MT OWEN
COMPLEX
GLENCORE

ANNUAL REVIEW

1 January 2018 – 31 December 2018

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Title Block

Name of operation	Mt Owen Complex
Name of operator	Mt Owen, Ravensworth East and Glendell Mines
Development consent/ project approval	MOC 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, 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 2017
MOP/ RMP end date	December 2021
Annual Review start date	01/01/2018
Annual review end date	31/12/2018

I, Ned Stephenson, certify that this audit report is a true and accurate record of the compliance status of Mt Owen Complex for the period 01/01/2018 to 31/12/2018 and that I am authorised to make this statement on behalf of Mt Owen Complex.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 122B (2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.

b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).

Name of authorised reporting officer	Ned Stephenson
Tittle of authorised reporting officer	Environment and Community Manager
Signature of authorised reporting officer	
Date	31/03/2019

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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 2018 to 31 December 2018. 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 was prepared in accordance with Department of Planning & Environment (DP&E) and the NSW Department of Industry – Resources and Energy (DI – R&E) requirements.

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.

Site	2018 ROM Coal (Mt)	ROM Consent Limit (Mt)	2018 Product Coal (Mt)
Mt Owen	8.82	10	4.37
Glendell	4.01	4.5	2.34
Ravensworth East	1.31	4	0.94
Total	**14.14**	**18.5**	**7.65**

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

On 29 May 2018 DPE approved the surrender of development consents DA 14-1-2004 (Mt Owen) and DA 52-03-99 (Ravensworth East), in accordance with Condition 10 Schedule 2 of DA SSD 5850.

Air Quality

On one day during 2018, the site contribution to 24-hour average PM_{10} concentrations (50.6µg/m^3) was calculated to exceed the criterion. The highest recorded 24-hour average result for 2018 was on 22 November 2018. On this day high winds and dry conditions generated a severe dust storm that affected most of NSW. Annual average PM_{10}, TSP and dust deposition concentrations in 2018 did not exceed the criteria at any of the monitoring locations.

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 PM_{10} or TSP concentrations. Three locations have experienced deposition levels above the criterion, in one or more years, though no monitors recorded above criterion in 2018 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 2018, in consultation with relevant government agencies. Surface water and groundwater quality triggers and groundwater drawdown triggers were revised as part of this review. MTO will seek approval for the revised water management plans in 2019.

2018 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 2018. All of these results were within the historical range, with the exception of

one TDS result for Bowmans Creek and one pH result for Swamp Creek. This is likely a result of the drier climatic conditions with the following month's result returning within the historical range. No results were attributable to MOC operations.

Stream condition at Bowmans Creek has decreased at one monitoring point and increased at another since 2017. At York's Creek, stream condition either remained the same or improved at the monitoring locations. There was no change in stream health at Swamp Creek from last year. At Bettys Creek, stream health remained constant or decreased across the two sites, compared to 2017. Compared to 2017, stream stability improved at one Main Creek site and decreased at the other site, with stream health remaining unchanged. Stream health has remained constant at Main Creek since 2014. 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.

MOC monitor groundwater level and quality for 98 groundwater monitoring bores as per the MOC GWMMP. Monitoring results for a number of bores exceeded the EC trigger during 2018. A review of these exceedances is currently being undertaken by SLR Consultants.

Biodiversity

No comprehensive fauna monitoring surveys were conducted within the MOC in 2018, with the monitoring program targeting habitat restoration areas. Despite this, one new species (Banded Lapwing) was detected in the Glendell Rehabilitation area. Four threatened fauna species were detected in 2018; however the nationally threatened Swift Parrot and Regent Honeyeater were not sighted at MOC in 2018. A frog survey, undertaken in early 2018, for endangered Green and Golden Bell Frogs, recorded very little frog activity due to the dry climatic conditions.

A total of 101 nest boxes were installed at a number of locations within the Mt Owen Complex in 2018. In addition, a number of nest boxes installed in the Pit C Strip 10 area were relocated to offset areas due to clearing of forest for expansion of Pit C.

Monitoring of the River Oak compensatory planting program undertaken in 2016/2017 showed that less than 10% survive. Further planting is scheduled for April 2019. The weed action plan implemented in 2017 continued in 2018, with targeted weed control continuing across the MOC.

During 2018 MOC became aware of two non-compliances with the EPBC Approval, EPBC 2013/6978. The non-compliances relate to MOC's failure to notify the Commonwealth Department of Environment and Energy (DoEE) of the modification of DA SSD-5850 in 2017 i.e Modification 1. Whilst the non-compliances occurred in 2017, MOC only became aware of them during the reporting period.

Noise

The noise monitoring program for MOC incorporates both continuous noise monitors and attended noise monitoring. During 2018 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 2018 MOC acquired a new Sentinex directional noise monitoring unit. This unit was installed in the Middle Falbrook area to allow for improved understanding of noise contributions from the MOC in this area. MOC also continued to develop the Noise Analysis Tool (NAT), to assist Mining Supervisors to plan and modify operational controls in adverse noise conditions.

Blasting

During 2018 a total of 219 blasts occurred at the MOC, consisting of 104 at Mt Owen, 95 at Glendell and 20 at Ravensworth East. One blast was undertaken in the MOC North Void, to allow for the completion of rehabilitation works in the MOC North Void area. MOC recorded one non-compliance with the Blast Management Plan during 2018. The non-compliance related to the failure to monitor a blast at MOC1 on 5 September 2018. All blasts were within limits detailed in respective development consents and EPLs.

Heritage

Inspections were carried out during the 2018 reporting period for Aboriginal and European cultural heritage sites, in accordance with the Ground Disturbance Permit process. In 2018 MOC, in conjunction with two Registered Aboriginal Parties (RAPs) and an OzArk archaeologist, continued the monitoring of Aboriginal heritage sites across both MOC and Integra Underground. During 2018, three sites were salvaged under permit, and in accordance with the ACHMP. This was to allow for mining under DA 80/952. Artefacts salvaged are under the care of MOC 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 heritage in 2018.

During the reporting period MOC continued to care for Ravensworth Homestead and undertook maintenance of the Ravensworth Public School. Archival recording of the Ravensworth Public School was also conducted in response to the Hebden Road Upgrade. No changes were noted.

Rehabilitation

Rehabilitation continued across the MOC during 2018 generally in line with the Rehabilitation Management Plan (RMP) / Mining Operations Plan (MOP). Glendell completed a total of 66 ha of rehabilitation during 2018 including 58 ha of open grassland or pasture areas and 8 ha of open woodland areas. In 2018 Mt Owen prepared and seeded a total of 38 ha of open forest rehabilitation. Rehabilitation across MOC 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. Weed incursion has been identified as the main issue at MOC. Weed populations are widespread and threaten the ecological integrity of the rehabilitated communities

Environmental Incidents

MOC recorded 43 environmental incidents during the reporting period, compared to 41 environmental incidents in 2017. Thirty eight incidents were classified as category 1, one was classified as category 2, and four were classified as category 0. Of the 38 Category 1 incidents, 33 were hydrocarbon spills less than 1000 L, one related to the spill of emulsion, two related to blasting and two related to air quality. The category 2 incident related to a diesel spill at the Mt Owen mine on 12 December 2018. Approximately 2,600 litres of diesel was spilt. Contaminated material was collected and taken to the bioremediation area at Glendell.

Community Complaints and Consultation

During 2018, a total of eight community complaints were recorded at MTO. This consisted of five relating to blasting, two for noise, and one for traffic. Glendell and Ravensworth East received a total of 39 community complaints consisting of 34 relating to noise, one for blasting (fume, dust and vibration), and four relating to air quality. Two Community Consultative Committee (CCC) meetings and one Community Gathering were held during 2018.

Visual Impact

MOC reviewed and updated the Lighting Plants Procedure during the reporting period to reflect considerations from Hansen Bailey's 2017 lighting and visual amenity compliance review. During the reporting period dilapidated buildings were also removed from a property at 144 Picton Lane to improve visual amenity in the area.

Demolition Works

During the reporting period the dilapidated former property at 144 Picton Lane was dismantled and disposed of to improve local visual amenity and farming land. Approximately 48 tonnes of waste was removed from the site including 8 tonnes of mixed waste, 27 tonnes of concrete waste, 12 tonnes of timber and 0.82 tonnes of asbestos material.

Independent Audit

MOC 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

The Mt Owen Complex (MOC) incorporates:

- Mt Owen Open Cut Mine (MTO), including the MOC 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.

The Mt Owen Complex holds over 100 approvals, containing more than 2,000 conditions. **Table 1** summarises the state of compliance against the site's major approvals during 2018. Non-compliances are listed in **Table 2** and detailed in later sections of this report.

Table 1: Statement of Compliance for 2018

Relevant Approvals	Compliance
MOC Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	Yes
DA SSD-5850 (Mt Owen / Ravensworth East)	No
DA 14-1-2004 (Mt Owen)*	Yes
DA 80/952 (Glendell)	Yes
DA 52-03-99 (Ravensworth East)*	Yes
EPBC 2013/6978	No
Mt Owen EPL 4460	Yes
Glendell EPL12840	Yes
Ravensworth East EPL10860	Yes
CCL0715	Yes
CL0358	Yes
CL0382	Yes
CL0383	Yes
ML 1355	Yes
ML 1419	Yes
ML 1453	Yes
ML 1561	Yes
ML 1475	Yes
ML 1608	Yes
ML 1410	Yes
ML 1415	Yes
ML 1476	Yes
ML 1694	Yes
ML 1629	Yes
MPL 343	Yes
Water Licences	Yes

* DA 14-1-2004 (Mt Owen) and DA 52-03-99 (Ravensworth East) were surrendered on 29 May 2018 (refer Section 3.0 for more detail)

Table 2: Non-Compliances

Relevant Approval	Condition #	Condition Description	2018 Compliance Status	Comment	Annual Review Section
DA SSD-5850	Table 6, Condition 16	• Terms of consent	Non-Compliant	Exceedance of air quality short term impact assessment criteria for PM_{10}	**Section 11**
Blast Management Plan	Section 4.1	• Terms of Management Plan	Non-Compliant	Breach of Blast Management Plan commitment	**Section 11**
EPBC 2013/6978	1(d)	• Notification to DoEE	Non-Compliant	DoEE was not notified of proposed changes to DA SSD-5850 conditions as a result of Modification 1.	**Section 11**
EPBC 2013/6978	1(e)	• Notification to DoEE	Non-Compliant	DoEE was not notified of changes to DA SSD-5850 conditions following approval of Modification 1.	**Section 11**

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: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low	Non-Compliant	Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non-Compliant	Only to be applied where the non-compliance does not result in any risk of environmental 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 3**.

Table 3: Statutory Requirements

Approval	Condition	Relevant Section of Document
Development Consents SSD-5850 (Mt Owen and Ravensworth) and 80/952 (Glendell), Schedule 5, Condition 5	By the end of March each year, or as otherwise agreed with the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must: (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against the: • relevant statutory requirements, limits or performance measures/criteria; • monitoring results of previous years; and • relevant predictions in the documents listed in condition 2(a) of Schedule 2 or 3; (c) identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance; (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;	6

Approval	Condition	Relevant Section of Document
	(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.	
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 4, 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 4, 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
Exploration Licence EL8184, Conditions 043 and 044	043. The licence holder must submit an Environmental Management Report to the Department in the following circumstances: a) where the licence holder is seeking to renew this exploration licence, an Environmental Management Report must accompany an exploration licence renewal application; or b) where the licence holder is seeking to cancel or part cancel this exploration licence, an Environmental Management Report must accompany an exploration licence cancellation application; c) where the licence holder is not seeking to renew or cancel this exploration licence, and Environmental Management Report must be submitted prior to the expiry of this exploration licence. 044. The report must be prepared in accordance with any Director-General's requirements for environmental and rehabilitation reporting on exploration licences and include information on all disturbance resulting from prospecting operations and rehabilitation carried out within the exploration licence area. The report must be prepared to the satisfaction of the Direction-General.	043. Entire document 044. Entire document
Mining Tenement CCL0715, Schedule 00 Conditions 004 and 005	004. The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. 005. The EMR must: a) report against compliance with the MOP; b) report on progress in respect of rehabilitation completion criteria; c) report on the extent of compliance with regulatory requirements; and d) have regard to any relevant guidelines adopted by the Director-General.	004. Entire document 005. a) 8 b) 8 c) Entire document d) Entire document
Mining Tenement CL0358, Schedule 00 Condition 004	The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. The EMR must: i) report against compliance with the MOP; ii) report on progress n respect of rehabilitation completion criteria; iii) report on the extent of compliance with regulatory requirements; and iv) have regard to any relevant guidelines adopted by the Director-General.	i) 8 ii) 8 iii) Entire document iv) Entire document
Mining Tenements ML1410, ML1415, ML1453, ML1475, ML1476, ML1561, Schedule 00 Conditions 003.01 and 003.02	003.01. Within 12 months of the commencement of mining operations and thereafter annually or, at such other times as may be allowed by the Director-General, the lease holder must lodge an Annual Environmental Management Report (AEMR) with the Director-General. 003.02. The AEMR must be prepared in accordance with the Director-General's guidelines current at the time of reporting and contain a review and forecast of performance for the preceding and ensuing twelve months in terms of:-	003.01 Entire document 003.02

Approval	Condition	Relevant Section of Document
	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.	a) 8 b) Various c) Various d) Various e) 4.2 f) 8
Mining Tenements ML1608 and ML1629, Schedule 00 Conditions 04 and 05	04. The lease holder must lodge Environmental Management Reports (EMR) with The Director-General annually or at dates otherwise directed by the Director-General. 05. The EMR must: - report against compliance with the MOP; - report on progress in respect of rehabilitation completion criteria; - report on the extent of compliance with regulatory requirements; and - have regard to any relevant guidelines adopted by the Director-General.	04. Whole document 05. - 8 - 18 - Entire document - Entire document
Mining Tenements ML1694 and MP0343, Schedule 00 Condition 04	The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. The EMR must: (i) report against compliance with the MOP; (ii) report on progress in respect of rehabilitation completion criteria; (iii) report on the extent of compliance with regulatory requirements; and (iv) have regard to any relevant guidelines adopted by the Director-General.	i) 8 ii) 18 iii) Entire document iv) Entire document

2 Introduction

The Mount Owen Complex (MOC) comprises of:

- Mt Owen Open Cut Mine (MTO), including the MOC 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 2018 to 31 December 2018. The report has been prepared in accordance with the NSW Department of Primary Industries – Mineral Resources (DPI) Guidelines and Format for Preparation of an Annual Review, dated October 2016. 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.

Development consents DA 14-01-2004 and DA 52-03-99 were surrendered on 29 May 2018. Conditions of these approvals have been incorporated into SSD-5850.

The Mount Owen Complex (MOC)

MOC is located on Hebden Road at Ravensworth, approximately 20km north-west of Singleton, NSW. MOC 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 the MOC.

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 3.6Mtpa 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 4.5Mt 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 4Mtpa. This allowed mining operations to commence in August 2000 and continue for up to 21 years.

Enex 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.

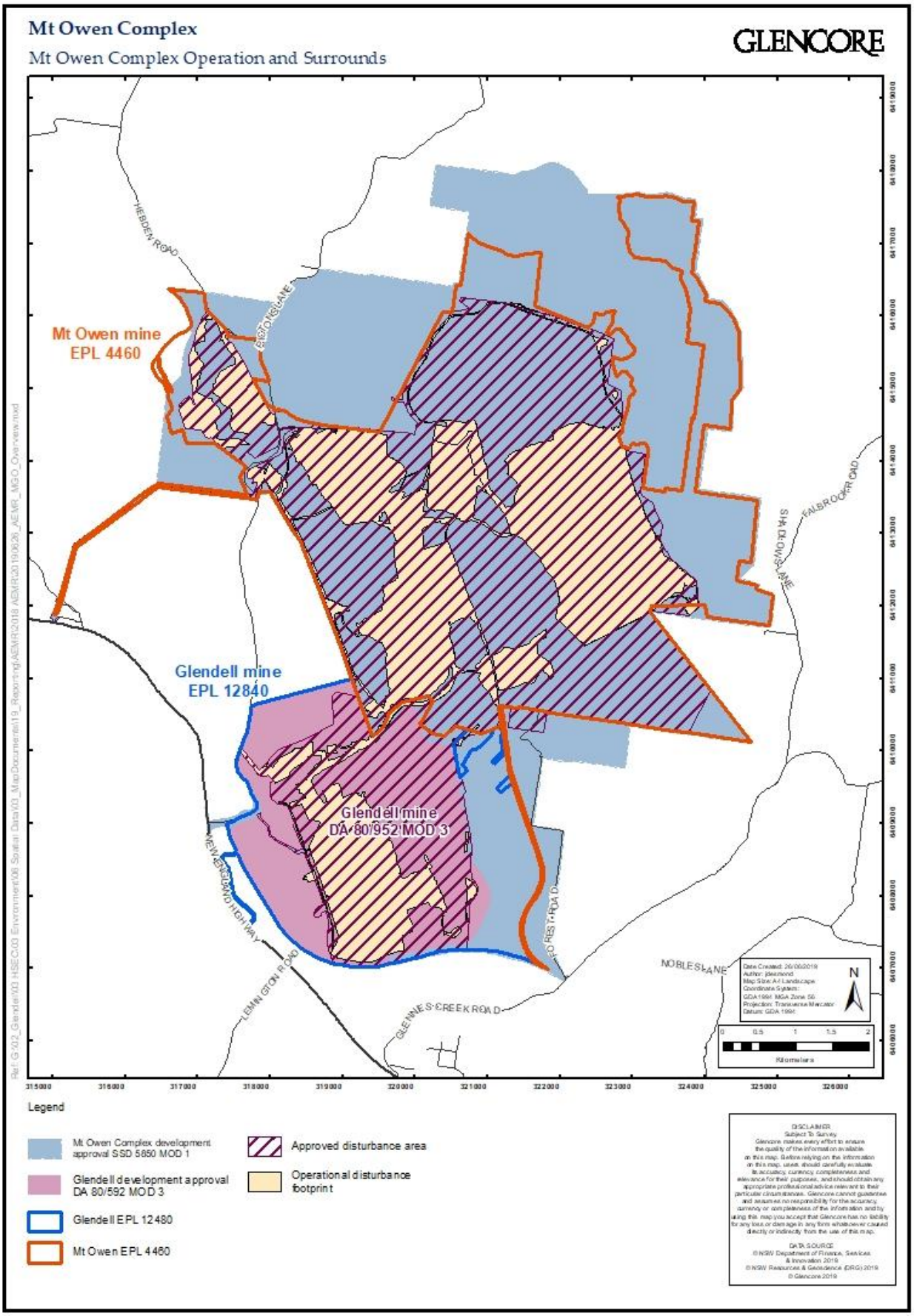


Figure 1: Mt Owen Complex Overview and Disturbance as at 31 December 2018

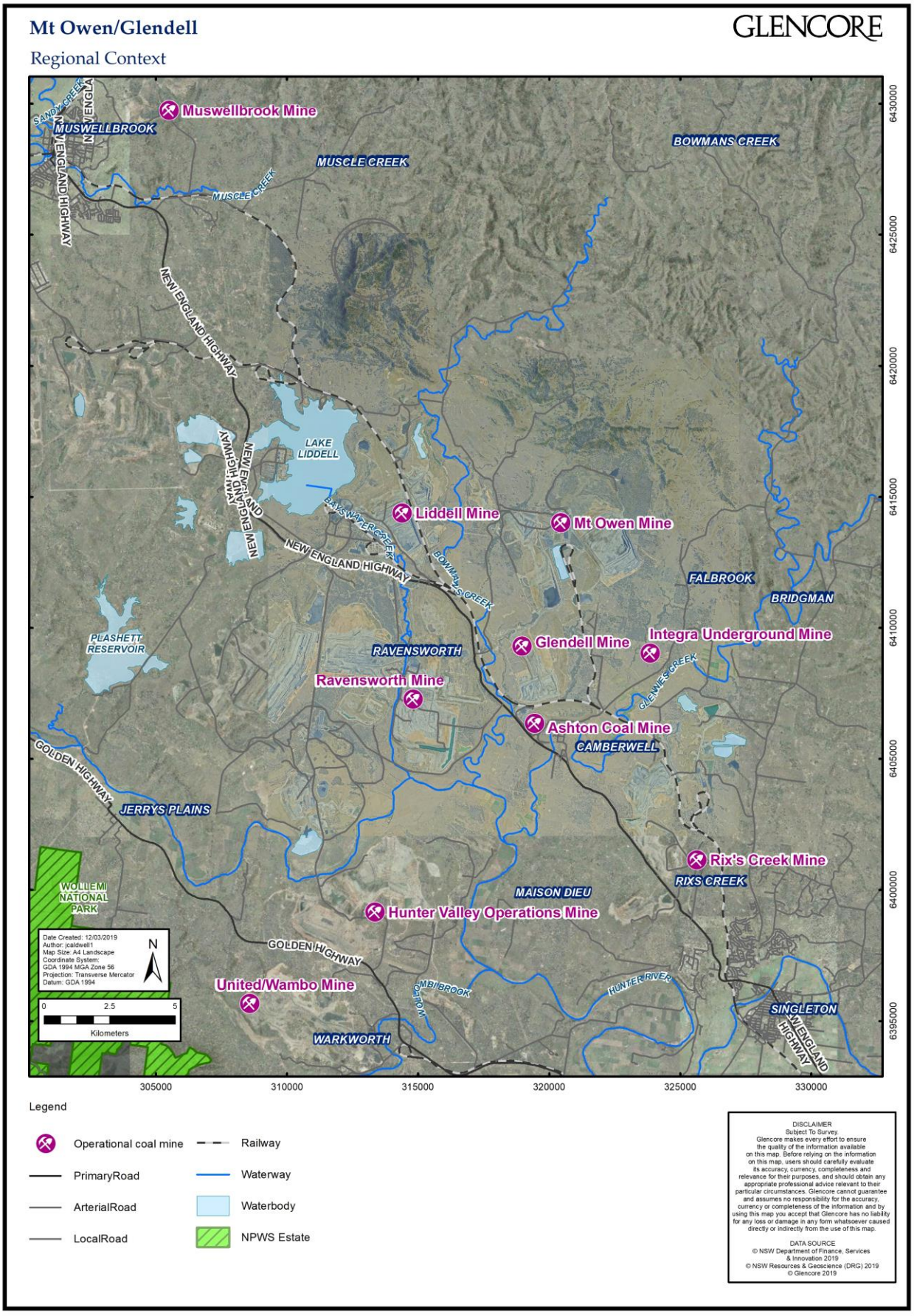


Figure 2: MOC Overview – Regional Context

Mine Contacts

Mine contacts are provided in **Table 4**.

Table 4: MOC Contact Details

Name	Position Held	Contact Details
Mount Owen Complex Management		
Ashley McLeod	Mt Owen Operations Manager	(02) 6520 2601
Jeroen Hendricks	Thiess Operations Manager	(02) 6570 0811
Mount Owen Complex Environment and Community		
Ned Stephenson	Environment and Community Manager	(02) 6520 2693
Jason Desmond	Environment and Community Coordinator	(02) 6520 2633
Mike Pereira	Environment and Community Officer	(02) 6520 2677
Mel Dillon	Environment and Community Officer	(02) 6520 2622
General Contact Details		
Mt Owen Complex		Street Address: 666 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 248 745 Emergency Response Line: 02 6570 0800 Website: www.mtowencomplex.com.au

3 Approvals

MOC operates under a number of approvals and licences which are summarised in **Table 5**.

On 29 May 2018 DPE approved the surrender of development consents DA 14-1-2004 (Mt Owen) and DA 52-03-99 (Ravensworth East), in accordance with Condition 10 Schedule 2 of DA SSD 5850. A copy of the approval letter is attached in **Appendix A.**

Table 5: MOC Approval Conditions

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
Mt Owen and Ravensworth East				
Approvals				
MOC MOP (Mt Owen, Glendell and Ravensworth East)	Mt Owen Complex Mining Operations Plan (Mt Owen, Glendell and Ravensworth East)	03/03/2017	31/12/2021	
DA SSD-5850 (Mt Owen and Ravensworth East)	Development Approval SSD-5850	03/11/2016	31/12/2031	
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	03/01/2019	
WA 20WA201677	Water Supply Works	01/07/2004	28/06/2018	
WA 20WA200727	Water Supply Works	01/07/2004	08/10/2018	
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	
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	

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
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)	17/08/2017	02/09/2019 (Review Date)	
EPL 10860	Environment Protection Licence 10860 (Ravensworth East)	18/08/2017	25/11/2019 (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	
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	

Consent Number	Consent Description	Date Granted	Expiry Date	Comments
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	
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 8184	Exploration Licence	13/10/2013	14/10/2018	Renewal sought
Licences				
EPL 12840	Environment Protection Licence 12840	17/08/2017	18/11/2019 (Review Date)	
WAL704	Water Licence (High Security)	02/05/2008	Perpetuity	

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

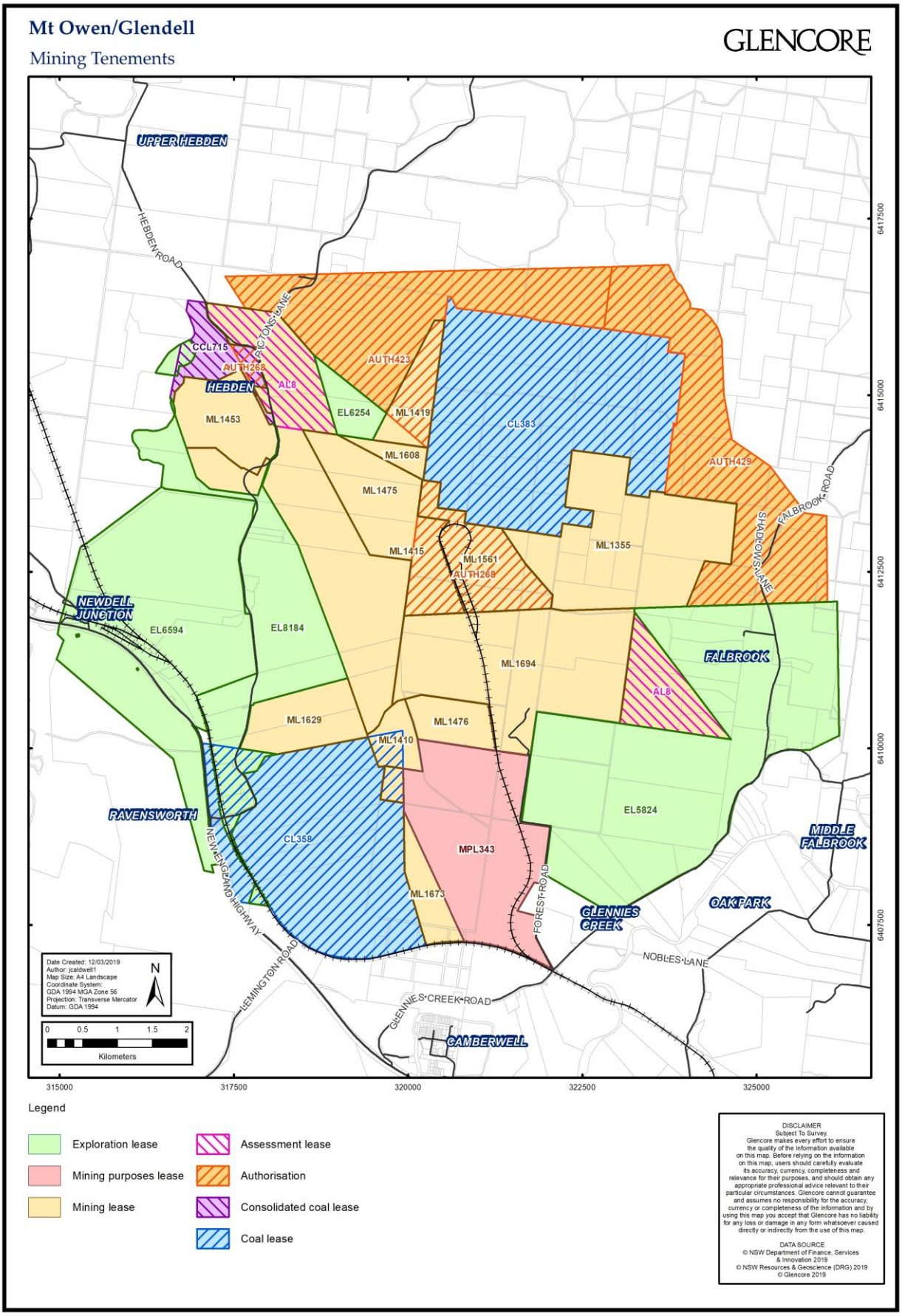


Figure 3: MOC Mining Tenements

Environmental management plans have been developed for the MOC and are outlined in **Table 6.** The date of the most recent review is provided below.

