 Noise Management provides the guideline for Sound Power Level testing and is used as a secondary reference. A copy of the assessment report is included in [Appendix D](#).

All equipment were tested against the ISO 6395:2008 Earth Moving machinery – Determination of sound power level – Dynamic test conditions. Of all 12 plant equipment tested only 1 plant item showed elevated results from previous test years and an action were raised with the maintenance department to review and check the equipment attenuated parts.

Mt Owen

Under the Mount Owen Continued Operations (SSD-5850) development approval a minimum of 20% of the mobile fleet requires sound power testing per year. Umwelt completed sound power testing of 16 plant items May 2019, representing approximately 24% of the fleet.

The assessment results were compared with the nominated sound power levels for the operating fleets 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 copy of the assessment report is included in [Appendix D](#).

Two plant items were above the nominated sound power levels for Mt Owen during the testing by more than 2 dB. The nominated sound power levels represent the average of the operating fleet where natural variation in the machines can result in some machines being below and some machines being the nominated sound power levels. The cut-off point to take a machine out of service occurs when the measured sound power level is greater than 2 dB above the nominated sound power levels. Following receipt of SPL testing results, the data was analysed in an effort to pinpoint the source of excessive sound. In addition, these machines will be retested as part of the 2020 sound power testing.

It was also noted that the monitoring results showed variability in the measured truck sound power levels with two additional machines above the nominated sound power levels by 2 dB or less. Various trucks were then inspected to ensure that noise attenuation

panelling were in place and undamaged, and truck exhausts were in good condition. These inspections were additional to the regular equipment servicing.

It was also noted that the bulldozers in reverse were up to 8 dB below the target sound power levels for Mt Owen.

6.1.4 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 Mt Owen in accordance with EPL 4460 during the reporting period. It is noted that noise monitoring point N17 representative NMG 4 was added to the Mt Owen attended noise monitoring campaign in September 2019 as part of the EPL4460 variation.

Results of the 2019 attended noise monitoring program are summarised in [Table 15](#) and [Table 16](#), for Mt Owen, and [Table 17](#) and [Table 18](#), for Glendell. Results indicate that, at the time of monitoring, both Mt Owen and Glendell Mines did not exceed the nominated criteria for each of the respective monitoring locations during applicable meteorological conditions. Full results for seasonal attended noise monitoring during 2019 can be found in [Appendix D, Tables 4 - 15](#) and [Appendix D, Figures 1 and 2](#). Seasonal noise reports are also available on the MGO website at www.mtowencomplex.com.au. The tabulated results presented in [Appendix D](#) 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 the predicted noise levels.

Attended monitoring results were compliant with the relevant criteria during the reporting period.

Table 15: Summary of Mt Owen 2019 Environmental Noise Level (dB(A)) Contribution (LAeq, 15min)

Location	Period	Criteria	Maximum Recorded Result 2019	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
N1	Day	35	<30	-	<25*	-	-	<25*	-	-	<30	I/A	-	-	-
	Evening	35	<20	-	<20	-	-	<30*	-	-	<20	I/A	-	-	-
	Night	35	<30	<25*	<20	<25	I/A	<30	I/A	32*	<20	I/A*	I/A	<25	<30*
N2	Day	N/A	40	-	<25	-	-	40*	-	-	32	<30	-	-	-
	Evening	N/A	41	-	<25	-	-	41*	-	-	<30	<25	-	-	-
	Night	N/A	42	<30*	<25	<30	I/A	39	33	42*	<25	<25*	I/A*	32*	39
N3	Day	41	<32	-	I/A*	-	-	<32*	-	-	I/A*	<30	-	-	-
	Evening	41	<32	-	I/A*	-	-	<32	-	-	I/A*	<30	-	-	-
	Night	41	<38	31*	30	<25	I/A	<32	<21	<38	I/A	<25*	<30*	37	<30*
N4	Night	42	39	I/A	36	I/A	I/A	<30	I/A	I/A*	I/A	I/A	<30	39	<35*
N8	Night	N/A	I/A	I/A*	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A*
N9	Night	N/A	I/A	I/A*	I/A*	I/A	I/A	I/A	I/A	I/A	I/A	I/A*	I/A*	I/A*	I/A*

MT OWEN GLENDELL OPERATIONS

Annual Review 2019

Location	Period	Criteria	Maximum Recorded Result 2019	Jan- 19	Feb- 19	Mar- 19	Apr- 19	May- 19	Jun- 19	Jul-19	Aug- 19	Sep- 19	Oct- 19	Nov- 19	Dec- 19
N10	Night	35	<20	I/A*	I/A*	I/A	I/A	<20	I/A	I/A	I/A	I/A	I/A*	I/A*	I/A*
N11	Night	35	<40*	I/A*	I/A*	I/A	I/A	<40*	I/A	I/A	I/A	I/A*	I/A*	I/A*	I/A
N17	Night	35	<30	-	-	-	-	-	-	-	-	-	<25	<30	I/A

Notes: "I/A" means Mt Owen Mine was inaudible at the time of monitoring.

"-" means monitoring not required during this period

"N/A" means there is no specific criteria for this monitoring location

* Adverse Meteorological Conditions present during monitoring. Noise criteria do not apply during adverse Meteorological Conditions (refer Appendix 4, SSD-5850 and MGO NMP, 2019)

Table 16: Summary of Mt Owen's Environmental Noise Level (dB(A)) Contribution (LA1, 1min) - Night

Location	Criteria	Maximum Recorded Result 2019	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
N1	45	40	<25*	<25	37	I/A	39	I/A	36	25	I/A*	I/A	<30	40*
N2	N/A	55	33*	27	33	I/A	51	40	55	<25	<25*	I/A*	42*	49
N3	45	<45	35*	39	<30	I/A	43	33	<45	I/A	<25*	38*	44	35*
N4	50	48	I/A	42	I/A	I/A	46	I/A	I/A	I/A	I/A	<30	48	<35*
N8	N/A	I/A	I/A*	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A	I/A*
N9	N/A	I/A	I/A*	I/A*	I/A	I/A	I/A	I/A	I/A	I/A	I/A*	I/A*	I/A*	I/A*
N10	45	44	I/A*	I/A*	I/A	I/A	33	44	I/A	I/A	I/A	I/A*	I/A*	I/A*
N11	45	43	I/A*	I/A*	I/A	I/A	43	I/A	I/A	I/A	I/A*	34*	I/A*	I/A

Notes: "I/A" means Mt Owen Mine was inaudible at the time of monitoring.

"N/A" means there is no specific criteria for this monitoring location

* Adverse Meteorological Conditions present during monitoring. Noise criteria do not apply during adverse Meteorological Conditions (refer Appendix 4, SSD-5850 and MGO NMP, 2019)

Table 17: Summary of Glendell's Environmental Noise Level (dB(A)) Contribution (LAeq, 15min) - Night

Location	Criteria	Maximum Recorded Result 2019	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
N1	N/A	I/A	I/A*	I/A	I/A	I/A	I/A	I/A	I/A*	I/A	I/A*	I/A	I/A	I/A*
N2	N/A	<25	I/A*	I/A	I/A	I/A	I/A	I/A	I/A*	<25	I/A*	I/A*	I/A*	I/A
N3	38	<35	<30*	I/A	I/A	I/A	I/A*	I/A	<30	I/A	I/A*	I/A*	I/A	<35*
N4	38	<35	<30	I/A	I/A	I/A	<30*	I/A	I/A*	I/A	<30	I/A	I/A	<35*
N8	35	<35	<30*	<25*	I/A	<30	<35*	I/A	I/A	I/A	I/A	I/A	I/A	<30*
N9	42	<42	I/A*	<25*	I/A	<30	<42*	I/A	<30	I/A	<35*	I/A*	<40*	<40*
N10	40	39	I/A*	I/A*	I/A	<30	39*	I/A	<25	I/A	<36	I/A*	<35*	<35*
N11	38	<30	I/A*	I/A*	I/A	I/A	I/A*	I/A	I/A	I/A	I/A*	I/A*	I/A*	I/A

Notes: "I/A" means Glendell Mine was not audible at the time of monitoring.

* Adverse Meteorological Conditions present during monitoring. Noise criteria do not apply during adverse Meteorological Conditions (refer MGO NMP, 2019)

Table 18: Summary of Glendell's Environmental Noise Level (dB(A)) Contribution (LA1, 1min) - Night

Location	Criteria	Maximum Recorded Result 2019	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
N1	N/A	I/A	I/A*	I/A	I/A	I/A	I/A*	I/A	I/A*	I/A	I/A*	I/A	I/A	I/A*
N2	N/A	32	I/A*	I/A	I/A	I/A	I/A*	I/A	I/A*	32	I/A*	I/A*	I/A*	I/A
N3	45	<40	<30*	I/A	I/A	I/A	I/A*	I/A	<40	I/A	I/A*	I/A*	I/A	<35*
N4	45	<35	34	I/A	I/A	I/A	<45*	I/A	I/A*	I/A	<35	I/A	I/A	<35*
N8	45	<30	33*	38*	I/A	<30	43*	I/A	I/A	I/A	I/A	I/A	I/A	<30*
N9	45	<40	I/A*	31*	I/A	32	45*	I/A	31	I/A	<40*	I/A*	44*	<45*
N10	45	<35	I/A*	I/A*	I/A	<30	45*	I/A	<30	I/A	<40	I/A*	35*	<35*
N11	45	34	I/A*	I/A*	I/A	I/A	I/A*	I/A	I/A	I/A	I/A*	I/A*	I/A*	I/A

Notes: "I/A" means Glendell Mine was inaudible at the time of monitoring.

"N/C" means there is no specific criteria for this monitoring location

* Adverse Meteorological Conditions present during monitoring. Noise criteria do not apply during adverse Meteorological Conditions (refer MGO NMP, 2019)

6.1.5 Continuous Improvement

As a part of the ongoing commitment to the management of noise impacts from the MGO, a range of activities have been undertaken during 2019 that fall within the continuous improvement program. The most important being:

- Ravensworth East EPL 10860 was amalgamated with Mt Owen EPL 4460
- Revision and update of the Mt Owen EPL 4460
- Implementation of Noise Management Plan and submission to DPIE for approval
- Modifications and improvement of real-time monitoring network
- Acquisition of a new Sentinex directional noise unit to replace Sx5, to better understand the MGO noise contribution in the Middle Falbrook area
- Relocation of the old Sx5 (now SX11) to Middle Falbrook (will be used as a spare monitor to better understand Mt Owen and Glendell contributions) and enhance Mt Owen NAT
- Review and simplification of noise alarm response
- Continued Implementation and improvement of Glendell and Mt Owen Noise Analysis Tool (NAT) to assist mining supervisors with the management of noise.

A number of activities to be undertaken in 2020 include:

- Continuous assessment and improvement of the real-time monitoring network and management alarms
- SMART alarming to be integrated in the NAT tool
- Approval of revised MGO NMP.

6.2 Blasting

6.2.1 Blast Management and Monitoring

MGO blast management practices for the life of operations are managed in accordance with the MGO Blast Management Plan. Blast monitoring locations are shown in [Figure 5](#).

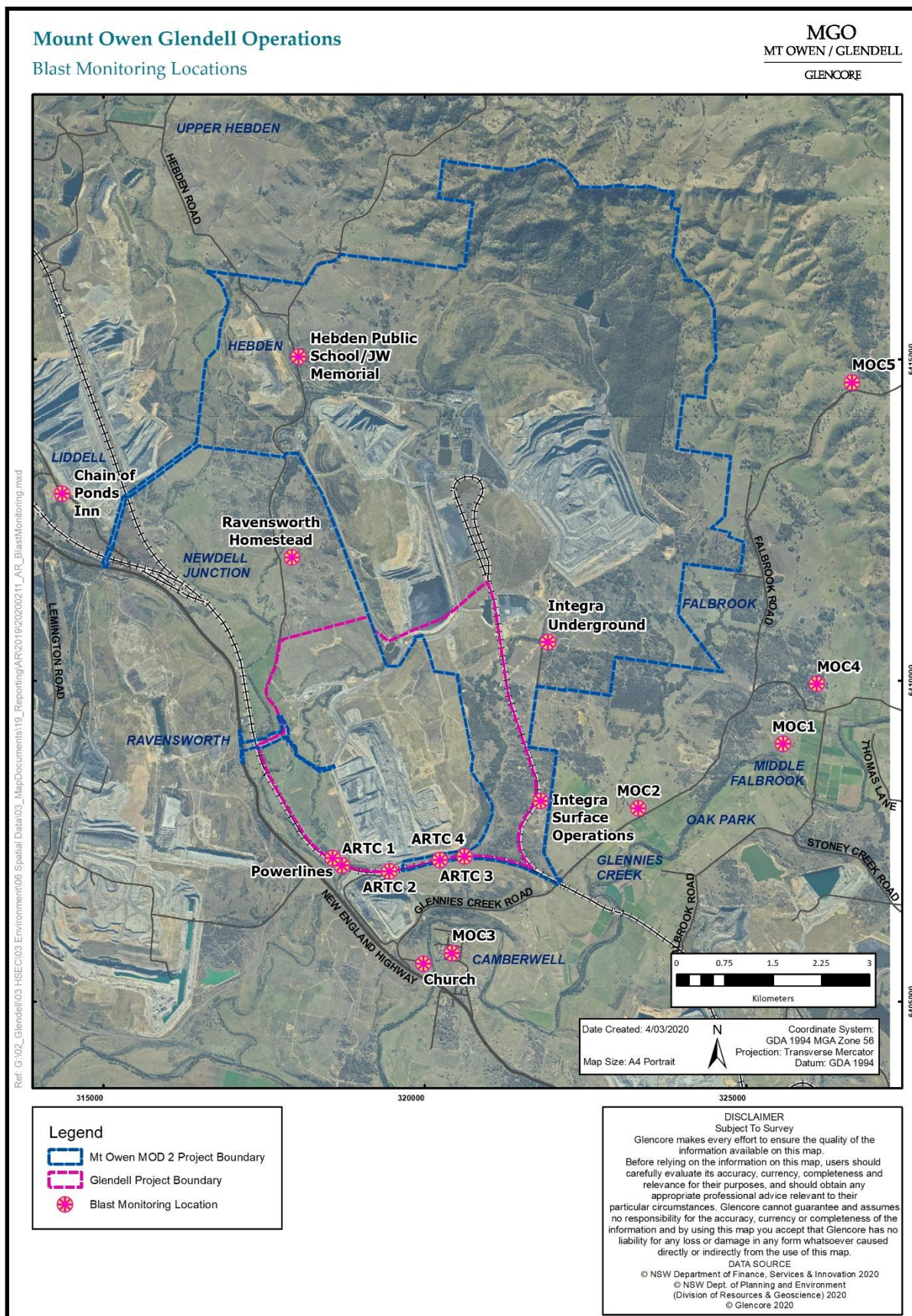


Figure 5: MGO Blast Monitoring Locations

6.2.2 Blast Performance

Table 19 summarises MGO's performance against the approved blasting hours and frequencies for 2019. **Table 20** summarises MGO's blasting criteria and performance for 2019. All blasts were fired within approved blasting hours. Two (2) blasts were fired at Mt Owen between 7am and 9am (Monday to Saturday inclusive). No blasts between the hours of 7am-9am (Monday to Saturday inclusive) were undertaken at Ravensworth East during 2019.

Table 19: MGO Blasting Hours and Frequencies for 2019

Approval	Operation	Compliant?	Approved blasting hours	Approved Blast Frequencies ¹		Actual Blast Frequencies (2019)		
				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	104	2	2.0 ⁵
SSD-5850	Ravensworth East	Yes	9am – 5pm Monday to Saturday ²	2	5 ⁴	42	2	0.8 ⁵
SSD-5850	Mt Owen	Yes		2	8 ⁴	103	2	2.0 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 7 am and 9 am (Monday to Saturday inclusive).

3. Averaged over a 12 month period

4. Averaged over a calendar year

5. Averaged over the 2019 calendar year i.e. 1 Jan 2019 – 31 Dec 2019

EST – Eastern Standard Time

DST – Daylight Savings Time

Table 20: MGO Blasting Criteria and Performance for 2019

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	120	10	0%	Compliant	Nil	Nil
	Ravensworth East Glendell	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
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		
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 Mt Owen are detailed in [Appendix E, Tables 18 to 23](#). Compliance summaries are provided in [Appendix E, Table 16](#) and [17](#).

There were a total of 103 blasts fired at Mt Owen during the reporting period averaging 2 blast fired per week, no blasting incidents or non-compliances identified at Mt Owen during the report period.

Glendell

Overpressure and vibration compliance results for Glendell are detailed in [Appendix E, Table 16](#) and [17](#). Compliance summaries are provided in [Appendix E, Tables 24 to 27](#).

There were a total of 104 blasts fired at Glendell during the reporting period averaging 2 blast fired per week, no blasting incidents or non-compliances identified at Glendell during the report period.

Ravensworth East

Overpressure and vibration compliance results for Ravensworth East are detailed in [Appendix E, Tables 28 to 32](#). Compliance summaries are provided in [Appendix E Tables 16](#) and [17](#).

There were a total of 41 blasts fired at Ravensworth East during the reporting period averaging less than 1 blast fired per week, no blasting incidents or non-compliances identified at Ravensworth East during the report period.

All blasting results from MGO are also available on the website at www.mtowencomplex.com.au.

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 D](#).

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 (as TSP)
- Dust deposition

[Appendix D, Tables 32 - 36](#) present the monitoring results for 2019 and for recent years. It should be noted that the measurement data represent the contributions from all sources that have at some stage been upwind of each monitor. In the case of particulate matter (as 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.

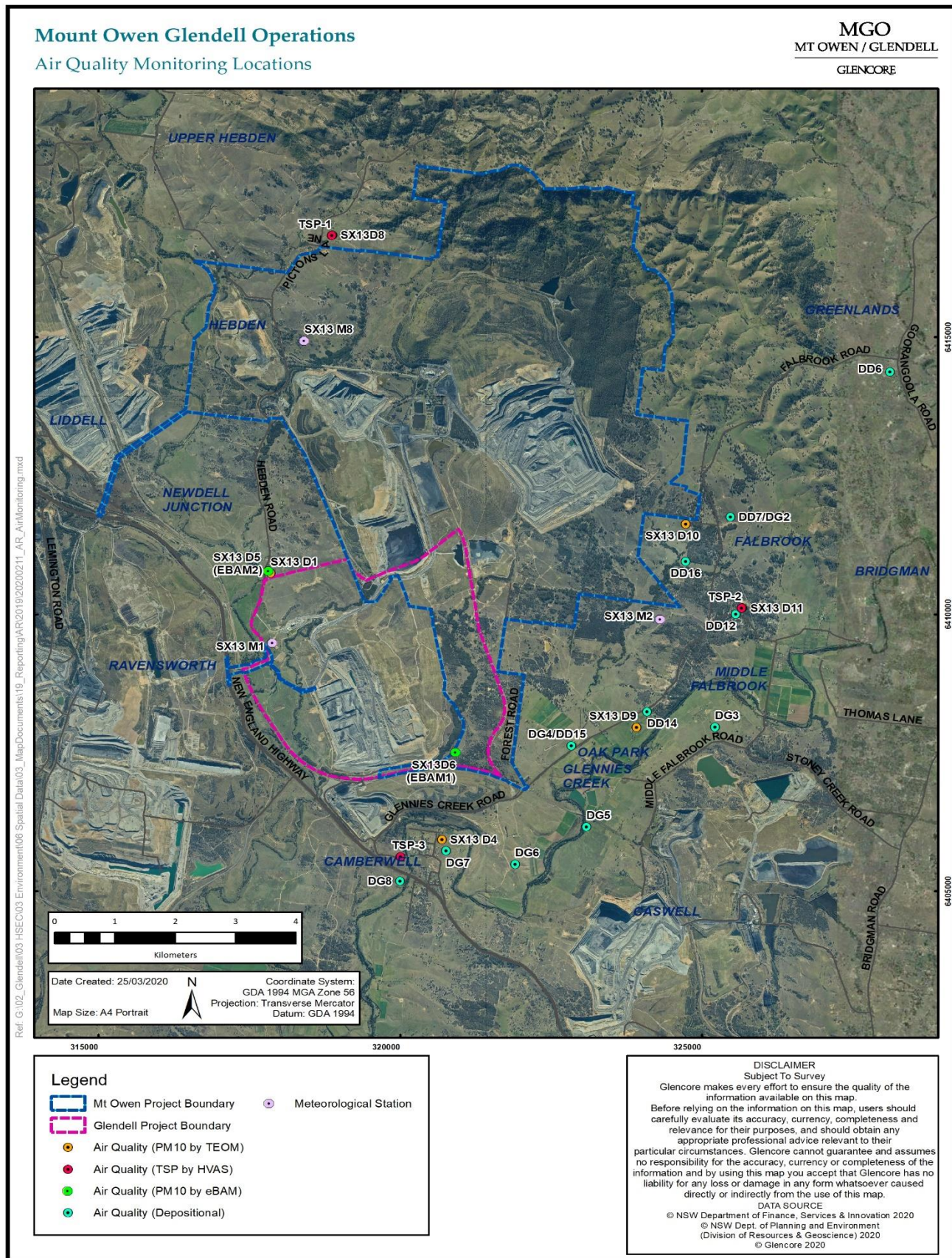


Figure 6: MGO Air Quality Monitoring Locations

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) 10 metre tower weather stations, Sx13 M1, Sx13 M2 and Sx13 M8, located to the west and south-east of the active mining areas respectively.

Annual wind roses for Sx13 M1, Sx13 M2 and Sx13 M8 are provided in [Figure 7](#). The prevailing winds recorded during the reporting period at MGO were southeast which occurred during the summer months and northwest which occurred during autumn, winter and spring.

Rainfall data for Singleton, collected from the Bureau of Meteorology (BoM) website, confirms that 2019 was drier than average. A total of 340 mm was recorded in 2019 and was below the long term average of 659 mm.

Approximately 397mm of rainfall was recorded at MGO at Sx13 M1 during the reporting period compared to approximately 484mm of rainfall recorded in previous reporting period, highlighting the longstanding drought period.

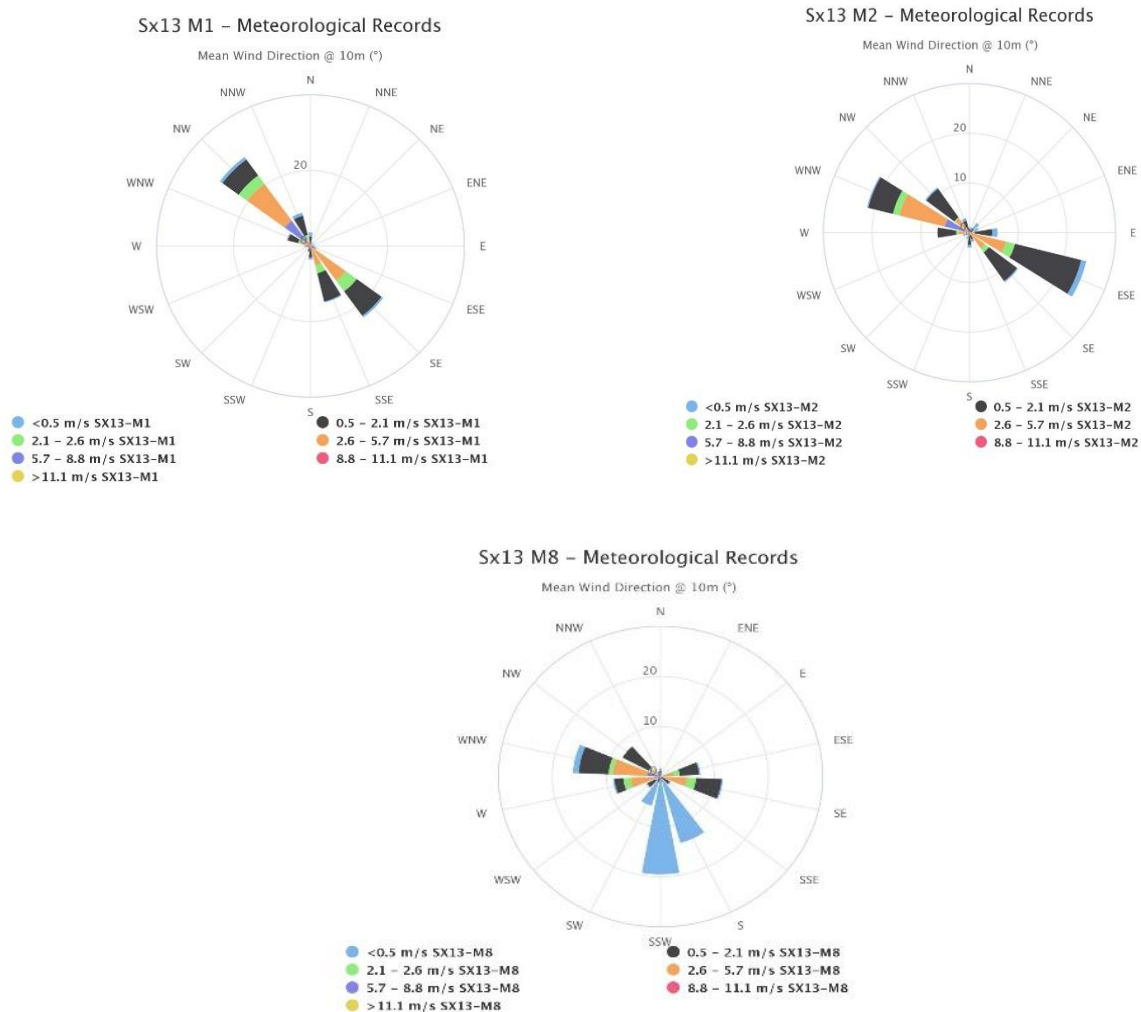


Figure 7: 2019 Annual Wind Roses for Sx13 M1, Sx13 M2 and Sx13 M8

6.3.3 Air Quality Performance

Overview

Late 2019 coincided with a period of unprecedented bushfires in Australia, predominantly across southeast Australia, but also affecting a reported 4 million hectares of land in NSW since early November 2019. Additional detail can be found at:

- <https://www.environment.nsw.gov.au/topics/air/air-quality-statement>

The bushfires adversely affected air quality across many parts of NSW and a total of 66 days in 2019 were subsequently declared as extraordinary events by the DPIE. The MGO data presented below have been reviewed in this context.

