

Annual Review 2019

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Ravensworth Complex Annual Environmental Review	
Name of Operation	Ravensworth Complex
Name of Operator	RAVENSWORTH OPERATIONS PTY LIMITED
Development Consent/ Project Approval #	PA 09_0176 and DA 104/96
Holder of Development Consent/ Project Approval	RAVENSWORTH OPERATIONS PTY LIMITED
ROC Titles/ Mining Leases	ML1325, ML 1357, ML1393, ML1502, ML 1576, ML 1669, ML 1683, MLA 322, CL 380, CL 378, CL 580, CCL 723, CCL 739.
RUM Titles/ Mining Leases	ML 1348, ML 1349, ML 1398, ML, 1416, ML 1477, ML 1484, ML 1485, ML 1495, ML 1506, ML 1564, ML 1580, ML 1581, ML 1591, ML 1595, ML 1625, ML 1667, ML 1668
Name of holder of Mining Lease	RAVENSWORTH OPERATIONS PTY LIMITED
Water Licence #	20SL037759, WAL10771 (replaces 20SL045564), 20BL170797, 20BL170749, 20BL170462, 20BL171344, 20WA200463, 20BL171784, 20BL171785, 20BL171786, 20BL171787, 20BL171788, 20BL171789, 20BL171790, 20BL171996, 20BL172050, 20BL172051, 20BL172052, 20BL172710, 20BL172711, 20BL173560, 20BL173561, 20BL173562, 20BL173563, 20BL173566, 20BL173574, 20BL168240, 20WA200745, 20AL200744 (WAL9050), 20BL171346, 20BL171394, 20BL170776, 20BL171459, 20BL171476, 20BL172413, 20BL172442, 20BL172735, 20BL173096, WAL13102, 20BL171422, 20BL168023, WAL1046, WAL8964, WAL1325
Name of holder of Water Licence #	RAVENSWORTH OPERATIONS PTY LIMITED/ CUMNOCK
MOP/ RMP start date	1 July 2017
MOP/ RMP end date	31 December 2020
Annual Review start date	1 January 2019
Annual Review end date	31 December 2019
<p>I, Klay Marchant, certify that this audit report is a true and accurate record of the compliance status of Ravensworth Complex for the period 1 January 2019 to 31 December 2019 and that I am authorised to make this statement on behalf of Ravensworth Complex.</p> <p><i>Note.</i> <i>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.</i> <i>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).</i></p>	
Name of authorise reporting officer	Klay Marchant
Title of authorise reporting officer	Environment and Community Manager
Signature of authorised reporting officer	
Date	31 March 2020

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1 Statement of Compliance

A summary of compliance at Ravensworth Complex is provided in **Table 1-1**.

Table 1-1: Statement of Compliance

Approvals	Compliant?
Project Approval 09_0176	NO
DA 104/96	YES
EPBC 2010_5839	YES
EPL 2652	NO
ML# 1325	YES
ML# 1327	YES
ML# 1348	YES
ML# 1349	YES
ML# 1357	YES
ML# 1393	YES
ML# 1416	YES
ML# 1477	YES
ML# 1495	YES
ML# 1398	YES
ML# 1502	YES
ML# 1506	YES
ML# 1564	YES
ML# 1576	YES
ML# 1580	YES
ML# 1581	YES
ML# 1591	YES
ML# 1595	YES
ML# 1625	YES
ML# 1667	YES
ML# 1668	YES
ML# 1669	YES
ML# 1683	YES
ML#1667	YES
ML#1668	YES

Approvals	Compliant?
CL# 380	YES
CL# 378	YES
CL# 580	YES
CCL# 723	YES
CCL# 739	YES
WAL 10771	YES
WAL 009050	YES
WAL 001046	YES
WAL 8964	YES
WAL 1325	YES

The non-compliances during the 2019 reporting period are discussed further in Section 11. The non-compliances categories are described in **Table 1-2**. A summary of the non-compliances with Project Approval 09_0176, EPL 2652 and relevant Mining Leases during the reporting period have been summarised in **Table 1-3**.

Table 1-2: Statement of Compliance Key

Risk Level	Colour code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless for the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> Potential for serious environmental consequences, but it is unlikely to occur; or Potential for moderate environmental consequences, but is likely to occur
Low	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> Potential for moderate environmental consequences, but it 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)

Table 1-3: Summary of Non - Compliances

Relevant approval	Condition #	Condition description	Compliance Status	Comment	Where addressed in the Annual Review
PA 09_0176	Schedule 3, Condition 20	All reasonable and feasible avoidance and mitigation measures are undertaken so that particulate matter emissions generated by the Ravensworth mine complex do not exceed the criteria listed in Table 10 (short term PM ₁₀ criterion) at any residence on privately-owned land or on more	Non-compliant	31 exceedances of the PM ₁₀ short term criteria occurred in 2019	Section 6.4.2.1 and Section 11

		than 25 percent of any privately-owned land.			
EPL 2652	M2.2	Continuously monitor PM ₁₀ at Point 9 and 10 (TEOM G1 and G2)	Non-compliant	Continuous PM ₁₀ data was not acquired.	Section 6.4.2.1 and Section 11

2 Introduction

The Ravensworth Complex comprises the following operations:

- Ravensworth Open Cut (ROC), which includes Narama, Narama West and Ravensworth North (this reporting period mining in Ravensworth North only);
- Ravensworth Underground Mine (RUM); and
- Ravensworth Coal Handling and Preparation Plant (RCHPP).

Figure 2.1 shows the layout of the Ravensworth Complex.

This Annual Review is for the reporting period 1 January 2019 to 31 December 2019. It includes PA 09_0176 (ROC), DA104/96 (RUM), various mining leases, and associated environmental management plans for the Ravensworth Complex.

Copies of this Annual Review will be made available to the Department of Planning, Industry and Environment (DPIE), the Resources Regulator (RR), the Biodiversity and Conservation Division (BCD) and the Environment Protection Authority (EPA). Copies and/or a link to the company website will also be provided to the members of the Ravensworth Complex Community Consultative Committee (CCC). A copy will also be made available on the Ravensworth Open Cut and Ravensworth Underground Mine website in accordance with PA 09_0176 and DA 104/96 for any public person to access.

2.2 The Ravensworth Complex

Ravensworth Open Cut (ROC)

ROC is owned and operated by Ravensworth Operations Pty Limited, which is managed by Glencore. An Environmental Assessment (EA) was submitted for the Ravensworth Operations Project in February 2010. The EA was approved by the Department of Planning, Infrastructure and Environment (DPIE) on 11 February 2011 (PA 09_0176). The approval granted the expansion of existing approved mining operations at ROC and enabled the consolidation of existing approvals for open cut mining and infrastructure within the Ravensworth area. The single project approval has enabled the amalgamation of operational aspects of the mining operations, which has facilitated a consistent and integrated approach to environmental management and mine planning.

Modifications to PA 09_0176 include:

- Modification 1 - Approved by the DPIE in August 2013, allowing for mining within the Narama West area at ROC;
- Modification 2 - Prepared and submitted in 2014, and was approved by the DPIE in December 2014. Modification 2 allows for an increase in height of the overburden emplacement areas (OEAs). This enables ROC to undertake landscape design to shape the OEAs with additional undulation and diversify topography so the final landform will blend with the surrounding natural topography. The area of the approved mining is outlined in Appendix 2 of PA09_0176.
- Modification 3 - Approved by the DPIE on 16 February 2016 and approved construction and operation of a tailings pipeline from the RCHPP at Ravensworth to the Mount Owen West Pit Void.

Ravensworth Underground Mine (RUM)

RUM has been managed by Glencore since February 2008. RUM is a joint venture operation between Resource Pacific Pty Limited (owned by Glencore and Marubeni) and Posco. As the majority shareholder of Resource Pacific Pty Ltd, Glencore oversees the management of RUM.

The area of land within the approved RUM development consent boundaries is owned by RUM, AGL Macquarie, Daracon, Ravensworth Operations Pty Limited, Glendell, and I. Bowman Pty Ltd. Where necessary, RUM undertakes consultation with the relevant parties, including consultation during the preparation of EA modifications and Subsidence Management Plan (SMP) applications.

RUM operates under development consent DA 104/96 dated 20 November 1996 (File No. N95/00395/001). A ninth modification (MOD 9) was submitted during 2012, primarily relating to changes in the longwall (LW) layout of the Liddell Seam (Liddell Seam Project). MOD 9 was approved by the DPIE on 20 June 2013.

The original 1996 development application was supported by an EA for the construction and operation of an underground coal mine. Through subsequent EA modifications, RUM has an approved maximum production of 7 Mtpa of ROM coal.

RUM's existing approved surface facilities include workshops, stores, employee amenities, access roads, offices, car parks, open air storage areas, sewage treatment facilities, water management infrastructure, ventilation infrastructure, and diesel and oil storage. ROM coal is transferred to the RCHPP for processing. Export coal is loaded into trains at this facility and transported to the Port of Newcastle along the Newdell Branch Line and Main Northern Railway.

RUM was placed in Care and Maintenance in October 2014.

In accordance with provisions of Schedule 1B Clause 14 of the Mining Act 1992, the Minister suspended the labour and expenditure conditions of RUM, effective from 14 July 2017, until 12 July 2018. In May 2018, Ravensworth applied to extend the suspension until 2021. This application was approved on the 15 March 2019. The suspension takes effect from 7 March 2019 for a period until 12 July 2021.

Ravensworth Coal Handling and Preparation Plant

RCHPP is located adjacent to the RUM pit top. Once the coal from ROC or RUM reaches the ROM stockpile it is required to be managed by RCHPP. RCHPP is managed under PA 09_0176.

RCHPP also receives product coal from Muswellbrook Coal Company. Coal is either fed directly into one of the three modules (20 Mt/year) at a rate of up to 3,600 tph prior to being loaded onto trains, or bypassed directly to domestic customers.

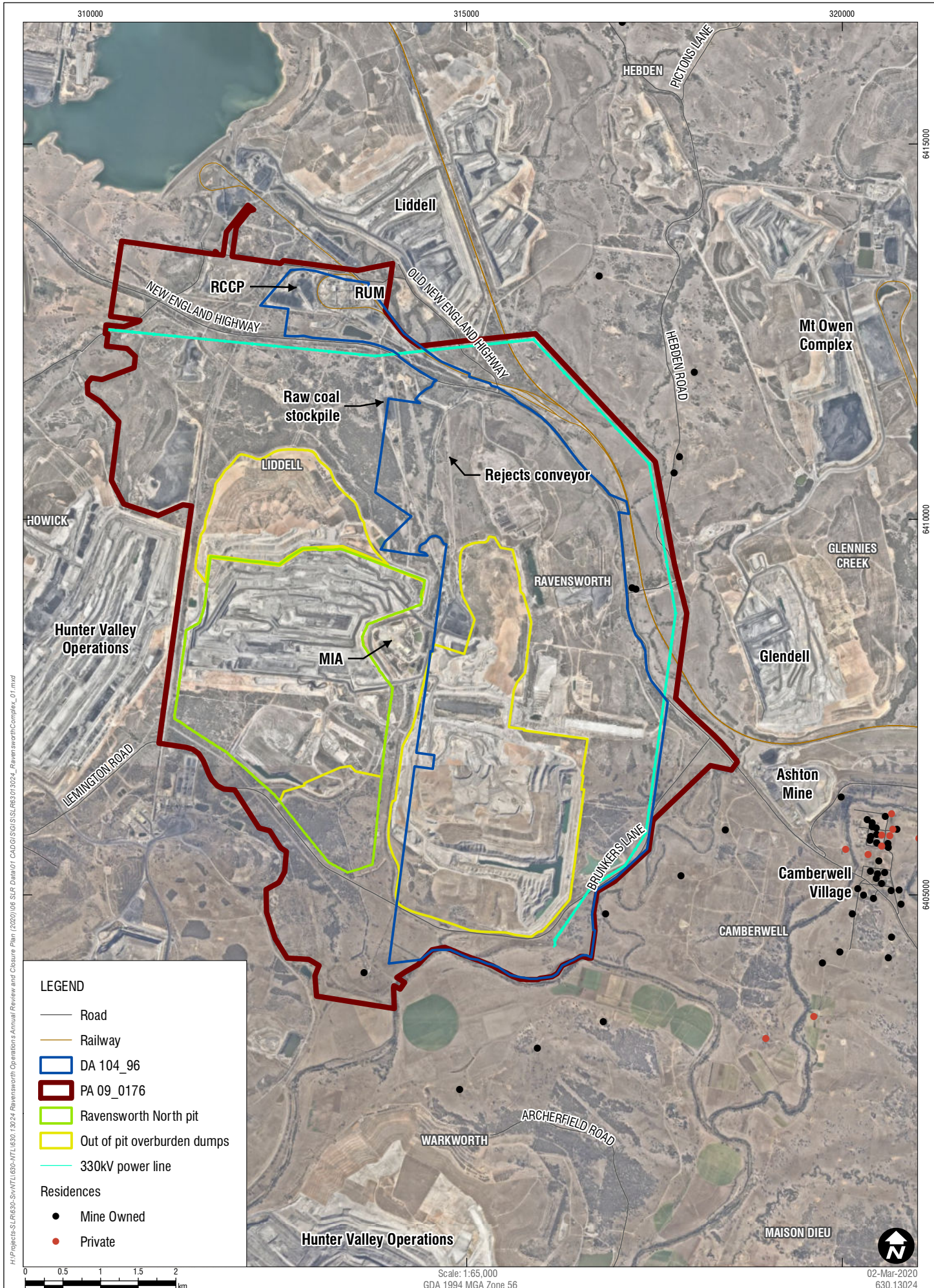
2.3 Mine Contacts

The relevant contact details for ROC, RUM and the RCHPP are shown in **Table 2-1**.

Table 2-1: Mine Contacts

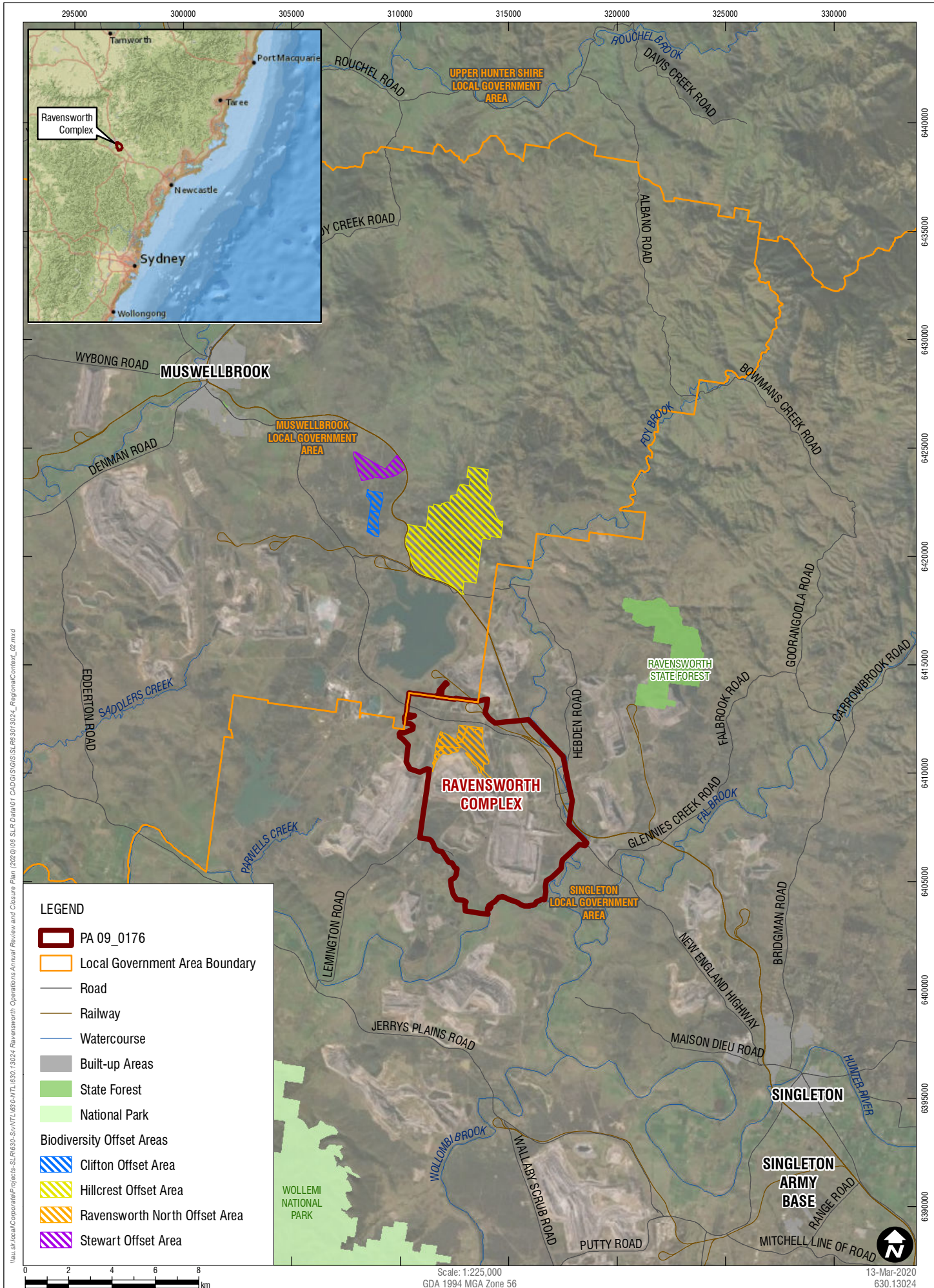
Name	Title	Contact Details
ROC	General Enquiries	Phone: 1800 620 553 Phone: (02) 6570 0700 Fax: (02) 6570 0747 Address: Lemington Road, Off New England Highway Ravensworth, via Singleton, NSW 2330 Postal: PO Box 294, Muswellbrook, NSW 2333 http://www.ravensworthoperations.com.au
RUM / RCHPP	General Enquiries	Phone: 1800 620 553 Fax: (02) 65700 747 Address: Liddell Station Rd, Ravensworth NSW 2330 Postal: P.O Box 528 Singleton 2330 https://www.ravensworthoperations.com.au/en/Ravensworth-Underground-Mine
Tony Israel	Operations Manager	Phone: (02) 6570 0700 Fax: (02) 6570 0747 E-mail: Tony.Israel@glencore.com.au
Dan Hallam	RCHPP Manager	Phone: (02) 6570 9337 Fax: (02) 6576 1511 Email: Dan.Hallam@glencore.com.au