Table 6: MOC Environmental Management Plans

Environmental Management Plans	Revision Date
MOC Environmental Management Strategy	October 2017
MOC Pollution Incident Response Management Plan	September 2018
MOC Noise Management Plan (revised NMP submitted to DP&E on 31 December 2018)	June 2017
MOC Blast Management Plan	October 2018
MOC Air Quality Management Plan	October 2018
MOC Aboriginal Cultural Heritage Management Plan	May 2018
MOC Historic Heritage Management Plan	May 2018
MOC Water Management Plan	November 2018
MOC Surface Water Management and Monitoring Plan (currently being updated)	October 2017
MOC Groundwater Management and Monitoring Plan (currently being updated)	October 2017
MOC Erosion and Sediment Control Plan	November 2018
MOC Surface Water and Groundwater Response Plan (currently being updated)	October 2017
MOC Creek Diversion Plan	November 2018
MOC Biodiversity Offset Management Plan (Incorporating the Flora and Fauna Management Plan and Offset Management Plan)	December 2018
MOC Mining Operations Plan (new MOP submitted to DP&E for approval on 4 December 2018)	March 2017
Glendell Greenhouse Gas and Energy Efficiency Plan	October 2017
Rehabilitation Strategy (currently with DP&E for approval)	-

4 Operations Summary

4.1 Mining Operations

In 2018, MOC produced a total of 14.14 Mtpa of ROM coal, consisting of:

- 8.82 Mt for MTO
- 1.31 Mt for Ravensworth East Mine
- 4.01 Mt for Glendell Mine.

A total of 7.65 Mt product coal was produced, with MTO, Ravensworth East and Glendell producing 4.37 Mt, 0.94 Mt and 2.34 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 7.**

Table 7: MOC Production Summary

Material	Approved limit (specify source)	2018 Reporting Period (Forecast)	2018 Reporting Period (Actual)	2019 Reporting Period (Forecast)
Mt Owen				
Prime Overburden (Mbcm)	-	39.95	38.43	39.75
ROM Coal Mined (Mt)	10 (Development Consent)	8.82	8.82	8.78
Saleable Product (Mt)	-	4.77	4.37	4.76
ROM Coal Fed (Mt)	-	8.82	8.62	8.78
Glendell				
Prime Overburden (Mbcm)	-	20.29	22.41	20.36
ROM mined (Mt)	4.5 (Development Consent)	4.50	4.01	4.12
Saleable Product (Mt)	-	2.74	2.34	2.31
ROM Coal Fed	-	4.50	3.98	3.99
Ravensworth East				
Prime Overburden (Mbcm)	-	10.83	10.24	10.73
ROM mined (Mt)	4 (Development Consent)	1.53	1.31	1.71
Saleable Product (Mt)	-	0.93	0.94	0.94
ROM Coal Fed	-	1.53	1.55	1.58
CHPP				
Coarse Waste Reject (Mt)	-	4.23	4.33	4.18
Total MOC ROM Coal Fed	18.5 (Development Consent)	14.85	14.14	14.35
Fine Waste Reject (Mt)	-	2.18	2.11	2.09

During 2018 a new MOP was drafted to include operational changes. The MOP was submitted to DP&E for approval on 4 December 2018.

In 2018, 281 people were employed at Glendell, 50 at Ravensworth East and 518 at Mt Owen (55 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, MOC modified SSD-5850 ('Modification 1') to allow for the construction of a mine water pipeline from Integra Underground Mine to the MOC.

During 2018 an application was made to the DP&E regarding a further modification of SSD-5850 ('Modification 2'). The modification seeks to increase the life of the operation by 6 years, to 2037, by mining an additional 35 Mt of ROM coal. The modification will allow for the optimisation of the North Pit mine plan to access coal resources obtained by Glencore through the acquisition of the Integra Underground Mine. The application is currently in the environmental assessment phase, with Glencore submitting its Response to Submissions on the proposed modification to DP&E in December 2018.

4.2.1.1 Hebden Road Bridge Upgrade

Approval was given under SSD-5850 for MOC to upgrade both the rail crossing and Bowmans Creek Bridge, along Hebden Road. These works commenced in September 2017 and were completed during the reporting period.

Works included the construction of an overpass on the Main Northern Rail line which crosses Hebden Road, and an upgrade to the single lane bridge which currently crosses Bowmans Creek. The construction of the bridge included dual lanes to allow for two-way traffic movements over Bowmans Creek. These works were to minimise traffic delays on Hebden Road, which is the primary employee and services access to the MOC. The works were also designed to minimise disturbance within the vicinity of the creek. Rehabilitation of disturbed areas was undertaken progressively.

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 DP&E. 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), will be submitted to the DP&E in the next 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 2.5 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 will be prepared and submitted to DP&E in the next reporting period.

4.3 Other Operations

4.3.1 Train and Conveyer Movements

Table 8 summarises the train and conveyor movements undertaken at the MOC during 2018. Daily train movements are provided in **Appendix B.**

Table 8: MOC Train and Conveyor Movements

Train Movements	Total
Annual Average Daily Train Movements	2.66 Trains Per Day
Total Train Movements 2018	969 Trains
Annual Average Daily Train Tonnage	20,841 Tonnes Per Day
Annual Average Monthly Train Tonnage	633,917 Tonnes Per Month
Total Product Coal Loaded from CHPP	7.65 Million Tonnes
Average Train Loading Time	107 Mins
Average Load Rate (Tonnes per hour)	4, 605.50 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.

4.3.1.1 Coal Transport Rates and Sales

ROM coal from MOC 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 MOC were 7.62 Mt. This included:

- 4.39 Mt from MTO
- 3.23 Mt from Glendell and Ravensworth East.

A total of 7.62 Mt of coal was loaded into 971 trains **(Table 8)** and railed from site in 2018.

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

Waste facilities at MTO are located between the CHPP and the Main Dump.

During the reporting period approximately 1,211 tonnes of material was recycled at Glendell and Ravensworth East. This is slightly more than in 2017 (1,102 tonnes). There was less scrap steel recycled in 2018 compared to 2017 (approximately 90 tonnes), which largely accounts for the difference. The recycling rate for 2018 (75%) was lower than 2017 (82%). This is likely due to the demolition and removal of waste from a

dilapidated former property which occurred in August 2018 (see **Section 6.8**). The demolition produced approximately 47.12 tonnes of non-hazardous waste and 0.82 tonnes of asbestos.

At MTO approximately 1,320 tonnes was recycled in 2018. This is slightly more than in 2017 (1,273 tonnes). The recycling rate for 2018 (82%) was lower than 2017 (85%). Comingled recyclables, steel and timber recycling volumes were all lower than 2017, while waste disposal to landfill increased slightly.

Waste oil, scrap steel, timber, paper and cardboard, oil filters and batteries were the major waste streams recycled during 2018 (**Table 9**).

Table 9: MOC Recycled Materials (2017 and 2018)

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2017	2018	2017	2018
Paper and Cardboard (t)	40.3*	15.6*	9.4	10.5
Waste Oil (Hazardous) (t)	459.5	561.6	576.8	598.3
Grease (t)	5.2	3.3	2.2	0.9
Oil filters (t)	29.5	36.0	22.4	24.6
Batteries (Hazardous) (t)	12.8	15.9	8.9	7.2
Scrap Steel (t)	308	272.5	188.8	99.0
Timber (t)	32.4	24.8	32.2	64.5

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

MOC disposes of waste tyres through deep burial in overburden dumps, the location of all tyres is tracked by using spatial data. During 2018, 106 tyres at Glendell and 166 at Mt Owen were buried as compared to tyres 145 at Glendell and 350 at Mt Owen in 2017. There was a noted decrease during 2018 at Mt Owen as a result of a back log on tyres from 2016.

Table 10: MOC Waste Tyre Burial (2017 and 2018)

Waste Stream	Mt Owen		Glendell and Ravensworth East	
	2017	2018	2017	2018
Waste Tyres	350	166	145	106

Bulk fuel facilities at the MOC are bunded and designed to hold 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 MOC, to monitor implementation of the Waste and Hydrocarbon Management Plans.

MOC implemented a number of waste management improvement actions during 2018, including:

- MTO: introduction of plastic straw recycling in July 2018. As a result 15kgs of plastic straws were diverted from landfill in 2018.
- Glendell: waste segregation area developed for the Ravensworth East maintenance area.

- Glendell: ongoing waste segregation training to reduce contamination

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

4.3.3 Environmental Incidents

Environmental incidents at the MOC 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 43 environmental incidents (**Table 10**) during the reporting period. This is similar to 2017, where forty one (41) environmental incidents were recorded.

Table 10: MOC Environmental Incidents

Incident Category	Mt Owen Incidents		Glendell & Rav. East Incidents		Total Mt Owen Complex	
	2017	2018	2017	2018	2017	2018
Category 0	1	0	1	4	2	4
Category 1	30	22	7	16	37	38
Category 2	2	1	0	0	2	1
Category 3	0	0	0	0	0	0
Total	33	23	8	20	41	43

The category 2 incident related to a diesel spill at the Mt Owen mine on 12 December 2018. A truck was moving overburden material from the Mt Owen North pit C10E block to RL160 dump. While travelling from RL160 dump to C10E, the operator noticed diesel leaking from the truck. The leak was caused by a rock hitting and becoming stuck in the quick fill nozzle of the diesel tank. Approximately 2600 litres of diesel was spilt. Contaminated material was collected and taken to the bioremediation area on site at MTO.

Of the 38 Category 1 incidents:

- thirty three (33) were hydrocarbon spills less than 1000L
- one related to a spill of emulsion
- two related to blasting (blast fume and failure to monitor)
- two related to air quality (excessive dust emissions and exceedance of criteria).

The three Category 0 incidents related to unauthorised site access (3) and minor spontaneous combustion in a coal stockpile (1).

A breakdown of the incidents is provided in **Appendix C, Table 2.**

4.3.4 Land Ownership

MOC landholdings total over 9000 hectares. The landholdings cover the immediate and surrounding areas of the MOC, excluding the Ravensworth State Forest (RSF), which is situated north-east of MTO. The RSF consists of approximately 880ha, 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 MOC is summarised in **Table 11.** During 2018, one property was acquired by MTO from a private landowner. The property, Lot 621 DP1097524, is 2.31 ha, and adjoins existing MTO landholdings. MTO also acquired an additional offset area during 2018; the Esparanga Offset (approx. 300ha).

Table 11: Land Ownership

Operation	Land Owned (ha)	Land Leased (ha)
Mt Owen	6,586.36	331^
Glendell	2733.1*	16.9
Total	9319.46	347.9

* Incorporates all offset areas and their associated Crown Roads

^ Incorporates 9.3ha of Crown Roads

4.3.5 Exploration

During 2018, the following exploration activities were conducted:

- Mt Owen (MOCO Mod 2) exploration drilling for structure, coal quality and greenhouse gas
- Integra exploration drilling for structure, coal quality and greenhouse gas
- Glendell Continued Operations exploration drilling for structure, coal quality and greenhouse gas

Details are listed in **Table 12.**

Table 12: Exploration completed in 2018

Site	No of Holes	Surface Lease	Subsurface Lease 1	Subsurface Lease 2
Mt Owen (MOCO Mod 2)	11	ML1694	CL382 (Integra)	-
	4	EL5824	CL382 (Integra)	-
	9	AL08 (MLA512)	ML1415	CL382 (Integra)
	2	CL1355		
Integra	2	ML1561	ML1415	A268
	1	ML1475	ML1415	A268
	1	ML1476	CL382 (Integra)	-
	4	ML1694	CL382 (Integra)	-

Glendell Continued Operations	2	ML1415	CCL708 (Liddell)	-
	2	ML1629	CCL708 (Liddell)	
	8	EL8184	CCL708 (Liddell)	
	6	EL6594	CCL708 (Liddell)	
	1	CL358		

4.3.6 Next Reporting Period

During the 2019 reporting period, it is projected that the following activities will occur at the Mt Owen Complex;

Mt Owen

- Mining and dumping will continue in a south-easterly direction. Mt Owen has 38.5 hectares of rehabilitation planned, consisting of woodland areas.

Glendell

- Mining and dumping will continue in the southern sections of the Barrett Pit and will transition to the north. Glendell has 59.5 hectares of rehabilitation planned, consisting of a mix between pasture and woodland areas. Continued capping of the northern section of Tailings Pit 1 will continue in 2019.

Ravensworth East

- Mining and dumping will continue in the Bayswater North Pit and will move to southeast during 2019. Rehabilitation will focus on areas to the north, where mining is now complete. Rehabilitation at Ravensworth East is predominantly open woodland.

5 Actions Required from Previous Annual Review

Table 13 summarises the actions required from the 2017 Annual Review and their status as at 31 December 2018.

Table 13: Actions Required from 2017 Annual Review

Action Required from Previous Annual Review	Action Taken	Section discussed in 2018 AR	Completion Date
Requested by DPE			
a) Plans – please include the operational disturbance footprint (as at the end of the reporting period) on the MOC Overview figure	Operational disturbance footprint (as at the end of the reporting period) added to Figure 2	Figure 2	Addressed in 2018 Annual Review
b) Blasting – please include the following information in the main report to confirm compliance with Schedule 3 condition 10 of SSD-5850 and Schedule 3 condition 12 of DA 80/952: a. Total number of blasts during the reporting period b. Maximum number of blasts per day c. Average number of blasts per week	New table added to AR to confirm compliance with approved blast frequencies	Table 18 (Section 6.2.2)	Addressed in 2018 Annual Review
c) Compensatory water – Schedule 3 condition 22 of SSD-5850 requires the proponent to provide a compensatory water supply to any landowner of privately-owned land whose water supply is adversely and directly impacts as a result of the project. It is noted that the 2017 Independent Environmental Audit report found this condition not triggered; however should this status change please provide commentary in the Annual Review.	No section included in AR which includes comment on whether compensatory water has been provided to any landowner during the reporting period	Section 7.5	Addressed in 2018 Annual Review
Requested by DPE (Division of Resources and Geoscience) – letter dated 13 Dec 2018 (Ref: DOC18/622636)			
1. A "traffic light" indicator code for rehabilitation Performance Summary tables (Table 51 & Table 52) to show how performance of monitored aspects is trending toward completion criteria required for relinquishment (eg green = improvement toward or is above closure criteria, amber = no change and not meeting closure criteria, red = decline since last monitoring) is to be incorporated in the AEMR for the 2018 reporting period and future years.	Tables 52 and 53 have been updated to include a traffic light indicator code to show how performance of monitored aspects is trending toward completion criteria required for relinquishment	Tables 52 and 53 (Section 8.1)	Addressed in 2018 Annual Review
2. A schedule to undertake remediation activities to address poor performance identified for rehabilitation and creek diversions is to be provided in the AEMR for the 2018 reporting period and future years.	A schedule to undertake remediation activities to address poor performance identified for rehabilitation and creek diversions has been included in Section 8.3	Section 8.3	Addressed in 2018 Annual Review
MOC Commitment from Section 12 of 2017 Annual Review			
1. Introduce remote sensing to the rehabilitation monitoring programme	Completed trial in 2017 across Mt Owen North Pit rehabilitation.	Section 8.2	Addressed in 2018 Annual Review
2. Further improve the Noise Analysis Tool (NAT) and expand its use to include Thiess Operations at Mt Owen	NAT is operational for both Mt Owen and Glendell and included also include a dust page.	Section 6.1.2	Addressed in 2018 Annual Review

Action Required from Previous Annual Review	Action Taken	Section discussed in 2018 AR	Completion Date
3. Review the commitments in all approved management plans to remove duplications across licences	All required management plans reviewed and resubmitted to DPE during 2018.		
4. Implement the actions from the Upper Betty's Creek Diversion Remediation Plan	Works completed as per the Upper Betty's Creek Remediation Plan.	Section 7.3.1	Addressed in 2018 Annual Review
5. Complete the recommendations in the Hansen Bailey Compliance Audit	Annual Review contains action reported progress	Section 10	Addressed in 2018 Annual Review
6. Bring the MOP in line with the revised mine plan for Mt Owen and Glendell	Submitted to DPE RR December 2018.		
7. Implement the recommendations of the HEC report into surface and ground water monitoring and reporting, including revision of water TARPs	Updated GWMMP and SWGWRP submitted to DPE in December 2018.	Section 7.4.2	2019 following approval of updated GWMMP by DPE
8. Progress the Wollombi Brook Cultural heritage Keeping & Teaching Place with the Bulga mine	Meetings held with RAPs April and December 2018. Construction of storage facility scheduled to commence in 2019	Section 6.6.1	Ongoing

6 Environmental Performance

MOC 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 6**) have been developed to minimise environmental impacts from the MOC. 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

MOC has a range of management strategies in place to limit the generation of noise from the MOC and noise impacts in the region surrounding MOC. During 2018, the following activities were undertaken:

- regular attended noise monitoring in accordance with the MOC 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 including acquisition of a new Sentinex directional noise unit to replace SX 5, use of the mobile continuous noise monitoring unit and review of the system noise level alarms
- ongoing measurement of machine sound power levels to monitor equipment performance and the potential for degradation of the noise attenuation equipment
- use of the Air Quality Control System environmental forecast summary report to identify periods of potential adverse weather that could affect the propagation of noise
- ongoing MOC employee education on noise management
- review and revision of the MOC Noise Management Plan (including the Noise Monitoring Program)
- implementation of a web-based Noise Analysis Tool (NAT) to assist in managing operational noise (refer **Section 6.1.2**).

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 MOC.

Compliance with the development consents and regulatory requirements is determined from the routine attended noise monitoring. Unattended 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 on **Figure 4.**

Attended noise monitoring locations N1 to N4, and N8 to N11, 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 MOC. Locations are reviewed and where necessary, changed over the life of operations.

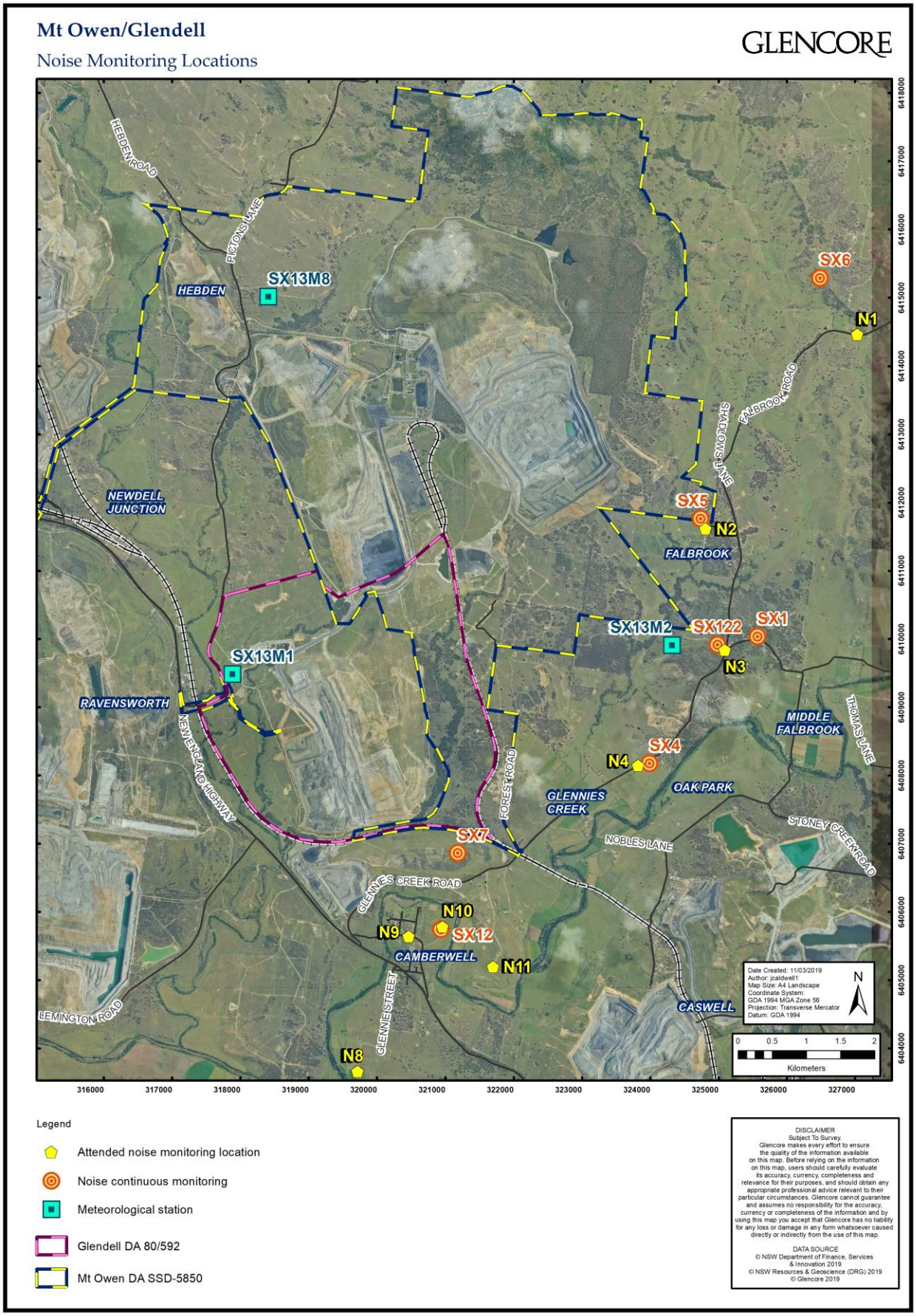


Figure 4: MOC Noise Monitoring Locations

6.1.2 MOC Noise Analysis Tool – NAT

During the reporting period MOC, with Umwelt assistance, developed a Noise Analysis Tool (NAT) to further monitor environmental impacts on the Camberwell and Falbrook areas. NAT is a web page based tool that assists Mining Supervisors to plan and modify operational controls in adverse noise conditions. In the reporting period the NAT became available to be used for both North, Barrett and Bayswater pits.

6.1.3 MOC Sound Power Level Assessment

Glendell

MOC is required to undertake an assessment of the equipment fleet against the indicative equipment listed in DA 80/952 every 5 years to confirm that noise impacts have not significantly changed. Global Acoustics measured the sound power noise level of 14 plant items at the Glendell mine on 9 and 31 November 2018. Where applicable, results were compared to the criteria from the Environmental Assessment for Modification of Glendell Mine Operations (Volume 2, August 2007). A copy of the assessment report is included in **Appendix D.**

Five plant items exceeded the target during the screen test. This equipment will be retested in 2019, against the more accurate ISO 6395:2008 Earth Moving machinery – Determination of sound power level – Dynamic test conditions.

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 13 plant items during September and October 2018. The monitoring results were compared to target sound power levels in the Mt Owen Continued Operations Environmental Assessment (2014) and the Glencore Coal Assets Australia (GCAA) protocol GCAA 11.11 Noise Management. A copy of the assessment report is included in **Appendix D.**

Two plant items exceeded the target sound power levels for Mt Owen during the testing. It was noted that the monitoring results showed variability in the measured truck sound power levels. As a result, two trucks were scheduled for retested in January 2019 with specific attention to be paid to checking the machines are appropriately prepared for testing, specifically the setting of the fan speed in the Hitachi truck, and to check the test methodology and test environment. 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, while noise monitoring of the day and evening periods occurred seasonally as dictated by the EPL.

Results of the attended noise monitoring program are summarised in **Table 14** and **Table 15**, for Mt Owen, and **Table 16** and **Table 17**, 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. Full results for seasonal attended noise monitoring during 2018 can be found in **Appendix D, Tables 4 - 15 and Appendix D, Figures 1 and 2**. Seasonal noise reports are also available on the MOC 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.

Throughout 2018, attended monitoring results were compliant with the relevant crieria.