Particulate Matter PM₁₀

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 35 Appendix F shows the measured 24-hour average PM₁₀ concentrations from each TEOM monitoring site for data collected between 2015 and 2019. The DA criterion for PM₁₀ micro grams per cubic metre (50 µg/m³). This criterion is equivalent to EPA's air quality assessment criteria for 24-hour average PM₁₀. There is a seasonal variation in the air quality conditions, with most exceedances of the criterion occurring during spring and summer.

There were more days where PM₁₀ levels recorded above 50 µg/m³ during the reporting period, compared to recent years. This observation is likely to have been influenced by drier than average conditions experienced and widespread bushfire activity across the region during the reporting period, as noted above.

Table 34, Appendix F summarises the measured PM₁₀ concentration data for each site and for 24-hour and annual average periods, for comparison with the respective criteria. **Table 33, Appendix F** also shows that all sites recorded at least one day above the 50 µg/m³ criterion in the past four years and most sites have measured at least one day above the 50 µg/m³ in the past five years.

As noted in **Section 1**, MOCO MOD 2 (SSD-5850) was approved during September 2019. As part of this approval, the long term impact assessment criteria for particulate matter (i.e. Schedule 3 Condition 16) was revised. That is, the long term impact assessment criteria was reduced from 30µg/m³ to 25µg/m³.

As advised by DPIE, this report has provided a calculated average for the period from 1 January 2019 to 3 September 2019 and 4 September 2019 to 31 December 2019, excluding extraordinary events. These periods represent only 65% and 17% of the reporting period and do not meet the minimum 90% data capture rate that is required for applications of air quality data analysis (see for example EPA 2016 and US EPA 2000). Therefore statistics for the 1 January to 3 September and 4 September to 31 December periods have been presented for information only, and not for determining compliance.

DPIE provided further advice during the preparation of this report and identified the localised environment and general region was impacted by 'extraordinary events' on sixty-six (66) days during the report period. Days which have been declared as 'extraordinary events' by DPIE are identified in **Appendix F** and are excluded from long term impact assessment calculations.

Based on all data in 2019, excluding extraordinary events, the annual average PM₁₀ concentrations did not exceed the 30 µg/m³ DA criterion at any of the monitoring locations.

Table 34 Appendix F shows the maximum 24-hour average PM₁₀ concentrations for continuous monitors during the last five years. The highest maximum 24 hour PM₁₀ result reported for all six TEOMs was recorded in 2019. This coincided with prolonged drought conditions and widespread bushfire activity affecting the Hunter region and a large part of NSW during November and December 2019. **Table 35 Appendix F** also provides the maximum 24 hour PM₁₀ results recorded during the report period that have not been influenced by 'extraordinary events'.

Figure 4, Appendix F shows the number of days above the 24hr average criterion, for the last five years. From these data, SX13 D1, SX13 D4, Sx13 D8, SX13 D9, and SX13 D11 experienced more days above 50 µg/m³ in 2019 than in previous years. The prolonged drier conditions experienced during 2017, 2018 and in the 2019 report period the year and bushfire events experienced throughout the region, and are likely to have influenced the measurements during the report period.

MGO has calculated the site contribution to 24-hour average PM₁₀ concentrations at locations upwind (northwest / SX13 D8) and downwind (southeast / SX13 D11) of Mt Owen and at locations upwind (north / Sx13 D1) and downwind (south east / Sx13 D4) of Glendell for each day during 2019. 24-hour average PM₁₀ contribution are represented in **Figure 4 Appendix F** with calculations undertaken in accordance with the MGO Air Quality Management Plan (2018).

The site contribution to each monitor was then calculated for every 15-minute average record in 2019 based on the concurrent wind direction, and using downwind concentration minus upwind concentration calculations. The site contribution to each monitor was calculated as a 24-hour average. There were no days recorded at MGO that exceeded the short term impact assessment criteria (i.e. 50µg/m³) during the 2019 reporting period, comparison against compliance criteria is showed in **Table 21**. Monitoring results for continuous PM₁₀ monitoring for 2019 are provided in **Appendix F, Table 34**.

HVAS TSP (Total Suspended Particulate)

TSP concentrations have been measured at three locations by HVAS. **Figure 6** shows the location of the monitoring sites. Monitoring results for TSP monitoring for 2019 are provided in **Appendix F, Table 33 & Table 36**, shows the annual average concentrations from data collected in the past five years, for comparison with the DAs criterion (90 µg/m³). The annual average results for TSP 1, TSP 2 and TSP 3 for the 2019 reporting period show compliance with the criterion (**Table 21**). As advised by the Department of Planning, Industry and Environment, days which have been confirmed as 'extraordinary events' may be excluded from annual average calculations. MGO engaged a suitable and qualified air quality specialist to review its annual averages against the compliance criterion and a copy of the report is attached on **Appendix F - Review of 2019 Annual Average PM10 and TSP Data**. The review concluded that that Mt Owen was in compliance with its Glendell (DA 80/952) and Mount Owen (SSD-5850) development consents in terms of TSP impacts at all reportable monitoring sites for data collected in 2019.

The annual average in 2019 for TSP 1 rose slightly in comparison to the previous reporting period, with concentrations at both TSP 2 and TSP 3 lower than the previous period. Annual average TSP concentrations at all three locations were below the criteria. It is noted that TSP 1 is on mine owned land and the rolling annual average for TSP 1 i.e. the average for the 12 months prior to the 18 February 2018 measurement, was well below the criteria.

Table 21: Long Term Assessment Criteria for Particulate Matter (PM₁₀ and TSP)

Pollutant	Averaging period	Consent	Approval Criteria*	Environmental Performance this Reporting Period	Key Trends	Implemented/ Proposed Management Actions
			Criterion ^d			
TSP	Annual	Glendell (DA 80/952)	90 µg/m³	Compliant	Nil	Continuation of existing management and mitigation measures
		Mt Owen (SSD-5850)				
PM ₁₀	Annual	Glendell (DA 80/952)	30 µg/m³	Compliant	Nil	
		Mt Owen 1 January 2019 – 3 September 2019 (SSD-5850)**		N/A Information purposes only		
		Mt Owen 4 September 2019 – 31 December 2019 (SSD-5850)**	25 µg/m³			

* criteria applies to privately owned land

** MOCO Mod 2 (SSD-5850) approved during September 2019. Long Term average criterion revised from 30 µg/m³ to 25 µg/m³ as part of modification. Long term average calculations are based upon advice received from DPIE.

^d Excludes extraordinary events such as bushfires, prescribed burning, dust storms fire incidents or any other activity agreed to by the Secretary

EIS Predictions for TSP and PM₁₀

The measured annual average PM₁₀ and TSP concentrations have been compared to the predictions made in the EIS for the MOCO Project; now the approved operation, and from the Glendell Mine Modification to Development Consent (Glendell EIS 2007). The MOCO EIS predictions for Year 5 (approximately 2019) and Glendell EIS predictions for Year 12 (approximately 2019) have been extracted for the comparison. At some locations no predictions were available in the respective EIS. Table 22 and Table 23 show the comparisons for PM₁₀ (TEOM) and TSP (HVAS).

Table 22: Summary continuous PM₁₀ Monitoring Results (µg/m³)

Monitoring Unit	Development Consent Criterion (µg/m ³)	EIS Prediction (MOCO Year 5)	EIS Prediction (Glendell Year 12)	2019 Annual Average (DA 80/952) (µg/m ³)	Result 2019 SSD-5850 (1 Jan - 3 Sep) (µg/m ³)	Result 2019 SSD-5850 (4 Sep – 31 Dec) (µg/m ³)	2019 24 Hr Maximum Reading (including extraordinary events) (µg/m ³)**	2019 24 Hr Maximum Reading (excluding extraordinary events) (µg/m ³)**	2019 24 Hr Minimum Reading (µg/m ³)
Sx13D8 - Pictons In	30 (25)*	N/A	15	23	21	27	221	60	7
Sx13D9 - Nobles In	30 (25)*	26	9	24	22	29	191	64	4
Sx13D11 - Middle Falbrook	30 (25)*	21	9	28	27	30	175	77	4
Sx13D1 - Project Office	30 (25)*	N/A	15	24	23	29	201	70	2
Sx13D4 - McInerney	30 (25)*	28	11	29	27	35	243	77	6

* MOCO Mod 2 (SSD-5850) approved during September 2019. Long Term average criterion revised from 30 µg/m³ to 25 µg/m³ as part of modification. Long term average calculations are based upon advice received from DPIE.

** 2019 24 Hr Maximum Readings include days identified as 'extraordinary events'. As advised by DPIE, days which were identified as 'extraordinary events' were not included in Long term impact assessment criteria.

Table 23: Summary HVAS TSP Monitoring Results

HVAS Site	Development Consent Criterion ($\mu\text{g}/\text{m}^3$)	Predicted Mt Owen Contribution EIS (MOCO Year 1)	EIS Prediction (Glendell Year 12)	2019 Annual Average ($\mu\text{g}/\text{m}^3$)	2019 24 Hr Maximum Reading ($\mu\text{g}/\text{m}^3$)	2019 24 Hr Minimum Reading ($\mu\text{g}/\text{m}^3$)
TSP 1**	90*	N/A	41	60	138	22
TSP 2	90	55	31	78	250	11
TSP 3	90	69	33	82	195	13

** 2019 24 Hr Maximum Readings include days identified as 'extraordinary events'. As advised by DPIE, days which were identified as 'extraordinary events' were not included in Long term impact assessment criteria.

** TSP 1 is on mine-owned property and as such the development consent criterion does not apply (only applies to privately owned land)

Table 22 shows that the MOCO EIS predictions for annual average PM_{10} were within 30 per cent of the 2019 measurement results. In contrast, the Glendell EIS predictions for annual average PM_{10} were lower than the 2019 measurement results. This outcome is most likely because the 2007 modelling had assumed that various surrounding mining operations had completed and were no longer sources of particulate matter. These comparison also reflect an improvement in the emission estimation, modelling and assessment approaches over time.

Table 23 shows the MOCO and Glendell EIS predictions for TSP compared with the measurement data. The MOCO EIS predictions were only available for two of the three monitoring locations. MOCO EIS predictions for annual average TSP were below 2019 measurement results.

At TSP 2 the MOCO EIS prediction for Year 1 ($55 \mu\text{g}/\text{m}^3$) was comparable to measurements in previous years. At TSP 3 the MOCO EIS prediction for Year 1 ($69 \mu\text{g}/\text{m}^3$) was lower than the measurement result in 2019 ($82 \mu\text{g}/\text{m}^3$). These comparisons are most likely due to the drier than average conditions in 2019.

As for PM_{10} , the TSP predictions from the Glendell EIS were under-estimated for these locations which are reasonably distant from the modelled sources. Again, due to assumptions on when surrounding operations would cease, as well as background levels which were likely to have been under-estimated but improved in the MOCO EIS.

Depositional Dust

Figure 6 shows the location of the monitoring sites. Results from monthly dust deposition monitoring at the MOC for 2019 are provided in Table 32, Appendix F. Table 34, Appendix F shows the annual average deposited dust levels for each gauge from data collected in the past five years. The results in

Table 24 can be compared with the DA criterion of 4 grams per square metre per month ($\text{g}/\text{m}^2/\text{month}$). Contaminated monthly samples were excluded from the calculation of these annual averages. DG8 (DA 80/952), located south-west of Camberwell Village, recorded an annual average of $4.7 \text{ g}/\text{m}^2/\text{month}$ during 2019. With exception to DG8,

Table 24 shows that no gauges have recorded readings above $4 \text{ g}/\text{m}^2/\text{month}$ in 2019.

Table 24: Summary of Depositional Dust Air Quality Monitoring Results 2019 (g/m²/month)

Dust Gauge Code	Location Description	DA Criterion	EIS Predicted Level		Long term Average (2003-2018)	2019	
			MOCO Year 5*	Glendell Year 12*		Annual Average	Data Capture (%)
Mt Owen and Ravensworth East Depositional Dust Monitoring Locations							
DD6	East of Mt Owen	4.0	N/A	N/A	N/A	1.5	100%
DD7	Falbrook Rd South-East of Mt Owen	4.0	2.9	0.9	1.1	2.9	100%
DD12	East of Ravensworth East	4.0	3.0	0.8	1.0	3.3	100%
DD14	East of Glendell	4.0	2.8	0.9	1.1	1.7	100%
DD16	East of Ravensworth East	4.0	3.3	1.0	1.2	3.5	100%
Glendell Depositional Dust Monitoring Locations							
DG3	Falbrook area	4.0	2.6	0.8	1.0	1.9	100%
DG4	Falbrook area	4.0	2.8	1.0	1.4	3.0	100%
DG5	Camberwell area	4.0	N/A	0.8	1.1	3.1	100%
DG6	Camberwell area	4.0	2.9	1.0	1.3	2.2	100%
DG7	Camberwell area	4.0	2.8	1.4	1.8	2.7	92%^
DG8	Camberwell area	4.0	N/A	1.0	1.2	4.7	100%

* The EIS predictions were not available for the location of these monitors so the data presented represents the predictions for the closest modelled receptor to each monitor.

^ DG7 sample was destroyed in February 2019, due to strong winds impacting on gauge condition, a new gauge pole were installed in the same month.

EIS Predictions for Depositional Dust

The measured annual average dust deposition rates have been compared to the predictions made in the EIS for the MOCO Project and from the Glendell Mine Modification to Development Consent (Glendell EIS 2007). The MOCO EIS predictions for Year 5 (approximately 2019) and Glendell EIS predictions for Year 12 (approximately 2019) have been extracted for the comparison. At some locations no predictions were available in the respective EIS.

Table 24 shows the MOCO and Glendell EIS predictions for dust deposition compared with the measurement data. The EIS predictions were not available for the location of monitors so the data presented below represent the predictions for the closest model receptor to each monitor. It's noted that MOCO EIS air quality model used the meteorological data available on 2011/2012.

For 2019, the depositional dust records were within MOCO EIS predictions for Year 5. On average, across all monitors, the MOCO predictions were in line with or higher than measured. These results are within the factor-of-two accuracy that has been recognised for these types of models (US EPA, 2005).

The Glendell EIS predictions were within 30 per cent of the long term averages but lower than the measurement results for 2019, most likely because of the 2007 assumptions on mines that would be operating at this time, as well as the unexpected adverse air quality conditions in 2019. The MOCO EIS adopted higher background levels which improved the correlation between measured and predicted deposition levels.

Summary

The recent 2019 bushfires in NSW associated with long period of drought have adversely influenced air quality conditions. Each of the PM₁₀ monitoring locations recorded at least one day above the 50 µg/m³ criterion in 2019 however no exceedances were recorded against short term impact assessment criteria for 24-hour average PM₁₀ site contribution during the reporting period. Annual average PM₁₀ concentrations in 2019 did not exceed the 30 µg/m³ DA criterion at any of the monitoring locations. Annual average TSP concentrations in 2019 did not exceed the 90 µg/m³ DA criterion.

Annual average dust deposition in 2019 did not exceed the 4 g/m²/month DA criterion at any of the monitoring locations, except for DG8 which showed an annual average of 4.7 g/m²/month. Further investigation of this result shows that the MGO was calculated to have contributed up to 1.0 g/m²/month to the measured 4.7 g/m²/month at DG8. The data do not indicate that the MGO was the cause of an exceedance of the "total impact" criteria (4 g/m²/month) at DG8. This is because the calculated contribution to DG8 (1.0 g/m²/month) was within the range of MGO contributions calculated for other monitoring sites, so the result is not considered to be an outlier. It is also useful make comparisons to the results at other locations to assist with determining possible causes of elevated results. For example, DG7 is located closer to the Glendell Mine than DG8 and experienced a higher proportion of winds from Glendell Mine towards the monitor, however the dust deposition at this location was lower than at DG8. This suggests that there were local sources of dust near DG8 that contributed to the measured result. Further information can be found in the independent air quality report exceedance report prepared by a suitably qualified air quality specialist [Appendix F](#).

MOCO EIS predictions of air quality in the vicinity of MOC were generally higher than the measurement data, indicating the background levels may have been over-estimated. The comparisons showed that EIS predictions were up to 46 per cent higher than annual averages measured in 2019.

Glendell EIS predictions of air quality in the vicinity of MOC were generally lower than the measurement data. This was mainly a result of the 2007 EIS assumptions on mines that would be operating at this time as well as assumed background levels which were too low, a factor which was since addressed in the MOCO EIS.

6.3.4 6.2.3 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 2019 that fall within the continuous improvement program. The most important being:

- Installation of two real time dust cameras, at Falbrook and Barrett Pit, to help manage visual dust impacts from Mt Owen and Glendell Operations
- Modification and improvement of real-time monitoring network
- Acquisition of refurbished TEOM unit from USA to be used as part replacement for old units
- Implementation of Glendell and Mt Owen Dust Analysis Tool on the existing Noise Analysis Tool (DNAT) web page, to assist mining supervisors with the management of dust.

A number of activities to be undertaken in 2020 include:

- Acquisition of two PM_{2.5} TEOMs monitors to be part of MGO Real Time Dust Monitoring Network
- Continuous assessment and improvement of the real-time monitoring network and management alarms
- Review and simplification of dust alarm response
- Further DNAT development to incorporate site specific contribution dust contribution
- Review and update of the Air Quality and Greenhouse Gas Management Plan

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 2019, the total emissions produced by GLD were estimated to be 156,001 t CO₂-e. Total emissions produced by MTO in 2019 was estimated to be 197,601.5 t CO₂-e. A summary of greenhouse gas emissions for 2019 is provided in [Table 25](#).

The Safeguard Baseline emissions number (a baseline for review of emissions performance under NGER) reported for GLD is 448,015 t CO₂-e. During the 2018/2019 NGER report period, this provided Net Position Number of 308,097 t CO₂-e, below the Safeguard Baseline value.

The Safeguard Baseline emissions number reported for MTO is 534,145 t CO₂-e. During the 2018/2019 NGER report period, this provided Net Position Number of 397,273 t CO₂-e, below the Safeguard Baseline value.

Table 25: Greenhouse Gas Emissions at Glendell/Mt. Owen Operations

Emission Source	Glendell (t CO ₂ -e)	Mt Owen (t CO ₂ -e)
Scope 1 Emissions		
Diesel	107,776	134,400
Petrol/ Gasoline	6.31	0
Liquid Petroleum Gas	0	0.5
Fugitive emissions	46,632	20,963
Scope 2 Emissions		
Electricity	1,587	42,238
Total Emissions	156,001	197,601.5

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
- careful grazing management
- noxious 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 Conservation Areas:

- 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 Offset 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 North Offset Site.

Details of the CAs and BOAs are provided in [Table 26](#) with their locations shown in in [Figure 8](#) and [Figure 9](#)

The specific location of the Rehabilitation Woodland Offset is yet to be determined; selection of this area will be undertaken in accordance with the Schedule 3 Condition 31 (d) of SSD-5850.

Table 26: Biodiversity Offset Areas

Offset Area	Plant Community Type	Size (ha)
DA 80/952		
Bettys Creek Habitat Management Area (HMA) incorporating*: <div><div>- Bettys Creek (Enex Foydell)</div><div>- Bettys Creek (Glendell))</div></div>	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 (Mount Owen Offsets)		
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	
Travelling Stock Reserve (TSR) Offset	Central Hunter Ironbark-Spotted Gum-Grey Box Forest	25.1
	Hunter Lowland Red Gum Forest	
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
Cross Creek Offset Site	1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (including red gum 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	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)	

Offset Area	Plant Community Type	Size (ha)
	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	
	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

* Conservation Areas 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).

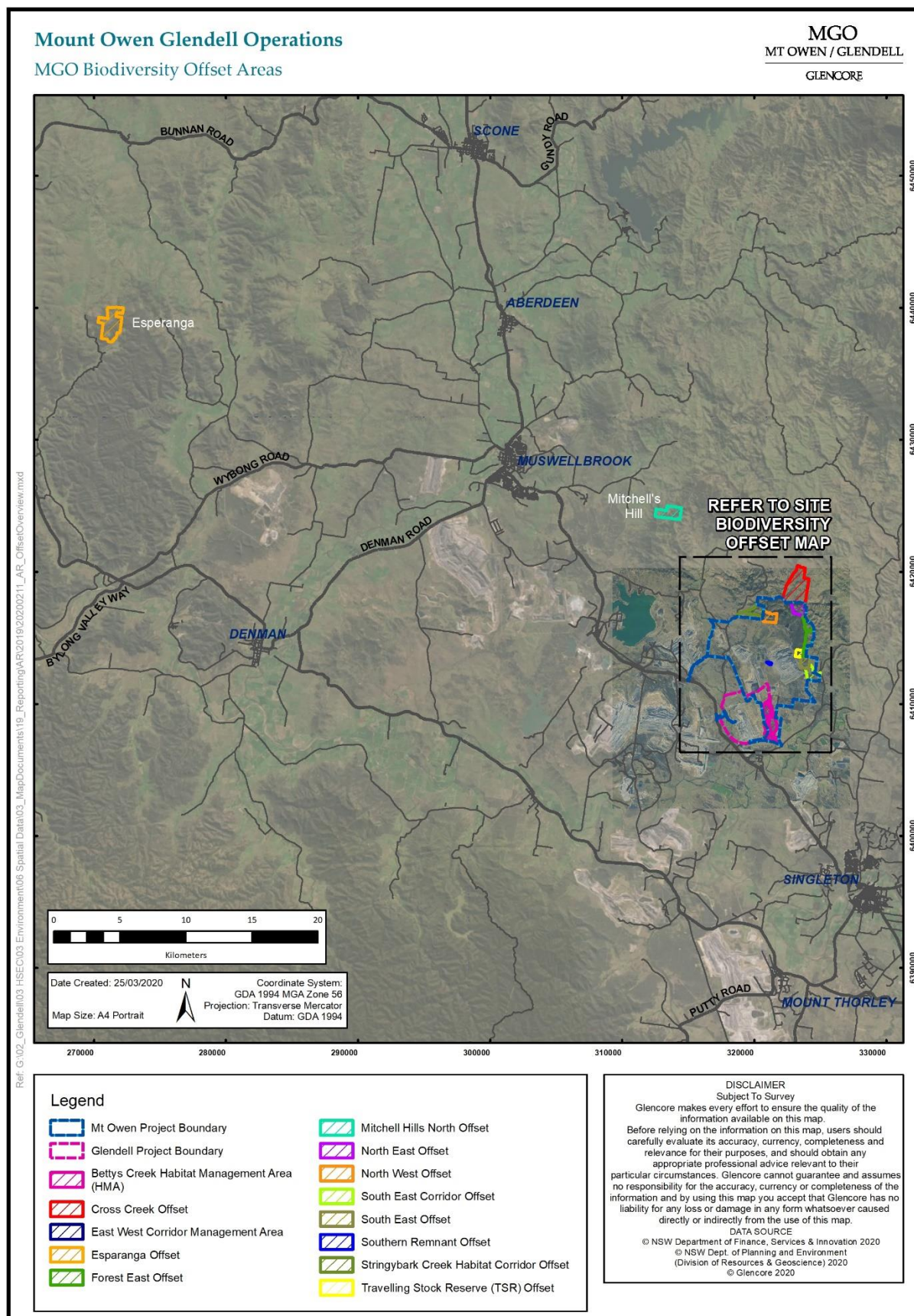


Figure 8: MGO Biodiversity Offset Areas

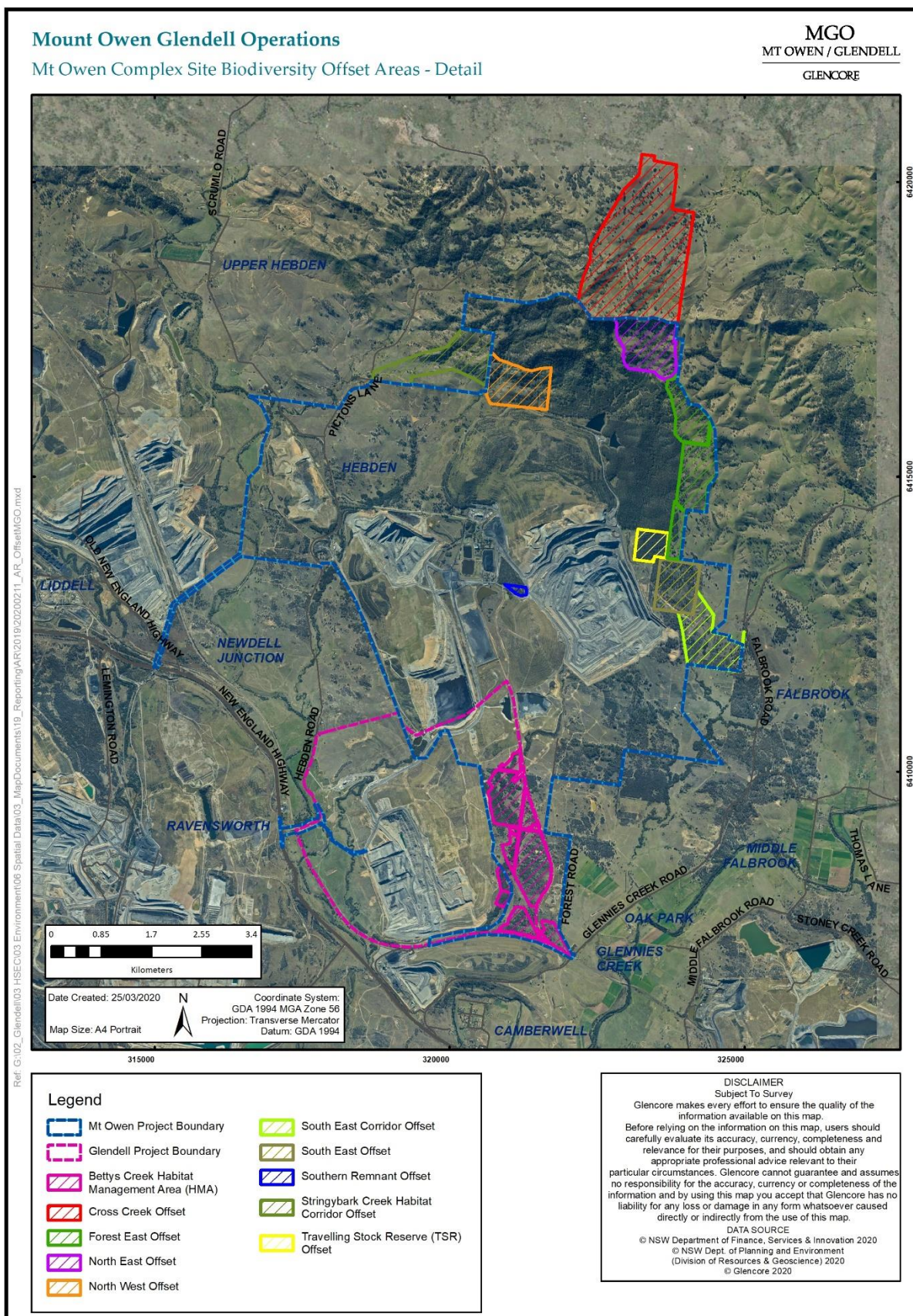


Figure 9: MGO Site Biodiversity Offset Areas - Detail

6.4.2 Flora Monitoring

Conservation Areas

As specified within Annexure D of the CAs, annual monitoring of each Conservation Area is required. Monitoring methods during 2019 were consistent with Annexure D of each CA and included:

- 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 and
 - sightings of threatened species.