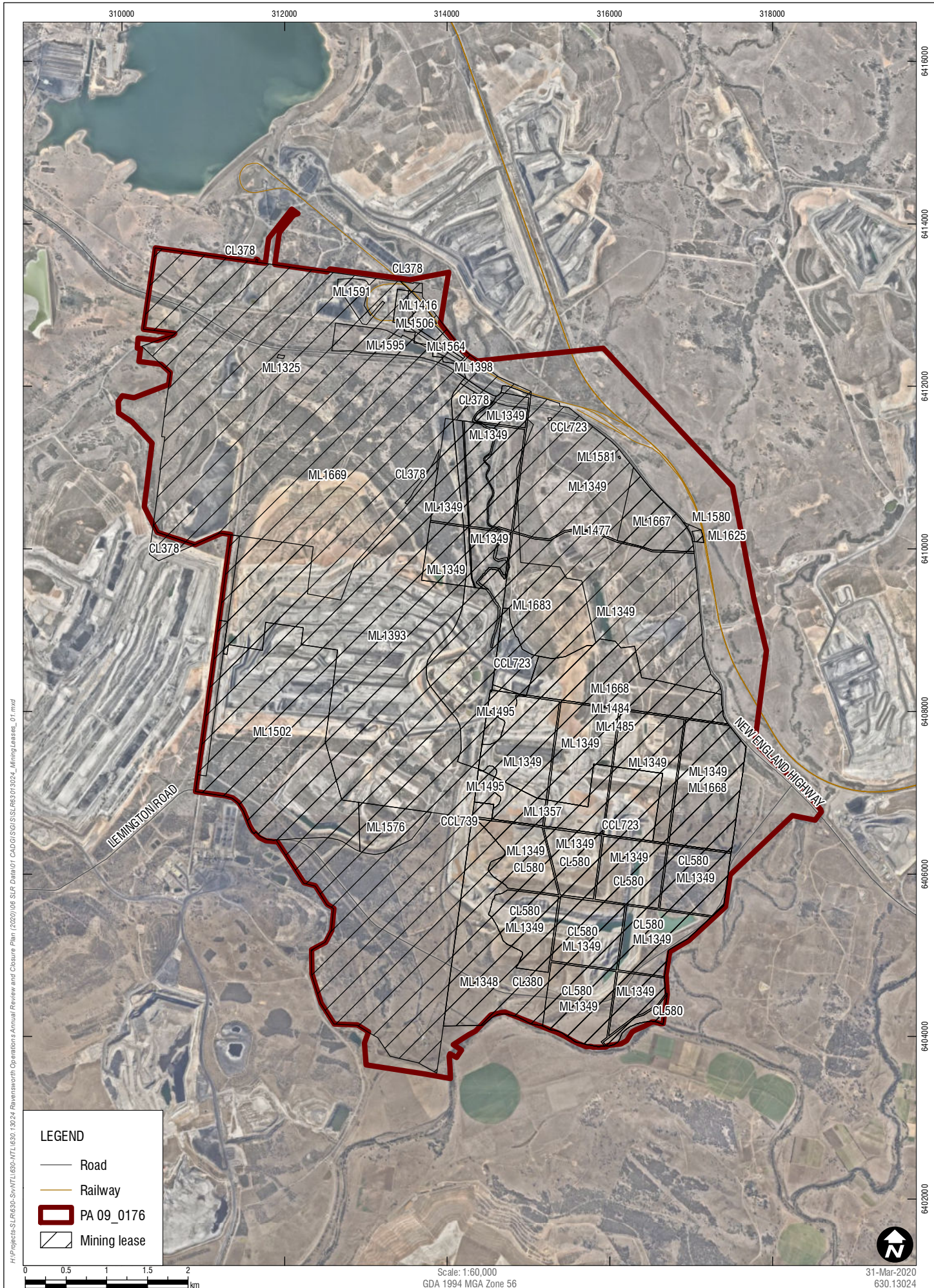
Name	Title	Contact Details
Klay Marchant	Environment & Community Manager (Ravensworth Complex)	Phone: (02) 6570 0700 Fax: (02) 6570 0747 Email: Klay.Marchant@glencore.com.au



Source: Nearmap (January 2020)

Sheet Size : A4





Source: Nearmap (January 2020)

Sheet Size : A4

The Ravensworth Complex Mining Lease Boundaries

FIGURE 2.3

3 Approvals

Operations at Ravensworth Complex are regulated by a range of leases, licences and approvals which are summarised below. No amendments, variations, changes or new approvals were obtained by the Ravensworth Complex during 2019.

3.1 Project Approval

Ravensworth Operations operate under Project Approval PA 09_0176 (granted on 11 February 2011), in accordance with the Ravensworth Operations Project Environmental Assessment dated February 2010 (2010 EA) and subsequent EA modifications. The 2010 EA related to the extension of existing mining operations and additional open cut mining and out of pit emplacement areas. PA 09_0176 allows for an annual production of up to 16 Mtpa until 2039. This project approval has been modified three times (see **Table 3-1**).

A separate approval applies to RUM; Development Consent (DA 104/96).

This Annual Review has been completed to fulfil the requirements of Schedule 5, Condition 3 of PA 09_0176 and Schedule 4, Condition 2 of DA 104/96.

Table 3-1: Ravensworth Complex PA 09_0176 Modifications

Approval	Title	Date Granted
09_0176	Original Approval	11 February 2011
09_0176 Mod 1	Extraction of approximately 2.7 million tonnes of coal in the Narama West mining area.	16 August 2013
09_0176 Mod 2	Allow for an increase in final landform heights to accommodate a more stable free flowing natural landform.	19 December 2014
09_0176 Mod 3	Construction and operation of a tailings pipeline from the RCHPP at Ravensworth Operations to the Mount Owen West Pit Void.	16 February 2016

3.2 Licences

3.2.1 Environment Protection Licence

Ravensworth operate under Environment Protection Licence (EPL) 2652, with an anniversary date of 12 January. Monitoring results are reported to the EPA as part of the Ravensworth Operations Pty Ltd Annual Return and monitoring data is available on the Ravensworth website.

During the reporting period Ravensworth Complex EPL was varied once: 1577443 – 1 April 2019 s.58 Licence Variation:

- Condition P1.3 - update to the Hunter River Salinity Trading Scheme (HRSTS) discharge and monitoring point type description;
- Condition M10.1 - updated reference to the HRSTS telemetry guidance document;
- Condition E2 - removed; and
- Condition E1.3 - inclusion of an hourly volume discharge limit.

The environmental reporting and monitoring activities undertaken at Ravensworth as required under EPL 2652, are discussed in **Section 6**.

3.2.2 Surface and Groundwater Licences

Ravensworth holds a number of surface and groundwater licences, which allow for surface and groundwater extraction and monitoring. Further details regarding these licences are provided in Section 7.2 and 7.3.

3.2.3 Radiation Licences

Radiation licences held by the site include Licence 5078362 with an expiry of 5 February 2020. This licence is held for fixed radiation gauges installed at the coal handling and preparation plants. There are 11 gauges in total which are inspected every two years to ensure they comply with EPA compliance requirements. The next scheduled inspection is in January 2020.

3.2.4 Other Approvals

3.2.4.1 Management Plans

The status of site Management Plans are summarised in **Table 3.2**. In accordance with Schedule 5, Condition 4 of PA 09_0176, Ravensworth will review, and if necessary, revise, the strategies, plans and programs required under the consent within three months of this Annual Review, to the satisfaction of the Secretary of the DPIE.

During the reporting period three Management Plans were submitted to DPIE for approval. These Management Plans included the Blast Management Plan, Water Management Plan and Aboriginal Cultural Heritage Management Plan (ACHMP). The ACHMP and Water Management Plan are yet to be approved by DPIE.

Table 3-2: Environmental Management Plans Status at 31 December 2019

Document	Reference	Approved
COMPLEX		
Ravensworth Complex Environmental Management Strategy (EMS)	PA 09_0176 Schedule 5, Condition 1	10 September 2018
Pollution Incident Response Management Plan (PIRMP)	Pollution Incident Response Management Plan	25 May 2019
Ravensworth Complex Noise Management Plan (NMP)	PA 09_0176 Schedule 3 Condition 9	10 September 2018
ROC / RCHPP		
Ravensworth Complex Blast Management Plan (BMP)	PA 09_0176 Schedule 3 Condition 17	5 February 2020
Ravensworth Complex Air Quality and Greenhouse Gas Management Plan (AQGGMP)	PA 09_0176 Schedule 3 Condition 24	10 September 2018
Ravensworth Complex Water Management Plan (WMP)	PA 09_0176 Schedule 3 Condition 31	21 September 2017 Updated plan awaiting DPIE approval.
Ravensworth Complex Biodiversity Management Plan (BioMP)	PA 09_0176 Schedule 3 Condition 31	10 September 2018
Ravensworth Complex Rehabilitation Management Plan (MOP/RMP)	PA 09_0176 Schedule 3 Condition 41	September 2017 – December 2020
Ravensworth Complex Heritage Management Plan (HMP)	PA 09_0176 Schedule 3 Condition 42	10 September 2018

Document	Reference	Approved
Aboriginal Cultural Heritage Management Plan (ACHMP)	PA 09_0176 Schedule 3 Condition 42	10 September 2018 Updated plan awaiting DPIE approval.
RUM		
Ravensworth Underground Air Quality and Greenhouse Gas Management Plan	DA 104/96, Schedule 2, Condition 14	December 2014
Biodiversity, Rehabilitation and Land Management Plan	DA 104/96, Schedule 2, Conditions 4, 7. Mining leases	Approved by the DP&I in 2012.
Lighting Management Plan	DA 104/96, Schedule 2, Condition 5.	Approved by the DP&I in 2012.
Bushfire Risk Hazard Reduction Management Plan	DA 104/96, Schedule 2, Condition 6.	Approved by the DP&I in 2012.
Mining Operations Plan – Care and Maintenance	DA 104/96	November 2017 – December 2020

3.2.4.2 Mining Operations Plan (MOP)

The Ravensworth Complex Mining Operations Plan (MOP) was amended in twice in 2019 (Amendment B and Amendment C) to include the Cumnock Rehabilitation Management Plan and the monitoring and maintenance plan for the rehabilitation of the Western Emplacement Area (WEA). MOP Amendment C was approved on 25 October 2019.

4 Operations During the Reporting Period

4.1 Mining Operations

During the reporting period, mining and coal preparation occurred at the Complex at Ravensworth North and RCHPP. RUM has remained in care and maintenance from October 2014.

During the reporting period, a total of 68,409 million bank cubic metres (Mbcm) of overburden was mined in Ravensworth North Pit to allow the extraction of 14.9 million tonnes (Mt) of Run of Mine (ROM) coal. No mining was undertaken at Narama, Narama West pit and RUM during the reporting period.

A summary for the Ravensworth Complex is outlined below (**Table 4-1**). Schedule 2, Condition 6 of PA 09_0176 stipulates that no more than 16 Mt of ROM coal will be produced through open cut mining and no more than 21 Mt of ROM coal will be produced by Ravensworth Operations as a whole. Ravensworth Operations produced 14.9 Mt of ROM coal during 2019.

Table 4-1: Complex Production and Waste Summary 2019

Material	Cumulative Production and Waste			
	Start of Reporting Period (Cumulative)	End of Reporting Period (Cumulative)	Next Reporting Period (Actual)	2019 Total (Actual)
Ravensworth North				
Prime Overburden (Mbcm)	347,102	415,511	66,830	68,409
ROM mined (kt)	62,683	77,605	14,738	14,922
Saleable Product (kt)*	40,940	50,331	10,044	9,391
RUM				
ROM Coal (kt)	0	0	0	0
Product Coal (kt)	0	0	0	0
RCHPP				
Coarse Waste Reject (t)	16,394,913	19,934,753	3,004,000	3,539,840
Fine Waste Reject (t)	10,453,249	12,444,409	1,690,000	1,991,160

4.2 Exploration

No exploration was carried out in 2019.

4.3 Construction

No construction was carried out in 2019.

4.4 Land Preparation

Land clearing is undertaken in accordance with the Ravensworth Environmental Management System. Areas are assessed prior to clearing to minimise potential ecological, water management, sediment and erosion and cultural heritage impacts in accordance with the pre-clearing requirements. During 2019 70ha at the Ravensworth Complex was levelled/contoured and topsoiled, in preparation for rehabilitation. During the reporting period 21.4ha was disturbed and 7.8ha was re-disturbed (i.e. Ravensworth West rehabilitation area). The Ravensworth West 30ML Dam (W125) was decommissioned during 2019 due to pit progression.

4.5 Mineral Processing

4.5.1 Rejects Emplacement and Tailings

4.5.1.1 Coarse Rejects

Rejects are conveyed from the RCHPP to a reject bin, where they are collected by haul trucks. The haul trucks transport rejects via internal haul roads for co-disposing in the overburden emplacement areas in accordance with regulatory approvals.

4.5.1.2 Tailings

During 2019, tailings were emplaced in the Mount Owen West Pit Void through the Greater Ravensworth Area Water and Tailings Strategy (GRAWTS).

At Ravensworth, the coarse and fine rejects are disposed together. The sub 120 µm reject material is disposed of as tailings through the thickeners.

A total of 3,539,840 coarse rejects and 1,991,160 of fine tailings reject produced by the RCHPP were disposed of into approved storage areas.

4.5.2 Train and Conveyor Movements

Product coal is transported to the port of Newcastle by rail only. RCHPP train movements are summarised in **Table 4-2**. All levels are compliant with the conditions set out in Schedule 2, Condition 7 of PA 09_0176, which specify that no more than 18 train movements (average) will occur each day, and no more than 20 million tonnes of product coal will be transported to/ from the RCHPP/RCT. Records of all train movements are provided in **Appendix A**.

Table 4-2: RCHPP Train Movements 2019

Train Movements	Total
Annual Average Daily Train Movements	2.2 movements per day
Max Daily Train Movements	6 max movements per day
Total Train Movements for 2017	804 total train movements
Annual Average Daily Train Tonnage	17,666 tonnes per day*
Max Daily Tonnes	87,015 tonnes
Total product coal loaded from RCHPP	6,448,015 tonnes
Average train loading time	116.1 minutes
Total loading time	1,360 hours
Average Load Rate	4,741 tonnes per hour

4.6 Waste Management

Waste is managed in accordance with the *Ravensworth Complex EMS*. The EMS has been developed in accordance with the requirements of the *Protection of the Environment Operations Act 1997* (POEO Act).

4.6.1 Waste Management and Reporting

The disposal of waste generated on the site is undertaken in accordance with existing regulatory guidelines and established site procedures. **Table 4-3** below provides waste generation for the Ravensworth Complex during 2016, 2017, 2018 and 2019. The total amount of waste that was disposed of and recycled at the Ravensworth Complex in 2019 was 3,809 tonnes and 3,196 tonnes, respectively. Since 2016 a high percentage of waste was recycled at ROC and RCHPP. The largest portion of waste was recycled at RUM, over 4 years.

Table 4-3: Waste Disposal and Recycling at the Ravensworth Complex

Site	Waste Disposed offsite (t)	Waste recycled (t)	Total waste produced (t)	Waste Recycled (%)
ROC 2019	3,481	2,932	4,065	83.8
ROC 2018	3,092	2,538	5,664	82.1
ROC 2017	2,652	2,298	4,277	53.7
ROC 2016	2,639	2,313	5,765	87.7
RUM 2019	150.6	146.1	150.6	88.1
RUM 2018	14.7	2.1	14.7	28.6
RUM 2017	13.3	5.9	13	22.1
RUM 2016	28	16	80	56
RCHPP 2019	177.8	117.7	397.2	63.5
RCHPP 2018	424	354	454	83.5
RCHPP 2017	252	194	313	70.3
RCHPP 2016	227	174	248	76.7

Ravensworth Operations reviews its waste minimisation strategies on an as needs basis.

4.7 Product Coal

4.7.1 RCHPP

A total of 9.3 Mt of product coal was transported by rail to the Port of Newcastle.

4.8 Next Reporting Period

4.8.1 Mining

During 2020, coal extraction will continue in the Ravensworth North Pit. Forecast production for 2020 in accordance with the MOP is 14 Mt of ROM coal and 9 Mt of product coal. Mining in 2020 will remain the same as in 2019 with the equivalent mining equipment, personnel and mining techniques to be utilised in-pit. Ravensworth North will continue progressing in line with the mine plan (and MOP) with rehabilitation expected to reach MOP predictions.