Table 14: Summary of Mt Owen's Environmental Noise Level (dB(A)) Contribution (LAeq, 15min)

Location	Period	Criteria	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
N1	Day	35	32	-	32	-	-	<30	-	-	<20	-	-	I/A	-
	Evening	35	32	-	I/A	-	-	32	-	-	<21	-	-	I/A	-
	Night	35	33	24	I/A	25	22	<31	<15	<27	33	I/A	26	<25	I/A
N2	Day	N/C	<30	-	21	-	-	<30	-	-	<22	-	-	<30	-
	Evening	N/C	<37	-	20	-	-	<37	-	-	<33	-	-	I/A	-
	Night	N/C	42	28	28	<26	36	35	<30	42	38	<24	37	35	20
N3	Day	41	<30	-	I/A	-	-	I/A	-	-	<23	-	-	<30	-
	Evening	41	<36	-	16	-	-	<30	-	-	<36	-	-	I/A	-
	Night	41	40	33	22	I/A	35	<30	I/A	<38	I/A	31	40	35	I/A
N4	Day	42	-	-	-	-	-	-	-	-	-	-	-	-	-
	Evening	42	-	-	-	-	-	-	-	-	-	-	-	-	-
	Night	42	<20	I/A	18	I/A	I/A	I/A	I/A	<20	I/A	I/A	I/A	I/A	I/A
N8	Day	N/C	-	-	-	-	-	-	-	-	-	-	-	-	-
	Evening	N/C	-	-	-	-	-	-	-	-	-	-	-	-	-
	Night	N/C	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	Day	N/C	-	-	-	-	-	-	-	-	-	-	-	-	-
	Evening	N/C	-	-	-	-	-	-	-	-	-	-	-	-	-
	Night	N/C	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	Day	39	-	-	-	-	-	-	-	-	-	-	-	-	-
	Evening	39	-	-	-	-	-	-	-	-	-	-	-	-	-
	Night	35	<32	I/A	I/A	I/A	I/A	I/A	<32	I/A	I/A	I/A	I/A	I/A	I/A
N11	Day	39	-	-	-	-	-	-	-	-	-	-	-	-	-
	Evening	39	-	-	-	-	-	-	-	-	-	-	-	-	-
	Night	35	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

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

"-" means not monitored on this day/evening/night

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

Table 15: Summary of Mt Owen's Environmental Noise Level (dB(A)) Contribution (LA1, 1min) - Night

Location	Criteria	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
N1	45	45	25	I/A	32	24	35	<20	42	45	I/A	35	<30	I/A
N2	N/C	48	37	37	32	46	43	40	47	48	<25	39	39	20
N3	45	45	41	36	I/A	38	43	I/A	45	I/A	38	41	43	I/A

Location	Criteria	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
N4	50	42	I/A	42	I/A	I/A	I/A	I/A	39	I/A	I/A	I/A	I/A	I/A
N8	N/C	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/C	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	I/A	44	I/A	I/A	I/A	I/A	I/A	I/A
N11	45	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

Notes: "I/A" means Mt Owen Mine was inaudible at the time of monitoring.
"N/C" means there is no specific criteria for this monitoring location

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

Location	*Period*	*Criteria*	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
N1	Day	35	I/A	-	I/A	-	-	I/A	-	-	I/A	-	-	I/A	-
	Evening	35	I/A	-	I/A	-	-	I/A	-	-	I/A	-	-	I/A	-
	Night	35	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	Day	35	I/A	-	I/A	-	-	I/A	-	-	I/A	-	-	I/A	-
	Evening	35	<30	-	I/A	-	-	<30	-	-	I/A	-	-	I/A	-
	Night	35	31	I/A	I/A	<26	I/A	31	I/A	<25	<20	I/A	I/A	I/A	I/A
N3	Day	38	<30	-	I/A	-	-	<30	-	-	I/A	-	-	I/A	-
	Evening	38	<23	-	I/A	-	-	<23	-	-	I/A	-	-	I/A	-
	Night	38	<31	24	I/A	<30	<20	<15	<30	<31	20	I/A	I/A	I/A	I/A
N4	Day	38	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Evening	38	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Night	38	37	37	I/A	<20	<30	<31	25	<27	I/A	I/A	35	I/A	I/A
N8	Day	35	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Evening	35	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Night	35	<35	26	I/A	I/A	<20	<20	<30	<35	<20	33	I/A	I/A	I/A
N9	Day	42	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Evening	42	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Night	42	<39	24	I/A	I/A	<20	<30	<32	<39	I/A	37	I/A	I/A	I/A
N10	Day	40	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Evening	40	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Night	40	<37	<20	I/A	<23	I/A	<25	I/A	<37	I/A	36	I/A	I/A	I/A
N11	Day	38	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-

Location	*Period*	*Criteria*	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
	Evening	38	I/A	-	I/A	-	-	-	-	-	-	-	-	-	-
	Night	38	35	28	35	I/A	<15	<30	I/A	33	I/A	I/A	I/A	I/A	I/A

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

"-" means not monitored on this day/evening/night

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

Location	Criteria	Maximum Recorded Result 2018	25-26/01/2018	24/27-28/02/2018	26-27/29-30/03/2018	25-26/29/04/2018	28-31/05/2018	21-22/06/2018	25/30-31/07/2018	20-24/28/08/2018	25-26/09/2018	25-26/10/2018	22/29 - 30/11/2018	06-07/12/2018
N1	N/C	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/C	42	I/A	I/A	28	I/A	36	I/A	36	42	I/A	I/A	I/A	I/A
N3	45	41	41	I/A	35	34	37	38	<39	32	I/A	I/A	I/A	I/A
N4	45	43	41	I/A	38	43	43	41	38	I/A	I/A	43	I/A	I/A
N8	45	44	35	I/A	I/A	38	36	<34	44	32	37	I/A	I/A	I/A
N9	45	44	28	I/A	I/A	33	39	<42	44	I/A	39	I/A	I/A	I/A
N10	45	45	<30	I/A	<30	I/A	43	I/A	45	I/A	39	I/A	I/A	I/A
N11	45	45	34	41.7	I/A	30	43	I/A	45	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

6.1.5 Continuous Improvement

As a part of the ongoing commitment to the management of noise impacts from the MOC, a range of activities have been undertaken during 2018 that fall within the continuous improvement program. The most important being:

- Update of Noise Management Plan and submission to DP&E for approval
- Modifications and improvement of real-time monitoring network
- Acquisition of a new Sentinex directional noise unit to replace SX 5, to better understand the MOC noise contribution in the Middle/Falbrook area
- Review and simplification of noise alarm response.
- Implementation of Glendell and Mt Owen Noise Analysis Tools (NAT) to assist mining supervisors with the management of noise.

A number of activities to be undertaken in 2019 include:

- Acquisition of two ultrasonic wind sensors to replace the mechanical sensors, current used for SX13M1 and SX13M8
- Continuous assessment and improvement of the real-time monitoring network and management alarms
- Further development of the NAT tool to capture responses to alarms
- Relocation of the old SX 5 to Middle Falbrook (will be used as a spare monitor to better understand Mt Owen and Glendell contributions) and enhance Mt Owen NAT

6.2 Blasting

6.2.1 Blast Management and Monitoring

MOC blast management practices for the life of operations are managed in accordance with the MOC Blast Management Plan. Blast monitoring locations are shown in **Figure 5**.

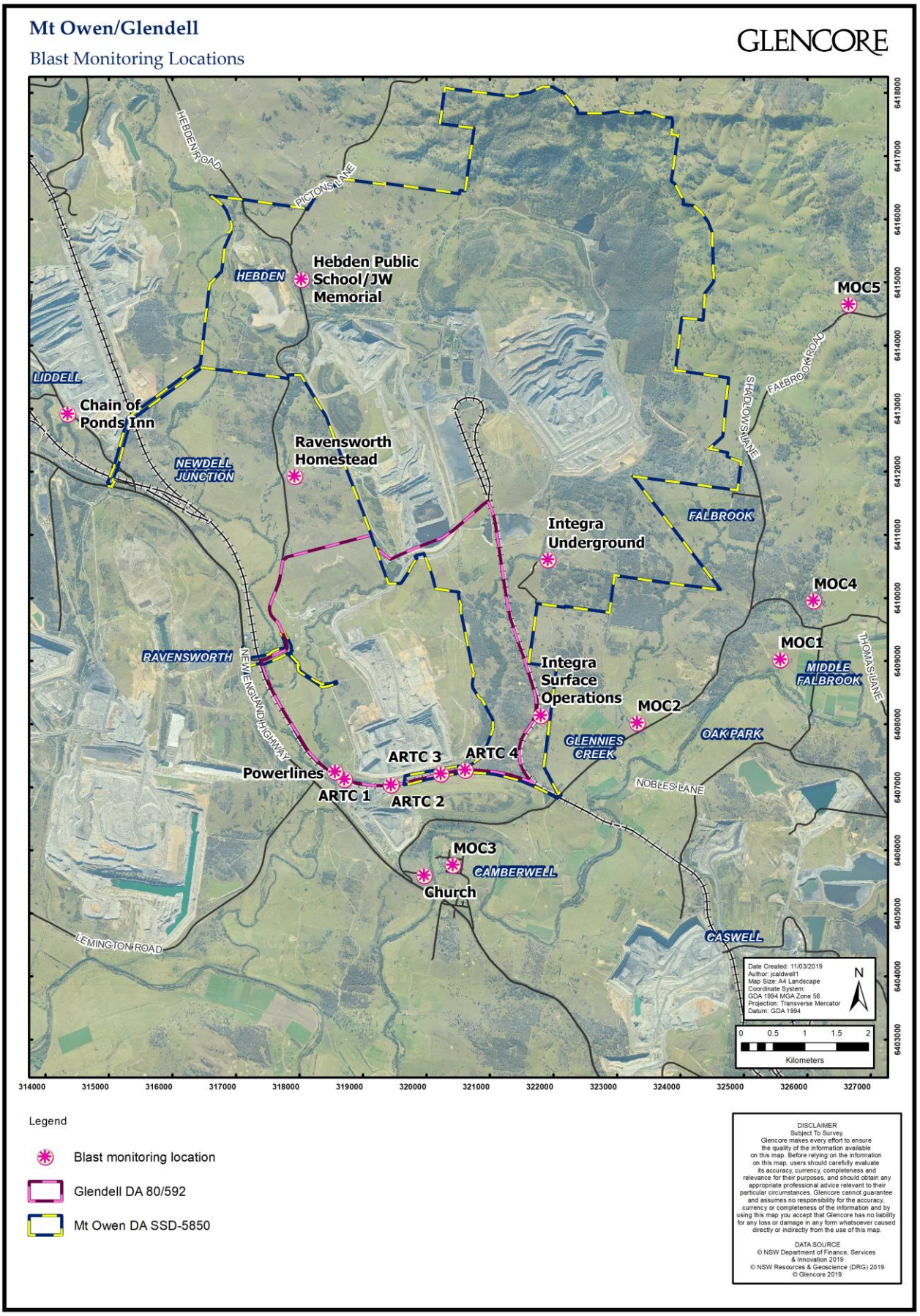


Figure 5: MOC Blast Monitoring Locations

6.2.2 Blast Performance

Table 18 summarises MOC's performance against the approved blasting hours and frequencies for 2018.

Table 19 summarises MOC's blasting criteria and performance for 2018. All blasts were fired within approved blasting hours. Five (5) blasts were fired at Mt Owen and three (3) were fired at Ravensworth East Mine between 7am and 9am (Monday to Saturday).

Table 18: MOC Blasting Hours and Frequencies for 2018

Approval	Operation	Compliant?	Approved blasting hours	Approved Blast Frequencies[1]		Actual Blast Frequencies (2018)		
				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 (EST)	2	5[3]	95	2	1.8[5]
SSD-5850	Ravensworth East	Yes	9am – 5pm Monday to Saturday[2]	2	5[4]	20	2	0.4[5]
SSD-5850	Mt Owen	Yes		2	8[4]	104	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 2018 calendar year i.e. 1 Jan 2018 – 31 Dec 2018*

Table 19: MOC Blasting Criteria and Performance for 2018

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

Location	Operation	Approval Criteria			Environmental Performance	Key Trends	Implemented/ Proposed Management Actions
		Airblast Over Pressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance			
				over a period of 12 months			
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 Underground Workings	Mt Owen	n/a	10 or 250	0%	Compliant	Nil	Nil

Mt Owen

A compilation of all blast results for 2018 at Mt Owen Complex is provided in **Appendix E, Tables 18** to **23.** Compliance summaries are provided in **Appendix E**, **Table 16** and **17**.

One blast was fired in the Mt Owen North Void on 17 October 2018, to allow for the completion of rehabilitation works in the MOC North Void area (previously part of Swamp Creek Mine). As the blast was within the prescribed North Void Tailings Dam (designated as Mt Owen-3 by the NSW Dams Safety Committee (DSC)), MOC was also required to seek approval from DRG prior to blasting. Approval was received on 9 October 2018. The blast was also within 500 metres of Hebden Road and the Ausgrid powerline, requiring the road to be closed temporarily and vibration monitoring to be undertaken at the nearest power pole. All relevant monitoring, inspections and notifications were undertaken in accordance with the Blast Management Plan and DSC approval, dated 27 September 2018. Monitoring results for this blast are included in **Appendix E, Tables 18-23.**

During the reporting period a non-compliance was recorded for MTO for failing to monitor a blast, at 1.33pm on 5 September 2018. This is a non-compliance with the MOC Blast Management Plan. The blast was fired in C9E_3356 block while the MOC 1 blast monitor was offline being serviced. An external consultant (Enviro Strata Consulting Pty Ltd) was engaged to estimate MOC 1 blast results for this blast, using C9E blast details and weather data supplied by Thiess personnel. The estimated blast results for MOC 1 were below MOC's blast criteria. These results have been included in **Appendix E**, along with the consultant's report. Further detail on the non-compliance is included in **Section 11.**

Glendell

Overpressure and vibration compliance results are detailed in **Appendix E, Table 16** and **17.** Individual blast results are provided in **Appendix E, Tables 24** to **27.**

Ravensworth East

Individual blast results for Ravensworth East are provided in **Appendix E, Tables 28** to **32** with overpressure and vibration compliance summaries provided in **Appendix E Tables 16** and **17**.

All blasting results from MOC 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 MOC Air Quality Management Plan. Monitoring locations are shown in **Figure 6.** Results of air quality monitoring are presented in **Appendix F**.

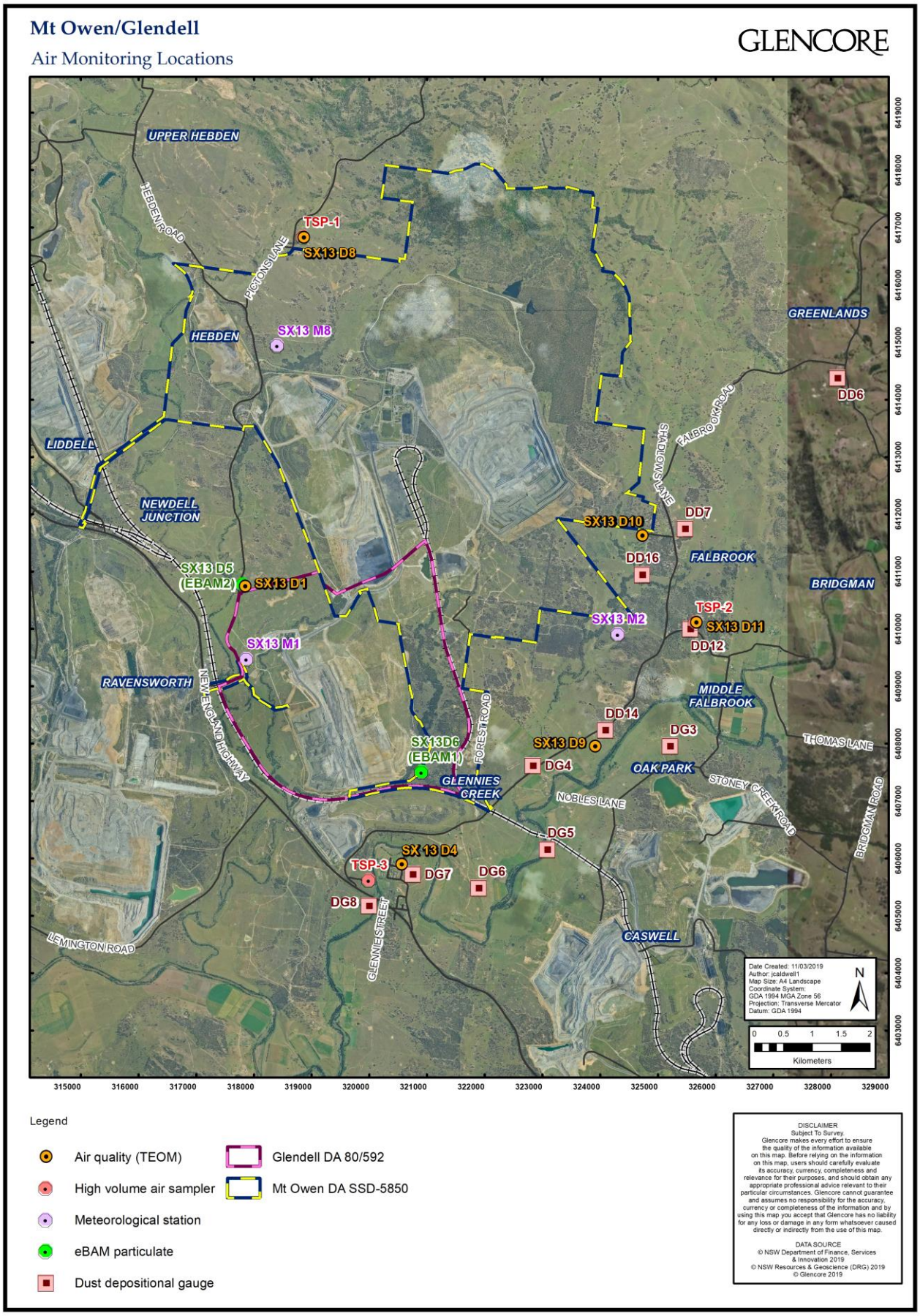


Figure 6: MOC Air Quality Monitoring Locations

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 MOC includes the measurement of:

- Particulate matter (as PM_{10})
- Particulate matter (as TSP)
- Dust deposition

Appendix F, Tables 33 - 37 present the monitoring results for 2018 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 PM_{10}), the background concentration may contain emissions from many sources such as from mining activities, construction works, bushfires and 'burning off', industry, vehicles, roads, wind-blown dust from nearby and remote areas, fragments of pollens, moulds etc.

6.3.2 Meteorological Conditions

Meteorological monitoring is undertaken at MOC in accordance with the Development Consents at the locations shown on **Figure 6**. The MOC continuous meteorological monitoring network includes three (3) 10 metre tower weather stations, Sx13 M1, Sx13 M2 and Sx13 M8, located to the west, south-east and north-west of the active mining areas respectively. Annual wind roses for Sx13 M1 and SxM2 show that winds were predominantly from the South East during 2018 (**Figure 7**).

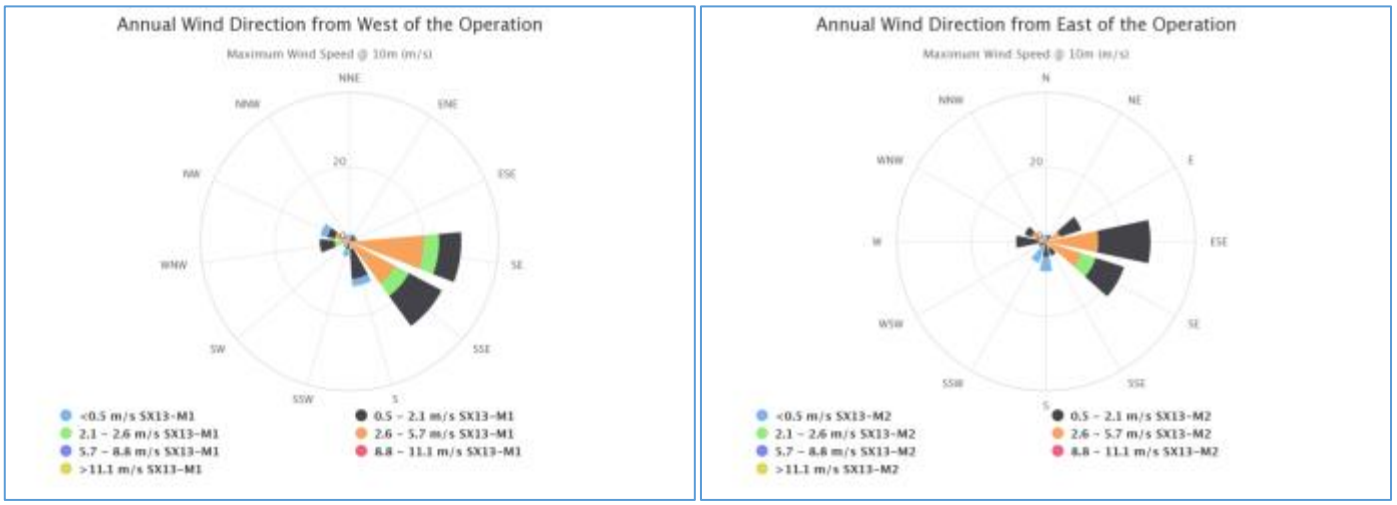


Figure 7: Annual Wind Roses for Sx13 M1 and Sx13 M2

Rainfall data for Singleton, collected from the Bureau of Meteorology website, confirms that 2018 was drier than average (**Figure 8**). A total of 391 mm was recorded in 2018, which is the lowest recorded rainfall at the Singleton STP (BOM Station number 061397) since it began operating in 2002. The long term average for this site is 653 mm.

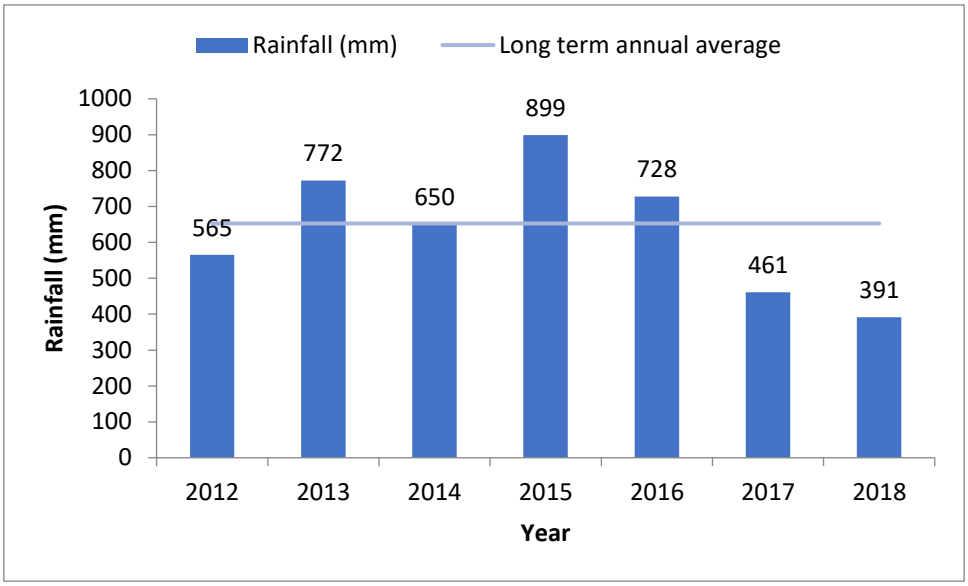


Figure 8: Rainfall at Singleton STP between 2012 and 2018 (Source – Bureau of Meteorology 2018)

6.3.3 Air Quality Performance

Particulate Matter PM_{10}

Figure 6 shows the location of monitors which are used to measure PM_{10} concentrations. The concentrations are measured by a variety of instruments including Tapered Element Oscillating Microbalance (TEOM) and High Volume Air Samplers (HVAS).

Figure 3, Appendix F shows the measured 24-hour average PM_{10} concentrations from each TEOM monitoring site for data collected between 2012 and 2018. The DA criterion for PM_{10} micro grams per cubic metre (50 µg/m^3) has also been shown on these graphs. This criterion is equivalent to EPA's air quality assessment criteria for 24-hour average PM_{10}, both project related. **Figure 4, Appendix F** shows that all sites recorded at least one day above the 50 µg/m^3 criterion in the past three years. There is a seasonal variation in the air quality conditions, with most exceedances of the criterion occurring in spring.

In 2018, there were more days where PM_{10} levels recorded above 50 µg/m^3, compared to recent years, particularly at SX13 D10. This observation is likely to have been influenced by drier than average conditions in 2018.

Table 33, Appendix F summarises the measured PM_{10} concentration data for each site and for 24-hour and annual average periods, for comparison with the respective criteria. Most sites have measured at least one day above the 50 µg/m^3 in the past six years. Annual average PM_{10} concentrations have not exceeded the 30 µg/m^3 DA criterion at any of the monitoring locations.

The PM_{10} concentrations have been examined by plotting the measurement data according to the geographical position of each monitor. **Figure 4, Appendix F** shows the maximum 24-hour average PM_{10} concentrations for continuous monitors during the last seven years. The highest maximum 24 hour PM_{10} result reported for all six TEOMs was recorded in 2018. This coincided with a large dust storm that affected a large part of NSW on 22 November 2018.

Figure 5, Appendix F shows the number of days above the 24hr average criterion, for the last seven years. From this data, SX13 D1, SX13 D9, SX13 D10 and SX13 D11 experienced more days above 50 µg/m^3 in 2018 than in previous years. SX13 D8, SX13 D10 and SX13 D11 also experienced a higher number of events in 2017. Betts et al (2014) and the OEH (2013a) both reported that the higher number of days above 50 µg/m^3 in 2013 was due to significant bushfires in the region, mainly in September, October and November. The drier conditions in 2017 extended to 2018, and are likely to have influenced the measurements for both years.

MOC has calculated the site contribution to 24-hour average PM_{10} concentrations at locations upwind (northwest / SX13 D8) and downwind (southeast / SX13 D11) of MOC for each day in 2018. The contribution was calculated by determining the wind direction ranges which coincided with a wind direction from MOC towards each monitor. The site contribution to each monitor was then calculated for every 15-minute average record in 2018 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 was one day in 2018 when the site contribution to 24-hour average PM_{10} concentrations was calculated to exceed the 50 µg/m³ criterion, 24 July 2018 (50.6 µg/m³). Details of this exceedance are provided in **Section 11.** Monitoring **r**esults for continuous PM_{10} monitoring for 2018 are provided in **Appendix F, Table 34.**

In 2018 MOC ceased monitoring of PM_{10} concentrations using high volume air samplers (HVASs) following approval of the updated MOC Air Quality Management Plan. MOC continues to monitor TSP using HVASs at three locations.

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 **r**esults for TSP monitoring for 2018 are provided in **Appendix F, Table 35. Table 36, Appendix F** shows the annual average concentrations from data collected in the past seven years, for comparison with the DA criterion (90 µg/m³). The annual average results for TSP 1, TSP 2 and TSP 3 for the 2018 reporting period show compliance with the criterion (**Table 20**). The annual average for TSP 1 rose slightly above the criterion following the 18 February 2018 measurement however it returned to below the criteria after the following measurement. 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 20: Long Term Assessment Criteria for Particulate Matter (PM_{10} and TSP)

Pollutant	Averaging period	Approval Criteria*	Environmental Performance this Reporting Period	Key Trends	Implemented/ Proposed Management Actions
		Criterion			
TSP	Annual	90 µg/m³	Compliant	Nil	Nil
PM_{10}	Annual	30 µg/m³	Compliant	Nil	Nil

* criteria applies to privately owned land

EIS Predictions for TSP and PM_{10}

The measured annual average PM_{10} 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 1 (approximately 2016) and Glendell EIS predictions for Year 9 (approximately 2016) have been extracted for the comparison. At some locations no predictions were available in the respective EIS. **Table 21 and Table 22** show the comparisons for PM_{10} (TEOM) and TSP (HVAS).