All monitoring works were undertaken by qualified ecologists. Monitoring was undertaken at the locations required as per Annexure D, Table 1 of each CA, and reproduced in

Table 27. Photo monitoring locations are shown in **Figure 10.**

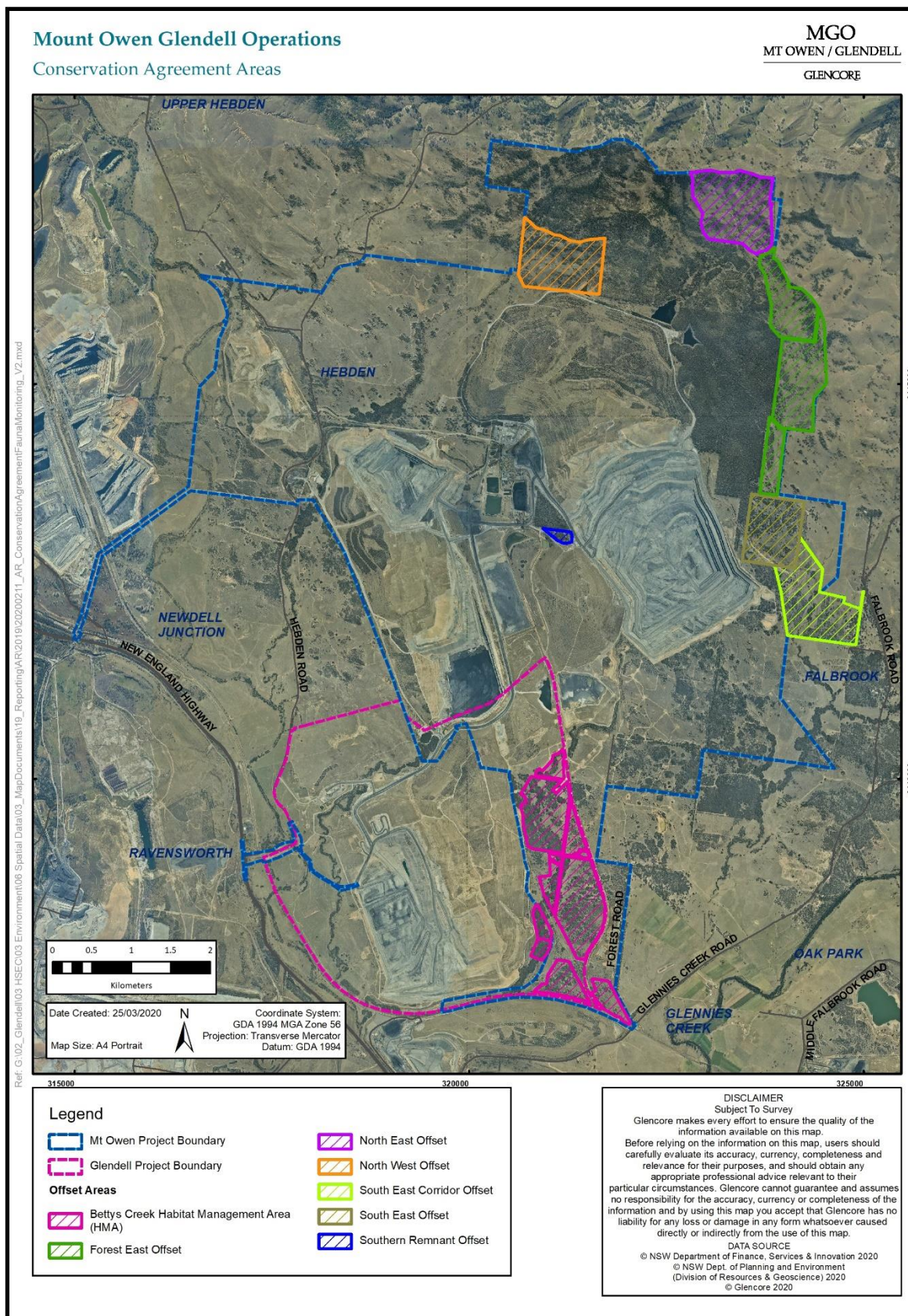


Figure 10. Photo monitoring locations for Conservation Areas.

Table 27: Conservation Agreement Monitoring Locations - 2019

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 [^]
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 26**); 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

Biodiversity Offset Areas

6.5 Flora Monitoring

In 2019 the flora monitoring methods were updated in the BOMP to align with the Biodiversity Assessment Methodology (BAM) (OEH 2017). The locations for flora monitoring are included in **Table 28**.

Flora monitoring of the BOAs involved the following methods:

- **Vegetation survey plots** – full floristic plot-based surveys using in a 20 x 20 metre quadrat (or 400m² or equivalent area) nested within a 20 x 50 metre plot (or equivalent 1,000m² area).
- **photographic monitoring** – undertaken at permanent monitoring points using a consistent methodology across the BOAs.

- **opportunistic** observations – sightings of high threat weeds and other invasive species, threatened species (see **Figure 11** and **Figure 12** and/or notes on management related issues (broken fences, track maintenance etc).

Table 28: Biodiversity Offset Area Monitoring Locations - 2019

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
CC01	1602 - Spotted Gum - Narrow - leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	Fauna
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
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
ESP01	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	Fauna
ESP02	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	Fauna
ESP03	1654 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	Fauna
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
MH01	624 Large-fruited Grey Gum - Narrow-leaved Stringybark open forest on sheltered sandstone hillslopes in the Scone region of the upper Hunter Valley	Fauna
MH02	1543 Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley	Fauna
MH03	1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Fauna
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

Site Name	Plant Community Type	Monitoring Type
S6	1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	Flora
SC01	1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Fauna

6.5.1.1 2019 Monitoring Results

Table 29 summarises biodiversity management performance in the Conservation Areas for 2019 and includes recommended management actions for 2020.

Table 29: Biodiversity Management Summary 2019 – Conservation Areas

Conservation Area	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
Bettys Creek (Enex Foydell) CA	<ul style="list-style-type: none"> Offset seed collection program Direct seeding Weed control Vertebrate pest control Biannual inspections Remote camera monitoring for unauthorised access Nest box installations Fence line and Gate condition review and maintenance Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) 	<ul style="list-style-type: none"> Sites received mostly Good composite site value scores. Two sites received Moderate scores (GHMA11 and P07) and one site, GHMA08 received a Low score, due to habitat feature deficits From baseline to 2019 there was an increase in native species richness at most sites despite drought conditions prevailing Native over-storey cover, native mid-storey cover and native groundcover were consistently lower in 2019 compared to previous years, a likely result of prevailing drought conditions Few attributes met benchmark values in passive and active regeneration areas Existing woodland and forest sites achieved benchmark values in native over-storey, native groundcover shrubs and fallen logs. Invasion of exotic grass (Coolatai) continues to invade open areas. Threatened grey-crowned babbler continues to be recorded Evidence of rabbits was recorded throughout the Conservation Area Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Weed Control of Coolatai Grass, African Boxthorn, Galenia and Prickly Pear Pest Control Supplementary planting Monitor direct seeding works Investigate canopy thinning of PCT 1692 Incorporate habitat features to active regeneration areas when resources become available.
Bettys Creek (Glendell) CA	<ul style="list-style-type: none"> Annual monitoring report 	<ul style="list-style-type: none"> Site received Low composite site value score, explained by the lack of mid and upper storey vegetation layers and absence of habitat features Condition of vegetation consistent with previous monitoring Exotic species dominant species richness of active regeneration areas Natural recruitment of canopy species is yet to commence at the monitoring site Evidence of rabbits was recorded throughout the Conservation Area Visible changes observed between the baseline and the 2019 photo monitoring include evidence of direct seeding works. 	

Conservation Area	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
Mount Owen Offsets CA	<ul style="list-style-type: none"> Offset seed collection program Direct seeding Weed control Vertebrate pest control Biannual inspections Remote camera monitoring for unauthorised access Nest box installations Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) Annual monitoring report 	<ul style="list-style-type: none"> Sites received Moderate and Good composite site value scores. Native over-storey cover, native mid-storey cover and native groundcover were consistently lower in 2019 compared to previous years, a likely result of prolonged drought conditions Native plant species richness increased at most sites from previous years PCT 1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter performed well Passive Regeneration areas of PCT 1731 performed poorly against benchmark values with only native overstorey cover and native groundcover grass reaching targets Only half of the attributes measured in PCT 1614 met benchmark values, including native mid-storey cover, native groundcover grass and native groundcover other and native plant species richness Natural regeneration continues to occur Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Weed control of Coolatai Grass, African Olive, Sharp Rush Galenia and Prickly Pear. Monitor European Rabbit, Brown Hare and macropod populations. Monitor direct seeding works and continue works if technique is successful. Incorporate habitat features such as fallen logs, rock piles in active regeneration areas. Native vine control (non-lethal) in PCT 1614. Realignment of Site P01 to avoid crossing the creek line and better represent the PCT's condition. This realignment will be completed in the 2020 monitoring period
North West Offset CA	<ul style="list-style-type: none"> Offset seed collection program Weed control Vertebrate pest control Biannual inspections Remote camera monitoring for unauthorised access Nest box installations Fence line and Gate condition review and maintenance Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) Annual monitoring report 	<ul style="list-style-type: none"> Sites received Moderate and Good composite site value scores. Native over-storey cover increased dramatically between 2017 and 2019 Native groundcover grasses and forbs was consistently lower in 2019 compared to previous years, a likely result of prolonged drought conditions Overall, the sites performed poorly across management zones, possibly symptomatic of prevailing dry conditions PCT 1602 met benchmark values including native over-storey cover, native mid-storey cover, native plant species richness and fallen logs For active regeneration areas only native groundcover grasses reached benchmark values – a likely result of drought conditions Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Weed control of African Olive, Coolatai Grass and Pear. Monitor pest species European Rabbit, Brown Hare and macropod populations. Incorporate habitat features such as fallen logs, rock piles in active regeneration areas

Conservation Area	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
Southern Remnant Offset CA	<ul style="list-style-type: none"> Offset seed collection program Direct seeding Weed control Vertebrate pest control Biannual inspections Remote camera monitoring for unauthorised access Nest box installations Installation of Offset Security Signage Biodiversity monitoring (photo, walkthrough, opportunistic threatened species observations) Annual monitoring report 	<ul style="list-style-type: none"> Site received a Good composite site value score Native species dominant total species richness Native over-storey cover, native groundcover shrub, number of trees with hollows and fallen logs all reached or exceeded benchmark values Native plant species richness, native groundcover grass and native groundcover other fell short, likely due to prolonged dry conditions Evidence of rabbits was recorded throughout Conservation Area – low densities Grey-crowned Babblers continue to breed in Conservation Area. No substantial changes were observed between the baseline and the 2019 photo monitoring 	<ul style="list-style-type: none"> Weed control of Prickly Pear. Monitor pest species European Rabbit, Brown Hare and macropod populations. Noisy Miner management. Monitor direct seeding works and continue works if technique is successful. Incorporate habitat features such as fallen logs, rock piles in active regeneration areas. Monitor nest box use by native animals and check condition. Nest box adjacent site Photo06 had fallen and was infested by bees

Table 30 summarises biodiversity management performance in the BOAs for 2019 and includes recommended management actions for 2020.

Table 30: Flora Management Summary 2019 – Biodiversity Offset Areas

BOA	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
Cross Creek Offset Site	<ul style="list-style-type: none"> Weed control Fence line and Gate condition review and maintenance Biennial monitoring report Biannual inspections 	<ul style="list-style-type: none"> Woodland sites (CC1 and CC2) performed better and reached more benchmark milestones than grasslands (site CC3) Sites showed low shrub and tree species richness, low groundcover diversity and cover, as well as low habitat functions Some areas showed promising signs of natural unassisted recovery indicating the ecological barriers to recovery have not been crossed by past farming practices (Figure 12) No passive regeneration in Derived Native Grassland monitoring sites Cattle continue to graze within the offset, albeit in low abundance 	<ul style="list-style-type: none"> Removal of grazing Weed Control of African Olive, Blackberry, Prickly Pear and Sharp Rush Pest Control Supplementary planting

BOA	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
		<ul style="list-style-type: none"> Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Incorporate habitat features such as fallen logs, rock piles in active regeneration areas. Blady Grass monitoring Erosion control Track maintenance
Stringybark Habitat Corridor Offset Site	<ul style="list-style-type: none"> Seed collection Weed control Fence line and Gate condition review and maintenance Biennial monitoring report Biannual inspections 	<ul style="list-style-type: none"> Native species richness represented a minimum of 48% to a maximum of 93% of total species richness in 2019 One monitoring site (grassland site S3) recorded higher exotic species richness than native species richness PCT 1598 performed well against benchmark values and can be considered resembling its target state PCT 1614 was assessed as progressing towards its target state. PCT 1602 and PCT 1731 did not resemble target state Grassland areas showed limited signs of natural regeneration of canopy and shrub species Extensive population of African Olive Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Removal of livestock grazing and installation of livestock fencing Weed Control of African Olive, Blackberry, Prickly Pear and Sharp Rush Pest Control Supplementary planting Incorporate habitat features such as fallen logs, rock piles in active regeneration areas Erosion control African Olive monitoring
Esparanga Offset Site	<ul style="list-style-type: none"> Weed control Fence line and Gate condition review and maintenance Biennial monitoring report Biannual inspections 	<ul style="list-style-type: none"> Remnant vegetation in good condition Native species richness in 2019 represented between 42% (grassland site E2) and 100% (woodland sites E6 and E8) of the total species richness. PCT 618 performed poorly and did not resemble target states The grasslands showed very limited signs of natural recruitment of native species PCT 1654 performed relatively poorly, meeting very few benchmark values and overall being assessed as not resembling their target state; however, do show some signs of shrub and tree regeneration PCT 1602 and PCT 1607 performed relatively well and resemble target state Visible changes observed between the baseline and the 2019 photo monitoring include decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation 	<ul style="list-style-type: none"> Weed Control of Prickly Pear Pest Control Erosion control Track maintenance Incorporate habitat features such as fallen logs, rock piles in active regeneration areas. Confirm presence of

BOA	Management actions undertaken in previous 12 months	Key Trends	Actions for 2020
			<p>threatened epiphytic orchid <i>Cymbidium canaliculatum</i></p> <ul style="list-style-type: none"> Reinstate remote field camera monitoring to detect cryptic species recorded previously.
Mitchell Hills North Offset Site	<ul style="list-style-type: none"> Weed control Fence line and Gate condition review and maintenance Biennial monitoring report Biannual inspections 	<ul style="list-style-type: none"> Native species richness increased in 2019 compared to 2017 at all but one monitoring site (site MH5) Native species richness represented a minimum of 60% (site MH2) to a maximum of 96% (site MH5) of total species richness in 2019. Regenerating rainforest site (PCT 1543) performed moderately well considering its disturbed state and was comparable to benchmark values in species richness of understorey species; however, it remained well below benchmark values for tree species richness. PCT 1590 (site MH1) performed well. Grasslands are progressing towards their target state. Critically Endangered <i>Rhodamnia rubescens</i> (Scrub Turpentine) trees were detected (Figure 11) No substantial changes were observed between the baseline and the 2019 photo monitoring. The only visible change observed related to decreases in the height and cover of groundcover vegetation. 	<ul style="list-style-type: none"> Weed Control of Coolatai Grass Pest Control Incorporate habitat features such as fallen logs, rock piles in active regeneration areas Develop performance indicators and completion criteria for PCT 1543 Develop Myrtle Rust management plan



Figure 11: A new record of Critically Endangered *Rhodamnia rubescens* at Mitchell Hills BOA



Figure 12: Example of natural tree regeneration of *Eucalyptus fibrosa* at Cross Creek BOA

6.6 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 (i.e. by 2022). 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.

6.7 Fauna Monitoring

6.7.1 Methods

Biodiversity Offset Areas

Fauna monitoring undertaken at each BOA consists of the following methods:

- diurnal woodland bird surveys
- targeted winter bird surveys
- micro-bat echolocation surveys
- diurnal herpetofauna surveys
- spotlighting surveys
- call playback surveys

6.7.2 2019 Monitoring Results

Climatic conditions experienced in 2019 were very dry with significant rainfall events only recorded in January and March 2019 [62mm + 138.2mm respectively]. The majority of dams and water bodies were dry or at very low water levels from the preceding years 2017 and 2018. Rainfall events recorded in 2019 did not improve water storage at any of the water bodies monitored for frogs. The annual rainfall for 2019 was 397mm, well below the annual average of 627mm.

Monitoring for mammal species in 2019 was undertaken with remote field cameras, trapping surveys for smaller mammals and microbats, and nest box inspections. Field cameras recorded a diverse number of medium to larger mammals, including 4 introduced species. The threatened Spotted-tail Quoll was detected in 2019 by field camera at 2 separate locations. The threatened Brush-tailed Phascogale (see [Figure 13 \(D\)](#)) and Squirrel Glider were also recorded in 2019. Captures of small terrestrial native mammals, the Common Dunnart and Yellow-footed Antechinus remain consistent between years. A total of 11 microbat species were recorded by trapping, echolocation call recordings, spotlight searches and nest box inspections. Captures of microbats in 2019 were significantly higher than previous monitoring periods, despite the MGO experiencing severe drought conditions.

Nest boxes installed in the rehabilitation areas supports the most mature remnant forest, recorded the presence of Squirrel Glider and Common Brushtail Possum. Boxes specific to the Common Brushtail Possum and other fauna groups were installed in late 2015. Uptake of the boxes was rapid, with all boxes exhibiting evidence of use within 12 months of installation. The Brush-tailed Phascogale was also detected utilising nest boxes in the rehabilitation in 2017. The species was also detected in a nest box in the South East Mount Owen Biodiversity Offset in 2017.

Four reptile species were detected in 2019, with the relatively low number of species observed during the year likely due to the influence of the ongoing drought and resulting limited ground cover. A total of 26 reptile species that have been recorded at MGO since the commencement of fauna monitoring ([Figure 13 \(C\)](#)). Similarly, counts of frogs were very low (three species identified), due to absence of ponds with water and aquatic vegetation. The annual rainfall recorded at MGO in 2019 was 397mm, well below the average of 649mm.

In 2019, 66 bird species were identified, including 6 threatened bird species. 3 non-flying mammals and 3 microbat species were also recorded. A total of 26 threatened bird species have been detected at the MGO since the commencement of fauna monitoring

(Figure 13 (A & B)). Inspections of installed nest boxes in 2019 revealed varying usage depending upon target species and location. Highest usage of nest boxes was recorded for bird boxes installed in rehabilitation areas, with 50% usage. Glider style boxes were also utilised, with 35% occupied in 2019 for those boxes located in the New Forest Area. A total of 15 individuals belonging to 6 fauna species were recorded in nest boxes in 2019. One box located in rehabilitation exhibited evidence of use by a larger forest owl, possibly Southern Boobook or Barn / Masked Owl. No individuals were directly observed, but regurgitation pellets consistent with owls were observed.

In 2019, a total of 76 nest boxes targeting various fauna groups were installed at MTO rehabilitation, North Void rehabilitation and Barrett Pit rehabilitation (GLD). Cavities cut into the trunk of established trees were also created, with almost immediate usage by nesting Eastern Rosella in spring 2019.

6.8 Conservation Agreement Offsets

In 2019, two MTO offsets, the North West and South-east Corridor were added to the monitoring program. Overall, the fauna monitoring for MGO, undertaken over the period 1996 – 2019, has recorded a total of:

- 168 native and 2 introduced bird species
- 41 native and 10 introduced mammal species
- 26 reptiles
- 16 frog species.

In the 2019 monitoring period, a total of 66 bird species, 15 native and 4 introduced mammals, 3 reptile and 3 frog species were recorded. The extended drought over the period 2017 – 2019 reflected the low abundance of reptile and amphibian species recorded.



A: Pied Currawong



B: Musk Lorikeet feeding on flowering Narrow-leaved Iron Bark.



C: Lace Monitor Resting on microbat nest box.



D: Brush-tailed Phascogale

Figure 13: Opportunistic photos of fauna identified in offset areas

Cumulative Threatened Fauna

MGO carries out seasonal fauna monitoring across site rehabilitation areas and onsite BOAs. This includes monitoring of birds, reptiles, mammals and frogs. [Table 31](#) lists the threatened species observed since 1996 at the MGO.

Table 31: Threatened species observed at MGO 1996 - 2019

Common Name	EPB C	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
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		√	√	√	√		√	√	√	√	√	√	√											√
Dusky Woodswallow		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	
Diamond Firetail		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√							
Spotted-tail Quoll	V	V					√	√	√	√	√		√	√	√	√	√	√	√	√	√			√		√
Brush-tailed Phascogale		V																√					√	√		√
Koala		V	√*																							√*

MT OWEN GLENDELL OPERATIONS

Annual Review 2019

Common Name	EPB C	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
Squirrel Glider		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√		
New Holland Mouse	V									√	√	√	√	√									√			
Grey-headed Flying-fox	V	V		√			√				√		√	√			√						√			√
Yellow-bellied Sheathtail-bat		V												√*		√*	√*		√*	√*						
Eastern Freetail-bat		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Large-eared Pied Bat	V	V				√*		√*					√*		√*						√*	√*				
Eastern Bentwing-bat		V	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√			√
Little Bentwing-bat		V						√*							√*	√										
Large-footed Myotis		V				√		√				√		√	?	?						√				
Greater Broad-nosed Bat		V					√	√	√		√				?	?	√		√	√						

E = Endangered

V = Vulnerable

√* Unconfirmed sighting

Biodiversity Management Works

6.8.1 Direct Seeding

In 2019 MGO carried out direct seeding works across its Conservation Areas. A total of 31 hectares were direct seeded within the vegetation community 1602 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter. A photo showing one seeded area is included in [Figure 14](#).



Figure 14 Example of direct seeding works completed at Bettys Creek (Glendell) Conservation Area

6.8.2 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 GLD and the installation of the Greater Ravensworth Area Tailing Pipeline Infrastructure during the 2017 reporting period. While clearing activities were minimised, 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.

During the reporting period, as a result of the low survival rate, MGO planted an additional 2,000 Hunter River Oak using the direct seed technique. Additionally, fencing was installed to protect plantings from grazing activities. MGO will continue to monitor the survival rate and report on planting progress in the next Annual Review.

6.8.3 South East Corridor – Tree Planting

As per BOMP requirements a total of 13,200 tubes were planted on South East Corridor Offset with a canopy to shrub ratio of 1.66. These activities were completed from 2017 - 2019 in order to enhance corridor function in this area. [Table 32](#) shows planted species.

Table 32: South East Corridor Offset tree planting species

Species	Common Name	Number
<i>Eucalyptus fibrosa</i>	Broad leaf ironbark	1000
<i>Eucalyptus crebra</i>	Narrow leaf ironbark	1060
<i>Corymbia maculata</i>	Spotted gum	340
<i>Eucalyptus moluccana</i>	Grey Box	400
<i>Allocasuarina luehmannii</i>	Bull oak	400
<i>Casuarina glauca</i>	Swamp oak	200
<i>Angophora floribunda</i>	Rough bark apple	120
<i>Eucalyptus tereticornis</i>	Forest red gum	1000
<i>Melaleuca styphelioides</i>	Prickly leaf paperbark	120
<i>M. decora</i>	White feather honey myrtle	120
<i>M. nodosa</i>	Ball honey myrtle	200
TOTAL overstorey		4960
<i>Acacia decora</i>	Western golden wattle	880
<i>Acacia decurrens</i>	Green Wattle	640
<i>Acacia falcata</i>	Falcate wattle	800
<i>Acacia parvipinnula</i>	Silver stem wattle	780
<i>Acacia implexa</i>	Hickory	880
<i>Daviesia ulicifolia</i>	Gorse bitter pea	400
<i>Acacia amblygona</i>	Fan wattle	540
<i>Acacia paradoxa</i>	Kangaroo thorn	80
<i>Dodonaea viscosa</i>	Hop bush	800
<i>Indigofera australis</i>	Indigo	600

Species	Common Name	Number
<i>Bursaria spinosa</i>	Blackthorn	800
<i>Breynia oblongifolia</i>	Coffee bush	600
<i>Kunzea occidentalis</i>	Tick bush	440
TOTAL shrubs		8 240
TOTAL plants		13 200

6.8.4 Habitat Augmentation

A total of 163 habitat argumentation structures were installed across MGO Biodiversity Offsets and Rehabilitation Areas ([Figure 15](#)). 17 Small Mammal Boxes, 39 Microbat Boxes, 25 Bird Boxes, 42 Glider Boxes, 12 Possum Boxes, 14 Spotted-tail Quoll Boxes, 2 Spotted-tail Quoll logs Polypipe, 2 Tree Creeper Bird Boxes and 10 Wood Duck Boxes.