4.8.2 Exploration

At ROC five exploration holes are proposed. All proposed exploration holes are within the current mining footprint and are planned primarily for coal quality, water pressure and geotechnical monitoring.

4.8.3 Construction

There is no construction planned for 2020.

4.8.4 Coarse Rejects and Tailings Disposal

During 2020 coarse rejects will continue to be co-disposed of in overburden emplacement waste areas in accordance with current statutory approval.

Tailings will be pumped into approved tailings areas during the next reporting period. Capping of 7 South Tailings Storage Facility is planned for 2020.

5 Actions required at Previous Annual Review Inspection

5.1 2018 Annual Review Actions

A reconciliation of the actions required from the previous Annual Review and actions taken in response by Ravensworth during the reporting period are outlined in **Table 5.1**.

The DPIE-RR advised on 14 August 2019 that the 2018 Annual Review was to the satisfaction of the Minister for Resources and Secretary for the DPIE.

After the lodgement of the 2018 Annual Review the RR undertook an inspection of the site. This resulted in a Section 240B of the *Mining Act 1992* being issued by RR on 2 July 2019. The notice required *“Amend the Mining Operations Plan to include a maintenance and monitoring schedule for all rehabilitation areas at the Western Emplacement Area that include:*

- *Specific and quantifiable monitoring parameters to identify and assess erosion features including rilling, scouring and gullyng. The Mining Operations Plan must nominate values or ranges to indicate satisfactory performance and "trigger values" or thresholds that indicate the emergence of performance issues or failure of remedial works carried out to satisfy this Notice;*
- *Specified timing of the monitoring events; and*
- *Appropriate management actions to be implemented if monitoring identified that any trigger values or threshold conditions have been met.”*

MOP Amendment C was prepared by Ravensworth in response to the notice.

Table 5-1: Actions from DPIE 2018 Annual Review

No.	Issue/Recommendation	Response from Ravensworth Complex
Department of Planning, Industry and Environment (18 April 2019)		
1	Regional Context Layout – please include the Biodiversity Offset Areas (BOAs);	The BOAs have been included in Section 2, Figure 2.2 .
2	Air Quality – please include the air quality monitoring results as an appendix to the report; and	The air quality results have been appended to the report (refer to Appendix B).
3	Independent Audit – please include a status update on the 2018 Independent Environmental Audit (IEA) Response to Auditor Recommendations (RAR) actions, as per the IEA and RAR acceptance letter dated 28 March 2019.	A status update on the 2018 Independent Environmental Audit (IEA) Response to Auditor Recommendations (RAR) actions, as per the IEA and RAR acceptance letter dated 28 March 2019 are included in Section 10, Table 10.1 .
4	As per Schedule 5, Condition 10 of the ROC approval, please make a copy of the 2018 Annual Review publicly available on the company website by 30 April 2019.	Refer to the ROC website: https://www.ravensworthoperations.com.au/en/publications/Pages/AEMR.aspx

6 Environmental Management and Performance

6.1 Environmental Risk Assessment

An environmental risk assessment workshop was held in February 2019 and the following key environmental risks were identified at the Ravensworth Complex:

- Rehabilitation;
- Air Quality;
- Noise and Vibration;
- Land Contamination;
- Water Quality;
- Weeds and Pests; and
- Aboriginal and Cultural Heritage.

6.2 Operational Noise

6.2.1 Environmental Management

Noise monitoring and management is outlined in the *Ravensworth Complex Noise Management Plan (RAVOC-1007099517-20)* which is available on the Ravensworth website.

Noise monitoring consists of both attended and unattended monitoring to meet the requirements of the PA 09_1076, DA 104/96 and EPL 2652. Noise monitoring locations are shown on **Figure 6.1**.

In addition to conducting noise monitoring, Ravensworth continues to implement a number of mitigation strategies with regard to the management of noise to minimise potential noise impact on nearby receivers, and to comply with the relevant conditions of the Project Approval.

6.2.2 Environmental Monitoring Results

6.2.2.1 Results from the reporting Period

Noise monitoring results for the reporting period are provided in **Appendix C**. Relevant noise criteria, as outlined in (PA 09_0176 Schedule 3 Conditions 2, 3 and 4) and compliance status is set out in **Table 6-1** and **Table 6-2**. As indicated by **Table 6.1** and **Table 6.2** and the results included in **Appendix C**, there were no exceedances (non-compliances) of noise approval criteria during the reporting period.

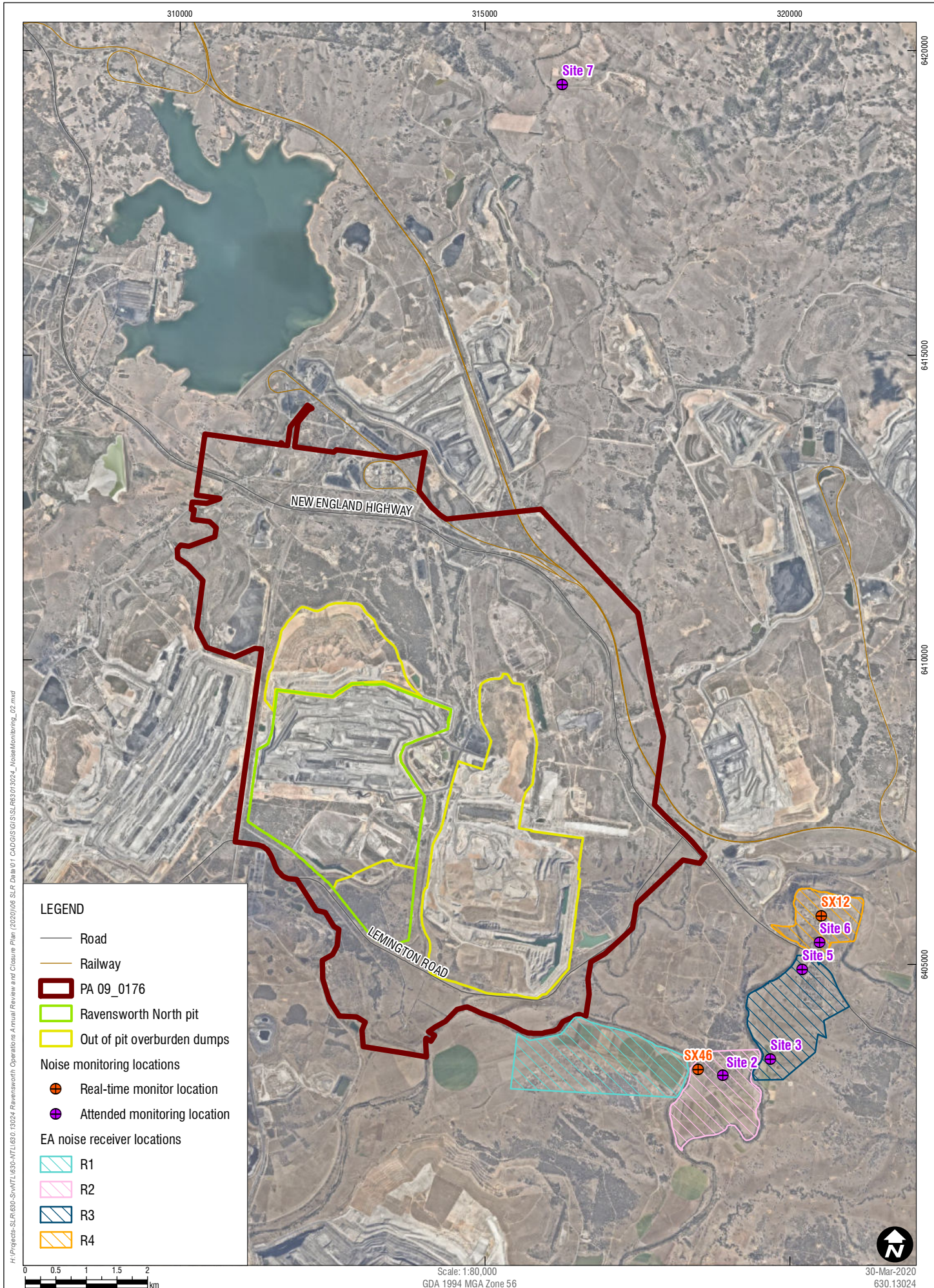


Table 6-1: Noise Criteria dB(A) and performance for 2019 reporting period.

Receiver Location	Receiver	Compliance Limit	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Performance during Reporting Period. See Appendix C for 2019 summary results
R2	2 – A Bowman	35	31	45	Compliant
R3	3 – W. Bowman	35	29	45	Compliant
	5 – Camberwell Sth	35	<20	45	Compliant
R4	6 - Camberwell Nth	35	<20	45	Compliant

*Cumulative noise assessment RUM night time criteria is LA (1 min)

Table 6-2: Cumulative noise criteria dB(A) LAeq (period) and performance for 2019 reporting period.

Receiver Location	Receiver	Cumulative LAeq (dB)	Noise Criteria	Performance during Reporting Period. See Appendix C for 2019 summary results
R2	2 – A Bowman	28	40	Compliant
R3	3 – W. Bowman	26	40	Compliant
	5 – Camberwell Sth	<20	40	Compliant
R4	6 - Camberwell Nth	34	40	Compliant

6.2.2.2 Comparison with Predictions

As indicated by the results in **Appendix C**, all noise monitoring results were within predicted levels for the reporting period.

6.2.2.3 Long Term Trend Analysis

The results are generally consistent with prior years (going back to three years). All results over the last four years have been within approved noise criteria.

6.2.3 Key Performance and Management Issues

There were no performance or management issues in relation to noise during the reporting period. This included no noise complaints.

6.2.4 Proposed Improvements

No management actions are required. Ravensworth will continue to use site procedures, processes and systems to manage noise. Noise monitoring will also continue to be undertaken.

6.3 Blasting and Vibration

6.3.1 Environmental Management

Blasting at Ravensworth is undertaken in accordance with the *Ravensworth Complex Blast Management Plan (RAVOC-1007099517-20)*, developed in accordance with Schedule 3, Condition 17 of PA 09_0176. ROC has a number of procedures in place to manage the impacts of blasting including overpressure, vibration, fume and dust.

In order to minimise the effect of meteorological conditions on blasting impacts, the following strategies are employed:

1. Notification of all blasts to neighbouring mines, the Council, and community members prior to any blasts;
2. An inversion impact assessment is undertaken based on a full day predictive model for the Hunter Valley;
3. A dust and fume plume assessment is undertaken using a predictive model; and
4. Real time monitoring of onsite weather conditions is conducted to minimise dust generated from blasting when wind conditions (speed and direction) could result in impacts at community locations.

Ravensworth Complex holds EPL 2652 that includes Condition L6, which limits blasting to the following criteria at private residences only:

1. The maximum overpressure limit is 120 dB(L); with only five percent of all blasts for the year permitted to exceed 115 dB(L);
2. The maximum vibration limit is 10 mm/sec; with only five percent of all blasts for the year permitted to exceed 5 mm/sec; and
3. Blasting is to be carried out between 0900 hours and 1700 hours, Monday to Saturday unless approved by the DPIE and EPA.

6.3.2 Environmental Monitoring Results

6.3.2.1 Results from the reporting Period

A record of all blasting compliance during the reporting period can be found in **Appendix D. Table 6-3** indicates performance of Ravensworth with regards to Schedule 3, Condition 10 of PA 09_0176.

During the reporting period the following three events recorded blast overpressure and vibration results greater than criteria specified in Schedule 3, Condition 10 of PA 09_0176, these were investigated and summarised as follows.

- Blast RN8_ULD_BL12 & RN8_MLDPS_BL12 was fired at 13:09 on the 9 September 2019. The Camberwell Village blast monitor recorded an overpressure level of 115.3 dB which is above

the limit of 115 dB, however still below the 5% allowable exceedances for blasts > 115 dB and < 120 dB.

- Blast RN10_BAYS_BL19 was fired at 16:12 on the 5 March 2019. The Ravensworth West monitor, the closest monitor to the Hunter Valley Conveyor, recorded a vibration result of 111.66 mm/s. Ravensworth engaged an independent third party (Bellairs Consulting Pty Ltd) to undertake an investigation into the event. The findings were as follows:
 - The Ravensworth West monitor is 70 m closer to the blast than the conveyor and therefore not representative, it was recommended that the monitor be shifted as close to the conveyor as possible.
 - Blast modelling indicated that based on the result at the Ravensworth monitor and distance to the conveyor, the actual vibration which would have been experienced at the conveyor would be 47.8 mm/s. A temporary monitor was placed next to the conveyor.
- Blast RN10_BAYS_BL20 was fired at 13:13 on the 13 March 2019. The Ravensworth West monitor, the closest monitor to the Hunter Valley Conveyor, recorded a vibration result of 106.53 mm/s. The temporary monitor located at the Conveyor recorded an actual vibration result of 84.55 mm/s.

As a result of the investigation and subsequent results recorded by the temporary monitor, it was concluded that the blast vibration generated at the conveyor by the two events was in compliance with the criteria outlined in Schedule 3, Condition 10.

Throughout the reporting period Ravensworth was compliant with all blasting criteria and the specified limit of two blasts per day and ten blasts a week averaged over the 12 month period.

Table 6-3: *Blasting Criteria and Performance for 2019 reporting period*

Location	Approval Criteria			Environmental Performance in this Reporting Period. See Appendix D for 2019 summary results
	Airblast overpressure (dB(Lin Peak))	Ground vibration (mm/s)	Allowable exceedance	
Residence on privately owned land and Camberwell church	120	10	0%	Compliant
	115	5	5% of the total number of blasts over a period of 12 months	Compliant
Ravensthorpe Public School and Chain of Ponds Hotel	133	10	0%	Compliant
Ravensthorpe Homestead	126	10	0%	Compliant
Aboriginal axe grinding groove site (REA86)	-	^c 175	0%	Compliant
1,000ML dam wall and proposed dam wall	-	^b 25	0%	Compliant
Conveyors, including the Hunter Valley Operations conveyor	-	^b 100	0%	Compliant
Main Northern Railway culverts and bridges	-	^b 25	0%	Compliant
Transmission lines	-	^b 50	0%	Compliant
Ashton underground mine	-	^b 6	0%	Compliant

^a Unless otherwise agreed with the relevant owner/s of the residence, and the Proponent has advised the Department in writing of the terms of this agreement.

^b Unless otherwise agreed with relevant infrastructure provider, owner or the regulator (in relation to the dams), and the Proponent has advised the Department in writing of the terms of this agreement.

^c Subject to meeting incremental limits under condition 10A (PA_0176).

6.3.2.2 Comparison with Predictions

The Ravensthorpe Operations Project Environmental Assessment (Umwelt, 2010) assessed the impacts of blasting. The assessment determined vibration and airblast (overpressure) criteria that applied to infrastructure and heritage sites that may be affected by the operations. These criteria are provided in the blast result tables, included in Appendix D.

During the reporting period both blast vibration and overpressure were generally consistent with EA predictions.

6.3.2.3 Long Term Trend Analysis

Since 2014, there have been no blast exceedances.

6.3.3 Key Performance and Management Issues

Two blasting complaints were received during the reporting period. Further details of these complaints are included in **Section 9.2**.

Ravensworth installed a portable monitor closer to the conveyor to produce more representative vibration results at the Ravensworth West monitor.

6.3.4 Proposed Improvements

Ravensworth will continue to use site procedures, processes and systems to manage blast impacts. Blast monitoring will continue to be undertaken.

Blast monitoring locations will continue to be reviewed and updated as mining progresses.

6.4 Air Quality

6.4.1 Environmental Management

Ravensworth operates in accordance with the approved *Air Quality and Greenhouse Gas Management Plan (AQGGMP)*, which is available on the Ravensworth website, and describes air quality management and monitoring requirements associated with the mine.