Table 21: Summary continuous PM_{10} Monitoring Results (µg/m³)

Monitoring Unit	Location	Development Consent Criterion (µg/m³)	EIS Prediction (MOCO Year 1)	EIS Prediction (Glendell Year 9)	2018 Annual Average (µg/m³)	2018 24 Hr Maximum Reading (µg/m³)	2018 24 Hr Minimum Reading (µg/m³)
SX13 D8 (TEOM 1)	Hebden Road North-West of Mt Owen Mine	30	N/A	33	23	169	5.5
SX13 D10 (TEOM 2)*	Falbrook Road	30	25	13	28	175	3.6
SX13 D9 (TEOM 3)	Glennies Creek Road	30	26	12	22	166	4.7
SX13 D11 (TEOM 4)	Middle Falbrook Road	30	21	11	26	163	4.5

Monitoring Unit	Location	Development Consent Criterion (µg/m³)	EIS Prediction (MOCO Year 1)	EIS Prediction (Glendell Year 9)	2018 Annual Average (µg/m³)	2018 24 Hr Maximum Reading (µg/m³)	2018 24 Hr Minimum Reading (µg/m³)
Sx13 D1 (TEOM 5)	North of Glendell Mine	30	N/A	27	23	145	1.5
Sx13 D4 (TEOM 6)	Camberwell Village	30	28	15	29	211	3.8

** SX13 D10 is located near TSP 2 on mine owned land and is not representative of nearby private residences. Mt Owen utilise this monitor as an early warning unit to assess dust impacts and provide the mine with an early warning unit.*

Table 22: Summary HVAS TSP Monitoring Results

HVAS Site	Location	Development Consent Criterion (µg/m³)	Predicted Mt Owen Contribution EIS (MOCO Year 1)	EIS Prediction (Glendell Year 9)	2018 Annual Average (µg/m³)	2018 24 Hr Maximum Reading (µg/m³)	2018 24 Hr Minimum Reading (µg/m³)	Data Capture (%)
TSP 1	Picton	90*	N/A	46	59	149	19	100%
TSP 2	Falbrook Road	90	55	34	78	267	14	100%
TSP 3	Camberwell Church	90	69	37	80.4	194	25	100%

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

Table 21 shows that the MOCO EIS predictions for annual average PM_{10} were within 20 per cent of the 2018 measurement results. 2018 average results were below the EIS predictions for Glendell (Year 9) at SX13 D8 and SX13 D1, however they were significantly higher than EIS predictions for the other monitoring locations.

Graphs showing annual average PM_{10} concentrations compared to EIS predictions are provided in **Appendix F, Figure 6**. In contrast to the MOCO EIS, the Glendell EIS generally over-predicted PM_{10} concentrations close to the modelled mining sources but under-predicted at locations further from the modelled sources. This is a result of mining emissions being over-estimated and background levels being under-estimated, factors that were since improved in the MOCO EIS.

Table 22 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 because TSP1 is upwind of the operations. MOCO EIS predictions for annual average TSP were well below 2018 measurement results.

At TSP 2 the MOCO EIS prediction for Year 1 (55 µg/m³) was comparable to measurements in previous years however the measurement for 2018 (78 µg/m³) was around 15 per cent lower than 2017. At TSP 3 the MOCO EIS prediction for Year 1 (69 µg/m³) was lower than the measurement result in 2018 (80.4 µg/m³). This is most likely due to the drier than average conditions in 2018.

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 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 2018are provided in **Table 37, Appendix F**. **Table 38, Appendix F** shows the annual average deposited dust levels for each gauge from data collected in the past five years. The results in **Table 23** can be compared with the DA criterion of 4 grams per square metre per month (g/m²/month). Contaminated monthly samples

were excluded from the calculation of these annual averages. **Table 23** shows that no monitors have recorded readings above 4 g/m^2/month in 2018.

Table 23: Summary of Depositional Dust Air Quality Monitoring Results 2018 (g/m^2/month)

Dust Gauge Code	Location Description	DA Criterion	EIS Predicted Level		Long term Average (2003-2018)	2018	
			MOCO Year 1*	Glendell Year 9		Annual Average	Data Capture (%)
Mt Owen and Ravensworth East Depositional Dust Monitoring Locations							
DD6	East of Mt Owen	4.0	N/A	0.9	N/A	1.1	100%
DD7	Falbrook Rd South-East of Mt Owen	4.0	2.9	2.6	1.1	2.4	100%
DD12	East of Ravensworth East	4.0	3.0	2.5	1.0	2.5	100%
DD14	East of Glendell	4.0	2.8	2.8	1.1	2.3	100%
DD16	East of Ravensworth East	4.0	3.3	2.6	1.2	2.5	91%^
Glendell Depositional Dust Monitoring Locations							
DG3	Falbrook area	4.0	2.6	1.4	1.0	1.5	100%
DG4	Falbrook area	4.0	2.8	2.5	1.4	2.6	100%
DG5	Camberwell area	4.0	N/A	2.3	1.1	2.4	100%
DG6	Camberwell area	4.0	2.9	1.9	1.3	2.5	100%
DG7	Camberwell area	4.0	2.8	2.6	1.8	2.5	100%
DG8	Camberwell area	4.0	N/A	3.6	1.2	3.2	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.

^ Monitoring was undertaken in February 2018 at DD16 however no result is available due to a laboratory error whereby the gauge was misplaced.

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 1 (approximately 2016) and Glendell EIS predictions for Year 9 (approximately 2016) have been extracted for the comparison. At some locations no predictions were available in the respective EIS.

Table 23 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.

For 2018, the depositional dust records were within MOCO EIS predictions for Year 1. On average, across all monitors, the MOCO predictions were in the order of 25 per cent 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 in the order of 150 per cent of the measurement results for 2018. The MOCO EIS adopted higher background levels which improved the correlation between measured and predicted deposition levels.

Summary

2018 was a drier than average year which appears to have adversely influenced air quality conditions.

Each of the PM_{10} monitoring locations recorded at least one day above the 50 µg/m^3 criterion in 2018. On 24 July 2018, the site contribution to 24-hour average PM_{10} concentrations was calculated to exceed the 50 µg/m^3 criterion (refer to **Section 11** for further details). Annual average PM_{10} concentrations in 2018 did not exceed the 30 µg/m^3 DA criterion at any of the monitoring locations.

Annual average TSP concentrations in 2018 did not exceed the 90 µg/m^3 DA criterion.

Annual average dust deposition in 2018 did not exceed the 30 µg/m^3 DA criterion at any of the monitoring locations.

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 2018.

Glendell EIS predictions of air quality in the vicinity of MOC were generally lower than the measurement data. This was mainly a result of assumed background levels which were too low, a factor which was since addressed in the MOCO EIS.

6.3.4 Haul Road Emissions Monitoring

Haul road emission monitoring was undertaken by Jacobs on 9 November 2018. Haul road dust control efficiency was determined by comparing emissions from controlled and uncontrolled roads at MOC. Monitoring locations for both controlled and uncontrolled road section were selected using the following criteria:

- A section of road that is representative of the conditions and traffic typical of the operation.
- Orientated so that a monitor located on the side of the road is perpendicular to the forecast prevailing winds.
- In a location that is not likely to generate unsafe conditions for operators should visible dust occur.

Additionally, the uncontrolled section required preparation using the following criteria:

- 100 – 200m section of road left unwatered for at least 12 hours prior to monitoring, and for the duration of the monitoring.

The control efficiency was calculated as:

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

Where CE = Control efficiency and E = Emission rate of activity

Average PM10 concentrations measured during the monitoring period and the calculated dust control efficiency for each location are presented in **Table 24**.

Table 24: Measured PM_{10} concentrations and calculated dust control efficiency at each location

Location	Watering regime	Monitoring period	Average PM_{10} concentration ($\mu S/m^3$)	Dust control efficiency
Barrett Pit	Controlled	8:10am-3:20pm	12.27	98%
Bayswater North Pit	Controlled	8:40am-3:40pm	8.16	99%
North Pit	Controlled	10:00am-2:50pm	44.58	92%
	Uncontrolled	10:00am-2:50pm	585.34	

MOC's overall dust control efficiency target is 85%. The control efficiency achieved by watering at MOC was measured above the target control efficiency of 85% at all three locations.

A copy of the Haul Road Emissions Monitoring Report is included in **Appendix F.**

6.2.3 Continuous Improvement

As a part of the ongoing commitment to the management of dust impacts from the MOC, a range of activities have been undertaken during 2018 that fall within the continuous improvement program. The most important being:

- Approval of updated Air Quality Management Plan by DP&E
- Modifications and improvement of real-time monitoring network
- 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.

A number of activities to be undertaken in 2019 include:

- Installation of two real time dust cameras, at Falbrook and Barrett Pit, to help manage visual dust impacts from Mt Owen and Glendell Operations.
- Continuous assessment and improvement of the real-time monitoring network and management alarms
- Review and simplification of dust alarm response
- Acquisition of refurbished TEOM unit from USA to be used as part replacement for old units

6.4 Greenhouse Gas

Energy consumption at MOC is monitored and reported in accordance with Glencore requirements and with the reporting requirements of the National Greenhouse & Energy Reporting (NGER) system. In 2018, the total emissions produced by Glendell were estimated to be 126,265 t CO2-e, compared to 129,015 t CO2-e in 2017. Total emissions produced by Mt Owen in 2018 were estimated to be 198,113.3 t CO2-e, compared with 184,231 t CO2-e in 2017. A summary of greenhouse gas emissions for 2018 is provided in **Table 25**.

Table 25: Greenhouse Gas Emissions at the Mt Owen Complex 2018

Emission Source	Glendell (t CO2-e)	Mt Owen (t CO2-e)
Scope 1 Emissions		
Diesel	102,620	125,634
Petrol/ Gasoline	6	9
Liquid Petroleum Gas	0	0.3

Fugitive emissions	21,864	29,997
Scope 2 Emissions		
Electricity	1,775	42,473
Total Emissions	**126,265**	**198,113.3**

6.5 Biodiversity and Land Management

A Biodiversity Offset Management Plan (BOMP) for MOC forms part of the MOC 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 MOC are based on land management principles, such as:

- 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.

6.5.1 Biodiversity Offset Areas

MOC is required to secure a number of Biodiversity Offset Areas (BOAs) in accordance with conditions of DA SSD-5850 and DA 80/952. Details of these BOAs are provided in **Table 26**. The locations of these BOAs are provided in **Figure 9** and **Figure 10** (with the exception of the Rehabilitation Woodland Offset, whose location has not yet been determined).

Table 26: Biodiversity Offset Areas

Offset Area	Offset Type	Size (ha)
DA 80/952		
Bettys Creek Habitat Management Area (HMA) incorporating: - Bettys Creek (Enex Foydell) - Bettys Creek (Glendell))*	Central Hunter Grey Box – Ironbark Woodland	174.0
	Central Hunter Bulloak Regeneration	
	Central Hunter Swamp Oak Forest	
	Derived Native Grassland	
DA SSD-5850		
Northwest Offset*	Central Hunter Ironbark – Spotted Gum – Grey Box	71.4
	Barrington Footslopes Dry Spotted Gum Forest	
	Derived Native Grassland	
Northeast Offset*	Barrington Footslopes Dry Spotted Gum Forest	83.6
	Dry Rainforest	
	Derived Native Grassland	
Southeast Offset*	Central Hunter Ironbark-Spotted Gum-Grey Box Forest (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*	Central Hunter Ironbark – Spotted Gum – Grey Box Forest (including planted variant)	74.1
	Derived Native Grassland	

Offset Area	Offset Type	Size (ha)
	Central Hunter Swamp Oak Forest	
Forest East Offset*	Central Hunter Ironbark – Spotted Gum – Grey Box Forest (including planted variant)	110.9
	Derived Native Grassland	
	Barrington Footslopes Dry Spotted Gum Forest	
Southern Remnant Offset*	Central Hunter Ironbark – Spotted Gum – Grey Box Forest (including planted variant)	4.0
Cross Creek Offset Site	Central Hunter Ironbark – Spotted Gum – Grey Box Forest (including red gum variant)	367.0
	Derived Native Grassland	
Stringybark Habitat Corridor Offset Site	Central Hunter Ironbark – Spotted Gum – Grey Box Forest	97.5
	Drainage Flat Red Gum Woodland	
	Dry Rainforest	
	Central Hunter Swamp Oak Forest	
	Derived Native Grassland	
	African Olive Infestation	
Esperanga Offset Site	Upper Hunter White Box - Ironbark Grassy Woodland	303.0
	Spotted Gum Open Forest Complex on Sandstone	
	Shrubby White Box Woodland	
	Red Gum Open Forest on Alluvium/Colluvium	
	Narrabeen Sheltered Dry Forest	
	Narrabeen Ironbark Woodland	
	Derived Native Grassland	
Mitchell Hills North Offset Site	Barrington Footslopes Dry Spotted Gum Forest	144.0
	Lower Hunter Dry Rainforest	
	Upper Hunter Hills Sheltered Moist Forest	
	Derived Native Grassland	
Rehabilitation Woodland	Central Hunter Ironbark – Spotted Gum – Grey Box Forest	518.0

* These offsets are in the process of being secured by way of Conservation Agreements (CAs) in consultation with the Office of Environment and Heritage (OEH) and the Biodiversity Conservation Trust (BCT) and as administered by the Minister administering the *National Parks and Wildlife Act 1974* (NPW Act).

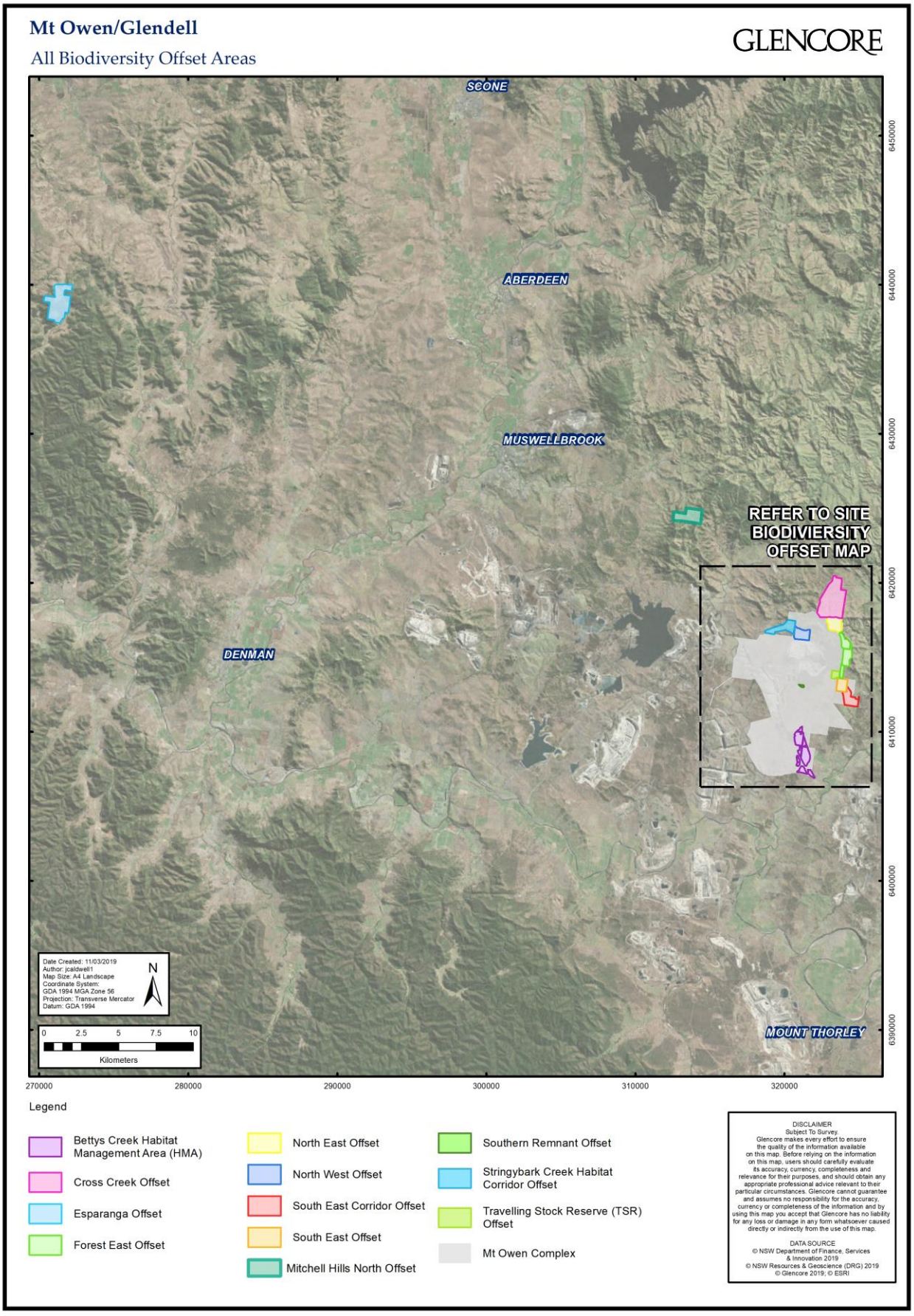


Figure 9: MOC Biodiversity Offset Areas

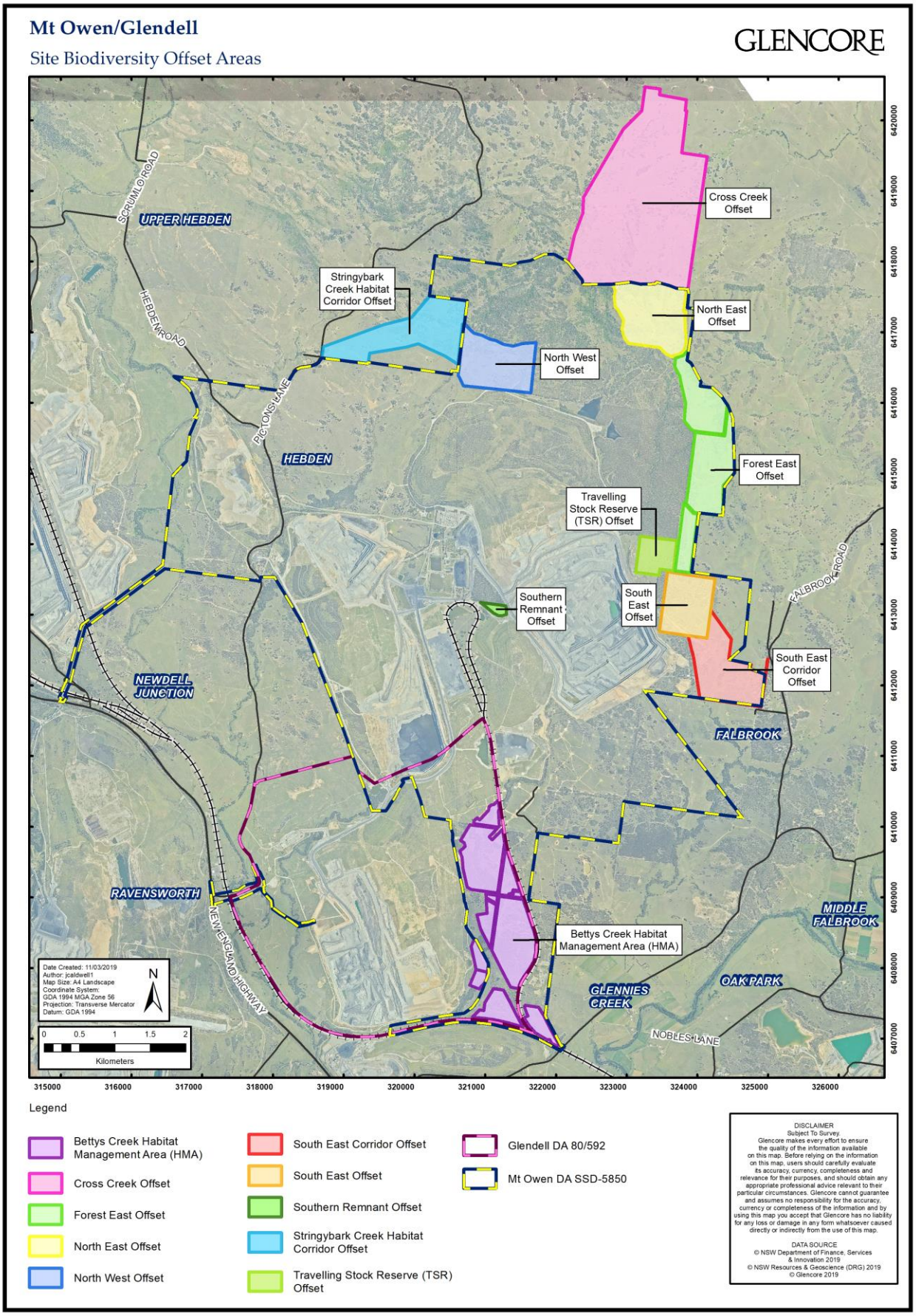


Figure 10: Mt Owen Complex Site Biodiversity Offset Areas - Detail

Conservation Agreement Monitoring

As specified within Annexure D of the Conservation Agreement (CAs), annual monitoring of each Conservation Area is required, with 2018 being the first year of operation of the CAs. Monitoring methods for 2018 were consistent with Annexure D of each CA and included:

- photo monitoring for comparison to baseline photos (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 on **Figure 11**.

Table 27: Conservation Agreement Monitoring Locations - 2018

Site Name	PCT	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
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 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

Site Name	PCT	Monitoring Type
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
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

* The CA naming conventions differ slightly from the BOAs (due to ownership/cadastral issues) in the following ways:

- Bettys Creek Habitat Management Area BOA is split into the Bettys Creek (Enex Foydell) and Bettys Creek (Glendell) CAs; and
- Northeast Offset, Southeast Offset, Southeast Corridor and Forest East Offset are amalgamated into the collective Mount Owen Offsets CA.

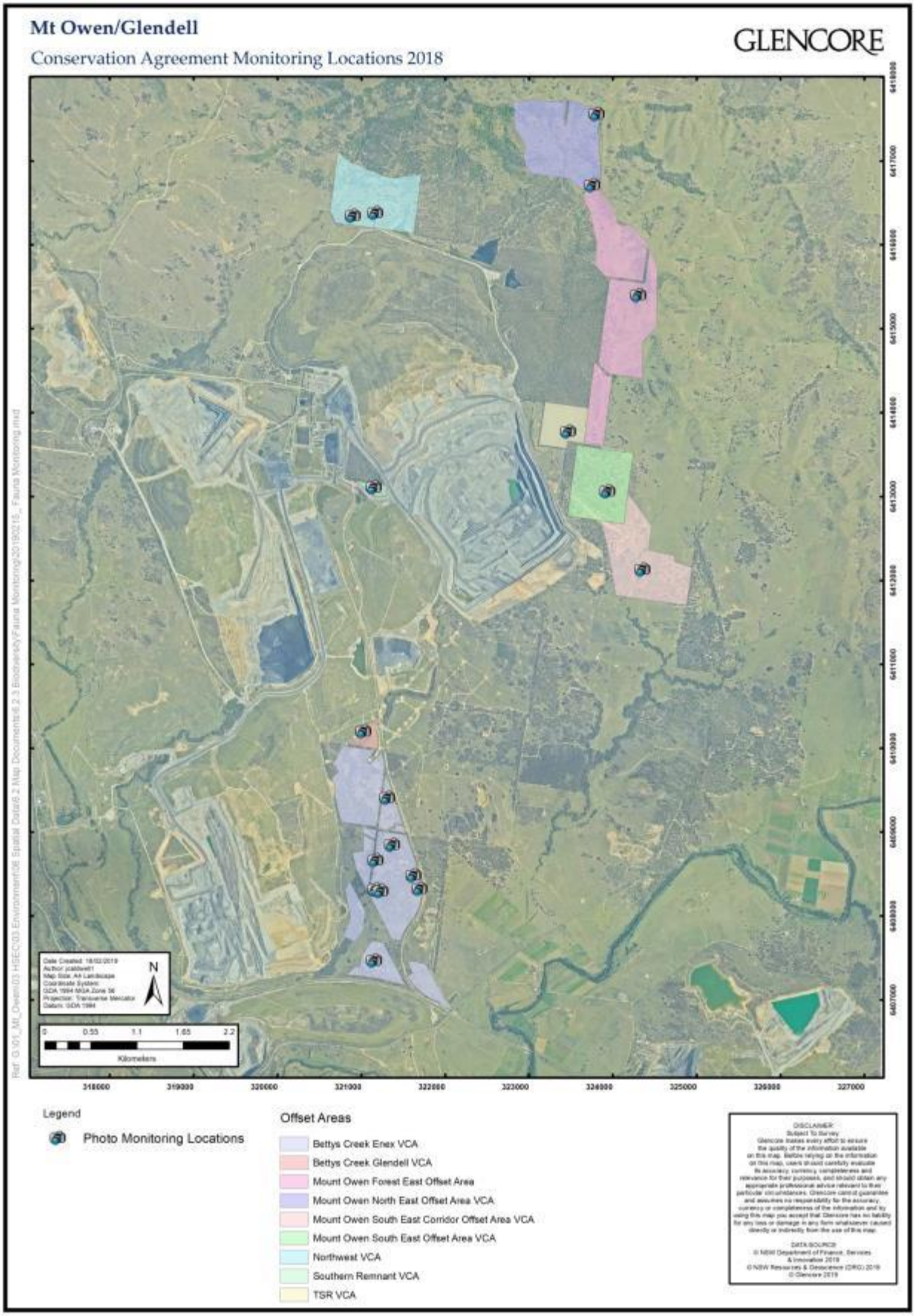


Figure 11: Conservation Agreement Monitoring Locations 2018

Conservation Agreement Performance

Table 28 summarises biodiversity management performance in the BOAs for 2018 and includes required management actions for 2019.