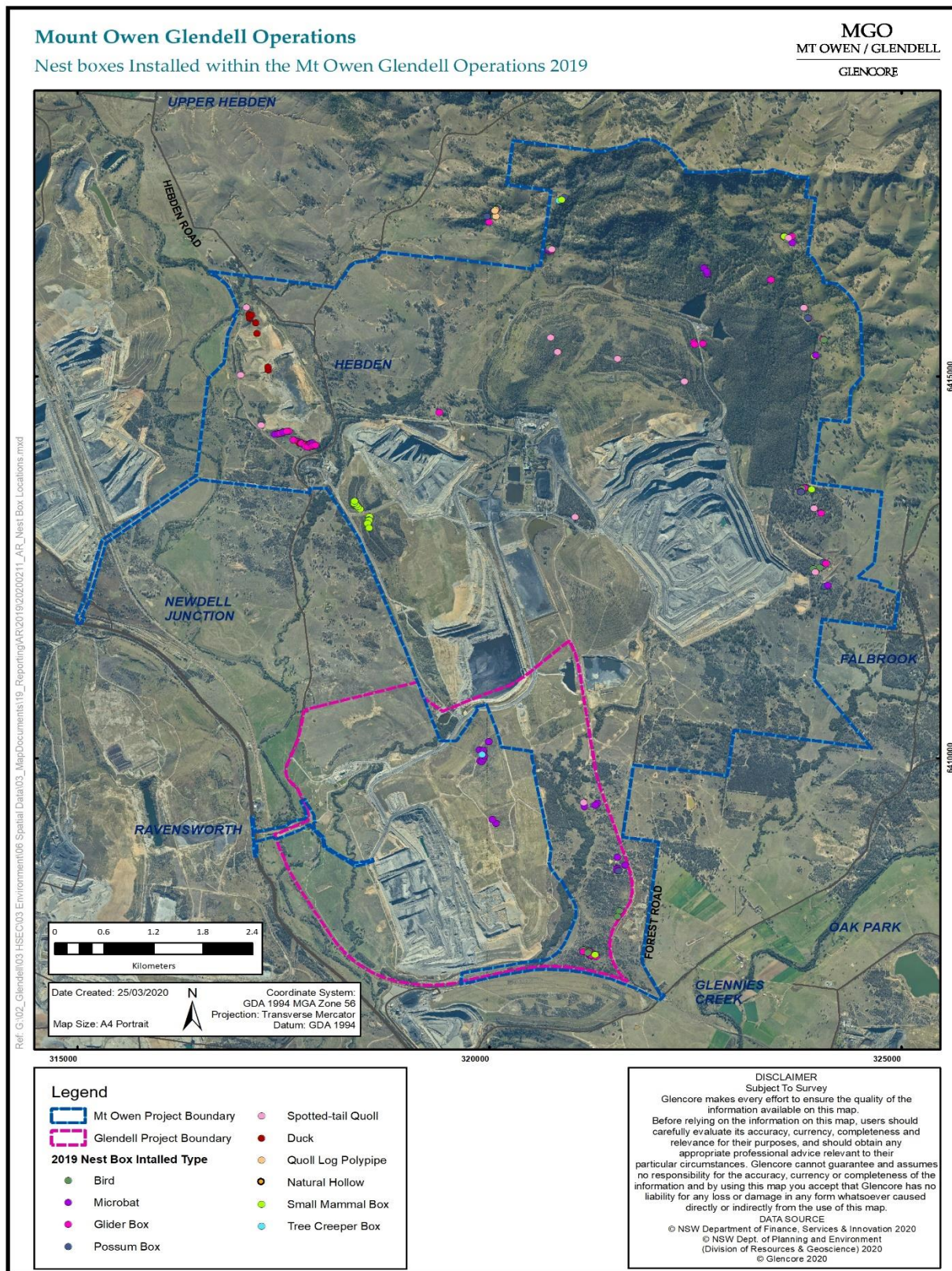


Figure 15 Nest Boxes Installed at MGO in 2019

The BOMP (2018) details specific habitat creation for Spotted-tail Quolls in the Stringybark Creek BOA. In 2019, habitat enhancement works for fauna included the installation of structures for the threatened Spotted-tail Quoll and nest boxes for tree hollow-dependent fauna. The Spotted-tail Quoll structures installed consisted of 5m lengths x 30cm diameter disused polypipe utilised by MGO for water management (refer to [Figure 16](#)). These pipes were recycled and trialled at Stringybark Creek BOA as an alternative to installing natural ground logs from felled trees. Monitoring of the pipes over time will determine the effectiveness of this material in providing habitat for the Spotted-tail Quoll. If successful, additional structures will be installed throughout MGO rehabilitation and offset areas.

No specific habitat enhancement works are specified for the Esparanga BOA. The offset supports a high density of habitat trees with hollows, negating the need for installation of specific fauna nest boxes.



Figure 16 Spotted-tail Quoll habitat structure installed at Stringybark Creek BOA in 2019.

6.8.5 Weed Management

A Weed Action Plan was developed to identify all targeted weed control activities at the MGO. The plan was implemented during the 2019 reporting period, continuing the active programs of control that have been implemented since 1996. Throughout the MGO rehabilitated areas, weeds targeted during 2019 included:

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

Weeds were also sprayed in areas 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*
- Inkweed - *Phytolacca octandra L.*
- Lantana - *Lantana camara*
- Prickly Pear - *Opuntia spp.*
- Scotch Thistle - *Onopordum acanthium*
- Tiger Pear - *Opuntia aurantiaca*
- Spear Thistle - *Cirsium vulgare*

A summary of weed management works undertaken in MGO biodiversity offsets during the reporting period is included in [Table 33](#). During 2019 a successful mulching program was implemented targeting Acacia Saligna, African Boxthorn and Kia Apple in buffer land and rehabilitation areas. Before and after images can be viewed below (see [Figure 17](#) and [Figure 18](#)).



Figure 17: African Boxthron Infestation Main Creek before Mulching

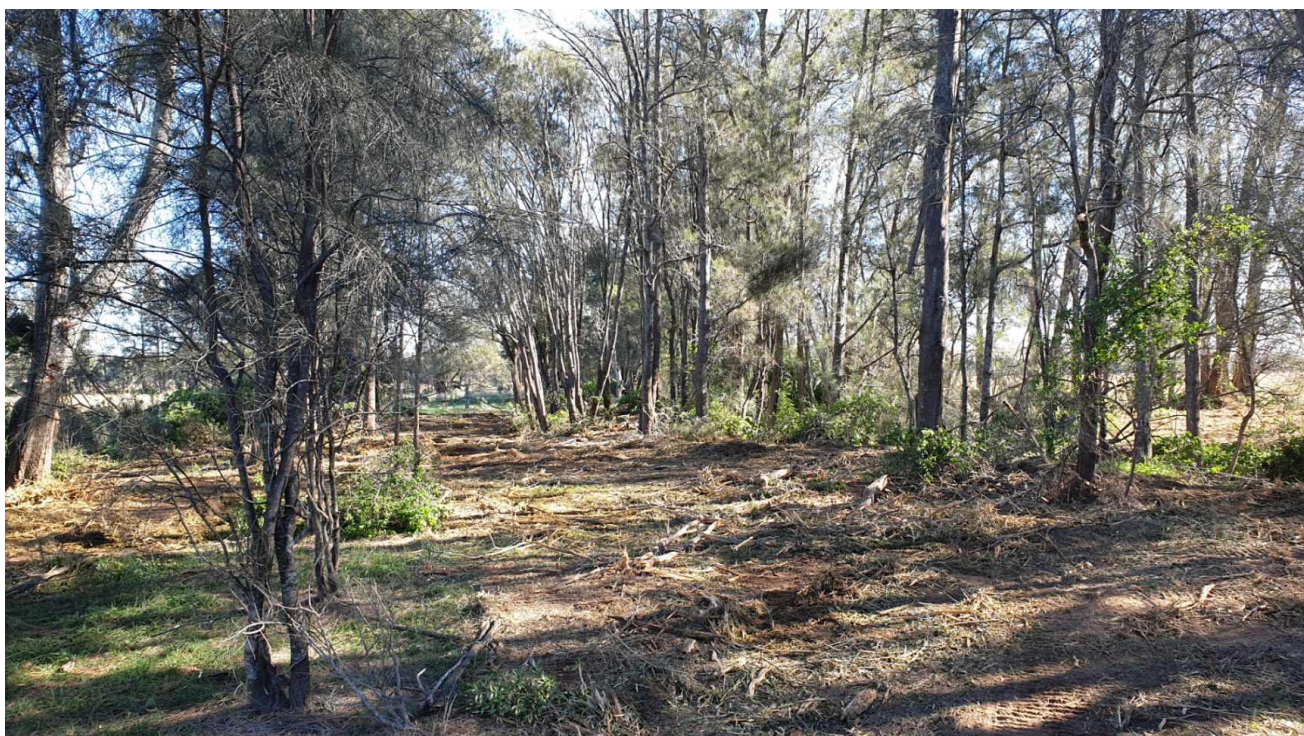


Figure 18 African Boxthron Infestation Main Creek after Mulching

Table 33: MGO Weed Works Completed in Biodiversity Offsets 2019

Offset Area	Weed Control Applied to Area	Weeds Targeted
Northwest Offset	Woody, herbaceous	<ul style="list-style-type: none"> • Low volume basal bark spray application of African Olive, • Low volume foliar spray application of Coolatai Grass, Prickly Pear. • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass.
Northeast Offset	Woody, herbaceous	<ul style="list-style-type: none"> • Low volume basal bark spray application of African Olive, • Low volume foliar spray application of Coolatai Grass, Prickly Pear. • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass.
Southeast Offset	Herbaceous	<ul style="list-style-type: none"> • Low volume spray application of E. curvula (African Lovegrass) and H. hirta (Coolatai Grass). • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass • High volume spray application targeting Prickly Pear.
Forest East Offset	Herbaceous	<ul style="list-style-type: none"> • Low volume spray application of E. curvula (African Lovegrass) and H. hirta (Coolatai Grass). • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass • High volume spray application targeting Prickly Pear.
Southeast Corridor Offset	Herbaceous	<ul style="list-style-type: none"> • Low volume spray application of E. curvula (African Lovegrass) and H. hirta (Coolatai Grass). • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass • High volume spray application targeting Prickly Pear
Southern Remnant Offset	Woody	<ul style="list-style-type: none"> • Low volume spray application of Prickly Pear.
Stringybark Creek Habitat Corridor	Woody, herbaceous	<ul style="list-style-type: none"> • Low volume basal bark spray application of African Olive, low volume foliar spray application of Coolatai Grass, Prickly Pear. • Cut and paint of African Olive using chainsaws and hand saws. • High volume spray application targeting Coolatai Grass.
Esparanga Offset	Foliar Spray	<ul style="list-style-type: none"> • Low volume foliar spray application of Coolatai Grass, Prickly Pear..
Mitchell Hills Offset	Foliar Spray	<ul style="list-style-type: none"> • Low volume foliar spray application of Coolatai Grass, Prickly Pear..
Bettys Creek Habitat Management Area (HMA)	Woody, herbaceous	<ul style="list-style-type: none"> • High volume spray application targeting Coolatai Grass and African Lovegrass. • Low volume spray application of Prickly Pear. • Low volume spray application of Galenia species. • Cut and paint application on African Boxthorn. • Low volume and high-volume spray application of lines 1m wide were applied to all vegetation.

6.8.6 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, a monthly canid ejector bait program across off-site BOAs. Trained personnel placed '1080' poison baits, and ejector baits around across all areas. Results of the 2019 offset baiting program are summarised in [Table 34](#), and photos in [Figure 19](#).

Table 34: Wild Dog and Fox Biodiversity Offset Baiting Program –2019 results

	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	78	234	38 (11 Wild Dogs & 27 Foxes)	16.2%
Spring	78	312	70 (24 Wild Dogs & 46 Foxes)	22.4%
Ejector Baiting Program				
Annual	23	276	108 (35 Wild Dogs & 73 Foxes)	39.1%



Figure 19: Images captured on motion cameras in Offset Areas during 2019

Buffer land Pest Control

During 2019, 69 baits were taken by non-target species, including feral pigs (14) and goannas (30). The poison is not lethal to these species. 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 30 baits taken by goannas, the vast majority (29) were taken during the spring program. One feral cat was spotted on a trail monitoring camera, but it did not show interest in taking the baits (see [Table 35](#) and photos in [Figure 20](#)).

Table 35: Wild Dog and Fox Buffer Land Baiting Program – 2019 results

	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	85	265	42 (26 Wild Dogs & 16 Foxes)	16.0%
Trapping				
Autumn	18	Nil	7 wild dogs 1 fox	45.0%
Spring	18	Nil	9 wild dogs 1 fox	56.0%

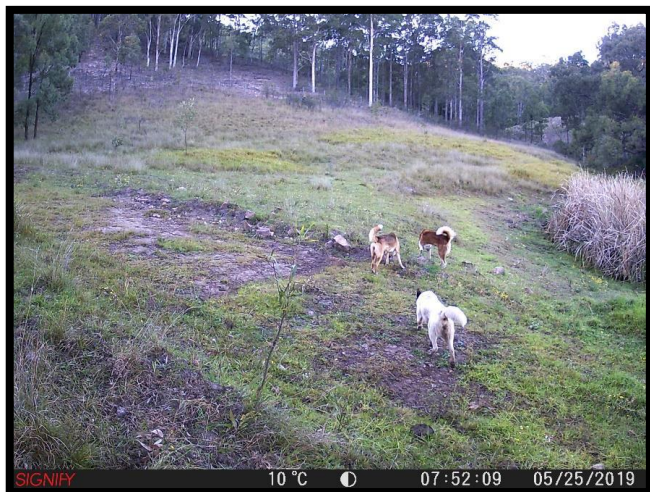


Figure 20: Images captured during buffer land spring baiting program

Combined Programs Results

A number of combined firearm culls were undertaken during 2019 across buffer lands and offsets. This resulted in the culling of the following target species listed in [Table 36](#).

Table 36: Wild Dog and Fox Buffer firearm cull – 2019 results

Target Species	Number
Kangaroos	188
Pigs	16
Deer	33
Rabbits	515

6.9 Heritage

6.9.1 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.

Meetings between MGO and the Aboriginal community were held in May and September 2019. The Aboriginal Cultural Heritage Working Group (ACHWG) representatives discussed the greater involvement of the Aboriginal community stakeholders in the conservation and management of Aboriginal cultural heritage. Further discussion was also held regarding the construction and housing of salvaged artefacts at the Wollombi Brook Conservation Agreement Area, with construction of the facility scheduled to commence in 2020. Open days were held in May and August with the Registered Aboriginal Parties (RAP's) to discuss management options for the York's Creek Aboriginal Conservation Area.

2019 Monitoring Program

In 2019 MGO, in conjunction with two RAPs and an OzArk archaeologist, continued the monitoring of Aboriginal heritage sites across both MGO and Integra Underground (see [Figure 21](#) and [Figure 22](#)). The monitoring, occurring quarterly, 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.

MGO monitored all four quadrants during 2019 with over 55 artefact sites visited. Artefacts were found to be well-preserved with minimal management recommendations required.



Figure 21: Knapped glass artefact monitored in 2019 in MGO's Buffer Lands



Figure 22: Large mudstone core artefact monitored in 2019 in MGO's Buffer Lands

Salvages During 2019

No salvages were undertaken in 2019.

6.9.2 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 identified a range of activities, from dairying to mixed farming, cropping, and mining activities.

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

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

During 2019 the former Hebden Public School was removed of dumped rubbish and tidied up (see [Figure 23](#)). Monitoring during the reporting period found that sites are well-preserved with minimal management recommendations required, such as the timber loading ramps pictured below in [Figure 24](#).



Figure 23: Former Hebden PS removal of rubbish and weed management



Figure 24: Timber loading ramp to be managed in-situ.

Salvages During 2019

No salvages were undertaken in 2019.

6.9.3 Visual Amenity

MGO undertook direct seeding and tube stock planting works in September 2019 as part of the development of the Middle Falbrook Tree Screening as described in MOCO MOD 2. 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.

MGO will continue to monitor and manage the development of the tree screen during the next reporting period in accordance with Schedule 3 Condition 39A of SSD-5850.

During the reporting period, dilapidated buildings and other structures were removed from a number of properties owned by MGO to improve the visual amenity of the area. Further discussion is provided in [Section 6.9.4](#).

6.9.4 Demolition Works

During the reporting period two properties were demolished which comprised of a dilapidated residence that was affected by fire on Picton Lane as well as a dilapidated dairy on Glennies Creek Road.

Picton Lane

The dilapidated fire effected former property at Lot 1 DP 801592 (Picton Lane) was dismantled and disposed of to improve local visual amenity, farming land and safety. Demolition commenced on the 4th of July 2019 and was completed with seeding on Friday 9th July 2019. [Figure 25](#) and [Figure 26](#) shows before and after photos of the demolition. Approximately 103.54 tonnes of waste was removed from the site including 84.62 tonnes of mixed waste, 101.14 tonnes of concrete waste and 2.4 tonnes of steel.

No asbestos was present at the property, as confirmed by a licensed independent certifier (EP Pty Ltd) who were engaged to undertake site monitoring and sampling. This inspection was undertaken on 9th of May 2019.



Figure 25: Demolition of fire effected Picton Lane property – before.



Figure 26: Demolition of fire effected Picton Lane property – after

Glennies Creek Road Dairy

The dilapidated former property at Lot 112 DP 850054 (Dairy on Glennies Creek Rd) was dismantled and disposed of to improve local visual amenity and farming land. Demolition commenced on the 12th of August 2019 and was completed with seeding 17th August 2019. **Figure 27** and **Figure 28** shows before and after photos of the demolition. Approximately 107.32 tonnes of waste was removed from the site including 71.36 tonnes of mixed waste, 33.76 tonnes of concrete waste, 2.20 tonnes of asbestos material.

Asbestos removal work was undertaken by a licensed asbestos removal contractor – JR Richards - in accordance with the Safe Work NSW *Code of Practice – How to Safety Remove Asbestos* 2016 and the *NSW Work Health and Safety Regulation* 2017, Clauses 473, 474 and 482. An independent certifier (TMT Industries) was engaged to undertake a visual inspection of the site to confirm the removal of the asbestos. This inspection was undertaken on 8th of August 2019 and ESP confirmed that the potential risk to human health following removal of asbestos from the site is extremely low.



Figure 27: Demolition of dilapidated dairy Glennies Creek Road – before



Figure 28: Demolition of dilapidated dairy Glennies Creek Road – after

7 Water Management

MGO operates under a suite of water management plans, all of which were approved by DPIE in the last two years. These include:

- Water Management Plan (Overarching) (November 2018)
- Surface Water Management and Monitoring Plan (SWMMP) (February 2019)
- Groundwater Management and Monitoring Plan (GWMMP) (February 2019)
- Erosion and Sediment Control Plan (November 2018)
- Creek Diversions Plan (November 2018)
- Surface Water and Groundwater Response Plan (SWGWRP) (February 2019)

The SWMMP, GWMMP and SWGWRP were all reviewed during 2019, in consultation with relevant government agencies. MGO will seek approval for the revised water management plans in 2020 following the approval of Mt Owen SSD-5850 Mod 2 in September 2019.

Mining related water licensing and relevant pumped volumes at MGO are outlined in [Table 37](#). Glencore owns a number of additional surface water licences associated with farm irrigation on Glencore land. These licences have been excluded from this annual review as they are not linked to mining and not required under any consent. Water take is water taken by the operation in the previous water year (1st July 2018 to 30th June 2019).

Table 37: MOC 2018 Water Licensing Summary

Water Licence Number	Water sharing plan, source and management zone (as applicable)	Licence Activity/ Entitlement	Description	Water take (ML) 1/7/ 2018 – 30/6/2019
Surface Water Licences				
WAL7814	Hunter Regulated Water Sharing Plan, Zone 3A (Glennies Ck)	Licence to pump 1000 units.	Water pumped to Mt Owen and Integra to be treated and used throughout operational facilities.	679
20WA210993	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	Upper diversion of Swamp Creek	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A
20WA211425	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	Middle Diversion of Swamp Creek	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A
20WA211430	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	Lower diversion of Swamp Creek	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A
20WA211429	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	York's Creek diversion	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A
20WA212187	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	Upper and middle diversion of Bettys Creek	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A

Water Licence Number	Water sharing plan, source and management zone (as applicable)	Licence Activity/ Entitlement	Description	Water take (ML) 1/7/ 2018 – 30/6/2019
20WA212660	Hunter Unregulated and Alluvial Water Sources, Jerrys Management Zone (Jerrys Water Source)	Lower diversion of Bettys Creek	Diversion complete being maintained through inspections and annual stream stability assessments.	N/A
Groundwater Licences				
20BL169337	N/A	Groundwater extraction for dewatering purposes – Mt Owen North Pit 140 units	Groundwater extraction at Mt Owen North Pit.	867
20BL170294	N/A	Groundwater extraction for dewatering purposes – Eastern Rail Tailings Pit 220 units	Groundwater extraction at Eastern Rail Pit.	
20BL170295	N/A	Groundwater extraction for dewatering purposes – Bayswater North and West Pit 800 units	Groundwater extraction at Bayswater North and West Pit	
20BL168209	N/A	Saline water extraction bore - 2,500 units	Additional allocation for groundwater extraction across the Mt Owen Complex. Groundwater take should be compared to total allocation to determine compliance with licensing.	
20BL169544	N/A	Saline water extraction bore - 2,500 units	Additional allocation for groundwater extraction across the Mt Owen Complex. Groundwater take should be compared to total allocation to determine compliance with licensing.	
20BL168116	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL169332	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL169333	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL169334	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL169335	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL169336	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171534	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171535	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171536	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171537	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A

Water Licence Number	Water sharing plan, source and management zone (as applicable)	Licence Activity/ Entitlement	Description	Water take (ML) 1/7/ 2018 – 30/6/2019
20BL171538	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171539	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171540	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171541	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171542	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171543	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171544	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171545	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171546	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL171547	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A
20BL168116	N/A	Monitoring bore	Monitoring bore used for groundwater monitoring.	N/A

7.1 Water and Salt Balance

The MGO operates a water management system designed to ensure the efficient operation of the MGO through control of water inflow and the ready provision for onsite demands. **Appendix G, Figure 5** details the water flow path throughout the complex. In average to dry rainfall periods, the MGO is predicted to operate with a water deficit in absence of water imports from either the GRAWTS or from licensed surface water allocations. A summary of the 2019 MGO water and salt balance is included in **Table 38**.

Table 38: MGO Water and Salt Balance for 2018-2019

Aspect	Volume (ML)	Salt (T)
INFLOWS		
Runoff	1,211	1,272
Glennies Creek Extraction	679	193
Transfers from Other Sites	1,692	9,063
Tailings Bleed Water to West Pit ¹	6,302	33,751
CHPP Feed ROM Moisture	881	4,716
Groundwater Inflow	867	2,833
Total	11,632	51,828
OUTFLOWS		
Evaporation	1,350	-
Exported to Other Sites	2,904	10,831
Entrainment ²	1,816	9,726
Dust Suppression	2,065	6,017
Total	8,135	26,574
Inflow – Outflow	3,497	25,254
Change in Storage	3,343	25,367
Inflow – Outflow – Change in Storage	154	-133
Error	<1%	<1%

1. Tailings bleed from Ravensworth and Liddell tailings

2. Includes water entrained in tailings, product coal and coarse rejects

3. Accounts for the estimated water storage in the West Pit overburden emplacement area spoil over the reporting period

*Salt levels calculated using average salinity of 5,832 µS/cm Electrical Conductivity (assumed salinity of entrained water)

In 2019 MGO continued to operate at a slight water excess which is mainly the result of water transfers within the GRAWTS. As part of the GRAWTS, water is able to be transferred between Liddell, Ravensworth Operations, Mt Owen Complex and Integra. This allows MGO to minimise the amount of water taken from the surface water allocation on Glennies Creek.

In 2019 a total of 2,904ML of water was exported to other sites from MGO. This included 2,829 ML to Ravensworth Operations and 75 ML to Liddell. The majority of this water was tailings return water from the GLD West Pit. 1,692 ML of water was returned to MGO from Liddell and Ravensworth Operations during 2019.

Groundwater seepage to pits was similar in 2019 compared to 2018 (867ML versus 774ML). This is mainly due to calculations of seepage from West Pit into Bayswater North being measured. During 2018 and 2019 bathymetric surveys were completed monthly to more accurately capture water stored on the tailing's surface. The other associated factor across the complex is due to drier climatic conditions resulting in a lower rate of groundwater recharge and subsequent outflow into pits. This is evidenced by the

number of groundwater monitoring bores being “dry” in 2018 (see [Section 0](#)). The decline in groundwater seepage to pits in 2018 has also resulted in a significantly lower salt inflow for the site, compared to 2017 (12,587ML versus 28,259ML).

There was also a 68% reduction in entrainment (waste and product) from the previous reporting period. This is also likely due to drier climatic conditions resulting in lower moisture rates in waste products (lower rate of spoil seepage due to decreased rainfall) and also coal (increased evaporation). This reduction in entrainment has also meant that salt outflows from site through product coal were lower, however this is largely counterbalanced by the increased volume of salt leaving site through exported water to other sites i.e. Ravensworth Operations and Liddell.

MGO water extraction from Glennies Creek under licence increased in 2019 in comparison to 2018 (679 versus 240 ML) for use as treated potable water. This relative increase was generally due to drier climatic conditions.

7.2 Hunter River Salinity Trading Scheme (HRSTS)

MGO currently holds 13 credits in the scheme. This is three less than 2017 (three credits expired in January 2018). MGO does not have an active discharge point. Water is transferred to other sites as part of the GRAWTS where discharges may occur under given conditions. Mt Owen credits would be transferred to the relevant discharge site if discharge was to occur. Surface Water

7.3 Surface Water

Monitoring Program and Triggers

7.3.1 Water Quality

MGO monitors surface water quality at 19 creek locations surrounding the site ([Figure 29](#)). These include:

- Bowmans Creek (5 sites: BMC1-BMC5)
- Yorks Creek (3 sites: YC1-YC3)
- Swamp Creek (4 sites: SC1-SC4) Bettys 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 within the site Environmental Monitoring Database. Results are assessed against baseline trigger levels outlined in the MGO SWMMP (Error! Reference source not found.).