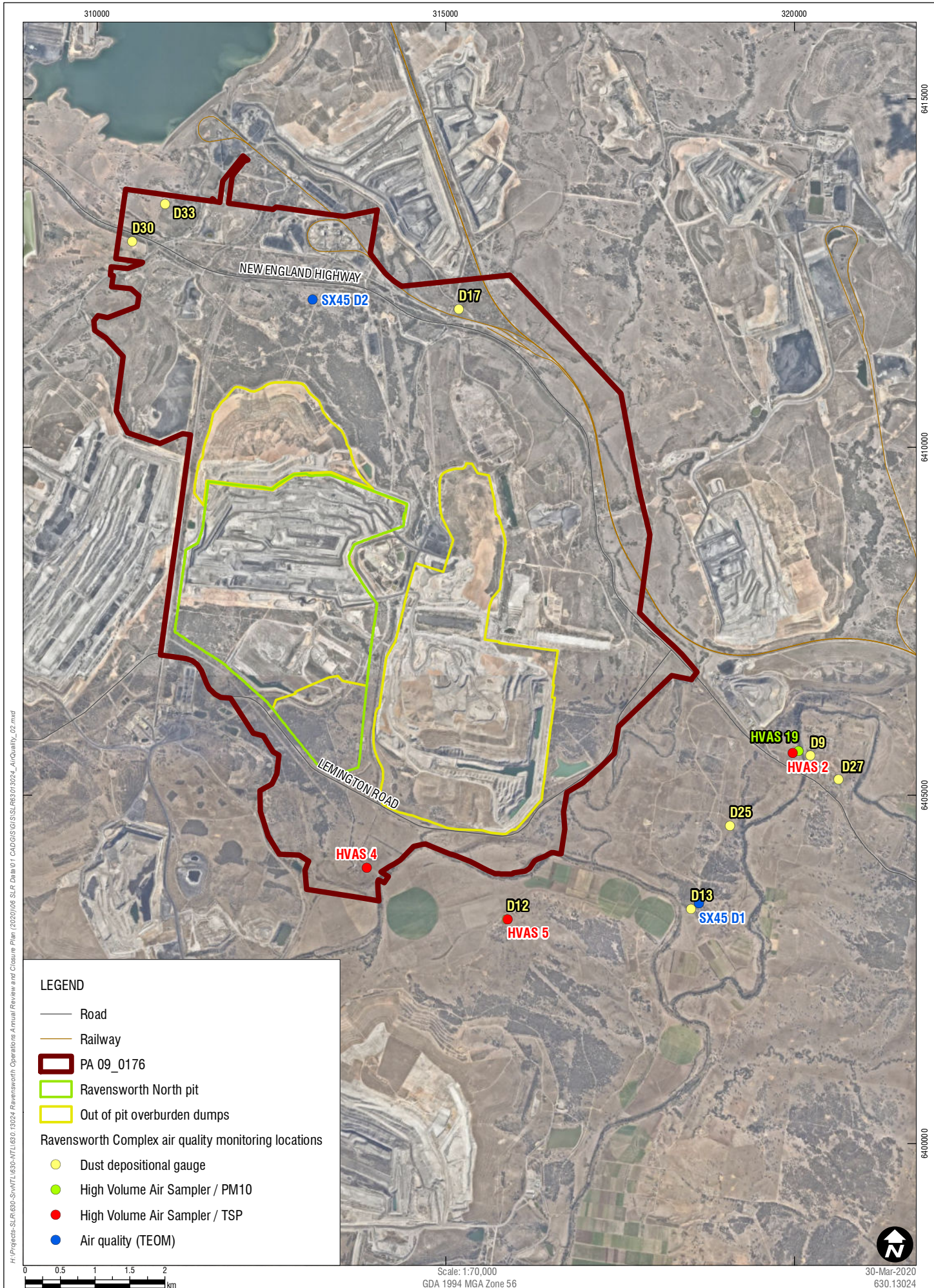
The objective of air quality management at the Ravensworth Complex is to reduce the generation of dust onsite and to minimise dust concentration levels at neighbouring residences. Dust deposition results are reported and reviewed internally, then made available on the website on a monthly basis. Air quality results and the effectiveness of dust mitigation procedures are also reviewed as part of the environmental audit program.

Dust monitoring is undertaken to ensure compliance with Schedule 3, Conditions 20-24 of PA 09_0176. The Ravensworth Complex operates two Tapered Element Oscillating Microbalance (TEOM) units, located to the south east of Narama on the Bowman property (TEOM G1) and to the north-west on Ravensworth owned land (TEOM G2). The location of these TEOM units is shown on **Figure 6.10**. TEOM G1 (EPA Point 9) and TEOM G2 (EPA Point 10) is monitored in accordance with Ravensworth's Environment Protection Licence (EPL) 2652.

Dust monitoring is undertaken at eight depositional dust gauges (depositional dust) and three High Volume Air Samplers (HVAS) (TSP and PM10). This monitoring is used for internal management purposes only.

In accordance with the AQGGMP and site Environmental Trigger Action Response Plan, Ravensworth modifies operations on occasions when exceedances occur. This includes but is not limited to:

- Altering exposed dumping locations to sheltered or in pit dumping locations;
- Shutting down loading units in response to visual dust triggers;
- Postponement of blasting; and
- The application of water continually to all haul circuits.



6.4.2 Environmental Monitoring Results

6.4.2.1 Results from the Reporting Period

An overview of environmental performance for air quality based on TSP and PM10 data (from the site's two TEOMs) and depositional dust is provided in **Tables 6.4 - 6.6**.

The TEOM G1 PM10 rolling annual average was below the 30 µg/m³ PA09_0176 criteria throughout 2019, with an annual average of 27.0 µg/m³. The PM10 24 hour criterion of 50 µg/m³ was exceeded 18 times¹ during 2019.

The G2 PM10 annual average was below the 30 µg/m³ PA09_0176 criteria throughout 2019 with an annual average of 24.9 µg/m³. The PM10 24 hour criterion of 50 µg/m³ was exceeded 13 times¹ during 2019.

See **Appendix B** for further detail on exceedance dates and results. Monitoring results in 2019 were affected by increased dry periods with minimal rainfall. All exceedances were reported in the EPL Annual Return to the NSW Environment Protection Authority (EPA).

The G1 and G2 24 hour average PM10 data for 2019 is provided in the figures included in **Appendix B**. Data gaps during 2019 were attributed to power outages and repairs, resulting in invalid data.

Table 6-4: Long term criteria for particulate matter

Pollutant	Averaging period	Approval Criteria	Environmental Performance this Reporting Period
		Criterion	
Total suspended particulate (TSP) matter	Annual	90 µg/m ³	Compliant
Particulate matter < 10 µm (PM10)	Annual	30 µg/m ³	Compliant

Note: TSP and PM10 performance based on TEOM data

Table 6-5: Short term criterion for particulate matter

Pollutant	Averaging period	Approval Criteria	Environmental Performance this Reporting Period
		Criterion	
Particulate matter < 10 µm (PM10)	24 hour	50 µg/m ³	Non-Compliant

Note: PM10 performance based on TEOM data

¹ Excludes extraordinary days identified by DPIE.

Table 6-6: Long term criteria for deposited dust

Approval Criteria				Environmental Performance this reporting period
Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level	
Deposited dust	Annual	2 g/m2/month	4 g/m2/month	Non-Compliant

Note: Deposited dust results are used for internal management purposes only.

6.4.2.2 Comparison to EA Predictions

Air quality predictions against the 2010 EA are outlined in **Table 6.7 - 6.9**.

Dust Deposition

Comparisons of dust deposition levels (Year 5) predicted in the 2010 EA and 2019 measured averages are shown for privately owned and mine owned residences in **Table 6.7**. All 2019 annual results are greater than the EA predicted values for dust depositional gauges. All gauges were below the project approval criteria of 4.0g/m2/month except for monitor D9 which was just over the criteria.

Table 6-7: ROC Dust Deposition EA Prediction Comparison – Privately Owned & Mine Owned Residences

Monitor	EA Residence ID	Year 5 Prediction		2019 Results
		Ravensworth Contribution	Cumulative	
D9	40B	0.2	0.7	4.3
D12*	34	0.2	0.7	3.9
D13	3	0.2	0.7	3.1
D27	5Z / 12	0.2	0.7	3.1

* Mine owned residence.

HVAS TSP and PM10

Comparisons of HVAS TSP and PM10 levels (Year 5) predicted in the 2010 EA and 2019 measured averages are shown for privately owned and mine owned residences in **Table 6.8** and **Table 6.9**, respectively.

All 2019 annual results are greater than the predicted values for both PM10 and TSP.

Table 6-8 ROC HVAS TSP and PM10 EA Prediction Comparison – Privately Owned Residences

Monitor	EA ID	Year 5 Prediction				2019 Results	
		Ravensworth Contribution (PM10)	Cumulative (PM10)	Ravensworth Contribution (TSP)	Cumulative (TSP)	PM10	TSP
HVAS 2 / HVAS 19	45	5	17	5	41	27*	82*

Note: * Excluding extraordinary events as determined by DPIE

Table 6-9: ROC HVAS TSP EA Prediction Comparison – Mine Owned Residence

Monitor	EA ID	Year 5 Prediction		2019 Results
		Ravensworth Contribution (TSP)	Cumulative (TSP)	
HVAS 4	29P	14	52	84*
HVAS 5	34	13	49	68*

Note: * Excluding extraordinary events as determined by DPIE

6.4.2.3 Long Term Trend Analysis

Reportable exceedances increased from 2017 to 2019 due to extended dry periods. In 2017 there were no exceedances, in 2018 there was 23 exceedances, compared with 31 exceedances in 2019.

TEOM G1 PM10 rolling annual average was higher than the 2015, 2016, 2017 and 2018 average results of 20µg/m³, 21.8 µg/m³, 20.8 µg/m³ and 25.2µg/m³ respectively. The PM10 24 hour criterion of 50 µg/m³ was exceeded a greater number of times during 2019 compared to 2018 (32 exceedances), 2017 (3 exceedances) and 2016 (no exceedances).

The G2 PM10 annual average was higher than 2016, 2017 and 2018 results of 17.4 µg/m³, 17.24 µg/m³ and 24 µg/m³ respectively. The number of exceedances of the PM10 24 hour criterion at G2 increased since 2018 with 38 more exceedances occurring in 2019, compared with 2018.

6.4.3 Key Performance and Management Issues

In August 2019 there was one dust complaint, however this was in relation to dust from a blast event.

6.4.4 Proposed Improvements

Ravensworth will continue to use site procedures, processes and systems to manage dust. Air quality monitoring will continue to be undertaken during the next reporting period.

In 2020 additional monitoring software (RAVDAT) will be implemented. This allows for real-time data and monitoring in the field by OCE's on mobile devices.

6.5 Biodiversity

6.5.1 Environmental Management

Biodiversity is managed in accordance with the *Ravensworth Complex Biodiversity Management Plan (RAVOC-1007099517-20_BMP)*. This plan has been developed and approved in accordance with Schedule 3, Condition 24 of PA09_0176. The Biodiversity Management Plan covers the management of biodiversity at the Ravensworth Complex and biodiversity offset areas (BOAs).

The Ravensworth Complex aims to mitigate effects of mining activities on native vegetation communities, fauna habitat and fauna species by planning and implementing programmes to maintain and improve the biological value of land. The programs are not only for rehabilitation areas but include other potentially degraded sites across the Ravensworth Complex holdings.

A large area has been offset as part of the establishment of Ravensworth North. This has involved the establishment, protection and enhancement of Offset Areas by an Implementation Program, which was approved in 2013. This will provide for the long term conservation of a range of significant ecological features.

6.5.2 Ravensworth Complex

No threatened flora or fauna species were recorded during the field surveys undertaken as part of the RUM 1996 EA due to the high degree of disturbance at the site. The pit top area is almost entirely cleared, with open pasture on gentle slopes and no significant remnant vegetation. One large *Eucalyptus crebra* (narrow-leaved Ironbark) and a number of sub-adults of this species

were identified, along with a small number of *Allocasuarina leuhamnii* (Bull Oak). The shrub layer is mainly absent and the dominant species in the ground layer is *Chloris gayana* (Rhodes Grass). The overall botanical and ecological viability of this area is considered to be low.

The 2009 EA for the Ravensworth Operations Project EA (2010) identified five threatened species in the Pikes Gully LW10 to 15 SMP Application Area. These included three species of bat (Eastern Bentwing Bat, Eastern Freetail Bat, and Large Footed Myotis), one bird species (Speckled Warbler) and one plant species (*Acacia pendula*). No mining activities occurred at Ravensworth underground during the reporting period.

6.5.3 Biodiversity Offset Areas - Overview

Ravensworth Operations owns and manages four BOAs required under NSW Project Approval (PA 09_0176) and the Federal EPBC Approval (2010/5389). The offset areas are managed in accordance with the Ravensworth Complex Offset Area Management Programme (OAMP). A spatial summary of these offset areas is described in **Table 6.10** and shown in **Figure 6.11**.

Table 6-10: Location and size of Ravensworth Operations Offset Areas.

Name	Size (ha)	Location Description
Ravensworth North Offset Area (RNOA)	288	Immediately North of Ravensworth North Open Cut Disturbance Area
Hillcrest Offset Area (HOA)	1402	Approx. 6km North of Ravensworth Complex
Clifton Offset Area (COA)	106	Approx. 7.5km North of Ravensworth Complex
Stewart Offset Area	165	Approx. 10km North of Ravensworth Complex

In accordance with the BMP (Ravensworth Open Cut, 2018), Offset and Green and Golden Bell Frog Management Plan (OMP) (Ravensworth Surface Operations, 2013) and the OAMP (Ravensworth Open Cut, 2019) Ravensworth Operations utilises suitably qualified and accredited ecologists to undertake an annual biodiversity monitoring program across all BOAs.

Biodiversity monitoring is undertaken at the BOAs on an annual basis. Monitoring involves vegetation condition assessments and fauna monitoring at twenty eight permanent monitoring locations across all Biodiversity Offset Areas (BOAs). The results of the 2019 monitoring program are discussed in the following section.

6.5.3.1 BOA Monitoring Results

Fauna

Bird census monitoring in 2019 recorded a total of 44 bird species. Two of these species were recorded in the BOAs for the first time since monitoring commenced in 2012. These comprised the Lewin's Honeyeater and Jacky Winter which were recorded in the Stewart Offset Area and Ravensworth North Offset Area, respectively. A total of four threatened bird species, listed under the *Biodiversity Conservation Act 2016 (BC Act)* and/or the *Environment Protection and Biodiversity Conservation Act 1999* were recorded during the 2019 monitoring programme. The targeted threatened birds, the Regent Honeyeater and Swift Parrot, were not recorded in 2019.

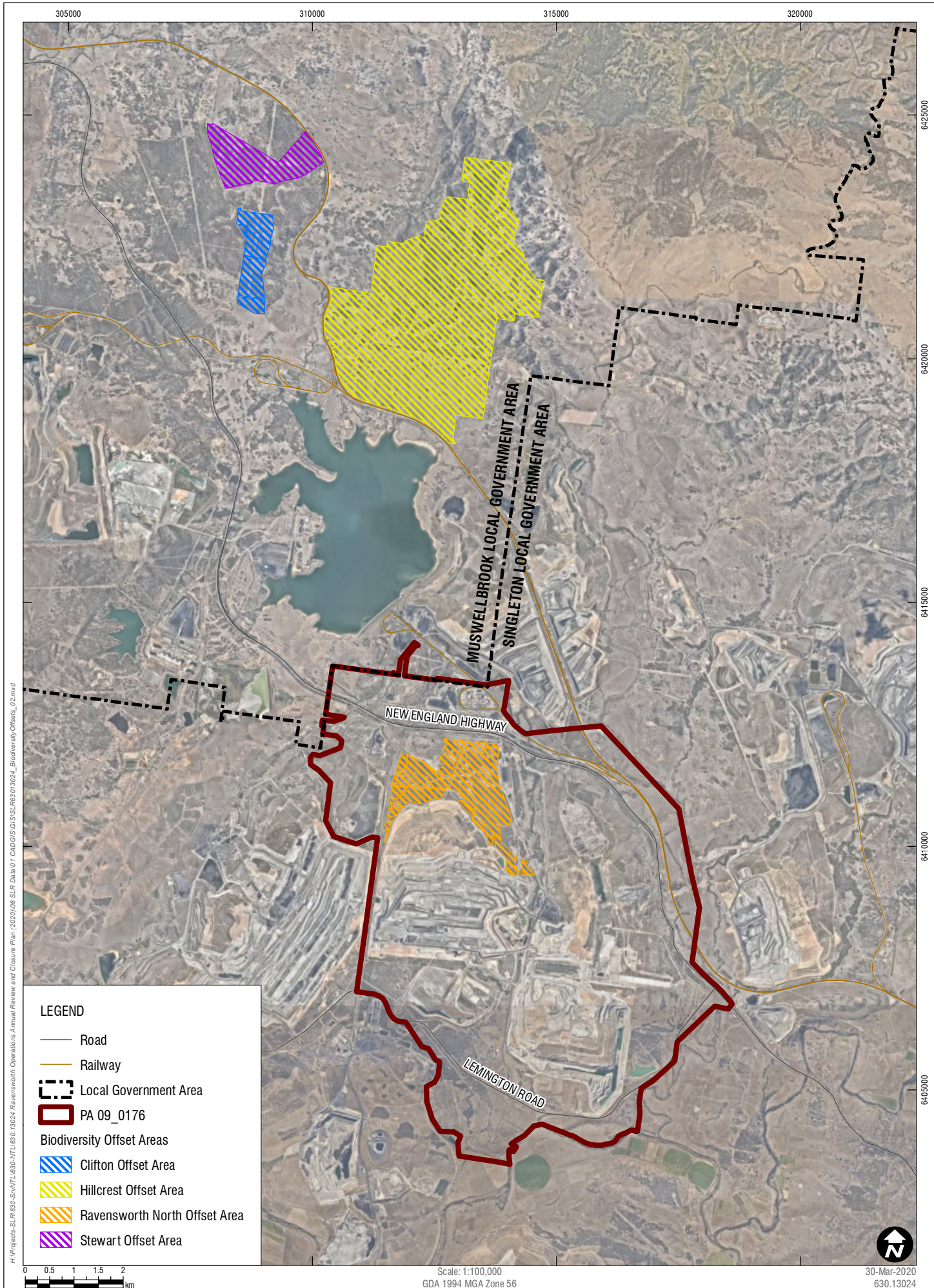
As with the previous monitoring year, bird species composition did not vary greatly between BOAs. Eight species were common across all four BOAs in 2019. With the Australian Raven, Australian Magpie and Noisy Miner most commonly recorded.