Table 28: Biodiversity Management Summary – Offset Areas

BOA	Management actions completed in last 12 months	Key Trends	Actions for 2019
Bettys Creek (Enex Foydell)	• Offset seed collection program • Weed control • Vertebrate pest control • Biannual inspections • Remote camera monitoring for unauthorised access • Nest box installations • Installation of Offset Security Signage • Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) • Annual monitoring report	• From baseline to 2018 there was an overall decline in native species richness (in 5 of 8 sites) – likely due to drought. • Overall decrease in percent foliage cover of groundcover (natives and exotics) • Overstorey percent foliage cover remained similar in grassland sites. Other sites underwent either an increase or decrease dependent on whether they were dominated by Myrtaceae (Eucalypts) (decrease) or Casuarinaceae (increase) • Exotic vegetation remained similar to baseline monitoring (approx. 40%) • Invasion of exotic grass (Coolatai) • Threatened grey-crowned babbler continues to be recorded • No substantial changes were observed between the baseline and the 2018 photo monitoring. Visible changes related to decreases in height and cover of groundcover, as well as increases in height of regenerating vegetation	• Weed Control • Pest Control • Fencing • Supplementary planting
Bettys Creek (Glendell)		• Condition of vegetation consistent with previous monitoring • Grass stratum dominates. Exotic species remain common (although at low densities) • Natural recruitment of canopy species is yet to commence in this area • Evidence of rabbits was recorded throughout CA – low densities • No substantial changes were observed between the baseline and the 2018 photo monitoring	
South East Offset **Forest East Offset** **South East Corridor Offset** **North East Offset**	• Offset seed collection program • Weed control • Vertebrate pest control • Biannual inspections • Remote camera monitoring for unauthorised access • Nest box installations • Installation of Offset Security Signage • Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) • Annual monitoring report	• From baseline to 2018 there was an overall decline in native species richness (in 2 of 3 sites) – likely due to drought. • Overall decrease in percent foliage cover of groundcover (native grasses) • Overstorey vegetation cover decreased slightly as did grassy groundcover, likely due to drought. • Mid-storey vegetation cover increased throughout the CA. Shrub groundcover increased at the regeneration monitoring site (P02) - no change in remnant monitoring locations. • An increase in Groundcover – Other vegetation was also observed across the CA, which is likely a result of the decrease in grassy groundcover • Natural regeneration continues to occur • Exotic vegetation cover increased across the CA • No substantial changes were observed between the baseline and the 2018 photo monitoring	• Weed Control • Pest Control • Supplementary planting • Fencing Southern Remnant Offset (Stock control)
North West Offset	• Offset seed collection program • Weed control • Vertebrate pest control • Biannual inspections	• From 2017 to 2018, native species richness declined, however remains similar to benchmark values for the PCT. • Overstorey and midstorey vegetation cover increased and both are approaching benchmark value parameters. Groundcovers showed a decline in cover, which is likely due to a poor growth year (minimal rainfall) in the region. Shrub groundcover remained similar.	• Weed Control

BOA	Management actions completed in last 12 months	Key Trends	Actions for 2019
	• Remote camera monitoring for unauthorised access • Nest box installations • Installation of Offset Security Signage • Biodiversity monitoring (photo, quadrat, walkthrough, opportunistic threatened species observations) • Annual monitoring report	• Exotic vegetation cover increased across the CA. • No substantial changes were observed between the baseline and the 2018 photo monitoring. The only visible change observed related to decreases in the height and cover of groundcover vegetation.	
Southern Remnant Offset	• Offset seed collection program • 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	• Condition of vegetation consistent with previous monitoring • A relatively dense canopy is present. Midstorey is sparse. Groundcover is dominated by grasses. • Exotic vegetation cover was approx. 10%. Narrow-leaved cotton bush was recorded in high densities near the access road • Evidence of rabbits was recorded throughout CA – low densities • No substantial changes were observed between the baseline and the 2018 photo monitoring	• Weed Control • Pest Control
Travelling Stock Reserve (TSR) Offset	• Weed control • Vertebrate pest control	• Remnant vegetation in good condition • Several weed species were identified • Natural recruitment occurring despite hot, dry conditions • Habitat features present at appropriate levels	• Weed Control • Pest Control
Cross Creek Offset Site	• Weed control • Vertebrate pest control	• Remnant Vegetation in good condition • Diversity of threatened species similar to baseline • No passive regeneration in areas of Derived Native Grassland	• Removal of Grazing • Weed Control • Pest Control • Supplementary planting
Stringybark Habitat Corridor Offset Site	• Weed control • Vertebrate pest control	• Remnant vegetation in moderate condition • Extensive population of African Olive • Compatibility of regeneration among Derived Native Grassland with remnant vegetation is low • High fauna diversity consistent with complex habitat features • High diversity of introduced fauna predators • Low levels of threatened species, similar to baseline	• Weed Control • Pest Control • Supplementary planting
Esperanga Offset Site	• Weed control • Vertebrate pest control	• Remnant vegetation in good condition • High diversity of introduced fauna species	• Weed Control

BOA	Management actions completed in last 12 months	Key Trends	Actions for 2019
		• Compatible vegetation regeneration • High fauna species diversity • Diversity of threatened species similar to baseline	• Pest Control
Mitchell Hills North Offset Site	• Weed control • Vertebrate pest control	• Remnant vegetation in good condition • Compatibility of regeneration with remnant vegetation generally low • High fauna diversity consistent with complex habitat features • Low introduced fauna species diversity • Diversity of threatened species higher than baseline	• Removal of Grazing • Weed Control • Pest Control

Rehabilitation Woodland Offset

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

Details of the rehabilitation to be undertaken in the Rehabilitation Woodland Offset Area are included in the MOP.

During 2018 weed management continued throughout the North Pit rehabilitation area as per the findings of Flora and soil monitoring completed by CSER. Strategic planting of understorey EEC planting was delayed due to drought conditions in which planting is planned for 2019. Monitoring of planting effectiveness will continue in 2019 as well as associated maintenance activities.

6.5.2 Fauna Monitoring

In 2017 the fauna monitoring program at MOC was modified to account for the requirements for fauna surveys to be conducted in several new biodiversity offset areas. Consequently, the fauna monitoring schedule for surveys in 2018 was brought forward in 2017, to account for both the new biodiversity offsets and the Mt Owen Complex.

Therefore, in 2018, no comprehensive fauna monitoring surveys at the nine sites were conducted within the MOC. Rather, the works in 2018 comprised:

- an initial frog survey in February 2018 for the endangered Green & Golden Bell Frog
- specific threatened fauna species surveys (winter bird census for Swift Parrot, Regent Honeyeater)
- habitat improvement works
- ongoing assessment of clearing operations in the C-Pit.

In 2018 the weather remained very dry with below average rainfall recorded (405mm compared to the 2002-2018 average of 649mm) (BOM data, 2018). Those rainfall events that occurred comprised limited rainfall totals (generally less than 30-40mm) with extended periods of dry

weather following. The majority of water bodies that are monitored for frogs at MOC were completely dry, and had been since mid-to-late 2017. Following an initial survey in February 2018, in which very limited frog activity or calling behaviour was recorded, it was decided that no further monitoring surveys be conducted until sufficient rainfall restored habitat quality. For the remainder of 2018, that rainfall failed to eventuate, and the majority of monitoring ponds remained dry.

In 2018, despite most of the works targeting habitat restoration, one new species was detected in the Glendell Rehabilitation area, the Banded Lapwing (see **Figure 12**(a)). This species is typically associated with drier inland habitats, however, many observations of this species were recorded in the Hunter Valley in 2018. Large flocks of Musk lorikeet foraged in the canopy of eucalypt and angophora trees in 2018, including in the MOC South-East Biodiversity Offset area (see **Figure 12** (b)). The cumulative total of native bird species since 1996 at MOC is 171. This figure includes the Rainbow Bee-eater, found in the MOC Stringybark Creek BOA (see **Figure 12** (c)), and Red-browed finch, found in MOC South-east biodiversity offset area (see **Figure 12** (d)).

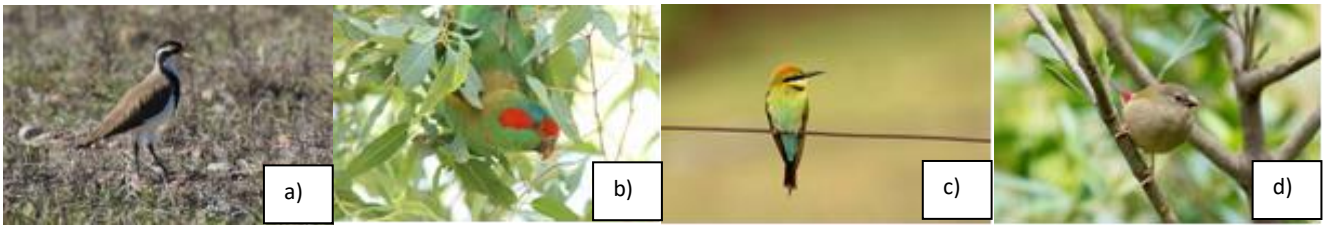


Figure 12: Birds observed at the Mt Owen Complex in 2018

The nationally threatened Swift Parrot and Regent Honeyeater were not sighted at MOC in 2018. The Swift Parrot was previously recorded in 2005, 2007 and 2014. Since monitoring began in 1995, the Regent Honeyeater has never been recorded within the MOC. Four threatened fauna species were detected in 2018; the White-bellied Sea Eagle, Speckled Warbler, Grey-crowned Babbler and Dusky Woodswallow. These species were recorded from opportunistic observations whilst conducting other duties. All four species have been recorded in previous monitoring years at the MOC.

A total of 101 nest boxes were installed at a number of locations within the Mt Owen Complex in 2018 (**Figure 13**), including the rehabilitation areas in both Glendell (20 boxes) and Mt Owen (30 boxes), and biodiversity offset areas (51 boxes).

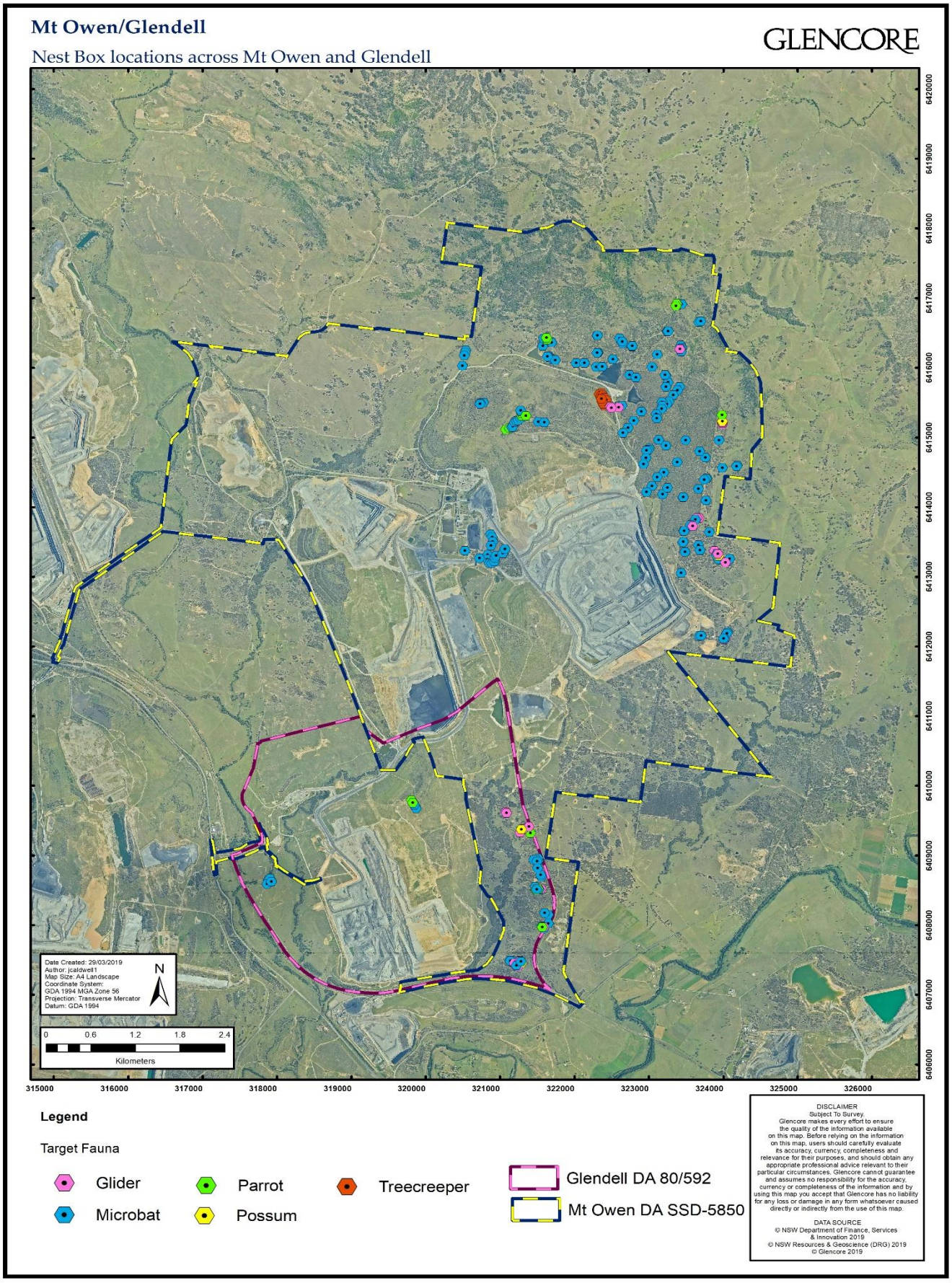


Figure 13: Nest box locations within the Mt Owen Complex - 2018

In addition, a number of nest boxes installed in the Pit C Strip 10 area were relocated to offset areas due to clearing of forest for expansion of Pit C. Boxes were either installed on trees (biodiversity offsets) or poles (rehabilitation) at a height of 3.5m above ground (**Figure 14**).

Figure 14: Nest boxes installed within the Mt Owen Complex in 2018

The BOMP (2018) details specific habitat creation for Spotted-tail Quolls in the Stringybark Creek Biodiversity Offset. In 2018, an assessment of this offset area identified both the type of habitat creation to be installed, as well as potential installation locations. Several potential sites were identified both along Stringybark Creek itself, and also other parts of the offset. However, potential locations along Stringybark Creek are problematic due to access issues for machinery. Parts of the creek line are narrow in width, limiting the area in which these structures could be implemented. Recommended habitat creations include either rock piles and or ground logs of sufficient height and width to create crevices of sufficient size and depth to accommodate the quolls.

The Performance Indicators and Completion Criteria outlined in Table D.1 - Appendix D of the approved BOMP that were achieved in 2018 (Year 2) is summarised below in Table 29.

Table 29: Short Term Performance Indicators (Year 2), BOMP - Mt Owen Complex, 2018

Short Term Performance Indicators	Actions performed in 2018	2018 Fauna Monitoring Report
Minimise Impacts on Biodiversity		
Pre-clearance surveys and tree felling supervision	Pit C Strip C_10	Appendix 4
Salvage of biodiversity features	Identified on preclearing surveys	Appendix 4
Habitat Enhancement		
Salvaged resources and nest boxes are re-instated into surrounding areas with low levels of habitat features	Nest box installation in Offsets	Appendix 2
Nest boxes and habitat features are providing habitat value for native fauna	Nest box inspections	Appendix 2
Biodiversity Monitoring	Summer frog and winter birds	Section 3.0 – Results
Reporting		
Collate data on actions implemented and results of inspections and monitoring into the AR	Throughout AR	-

6.5.3 Threatened Fauna

The MOC carries out seasonal fauna monitoring across site rehabilitation areas and onsite biodiversity offset areas. This includes monitoring of birds, reptiles, mammals and frogs. Table 30 describes the threatened species observed since 1996 at the MOC.

Table 30: Threatened species observed at MOC 1996 - 2018

Common Name	EPBC	BC Act	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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	√*																						

Common Name	EPBC	BC Act	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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

6.5.4 Compensatory Planting

In 2016/2017 MOC cleared 198 River Oak trees to make way for the realignment of the 132kV Ausgrid transmission line and installation of a tailings line from Ravensworth Operations to MOC's West Pit storage facility. Compensatory planting was undertaken in accordance with the conditions of DA 80/952 (Modification 3) and SSD 5850. Approximately 2000 River Oak trees were planted in and around the Bowmans Creek riparian corridor. A number of solar powered electric fences were also installed to protect plantings from grazing.

In December 2018, the progress of the River Oak tree planting was observed and noted. It was found that less than 10 percent of River Oaks planted as compensatory revegetation in the Bowman creek area continue to survive. As a result further tree planting and subsequent monitoring is required.

During the next reporting period 2000 River Oak trees will be planted in two locations along Bowmans creek, using direct seeding methods. These areas will be fenced and monitored to ensure seeded areas are adequately protected.

6.5.5 Active Revegetation

As per 2018 BOMP, MOC carried out active revegetation on the South East Corridor offset. A total of 8ha (7000 tubes) were planted with the vegetation community HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter. **Table 31** below shows the species planted. A photo showing the planting area is included in **Figure 15**.

Table 31: South East Corridor Offset Active Revegetation Program – Species Planted in 2018

Species	Number of tubes planted
Eucalyptus fibrosa	1000
Corymbia maculata	340
Acacia amblygona	140
Acacia implexa	1680
Acacia decora	280
Acacia parvipinnula	180
Eucalyptus crebra	1060
Acacia decurrens	640
Eucalyptus tereticornis	1000
Melaleuca nodosa	200
Dodonaea viscosa	400
Acacia paradoxa	80
Total	**7000**

Figure 15: Drone View of the South East Corridor Offset Planting (2018)

Another 7000 tubes are scheduled to be planted in April/May 2019, in association with habitat augmentation following salvage works associated with clearance activities.

6.5.6 Habitat Clearing

Habitat clearing in 2018 was conducted in the Pit C Strip 10 area, whereby approximately 43.9 hectares of remnant forest and replanted areas was cleared. Several fauna species and habitat features (habitat trees with hollows, ground logs and rocks, Grey-crowned Babbler nest) were removed from the clearing area and relocated to nearby remnant forest / rehabilitation areas. Habitat features for four threatened species were relocated in 2018:

- nest boxes containing Squirrel Gliders (three individuals)
- one box containing nesting structure of Brush-tailed Phascogale
- one box containing Eastern Freetail Bats (six individuals)
- 15 disused nests of the Grey-crowned Babbler.

All the structures were removed from the clearing area and located in adjoining remnant forest or biodiversity offsets.

Two fauna species were recovered from tree felling operations in the Pit C Strip_10 clearing area in 2018:

- Common Brushtail Possums (5 individuals)
- Lace Monitors (4 individuals).

All nine individuals appeared in good condition and left in-situ in the tree hollows. Each habitat tree was left for 2-3 days for the individual animals to abandon prior to removal from the clearing area.

6.5.7 Weed Management

A Weed Action Plan was developed to identify all targeted weed control activities at the MOC. The plan was implemented during the 2018 reporting period. A number of environmental weed species have been identified at the MOC. Active programs of control have been implemented since 1996. Throughout the MOC rehabilitated areas, weeds targeted during 2018 included:

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

Weeds were also sprayed in isolated stands across the MOC buffer land and offset areas, including:

- African Boxthorn - *Lycium ferocissimum*
- African Olive - *Olea europaea subsp. Cuspidate*
- 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*

Table 32 summarises weed management works undertaken at MOC during 2018.

Table 32: Mt Owen Complex Weed Works Completed in 2018

Offset	Area (ha)	Weed Control Applied to Area	Weeds Targeted
Bettys Creek HMA	10.1	Foliar Spray and Cut & Paint	Creeping Pear, Galenia, Coolatai Grass, African Boxthorn, Scotch Thistle, Purpletop
South East Corridor	2	Foliar Spray and Cut & Paint	Creeping Pear, Lantana, Sweet Briar, African Boxthorn, African Olive
North East TSR	12.5		
Forest East	45.5		
Cross Creek	77	Foliar Spray	Coolatai Grass, Sweet Briar, Blackberry, Prickly Pear, Wild Cotton, Silver Nightshade
Esperanga Offset	42	Foliar Spray	Pear, Sweet Briar, Thistles
Stringybark Creek Habitat Corridor	8	Basal Bark & Foliar Spray	African Olive, Creeping Pear & St John's Wart
North West	11		

6.5.8 Feral Animals

In 2018, targeted wild dog and fox baiting programs were conducted across the MOC during Autumn (May) and Spring (October). Trained personnel placed '1080' poison baits, and ejector baits around Glendell, Mt Owen and Mt Owen CHPP areas. Results of the 2018 baiting program are summarised in **Table 33**. The aerial baiting area for Mitchell Hills Offset area is shown in **Figure 16**.

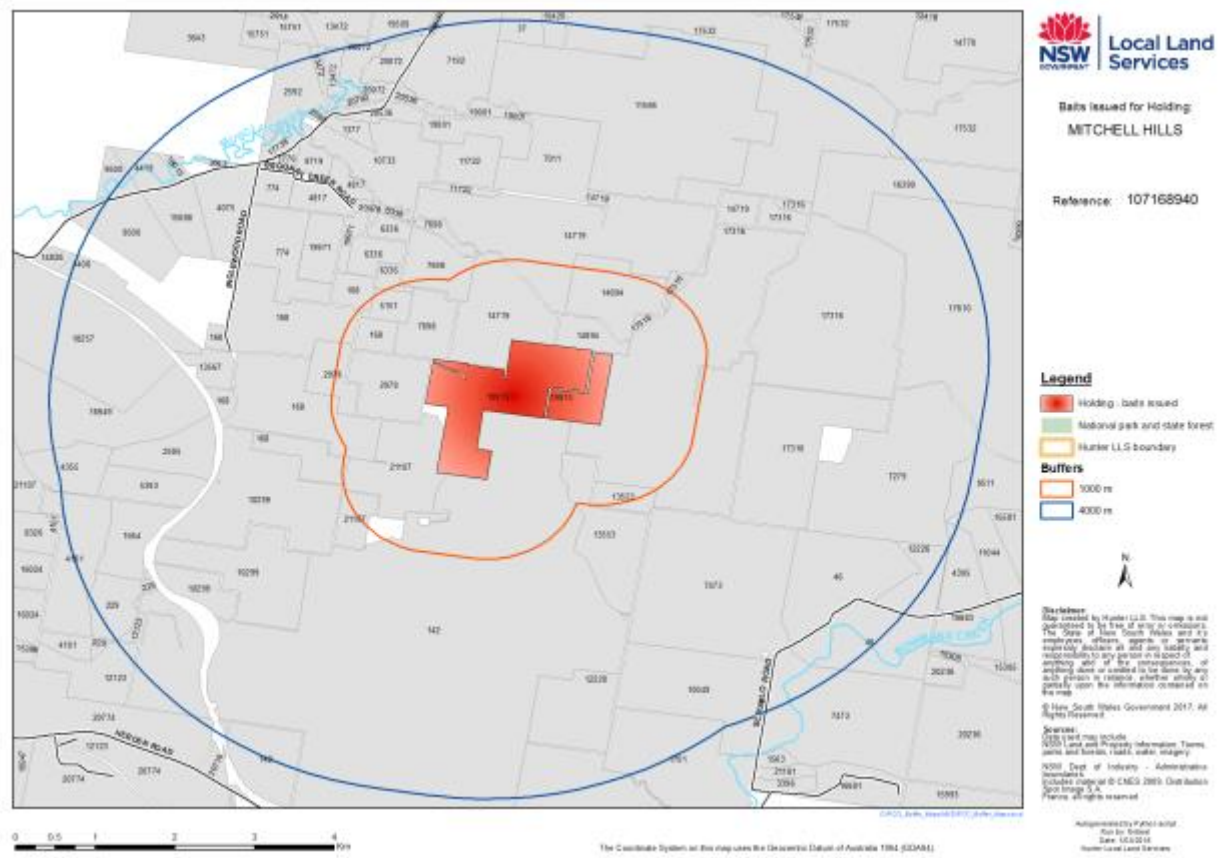


Figure 16: Aerial Baiting Program – 2018 Baiting Area - Mitchell Hills Offset

Table 33: Wild Dog and Fox Baiting Program –2018 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	96	285	66 (26 Wild Dogs & 40 Foxes)	23%
Spring	93	288	54 (28 Wild Dogs & 26 Foxes)	19%
Ejector Baiting Program				
Autumn	4	12	1 (Fox)	8%
Spring	3	9	2 (Fox)	22%

During 2018, 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.

A number of firearm culls were undertaken during 2018 across buffer lands. This resulted in the culling of:

- 274 kangaroos
- 30 pigs
- 6 piglets
- 3 wild dogs.

Figure 17: Images captured during spring baiting program

During the reporting period MOC also implemented a Vertebrate Pest Monitoring Program in MOC's offset areas using permanent motion detection cameras. Data from the camera monitoring program is reviewed against CSIRO guidelines to give a pest rating for the site. This information is used by MOC to help identify appropriate weed and pest control requirements for specific offset areas.

During 2018 the cameras detected a range of pests in the offset areas, including deer, pigs, foxes and humans (unauthorised access by motorbike riders). The cameras also detected native fauna, with Tiger Quolls photographed on the camera at Mitchells Hills and Cross Creek offset areas. **Figure 18** shows some of the images captured during the monitoring program.

Figure 18: Images captured on Permanent Motion Cameras in Offset Areas during 2018

6.6 Heritage

6.6.1 Aboriginal Heritage

MOC 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 operations disturbance boundaries. These areas retain Aboriginal and archaeological values that require management, despite being salvaged.

MOC utilises ground disturbance permits (GDPs) to prevent damage to known valid Aboriginal sites. These areas have been cleared under a 'Section 90' permit. Alternatively, a due diligence assessment is conducted, and any necessary controls implemented. This is completed prior to authorisation of ground disturbance work.

Meetings between MOC and the Aboriginal community were held in April at MOC and December at the Bulga Keeping and Teaching Place. The Aboriginal Cultural Heritage Working Group (ACHWG) representatives discussed the greater involvement of the Aboriginal communities 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 2019

2018 Monitoring Program

In 2018 MOC, in conjunction with two RAPs and an OzArk archaeologist, continued the monitoring of Aboriginal heritage sites across both MOC and Integra Underground. 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.

MOC monitored all four quadrants during 2018 with over 50 artefact sites visited. Artefacts were found to be well-preserved with minimal management recommendations required.

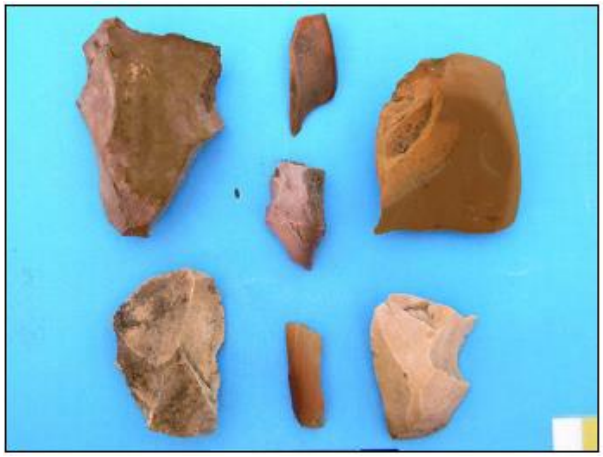


Figure 19: Artefacts location during quarterly monitoring program

Salvages During 2018

During 2018, three sites were salvaged under permit, and in accordance with the ACHMP. This was to allow for mining under DA 80/952. Artefacts salvaged are under the care of MOC and will be housed in the storage facility at the Wollombi Brook Conservation Agreement Area in the future.

6.6.2 European Heritage

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

MOC has committed to several historical heritage management initiatives. They include:

- use of a qualified heritage consultant to undertake archival recording of sites identified within MOC
- installation of fencing to protect remaining sites from damage

During the reporting period MOC continued to care for Ravensworth Homestead and undertook maintenance of the Ravensworth Public School. Archival recording of the Ravensworth Public School was also conducted in response to the Hebden Road Upgrade. No changes were noted.

Figure 20: Archival recording April 2017 and August 2018 Ravensworth Public School

Salvages During 2018

No salvages were undertaken in 2018.

6.7 Visual Amenity

In October 2017, Hansen-Bailey undertook a lighting and visual amenity compliance review of Glendell Mine. The review reported that MOC were generally compliant with commitments made within the Glendell EA and MOCO EIS. No major non-compliances were identified. It was noted in the report that a small number of lighting plant require further consideration of placement prior to being used. MOC reviewed and updated the Lighting Plants Procedure during the reporting period to reflect considerations.

During the reporting period dilapidated buildings were also removed from a property at 144 Picton Lane to improve visual amenity in the area.

6.8 Demolition Works

During the reporting period the dilapidated former property at 144 Picton Lane was dismantled and disposed of to improve local visual amenity and farming land. Demolition commenced on 16 July and was completed with the seeding of Pictons Lane on 31 July 2018. **Figure 21** shows before and after photos of the demolition. Approximately 48 tonnes of waste was removed from the site including 8 tonnes of mixed waste, 27 tonnes of concrete waste, 12 tonnes of timber and 0.82 tonnes of asbestos material.