Table 39: Surface Water Quality Triggers

Water Quality Variable	Bowmans Creek	Yorks 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	10 - 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.

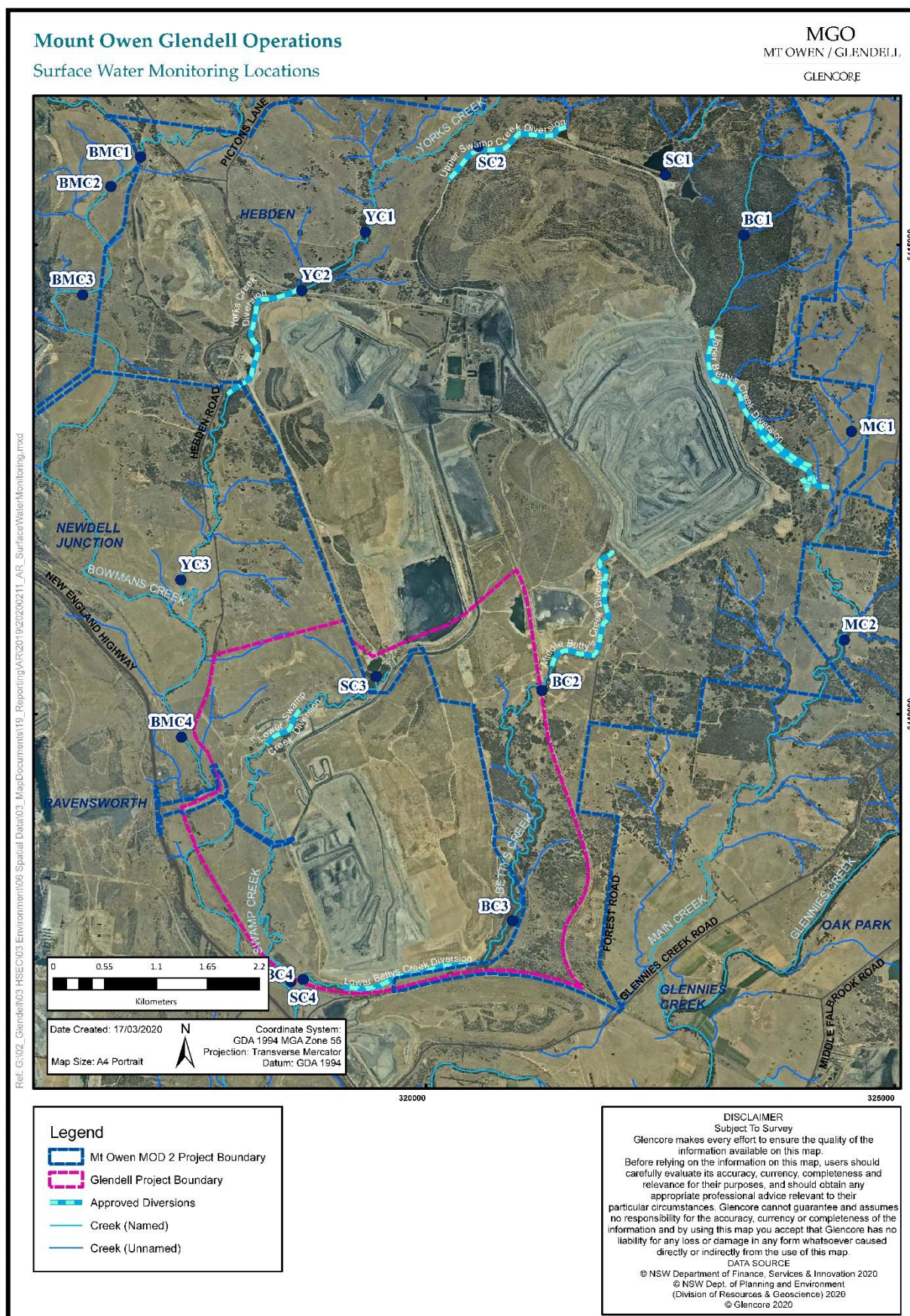


Figure 29: MGO Surface Monitoring Locations

Channel Stability and Stream Health

Annual channel stability and stream health assessment is also carried out across both existing creeks and creek diversions at the site. MGO monitors channel stability and stream health at 41 locations ([Figure 30](#)). These include:

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

Channel stability is assessed using the CSIRO Ephemeral Stream Assessment and Stream Health (2011) and the using the Rapid Appraisal of Riparian Condition (RARC) (2005) methodologies. [Table 40](#) and

[Table 41](#) outline the scoring system for both these methodologies.

Table 40: CSIRO CSIRO Ephemeral Stream Assessment Stability Classifications (CSIRO, 2011)

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 41: Summary Table of Indicators, Functions and Components Assessed in the RARC Index (Jansen et al. 2005).

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 logs, ground cover vegetation, leaf litter cover
Controlling stream microclimate/discharge/water temperatures	Riparian forest	Canopy cover
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 other 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 other habitat

Table 42: Summary RARC Classification System

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

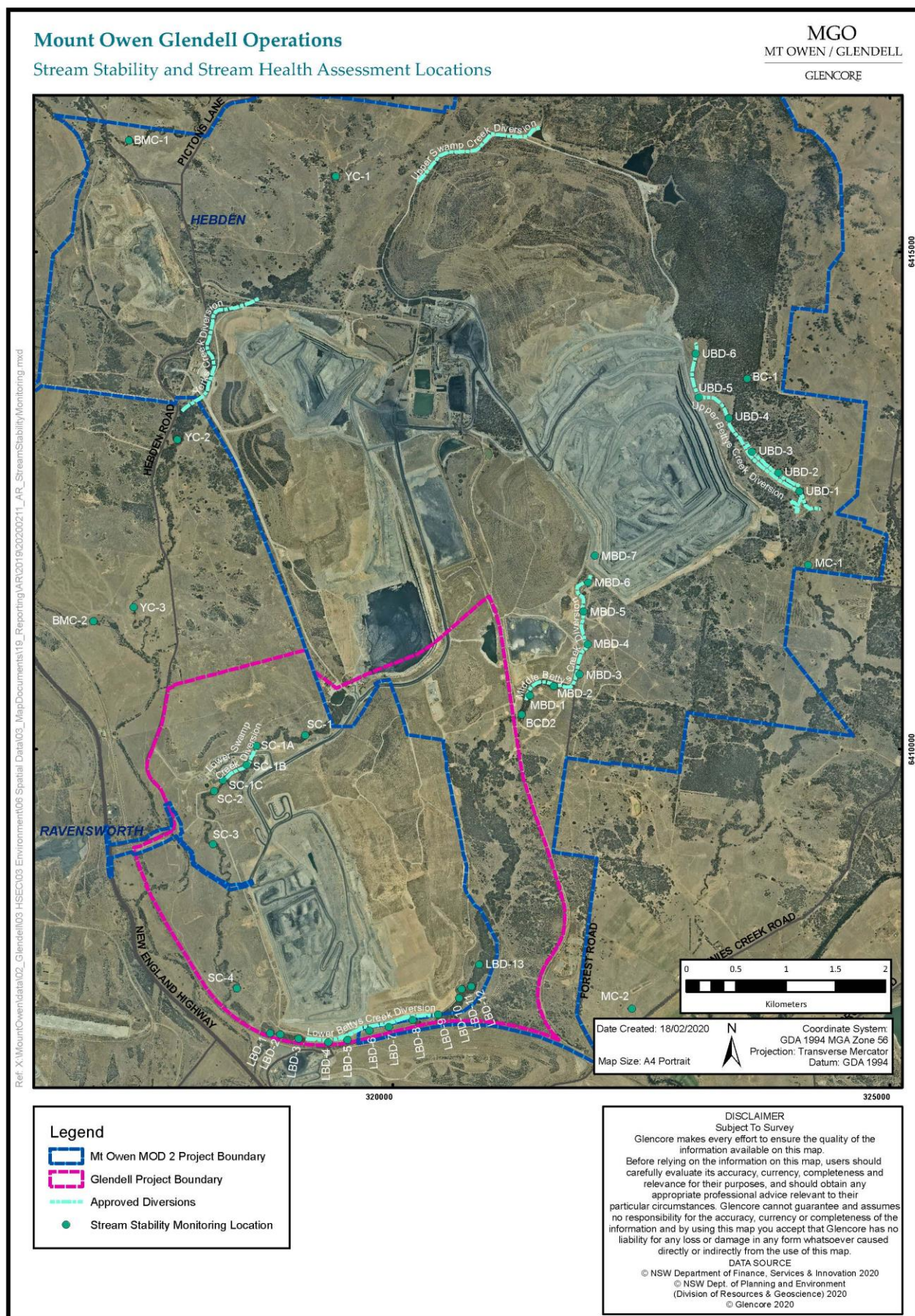


Figure 31: Stream Stability and Stream Health Assessment Locations

7.3.2 Surface Water Performance

Over the last several years MGO has received lower than average rainfall (see [Section 6.3](#)). This has resulted in long periods of no flow conditions within MGO's creek systems. As a result MGO was unable to obtain water samples from a number of locations during the reporting period. These included Yorks Creek (YC2 and YC3), Swamp Creek (SC3 and SC4), Bettys Creek (BC1, BC2 and BC3) and Main Creek (MC3). Where samples were able to be collected, in the majority of cases, these samples were collected during no flow conditions.

A summary of the monitoring results is presented in [Tables 43](#). A copy of the surface water monitoring results for all monitoring locations is included in [Appendix G, Tables 35-45](#). A comparison of 2019 data against historical data for the last five years is provided in [Appendix G, Tables 41-43](#).

Table 43: Summary of Surface Water Monitoring Results 2019

Site	pH			EC (µS/cm)			TSS (mg/L)			Data Capture (%)	Comment
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
BMC1	7.10	8.10	7.82	1559	2880	1972	1	23	7	100%	Samples collected under no flow conditions
BMC2	7.20	8.80	7.77	1536	2820	1948	27	642	116	100%	Samples collected under no flow conditions
BMC3	7.00	8.40	7.90	2410	2600	2505	4	134	69	100%	Dry all year except Jan & June (samples collected under no flow conditions)
BMC4	7.00	7.90	7.47	1290	1850	1399	5	201	34	100%	Samples collected under no flow conditions
BMC 5	7.60	8.30	7.96	3930	5620	4346	17	18	17.5	100%	Dry all year except April-July (samples collected under no flow conditions)
YC1	-	-	-	-	-	-	-	-	-	100%	Dry all year
SC1	7.30	9.40	8.69	421	590	522	1	47	12	100%	Samples collected under no flow conditions
SC2	7.10	9.50	8.04	409	938	609	3	57	23	100%	
BC4	6.60	7.30	6.97	288	493	403	9	66	24	100%	Dry all year except March - Sept (samples collected under no flow conditions)
MC1	6.80	6.80	6.80	207	207	207	39	39	39	100%	Dry all year except October (sample collected under no flow conditions)
MC2	-	-	-	-	-	-	-	-	-	100%	Dry all year

Red indicates exceedance of trigger – refer discussion below.

Bowmans Creek

Monitoring data collected for 2019 for Bowmans creek was generally in line with baseline conditions (refer [Appendix G, Table 43](#)). Exceedances of SWMMP trigger levels are outlined in [Table 44](#). Results for a majority of sites in 2019 showed variances that were still within the historical range (highest and lowest measurements recorded throughout the entire monitoring period) in which the measurements are not considered extraordinary. The sites that triggered SWMMP criteria in 2019 were internally reviewed in accordance with the 2019 SWGWRP. These reviews confirmed that external reporting of these results was not required in line with the SWGWRP. These sites were all sampled under “no flow” conditions during 2019.

Table 44: Summary of SWMMP Trigger Exceedances for Bowmans Creek for 2019

Sample Site	Date	Analyte	Result	Trigger Level	Historical Range	Comments
BMC1	April & June	pH	7.6 & 7.1	7.7 – 8.1	6.8 - 8.3	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC1	Jan - Dec	EC	2880 (Max)	1288	1,530 - 4,060	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC1	March - May	TSS	23 (Max)	10	1 - 414	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC2	Feb – July, Oct	pH	7.2 (Min) & 8.8 (Max)	7.8 - 8.1	6.8 - 8.3	Sampled under no flow conditions. Generally within historical range. One result outside of historical range Not attributable to MGO.
BMC2	Jan - Oct	EC	2820 (Max)	1386	1,530 - 4,060	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC2	Jan - Oct	TSS	642 (Max)	26	1 - 414	Sampled under no flow conditions. Generally within historical range. One result outside of historical range Not attributable to MGO.
BMC3	Jan & June	pH	8.4 & 7.4	7.8 & 8.1	6.8 - 8.3	Sampled under no flow conditions. Generally within historical range. Not attributable to MGO.
BMC3	Jan & June	EC	2600 (Max)	1950	1,530 - 4,060	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC3	Jan	TSS	134	24	1 - 414	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC4	Feb – Mar, May - August	pH	7.0 (Min)	7.5 – 8.0	6.8 - 8.3	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC4	Jan - Dec	EC	1850 (Max)	1257	1,530 - 4,060	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC4	Aug, Oct-Dec	TSS	201 (Max)	17	1 - 414	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC5	April & July	pH	7.6 & 8.3	7.7 – 8.0	6.8 - 8.3	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC5	Jan, Apr-July	EC	5620 (Max)	2430	1,530 - 4,060	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
BMC5	June & July	TSS	18 (Max)	14	1 - 414	Sampled under no flow conditions. Within historical range. Not attributable to MGO.

Bowmans Creek was assessed for stream stability and stream health at two locations and results are included in [Table 45](#)**Error! Reference source not found.** Compared to 2018, stream condition has decreased slightly at both monitoring points. There has been no overall change in stream health classification. The ‘Very Poor’ stream health classification for Bowmans Creek is generally a reflection of past land use and management. Ongoing weed management of Mother-of-millions and Acacia saligna will be completed in 2020 following on from 2019 weed management works.

Table 45: Bowmans Creek Stream Health and Stability – 2019 and 2018

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2019	2018	2019	2018
BMC1	63% (Potentially Stabilising)	69% (Potentially Stabilising)	Very Poor	Very Poor
BMC2	72% (Stable)	78% (Very Stable)	Very Poor	Very Poor

Yorks Creek

Yorks Creek was dry for the all of 2019. No sites were able to be monitored due to the dry conditions (refer [Appendix G, Table 40](#)). Monitoring was not even possible under “no flow” conditions.

Yorks Creek was assessed for stream stability and stream health at three locations and results are included in [Table 46](#). Stream stability has remained similar to 2018 results at all three monitoring sites. Stream health remains unchanged from 2018.

Table 46: Yorks Creek Stream Health and Stability – 2019 and 2018

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2019	2018	2019	2018
YC1	53% (Active)	59% (Active)	Very Poor	Poor
YC2	72% (Stable)	72% (Stable)	Poor	Average
YC3	63% (Potentially Stabilising)	66% (Potentially Stabilising)	Very Poor	Very Poor

Swamp Creek

Swamp Creek sample sites SC3 and SC4 were dry for all of 2019. Sample sites SC1 and SC2 were able to be recorded, however, monitoring was carried out under “no flow” conditions. There were 11 exceedances of SWMMP trigger levels at SC1 during 2019, as detailed in [Table 47](#). Monitoring data for Swamp Creek is included in [Appendix G, Table 43](#).

2019 monitoring results for SC1 in exceedance of SWMMP trigger levels were internally reviewed in accordance with the 2019 SWGWRP. These reviews confirmed that external reporting of the results was not required in line with the SWGWRP. These sites were all sampled under “no flow” conditions during 2019.

Table 47: Summary of Exceedances for Swamp Creek for 2019

Sample Site	Date	Analyte	Result	Trigger Level	Historical Range	Comments
SC1	Jan-Mar, May-Dec	pH	7.3 (Min) & 9.4 (Max)	7.7 – 8.6	6.4 – 10.1	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
SC1	April & May	TSS	47 (Max)	21	1 – 290	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
SC2	Jan-Mar, June, Sept-Nov	pH	7.1 (Min) & 9.5 (Max)	7.4 – 8.2	6.4 – 10.1	Sampled under no flow conditions. Within historical range. Not attributable to MGO.
SC2	Jan & Sept	TSS	57 (Max)	35	1 – 290	Sampled under no flow conditions. Within historical range. Not attributable to MGO.

Swamp Creek was assessed for stream stability and stream health at four locations. Results are included in [Table 48](#). Stream stability remained constant or slightly increased across four sites (since 2018). Stream health remained constant, and was generally classified as 'Very Poor' (between 2014 and 2019). Similar to 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. Fencing inspections completed bi-annually will be undertaken in 2020 to ensure cattle are excluded from these areas.

Table 48: Swamp Creek 2019 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2019	2018	2019	2018
SC1	66% (Potentially Stabilising)	69% (Potentially Stabilising)	Very Poor	Very Poor
SC2	59% (Active)	59% (Active)	Very Poor	Very Poor
SC3	63% (Potentially Stabilising)	59% (Active)	Very Poor	Very Poor
SC4	63% (Potentially Stabilising)	59% (Active)	Very Poor	Very Poor

Betty's Creek

Betty's Creek was dry for the majority of 2019. Monitoring of one site (BC4) was only possible in March to September and monitoring was carried out under "no flow" conditions. There were four exceedances. Monitoring data for Betty's Creek is included in [Appendix G, Table 42](#).

2019 monitoring results for BC4 in exceedance of SWMMP trigger levels were internally reviewed in accordance with the 2019 SWGWRP. These reviews confirmed that external reporting of the results was not required in line with the SWGWRP. These sites were all sampled under "no flow" conditions during 2019 (see [Table 49](#)).

Table 49: Swamp Creek 2019 Stream Health and Stability

Sample Site	Date	Analyte	Result	Trigger Level	Historical Range	Comments
BC4	Mar-April, June, Sept	pH	6.6 (Min)	7.1 – 7.8	5.0 – 9.4	Sampled under no flow conditions. Within historical range. Not attributable to MGO.

Bettys Creek was assessed for stream stability and stream health at two locations. Results are included in [Table 50](#). Stream stability remained constant or has slightly decreased across the two sites (since 2014). Stream health remained constant at one site whilst slightly decreasing at another, generally being classified as 'Good' and 'Very Poor' at the two sites.

Table 50: Bettys Creek 2019 and 2018 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2019	2018	2019	2018
BC1	66% (Potentially Stabilising)	69% (Potentially Stabilising)	Good	Good
BC2	78% (Stable)	78% (Stable)	Very Poor	Very Poor

Main Creek

Main Creek was dry for the majority of 2019. Monitoring was only possible at one site (MC1) during October, with monitoring carried out under "no flow" conditions. There was only one exceedance at this location, at MC1 during the October monitoring round. A pH reading of 6.8 was recorded, which is lower than the SWMMP trigger level range of 7.1 to 7.6. The result is well within the historical range (6.1 – 8.9) and was likely caused by localised impacts. Monitoring data for Main Creek is included in [Appendix G, Table 43](#).

Main Creek was assessed for stream stability and stream health at two locations. Results are included in [Table 51](#). Compared to 2018, stream stability improved at one site (MC1) and decreased at the other site (MC2). Stream health remained constant, and was generally classified as 'Very Poor'. Main Creek has been cleared in the past and has minimal riparian vegetation. This is the main reason for the low health score. No signs of waterlogging were recorded during routine monthly monitoring or annual stream stability and health assessments. Ongoing control of African Boxthorn will be completed along Main Creek in 2020.

Table 51: Main Creek 2019 and 2018 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2019	2018	2019	2018
MC1	63% (Potentially Stabilising)	63% (Potentially Stabilising)	Very Poor	Very Poor
MC2	56% (Active)	59% (Active)	Very Poor	Very Poor

Creek Diversions

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

[Table 52](#) presents a comparison of diversion condition between 2014 and 2019 and [Table 53](#) shows a similar comparison for stream health. Monitoring locations are shown on [Figure 31](#).

Table 52: Comparison of Creek Diversion conditions – 2014 and 2019

Creek Diversion	Transect	2014 Condition	2019 Condition	Condition Trajectory
Upper Bettys Creek Diversion	UBD-1	Active	Potentially Stabilising	Static
	UBD-2	Active	Potentially Stabilising	Improved
	UBD-3	Active	Potentially Stabilising	Improved
	UBD-4	Very Stable	Potentially Stabilising	Decreased
	UBD-5	Stable	Stable	Static
	UBD-6	Very Stable	Stable	Decreased
Middle Bettys Creek Diversion	MBD-1	Stable	Very Stable	Static
	MBD-2	Potentially Stabilising	Stable	Static
	MBD-3	Stable	Stable	Static
	MBD-4	Active	Potentially Stabilising	Improved
	MBD-5	Very Stable	Very Stable	Static
	MBD-6	Potentially Stabilising	Potentially Stabilising	Static
Lower Bettys Creek Diversion	LBD-1	Potentially Stabilising	Potentially Stabilising	Static
	LBD-2	Potentially Stabilising	Potentially Stabilising	Improved
	LBD-3	Stable	Potentially Stabilising	Static
	LBD-4	Stable	Stable	Static
	LBD-5	Stable	Potentially Stabilising	Decreased
	LBD-6	Stable	Stable	Static
	LBD-7	Stable	Stable	Static
	LBD-8	Stable	Stable	Static
	LBD-9	Stable	Potentially Stabilising	Static
	LBD-10	Potentially Stabilising	Potentially Stabilising	Static
	LBD-11	Stable	Stable	Improved
	LBD-12	Very Stable	Stable	Improved

Creek Diversion	Transect	2014 Condition	2019 Condition	Condition Trajectory
	LBD-13	Stable	Stable	Improved
Swamp Creek Diversion	SC-1A	Active	Potentially Stabilising	Static
	SC-1B	Very Stable	Stable	Decreased
	SC-1C	Very Stable	Stable	Decreased

Table 53: Stream Health at MGOC diversions - 2014 to 2019

Site Description	2014 Classification	2019 Classification	Trend	Description of change
Swamp Creek 1A (SC1A)	Very Poor	Very Poor	Stable	No change.
Swamp Creek 1B (SC1B)	Very Poor	Poor	Improving	Total score of 26 in 2019 just within the "Poor" category suggesting there is no change from 2018 (which recorded 25) and overall change in stream condition from previous monitoring in 2015 may be marginal or may reflect artefacts of changes in field assessor. It was observed there were numerous dead trees, however these were not large enough to be assessed as per the RARC criteria.
Swamp Creek 1C (SC1C)	Very Poor	Very Poor	Stable	Generally stable, no significant change. Slight decrease in parameters including 'leaf litter' and 'fallen logs'.
Upper Bettys Diversion 1 (UBD1)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 2 (UBD2)	Very Poor	Very Poor	Stable	Slight decrease in score. However last transect at this monitoring point covered an area which had recently been cleared and rehabilitated reducing the score for the rest of the site. The new rehabilitation was performing well with evidence of soil stabilisation and native canopy species beginning to grow.
Upper Bettys Diversion 3 (UBD3)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 4 (UBD4)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 5 (UBD5)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 6 (UBD6)	Very Poor	Very Poor	Stable	No change.

Site Description	2014 Classification	2019 Classification	Trend	Description of change
Middle Bettys Diversion 1 (MBD1)	Poor	Poor	Stable	Total score of 35 in 2019 has fallen back to just within the "Poor" category. In 2018, the site had moved to 29 just below the 'Average' category.
Middle Bettys Diversion 2 (MBD2)	Poor	Very Poor	Declining	The site scored in the higher range of the "Very Poor" category. The clearing of vegetation due to the construction of a rock batter downstream may be the cause of the lower score. This should change as vegetation establishes at the downstream monitoring point.
Middle Bettys Diversion 3 (MBD3)	Poor	Poor	Stable	No change.
Middle Bettys Diversion 4 (MBD4)	Very Poor	Very Poor	Stable	No change.
Middle Bettys Diversion 5 (MBD5)	Very Poor	Very Poor	Stable	No change.
Middle Bettys Diversion 6 (MBD6)	Very Poor	Very Poor	Stable	No change.
Middle Bettys Diversion 7 (MBD7)	Very Poor	N/A*	N/A*	No change.
Lower Bettys Diversion 1 (LBD1)	Very Poor	Poor	Stable	Total score is at the low end of the "Poor" category with no change since the previous survey. It was noted that site is dominated by African boxthorn.
Lower Bettys Diversion 2 (LBD2)	Very Poor	Poor	Stable	This site scored at the low end of the "Poor" category with no change since the previous surveys in 2017 and 2018.
Lower Bettys Diversion 3 (LBD3)	Poor	Poor	Declining	This site scored in the "Poor" category, showing a slight increase in total score relative to 2018. An increase of native canopy species regeneration was recorded; however, improvements generally appear to be minimal. There is still an overall decrease from 2017 which was due mainly to vegetation clearing at the upstream point as part of the creek diversion works, as apparent by the piled logs towards the end of the transect.
Lower Bettys Diversion 4 (LBD4)	Very Poor	Very Poor	Stable	No Change. Note that there is limited vegetation from LBD4 to LDB8 due to the creek diversion works.
Lower Bettys Diversion 5 (LBD5)	Very Poor	Very Poor	Stable	No change.
Lower Bettys Diversion 6 (LBD6)	Very Poor	Very Poor	Stable	No change.
Lower Bettys Diversion 7 (LBD7)	Very Poor	Very Poor	Stable	No change.