Fauna monitoring in the Ravensworth North Offset Area indicated a decline in the diversity of mammals recorded. This decline of mammals detected is largely due to additional survey methods conducted in the initial survey years, which attributed to a large number of mammal species recorded. Incorporating this difference in survey effort, no distinct difference in the assemblage of fauna species has been observed. Feral species are evidently still present within this offset area with the European Rabbit most commonly recorded in 2019. Slight alterations in fauna monitoring methods have been recommended in order to improve the likelihood of sightings of these and all faunal species.

Flora

Canopy regeneration assessments revealed that most sites showed some sign of natural regeneration occurring. There remain a few sites however which continue to show no signs of natural regeneration and focus should be made on these areas for assisted regeneration efforts.

Species richness in grassland sites remained fewer than those of woodland sites, with the extent of this difference much more pronounced than the 2018 monitoring survey. These results in 2019 were much more representative of the monitoring years prior to 2018, where grassland sites contained significantly fewer bird species.



The 2019 monitoring surveys found that the number of native flora species has continued to decline since 2016. The timing of this decline of flora species is in line with drought conditions experienced in the region since mid-2017. Drought conditions are detrimental for flora growth and may be indicative of the lower diversity in flora species recorded during the 2019 monitoring programme.

The 2019 monitoring surveys also found that since 2016, the number of exotic species recorded has continued to decline. Although the number of exotic flora species has declined since the previous monitoring, densities remain high in all BOAs. The highest number exotics were commonly observed in grassland sites, which remains a general trend across all BOAs since monitoring commenced. Of particular concern is the presence of the target species, the Common Prickly Pear, which was regularly observed in three of the four BOAs.

The only BOA which did not contain target weeds species (within monitoring sites) at the time of monitoring was the Stewart Offset Area.

6.5.3.2 Revegetation/Regeneration of BOAs

While most of the Ravensworth Complex BOAs are either well vegetated or expected to become well vegetated through passive regeneration processes, the southern portion of Hillcrest Offset Area (HOA) had been identified as requiring active regeneration. Planting of tubestock woodland species occurred in the southern portion of HOA during 2017 and due to the lack of rainfall received, the success rate was low. Further revegetation of HOA was planned during the 2018 and 2019 reporting period but it has been delayed due to ongoing drought conditions throughout the Hunter Valley. Planting/seeding of this offset area will be undertaken in 2020.

6.5.4 Key Performance and/or Management Issues

Weeds (particularly *Opuntia ficus-indica* [Prickly Pear], *Hypericum perforatum* [St John's Wort], *Lantana camara* [Lantana] and *Hyparrhenia hirta* [Coolatai Grass]) and pests continue to be a focus of management within the BOA areas.

No incidents occurred in the BOAs during the reporting period.

6.5.5 Proposed Improvements

The site's biodiversity and offset areas will continue to be managed consistent with approved management plans. Pest and weed management will be undertaken at the BOAs during 2020.

6.6 Erosion Management

6.6.1 Environmental Management

Erosion and sediment controls have been implemented during the ongoing operation and rehabilitation phases at the Ravensworth Complex to mitigate the potential impacts of erosion and sedimentation on nearby watercourses and the surrounding environment. Standard erosion and sediment control techniques are used in accordance with the requirements of:

- Managing Urban Stormwater: Soils and Construction (the Blue Book), Volume 1;
 - Volume 2A Installation of Services;
 - Volume 2C Unsealed Roads;
 - Volume 2D Main Road Construction; and
 - Volume 2E Mines and Quarries (Landcom, 2004 and DECC, 2008).
-

The main operational erosion and sediment controls used by the Ravensworth Complex include:

- Training;
- Clean water diversion drains and banks;
- Catch drains;
- Sediment fences and other temporary controls;
- Completion of revegetation works;
- Sediment dams; and
- Ongoing maintenance of erosion and sediment control structures.

Erosion measures within the HOA will require management in accordance with the sites ACHMP and consultation with key stakeholders.

6.6.2 Environmental Monitoring Results and Works Undertaken

Monitoring of eroded areas within Ravensworth in 2018 and 2019 identified several areas that required remediation works. These remediation areas included HOA. Cattle have also been excluded from these eroded areas.

Sediment dams and drainage were installed to the south of the Ravensworth North Pit, due to the progression of mining.

A number of sediment dams were also de-silted on site during 2019. These dams included the W111 Dam (Crushing Plant Dam), the sediment dam that is located north of the workshop, the W17 Dam (Sediment Dam 01) and the W1 Dam (Office Dam). General maintenance on the existing silt mesh and de-silting of silt mesh was also undertake on Sediment Dam 01 and along the access road at the toe of Crossing 8 haul road batter rehabilitation. .

Works was also undertaken on the WEA to improve erosion and sediment control, in accordance with the Section 240 notice.

6.6.3 Key Performance and/or Management Issues

Erosion and sediment is actively managed with erosion and sediment controls in place, erosion monitoring undertaken and maintenance works undertaken on an annual basis.

6.6.4 Proposed Improvements

Erosion monitoring will continue to be undertaken during 2020, along with maintenance and upgrades to erosion and sediment controls, as required.

Eroded gullies and drainage lines at the HOA will also be repaired, following the approval of the ACHMP.

6.7 Aboriginal Heritage

6.7.1 Environmental Management

Remaining archaeological (Aboriginal heritage) sites within the Ravensworth Complex Approval boundary (PA 09_0176) are shown on **Figure 6.12**.

A monitoring program is undertaken for Aboriginal heritage sites that are not directly impacted by approved mining activities, in accordance with the Ravensworth Complex ACHMP. Monitoring is conducted on an annual basis. Results from the monitoring program are discussed below.



6.7.2 Environmental Monitoring Results

The Aboriginal monitoring program involved Aboriginal stakeholders and an archaeologist, inspecting a number of heritage sites within the Project Approval boundary but outside of the impact area for the purpose of ensuring site management objectives were being met.

During the 2019 Aboriginal heritage survey, seven additional sites were recorded. These included two isolated finds and five artefact scatters.

The survey also indicated that in general, natural erosion is a significant issue for a number of Aboriginal sites within the Ravensworth Project Area. In many cases the erosion has been severe in the past and is now beginning to stabilise, although in other cases the erosion it is on-going and sometimes extensive². The result of this erosion leaves two very different archaeological contexts: the visible artefacts within eroded areas and possible archaeological deposits in non-eroded portions of a site.

The archaeological landscape surviving at ROC is generally in poor condition due to the long history of impacts including vegetation clearing, soil loss and the impacts of agricultural, residential and mining activities. The sites are often located in landforms with thin soils and only rarely were surface artefacts visible at the sites. This would tend to indicate that the recorded artefacts have been obscured either by being covered (unlikely in landforms with already thin soils), or more probably, being relocated by water movement or sheet wash erosion.

Aboriginal sites at ROC are fenced and sign posted. No impacts other than natural deterioration were noted at any of the monitored sites and it is noted that the fencing program has aided the lack of inadvertent impacts to sites.

6.7.3 2019 Improvements

During the reporting period the following was undertaken to improve heritage management at the site:

- Removal of rubbish at artefact sites REA86 and REA144;
- Completed fencing repairs at sites RUM-OS1, REA144, REA232 and REA394;
- Installed signage at REA 232 and REA 394;
- Fenced sites REA88 and REA250;
- Placed erosion controls (hay bales) at sites RW32, CUM-30, REA148, CUM-43, NARD2, REA32, REA68, REA188, REA228; and
- Undertook a gap analysis and review of the Ravensworth Complex Aboriginal Heritage Information Management System (AHIMS) and the Ravensworth Complex Aboriginal Heritage Geospatial database.

6.7.4 Key Performance and/or Management Issues

During the reporting period there was no salvage of Aboriginal heritage items. There were no complaints or incidents involving Aboriginal heritage sites.

6.7.5 Proposed Improvements

Ravensworth Complex will continue to hold the monitoring program site inspections on an annual basis in accordance with the project ACHMP. This will include monitoring of sites identified as a priority in the 2019 monitoring program, as they were not monitored in 2019. These sites include RW32, REA148, CUM-43 and REA191.

² Note: Erosion is due to natural processes and not directly a result of mining operations.

Sites that will be replaced in the 2020 monitoring program will include REA229.

6.8 European Heritage

The Ravensworth Complex has committed to the following heritage management measures in the *Heritage Management Plan*:

- Manage blasting practices to meet relevant blast impact assessment criteria at listed heritage sites / items within the vicinity of the Project Area; and
- Structural assessment of the Oakland's complex buildings at key stages of the mining process, this complex is to be removed from further monitoring.

6.8.1 Environmental Monitoring Results

An A structural assessment inspection of the Oaklands homestead site was undertaken WSP on the 27 November 2019. The purpose of the inspection was to document the structural condition of the buildings and other structures on the site. The results of the inspection are summarised below:

Main Building External:

- Main building was generally in average condition;
- Front veranda required repairs for safety;
- Dry rot present in architectural timber;
- Roof sheets either bent or dislodged; and
- External concrete steps required re-levelling.

Main Building Internal

- The building was showing some signs of movement but nothing considered excessive for the period of the house; and
- The toilet, bathroom and master bedroom require further investigation to determine cause of the foundation settlement and recommendation for remedial works.

External Outbuildings

- Repairs to the outside laundry would be required. Noting that the material is likely to be asbestos;
- Most of the stables are fit for purpose but do not conform to Australian Standards;
- The water tank is near collapse and would need to be demolished;
- The shed complex identified as Building 7 on the site plan is in an unsafe condition. Significant restoration will be required to salvage any areas of historical value. The building should be secured via fencing due to safety concerns; and
- The shed with a mezzanine floor has significant termite damage. Recommendations for mezzanine floor to be demolished and the building to be cordoned off until remediation.

Generally the following recommendations were provided:

- Recommended that all buildings be inspected by a qualified pest inspector for termite activity; and
 - A risk assessment be undertaken to determine if further structural analysis of the sheds will be required prior to occupation.
-

6.8.2 Key Performance and/or Management Issues

During the reporting period the Ravensworth School was destroyed due to fire. The fire was reported to DPIE, the Environment, Energy and Science (EES) Group (formerly OEH), Singleton Council and the NSW Police. The site has been fenced off.

6.8.3 Proposed Improvements

Further assessments of the Oaklands Homestead are proposed in 2020 prior to any activities being undertaken.

6.9 Meteorological Monitoring

The Ravensworth Complex has a weather station onsite to measure atmospheric conditions, including wind speed, wind direction, sigma-theta, humidity, rainfall and temperature. This allows up to date predictions to be made on the impact of weather conditions on mining operations. A summary of results is provided in **Appendix E**.

6.9.1 Average Temperature and Windspeed

Throughout the reporting period the average mean wind speed was 2.34 m/s.

The average mean air temperature (at 10m) was 19.5 degrees Celsius. The hottest temperature recorded was 43.9 degrees Celsius, and this was experienced in January 2019.

6.9.2 Rainfall

During the reporting period a total rainfall of 354 mm was received. This was less than the previous year when 451.8 mm of rain was received. The largest amount of rainfall was received during the months of January 2019 to March 2019.

6.10 Weed and Pest Management

6.10.1 Environmental Management Activities and Monitoring Results

6.10.1.1 Weed Management Activities

Monthly environmental inspections at the Ravensworth Complex are used to identify areas of weed infestations as well as review the success of previous weed control programs.

Weeds are controlled in order to assist successful establishment of rehabilitated areas, maintain pasture quality and provide a productive post mining land use. Weed management also occurs in buffer lands to protect the existing biodiversity of these surrounding areas and remove potential seed banks for weed invasion into rehabilitated areas. The control of noxious weeds is conducted in accordance with the *Noxious Weed Act 1993*.

A summary of weed control activities at the Ravensworth Complex and in BOAs is presented in **Table 6.11**. Weed control was predominantly conducted in rehabilitation pasture areas, buffer lands and BOA's. Weed inspections completed across rehabilitation areas during annual long term rehabilitation monitoring and walkover inspections completed in Spring 2019. Weed infestations were recorded in the GIS database.

Table 6-11: The Ravensworth Complex Weed Control Methodologies at the Ravensworth Complex and in BOAs

Weed	Control Method
Galenia	Targeted with Grazon
St John's Wort	Targeted with Grazon
Prickly Pear	Targeted with Grazon
Mother of Millions	Targeted with Roundup Biactive
African Olive	Targeted with Galon
Acacia Saligna	Cut and paint

6.10.1.2 Feral and Pest Animal Management Activities

The management strategy for feral animals continued with baiting program conducted during the reporting period. The program was carried out by an experienced consultant and adhered to all best practice guidelines set by NSW Environment, Energy and Science (previously known as OEH) and the Local Land Service (formerly Livestock Health and Pest Authority). Baiting programs were conducted in Spring at the offsets areas (RNOA, COA, HOA and Stewart) and also on-site, at ROC and RCHPP. The 2019 program used a baiting approach of 1080 lethal baiting to target wild dogs and foxes.

During 2019, the number of baits taken by wild dogs and foxes in offset areas was 8 and 6, respectively. In total, 28 baits were taken from the operational areas, with 21 baits taken by dogs and 7 baits taken by foxes.

6.10.2 Key Performance and/or Management Issues

No reportable incidents, performance or management issues regarding weeds and feral animal management occurred during the reporting period.

6.10.3 Proposed Improvements

Throughout 2020 weed monitoring will continue to be undertaken, as well as weed and pest management.

6.11 Visual and Lighting

6.11.1 Environmental Management

The Ravensworth Complex employs various management strategies for mitigating and minimising its impacts on the visual amenity from community locations and public roads.

The Ravensworth Complex undertakes regular community inspections. A photographic record is maintained at strategic monitoring locations around the Ravensworth Complex as evidence, and if there are issues identified during the inspection the Open Cut Examiner (OCE) is informed and actions to address any amenity issues from mining operations are completed.

6.11.2 Environmental Monitoring Results

No lighting surveys were undertaken during the reporting period.

6.11.3 Key Performance and/or Management Issues

There were no performance or management issues regarding visual mitigation or lighting during the reporting period.

6.11.4 Proposed Improvements

There are no proposed visual and lighting improvements for 2020.

6.12 Spontaneous Combustion, Methane Drainage and Ventilation

6.12.1 Environmental Management

6.12.1.1 ROC / RCHPP

ROC and the RCHPP have a comprehensive management plan in place that addresses the placement of carbonaceous materials to ensure the potential for spontaneous combustion is minimised. The procedure identifies potential sources of carbonaceous material at the mine and details methods to be used when handling and disposing. A specific training module has been developed to communicate the requirements of this procedure to appropriate personnel.

6.12.1.2 RUM

Methane drainage and ventilation is undertaken by RUM in accordance with the approved Ventilation Arrangements Management Plan (RUM MIN PLN 0018). The plan documents and the management strategies associated with mine ventilation.

6.12.2 Environmental Monitoring Results

One area of minor spontaneous combustion was identified during the reporting period (see Section below for further details).

6.12.3 Key Performance and/or Management Issues

During the reporting period a minor spontaneous combustion event (spot heating) occurred at RUM (eastern emplacement area).

No spontaneous combustion events occurred at ROC / RCHPP.

6.12.4 Proposed Improvements

Improvements to spontaneous combustion, methane drainage and ventilation are not proposed for the 2020 period. Current management activities are deemed sufficient.

6.13 Bushfire Management

6.13.1 Environmental Management

Slashing of grasses is conducted on a regular basis where cattle grazing cannot be utilised, such as road verges, infrastructure areas, and sensitive and high risk growth areas to reduce excessive fuels.

The *Ravensworth Complex Bushfire Management Plan* outlines the key mitigation measures for managing bushfire risk at ROC and the RCHPP.

6.13.2 Environmental Monitoring Results

See **Section 6.13.3** below, for details in regards to details about bushfire monitored during the reporting period.

6.13.3 Key Performance and/or Management Issues

There were two grassfires at the Ravensworth Complex during 2020. One was at the Hillcrest Offset Area and the other was on AGL Macquarie owned land within PA 09_0176 area.

There was also a fire at the Ravensworth School during the reporting period. Further details of this fire are provided in **Section 6.8**.

6.13.4 Proposed Improvements

The *Biodiversity Management Plan* and the *Ravensworth Complex Bushfire Management Plan* will be reviewed and updated in 2020. No other improvements are/were required.

6.14 Mine Subsidence

6.14.1 Environmental Management

Ravensworth Underground Mine have a Subsidence Management Plan to ensure adequate management of any subsidence impacts associated with surface cracking, erosion, slope instability, land degradation and spontaneous combustion due to longwall mining.

Visual subsidence monitoring is undertaken and subsidence repairs are completed in accordance with the SMP.

6.14.2 Environmental Monitoring Results

Ravensworth Underground Mine was in care and maintenance during the reporting period and no underground mining activities occurred.

Visual subsidence monitoring continued during 2019. Monitoring did not identify any subsidence related issues.

6.14.3 Key Performance and/or Management Issues

No remedial repair works were required during the reporting period.

6.14.4 Proposed Improvements

There are no proposed improvements in 2020.

6.15 Hydrocarbon and Chemical Management

6.15.1 Environmental Management

All hydrocarbon contaminated waste material within pit, hardstand and truck wash areas is bio remediated and disposed onsite in a bioremediation area. The site has been designed to prevent contamination and the storage and handling of chemicals is undertaken in accordance with Australian Standards and relevant guidelines.