Asbestos removal work was undertaken by a licensed asbestos removal contractor – TMT Industries - 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 (Environmental and Safety Professionals) was engaged to undertake a visual inspection of the site to confirm the removal of the asbestos. This inspection was undertaken on 24 September 2018 and ESP confirmed that the potential risk to human health is extremely low.

Figure 22: Demolition of dilapidated former property at 144 Picton Lane – before and after

7 Water Management

MOC operates under a suite of water management plans, all of which were approved in October 2017 and November 2018. These include:

- Water Management Plan (Overarching) (Nov 2018)
- Surface Water Management and Monitoring Plan (SWMMP) (Oct 2017)
- Groundwater Management and Monitoring Plan (GWMMP) (Oct 2017)
- Erosion and Sediment Control Plan (Nov 2018)
- Creek Diversions Plan (Nov 2018)
- Surface Water and Groundwater Response Plan (SWGWRP) (Oct 2017)

In 2018 MOC engaged HEC to undertake a review and assessment of performance criteria associated with surface water and groundwater monitoring at MOC. Recommendations from this review included:

- Recording a field observation during surface water monitoring in creeks of whether there is flow or no flow
- Revising the water quality trigger values for Bowmans Creek (pH - upper) (to the 80th percentile, averaged over the five monitoring sites) and Yorks Creek (EC), (to the 80th percentile of all historical data for all three Yorks Creek sites).
- Further investigation into exceedances in 2017 at Swamp Creek (pH and EC), Bowmans Creek (EC) and Yorks Creek (EC)
- Revising the groundwater drawdown triggers in NPZ12a, GNP5 (Hebden), GNP6 (Middle Liddell) and SM0028 (LCF and LBA/LBB) (to historical average plus one standard deviation)
- Revising the groundwater quality trigger values for NPZ11a and NPZ12a (pH – upper trigger) and BC-SP08, NPZ1, NPZ4, NPZ4a, NPZ104, NPZ101 and NPZ106 (EC) to the 80th percentile of all recorded data
- Further investigation into NPZ7, NPZ8 and NPZ12a (EC) historical data

MTO have engaged SLR Consultants to undertake a further review of the groundwater level and quality trigger exceedances for the 16 bores mentioned above. This review includes a preliminary desktop review of available data for each bore and recommendations for further work, as required.

The SWMMP, GWMMP and SWGWRP were all reviewed during 2018, in consultation with relevant government agencies. Surface water and groundwater quality triggers and groundwater drawdown triggers were revised as part of this review, in line with the recommendations from the HEC review mentioned above. MTO will seek approval for the revised water management plans in 2019.

Mining related water licensing and relevant pumped volumes at the MOC are outlined in **Table 34**. 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 2017 to 30th June 2018).

Table 34: 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/ 2017 – 30/6/2018
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.	240
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
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.	3,598
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

Water Licence Number	Water sharing plan, source and management zone (as applicable)	Licence Activity/ Entitlement	Description	Water take (ML) 1/7/ 2017 – 30/6/2018
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
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 MOC operates a water management system designed to ensure the efficient operation of the MOC through control of water inflow and the ready provision for onsite demands. **Appendix G, Figure 7** details the water flow path throughout the complex. In average to dry rainfall periods, the MOC 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 2018 MOC water and salt balance is included in **Table 35.**

Table 35: MOC Water and Salt Balance for 2017-2018

	Water Flux (ML)		Salt Flux (T)	
	2017	2018	2017	2018
Inflows to MOC				
Rainfall / Runoff (estimated)	921	1,044	1,016	1,042
Drawn from Glennies Creek (Mt Owen Only)	119	240	33	68
Pumped from Other Sites	1,220	995	3,949	3,368
Entrainment	816	849	4,759	4,951*
Groundwater Seepage to pits (estimated)	3,598	774	18,502	3,158
Total Inflows	**6,571**	**3,902**	**28,259**	**12,587**
Outflows				
Evaporation from Storages	802	1,118	0	0
Exported to Other Sites	430	3,561	949	13,648
Entrainment (Waste and Product)	2,967	946	16,739	5,517
Haul Road Dust Suppression	1,653	1,971	7,456	4,755
Total Outflows	**5,852**	**7,596**	**25,144**	**23,920**
Change	**822**	**-3,694**	**3,115**	**-11,333**

*Calculated using average salinity of 5,832EC (assumed salinity of entrained water)

In 2018 MOC 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 MOC to minimise the amount of water taken from the surface water allocation on Glennies Creek.

In 2018 a total of 3,561ML of water was exported to other sites from MOC. This included 2,902ML to Ravensworth Operations and 659ML to Liddell. The majority of this water was tailings return water from the Glendell West Pit. 995 ML of water was returned to MOC from Liddell and Ravensworth Operations during 2018.

Groundwater seepage to pits was significantly lower in 2018 compared to 2017 (774ML versus 3,598ML). This is mainly due to previous calculations of seepage from West Pit into Bayswater North being calculated and not measured. During 2018 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 7.4.1**). 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.

Only a small component of the MOC water usage (240 ML) was drawn from Glennies Creek under licence for use as treated potable water. Water quality results do not show a significant change in EC levels within site storages either.

7.2 Hunter River Salinity Trading Scheme (HRSTS)

The MOC currently holds 13 credits in the scheme. This is three less than 2017 (three credits expired in January 2018). MOC 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.

7.3 Surface Water

7.3.1 Monitoring Program and Triggers

Water Quality

MOC monitors surface water quality at 19 creek locations surrounding the mining operation (**Figure 23**). These include:

- Bowmans Creek (5 sites: BMC1-BMC5)
- Bettys Creek (4 sites: BC1-BC4)
- Swamp Creek (4 sites: SC1-SC4)
- Yorks Creek (3 sites: YC1-YC3)
- Main Creek (3 sites: MC1-MC3)

Sites are monitored for pH, electrical conductivity (EC), total suspended solids (TSS) and total dissolved solids (TDS). Results are recorded within the site Environmental Monitoring Database. Results are assessed against baseline trigger levels outlined in the MOC Surface Water Management and Monitoring Plan (**Table 36**).

Table 36: Surface Water Quality Triggers

Water Quality Variable	Bowman's Creek	Ephemeral Creek Systems	
		Flow Conditions	No Flow Conditions
pH	6.5[1] – 8.0[1]	6.5[1] – 8.32	6.5[1] – 8.6
EC (µS/cm)	2,200[1]	2,200[1]	6,668
TSS (mg/L)	21	50[1]	68
TDS (mg/L)	890	1,006	4,384

[1] *ANZECC (2000) guidelines for aquatic ecosystems*

All other values - Comparison of the baseline monitoring results to the ANZECC (2000) default trigger values indicates that the existing water quality in the creek systems surrounding MOC can exceed the ANZECC (2000) default trigger values for pH, EC and TSS. Based on the monitoring results for Bowmans Creek, the trigger values for flow conditions in all creeks would be the ANZECC (2000) default trigger values. The 80th percentile values determined from the long term monitoring results for all the ephemeral creeks provides appropriate trigger values for no flow conditions in the ephemeral creeks. Where the 80th percentile value is lower than the ANZECC (2000) guidelines, the ANZECC (2000) default trigger values have been selected as the trigger value for that specific parameter

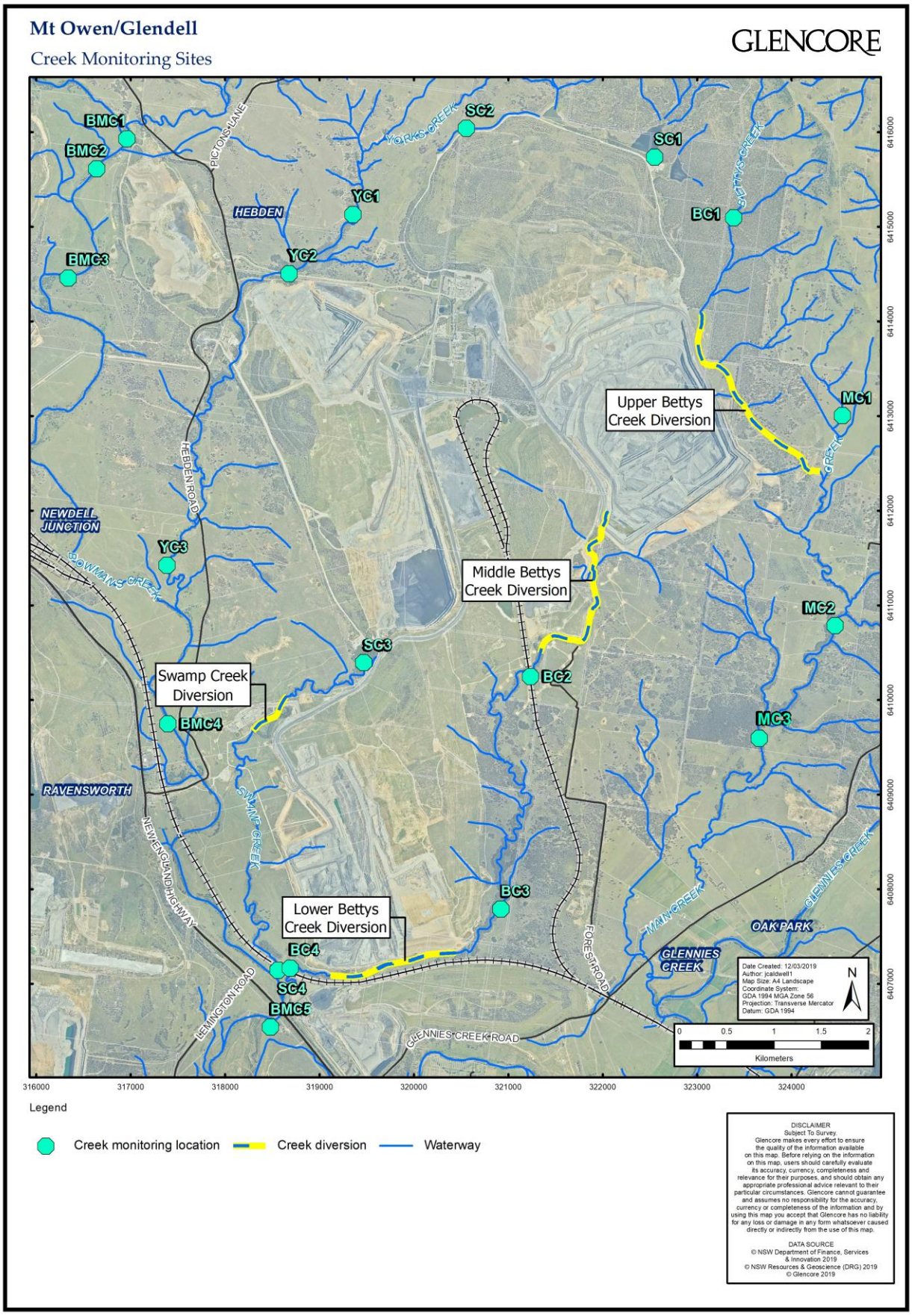


Figure 24: MOC Surface Monitoring Locations

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. MOC monitors channel stability and stream health at 41 locations (**Figure 25**). 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 is assessed using the Rapid Appraisal of Riparian Condition (RARC) methodology. **Table 37**, **Table 38** and **Table 39** outline the scoring system for both these methodologies.

Table 37: CSIR0 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 38: 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

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
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 39: Summary RARC Classification System

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

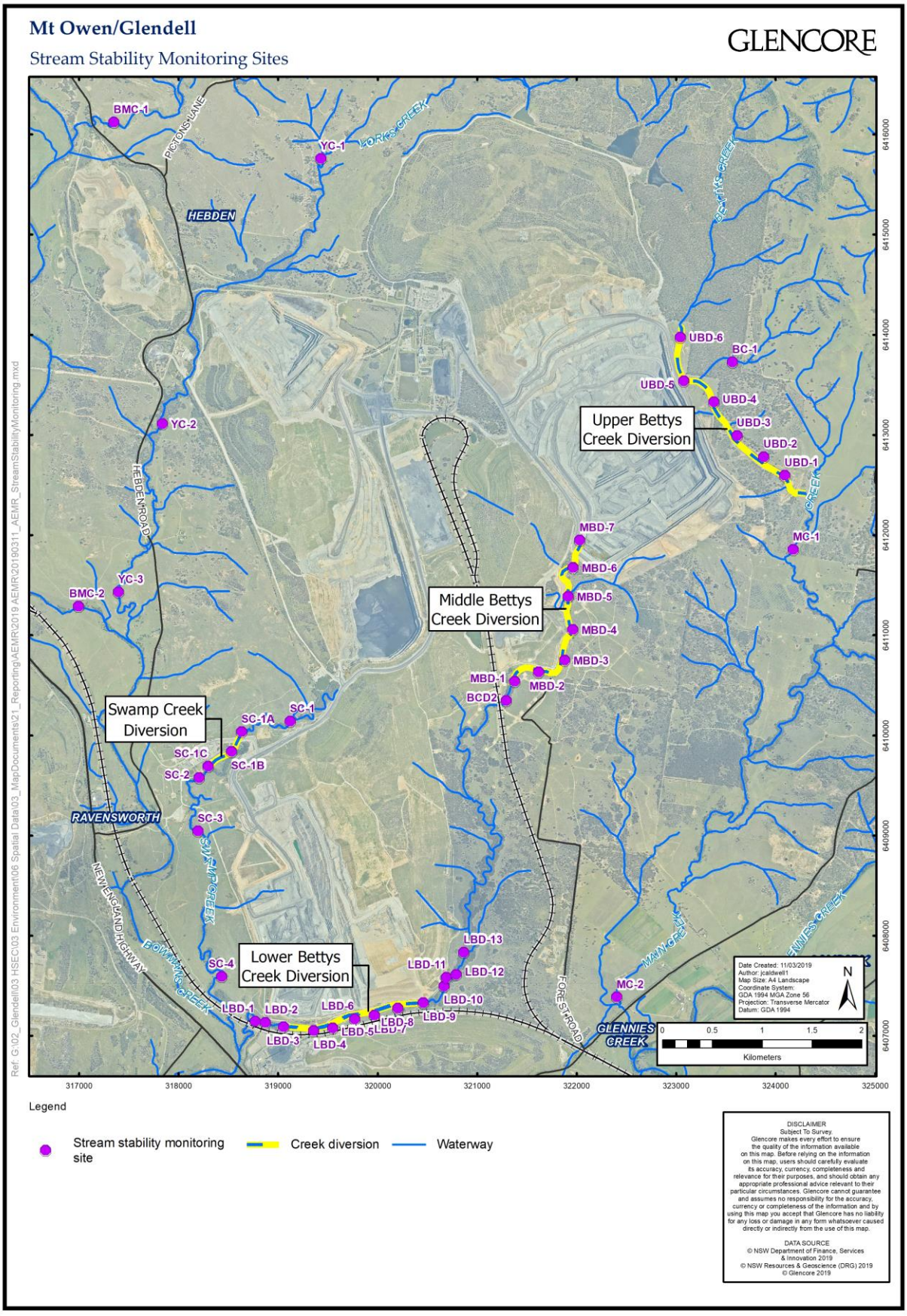


Figure 26: Stream Stability and Stream Health Assessment Locations

7.3.2 Surface Water Performance

Over the last few years MOC has received lower than average rainfall. This has resulted in long periods of no flow conditions within MOC's creek systems. As a result MOC 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 **Table 40.** A copy of the surface water monitoring results for all monitoring locations is included in **Appendix G, Tables 39 - 43.** A comparison of 2018 data against historical data for the last five years is provided in **Appendix G, Tables 44 - 47.**

Table 40: Summary of Surface Water Monitoring Results

Site	pH			EC (µS/cm)			TSS (mg/L)			TDS (mg/L)			Data Capture (%)	Comment
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg		
BMC1	7.30	8.00	7.69	911	3,370	1,447	<1	25	5	595	2,480	964	100%	No flow during Feb, July & Dec monitoring rounds
BMC2	7.30	8.00	7.78	930	1,594	1,293	1	44	19	566	954	827	100%	No flow during Feb, July, Nov & Dec monitoring rounds
BMC3	7.20	8.20	7.87	834	2,090	1,656	1	63	33	501	1,290	1,052	100%	No flow during Jan, Feb & June-Dec monitoring rounds
BMC4	7.00	7.70	7.40	972	1,956	1,274	3	30	10	674	1,280	781	100%	No flow during Feb & June-Dec monitoring rounds
BMC 5	7.40	8.60	8.11	2,940	5,250	3,888	10	54	20	1,780	3,550	2,463	100%	No flow during all monitoring rounds
YC1	6.7	6.7	6.7	4,990	4,990	4,990	14	14	14	3,240	3,240	3,240	100%	Dry all year except March (sample collected under no flow conditions)
SC1	7.9	10.1	9.13	374	626	524	1	15	7.27	285	451	344.2	100%	Samples collected under no flow conditions
SC2	6.80	8.70	7.64	273	625	469	5	67	25.6	272	425	331	100%	
BC4	6.6	6.7	6.65	276	324	300	54	58	56	239	291	265	100%	Dry all year except March & Dec (samples collected under no flow conditions)
MC1	7.50	6.70	7.10	1,144	1,498	1,321	63	136	100	634	990	812	100%	Dry all year except March & April (samples collected under no flow conditions)
MC2	7.00	7.00	7.00	1,720	1,720	1,720	56	56	56	1,080	1,080	1,080	100%	

Red indicates exceedance of trigger – refer discussion below.

Bowmans Creek

Monitoring data collected for 2018 for Bowmans creek was generally in line with baseline conditions (refer **Appendix G, Table 39**). Exceedances of trigger levels are outlined in **Table 41**. A majority of sites were 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 had triggered under a single event in which investigations were completed which aligned with the 2017 SWGWRP. This resulted in an internal review in which external reporting was not required in line with the SWGWRP. These sites then returned within trigger level ranges in following monitoring rounds.

Table 41: Summary of Exceedances for Bowmans Creek for 2018

Sample Site	Date	Analyte	Result	Trigger Level	Historical Range	Comments
BMC2	3/01/2018	pH	8.0	8	6.8 - 8.3	Natural variation, within historical range. Not attributable to MOC operations.
BMC1	29/03/2018	TSS	25	21	1 - 414	Natural variation, within historical range. Not attributable to MOC operations.
BMC2	29/03/2018	TSS	38	21	1 – 414	Natural variation, within historical range. Not attributable to MOC operations.
BMC3	29/03/2018	TSS	53	21	1 - 414	Natural variation, within historical range. Not attributable to MOC operations.
BMC1	18/05/2018	pH	8.0	8	6.8 - 8.3	Natural variation, within historical range. Not attributable to MOC operations.
BMC1	14/06/2018	EC	3,370	2,200	1,530 - 4,060	Natural variation, within historical range. Not attributable to MOC operations.
BMC1	14/06/2018	TDS	2,480	890	208 - 2340	Sample comments noted flow rate to be a 'Trickle'. The reading has exceeded the flow trigger level and historical range. This is likely a result of the drier climatic conditions. The July result at this site returned within historical range.
BMC2	11/09/2018	TDS	894	890	208 - 2340	Natural variation, within historical range. Not attributable to MOC operations.
BMC2	3/01/2018	pH	8.0	8	6.8 - 8.3	Natural variation, within historical range. Not attributable to MOC operations.

Bowmans Creek was assessed for stream stability and stream health at two locations and results are included in **Table 42**. Compared to 2017 stream condition has decreased slightly at one monitoring point and increased at another. There has been no change in stream health. 'Very Poor' stream health is a reflection of past land use and management.

Table 42: Bowmans Creek Stream Health and Stability – 2018 and 2017

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2018	2017	2018	2017
BMC1	69% (Potentially Stabilising)	66% (Potentially Stabilising)	Very Poor	Very Poor
BMC2	78% (Very Stable)	81% (Very Stable)	Very Poor	Very Poor

Yorks Creek

Yorks Creek was dry for the majority of 2018. The only site able to be monitored was Yorks Creek Upstream (YC1) in March conditions (refer **Appendix G, Table 40)**. Monitoring was carried out under "no flow" conditions. No recorded values exceeded baseline trigger levels, all results were within the historical range.

Yorks Creek was assessed for stream stability and stream health at three locations and results are included in **Table 43**. Stream stability has improved at both YC2 and YC3 monitoring sites since 2017. Stream health remains unchanged from 2017.

Table 43: Yorks Creek Stream Health and Stability – 2018 and 2017

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2018	2017	2018	2017
YC1	59% (Active)	59% (Active)	Poor	Poor
YC2	72% (Stable)	59% (Active)	Average	Average
YC3	66% (Potentially Stabilising)	44% (Very Active)	Very Poor	Very Poor

Swamp Creek

Swamp Creek sample sites SC3 and SC4 were dry for the entirety of the year. Sample sites SC1 and SC2 were able to be recorded; however monitoring was carried out under "no flow" conditions. There were ten exceedances at SC1 during 2018, as detailed in **Table 44**. Monitoring data for Swamp Creek is included in **Appendix G, Table 41.**

Table 44: Summary of Exceedances for Swamp Creek for 2018

Sample Site	Date	Analyte	Result	Trigger Level	Historical Range	Comments
SC1	3/01/2018	pH	9.6	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	7/02/2018	pH	10.1	8.6	6.4-10	The reading has exceeded the historical range. This is likely a result of the drier climatic conditions. The March result at this site returned within historical range.
SC1	19/04/2018	pH	9.3	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	18/05/2018	pH	9.3	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	14/06/2018	pH	9	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	18/07/2018	pH	9.3	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	11/09/2018	pH	9.1	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	24/10/2018	pH	8.9	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	15/11/2018	pH	9.2	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.
SC1	11/12/2018	pH	8.8	8.6	6.4-10	Natural variation, within historical range. Not attributable to MOC operations.

Swamp Creek was assessed for stream stability and stream health at four locations. Results are included in **Table 45**. Stream stability remained constant or decreased across three sites (since 2017). Stream health remained constant, and was generally classified as 'Very Poor' (Between 2014 and 2018). 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.

Table 45: Swamp Creek 2018 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2018	2017	2018	2017
SC1	69% (Potentially Stabilising)	69% (Potentially Stabilising)	Very Poor	Poor
SC2	59% (Active)	63% (Potentially Stabilising)	Very Poor	Very Poor
SC3	59% (Active)	72% (Stable)	Very Poor	Very Poor
SC4	59% (Active)	63% (Potentially Stabilising)	Very Poor	Very Poor

Betty's Creek

Bettys Creek was dry for the majority of 2018. Monitoring of one site (BC4) was only possible in March and December and monitoring was carried out under "no flow" conditions. There were no exceedances. Monitoring data for Betty's Creek is included in **Appendix G, Table 42.**

Bettys Creek was assessed for stream stability and stream health at two locations. Results are included in **Table 46**. Stream stability remained constant or decreased across the two sites (since 2014). Stream health remained constant at one site whilst decreasing at another, generally being classified as 'Good' and 'Very Poor' at the two sites.

Table 46: Bettys Creek 2018 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2018	2017	2018	2017
BC1	69% (Potentially Stabilising)	69% (Active)	Good	Good
BC2	78% (Stable)	78% (Stable)	Very Poor	Poor

Main Creek

Main Creek was dry for the majority of 2018. Monitoring of all sites was only possible through March and April, with monitoring carried out under "no flow" conditions. There was only one exceedance at this location, at MC1 during the April monitoring round. A TSS reading of 136mg/L was recorded, which exceeds the trigger level (68mg/L). The result is well within the historical range (3 – 1,990mg/L) 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 47**. Compared to 2017, 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.

Table 47: Main Creek 2018 Stream Health and Stability

Monitoring Point	Stream Stability (CSIRO)		Stream Health (RARC)	
	2018	2017	2018	2017
MC1	63% (Potentially Stabilising)	59% (Active)	Very Poor	Very Poor
MC2	59% (Active)	66% (Potentially Stabilising)	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 48 presents a comparison of diversion condition between 2014 and 2018 and **Table 49** shows a similar comparison for stream health. Monitoring locations are shown on **Figure 27.**

Table 48: Comparison of Creek Diversion conditions – 2014 and 2018

Creek Diversion	Transect	2014 Condition	2018 Condition	Condition Trajectory
Upper Bettys Creek Diversion	UBD-1	Active	Potentially Stabilising	Improved
	UBD-2	Active	Active	Static
	UBD-3	Active	Active	Static
	UBD-4	Very Stable	Stable	Decreased
	UBD-5	Stable	Stable	Static
	UBD-6	Very Stable	Very Stable	Static
Middle Bettys Creek Diversion	MBD-1	Stable	Very Stable	Improved
	MBD-2	Potentially Stabilising	Potentially Stabilising	Static
	MBD-3	Stable	Stable	Static
	MBD-4	Active	Active	Static
	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	Active	Decreased
	LBD-3	Stable	Potentially Stabilising	Decreased
	LBD-4	Stable	Stable	Static
	LBD-5	Stable	Stable	Static
	LBD-6	Stable	Stable	Static
	LBD-7	Stable	Stable	Static

Creek Diversion	Transect	2014 Condition	2018 Condition	Condition Trajectory
	LBD-8	Stable	Stable	Static
	LBD-9	Stable	Potentially Stabilising	Decreased
	LBD-10	Potentially Stabilising	Potentially Stabilising	Static
	LBD-11	Stable	Potentially Stabilising	Decreased
	LBD-12	Very Stable	Potentially Stabilising	Decreased
	LBD-13	Stable	Potentially Stabilising	Decreased
Swamp Creek Diversion	SC-1A	Active	Potentially Stabilising	Increased
	SC-1B	Very Stable	Very Stable	Static
	SC-1C	Very Stable	Very Stable	Static

Table 49: Stream Health at MOC diversions - 2014 to 2018

Site Description	2014 Classification	2018 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 25 in 2018 suggesting there is no change from 2017 and overall change in stream condition from previous monitoring in 2015 may be marginal or may reflect changes in surveyor.
Swamp Creek 1C (SC1C)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 1 (UBD1)	Very Poor	Very Poor	Stable	No change.
Upper Bettys Diversion 2 (UBD2)	Very Poor	Very Poor	Stable	No change.
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.
Middle Bettys Diversion 1 (MBD1)	Poor	Good	Improving	Total score of 35 in 2018 just within the “Good” category suggesting the slight change from 2017 may reflect changes in surveyor.
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

Site Description	2014 Classification	2018 Classification	Trend	Description of change
				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.
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 survey.
Lower Bettys Diversion 3 (LBD3)	Poor	Poor	Declining	This site scored at the high range of the "Poor" category, showing a slight decrease in total score relative to 2017. This decrease 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.
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.
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 2017.
Lower Bettys Diversion 11 (LBD11)	Poor	Average	Improving	The category increased from "Poor" to "Average" from 2017 to 2018 due mainly to an increase in the Habitat and Debris scores. An increase in the Debris score suggests some recovery in the function of the riparian zone at this site.
Lower Bettys Diversion 12 (LBD12)	Average	Average	Stable	No change.