Site Description	2014 Classification	2019 Classification	Trend	Description of change
Lower Bettys Diversion 8 (LBD8)	Very Poor	Very Poor	Stable	No change.
Lower Bettys Diversion 9 (LBD9)	Very Poor	Very Poor	Stable	No change.
Lower Bettys Diversion 10 (LBD10)	Average	Good	Stable	No change from 2018.
Lower Bettys Diversion 11 (LBD11)	Poor	Average	Improving/Stabilising	An increase in the Debris score recorded in 2018 suggested some recovery in the function of the riparian zone at this site. The site continues to stabilise with 2019, with monitoring recording minimal change from 2018. Note there are large quantities of African boxthorn at the site.
Lower Bettys Diversion 12 (LBD12)	Average	Average	Stable	No change.
Lower Bettys Diversion 13 (LBD13)	Average	Good	Improving	The category increased from "Average" to "Good" from 2017 to 2018 due mainly to high Habitat, Cover and Debris scores. An increase in the Cover and Debris scores suggests some recovery in the function of the riparian zone at this site. Monitoring in 2019 revealed a slight decrease in score primarily attributed to a decrease in canopy score. The score attributed to this site, 34, is just below the threshold of the 'Good' range of 35. This slight change may be a result of different interpretations of field assessors.
Main Creek 1 (MC1)	Very Poor	Very Poor	Stable	While the site remains in the 'Very Poor' range, a slight increase in canopy density and the number of regenerative native canopy species was identified in 2019.
Main Creek 2 (MC2)	Very Poor	Very Poor	Stable	No change. Site located in a heavily grazed paddock.
Bowmans Creek 1 (BMC1)	Very Poor	Very Poor	Stable	No change.
Bowmans Creek 2 (BMC2)	Very Poor	Very Poor	Stable	No change.

N/A - Data not available due to clearing/earthworks within the predetermined transect

Erosion and Sediment

MGO carries out quarterly and post-rainfall erosion and sediment control inspections. These inspections are to identify issues that require maintenance, and where possible these issues are rectified prior to the next inspection. As a result of low rainfall and ongoing management, MGO did not have any instances where sediment dams overflowed during 2019. There were also no environmental incidents or complaints relating to erosion and sediment control.

Further Improvements

Ongoing repairs and maintenance across all creek diversions are an ongoing focus at MGO. 2018 saw the review and approval of the MOC Creek Diversion Plan. The plan ensures MGO will continue to monitor the Creek Diversion as per the current monitoring program. There is one site of gully erosion near Hebden Road that will be repaired in 2020. This will require the infilling of soil and pasture seeding to stabilise the diversion bank.

The Upper Bettys Creek Diversion Remediation Plan (requested by DPIE) was implemented in 2018 and is aimed at establishing a resilient vegetation layer to provide sustained protection from further erosion in and around the diversion. The remediation works in the plan will continue to be monitored for establishment in 2019 [Figure 32](#) shows remediation works undertaken in 2018 and additional works undertaken in 2019. Remedial works are planned for Upper Betty's Creek and Middle Betty's Creek in 2020 to repair areas of minor erosion in line with 2019 stream health monitoring. In-fill tree and reed planting is planned for Lower Betty's Creek diversion in 2020 for areas of limited success since establishment in 2014. Approximately 3000 tubestock and 500 reeds will be planted within this diversion.



Figure 32: Upper Bettys Creek remediation works completed in 2019.

Acid mine drainage is monitored on-site by site geologist as part of the blasting process. No areas identified acid rock drainage in 2019. Aside to this current monitoring, in 2020 MGO will complete annual sampling of surface water contained within open cut mining areas (sumps) to further validate that acid rock drainage is not present at MGO.

7.4 Groundwater

Monitoring Program and Triggers

Groundwater monitoring is undertaken in accordance with the approved MGO GWMMP, and includes depth to water (to calculate drawdown), pH and EC. The location of monitoring bores is shown in [Figure 33](#). Monitoring data is compared to the groundwater performance criteria in [Table 54](#).

Table 54 Relevant Groundwater Performance Criteria

Aspect	Performance Measures	Performance Indicator
Alluvial aquifers	Negligible change in groundwater levels (compared to predicted impacts)	Depth to groundwater increased by 1 m compared to historical average over more than one monitoring round.
	Negligible change in groundwater quality (compared to predicted impacts)	pH of 6.5 to 8.0 EC < 12,800 µS/cm (for all except Main Creek) EC < 8,060 µS/cm (Main Creek) Groundwater quality concentrations outside of trigger value (above) for at least one parameter for more than one consecutive monitoring round Groundwater quality concentrations vary more than 1,000 µS/cm compared to the previous quarterly monitoring round results
Hardrock aquifers	Negligible change in groundwater levels (compared to predicted impacts)	Depth to groundwater increased by 1 m compared to historical average over more than one consecutive monitoring round
	Negligible change in groundwater quality (compared to predicted impacts)	pH of 6.5 to 8.0 EC < 12,250 µS/cm Groundwater quality concentrations outside of trigger value (above) for at least one parameter for more than one consecutive monitoring round Groundwater quality concentrations vary more than 1,000 µS/cm compared to the previous quarterly monitoring round results
Backfilled voids	Negligible impacts of seepage/leachate impacts from backfilled voids on regional groundwater quality	No increasing trends in water quality parameters in monitoring bores surround backfilled voids. An increasing trend would be indicated by three water quality readings showing continual increases in analyte concentrations.
Groundwater inflows to mining pits	Groundwater inflows to mining pits consistent with groundwater model predictions and all take is covered by relevant licences	Groundwater inflow to mining pits is >10% higher than predicted for three consecutive months

Based on the first groundwater performance indicator in [Table 54](#), drawdown triggers were defined for each bore by calculating the historical average drawdown between monitoring points and plotting against that value below 1 m.

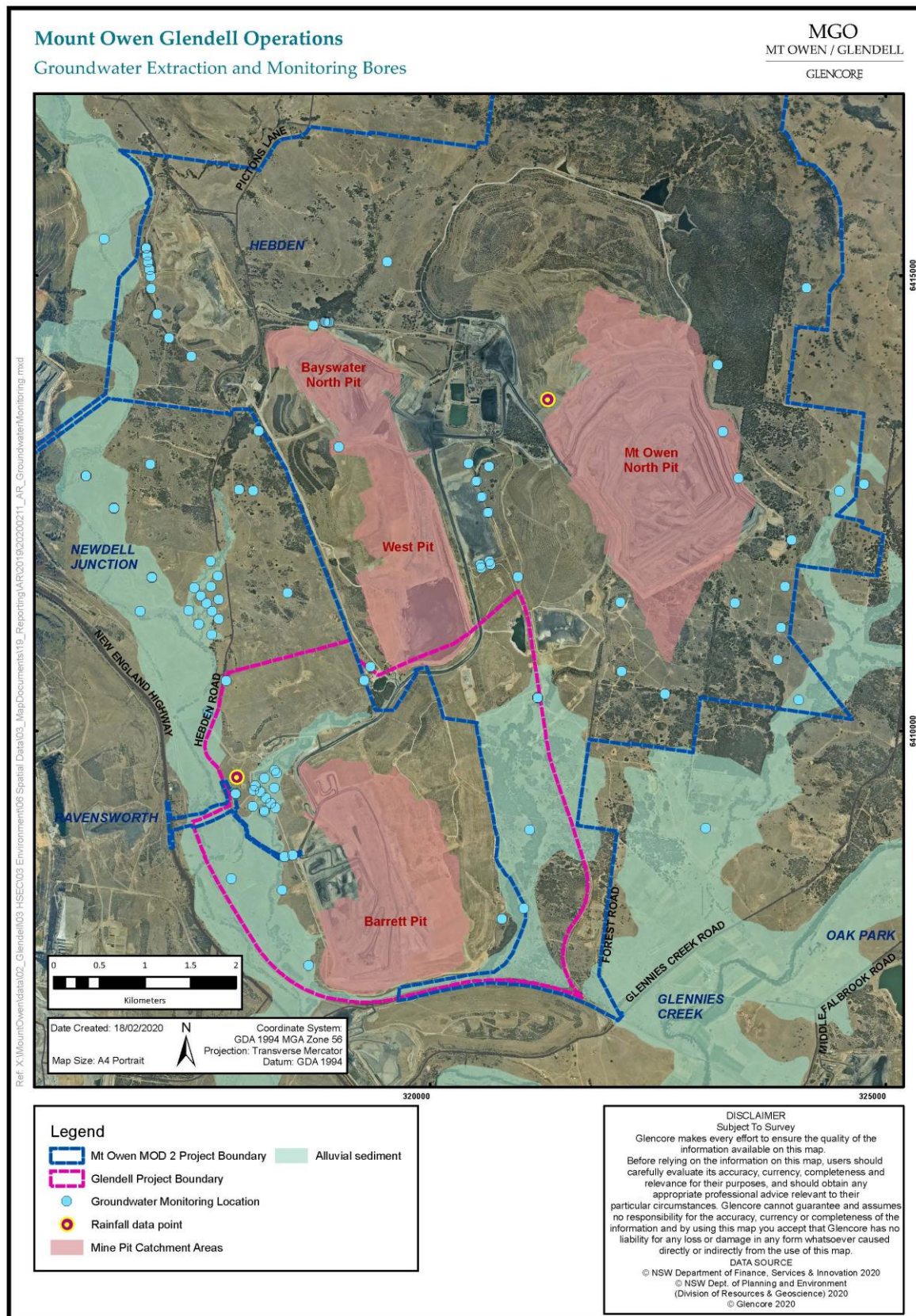


Figure 33: MGO Groundwater Extraction and Monitoring Bores

7.4.1 Groundwater Performance

Groundwater monitoring results for 2019 were used to assess the predicted impacts on the surrounding areas and compared against predicted studies. A summary of the findings is provided in [Table 55](#).

The review for the 2018 monitoring period (SLR, 2019a) identified several GWMMP trigger exceedances in the alluvial and Permian units, as summarised below:

- Eight alluvial bores (NPZ101, NPZ104, NPZ106, NPZ3, NPZ12, BC-SP08, BC-SP21 and BC-SP22) recorded a decline in groundwater level below the trigger limit;
- One Permian Bore (NPZ3a) showed a significant increase in groundwater level in the second half of 2018;
- NPZ11a and NPZ12a that intersect Pikes Gully Upper Seam were recorded as not monitored due to high gas levels;
- Water quality trends at 3 bores intercepting Permian units (NPZ1, NPZ3a and NPZ4) showed rising EC levels exceeding the trigger limit for two or more consecutive monitoring rounds.

Further investigations into the identified 2018 trigger exceedances was conducted over 2019, including a site visit (in August 2019) and desktop review conducted by SLR (2019b). A summary of the findings from these ongoing investigations are included below:

- Alluvial bores along Main Creek (NPZ101), Yorks Creek (BC-SP08) and Bettys Creek (NPZ104 and NPZ106) show groundwater level trends that correspond with climate trends (SLR 2019b). EC trigger values were found to be below historical baseline readings, therefore updates to the respective GWMMP trigger values was recommended. No adverse impacts due to MGO operations were identified by SLR
- Alluvial bores BC-SP21 and BC-SP22 along Bowmans Creek were not be accessed during the SLR site visit. Further review of these bores is required. This is planned to be undertaken in 2020
- Bore NPZ3 and NPZ3a were not inspected during the SLR site visit. Desktop review of groundwater conditions near the bores was conducted by SLR in relation to the Eastern Rail Pit (ERP). The study identified the presence of alluvial sediments localised along the original alignment of Bettys Creek, which was mined through at the ERP. Additional groundwater monitoring locations south of the ERP were proposed as part of the study
- Nested bores NPZ11/NPZ11a and NPZ12/NPZ12a are screened within the coal measures and were inspected during the SLR site visit (SLR 2019b). The condition of NPZ12/NPZ12a was found to be impacted by gas release, and the bore was subsequently planned to be grouted up and abandoned. Field records for NPZ11a indicate it has been blocked at 57 m below top of casing since April 2018. Gas was detected at the well casing and the NPZ11 bores were also recommended to also be grouted up and abandoned. Replacement monitoring locations were recommended by SLR for the area
- Bore NPZ4 was inspected during the site visit by SLR (2019b) and found to be outside of the extent of alluvium. It was considered that the bore likely intersects overburden material to a total measured depth of 28.5 m below surface, instead of the 60 m depth as previously recorded. It was recommended that the construction of the bore should be reviewed to verify if it was constructed with screen to 28.5 m or if the bore is blocked. Review of water quality at NPZ4, by comparison of sulphate concentrations and pH to SO₄/Cl ratio, indicated a potential water source having undergone acid sulphate processes requiring further investigation

- Bores within the Permian coal measures (NPZ1 and NPZ8) show a decline in groundwater levels and a rise in EC over time. The decline in groundwater levels was reviewed by SLR (2019b) and found to correlate with depressurisation as a result of mining at North Pit, consistent with predicted drawdown for approved operations in the Glendell EIS. It was recommended that the construction and current total depth of bores NPZ1 and NPZ8 be undertaken, to check if groundwater levels are at or close to the base of the bore screen.

A copy of the monitoring results for individual groundwater monitoring locations is included in [Appendix G, Table 45](#) along with a summary of the 2019 results for all bores ([Appendix G, Table 45](#)).

A comprehensive review of groundwater is located in the 2019 Annual Groundwater Review (SLR, 2020) report, which is also included in [Appendix G](#).

Table 55: Summary of Groundwater Bores against Performance Data in 2019

Investigation Criteria Triggered?				
Site ID	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
Yorks Creek Alluvium				
BC-SP06	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP07	✓ (Q2, Q3, Q4)	x	x	x
BC-SP08	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP09	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ4	x	x	x	x
NPZ11	x	x	x	x
NPZ12	ND	ND	ND	ND
Yorks Creek and Bowmans Creek Alluvium				
BC-SP02	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP03	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP04	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP05	✓ (Q1, Q2, Q3, Q4)	x	x	x
Bowmans Creek Alluvium				
BC-SP18	x	x	x	x
BC-SP22	x	x	x	x
GNSP-02	✓ (Q1, Q2, Q3, Q4)	x	x	x
GNSP-06	✓	x	x	x

Site ID	Investigation Criteria Triggered?			
	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
	(Q1, Q2, Q3, Q4)			
Swamp Creek and Bowmans Creek Alluvium				
BC-SP20	x	x	x	x
BC-SP21	✓ (Q2, Q3, Q4)	x	x	x
Swamp Creek Alluvium				
BC-SP10	x	x	x	x
BC-SP11	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP12	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP14	✓ (Q1, Q2, Q3, Q4)	x	x	x
BC-SP15	ND	ND	ND	ND
BC-SP16	ND	ND	ND	ND
BC-SP17	✓ (Q3)	x	x	x
GA1	x	x	x	x
GA2	x	x	x	x
NPZ13	x	x	x	x
NPZ16	✓ (Q1, Q2, Q3, Q4)	x	x	x
Bettys Creek Alluvium				
North	x	x	x	x
NPZ1	✓ (Q1, Q2, Q4)	x	x	x
NPZ3	x	x	x	x
NPZ6	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ9	x	x	x	x
NPZ10	x	x	x	x
NPZ103	x	x	x	x
NPZ104	ND	ND	ND	ND
NPZ106	x	x	x	x
Main Creek Alluvium				
NPZ7	✓ (Q2, Q3, Q4)	x	x	x
NPZ8	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ101	x	x	x	x
NPZ102	x	x	x	x
Hard Rock Aquifer				
MOP812	ND	ND	ND	ND

Site ID	Investigation Criteria Triggered?			
	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
NPZ1a	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ3a	x	x	x	x
NPZ4a	x	x	x	x
NPZ6a	ND	ND	ND	ND
NPZ7a	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ8a	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ9a	ND	ND	ND	ND
NPZ10a	ND	ND	ND	ND
NPZ11a	✓ (Q1, Q2, Q3, Q4)	x	x	x
NPZ12a	ND	ND	ND	ND
NPZ13a	✓ (Q3, Q4)	x	x	x
SMC002	x	NM	NM	NM
SM0023	NM	NM	NM	NM
SM0028	NM	NM	NM	NM
GNP 1	NM	NM	NM	NM
GNP 2	NM	NM	NM	NM
GNP 3	NM	NM	NM	NM
GNP 4	NM	NM	NM	NM
GNP 5	NM	NM	NM	NM
GNP 6	NM	NM	NM	NM
GNP7	NM	NM	NM	NM

NM – Not Monitored (no EC or pH for bores with automatic loggers)

ND – No Data due to blocked piezos / bore decommissioned

Following the annual review for the 2019 monitoring period, groundwater trigger exceedances were identified by MGO. SLR (2019 and 2020) were engaged to conduct initial investigation into the trigger exceedances. The exceedances included:

- 48 bores recorded a decline in groundwater level in 2019 of over 1 m, when compared to historical average levels, over more than one consecutive monitoring round. This abundance of groundwater level drawdown trigger events occurs across all aquifers because the currently approved GWMMP does not allow enough variability in water levels to encompass natural variability (low rainfall) and predicted mining impacts for Permian aquifers. The trigger definition will, therefore, be reassessed to decrease sensitivity to natural fluctuations and to only trigger by events that have high likelihood of being mining associated.

Review of water quality results and comparison to trigger levels for EC and pH identified several trigger exceedances in 2019. Generally, these exceedances were either in line with historical trends or correlated with rainfall events.

As at the end of 2019 calendar year, MGO had submitted an updated GWMMP to DPIE following the approval of MOCO MOD2 on the 4 September 2019.

7.4.2 Groundwater Inflows Estimates

For each MGO pit, modelled rainfall-runoff, supplied pit dewatering volumes and assumed change in storage was used to calculate the groundwater inflow monthly for 2019. This calculated groundwater inflow was then compared to the model predicted groundwater inflow provided in relevant EIS approval documents. A summary is provided in [Table 56](#).

Table 56: Summary of Groundwater Seepage Data for 2019

In	Out	Accumulation	Balance		
Modelled Runoff (ML)	Dewatered Volume (ML)	Change in Stored Water Volume (ML)	Calculated Groundwater Inflow (ML)**	2014 Modification EA Predicted Groundwater Inflow (ML)	Difference between calculated and predicted groundwater inflow (ML)
Mt Owen (North Pit)					
288	226	141	79	334	255
Glendell*					
123	7	136	20	0	20
Ravensworth East (Bayswater North Pit)					
76	10	-81	15	81	66
In	Out	Accumulation	Balance		
Modelled Runoff + Tailings Recovery + Pump In (ML)	Supplied Dewatered Volume + Evaporation (ML)	Assumed Change in Stored Water Volume (ML)	Calculated Groundwater Inflow (ML)	2014 Modification EA Predicted Groundwater Inflow (ML)	Difference between calculated and predicted groundwater inflow (ML)
Ravensworth East (West Pit)**					
8,875	9,148	497	770	110	660

Note: * Glendell predicted groundwater inflow (ML) was calculated from the 2007 Modification EA.

** Other inflows are under investigation which may reduce the 'balance' currently attributed to groundwater inflow.

Mt Owen (North Pit)

As [Table 56](#) shows, 288 ML of runoff was modelled as reporting to the North Pit while dewatering estimates totalled 226 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in a 141 ML increase over the 2019 reporting period (this would include water stored within the in-pit waste rock emplacement). The difference between runoff, dewatering and stored volume values gives 79 ML (i.e. 226 ML plus 141 ML minus 288 ML) which is the calculated groundwater inflow. This is 255 ML less than the total 2014 MOCO Project EIS model predicted groundwater inflow volume for 2019 of 334 ML.

Glendell Pit

Data provided in [Table 56](#) shows that 123 ML of runoff was modelled as reporting to the Glendell Pit while dewatering estimates totalled 7 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in a 136 ML increase over the 2019 calendar year, with a total stored water volume of 136 ML at the end of the year (this would include water stored within the in-pit waste rock emplacement). The difference between runoff, dewatering and stored volume values gives 20 ML (i.e. 7 ML plus 136 ML minus 123 ML) which is the calculated groundwater inflow. This is 20 ML greater than the total 2007 Modification EA model predicted groundwater inflow volume for 2019 of 0 ML.

It should be emphasised that, given the lack of available estimates of stored water volume, the monthly stored water volumes are an assumption. It is also noted that mining in the Glendell Pit is occurring up-dip and therefore there is likely to be a significant volume of water stored within backfilled in-pit waste rock. This assumption directly affects the estimated groundwater inflow rates.

Ravensworth East (Bayswater North Pit)

As [Table 56](#) shows, 76 ML of runoff was modelled as reporting to the Bayswater North Pit while dewatering estimates totalled 10 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in an 81 ML decrease over the 2019 reporting period. The difference between runoff, dewatering and stored volume values gives 15 ML (i.e. 10 ML plus 81 ML minus 76 ML) which is the calculated groundwater inflow. This is 66 ML more than the total 2014 MOCO Project EIS model predicted groundwater inflow volume for 2019 of 81 ML.

Ravensworth East (West Pit)

As [Table 56](#) shows that 8,875 ML of runoff, tailings water recovery and water pumped in was modelled as reporting to the West Pit while dewatering and evaporation estimates totalled 9,148 ML. To try to match the estimated stored water volumes at the start, middle and end of the year, the stored pit water volumes shown were assumed which resulted in a 497 ML increase over the 2019 reporting period (this would include water stored within the adjacent in-pit waste rock emplacement). The difference between inflows, outflows and accumulation values gives 770 ML (i.e. 9,148 ML plus 497 ML minus 8,875 ML) which is the calculated groundwater inflow. This is 660 ML more than the total 2014 MOCO Project EIS model predicted groundwater inflow volume for 2019 of 110 ML.

The estimates of stored water volume directly affect the calculation of groundwater inflow. An increase in the estimated stored water volumes would increase the calculated groundwater inflow volumes. Similarly, estimates of tailings water recovery directly affect groundwater inflow estimates. Higher rates of water recovery from the settling tailings would decrease the calculated groundwater inflow volumes.

Alluvium Monitoring

During 2019 there was no mining at either GLD or MTO that further intersected alluvium. Southern areas of the GLD Barrett Pit are monitored as a part of site wide geotechnical assessments. To date, there has been no observed inflow from alluvium in this area and as a result no cut off wall or similar is required.

Groundwater Licence 20BL169337

In accordance with Condition 4 of Groundwater Licence 20BL169337, an assessment of compliance against the conditions is presented in [Table 57](#).

Table 57: Assessment of Compliance with Licence 20BL169337

Condition Number	Condition description (detailed summary)	Compliance Status	Comment	Where addressed in Annual Review
1)	The following definitions apply to this licence: Alluvial water inflow means water contained within an alluvium which, if intercepted by mining activity, will give rise to an inflow of water into a mine work. Annual review means the annual review required by condition 3, schedule 6 of the project approval (DA 14-1-2004). The alluvium is defined as an extensive stream-laid deposit of unconsolidated material, including gravel, sand, silt and clay. Mine works means any extraction of material from land for excavation relating to the construction and/or operation of open-cut mining at Mt Owen mine.	NA	NA – definitions only	NA
2)	The licence holder must implement a methodology to the satisfaction of DPI Water to estimate the annual volume of alluvial water inflow (water budget) that the licence holder is likely to extract during the water year. This estimate must be reported annual in the annual review.	Compliant		Section 7.4
3)	The licence holder must include in the Annual Review a map which shows the licensed site and the current areas where mine works have interfered with alluvial sediment.	Compliant		Section 7.4 (Groundwater Monitoring Bores)
4)	The licence holder must report in the Annual Review:	Compliant	As reported.	Section 7.4 Groundwater & Appendix G
	I) The monitoring results of any groundwater monitoring with respect to this licence;	Compliant	This Table	Table 57
	II) A summary of new bores or pits constructed during the year;	Compliant.	There were no new bores or pits constructed during the year. There was no VWP's installed throughout 2019.	N/A
	III) The trend graphs for monitoring data collected for each bore associated with the mine works;	Compliant	As reported in the Appendix (SLR report)	Appendix G
	IV) A summary of any contingency event (event) that impacted on groundwater during the last report period, including actions taken to remedy the event and	Compliant	No event has occurred that has impacted on groundwater during 2019.	Section 7.4

Condition Number	Condition description (detailed summary)	Compliance Status	Comment	Where addressed in Annual Review
	any additional monitoring carried out on the event.			
5)	An extraction measurement device must be installed and maintained on each extraction device (pump) used for extraction of water under this licence, and such devices must be of a type and standard, and must be maintained in a manner, which is acceptable to DPI Water.	Compliant	A flow meter device was installed in 2017.	N/A
6)	The licence holder must ensure that the independent environmental audit as required by condition 8 of schedule 6 DA 14-1-2004 is submitted to DPI Water. The audit must: I) Assess compliance with the conditions of the licence, including the groundwater monitoring and contingency plan;	Compliant	Refer to Independent Audit Report www.mtowencomplex.com.au	N/A
	II) Review actual impacts of the extractions on any aquifers, groundwater dependent eco-systems and any streams in the area;	Compliant	Refer to Independent Audit Report www.mtowencomplex.com.au	N/A
	III) Make comparisons between actual and predicted impacts (modelled results);	Compliant	Refer to Independent Audit Report www.mtowencomplex.com.au	Table 56
	IV) Provide recommendations as to works that ought to be performed or additional obligations that ought to be imposed in order to rectify any impacts on groundwater.	Compliant	Refer to Independent Audit Report www.mtowencomplex.com.au	N/A
7)	DPI water shall have the right during the currency of this licence to vary at any time the volumetric allocation, or the rate at which this allocation is taken.	NA	N/A – note only	N/A
8)	The volume of groundwater extracted from the works authorised by this licence shall not exceed 140 megalitres in any 12 month period commencing 1 st July.	Compliant	The extraction beyond this licence limit is included in the 5.9GL of allocated hardrock aquifer licences held by MGO	Section 7.4

Further Improvements

The following summarises the recommendations made by the 2019 Annual Groundwater review (SLR):

- Review of groundwater level trigger limits to prevent natural variations and predicted drawdown from mine activities resulting in trigger exceedances;
- Remove bores from GWMP monitoring requirements that have been decommissioned;

- Decommission NPZ11a and consider alternate Pikes Gully Seam monitoring locations;
- Review construction and current total depths of bores NPZ1 and NPZ8 to determine if groundwater levels are at or close to the base of the bore screens;
- Review construction details at GA1 and GA2 to determine screened lithology;
- Further review of water quality and construction details at NPZ4 and NPZ10 to assess seepage potential from nearby site activities;
- Review construction details at TPZ series bores to determine screened lithology;
- Investigate the condition of GNP09D and if sediment is present within the base of the bore and influencing results;
- Investigate water level and EC rise at NPZ3a;
- Investigate elevated EC at NPZ16;
- Investigate high pH observed at NPZ107D and NPZ108D;
- Investigate incomplete VWP data at GNOH030 316-652, GNP2 and GNP5-Bar;
- Investigate rising water levels at VWPs SMO057 316-301, SMO063 316-302 SMO076R 316-651, GNOH030 316-584 and GNOH031 S827;
- Review analyte concentrations at seepage bores to determine if field EC variability is accurate or the result of measurement error;
- Review the groundwater monitoring network to clearly identify the screened lithology in each bore and outline the purpose and applicability of each bore for assessing potential groundwater related impacts. This include the removal of bores that have been blocked for several years and that cannot be recovered;
- Conduct further investigation into the groundwater quality trigger exceedances, reviewing the geology, field sampling records, site activities, groundwater conditions, previous groundwater model predictions and surface water quality trends at site;
- Continue to ensure all bores are monitored in accordance with approval requirements, including the backfilled void bores;
- Amend the GWMMP to reflect correct lithology at each bore; and
- Amend the GWMMP to reflect changes in bore network.