Hydrocarbon contaminated material resulting from spillages in the impervious workshop areas are cleaned up using oil absorbent material. This material is then taken offsite by appropriately licensed

waste contractor to a licensed facility for treatment and disposal in accordance with site procedures as part of the Ravensworth Complex EMS. Hydrocarbon contaminated water is contained and separated in the site's industrial oily water separators where treated water is recycled for reuse and separated oil is disposed of offsite by the licensed waste contractor. In the event of accidental contamination of onsite dams, contaminated water is contained and transported offsite for treatment by a licensed waste contractor.

At the Ravensworth Complex there are a number of procedures in place that deal with the safe handling and disposal of chemicals on the mine site. Safety Data Sheets (SDS) are made available to all employees at the store facility or via the *ChemAlert* computer database, which provides computer based information on all chemicals held onsite.

6.15.2 Environmental Monitoring Results

The bioremediation area is tested once cells are full and dry or inspection deems testing necessary. Cells 1 – 20 were tested in May 2019.

All cells that have been successfully remediated have been removed from the bioremediation area.

All facilities utilised for the storage of chemicals on-site conform to relevant Australian Standards and are regularly inspected as part of the monthly work area safety inspections and internal environmental audits.

The bioremediation area remains in good condition with ongoing maintenance to access and lay-down areas throughout the reporting period as required.

6.15.3 Key Performance and/or Management Issues

Minor spills (Category 1 and below) occurred during the reporting period. There was no Category 2 spills. Contaminated material was taken to the onsite bioremediation area.

There were no significant issues regarding the storage of chemicals throughout the reporting period.

6.15.4 Proposed Improvements

Hydrocarbon spills will continue to be managed appropriately, with any spills cleaned up and contaminated material sent to the bioremediation area.

6.16 Greenhouse Gas and Energy

6.16.1 Environmental Management

The Ravensworth Complex is committed to reducing GHG emissions from its operation. The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cth) provides methods and criteria for calculating GHG emissions and energy data under the NGER Act. Each reporting year technical guidelines based on the Determination are developed, reflecting improvements in estimation methods and in response to industry feedback. The Ravensworth Complex, through Glencore, uses an online reporting tool known as AQS, which calculates energy consumption and GHG emissions for every site in accordance with the technical guidelines.

6.16.2 Environmental Monitoring Results

6.16.2.1 Results from the Reporting Period

Data relating to electricity consumption, diesel usage and liquefied petroleum gas, and the associated greenhouse gas emissions, during the 2019 reporting period is presented in Table 6-12. In 2019, the total emissions produced by ROC were 96,328 which represents a 21.9% increase from 2018.

Table 6-12 GHG Emissions Summary 2019

Emission Source	T CO ₂ -e
Ravensworth CHPP	
<i>Scope 1 Emissions</i>	
Diesel Consumed in Non-Road Registered Vehicles	4,316.49
Diesel Consumed in Road Registered Vehicles	17.80
Grease consumed on site	1.22
Industrial Processes (SF6)	1,161.65
Oils consumed on site	4.20
<i>Scope 2 Emissions</i>	
Electricity	79,644
Sub-total	
Ravensworth OC	
<i>Scope 1 Emissions</i>	
Diesel Consumed in Non-Road Registered Vehicles	263,463.60
Diesel Consumed in Road Registered Vehicles	192.98
Grease consumed on site	50.17
Industrial Processes (SF6)	354.24
LPG Consumed on site	16.35
Oils consumed on site	1,333.50
Petrol Consumed in Road Registered Vehicles	2.68
Open Cut ROM tonnes Produced	46,330.73
<i>Scope 2 Emissions</i>	
Electricity	11,567
Sub-total	11,879
Ravensworth UG	
<i>Scope 1 Emissions</i>	
Industrial Processes (SF6)	230.03
CH ₄ Sent to Vent or Bypass	159,538.52
CO ₂ Sent to Vent or Bypass	1,745.11
<i>Scope 2 Emissions</i>	
Electricity	4,638
Sub-total	4,800
TOTAL	96,328

6.16.2.2 Comparison with Predictions

The Scope 1 and 2 GHG emissions from the Ravensworth Complex have been estimated at the annual average of 869,681 T CO₂ -e. Actual GHG emissions for 2019 were significantly less than predicted levels.

6.16.3 Key Performance and/or Management Issues

There were no significant issues regarding GHG throughout the reporting period.

6.16.4 Proposed Improvements

There are no proposed improvements for greenhouse gas in 2020, with 2019 GHG emissions falling well below predicted levels.

7 Water Management

7.1 Water Balance

The overall water balance for the Ravensworth Complex in 2019 was a deficit of -1,776 ML (-4.8 ML/day) which compares well with the water balance predicted deficit of approximately -1,930ML (-5.3 ML/day) for the Ravensworth Operations Project water balance in a 10th percentile rainfall year in 2019.

Table 7-1: Ravensworth Complex Water Imports, Usage and Exports, 2019 (ML)

Month	Fresh Water Import	Import from GRAWTS	Potable Water Import	Dust Suppression & Wash bays	Export to GRAWTS	HRSTS Discharge
Jan	9.9	83.5	0.3	120.4	565.6	0.0
Feb	4.8	122.3	0.3	141.5	583.5	0.0
Mar	6.9	278.0	0.3	116.3	656.1	0.0
Apr	6.5	350.9	0.4	95.5	539.3	0.0
May	7.1	289.4	0.3	94.4	475.4	0.0
June	6.4	258.5	0.3	78.1	546.9	0.0
Jul	4.9	308.8	0.5	50.1	596.3	0.0
Aug	6.0	216.2	0.4	71.5	566.9	0.0
Sep	7.0	247.3	0.6	101.9	475.5	0.0
Oct	5.7	259.5	0.4	108.7	612.2	0.0
Nov	5.9	281.5	0.3	142.5	666.6	0.0
Dec	5.4	285.8	1.5	143.6	607.6	0.0
Total	76.5	2981.7	5.5	1264.5	6891.9	0.0

7.2 Water Take

Ravensworth Complex holds water access licences (WAL) 9050, WAL 10771 and WAL 18317 that allow for extraction of water from the Hunter River and Bayswater Creek. The RCHPP also holds WAL 1046, WAL 8964 and WAL 1325 which also allows extraction from the Hunter River.

In 2019 three water allocation assignments totalling 74.5 ML with entitlement transferred from WAL 9050 to WAL 10771.

During the 2019 monitoring period, a total of:

- 0 ML of water was extracted from Bayswater Creek, in accordance with the extraction limit of 20 ML under licence WAL 18317;
- 0 ML of water was extracted from the Hunter River by ROC, in accordance with the extraction limit of 425.5 General Security units under WAL 009050 and 1.5ML of the 25 High Security units under WAL 010771;
- 74.5ML of water was extracted from the Hunter River , in accordance with the extraction limit of 74.5ML General Security limits; and
- 0 ML of water was extracted from the Hunter River by RCHPP, in accordance with the extraction limit of 1590 General Security units under WAL 008964 and 3 High Security units under WAL 001046. .

Ravensworth 2019 water take is outlined in **Table 7.2**. The extraction of surface water was undertaken in compliance with the conditions of the relevant licences.

Table 7-2: Surface Water Extractions 2019

Water Licence #	Water Source / Management Zone	Category	Entitlement	Extracted Volume (ML)
WAL10771 (replaces 20SL045564)	Hunter River Regulated / Zone 1b (Hunter River from Goulburn River Junction to Glennies Creek Junction)	General Security (transfer from WAL 9050)	74.5 ^B	74.5
		High Security	25	1.5
WAL 18317	Hunter Unregulated and Alluvial Water Source/Jerry Water Source/Jerrys Management Zone (extraction from Bayswater Ck)	General Security	20	0
WAL 9050 (20AL200462)	Hunter River Regulated / Zone 1b (Hunter River from Goulburn River Junction to Glennies Creek Junction)	General Security	425.5 ^A	0
WAL 8964	Hunter River Regulated / Zone 1b (Hunter River from Goulburn River Junction to Glennies Creek Junction)	General Security	1590	0

WAL 1046	Hunter River Regulated / Zone 1b (Hunter River from Goulburn River Junction to Glennies Creek Junction)	High Security	3	0
WAL 1325	Hunter River Regulated / Zone 1b (Hunter River from Goulburn River Junction to Glennies Creek Junction)	Supplementary	13	0

ROC holds six water licences that allow the extraction of groundwater.

Table 7-3 Groundwater Extractions 2019

Licence #	Water Source / Management Zone	Category	Entitlement (ML)	Extracted Volume (ML)
WAL 41496	Cumnock UG Extraction	None	2,520	257
WAL 41531	Narama Void Incidental Groundwater Interception	None	150	146
WAL 41530	Ravensworth West Pit Void Incidental Groundwater Interception	None	100	0
WAL 41507	Ravensworth North Pit Incidental Groundwater Interception	None	576	6.4
WAL 41529	Ravensworth Underground Mine Dewatering	None	400	0

The extraction of groundwater was undertaken in accordance with the conditions of all relevant licences in 2019.

7.1 Water Supply, Use and Discharges

7.1.1 ROC

The ROC water management system comprises a range of infrastructure including water storages, pipes and pumps for water transfers (within the mine complex and between external water sources and sinks) and instrumentation for flow and level measurement.

Water sources for the ROC include:

- Rainfall / runoff within the ROC and RCHPP;
- Groundwater seepage into operating mine pits (ROC and RUM) and spoils seepage to Narama Pit
- Moisture in ROM coal;
- Groundwater extracted from former Cumnock underground workings;
- Fresh water imported from the Mount Owen Complex or Liddell Mine under the Greater Ravensworth Area Water Sharing Systems (GRAWTS);
- Fresh water pumped from the Hunter River and Bayswater Creek; and
- Potable water trucked to site.

Water demands for the ROC include:

- Evaporative losses from water storages;
- Dust suppression (haul roads, stockpiles and handling) and vehicle wash bay losses;
- Moisture bound with product coal and rejects (coarse and fine);
- Discharges under the Hunter River Salinity Trading Scheme (HRSTS); and
- Transfers to the Mount Owen Complex or Liddell Mine under the GRAWTS.

Surplus surface water at ROC is transferred to the RCHPP or discharged from the Narama In-pit Storage Dam to the Hunter River via Bowmans Creek under the conditions of ROC EPL No. 2652 and the HRSTS or transferred to other Glencore mine sites under the GRAWTS. In 2019, ROC did not discharge any water from the Narama In-pit Storage Dam under the HRSTS and EPL 2652. Furthermore, no unregulated discharges from ROC occurred during 2019. This is consistent with 2018.

There was an increase in water used for dust suppression from 1,154.37 ML in 2018 to 1,264.5 ML in 2019.

There was a decrease in freshwater pumped or trucked to site, from 114.9ML in 2018 to 76.5 ML in 2019.

7.1.2 Hunter River Salinity Trading Scheme

Surface water management across the Ravensworth Complex is undertaken in accordance with the *Ravensworth Complex Water Management Plan*. This plan has been developed in consultation with relevant agencies and approved by the DPIE in accordance with Schedule 3, Condition 31 of PA 09_0176.

Zero (0) ML of water was discharged from the Narama In-Pit Storage Dam during the 2019 reporting period.

The Greater Ravensworth Water Sharing Strategy between other Glencore sites transfers water to the Narama In pit Storage Dam and is the primary discharge point for the Complex.

7.2 Surface Water Monitoring

7.2.1 Environmental Management

Surface water management across the Ravensworth Complex is undertaken in accordance with the *Ravensworth Complex Water Management Plan*. This plan has been developed and approved by the DPIE in accordance with Schedule 3, Condition 31 of PA 09_0176.

The *Ravensworth Complex Water Management Plan* outlines the interactions of the water management system across the sites that form part of the Ravensworth Complex.

The objective of the Ravensworth Complex water management system is to manage all surface and sub-surface water so impacts on the surrounding environment are minimised and to ensure minimal interference to mining production.

The surface water monitoring program includes observation of the following elements of the Ravensworth Complex water management system and surrounding creeks:

- surface water quality;
- on-site water management; and
- discharge to the Hunter River via Bowmans Creek under the Hunter River Salinity Trading Scheme (HRSTS).

The Ravensworth Complex maintains a large network of surface water monitoring locations, including computer controlled saline pit water dams, sedimentation dams and local watercourses.

The surface water monitoring program includes the following:

- 14 mine site water storage dams;
- 7 sediment dams; and
- 11 creek monitoring locations.

As a minimum, each of these monitoring points is tested monthly for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). The watercourse locations are also monitored for flow.

Water quality sampling is undertaken monthly in Bowmans Creek, Bayswater Creek and Emu Creek. Water quality monitoring is undertaken in Davis Creek and Pikes Creek every second month.

Ravensworth Complex undertakes stream health and channel stability monitoring in Bayswater, Emu, Bowmans, Davis and Pikes Creeks. This monitoring involves site inspections and stability assessments, macro invertebrate sampling and water quality monitoring at seven sites across the Complex. The results are compared to reference sites located in the Stewart and Clifton Offset Areas.

7.2.2 Environmental Monitoring Results

7.2.2.1 Surface Water Quality Monitoring Results

Water quality results (pH, EC, TDS and TSS) for the sampling program, with analysis (minimum, maximum and average) and time-series charts are presented in Tables A3.1 to A3.6 and Charts A3.1 to A3.22 in **Appendix F**.

7.2.2.2 Stream Health Monitoring

Stream health monitoring is undertaken at Bayswater Creek, Bowmans Creek and Emu Creek on a monthly basis, while monitoring at Pikes Creek and Davis Creek is undertaken on a two-monthly basis. Monitoring is also undertaken at control sites. The results of the monitoring program; Habscores, AusRivAs [Signal2] and erosion and stability observations are provided in **Table 7-4**. The Habscore provides a relative indicator of stream health at dry and wet sites. The AusRivAs (Signal2) provides an indication of the macroinvertebrate community's overall tolerance to pollution or disturbance.

The 2019 monitoring program indicated poor stream health conditions across both monitoring and control sites. In regard to stream stability, photographic records suggest the streams have remained relatively stable over the monitored period with any changes being related to seasonal increase/decrease of vegetation in the streams or the prolonged dry periods which occurred during the monitoring period.

Table 7-4: Stream Health at Ravensworth Complex for 2018 and 2019

	Site	2019 Erosion / Stability Observations	HABSCORE		AusRivAs (Signal2)		HABSCORE		AusRivAs (Signal2)	
			Autumn 2018	Spring 2018	Autumn 2018	Spring 2018	Autumn 2019	Spring 2019	Autumn 2019	Spring 2019
BWC-AQ2	Bayswater Creek Mid 1	Some minor bank erosion observed immediately upstream of site as with previous seasons, partially healed over as a result of regeneration of fringing vegetation.	24 (P)	44 (M)	Dry	Dry	70 (S)	29 (M)	Dry	Dry
BWC-AQ3	Bayswater Creek Mid 2	Areas of significant erosion were recorded around this site, mostly where minor ephemeral waterways flow into Bayswater Creek.	16 (P)	26 (M)	3.14	3.31	21 (P)	25 (P)	3.50	3.09
BWC-AQ4	Bayswater Creek D/S	Minor erosion of the channel edges around the gabion and rip-rap erosion prevention structures was observed during between 2017 and 2019.	10 (P)	24 (P)	Dry	Dry	24 (P)	25 (P)	3.60	Dry
DAC-AQ1	Davis Creek U/S	Sections of the monitoring reach have undercut and eroded banks, which are somewhat stabilised with vegetation.	39 (M)	45 (M)	Dry	Dry	27 (M)	37 (M)	3.25	Dry
DAC-AQ2	Davis Creek D/S	Areas of significant erosion surround the site, mostly where heavy ephemeral flows from minor tributaries meet Davis Creek.	21 (P)	29 (M)	Dry	Dry	49 (M)	27 (M)	Dry	Dry
EMC-AQ2	Emu Creek D/S	Significant erosion and undercutting of the left bank did not deteriorate further between 2016 and 2019 sampling despite limited stabilising vegetation being present. This may be a result of the reduced flows during the period.	17 (P)	36 (M)	Dry	Dry	35 (M)	19 (P)	3.33	Dry

Note: HABSCOREs for autumn and spring 2019 sampling seasons and corresponding habitat condition categories where O=optimal; S=suboptimal; M=marginal; P=poor

7.2.2.3 Comparison to EA Predictions

Stream Health Monitoring

Water quality parameters recorded at the monitoring sites during autumn and spring 2019 sampling were compared against the Ravensworth Complex adopted impact assessment criteria (Umwelt, 2014) (refer to **Table 7.5**). All monitoring sites that held water recorded an exceedance of at least one of the adopted water quality criteria in 2019³.

Table 7-5: Adopted Impact Assessment Criteria

Site	pH	Oxygen % saturation	Maximum conductivity (µs/cm)
Bayswater Creek (BWC) sites	6.5 – 8.0 (all conditions)	85 – 110 (all conditions)	2100 (all conditions)
Other monitoring sites	6.5 – 8.0 (flow), 6.5 – 8.4 (no flow)	85 – 110 (all conditions)	2100 (flow), 6100 (no flow)

7.2.2.4 Long Term Trend Analysis

Despite seasonal and annual fluctuations in water availability, monitoring sites and control sites overall have remained in a relatively stable but poor condition. A decline in stream health conditions across control and monitoring sites was observed during 2018, a result of the extremely dry conditions preceding and during that sampling period. A continuation of this trend was observed in 2019, with the majority of sites dry in spring. The stream health monitoring program included the concurrent assessment of control sites, and no difference has been observed between monitoring sites and control sites.