Site Description	2014 Classification	2018 Classification	Trend	Description of 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.
Main Creek 1 (MC1)	Very Poor	Very Poor	Stable	No change.
Main Creek 2 (MC2)	Very Poor	Very Poor	Stable	No change.
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

MOC 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, MOC did not have any instances where sediment dams overflowed during 2018. 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 MOC. 2018 saw the review and approval of the MOC Creek Diversion Plan. The plan ensures MOC will continue to monitor the Creek Diversion as per the current monitoring program.

The Upper Bettys Creek Diversion Remediation plan (requested by DPE) 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 28** shows remediation works undertaken in 2018.

Figure 29: Upper Bettys Creek remediation works completed in 2018.

7.4 Groundwater

7.4.1 Monitoring Program and Triggers

Groundwater monitoring is undertaken in accordance with the approved MOC Groundwater Management and Monitoring Plan, and includes depth to water (to calculate drawdown), pH and EC. The location of monitoring bores is shown on **Figure 30.** Monitoring data is compared to the groundwater performance criteria in **Table 50**.

Table 50 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 50**, drawdown triggers were defined for each bore by calculating the historical average drawdown between monitoring points and plotting against that value plus 1 m to assess against the performance indicator.

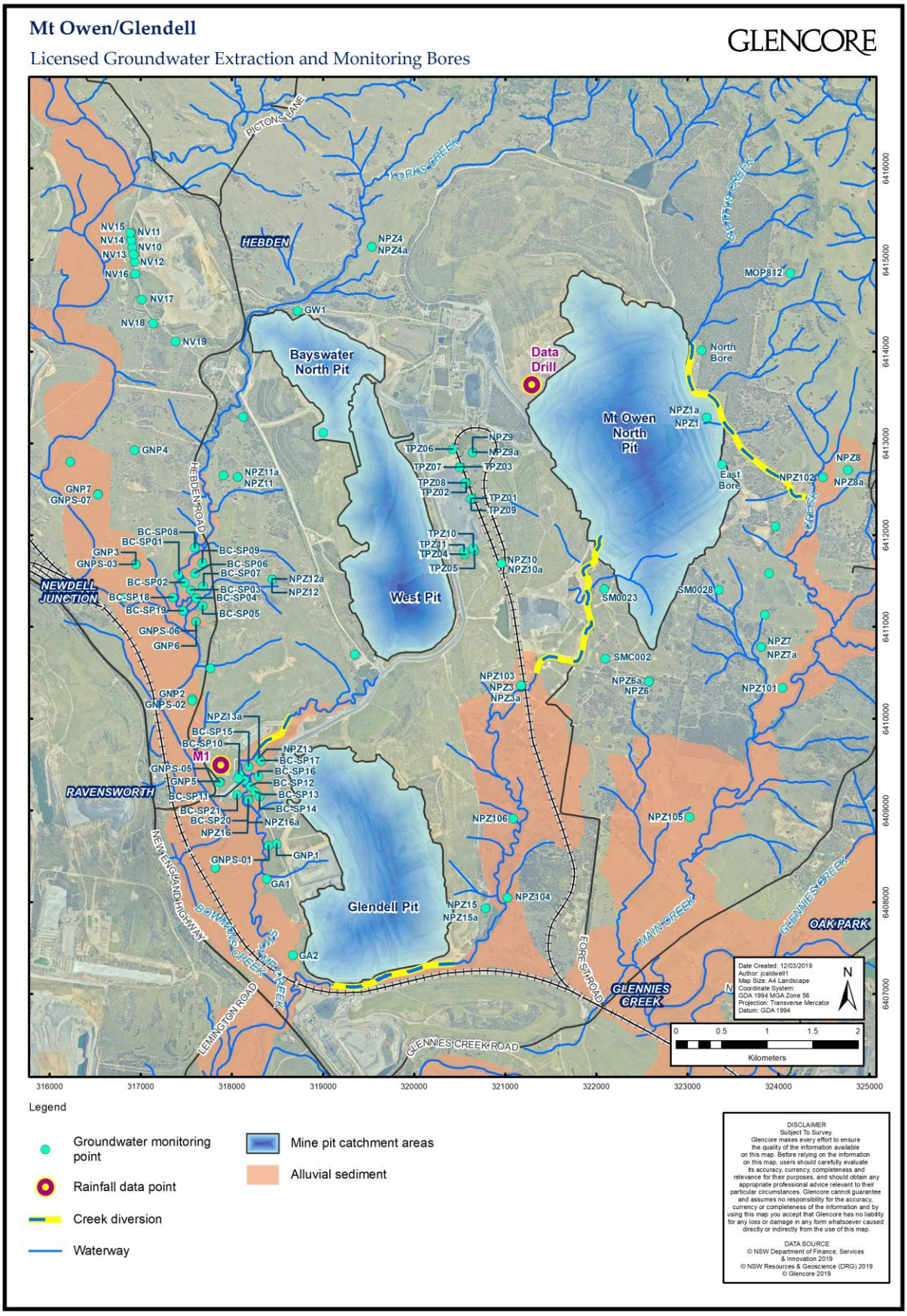


Figure 31: MOC Groundwater Extraction and Monitoring Bores

7.4.2 Groundwater Performance

Groundwater monitoring results for 2018 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 51.** Monitoring results for a number of bores exceeded the EC trigger during 2018. A review of these exceedances is currently being undertaken by SLR Consultants (see discussion at beginning of **Section 7**).

A copy of the monitoring results for individual groundwater monitoring locations is included in **Appendix G, Table 48** along with a summary of the 2018 results for all bores (**Appendix G, Table 49).**

A comprehensive review of groundwater is located in the 2018 Annual Groundwater Review (SLR, 2018) report, which is also included in **Appendix G**.

Table 51: Summary of Groundwater Bores against Performance Data in 2018

Site ID	Investigation Criteria Triggered?			
	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
Yorks Creek Alluvium				
BC-SP06	x	x	✓ (Sep)	✓ (Jun to Sep and Sep to Dec)
BC-SP07	x	x	x[1]	✓ (Jun to Dec)
BC-SP08	x	x	✓ (Mar, Jun, Sep)	✓ (June to Sep, Sep to Dec)
BC-SP09	x	x	x	✓ (Sep to Dec)
NPZ4	x	x	✓ (all months)	✓ (Mar to Jun and Jun to Sep)
NPZ11	x	x	✓ (Sep)	✓ (June to Sep and Sep to Dec)
NPZ12	ND	ND	ND	ND
Yorks Creek and Bowmans Creek Alluvium				
BC-SP02	x	x	x	✓ (Jun to Sep and Sep to Dec)
BC-SP03	x	x	x	✓ (Sep to Dec)
BC-SP04	x	x	✓ (Sep)	✓ (Jun to Sep and Sep to Dec)
BC-SP05	x	x	✓ (Sep)	✓ (Jun to Sep and Sep to Dec)
Bowmans Creek Alluvium				
BC-SP18	x	ND	ND	ND
BC-SP22	x	x	✓ (all points)	✓ (Jun to Sep and Sep to Dec)
GNSP-02	x	x	x	x
GNSP-06	x	x	x	x
Swamp Creek and Bowmans Creek Alluvium				
BC-SP20	x	x	x	✓

Site ID	Investigation Criteria Triggered?			
	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
				(Mar to Dec)[2]
BC-SP21	x	x	x	✓ (Jun to Sep and Sep to Dec)
Swamp Creek Alluvium				
BC-SP10	x	x	x	✓ (Jun to Sep)
BC-SP11	x	x	x	✓ (Jun to Sep and Sep to Dec)
BC-SP12	x	x	x	x
BC-SP14	x	x	x	✓ (Sep to Dec)
BC-SP15	ND	ND	ND	ND
BC-SP16	ND	ND	ND	ND
BC-SP17	ND	ND	ND	ND
GA1	x	x	x	x
GA2	x	x	x	x
NPZ13	x	x	x	x
NPZ16	x	x	x	✓ (Jun to Sep and Sep to Dec)
Bettys Creek Alluvium				
North	x	x	x	✓ (Sep to Dec)
NPZ1	x	x	✓ (Mar, Jun, Sep)	✓ (Mar to Jun and Sep to Dec)
NPZ3	x	x	x	✓ (Sep to Dec)
NPZ6	x	x	x	x
NPZ9	x	x	x	✓ (Sep to Dec)
NPZ10	x	x	x	✓ (Sep to Dec)
NPZ103	x	x	x	✓ (Sep to Dec)
NPZ104	ND	ND	ND	ND
NPZ106	x	x	✓ (Mar, Jun)	x
Main Creek Alluvium				
NPZ7	x	x	x	✓ (Sep to Dec)
NPZ8	x	x	✓ (all points)	✓ (Jun to Sep and Sep to Dec)
NPZ101	x	x	✓ (Mar, Jun, Sep)	✓ (Sep to Dec)
NPZ102	x	x	x	✓ (Sep to Dec)

Site ID	Investigation Criteria Triggered?			
	Drawdown	pH	EC	
			12,800 µS/cm trigger	>1,000 µS/cm change
Hard Rock Aquifer				
MOP812	ND	ND	ND	ND
NPZ1a	x	x	x	x
NPZ3a	x	x	✓ (Sep, Dec)	✓ (Mar to Sep)[3]
NPZ4a	x	x	✓ (all points)	✓ (Mar to Jun and Jun to Sep)
NPZ6a	ND	ND	ND	ND
NPZ7a	x	x	x	x
NPZ8a	x	x	x	x
NPZ9a	ND	ND	ND	ND
NPZ10a	ND	ND	ND	ND
NPZ11a	x	ND	ND	ND
NPZ12a	ND	ND	ND	ND
NPZ13a	x	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

1. BC-SP07 EC - No data for Sep - dry
2. BC-SP20 – EC - No data Jun/Sep (dry/too low to sample)
3. NPZ3a - No data for June as piezo was blocked.

Following the annual review for the 2017 monitoring period, groundwater trigger exceedances were identified by MOC. HEC (2018) and SLR (2018) were engaged to conduct initial investigation into the trigger exceedances. The exceedances included:

- Five bores (NPZ12a, GNP5, GNP6, SM0028 and SM0028 recorded a decline in groundwater level in 2017 of over 1 m, when compared to historical average levels, over more than one consecutive monitoring round;
- Two bores (NPZ11a and NPZ12a) recorded pH values outside the trigger range of 6.5 to 8.0, over more than one consecutive monitoring round in 2017; and
- Ten bores (BC-SP08, NPZ4, NPZ1, NPZ104, NPZ106, NPZ7, NPZ8, NPZ101, NPZ4a, NPZ12a) recorded an EC outside of the EC trigger range in 2017.

The work conducted by HEC (2018) and SLR (2018) included review of available bore construction data and analysis of groundwater level and quality trends. The review by SLR (2018) recommended additional works to further investigate the trigger exceedances, which are currently

planned for 2019. As at the end of 2018 calendar year, MOC had submitted an updated Groundwater Monitoring and Management Plan to the Department of Planning and Environment.

7.4.3 Groundwater Inflows Estimates

For each pit, modelled rainfall-runoff, supplied pit dewatering volumes and assumed change in storage was used to calculate the groundwater inflow monthly for 2018. This calculated groundwater inflow was then compared to the model predicted groundwater inflow provided in EIS approval documents. A summary is provided in **Table 52**.

Table 52: Summary of Groundwater Seepage Data for 2018

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)					
79	181	118	220	334	-114
Glendell*					
41	46	26	31	0	31
Ravensworth East (Bayswater North Pit)					
38	170	-14	118	81	37
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)**					
5,077	5,762	242	927	110	817

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 52** shows, 79 ML of runoff was modelled as reporting to the North Pit while dewatering estimates totalled 181 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in a 118 ML increase over the 2018 reporting period (this would include water stored within the in-pit waste rock emplacement). The difference between runoff, dewatering and stored volume values gives 220 ML (i.e. 181 ML plus 118 ML minus 79 ML) which is the calculated groundwater inflow. This is 114 ML less than the total 2014 MOCO Project model predicted groundwater inflow volume for 2018 of 334 ML.

Glendell Pit

Data provided in **Table 52** shows that 41 ML of runoff was modelled as reporting to the Glendell Pit while dewatering estimates totalled 46 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in a 26 ML increase over the 2018 calendar year, with a total stored water volume of 36 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 31 ML (i.e. 46 ML plus 26 ML minus 41 ML) which is the calculated groundwater inflow. This is 31 ML less than the total 2007 Modification EA model predicted groundwater inflow volume for 2018 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 52** shows, 38 ML of runoff was modelled as reporting to the Bayswater North Pit while dewatering estimates totalled 170 ML. To ensure calculated groundwater inflows in each month were not negative, the stored pit water volumes were assumed which resulted in an 14 ML decrease over the 2018 reporting period. The difference between runoff, dewatering and stored volume values gives 118 ML (i.e. 170 ML plus -14 ML minus 38 ML) which is the calculated groundwater inflow. This is 37 ML more than the total 2014 MOCO Project model predicted groundwater inflow volume for 2018 of 81 ML.

Ravensworth East (West Pit)

As **Table 52** shows that 5,077 ML of runoff, tailings water recovery and water pumped in was modelled as reporting to the West Pit while dewatering and evaporation estimates totalled 5,762 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 242 ML increase over the 2018 reporting period (this would include water stored within the adjacent in-pit waste rock emplacement). The difference between inflows, outflows and accumulation values gives 927 ML (i.e. 5,762 ML plus 242 ML minus 5,077 ML) which is the calculated groundwater inflow. This is 817 ML more than the total 2014 MOCO Project model predicted groundwater inflow volume for 2017 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 2018 there was no mining at either Glendell or Mt Owen Mine that further intersected alluvium. Southern areas of Glendell's 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 53**.

Table 53: 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

Condition Number	Condition description (detailed summary)	Compliance Status	Comment	Where addressed in Annual Review
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		Error! R eference source not found. (Groundwater Monitoring Bores)
4)	The licence holder must report in the Annual Review: I) The monitoring results of any groundwater monitoring with respect to this licence;	Compliant	As reported.	**Section 7.4** Groundwater & **Appendix G**
	I) An assessment of compliance with the conditions of this licence;	Compliant	This Table	**Table 53**
	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 eight VWP's installed throughout 2018.	**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 any additional monitoring carried out on the event.	Compliant	No event has occurred that has impacted on groundwater during 2018.	**Section 7.4**
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

Condition Number	Condition description (detailed summary)	Compliance Status	Comment	Where addressed in Annual Review
	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 52**
	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 1st July.	Compliant	The extraction beyond this licence limit is included in the 5.9GL of allocated hardrock aquifer licences held by MOC	**Section 7.4.3**

Further Improvements

The following summarises the recommendations made by the 2018 Annual Groundwater review:

- Review of 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;
- Review the data (and survey if necessary) available for each piezometer. It should include barometric compensation (vented or not), on site calibration data and depth of port inlet. For non-vented piezometer it is also recommended that an accurate barometer be available on site;
- 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;
- Ensure all bores are monitored in accordance with approval requirements, including the backfilled void bores;
- Amend the GMMP to reflect correct lithology for each bore;
- Amend the GMMP to reflect changes in bore network; and
- Amend the GMMP to provide details of individual pipes for each multipipe piezometer, include the depth and screen lithology.

Note that several of these recommendations were addressed in the revised GWMMP submitted to DPE in December 2018.

7.5 Compensatory Water

No compensatory water was supplied to private landowners during the reporting period.

8 Rehabilitation

During the reporting period MOC submitted a new MOP/Rehabilitation Management Plan to DP&E for approval. The revised MOP included:

- A revised MOP term i.e. 1 September 2018 - 31 December 2019
- 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 1 (Integra Underground to Mt Owen Water Pipeline and Ancillary Infrastructure).

Rehabilitation was carried out in accordance with:

- Mt Owen Complex MOP/Rehabilitation Management Plan
- Mt Owen Complex Biodiversity and Offset Strategy
- Mt Owen Complex Rehabilitation Strategy (still in draft)
- Mt Owen and Glendell Annual Rehabilitation and Land Management Plan (internal 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.

Table 54 provides a summary of rehabilitation activities at MOC for 2017 and 2018 and the rehabilitation forecast to be undertaken in 2019.

Table 54: Mt Owen Complex Rehabilitation Summary

Mine Area Type	Previous Reporting Period (2017)	This Reporting Period – Forecast (2018)*	This Reporting Period - Actual (2018)	Next Reporting Period – Forecast (2019)
Total Mine Footprint	2775	2808	2808	2839
Total active Disturbance	1512	1448	1448	1388.6
Land being prepared for rehabilitation	0	0	0	0
Land under active rehabilitation	1263	1360	1360	1451
Completed Rehabilitation	0	0	104	91

* Forecasts for 2018 differ from values within the current MOP. MOC is preparing to resubmit the MOP in H1 2018.

Rehabilitation continued across the MOC during 2018 generally in line with the Annual Rehabilitation Land Management Plan (ARLMP) / Mining Operations Plan (MOP) (**Table 55**). 104 ha of rehabilitation was completed across the MOC made up of 66ha at Glendell and 38 ha at Mt Owen.

Table 55: 2018 Rehabilitation works compared to MOP

Mine Area Type	2018 Actual Data (Mt Owen Complex)	MOP Prediction
Rehabilitation (ha)	104	71.7
Disturbance (ha)	65	27.4
Rehabilitation Disturbance (ha)	13.9	9.5

Glendell

Glendell completed 66 ha of rehabilitation during 2018 including 48 ha of open grassland or pasture areas and 18 ha of open woodland areas. Glendell 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, Glendell 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. Glendell also made improvements to the rehabilitation process, deep ripping directly prior to seeding. This change provides a rougher finish improving infiltration, limiting surface runoff and therefore reducing any potential erosion issues.

Mt Owen

In 2018 Mt Owen prepared and seeded 38 ha of open forest rehabilitation. Rehabilitation methodology remains largely unchanged at Mt Owen 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 2018 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.

Figure 32: Newly completed rehabilitation at Glendell capped Tailing's Pit 1, with WOOP dump in the background

8.1 Rehabilitation Monitoring

MOC revised and improved the rehabilitation monitoring program during 2018. 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.

Steps taken within the 2018 monitoring program included:

- desktop assessment of rehabilitation records using ARC GIS
- 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 56** and an example of results is included in Error! Reference source not found.. In addition to these transects photo points were also recorded for ongoing visual assessment of r ehabilitation 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, etc. (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 in the future and photo-monitoring continued to demonstrate the evolution of the site condition over time.

Table 56 - 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
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

Parameter	Assessment Area	Method	Frequency
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: • Cumulative length of fallen logs >10cm in diameter, only measuring the parts of the logs in contact with the ground; • Total number of hollows in trees which trunks were within the plot boundaries[3]; • 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).	Year 5 and 10 only
Vegetation health	20m x 50 m plot	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: • Dead. • Very sick: no new growth, several limbs showing dieback, severe leaf discoloration, necrosis or insect attack.	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).
[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.

Parameter	Assessment Area	Method	Frequency
		• 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.	
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	Erosion was assessed using the following rating system: • 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] Where rills or gully features were present, their location, depth and width were recorded as they intercepted the transect line.	All years
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

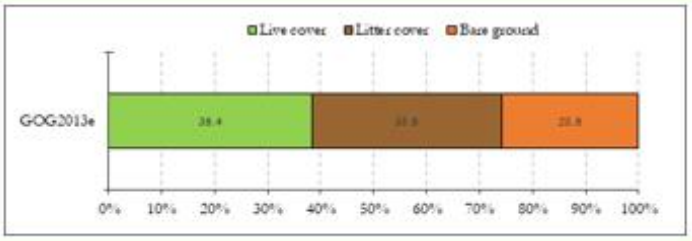
[4] Note that there is no Australian consensus on quantitative measures for minor, major or severe erosion as defined National Committee on Soil and Terrain (2009), and the proposed raking system is a broad aggregation of multiple (gully, sheet, rill, tunnel) erosion measures, giving consideration to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

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

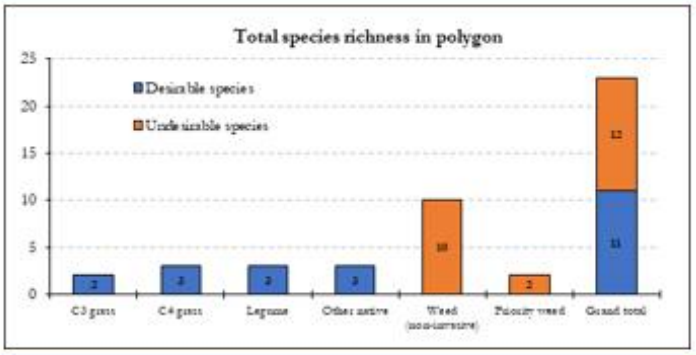
- A total of five or six sub-samples were collected from different areas within the sampling plot using a hand spade to a depth of 0.1m.
- Care was taken to avoid the inclusion of organic matter (e.g. litter, twigs, etc.), subsoil or overburden material and other foreign materials (for example stones 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	GOG2013e
Slope	17%
Erosion status	Stable
Erosion score	1 (no erosion)
Land Capability	III

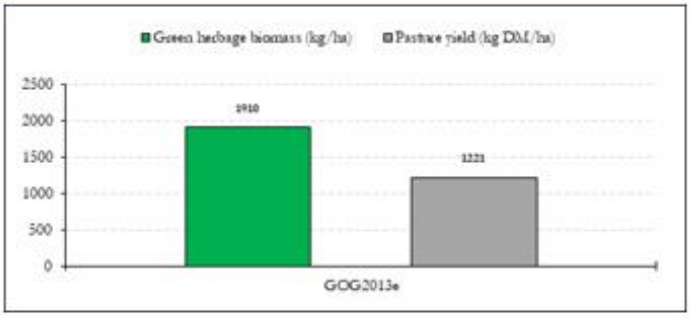
Ground Cover Protection	
Live (%)	38.4
Litter (%)	35.8
Bare (%)	25.8



Pasture Composition	
Species richness	23
Desirable species	11
Desirable species cover (%)	35.5
Priority weeds	2
Priority weed cover (%)	<0.2



Pasture Productivity	
Biomass (kg/ha)	1,910
DM content (%)	64
Yield (kg DM/ha)	1,221
Legumes	3
Legume proportion (%)	0.1



Soil Performance			
Topsoil cover (mm)	300	Total N (mg/kg)	700
pH ($CaCl_2$)	6.8	Total P (mg/kg)	135
EC (µS/cm)	960	Colwell K (mg/kg)	<200
ESP (%)	19	OC (%)	0.8

Figure 33: Example of Results for Each Polygon

Performance against key rehabilitation metrics was assessed for each rehabilitation polygon. Summary of this data is presented in **Table 57** and **Table 58** and displayed in Error! Reference source not found. Each polygon is assigned one of four performance rankings:

- 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).

Table 57: 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	
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

Polygons assessed		Performance condition summary							Overall performance status
Year	Size (ha)	Erosion	Ground cover	Species assemblages	Weeds	Topsoil cover	Pasture productivity	Soil properties	
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
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 58: 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	
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
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

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	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
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

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	
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

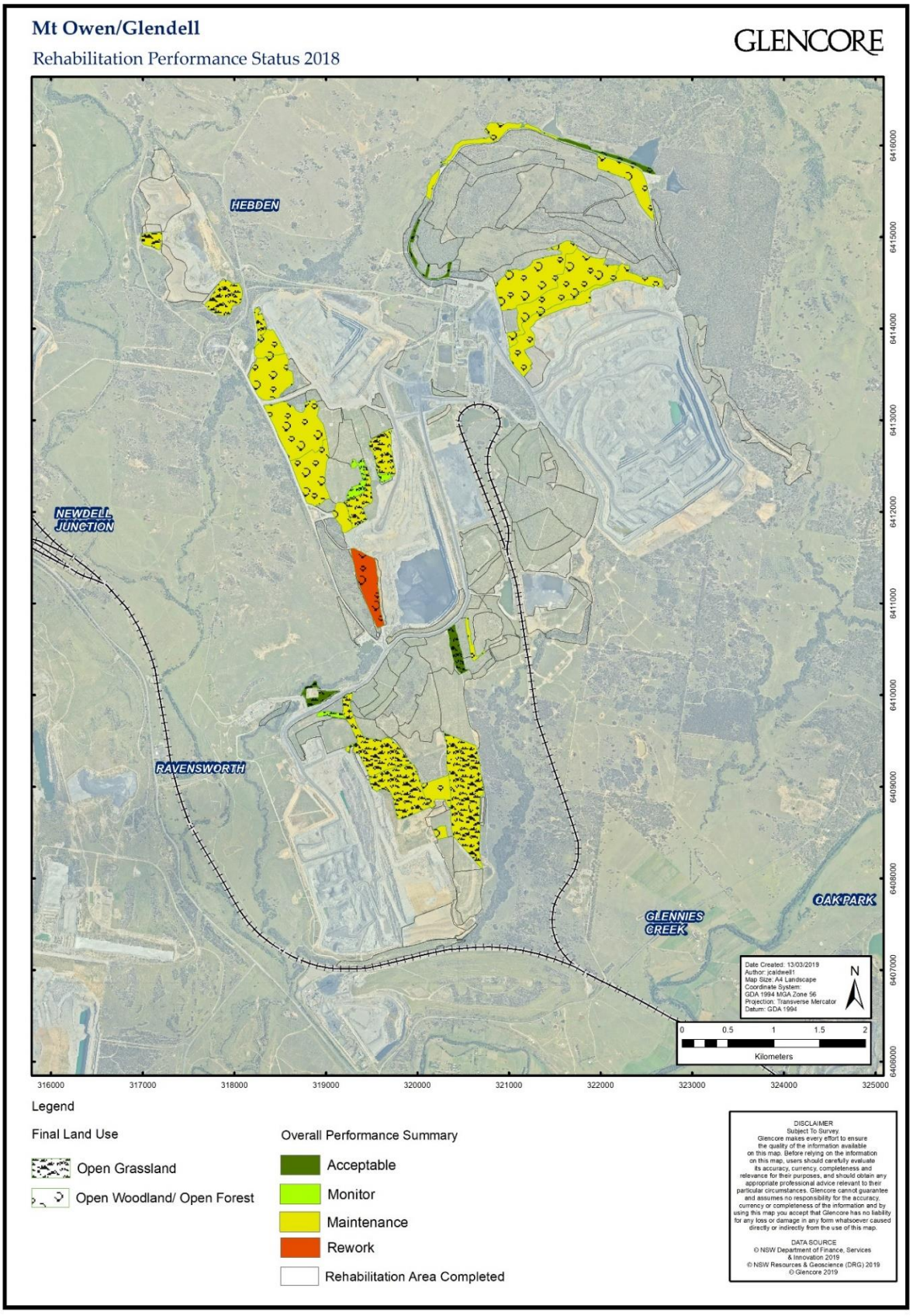


Figure 34: Summary of Rehabilitation Performance for 2018 Monitoring

In areas currently showing an unsatisfactory performance, 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 MOC 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. One area was identified as 'rework' status on the western side of West Pit tailing's dam as seen in **Figure 35.**

Weed incursion has been identified as the main issue at MOC. Weed populations are widespread and threaten the ecological integrity of the rehabilitated communities. The main species of concern at the time of the 2018 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.