It should be noted that several of these recommendations were incorporated into the updated GWMMP submitted to DPIE for approval in December 2019. This Management Plan was not approved prior to the end of the reporting period.

8 Rehabilitation

During the reporting period MGO submitted a new MOP/Rehabilitation Management Plan to Resources Regulator for approval.

The revised MOP included:

- A revised MOP term i.e. 1 January 2020 - 30 June 2024
- Updated text and plans to reflect current construction activities, mining operations and rehabilitation
- Updated text and plans to include changes associated with SSD-5850 MOD 2 (MTO additional mining area).

Rehabilitation was carried out in accordance with:

- MGO MOP/Rehabilitation Management Plan
- MGO Biodiversity and Offset Strategy
- MGO Rehabilitation Strategy
- Mt Owen and Glendell Annual Rehabilitation and Land Management Plan (ARLMP, 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 58 provides a summary of rehabilitation activities at MGO for 2018 and 2019 and the rehabilitation forecast to be undertaken in 2020. All values presented are in hectares.

Table 58: Mt Owen Complex Rehabilitation Summary

Mine Area Type	Previous Reporting Period (2018)	This Reporting Period – Forecast (2019)*	This Reporting Period - Actual (2019)	Next Reporting Period – Forecast (2020)
Total Mine Footprint	2808	2839	2860	3006
Total active Disturbance	1448	1388	1396	1447
Land being prepared for rehabilitation	0	0	0	0
Land under active rehabilitation	1360	1451	1464	1559
Completed Rehabilitation	104	127	104	95

* Forecasts for 2018 and 2019 differ from values within the current MOP. MGO gained approval of 2020 MOP in December 2019.

Rehabilitation continued across MGO during 2019 generally in line with the ARLMP / MOP (**Table 59**). 104 ha of rehabilitation was completed across MGO, made up of 54 ha at Glendell and 50 ha at Mt Owen.

Table 59: 2019 Rehabilitation works compared to MOP

Mine Area Type	2019 Actual Data (Mt Owen Complex)	MOP Prediction
Rehabilitation (ha)	104	127*
Disturbance (ha)	34	27.4
Rehabilitation Disturbance (ha)	9.5	9.5

* Forecasts for 2018 and 2019 totalled 198.7 ha of rehabilitation in which 208 ha was rehabilitated (104 ha in 2018 and 104 ha in 2019).

Glendell

GLD completed 54 ha of rehabilitation during 2019 including 10 ha of open grassland or pasture areas and 44 ha of open woodland areas. GLD continued to use biosolids as a rehabilitation resource, typically applying at 100t/ha in open grassland rehabilitation areas. Biosolids provides much needed organic material to the soil as well as a nitrogen boost for pasture grasses.

In woodland areas, GLD continued to use a species mix which incorporates a number of shrub and understorey species, characteristic of the Central Hunter Ironbark-Spotted Gum-Grey Box Forest. GLD also made 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

In 2019 MTO prepared and seeded 50 ha 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 2019 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. 2019 was the first year natural landform design was incorporated into the rehabilitation process, with 27.5 ha was completed on the North Pit rehabilitation area (see [Figure 34](#)).



Figure 34: Newly completed rehabilitation at Mt Owen North Pit incorporating natural landform design. Note older rehabilitation areas in the background

8.1 Rehabilitation Monitoring

MGO revised the rehabilitation monitoring program during 2019. The objectives of rehabilitation monitoring are to:

- assess the long term stability and functioning of re-established ecosystems on mine affected land
- assess rehabilitation performance against the closure criteria
- facilitate continuous improvement in rehabilitation practices.

The 2019 monitoring program included:

- desktop assessment of rehabilitation records using ArcGIS
- field monitoring and assessment
- preparation of a report outlining rehabilitation performance against criteria.

Rehabilitation monitoring used the biometric monitoring approach. Parameters monitored are outlined in [Table 60](#) and an example of results is included in [Figure 35](#). In addition to these measures, transects photo points were also recorded for ongoing visual assessment of rehabilitation and a rapid “walkover assessment” was also carried out to pick up issues outside transects. Issues identified in walkover inspections include:

- presence and severity of active erosion areas (e.g. rill, gully and tunnel erosion)
- stability of slopes and landforms
- function and condition of existing erosion and sediment control structures and landform features, including water management structures (e.g. spine drains), water ponding areas, (where applicable)
- visual assessment of ground protection and vegetation cover, vegetation health and growth rates (high level assessment)
- areas of significant weed incursion
- evidence of presence/impact of vertebrate pests
- any other disturbance factors or features which may impact on site safety, such as presence of mine waste (e.g. signage, tyres, pipes, drums, etc.), track disturbance, damaged fences etc.

GPS points (2-4m accuracy) and geo-referenced photographs were taken of all observations made during the assessment. By collecting geo-located photos, areas can be re-visited and photo-monitoring continued to demonstrate the evolution of the site condition over time.

Table 60 - Rehabilitation Parameters Monitored

Parameter	Assessment Area	Method	Frequency
Open Grassland Rehabilitation			
Pasture composition	1m x 1m quadrats	All ground cover species (grasses, herbs, forbs) were identified and recorded, and their individual contribution to the total projected live cover determined in percentage cover estimate.	All years

Parameter	Assessment Area	Method	Frequency
Ground cover	1m x 1m quadrats	The percentage cover of live vegetation, organic litter and bare ground were estimated (and other attributes where relevant, for example cryptogram cover or rocks).	All years
Biomass/ productivity	Alternative 1m x 1m quadrats	In every second quadrat, pasture productivity was assessed by cutting all herbage to ground level using hand shears, and weighing the clipped material in situ using a digital scale to determine the green herbage biomass. All clipped material from one of the quadrats plots (chosen to be representative of the site) was collected, stored in a paper bag, air-dried and weighed again – once dried, to determine the dry matter (DM) content of the sample and calculate dry herbage mass (kg DM / ha) for each site.	Year 5 and 10 only
Surface rocks	20m x 50 m plot	The presence of large rocks (>50cm) on the soil surface was assessed and an estimate made of their coverage (in m ²).	All years
Open Woodland and Open Forest Rehabilitation			
Floristics	20m x 20m plot	A full floristics survey was undertaken. All vascular species were identified, and a cover abundance rating assigned in accordance with the Braun-Blanquet 6-point scale ¹ .	All years
Foliage cover	At 10 points along 50m transect	At every 5 metres along the transect line, the foliage percent cover (FPC ²) of both over and mid-storey vegetation directly overhead was estimated to the nearest 5%.	Year 5 and 10 only
Ground cover	50m transect	At every 0.5m along the transect line, the type of ground cover intersecting the tape was recorded as either: native species, exotic species, bare ground, litter, cryptogram or rock.	All years
Vegetation structure	20m x 50 m plot	All woody species (trees and shrubs) were recorded and identified to determine the overall stem density for the site. The height of all individuals over 2m was estimated to determine the average vegetation height for the site.	All years
Habitat potential	20m x 50 m plot	The following habitat features were recorded: <ul style="list-style-type: none"> Cumulative length of fallen logs >10cm in diameter, only measuring the parts of the logs in contact with the ground; 	Year 5 and 10 only

¹¹ Braun-Blanquet cover abundance scale: '1' = <1%; '2' = 1-5%; '3' = 6-25%; '4' = 26-50%; '5' = 51-75%; '6' = 76-100%.

² All FCP estimates were made using the estimation charts provided in the National Committee on Soil and Terrain's *Australian Soil and Land Survey Field Handbook* (2009).

Parameter	Assessment Area	Method	Frequency
		<ul style="list-style-type: none"> Total number of hollows in trees which trunks were within the plot boundaries³; Total number of stags (standing dead trees); and Number of large rock tumbles (i.e. rock piles or rocks large enough to provide potential habitat). 	
Vegetation health	20m x 50 m plot	<p>A total of up to 20 shrubs/trees (where present) representative of the dominant species were randomly selected and tagged (for future monitoring). Their health condition was assessed using the following ranking system:</p> <ul style="list-style-type: none"> Dead. Very sick: no new growth, several limbs showing dieback, severe leaf discoloration, necrosis or insect attack. Sick: little new growth, branch dieback on some limbs, obvious leaf discoloration, necrosis or insect attack. Healthy: active new growth, no or negligible tip dieback, no or negligible leaf discoloration, necrosis or insect attack. 	Year 5 and 10 only
Regeneration	20m x 50 m plot	The number of species with second generation seedlings (i.e. <2m) and the number of species bearing reproductive material (i.e. flowers/fruits) were recorded.	Year 5 and 10 only
All domains (i.e. all transects)			
Slope	50 m transect line	The slope gradient (in %) at the transect line was measured using a digital clinometer for accurate results.	All years
Erosion	50 m transect line and 20m x 50 m plot	<p>Erosion was assessed using the following rating system:</p> <ul style="list-style-type: none"> 1 – no erosion; 2 – sheet erosion; 3 – rill erosion <0.2m deep; 4 – gully erosion >0.2m but <1m deep; or 5 – gully erosion >1 m deep or tunnel erosion.⁴ <p>Where rills or gully features were present, their location, depth and width were recorded as they intercepted the transect line.</p>	All years

³ As per the BioBanking guidelines, a hollow will was recorded if: (a) the entrance could be seen; (b) the minimum entrance width was at least 5 cm across; (c) the hollow appeared to have depth (i.e. could not see solid wood beyond the entrance); and (d) the hollow was at least 1 m above the ground.

⁴ Note that there is no Australian consensus on quantitative measures for minor, major or severe erosion as defined National Committee on Soil and Terrain (2009), and the proposed rating system is a broad aggregation of multiple (gully, sheet, rill, tunnel) erosion measures, giving consideration to the MOP completion criteria of 200mm maximum rill depth.

Parameter	Assessment Area	Method	Frequency
Soil profile	Localised	A hand auger was used to determine the soil profile structure as deep as possible and up to a depth of 0.5m. The depth of each soil layer / horizon was be measured and a photograph of the soil structure taken.	All years
Soil characteristics	20m x 50 m plot	Soil sampling and analysis was undertaken to determine the chemical properties of the growing media ⁵ . The following parameters were tested: pH, electrical conductivity, exchangeable cations and Cation Exchange Capacity (including Exchangeable Sodium Percentage ESP), organic carbon, nitrogen, phosphorous and potassium.	Year 5 and 10 only

⁵ Soil sampling was undertaken using recognised standard soil sampling procedures, as follows:

- A total of five or six sub-samples were collected from different areas within the sampling plot using a hand spade to a depth of 0.1m.
- Care was taken to avoid the inclusion of organic matter (e.g. litter, twigs, etc.), subsoil or overburden material and other foreign materials (for example stones or roots).
- All sub-samples were bulked in a bucket and mixed well to create a composite sample for the site.
- Approximately 500 grams of the composite sample was bagged in a strong plastic zip-lock bag and labelled appropriately, then stored in an ice-cooled box (and subsequently in a fridge at the end of the working day) to avoid sample deterioration (especially in relation to Nitrogen content).
- All samples were sent to and tested by a NATA-accredited laboratory.

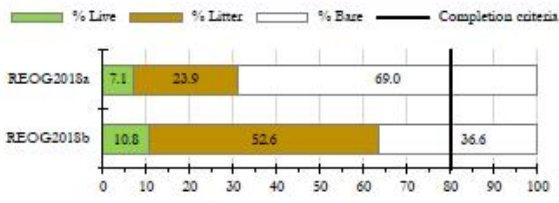
Monitoring Sites Attributes			
Site code	REOG2018a	Site code	REOG2018b
Slope	3 degrees	Slope	0 degree
			
Soils and Erosion			
Soil cover	80 mm	Soil cover	140 mm
Soil type	Sandy clay loam	Soil type	Sandy clay loam
Erosion status	Stable	Erosion status	Stable
Erosion severity	Negligible (sheet only)	Erosion severity	Nil erosion
Ground Cover Protection			
Live (%)	7.1 – 10.8 (\bar{x} =8.9)		
Litter (%)	23.9 – 52.6 (\bar{x} =38.3)		
Bare (%)	36.6 – 69.0 (\bar{x} =52.8)		
Rocks >200mm (%)	0.0 – 0.0 (\bar{x} =0.0)		
Pasture Composition			
Total species richness	9 – 18 (\bar{x} =13.5)		
Desirable species	4 – 10 (\bar{x} =7.0)		
Non-desirable species	5 – 8 (\bar{x} =6.5)		
% desirable species	44.4 – 55.6 (\bar{x} =50.0)		
Weeds			
Non-invasive exotics	4 – 7 (\bar{x} =6.5)		
Non-invasive exotics cover (%)	0.8 – 1.8 (\bar{x} =1.3)		
Priority weeds	1 – 1 (\bar{x} =1.0)		
Priority weeds cover (%)	3.1 – 5.4 (\bar{x} =4.25)		

Figure 35: Example of Results for Each Polygon

Performance against key rehabilitation metrics was assessed for each rehabilitation polygon. A summary of this data is presented in [Table 61](#) and [Table 62](#) and displayed in [Error! Reference source not found.](#) Each polygon is assigned one of four performance rankings as per [Table 61](#):

- acceptable (i.e. successful rehabilitation meeting the objectives),
- monitor (i.e. on trajectory towards achieving the objectives unassisted),
- maintenance (i.e. not meeting the objectives and requiring routine maintenance works) or
- 'rework' (i.e. failed rehabilitation needing extensive rework).

Category	Criteria
Rework	<ul style="list-style-type: none"> • 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, very severe and widespread erosion, established ecosystems not aligned to targeted communities, etc. • TARP Condition Red.
Maintenance	<ul style="list-style-type: none"> • Does not meet completion criteria. • Major maintenance works required; e.g. large-scale weed control (i.e. outside routine weed management program), large-scale vegetation improvements (e.g. re-seeding large areas or intensive supplementary plantings), repair of localised erosion features, growing media improvements, etc. • TARP Condition Amber.
Monitor	<ul style="list-style-type: none"> • On trajectory towards completion criteria but does not meet all criteria and requires continued monitoring (e.g. ecologically young areas, variable soil results etc.). • Minor maintenance may be required (e.g. ongoing implementation of the routine weed control program, localised infill plantings of small areas, etc), but with no significant maintenance interventions required that would fall outside routine land management. • TARP Condition Green.
Acceptable	<ul style="list-style-type: none"> • In younger rehabilitation: rehabilitation is progressing well with no key issues or barriers likely to constrain future rehabilitation success, and objectives relative to the age of the rehabilitation are generally achieved. • In mature rehabilitation: 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 61: Rehabilitation Performance Summary – Open Grassland Rehabilitation

Polygons assessed		Performance condition summary							Overall performance status
Year	Size (ha)	Erosion	Ground cover	Species assemblages	Weeds	Topsoil cover	Pasture productivity	Soil properties	
2019 (REOG2017-1)	8.4	Stable	Poor	Poor	Poor	Good	n/a	n/a	Rework
2019 (REOG2017-2)	9.2	Stable	Poor	Good	Good	Good	n/a	n/a	Monitor
2019 (GOG2017)	21.4	Repair	Poor	Poor	Good	Poor	n/a	n/a	Rework
2019 (GOG2014-1)	40.6	Repair	Good	Good	Good	Good	n/a	n/a	Maintenance

Polygons assessed		Performance condition summary							Overall performance status
Year	Size (ha)	Erosion	Ground cover	Species assemblages	Weeds	Topsoil cover	Pasture productivity	Soil properties	
2019 (GOG2014-2)	6.2	Stable	Good	Good	Good	Good	n/a	n/a	Maintenance
2019 (GOG2009)	5.7	Stable	Good	Good	Good	Good	n/a	n/a	Maintenance
2018	21.9	Repair	Poor	Poor	Poor	Poor	n/a	n/a	Maintenance
2018	8.2	Stable	Good	Poor	Poor	Good	n/a	n/a	Maintenance
2018	9.3	Stable	Good	Good	Good	Good	n/a	n/a	Maintenance
2018	21.4	Repair	Poor	Good	Good	Good	n/a	n/a	Maintenance
2018	4.0	Stable	Good	Good	Good	Good	n/a	n/a	Monitor
2018	1.0	Stable	Poor	Good	Good	Good	n/a	n/a	Monitor
2018	3.3	Stable	Poor	Poor	Poor	Good	n/a	n/a	Maintenance
2018	10.5	Repair	Poor	Poor	Poor	Poor	n/a	n/a	Maintenance
2018	3.7	Good	Good	Good	Good	Good	n/a	n/a	Acceptable
2018	1.5	Good	Poor	Good	Good	Good	n/a	n/a	Monitor
2018	5.3	Good	Good	Good	Good	Good	n/a	n/a	Acceptable
2018	40.7	Repair	Good	Good	Poor	Good	n/a	n/a	Maintenance
2018	2.9	Good	Good	Good	Poor	Good	n/a	n/a	Maintenance
2016	17.6	Repair	Poor	Good	Good	Good	n/a	n/a	Maintenance
2016	1.9	Repair	Good	Poor	Poor	Good	n/a	n/a	Maintenance
2016	5.3	Repair	Good	Good	Poor	Good	n/a	n/a	Maintenance
2016	11.2	Stable	Poor	Good	Poor	Good	n/a	n/a	Maintenance
2016	6.3	Stable	Good	Poor	Poor	Good	n/a	n/a	Maintenance

Polygons assessed		Performance condition summary							Overall performance status
Year	Size (ha)	Erosion	Ground cover	Species assemblages	Weeds	Topsoil cover	Pasture productivity	Soil properties	
2015	15.2	Stable	Good	Good	Good	Good	n/a	n/a	Monitor
2015	5.2	Stable	Good	Poor	Poor	Good	n/a	n/a	Maintenance
2015	23.4	Stable	Good	Good	Good	Good	n/a	n/a	Monitor
2012	24.7	Repair	Good	Good	Poor	Good	Poor	Good	Maintenance
2012	21.4	Repair	Good	Poor	Poor	Good	Good	Good	Maintenance
2007	11.2	Stable	Good	Good	Good	Good	Good	Good	Acceptable

Table 62: Rehabilitation Performance Summary – Open Woodland and Open Forest Rehabilitation

Polygons assessed		Performance condition summary											Overall performance status
Year	Size (ha)	Erosion	Ground cover	Weeds	Species assemblages	Stem densities	Topsoil cover	Vegetation structure	Vegetation health	Regeneration	Habitat potential	Soil properties	
2019 (GHC2018)	11.6	Stable	Poor	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (GHC2014)	8.8	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Monitor
2019 (REOW2018 -1)	16.0	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Rework
2019 (REOW2018 -2)	13.3	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (REOW2017 -1)	6.6	Stable	Good	Good	Good	Poor	Good	n/a	n/a	n/a	n/a	n/a	Monitor

Polygons assessed		Performance condition summary											Overall performance status
Year	Size (ha)	Erosion	Ground cover	Weeds	Species assemblages	Stem densities	Topsoil cover	Vegetation structure	Vegetation health	Regeneration	Habitat potential	Soil properties	
2019 (REOW2017-2)	4.5	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (MOOF2017)	21.7	Repair	Poor	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (MOOF2014)	3.4	Stable	Good	Good	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (MOOF2009-1)	6.6	Stable	Good	Good	Poor	Good	Good	n/a	n/a	n/a	n/a	n/a	Monitor
2019 (MOOF2009-2)	35.9	Stable	Good	Good	Poor	Good	Good	n/a	n/a	n/a	n/a	n/a	Monitor
2019 (REOW2009)	29.7	Stable	Good	Poor	Poor	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (MOOF2004)	17.8	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (REOW2004)	4.3	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Rework
2019 (MOOF1999-1)	16.4	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2019 (MOOF1999-2)	3.2	Stable	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Acceptable
2018	6.7	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	4.3	Stable	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance

Polygons assessed		Performance condition summary											Overall performance status
Year	Size (ha)	Erosion	Ground cover	Weeds	Species assemblages	Stem densities	Topsoil cover	Vegetation structure	Vegetation health	Regeneration	Habitat potential	Soil properties	
2018	21.2	Stable	Poor	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	16.8	Repair	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Rework
2018	34.7	Stable	Poor	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	2.0	Stable	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	7.5	Stable	Good	Good	Good	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	1.7	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	30.1	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	17.9	Stable	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	27.7	Good	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	18.3	Good	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	3.2	Good	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Acceptable
2018	10.4	Good	Good	Poor	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2018	4.2	Good	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Acceptable
2018	13.0	Stable	Good	Good	Good	Good	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2016	34.7	Good	Poor	Good	Good	Poor	Good	n/a	n/a	n/a	n/a	n/a	Monitor
2016	1.9	Good	Poor	Good	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Monitor
2016	20.0	Good	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Rework
2015	14.4	Repair	Poor	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance
2015	14.7	Repair	Good	Poor	Poor	Poor	Good	n/a	n/a	n/a	n/a	n/a	Maintenance

Polygons assessed		Performance condition summary											Overall performance status
Year	Size (ha)	Erosion	Ground cover	Weeds	Species assemblages	Stem densities	Topsoil cover	Vegetation structure	Vegetation health	Regeneration	Habitat potential	Soil properties	
2012	1.7	Good	Good	Good	Good	Good	Good	Good	Poor	Absent	Good	Good	Monitor
2012	12.5	Good	Good	Good	Good	Good	Good	Good	Good	Absent	Good	Good	Monitor
2012	42.9	Repair	Good	Poor	Good	Good	Good	Good	Good	Absent	Good	Good	Maintenance
2012	8.4	Good	Good	Poor	Poor	Poor	Good	Poor	Good	Absent	Good	Good	Maintenance
2012	24.4	Good	Good	Good	Good	Poor	Good	Good	Good	Absent	Good	Good	Monitor
2012	36.8	Repair	Good	Poor	Good	Poor	Good	Good	Good	Absent	Good	Good	Maintenance
2007	1.9	Good	Good	Good	Good	Poor	Good	Good	Good	Present	Good	Good	Monitor
2007	3.4	Good	Good	Good	Good	Poor	Good	Good	Good	Present	Good	Good	Monitor
2007	2.7	Good	Good	Good	Poor	Good	Good	Poor	Good	Present	Good	Good	Monitor
2007	150.7	Repair	Good	Poor	Good	Good	Good	Good	Good	Present	Good	Good	Maintenance

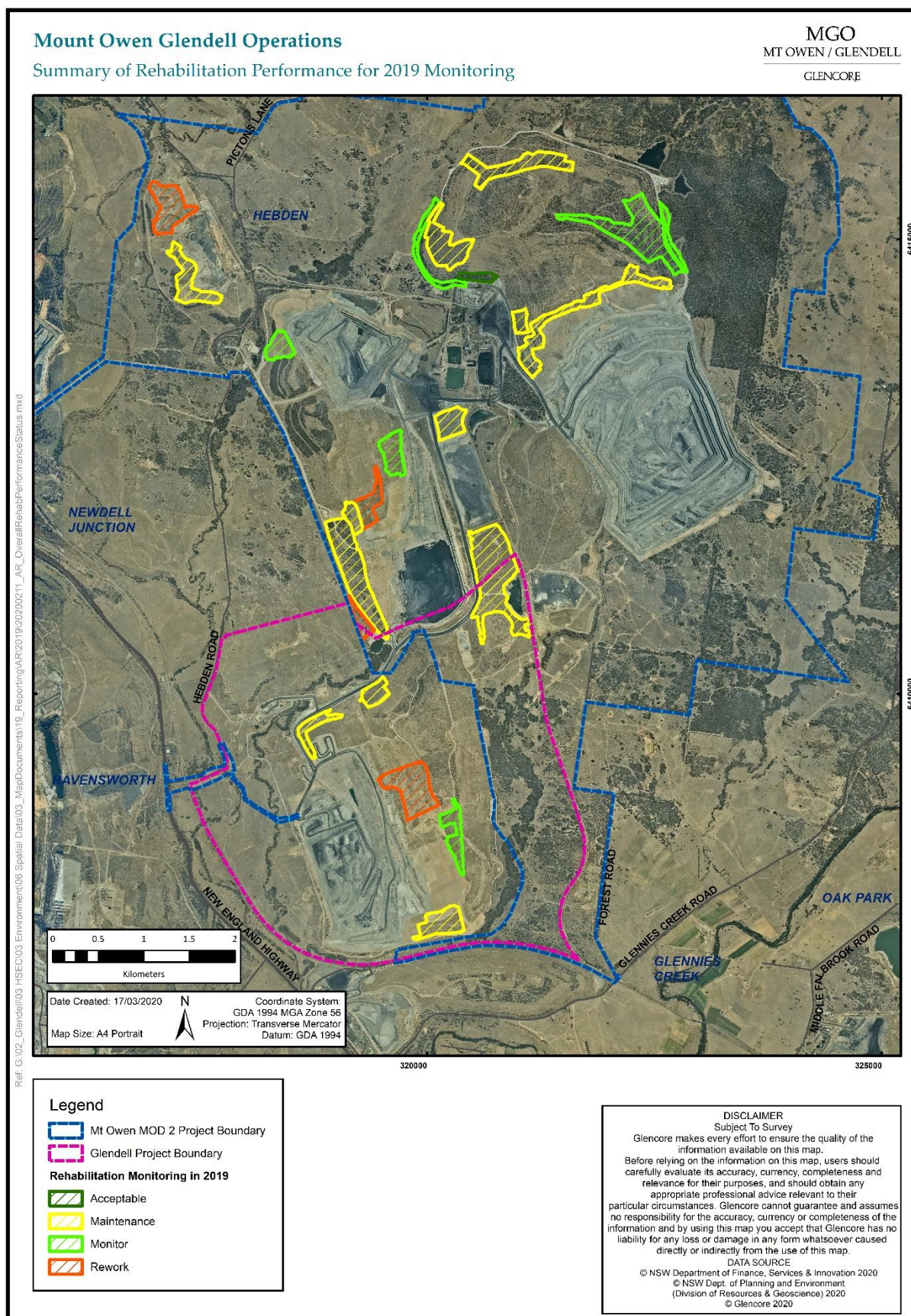


Figure 36: Summary of Rehabilitation Performance for 2019 Monitoring

In areas currently as showing an unsatisfactory performance in 2019, it was identified that the key issues and factors impeding the successful establishment of stable and self-sustaining vegetation communities include:

- erosion;
- weed incursion; and
- sub-adequate species assemblages.