7.2.3 Key Performance and/or Management Issues

Stream health continues to be a focus for management at ROC. Refer to the **Section 7.2.4** below for proposed improvements in 2020, in relation to stream health.

7.2.4 Proposed Improvements

Stream health monitoring will continue to be undertaken during the reporting period.

7.3 Groundwater Management

7.3.1 Environmental Management

The *Ravensworth Complex Water Management Plan* (WMP) was prepared to satisfy the requirements of the Project Approval PA 09_0176 Schedule 3, Condition 31.

The groundwater management strategies and practices employed by the Ravensworth Complex include:

- Groundwater quality monitoring program and network;
- Groundwater level monitoring program and network;
- Site water balance including water usage metering to determine groundwater interception volumes;

³ Four of the monitoring sites held water during autumn, following a period of substantial rain with only one monitoring site holding water in spring.

- Established groundwater impact criteria and assessment of impacts on other users; and
- Documented Groundwater Impact Contingency Plans if other groundwater users are impacted by ROC activities.

7.3.2 Environmental Monitoring Results

7.3.2.1 Results from the Reporting Period

Groundwater Quality

Groundwater quality results for pH were generally within the impact assessment criteria (IAC) adopted across the site. This was with the exception of a result in the Lemington Seam (NPZ1 Tall) where three of the four results were marginally above (7.4) the adopted IAC pH range of 7.0 to 7.3. The four results in the Coffey Dam Borehole were below the adopted pH IAC range of 9.2 to 10.0. The mean pH was 8.0 which follows the downward trend in pH since 2014 result of pH 9.9.

Monitoring results for all seams showed elevated EC levels consistent with the elevated levels of salinity within the Hunter Coal Measures.

Historically elevated concentrations of sodium, chloride, sulphate and manganese have been reported across the ROC relative to ANZECC Guidelines. The majority of these parameters were either down from previous results or consistent. This was the exception of sodium and chloride which was up from previous in the Broonies and Liddell Seam.

Several bores were not monitored throughout 2019 due to being either blocked, dry or have been mined through. These bores included: NPZ1 Mid, NPZ5B P2, CS454B MID, CS4545, CS4545B Small, CS4545B Tall, NPZ6 Tall and NPZ 7 Mid.

Monitoring results for 2019 are shown in **Table 7-6:**

Table 7-6: Groundwater Monitoring Results

Monitoring Location	Target	pH			Electrical Conductivity (µS/cm)		
		Min	Max	Mean	Min	Max	Mean
Coffey Dam Borehole	Liddell	7.7	8.7	8.0	5,600	5,960	5,740
CS4539A	Pikes Gully	6.9	6.9	6.9	7,520	7,520	7,520
CS4545	Liddell	-	-	-	-	-	-
CS4545B Tall	Liddell	-	-	-	-	-	-
CS4545B Mid	Lemington	-	-	-	-	-	-
CS4545B Small	Broonies	-	-	-	-	-	-
CS4641C	Pikes Gully	7.7	7.9	7.8	8,850	9,130	8,990
NPZ1 Mid	Bayswater	-	-	-	-	-	-
NPZ1 Tall	Lemington	7.3	7.4	7.4	8,010	8,280	8,120
NPZ2 Tall	Lemington	8.3	8.4	8.3	9,650	10,020	9,850

Monitoring Location	Target	pH			Electrical Conductivity ($\mu\text{S}/\text{cm}$)		
		Min	Max	Mean	Min	Max	Mean
NPZ5B P1	Broonies	7.1	7.4	7.3	4,620	5,160	4,960
NPZ5B P2	Bayswater Creek Alluvium	-	-	-	-	-	-
NPZ6 Tall	Broonies	-	-	-	-	-	-
NPZ7 Small	Hunter River Alluvium	7.3	7.4	7.4	6,070	6,940	6,480
NPZ7 Tall	Bayswater	7.3	7.4	7.4	6,390	6,920	6,650
NPZ7 Mid	Broonies	-	-	-	-	-	-
WPP1	-	6.9	7.0	7.0	8,390	9,070	8,660
WPP2	-	7.0	7.1	7.0	9,060	9,800	9,460

Groundwater Levels

Groundwater levels were monitored at twenty three locations as shown in **Figure 7.3**. The results from the 2019 monitoring program are included in **Appendix G**. Groundwater levels were typically measured monthly, although some locations were measured quarterly.

Groundwater levels recorded at NPZ7 Small showed the greatest fall in water level over the 2019 monitoring period, falling from 34.10 mAHD in January to 30.37mAHD in December, a change of -3.73m. It is considered this fall is attributable to the slow recharge of the alluvium due to the extended dry period.

Groundwater levels at CS4539A (S2) continued to fall in 2019, from 19.96 mAHD in January to 16.57 mAHD in February seeing an overall change of -3.39 m until measurement stopped. Falling groundwater levels are likely a result of extensive mining activities in the surrounding area and the dewatering of the former Cumnock Underground workings.

SDH16 also recorded a fall in groundwater level, seeing a steady decrease from 17.23m in January to 14.78m in December (-2.45m). NPZ7 Tall, NPZ1 Tall and Borehole P also experience substantial drops in levels in 2019 of -2.09m, -2.01m and -1.95m respectively. A falling groundwater level in Borehole B is likely due to dewatering at the former Cumnock Underground. Falls in NPZ7 Tall and NPZ1 Tall is likely due the extensive mining surrounding the bores.

There were minor increases in groundwater levels at MW2, MW3, MW4, MW%, MW6 and MW10. Increases ranged from 0.08m at MW3 to 0.75m at MW10.

Historical trends in groundwater levels are shown in **Figure 7-1**, overleaf.

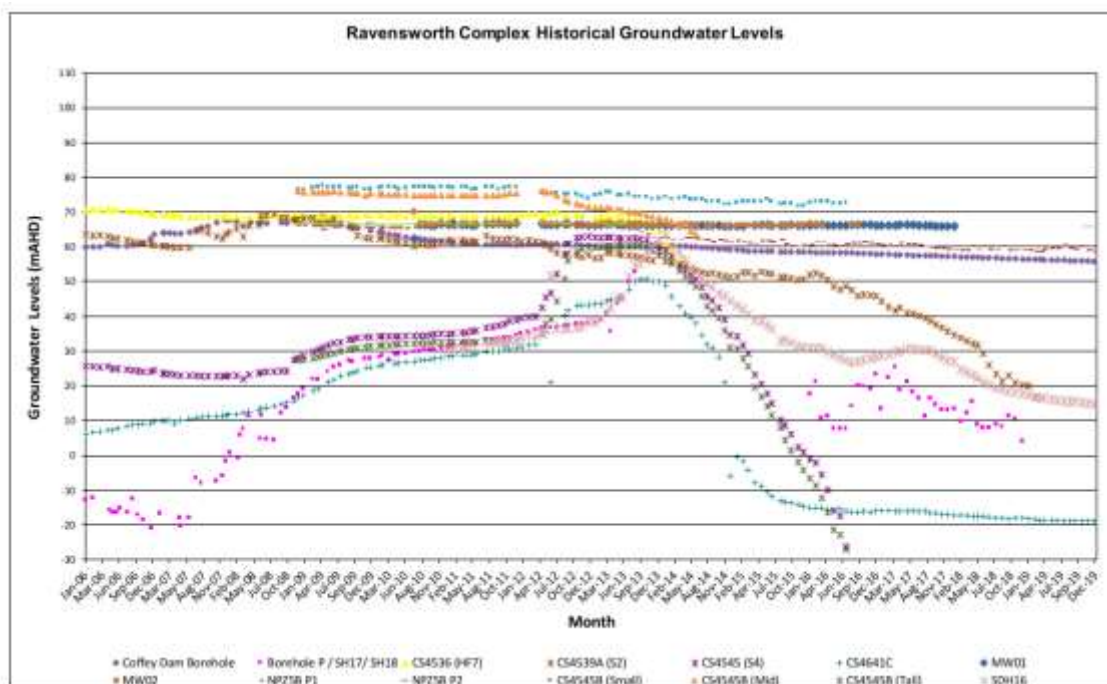


Figure 7.1 Ravensworth Complex Summary Historical Groundwater Levels

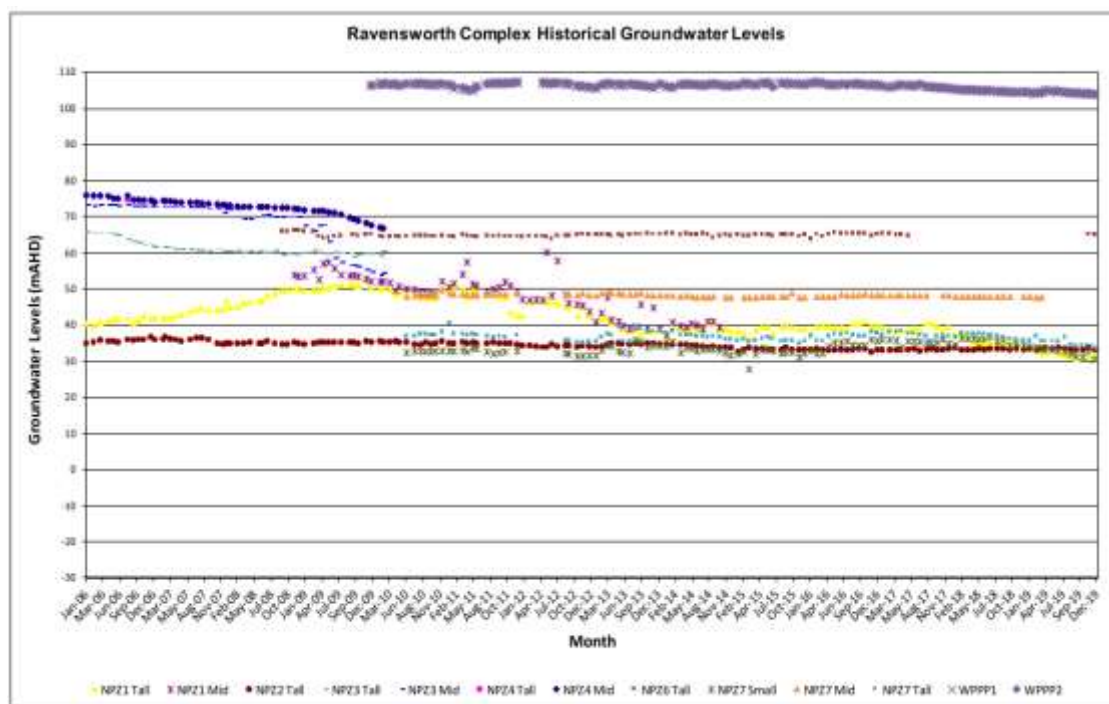


Figure 7.2 Ravensworth Mining Complex Historical Groundwater Levels



8 Rehabilitation

8.1 Objectives and Final Land Use

The principal objective of rehabilitation at the Ravensworth Complex is to return the site to a condition in which its landform, soils, hydrology and biodiversity are stable, sustainable and compatible with the surrounding landscape and pre-mining land use.

Table 8-1: Objectives and Final Land Use for Ravensworth Complex

Ravensworth Complex Area	Objective	Final Land Use
ROC	Establishment of native vegetation communities to be representative of the pre-mining landscape and be consistent with PA 09_0176.	Predominately woodland (Class IV) rehabilitation with an area of pasture for cattle grazing (Class V) consistent with the EA.
RUM	Disturbed land will be returned to a land capability consistent to that which existed before mining.	Minimal disturbance due to underground nature of mining. Life of mine rehabilitation include: <ul style="list-style-type: none"> • Subsidence crack remediation; • Areas of the surface facilities requiring revegetation after disturbance; • Key areas of the operation requiring visual screening with vegetation; • Maintenance of previously rehabilitated areas; and • Final rehabilitation.
RCHPP	Decommissioning and establishment of native vegetation communities' representative with the pre-mining landscape consistent with PA 09_0176 unless the DPIE agree otherwise.	Disturbed land will predominantly return to woodland (Class IV).

8.2 Rehabilitation of Disturbed Land

8.2.1 Key issues that may affect successful rehabilitation

Table 8-2: Key Rehabilitation Issues

Key Issue	Discussion
Rainfall & Climate	<p>The project area experiences a temperate climate with warm summers and no defined dry season. Summer daytime temperatures average around 30–32° C; but on occasion exceed 38–40°C. In the winter months, daytime temperatures are on average 8–9°C; but have been known to drop below zero in places. The area experiences frost conditions.</p> <p>The region experiences an average annual rainfall of approximately 650 mm/year. Rainfall depths of 30–60 mm occur in most months of the year, with higher falls dominant in the summer months.</p> <p>The number of rain days per month may be used as an indicator of how often runoff may occur, and, therefore, potential for erosion. Depending on recent preceding rainfall events, storms less than 10 mm are considered to have little potential to cause erosion as much of the water will infiltrate into the soil and run-off will be minimal. In the wetter summer months, the incidence of rainfall days with rainfall depths greater than 10 mm is approximately 20 occasions per year; with rainfall depths exceeding 25 mm on 5 to 6 occasions per month (BoM, 2016).</p>
Topsoil Management	<p>Topsoil analysis records for Ravensworth Operations indicate materials tend to be <i>sandy clay</i> and <i>medium clay</i> textured and of relatively poor quality. Results indicate the topsoil materials are sodic and magnesian (and likely dispersive), sometimes moderate to highly saline, and have pH ranges from near neutral 7.1 to highly alkaline at 10.1. There are no known Acid Mine Drainage (AMD) issues at Ravensworth Operations. Therefore this aspect is not a major consideration in relation to rehabilitation on site during the MOP period. Testing has been conducted on exploration samples to determine propensity for AMD generation, across the site. No evidence of AMD has been found to date.</p>
Subsoil and overburden Management	<p>Spoil materials are overburden and inter-burden from the mine pit. Materials are reported to be moderately alkaline (pH 7.1–8.7), moderately saline, sodic, with appreciable levels of magnesium. Laboratory reports recommended gypsum rates for these spoil materials, however there is no record that gypsum has been applied to spoil materials.</p> <p>Ravensworth revised the internal rehabilitation procedure in 2018 and has implemented the following changes to the rehabilitation methodology:</p> <ol style="list-style-type: none"> 1. Ripping and raking of subsoil to extract large rocks and strategically placing the rocks in high erosion prone areas; and 2. Applying gypsum to subsoils at a rate of ~ 8tonne/Ha
Slope Considerations	<p>Landform design is predominantly undertaken at the environmental assessment (approval) phase of an operation and is then integrated in the MOP. This process involves the selection of emplacement locations and sizes, location of final voids and the development of a 'final landform' which must be adhered to throughout the life of the operation. Considerations such as landform profiles, dump heights, gradients and drainage flow paths are largely developed at this stage.</p>

	<p>Therefore, the main consideration relating to landform and slope design throughout the life of the operation is ensuring that the construction of emplacements etc. comply with the approved final landform. The Design Compliance procedure (RAV TS PRO 0013) details the checks to be completed at the various stages of the mining operation to ensure that final designs are achieved.</p> <p>Ravensworth has opted to use the micro-relief (geofluv) landform design. The objective of the design is to mimic a natural, free draining, stable landform with a variety of slope lengths grades and drainage pathways.</p>
Vegetation Cover	<p>Ravensworth is committed to restore self-sustaining ecosystems, including establishing at least 1,767 ha of woodland vegetation in accordance with the Ravensworth Biodiversity offset strategy.</p> <p>Ravensworth is committed to carry out rehabilitation progressively, that is, as soon as reasonably practicable following disturbance.</p> <p>The Rehabilitation Strategy for the Project is integrated with the Biodiversity Management Plan for the Project through creating extensive areas of woodland within rehabilitated areas associated with the Project that target the following vegetation communities:</p> <ul style="list-style-type: none"> • Central Hunter Box-Ironbark Woodland; • Central Hunter Swamp Oak Forest; • Central Hunter Bullock Forest Regeneration; and • Grassland.
<p>Management of the above rehabilitation issues will be conducted in accordance with:</p> <ul style="list-style-type: none"> • Ravensworth Complex Conceptual Rehabilitation and Mine Closure Plan • Ravensworth Complex Rehabilitation Management Plan • Ravensworth Complex Biodiversity Management Plan • Ravensworth Complex Mining Operations Plan 	

8.2.2 Spoil Shaping and Landform Design

ROC

The conceptual final landform for ROC has been designed to blend into the surrounding environment and will be shaped in accordance with the approved 2017 – 2020 MOP. The geofluv design mimics the natural landform of the Hunter Valley. The geofluv landform has the potential to significantly reduce the need for engineered drop structures and is not dependent on contour drains in the longer term. These landforms offer a diversity of habitat that can enhance the value of rehabilitated ecological systems.

RCHPP

Once the tailings storage facilities at Cumnock are capped, they will be shaped in accordance with the approved MOP for ROC/RCHPP and rehabilitated to achieve local woodland ecological communities.

RUM

Final landform management is outlined in the *RUM Conceptual Rehabilitation and Mine Closure Plan*. The final landform will be a free draining surface that incorporates drainage controls to manage potentially sediment-laden water from the areas along with minimising the possibility of erosion.

8.2.3 Revegetation

The final land use at ROC will be predominantly returned to a woodland ecological community, interspersed with pasture. A typical list of tree and shrub species used for rehabilitation at ROC is shown in **Table 8-3**.