While there are issues across the site (which in most cases could be successfully controlled/ treated), established rehabilitation at MOC generally showed good performance. It should be noted that well below average rainfall conditions were received in the 12-18 month period prior to the 2018 rehabilitation monitoring being completed. Some further observations:

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, in all areas of Year 10 rehabilitation active natural regeneration (i.e. second generation seedlings of native trees) was observed, which implied that tree densities should increase over time without the need for assisted management.

Going forward the continued monitoring of rehabilitation performance will allow MOC to build a robust database of relevant and scientific data. From this an accurate and reliable assessment of rehabilitation performance can be made against regulatory requirements, presenting a strong case for successful land relinquishment in the future.

8.2 Further Improvements, Trials and Research

MOC is continually assessing rehabilitation performance and methods for ways to do things better. Use of remote sensing to improve the spatial coverage and repeatability of rehabilitation monitoring over large areas was trialled in 2018. As part of the trial, Mt Owen collected a number of different data to assess which are useful for comparison against performance criteria. Some of the possible metrics that can be assessed by remote sensing include:

- vegetation mapping

- soil and bare areas
- pasture biomass
- rehabilitation condition and health
- weed mapping (particularly relevant for MOC).

In 2019 the programme will be expanded to a biodiversity offset and used to develop spectral libraries for future broad-scale condition mapping of rehabilitation and regeneration areas.

MOC also 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 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 of patches of plants from which seed can be harvested in the future for use on new rehabilitation
- 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 will be reported on in future annual reviews.

Mt Owen has been a rich source of research and trials over a number of years. However during inspections in early 2017 it was raised that some of these trials have been in place for a long time and are not meeting rehabilitation requirements. A review of all trial sites will be carried out in 2019-20 and those that are no longer providing relevant data will be rehabilitated using normal methodologies.

8.3 Rehabilitation Activities for the next reporting period (2019)

Rehabilitation activities planned at MOC for 2019 include:

Mt Owen

- 38 ha of Open Woodland and Forest Rehabilitation
- 0ha of planned disturbance
- In fill tree planting on the Western Bank of North Void

Glendell

- 66ha of Open Grassland and Open Woodland Rehabilitation
- 0 ha of planned disturbance

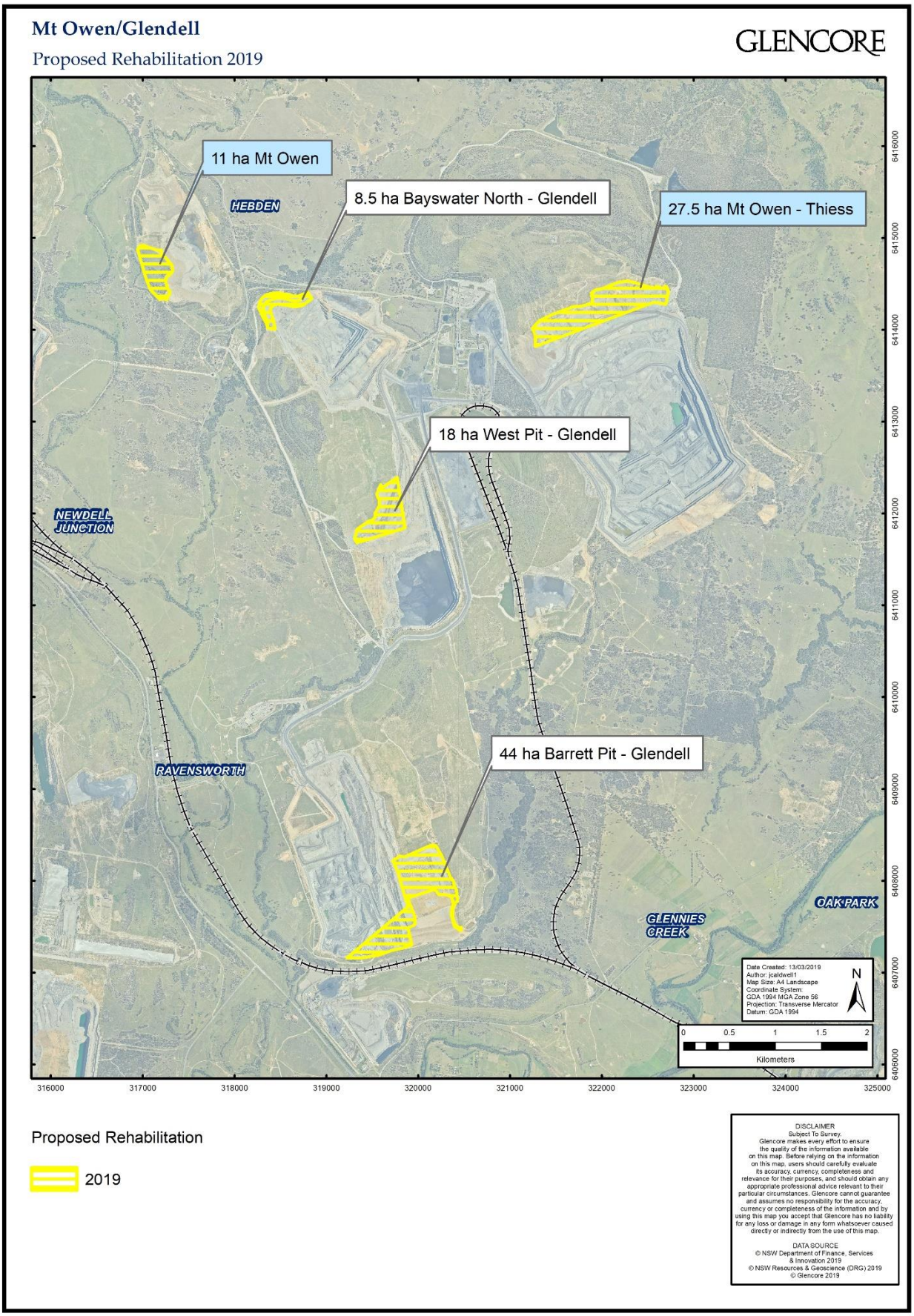


Figure 36: Mt Owen Complex Proposed Rehabilitation for 2019

9 Community

9.1 Community Engagement and Activities 2018

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

MOC 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.

Topics of discussion included:

- progress of the MOCO Mod 2 Project
- progress on the GCOP Project
- progress of the Glendell Mod 4
- current operational environmental performance
- environmental monitoring results
- rehabilitation progress.

Details of community engagement activities undertaken at MOC during 2018 are included in **Table 59**.

Table 59: Community Engagement Activities for 2018

Date	Community Group	Community Activity	Topics Covered
19 April 2018	CCC	Community Consultative Committee Meeting	General overview of MOC operations, environmental performance, continued operations and Integra Mine update.
26 April 2018	MOC and Integra Aboriginal Cultural Heritage Working Group	Working Group Meeting	Meeting to discuss ongoing Aboriginal Cultural Heritage Management at MOC
April 2018	All local residents	Greater Ravensworth Community Newsletter	Environment, land management, community, rehabilitation, MOC Projects and general news.
July 2018	All local residents and Singleton Area	GCOP Newsletter	GCOP Project Update and Overview Ravensworth Homestead
11 October 2018	CCC	Community Consultative Committee Meeting	General overview of MOC operations, environmental performance, continued operations and Integra Mine update.
November 2018	All local residents	Greater Ravensworth Community Newsletter	Environment, land management, community, rehabilitation, MOC Projects and general news.

Date	Community Group	Community Activity	Topics Covered
21 November 2018	CCC, local residents, Mt Pleasant school	Mt Owen Community Gathering/ Information Day	Post-mining land use, rehabilitation, updates on MOCO Mod 2, Glendell Mod 4 and Glendell continued operations, blast and noise management.
5 December 2018	MOC Cultural Heritage Group	Keeping and Teaching Place Open Day – Wollombi Brooke	Meeting to discuss ongoing Aboriginal Cultural Heritage Management and collective artefact keeping place at Wollombi Brook

MOC organised a community gathering and information afternoon at the Mt Olive Community Hall for the residents of the Goorangoola, Falbrook, Camberwell Village and Hebden areas, as well as the CCC representatives in December. The evening provided an opportunity to discuss topics such as:

- post-mining land use
- rehabilitation
- updates on the MOC projects
- feral animal control
- blast and noise management.

Thirty three residents attended as compared to eight in 2017, with overall the feedback being positive. Residents provided valuable input into environmental management practices at MOC.

9.2 Community Contributions

Table 60 summarises the community contributions made by MOC during 2018.

Table 60: 2018 MOC Community Contributions

Date	Community Group	Reason for Contribution	Amount
Feb 2018	Northern NSW Helicopter Service	Ski Marathon Lake Chaffey	$500
March 2018	Cancer Council	Local Head Shave Event	$500
April 2018	Maitland Community Preschool	Platinum Jubilee	$1250
April 2018	Bears of Hope	Gresford Billy Cart Event	$500
April 2018	Rotary Club Singleton	Lake St Clair Charity Bike Ride	$4000
May 2018	Wildlife Aid	Food and medical supplies injured animals	$3000
May 2018	Oxfam		$1000
May 2018	Salvation Army	Bus to pick up children	$663
June 2018	Glendell Team	Westpac Rugby League Fundraiser	$1500
June 2018	Rotary Club Singleton	Lake St Clair Charity Bike Ride	$4000
July 2018	PCYC	Light Box	$506
July 2018	Team McInerney and Team Hassett	Relay for Life	$2000
July 2018	Singleton Fire Brigade Social Club	Annual Singleton Lolly Run	$2000
August 2018	Mt Pleasant Public School	Representative Sports Uniforms	$4235
August 2018	Hunter Medical Research Institute	Brain Cancer Research	$1000

Date	Community Group	Reason for Contribution	Amount
August 2018	Redbull Flugtag - Men's Mental Health	Glendell Team	$500
August 2018	Mt Olive Community Hall	Country Charm Fundraiser	$1000
August 2018	Rotary Club Singleton	Lake St Clair Charity Bike Ride	$5000
September 2018	Mt Pleasant Public School	Stream Health & Water Bugs	$2000
September 2018	Rotary Club Singleton	Lake St Clair Charity Bike Ride	$7000
October 2018	Men's Education Health Rural Van	Men's Health	$500
October 2018	Rural Fire Service - Glennie's Ck Group 2	Blowers for firefighting	$2000
November 2018	Mt Pleasant Public School	Macqlit Educational Program	$5000
November 2018	Movember – Men's Health	Glendell Team Member	$100
November 2018	Singleton Family Support	Community Support Group	$1000
November 2018	Singleton Swim Club	Event Support	$120
December 2018	Hunter Valley Comms Brigade	RFS communication system	$2000
December 2018	Rosebuds Youth Player	Development Sponsorship	$500
December 2018	Samaritans Singleton	Christmas Lunch	$2000
MOC Total Community Contributions			**$55,374**

Note: MOC also paid $235,000 to Singleton Shire Council during December 2017 as part of its Voluntary Planning Agreement (VPA). These payments were inadvertently omitted from the 2017 Annual Review. The payments went towards the following projects:

- Support for Aboriginal Cultural Events - Annual Aboriginal Art Award ($8,000)
- All Abilities Playground at Rose Point Park - Stage 8 & 9 ($177,000)
- Economic Development Initiatives - Riverfront Beautification ($50,000)

9.3 Summary of MOC Community Complaints

A total of 8 community complaints were recorded at Mt Owen during 2018. This consisted of:

- five relating to blasting
- two for noise
- one for traffic.

Glendell and Ravensworth East received a total of 39 community complaints consisting of:

- thirty four (34) for noise
- one for blasting (fume, dust and vibration)
- four for air quality.

MOC responded to all complaints during 2018. Further information can be found in **Appendix H, Table 50.**

9.4 Complaint Trends and Actions

In 2018 Mt Owen received eight community complaints, compared to seven received in 2017 (**Figure 37**). This included five complaints for blasting in 2018, compared to four for 2017.

Glendell / Ravensworth East Mine received 39 community complaints in 2018, which is similar to 2017 (38) and 14 less than 2016 (53). There was a significant reduction in blast complaints from seven in 2017 to one in 2018.

Each complaint is investigated individually for compliance.

Noise complaints during the morning dominated during 2018. This is consistent with a predominant temperature inversion at that time of the day. Temperature inversions are monitored across the MOC daily in an effort to reduce associated impacts. MOC adjust production to reduce noise impacts associated with heavy machinery during periods of increased risks.

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 the MOC were all within compliance limits.

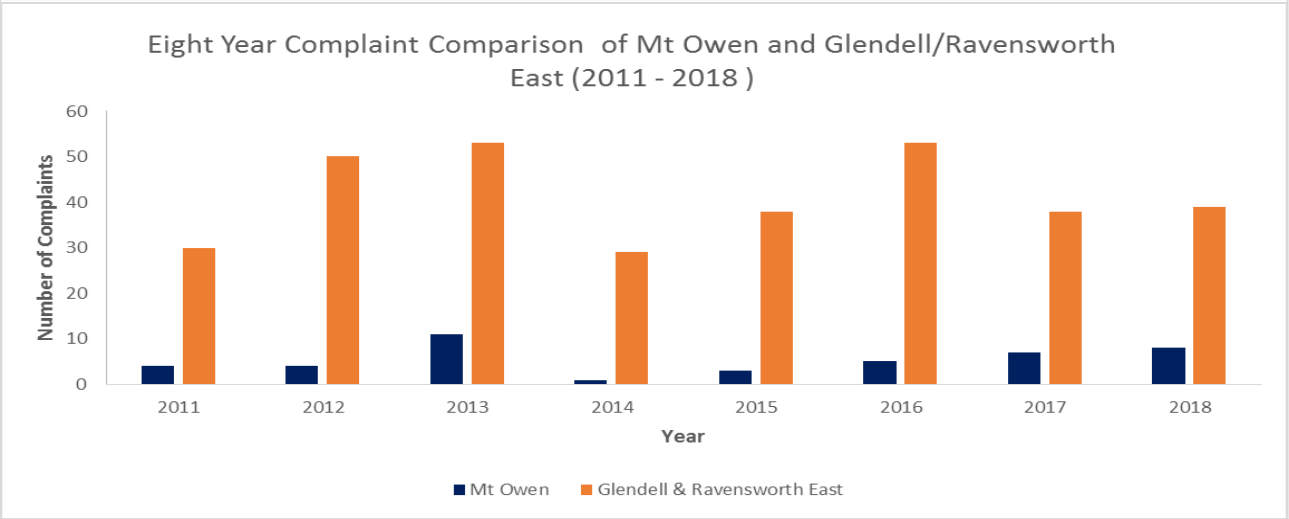


Figure 37: Comparison of Complaints Received at Mt Owen, Glendell and Ravensworth East from 2011 to 2018

10 Independent Audit

An independent audit was conducted by Hansen-Bailey at the MOC 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 MOC staff, and a field inspection of the MOC. 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', 2 as a 'low-risk', and 10 issues were classified as administrative in nature.

MOC submitted the audit report and action plan to the report recommendations to the DP&E. At the time of the audit, MOC were aware of the majority of the non-compliances and were actively working to address them. **Table 61** below summarises the status of actions as at the end of the reporting period.

Table 61: 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 MOC operations sought during the next renewal / variation (due in 2020).	Administrative	Not yet triggered	Pending
SSD 5850 Non-compliance Recommendations				
	Recommend that written records of selection of rolling stock are kept to confirm future compliance (Sch 3, Con 6).	Administrative	ARTC direct the rail and site cannot restrict those movements, and are unable to retain those records.	Cancelled
	Blasting notices to be updated on the website to ensure they remain current (Sch 3, Con 13).	Administrative	Weekly blast scheduled updated on website	Complete
	It is noted that while DD11 is discussed in all Annual Reviews, it is not detailed within the approved Air Quality Management Plan. This should be updated, or justification for its removal provided to regulators (Sch 3, Con 16).	Administrative	AQMP reviewed and approved by DPE on 2018.	Complete
	Recommend that monitoring networks are reviewed to ensure consistency with management plans. TSP monitoring was not relocated until recently to comply with SSD-5850 AQMP location (Sch 3, Con 19).	Administrative	AQMP reviewed and approved by DPE on 2018.	Complete
	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	Regular follow up with DPI – Water will be undertaken.	Ongoing
	Undertake a review to ensure monitoring results are accurate as drawdown was reported as >3 m in the Annual Review at some locations (Sch 3, Con 25).	Administrative	Hydro Engineering and Consulting was engaged to investigate the causes for drawdown in some of the MOC monitoring bores in 2018. SLR completed the 2018 Annual	Complete

IEA Ref	Description	Risk	Mt Owen Response and Action Plan	Status
			Groundwater review with recommendations in this Annual Review. A copy of the report is in Appendix G of the 2018 Annual Review.	
Recommend that OEH be contacted to ensure that the amended site cards that were developed following the archaeology incident are included on the AHIMS database (Sch 3, Con 3).		Medium	Extensive site search undertaken by OzArk indicates OEH AHIMS register has site status set as destroyed.	Complete
Approval from council should be followed up for the Sewerage Treatment Plants (Sch 3, Con 41).		Administrative	Council conducted site visit 27/02/2019 – Final requests required. Final requests completed and returned to council, awaiting final approval 20/03/19	Awaiting Council Approval
Recommend that a register/record is kept to confirm reviews of strategies, plans, and programs required under this condition are undertaken following each trigger specified in a-d (Sch 5, Con 6).		Administrative	Actions have been entered into site compliance database (CMO).	Complete
All exceedances to be reported to the Secretary within 7 days of an incident (Sch 5, Con 9)		Administrative	Noted	N/A
SSD 5850 Continual Improvement Recommendations				
Review and utilise a more formal blast coordination protocol with surrounding mines e.g. Rix's Creek North (Sch 3, Con 13).		Administrative	Jacobs Pre-blast Assessment updated to include commutative blast from surrounding mines.	Complete
Check and document surrounding mine blasting schedules as part of documented pre-blast checks.		Administrative	As with Ref.13	Complete
Add actions from the Quarterly Creek Diversions inspection reports to CMO to ensure they are followed up.		Administrative	Noted. During 2018 these inspections have been captured in CMO.	Complete
Disused sediment fence at the Lower Betty's Creek diversion is removed if no longer required.		Administrative	Removed in 2018	Complete
Continue monitoring for rill erosion on the batters of the diversion.		Administrative	Now included in each Quarterly Creek Diversions inspection	Complete
Report the progress of the River Oak Tree plantings in the Annual Reviews		Administrative	Progress and action plan included in 2018 Annual Review	Complete
Approval from DP&E should be sought for the Rehabilitation Strategy.		Administrative	Rehabilitation Strategy final version submitted to DP&E in 2018 and awaiting approval.	Awaiting approval
All recommendations from DPI-Water letter dated 14/03/17 should be included in the RMP (Updates to Table 20) at next review.		Administrative	Rehabilitation Management Plan (MOP) was revised in 2018.	Complete
Recommend a comparison of the environmental performance against the predictions in the environmental		Administrative	Section 6 of this report	Complete

IEA Ref	Description	Risk	Mt Owen Response and Action Plan	Status
assessments is made in the Annual Reviews for all aspects (Sch 5, Con5).				
Recommend that responses to the previous audit recommendations are included in future Annual Reviews (Sch 5, Con 12).		Administrative	Table 61 of this report	Complete
DA 80/952 Non-compliance Recommendations				
Recommend all required approvals for construction of new buildings are obtained and records of approval kept for any future construction (Sch 2, Con 10).		Administrative	Construction of new buildings is classified as complying development under Mining SEPP Clause 11. Occupation certificates available.	Complete
Recommend that a protocol to obtain the final completion against the GDP or relevant sign off is obtained from contractors to show that works have been completed in accordance with GDP. The GDP completion should be updated to CMO or an equivalent database (Sch 2, Con15)		Administrative	Site has developed a GDP register which includes scans of closed out permits	Complete
Recommend pre-blasting checks are considered prior the blasting and appropriate management measures implemented (Sch 3, Con 16)		Low	As Ref 13	Completed
Recommend that any reports to landholders are provided with a cover letter and recorded internally in a database (or similar) as evidence of compliance (Sch 3, Con 18). / Noted. To be added to CMO as required.		Administrative	Historic reports to landholders provided with a cover letter and saved as a meeting referenced to Section 3.9 of the SES	Completed
Recommended EPA and DPI - Water are consulted for fte revisions of the LMP (Sch 3, Con 39)		Administrative	2018 MOP revision was sent to EPA and DPI Water	Complete
Recommend the BOMP is updated to include a description of riparian revegetation and maintenance works associated with the Transmission Line when next updated.		Administrative	BOMP reviewed and approved by DPE on 2018.	Completed
DA 80/952 Continual Improvement Recommendations				
Recommend that landowners are notified about right to property inspection on a 5 yearly basis to allow for change in ownership and/or good practice.		Administrative	Landholder's notifications distributed 2017. Recurring action for every five years.	Completed
Consider direct seeding for River Oaks for large areas that may be required.		-	Noted. Progress and action plan included in 2018 Annual Review	Completed
Recommend that Table 2-2 of the BOMP is updated to include this condition at the next revision. Clarification of which documents are contained in the MOP and BOMP under this condition should be added to the plans.		-	BOMP reviewed and approved by DPE on 2018.	Completed
EPL 10860 – Ravensworth East				
Consider whether the production capacity can be reduced from >2000000-3500000 T annually.		Administrative	EPL variation is being reviewed by MGO and will be submitted in 2019	Pending
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	Condition 8 was taken from EPL variation and will be submitted in 2019	Pending
EPL 12840 – Glendell				
Recommend map in EPL 12840 - Glendell is updated to include monitoring point 6 (N3).		Administrative	Updated premises map was submitted to EPA in 2018.	Completed
If Glendell has a sewerage system this should be added to the EPL and relevant council approvals sought.		Administrative	Council approvals received, will be added to EPL at next variation	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			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
CL358 - Glendell				
Recommend the Annual Review is updated the include Environmental Incident Report as part of Annual Review.		Administrative		
General Recommendations				
Community	Commitment 7 of the SGRP relates to community complaints being investigated in accordance with the GCAA Community Handling Procedure. Suggest this is removed at the next update	Administrative	SGRP revised in 2018 currently with with DPE for approval. Commitment removed.	Complete
Noise	The NMP states noise monitoring will occur monthly for the initial 12 months following approval and triggering of SSD-5850, then will occur quarterly unless directed otherwise by the Secretary. However, the Glendell EPL 12840 requires monthly noise monitoring at defined locations, therefore quarterly noise monitoring is not sufficient to address this EPL condition. A revision to the NMP is recommended to address this issue.	Administrative	NMP reviewed and approved by DPE in 2019	Complete
Waste	It is suggested that a review or census is conducted to determine the amount of waste tyres on site. / Noted. Findings to be included in the 2018 Annual Review.	Administrative	Table10 of this report	Complete
Heritage	Recommend that completed actions in the ACHMP are added as an appendix at next review. / Noted. The ACHMP was revised in May 2018. Completed commitments were removed from the body of the plan and included in the Appendix.	Administrative	Completed actions included in the ACHMP as an appendix	Complete

The next Independent Audit is to be scheduled for Q4 2020. The audit report and recommendations is located on the MOC website:

www.mtowen.com.au

11 Incidents and Non-Compliances 2018

MOC reported four (4) non-compliances during 2018, as detailed in **Table 62**.

Table 62: Non-Compliances Reported in 2018

Agency	Approval	Description	Follow up/ Action taken

NSW DP&E	DA SSD-5850, Schedule 3, Condition 16 (Table 6: Short term impact assessment criteria for PM_{10})	PM_{10} dust monitor Sx10-G2 recorded a project specific result of 50.6 µg/m³ on 24 July 2018. This exceeded the short-term impact assessment criterion of 50 µg/m³ for PM_{10}.	• Extensive action was taken in the 24hrs leading up to the exceedance to minimise dust generation from North Pit and Bayswater operations.
			• Below average rainfall during 2018 contributed to dry conditions throughout the Hunter Valley.
			• Notification was made to DP&E and no further action was required.
			• Further details are provided in the incident report attached in **Appendix C**.
			• MOC continue to implement best-practice dust management measures, including:
			  • training and coaching shift supervisors and plant operators on alertness to downwind dust levels, and trends towards exceedances
			  • investigations into the use of chemical dust suppressants
			  • commissioning of a secondary water fill point in closer proximity to the pit to minimise haul distance of water carts
			  • replacement of smaller water carts with ones of larger capacity

NSW DP&E	DA SSD-5850, Schedule 3, Condition 15 (Blast Management Plan)	At 1.33pm on 5 September 2018 a blast was fired in the Mt Owen mine C9E_3356 block while the MOC 1 blast monitor was offline being serviced. This resulted in a failure to monitor, which is a non-compliance with the approved MOC Blast Management Plan.	• Blast notifications to key personnel had been completed by Thiess personnel prior to the blast however the Glencore E&C Officer's email address was not on the notifications list. This meant that the Glencore E&C Officer was unaware that a blast was scheduled to occur at the same time that the monitor was due to be serviced and could not advise Thiess personnel to reschedule the blast. • MOC 1 blast monitor was operational at the time that the pre-blast checklist was completed (approx 12pm). The monitor was taken offline for maintenance between 1.00pm and 1.40pm. • An external consultant (Enviro Strata Consulting Pty Ltd) was engaged to estimate MOC 1 blast results for C9E, using C9E blast details and weather data supplied by Thiess personnel. The estimated blast results for MOC 1 were below MOC's blast criteria (see consultant's report in **Appendix E**).
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.	• It is noted that these non-compliances occurred in the previous reporting period however they were only identified during the preparation of the Annual Compliance Report for EPBC 2013/6978, which was prepared in May 2018.

Agency	Approval	Description	Follow up/ Action taken
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 2019

Table 63 list activities recognised during 2018 that should aid in improving the overall environmental performance at the MOC for 2019 reporting period.

Table 63: Performance Improvement Summary for 2019

Aspect	Implementation Timeframe	Effect on Management Plans	Improvement Action
Rehabilitation	Q1-Q4	Nil	Introduce remote sensing to the rehabilitation monitoring programme. Implement maintenance activities in line with 2018 Annual rehabilitation walkover report recommendations.
Noise Analysis Tool	Q1-Q2	Nil	Further improve the NAT and expand its use to include Thiess Operations at Mt Owen
Management Plans	Q1-Q2	Revisions to all plans	Review the commitments in all approved management plans to remove duplications across licences
Creek Diversions	Q3	Nil	Further implement the actions from the Upper Betty's Creek Diversion Remediation Plan and add to 2018 remediation works.
Independent Compliance Audit	Q1-Q4	Nil	Complete the recommendations in the Hansen Bailey Compliance Audit
Mine Operations Plan	Q4	Revised MOP	New MOP to be compiled once 2018-19 MOP currently with DRG is approved. This MOP will be required past the 2019 calendar year.
Water Monitoring and Reporting	Q1-Q2	Revisions to the Water Management Plan suite	Implement revision of water management plan once approved from DP&E and complete recommendations from 2018 Annual groundwater review.
Cultural Heritage	Q4	Nil	Progress the Wollombi Brook Cultural heritage Keeping & Teaching Place with the Bulga mine