Rehabilitation across MGO was generally stable and no critical erosion features were identified. There is however localised active erosion which exceeded the relevant MOP completion criteria. This includes several areas with low severity tunnel erosion and/or moderately severe rill erosion which requires maintenance.

Weed incursion has been identified as the main issue for rehabilitation impacts at MGO. Weed populations are widespread and threaten the ecological integrity of the rehabilitated communities. The main species of concern at the time of the 2019 monitoring included *Galenia pubescens* (Galenia), *Acacia saligna* (Golden wreath wattle) and *Hyperhenia hirta* (Coolatai grass). The management of these species will require a systematic and continuous control strategy.

Several areas displayed inadequate species diversities and community assemblages. This is of lesser concern in areas of younger rehabilitation (Year 1 and 2) given the young ecological age of the communities, in well-established rehabilitation (Year 5 and 10) assisted management may be required to increase species diversity and achieve the relevant objectives. Five areas were identified as 'rework' status across MGO in 2019 as seen in [Figure 36](#).

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 2019. It should be noted that well below average rainfall conditions were received in the 12-18 month period prior to the 2019 rehabilitation monitoring being completed. Some further observations from the monitoring of established rehabilitation in 2019 include:

- Established grassland rehabilitation showed excellent ground cover protection and the available herbage was dominated by species suitable for cattle grazing in the Hunter region (i.e. exotic pasture species). However, it is noted that the proportion of leguminous species was typically very low, which moderates the potential productivity of the pastures;
- Established forest / woodland rehabilitation showed excellent ground cover protection (albeit largely dominated by exotic grasses) and a high diversity of native shrubs and tree species, indicating a high species germination and establishment success rate through the currently used revegetation methods. In a majority of the monitored polygons the existing species assemblages in the upper storey layer were assessed as being adequately aligned to the desired Central Hunter Ironbark-Box-Gum vegetation community. Although many monitored locations were not achieving the required stem densities, active natural regeneration (i.e. second generation seedlings of native trees) was observed in all areas of Year 10 rehabilitation, which implied that tree densities should increase over time without the need for assisted management; and
- 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, Trials and Research

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 2018 and 2019 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 under represented 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.

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

During 2019, MGO created supplementary habitat in older rehabilitation areas (approximately 30 years since establishment) at MTO North Void. This included chainsaw hollows being cut into mature natural tree's with a trunk diameter of 400-700mm. The 20 chainsaw hollows were installed to provide habitat for microbats and squirrel gliders in particular (see [Figure 37](#)). In comparison, 20 traditional nest boxes were installed in close proximity for comparison of effectiveness in providing habitat resources. It is believed the chainsaw hollows should have the thermal properties similar to that of natural tree hollows and be preferentially inhabited by target species. During 2020, monitoring will take place to review the success of this trial. Aside to this in 2019, there was an additional 76 nest boxes installed throughout rehabilitation areas suitable for species such as Spotted-quoll, antechinus, microbat, squirrel glider, ducks and small parrots in line with target species in MGO's approved Rehabilitation Strategy.



Figure 37: Example of chainsaw hollow installed for microbat habitat.

During 2019, a rehabilitation viewing platform was installed at MTO North Pit for site visitors to view an existing rehabilitation area (see [Figure 38](#)). This work also included a signage network that was installed along rehabilitation tracks similar to those found in National Parks. These tracks allow ongoing maintenance of the rehabilitation areas as well as access points for bushfire management.



Figure 38: Mt Owen North Pit rehabilitation viewing platform.

During 2019, the Centre for Mined Land Rehabilitation (University of Queensland) completed a Rehabilitation Monitoring Procedure review as part of an overall GCAA review. MGO will consider incorporating improvements into the 2020 rehabilitation monitoring such as monitoring during consistent times of the year i.e. spring, the consideration of remote sensing on young rehabilitation (less than 3 years) for condition and visual assessment, use of native woodland reference sites from other GCAA sites and consideration of establishment of a pasture reference site in high performing pasture rehabilitation on site.

8.3 Rehabilitation Activities for the next reporting period (2020)

Rehabilitation activities planned at MGO for 2020 include (see [Figure 39](#) and [Table 58](#)):

Mt Owen

- 38.8 ha of Open Woodland and Forest Rehabilitation
- 55 ha of planned disturbance
- 10 ha of tree seeding on the north-western side of the WOOP dump to Open Woodland community (currently pasture dominated)
- In fill tree planting on the Western Bank of North Void (following on from 2019)

Glendell

- 56.5 ha of Open Grassland and Open Woodland Rehabilitation
- 74 ha of planned disturbance
- 15 ha of re-work on the western side of West Pit tailing's dam to repair erosion and establish Open Woodland Rehabilitation (currently pasture dominated)
- In fill tree planting on the Lower Betty's Creek Diversion

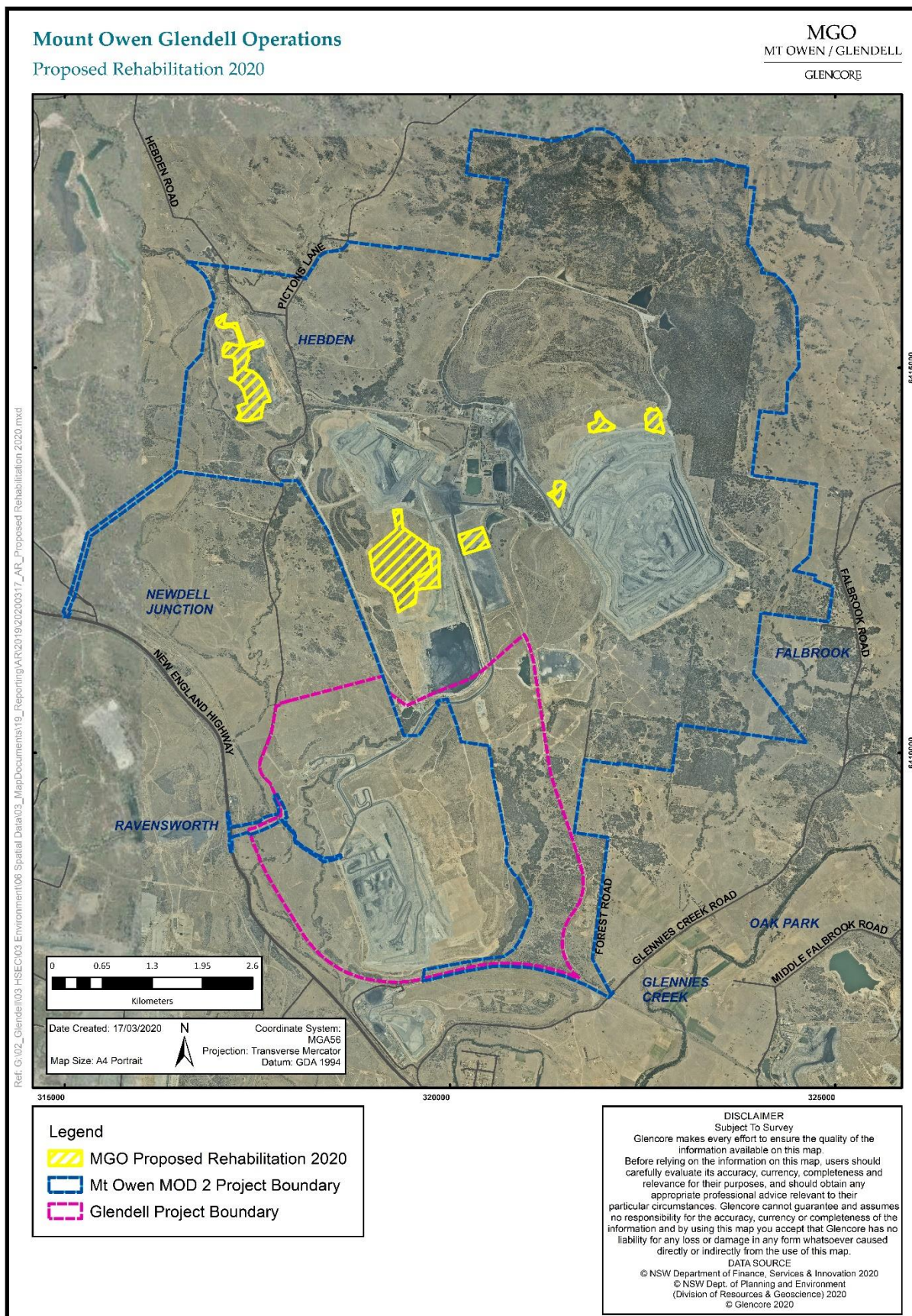


Figure 39: Mt Owen Complex Proposed Rehabilitation for 2020

9 Community

9.1 Community Engagement and Activities 2019

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 2019 are included in [Table 63](#) with an example in.

Table 63: Community Engagement Activities for 2019

Date	Community Group	Community Activity	Topics Covered
11 April 2019	CCC	Community Consultative Committee Meeting	General overview of MGO operations, environmental performance, continued operations and Integra Mine update.
05 May 2019	Yorks Creek Conservation Area (VCA)	Open Day Meeting	General overview of MGO operations, environmental performance, continued operations and Integra Mine update. Further detailed discussion regarding plans for Yorks Creek VCA area.
15 May 2019	Aboriginal Cultural Heritage Working Group Meeting	Biannual Meeting	General overview of MGO operations, environmental performance, continued operations, Integra Mine update and plans for Yorks Creek VCA area.
28 May 2019	Hebden Community Gathering	Community Gathering	General overview of MGO operations, environmental performance, continued operations and Integra Mine update.

Date	Community Group	Community Activity	Topics Covered
07 August 2019	Yorks Creek Conservation Area (VCA)	Open Day Meeting	Detailed discussion regarding plans for Yorks Creek VCA area.
18 September 2019	Aboriginal Cultural Heritage Working Group Meeting	Biannual Meeting	General overview of MGO operations, environmental performance, continued operations, Integra Mine update and plans for Yorks Creek VCA area.
08 October 2019	Mt. Olive Community Gathering	Mt Owen Community Gathering / Information Day	General overview of MGO operations, environmental performance, continued operations and Integra Mine update.
10 October 2019	CCC	Community Consultative Committee Meeting	General overview of MGO operations, consultation regarding MOP/RMP, environmental performance, continued operations and Integra Mine update.
14 November 2019	Mt Pleasant Public School	MGO Apprentice Pay Back Program	Installed garden beds at the Mt Pleasant Public School (see Figure 40)



Figure 40: MGO Apprentice Pay Back Program

MGO organised a community gathering and information afternoon at the Hebden and Mt Olive Community halls for the residents of the Goorangoola, Falbrook, Camberwell Village and Hebden areas, as well as the CCC representatives. The evening 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.

36 residents attended the Hebden Gathering and 22 attended the Mt Olive Gathering with overall the feedback being positive. Residents provided valuable input into environmental management practices at MGO.

9.2 Community Contributions

Table 64 summarises the community contributions made by MGO during 2019.

Table 64: 2019 MGO Community Contributions

Date	Community Group	Reason for Contribution	Amount
March 2019	Life Line	Support of service	\$250
April 2019	Wildlife Aid	Food and medical supplies injured animals	\$2000
May 2019	Police Citizens Youth Club	Creative kids space	\$2028
June 2019	Polocrosse	Glendell Team Support	\$800
June 2019	Westpac Rescue Helicopter	Annual Rugby League Charity Match	\$1500
June 2019	Rural Fire Service - Glennie's Ck Group 2	Navigation Systems	\$4041
July 2019	Hebden Community Hall	Solar system	\$2160
July 2019	Mt Pleasant Public School	Mathletics Program	\$1984
July 2019	Singleton Public School	Fund raising event support	\$2000
August 2019	Hunter Valley Ranch Sorting	Competition prizes – Horse rugs	\$1000
September 2019	Mt Olive Community Hall	Fundraising Ball	\$1500
September 2019	Samaritans Singleton	Christmas Lunch	\$3000
September 2019	Mt Pleasant Public School	Laptops	\$3000
October 2019	Polocrosse	Glendell Team Support	\$800
October 2019	Mt Pleasant Public School	Environmental Education Program	\$2595
November 2019	Mt Pleasant Public School	Apprentice payback program (garden construction)	\$6566
November 2019	Mt Pleasant Public School	Sports Program	\$3000
November 2019	Rural Fire Service - Glennie's Ck Group 2	Crew community donation	\$500
November 2019	Singleton Men's Shed	Crew community donation	\$500
December 2019	Mt Pleasant Public School	Soil and plants	\$1368
December 2019	Rural Fire Service - Singleton	Crew community donation	\$250

Date	Community Group	Reason for Contribution	Amount
December 2019	Wildlife Aid	Crew community donation	\$250
December 2019	Samaritans	Crew community donation	\$250
December 2019	Upper Hunter Homeless Support	Crew community donation	\$250
December 2019	Rural Fire Service - Singleton	Annual community lolly run	\$1000
MOC Total Community Contributions			\$42,592

Note: MGO also paid \$361,000 to Singleton Shire Council since 2017 as part of its Voluntary Planning Agreement. The payments went towards the following Singleton Shire Council projects:

- Economic Development Initiatives - Riverfront Beautification (\$100,000)
- All Abilities Playground at Rose Point Park - Stage 8 & 9 (\$177,000)
- Rotary Soft Cogs (\$60,000)
- Support for Aboriginal Cultural Events - Annual Aboriginal Art Award (\$24,000)

9.3 Summary of MGO Community Complaints

Mt Owen received one community complaint regarding operational Air Quality during 2019.

Glendell and Ravensworth East received a total of 43 community complaints during 2019 consisting of:

- 30 for noise;
- 10 for air quality;
- two for blasting (fume, dust and vibration); and
- one for lighting.

MGO responded and investigated all complaints received during 2019. All complaints are contained within the Community Complaints Register which is available on the Mt Owen complex website: <https://www.mtowencomplex.com.au>

Further information can be found in **Appendix H, Table 50**.

9.4 Complaint Trends and Actions

In 2019 Mt Owen received one community complaint, compared to eight received in 2018 (**Figure 41**). This is a significant reduction in the number of complaints received from the previous year.

Glendell / Ravensworth East Mine received 43 community complaints in 2019, an increase of four complaints received in 2018 (39). This included a decrease of four noise complaints and an increase of six air quality complaints compared to 2018.

Each complaint is investigated individually for compliance.

Noise related complaints during the morning period dominated during 2019. This is consistent with a predominant temperature inversion at that time of the day. Temperature inversions are monitored across MGO on a daily basis in an effort to reduce associated impacts. MGO adjust production to reduce noise impacts associated with heavy machinery during periods of increased risk.

Blasts are systematically monitored and constant improvements are made through meteorology predictions and blast modelling to reduce community impacts. Blast overpressure and vibration results for MGO were all within approval compliance limits during the report period.

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

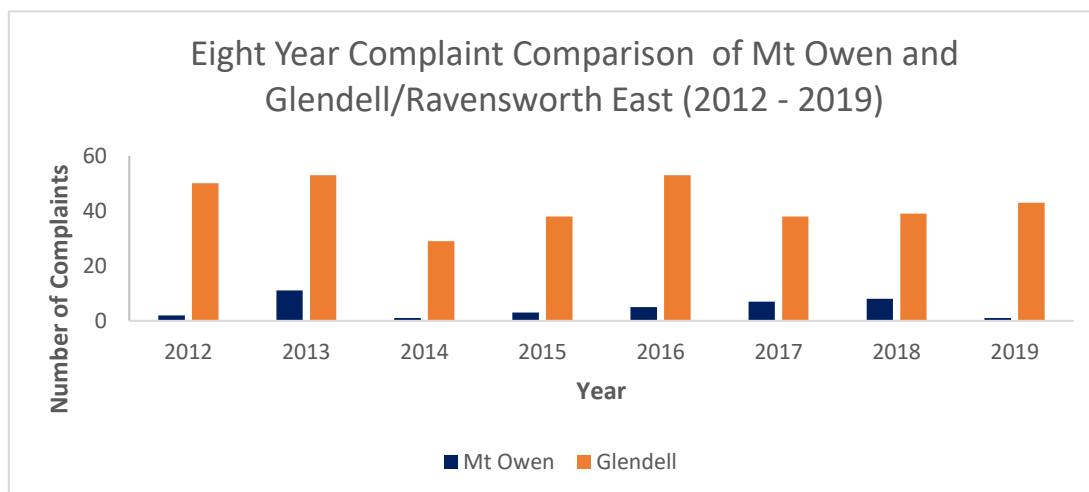


Figure 41: Comparison of Complaints Received at Mt Owen, Glendell and Ravensworth East from 2012 to 2019

10 Independent Audit

An independent audit was conducted by Hansen-Bailey at MGO during December 2017. The audit covered the reporting period 01 November 2014 to 31 October 2017, and consisted of a desktop review of documentation, interviews with key MGC staff, and a field inspection.

The audit was conducted generally in accordance with *ISO 14010 – Guidelines and General Principles for Environmental Auditing*, *ISO 14011 – Procedures for Environmental Auditing*, and the *Independent Audit Guideline, October 2015* (DP&E 2015).

The audit identified 24 non-compliances relating to 13 issues. No 'high-risk' non-compliances were identified. One issue was reported as a 'medium-risk', two as a 'low-risk', and 10 issues were classified as administrative in nature.

Table 65 below summarises the status of outstanding audit actions and how they were addressed during the report period.

The next Independent Audit is to be scheduled for Q4 2020. Previous audit reports and recommendations are located on the MGO website: <https://www.mtowencomplex.com.au/en/Pages/home.aspx>.

Table 65: Status of IEA actions as at the end of the reporting period

IEA Ref	Description	Risk	Mt Owen Response and Action Plan	Status
Previous Audit Recommendations				
	Recommend a modification to mining authority conditions referring to dam notification areas which are not applicable to MGO operations sought during the next renewal / variation (due in 2020).	Administrative	Not yet triggered.	Pending
SSD-5850 Non-compliance Recommendations				
	Recommend that Mt Owen seek written confirmation from DPI-Water to combine water licences or adjust operations to ensure water take is within that allocated by the existing water licences held (Sch 3, Con 21).	Medium	DPI – Water consultation ongoing.	Ongoing
	Approval from council should be followed up for the Sewerage Treatment Plants (Sch 3, Con 41).	Administrative	Singleton Council granted approval of Operations of Sewage System during report period – refer to Section 4.3 .	Complete
SSD-5850 Continual Improvement Recommendations				
	Approval from DPIE should be sought for the Rehabilitation Strategy.	Administrative	DPIE granted approval of MGO Rehabilitation Strategy on 13 May 2019.	Complete
EPL 10860 – Ravensworth East				
	Consider whether the production capacity can be reduced from >2000000-3500000 T annually.	Administrative	Ravensworth East and Mt Owen Mine EPLs consolidated during report period. EPL 10860 surrendered on 19 September 2019.	Not Required (Complete)
EPL 4460 – Mt Owen				

IEA Ref	Description	Risk	Mt Owen Response and Action Plan	Status
	Condition 8 of EPL 4460 - Mt Owen relates to pollution studies and reduction programs that have been finalised. Recommend this condition is removed at next update.	Administrative	Variation to Mt Owen Mine EPL 4460 approved on 19 September 2019.	Complete
EPL 12840 – Glendell				
	If Glendell has a sewerage system this should be added to the EPL and relevant council approvals sought.	Administrative	Council approvals received, this will be added to EPL at next variation. No variation received in 2019.	Pending
ML1355				
	Recommend the next Annual Review states it meets the requirements of the Compliance Report and relevant sections included	Administrative	Request will be made at next anniversary of the ML Compliance report.	Pending
	Recommend the Annual Review is included of the Compliance Report and relevant sections included	Administrative	Request will be made at next anniversary of the ML Compliance report.	Pending
	Recommended that the mining lease and coal lease annual report dates are requested to DRG to coincide with the Annual Review submission date.	Administrative	Request not yet made	Pending

11 Incidents and Non-Compliances 2019

MGO reported four (4) non-compliances during 2019, as detailed in [Table 66](#).

Table 66: Non-Compliances Reported in 2019

Agency	Approval	Description	Follow up/ Action taken
NSW DPIE	DA SSD-5850, Schedule 3, Condition 18	Breach of Air Quality Operating conditions.	<ul style="list-style-type: none"> \$15,000 Penalty Notice was received due to an event on 16 August 2019. Particulars of the Breach received by DPIE: <ul style="list-style-type: none"> "Mt Owen has failed to comply with Schedule 3, Condition 18 (a) and (b) of SSD-5850 (the consent) for the Mt Owen Open Cut". Mt Owen provided to DPIE a detail investigation with the following findings: <ul style="list-style-type: none"> Mt Owen did not exceed its Short-Term (24hr) Impact Criteria Adverse weather condition, high winds and gust conditions Due to a Telstra outage dust alarms were not generated prior to the incident Mt Owen offsite cameras confirmed adverse weather conditions Mt Owen undertook all the reasonable and feasible actions as soon as become aware of the conditions.
NSW DPIE	DA 80/952, Schedule 3, Condition 20 (Table 10: Long term impact assessment)	Deposit dust DG8 recorded an annual average of 4.7g/m ² /month. This exceeded the long term impact assessment	<ul style="list-style-type: none"> Upon receipt of December 2019 deposited dust data, the annual average was noted to be outside of DA 80/952 Development Consent long term impact criteria for GLD.

Agency	Approval	Description	Follow up/ Action taken
	criteria for deposit dust)	criterion of 4.0g/m ² /month for Deposit Dust.	<ul style="list-style-type: none"> Notification was made to DPIE and a suitably qualified and independent consultant was engaged to review the abnormal result. Extraordinary Bushfire events throughout 2019 contributed to the result. Below average rainfall during 2019 contributed to dry conditions throughout the Hunter Valley. A detail report incident report attached in Appendix F.
Commonwealth Department of Environment and Energy	EPBC 2013/6978, Condition 1(d) (Notifications)	Condition 1(d) of EPBC 2013/6978 requires Mt Owen Pty Ltd to notify DoEE in writing of any proposed change to DA SSD-5850 conditions 1, 2, 4, 6, 7 and 8 (Schedule 2) and 21, 23-26, 28, 31 and 43-45 (Schedule 3). MOC did not notify DoEE in writing of any proposed changes to the SSD-5850 conditions as part of Modification 1, which is a non-compliance with Condition 1(d) of EPBC 2013/6978.	<ul style="list-style-type: none"> The non-compliances relate to MOC's failure to notify the Commonwealth Department of Environment and Energy (DoEE) of the modification (2) of DA SSD-5850 within 14 days of its approval. MOC has since notified DoEE as soon as become aware of the non-compliance.
Commonwealth Department of Environment and Energy	EPBC 2013/6978, Condition 1(e) (Notifications)	Condition 1(e) of EPBC 2013/6978 requires Mt Owen Pty Ltd to notify DoEE in writing of any change to DA SSD-5850 conditions 1, 2, 4, 6, 7 and 8 (Schedule 2) and 21, 23-26, 28, 31 and 43-45 (Schedule 3). Modification 1 to DA SSD-5850 was approved in August 2017, which included minor changes to condition 2 (Sch 2) and 31 (Sch 3). MOC did not notify DoEE in writing of these changes, which is a non-compliance with Condition 1(e) of EPBC 2013/6978.	

12 Activities to Improve Environmental Management in 2020

Table 67 list activities recognised during 2019 that should aid in improving the overall MGO environmental performance in 2020.

Table 67: Performance Improvement Summary for 2020

Aspect	Implementation Timeframe	Effect on Management Plans	Improvement Action
Rehabilitation	Q1-Q4	Nil	Implement maintenance activities in line with 2019 Annual rehabilitation monitoring report recommendations. Consider implementation of recommendations from Centre for Mined Land Rehabilitation (University of Queensland) Rehabilitation Monitoring review completed in 2019.
Biodiversity	Q1-Q4	Biodiversity and Offset Management Plan and Strategy	Installation of recycled Spotted-quoll habitat throughout MGO biodiversity offsets
Noise Analysis Tool	Q1-Q2	Noise Management Plan	Implement SMART alarming using the NAT tool system
Dust Analysis Tool	Q3-Q4	Air Quality and Greenhouse Gas Management Plan	Further improve the DNAT and expand its use to include dust contribution
Management Plans	Q1-Q2	Revisions to all plans	Review all management plans in line with SSD-5850 and DA 80/952 approvals received in 2019 and 2020.
Creek Diversions	Q2	Nil	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.
Independent Compliance Audit	Q4	Nil	Complete 3-yearly Independent Environmental Audit.
Mine Operations Plan	Q1	MOP Amendment	MOP Amendment to be compiled if Glendell DA 80/952 MOD4 is approved. 2020- June 2024-MOP currently approved until 31 December 2020.
Water Monitoring and Reporting	Q2-Q4	Nil	Complete recommendations from 2019 Annual groundwater review.
Cultural Heritage	Q4	Nil	Progress the Wollombi Brook Cultural heritage Keeping & Teaching Place with the Bulga Mine.