Table 8-3: Typical Species used for Woodland and Pasture Rehabilitation at ROC

Woodland Rehabilitation				Pasture
Overstorey	Middle storey	Understorey	Riparian	
<i>Acacia implexa</i>	<i>Acacia decurrens</i>	<i>Dianella caerulea</i>	<i>Juncus usitatus</i>	Japanese Millet
<i>Acacia salicina</i>	<i>Acacia filicifolia</i>	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	<i>Lomandra multiflora</i>	Ryecorn/ Oats
<i>Allocasuarina luehmannii</i>	<i>Acacia longifolia</i> subsp. <i>Multiflora</i>	<i>Austrodanthonia linkii</i>		Couch Grass
<i>Angophora floribunda</i>	<i>Acacia parvipinnula</i>	<i>Austrostipa scabra</i>		Wimmera Ryegrass
<i>Brachychiton populneus</i> subsp <i>populneus</i>	<i>Bursaria spinosa</i>	<i>Chloris verticosa</i>		White Clover
<i>Callitris endlicheri</i>	<i>Notelaea microcarpa</i> var. <i>macrocarpa</i>	<i>Cynodon dactylon</i>		Lucerne
<i>Casuarina glauca</i>	<i>Acacia decora</i>	<i>Dichondra repens</i>		Sub Clover
<i>Eucalyptus crebra</i>	<i>Acacia paradoxa</i>	<i>Themada australis</i>		<i>Phalaris sirosa</i>
<i>Eucalyptus tereticornis</i>	<i>Dodonaea viscosa</i>	<i>Bothriochloa macra</i>		Kikuyu
<i>Eucalyptus molucanna</i>		<i>Microlaena stipoides</i> var		Green Panic
				Setaria
				Sephic Medic

Once overburden dumping is completed, emplacements are bulk shaped to the final landform profile. On completion of overburden bulk shaping, and prior to topsoiling; ameliorate application (if required), deep ripping, and rock raking is conducted to remove any large rocks in the upper profile. During this process, gypsum is incorporated into the overburden to improve the soil structure. Topsoil is then spread across the rehabilitation areas and appropriate application of fertilisers or other ameliorants as determined by soil / subsoil characterisation analysis is incorporated into the topsoil, which is then re-ripped and seeded.

Sowing and planting times are generally conducted, where practical, in autumn and/or spring to increase germination and survival rate.

Areas that have been previously used for overburden, tailings and coarse rejects emplacement from the Ravensworth Complex will be shaped and rehabilitated, using a combination of woodland and grassland species mix.

RUM

There are minimal areas available for revegetation at RUM. Subsequently, during the reporting period no rehabilitation activities occurred at RUM.

8.3 Rehabilitation Performance

8.3.1 Rehabilitation Status at End of the Reporting Period

Ravensworth Complex rehabilitation and disturbance areas for 2018 through to 2020 are summarised in **Table 8.4**. During the 2019 reporting period Ravensworth completed a total of 70.0 Ha of rehabilitation comprising of Central Hunter Grey Box Ironbark Woodland in accordance with the approved MOP.

A total of 21.4 Ha of new disturbance associated with the progression of the Ravensworth North pit occurred during the reporting period. **Figure 8.5** includes a map of areas disturbed and rehabilitated during 2020. Photographs of rehabilitation are also provided. Annual rehabilitation implementation performance monitoring was conducted during 2019, a summary is reported in **Table 8-5**:

Table 8-4: Ravensworth Complex Annual Rehabilitation and Disturbance – 2018 - 2019

Mine Area Type	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Total Mine Footprint (Ha)	2564.2	2585.6	2,624.6
Disturbance (Ha)	1683.4	1712.6	1,751.6
Land Being Prepared for Rehabilitation (Ha)	131.0	70.0	70.0
Land under Active Rehabilitation (Ha)	880.76	950.76	1,020.76
Completed Rehabilitation (Ha)	0	0	0

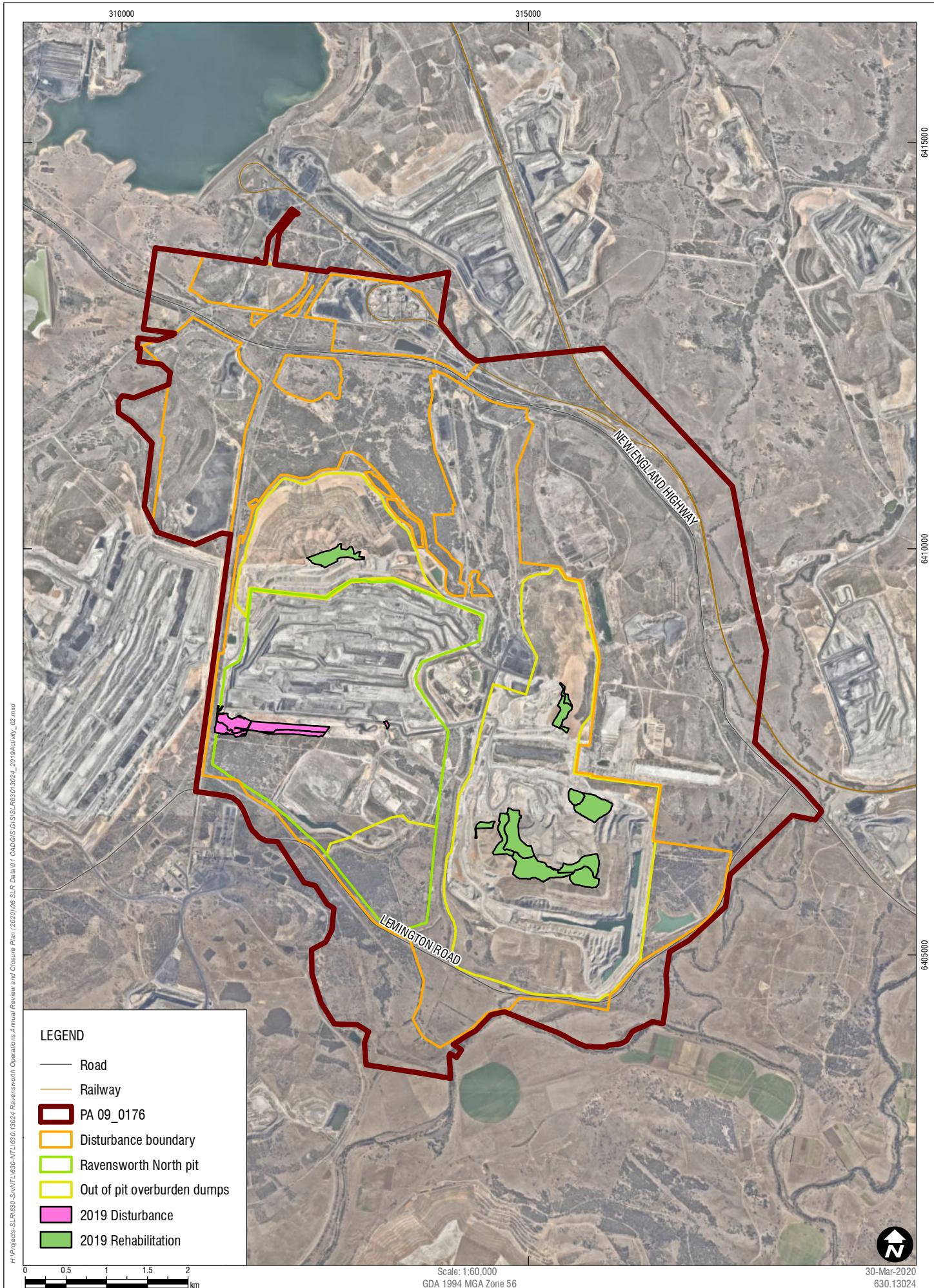
** Project Approval granted in 2011 (PA_09_0176) allowed for re-disturbance of existing rehabilitated areas for overburden emplacement and mining. During 2019 previously rehabilitated areas were re-disturbed reducing the total land under active Rehabilitation figures.*

Table 8-5: Rehabilitation Performance – Ravensworth Operations 2018 - 2019

Rehabilitation Site Name	Rehabilitation Type	Rehabilitation Area (Ha)	Rehabilitation Summary
Ravensworth Western Emplacement	Central Hunter Grey Box Ironbark Woodland	8.4	Final landform seeded with a native woodland mix and cover crop
Ravensworth Eastern Emplacement	Central Hunter Grey Box Ironbark Woodland	61.6	Final landform seeded with a native woodland mix and cover crop

Table 8-6: Topsoil salvage – Ravensworth Operations 2018 - 2019

Previous Reporting Period (m ³)	This Reporting Period (m ³)	Next Reporting Period (m ³)
138,960	68,256	79,820





Photograph 8.1: Cover crop germination across Eastern Emplacement rehabilitation seeded with Central Hunter Grey Box Ironbark Woodland during 2019.



Photograph 8.2: Area of Central Hunter Grey Box Ironbark woodland rehabilitation established in 2013.



Photograph 8.3: Areas of natural landform rehabilitation established between 2018 and 2019.



Photograph 8.4: Natural landform rehabilitation established during 2019

8.3.2 Summary of Rehabilitation Monitoring

During the reporting period long-term rehabilitation monitoring and a rehabilitation walkover assessment was conducted to compare current conditions of the rehabilitation with closure criteria outlined in the MOP. This information developed management recommendations to guide the rehabilitation towards targeted Ecological Communities and final landform criteria.

8.3.2.1 Assessment of rehabilitation towards closure criteria

Field surveys were undertaken in spring, during an officially declared state of drought throughout the Hunter Valley. The monitoring included the assessment of 11 different rehabilitation sites across the following areas:

- Five polygons of 2018 rehabilitation (Year 1) comprising two pasture and three woodland areas – for a combined area of ~125.7 ha;
- Two polygons of 2017 rehabilitation (Year 2) comprising one pasture and one woodland areas – for a combined total area of ~79.2ha;
- Three polygons of 2014 rehabilitation (Year 5), all being returned to woodland – for a combined total of ~41.4 ha; and
- One polygon of 2009 woodland rehabilitation (Year 10) covering an area of ~9.7 ha.

Monitoring methods were specifically developed to align with the rehabilitation objectives and performance indicators defined in the current MOP, and included both transect/plot monitoring to collect detailed data on vegetation community development (65 sites were monitored) and a walkover inspection of the study polygons to identify any issues or deficiencies requiring treatment. Based on the analysed field data, rehabilitation performance in each polygon was assessed against completion criteria defined in the MOP and in accordance with Glencore's internal procedure '**11.16 – Completion Criteria and Rehabilitation Monitoring**'.

Each rehabilitation polygon was assessed and assigned one of four performance rankings as follows:

- 'Acceptable' (i.e. successful rehabilitation meeting the objectives);
- 'Monitor' (i.e. on trajectory towards achieving the objectives unassisted);
- 'Maintenance' (i.e. not meeting objectives and requiring routine maintenance works); or
- 'Rework' (i.e. failed rehabilitation needing rework or extensive management actions).

Of the 11 polygons of rehabilitation monitored during the 2019 monitoring campaign:

- One was assessed as requiring monitoring only;
- Seven require routine maintenance works relating to erosion repairs, weed control (*Acacia saligna*) and/or community composition improvements; and
- Three required rework due to erosion repair works, weed infestation and supplementary planting.

The rehabilitation monitoring undertaken in 2019 identified that there was a varied performance across the sites. Likely to be due to the severe drought conditions, the key issues and factors impeding rehabilitation as observed in 2019 were erosion, weed infestations and locally inadequate diversity and/or abundance of native species. The rehabilitation report provides a summary of the identified issues, detailed and targeted maintenance / improvement actions that may be implemented to enhance rehabilitation performance.

Young rehabilitation (Year 1 & 2)

A total of ~100.4ha of young pasture was assessed at Narama in the 2019 monitoring. It was noted that the establishment of pasture rehabilitation has been affected by drought conditions. Whilst the species diversity was assessed as good, their establishment and level of cover has been impacted. In total there were 56 species identified in the 2019 surveys,

Intermediate rehabilitation (Year 5)

The condition of year 5 woodland rehabilitation was variable between the monitored areas.

At Cumnock the areas were stable and generally showed good vegetation cover and growth, particularly of mid storey-species. Local native species were represented in the ground and upper storeys but their abundance was typically low and management action will likely be required to improve their densities.

At Narama areas of established vegetation typically consisted of *Acacia saligna* shrubland with a ground layer of exotic grasses and an absent canopy layer. Maintenance and improvement works will be required to improve community composition. Despite residual erosion features (mostly inactive), the areas achieved satisfactory slope and landform stability.

At Ravensworth North positive signs were recorded of local native species establishment and growth in all vegetation layers (albeit inconsistently across the areas). Some weed infestations also occurred in places, particularly of *Galenia pubescens* (Galenia). Finally, active and locally gully erosion occurred throughout the areas that will require repair works.

Mature rehabilitation (>10 years)

Mature pasture rehabilitation showed excellent performance, with good vegetative cover and slope stability throughout. Pasture composition and herbage biomass were largely dominated by perennial grasses suitable for cattle grazing and weed prevalence was typically minimal.

Areas of mature woodland assessed at Narama and Cumnock showed excellent landform stability and typically good woodland vegetation establishment and growth. However, species assemblages were typically poor compared to those characteristic of native vegetation communities, particularly with a tree layer dominated by the exotic Sugar Gum in several locations. In addition, weed prevalence was typically high in the mid and lower storey, with several infested areas recorded. These areas will require active management effort to achieve the defined rehabilitation objectives, for which a detailed strategy including management priorities was developed in 2016 by Emergent Ecology.

8.3.2.2 Fauna

Fauna monitoring in rehabilitation is required every three years, monitoring was last undertaken during 2017 and therefore was not required in 2019.

8.3.3 Rehabilitation Maintenance

8.3.3.1 Western Emplacement

During the 2016 Annual Review inspection, DPIE raised concerns around the Western Emplacement Area (WEA) rehabilitation not progressing towards final land use as described in the Project Approval 09_0176. Ravensworth committed to remediate areas of poor rehabilitation performance.

Ravensworth engaged external consultant, Landloch, in 2017 to develop actions to achieve a stable landform to be vegetated with Hunter Ironbark Complex Woodland on the WEA.

Summary of these actions included:

- Infill works to backfill gullies and re-shape land surface;
- Improving topsoil quality;
- Construction of temporary ponded banks;
- Reseeding; and
- Dressing with OGM or forest mulch.

During 2019 remediation works commenced across an additional ~40 ha of the Western Emplacement Area. Works include the repair of erosion features, installation and maintenance of drainage structures, topsoiling of surfaces, treatment of topsoil, installation of habitat and seeding of native woodland species. These works are scheduled for completion during 2020.

The areas subject to maintenance across the WEA were inspected during the 2018 and 2019 annual walkover and long term monitoring programs, these areas were reported to be stable and well-performing. These areas will be subject to ongoing monitoring and maintenance during 2020 as required.

8.3.3.2 Cumnock

Following the 2018 Annual Review inspection the DPIE issued a Section 240 notice for areas of Cumnock Rehabilitation which are not trending towards the final land use defined in the Project Approval 09_0176 or rehabilitation criteria outlined in the current MOP.

Ravensworth was required to prepare a management plan to address risks to achieving the approved final land use for the Cumnock rehabilitation area. The Cumnock Rehabilitation Plan has been developed and approved by the DPIE - Resources Regulator.

The plan will comprise a schedule of works to be carried out over a 6 year period, including;

- Earthworks;
- Weed management;
- Tree thinning;
- Infrastructure removal; and
- Planting of tube stock.

Weedy perennial grass species; *Chloris gayana* (Rhodes grass), *Hyparrhenia hirta* (Coolatai grass) and *Eragrostis curvula* (African Love grass) has been targeted throughout the Cumnock rehabilitation in 2019.

Initial *Acacia saligna* (Golden Wreath Wattle) management was also commenced in 2019, with over 3 hectares mulched. As this species produces a large and persistent seed bank multiple campaigns will be conducted in subsequent years. Other targeted species include, *Galenia pubescens* (Galenia), *Hyparrhenia hirta* (Coolatai grass), *Olea europaea* (African Olive) and various Pear species.

8.3.3.3 2020 Rehabilitation Maintenance

During the next reporting period, Ravensworth will continue to develop and implement a rehabilitation strategy in order to progress rehabilitation to final landform consistent with final land use objectives. In 2020 Ravensworth will complete ongoing maintenance in previously rehabilitated areas. Priority actions for rehabilitation maintenance include:

- Continued implementation of the Western Emplacement Area remediation plan;
- Erosion, water management and drainage structure repairs;
- Control of priority weed species as identified during the 2019 rehabilitation inspection, long-term monitoring and weed surveys;
- Management of animal pest populations including kangaroos, wild dogs, and feral pigs;
- Increasing tree densities through supplementary seeding and or tube stock planting; and
- Increasing habitat potential through adding rocks, logs, woody debris and nest boxes to rehabilitation areas for fauna.

8.4 Rehabilitation Trials and Research

ROC has undertaken numerous rehabilitation trials in the past, with excellent rehabilitation results achieved. Many of these trials have been completed at Narama, Ravensworth West and Cumnock and have involved innovative practices for habitat augmentation. Soil ameliorates such as biosolids, gypsum and lime have successfully been used at ROC to improve rehabilitation results.

Progressive rehabilitation has the advantage of allowing for practical trials of rehabilitation techniques that may require refining, or the commencement of detailed research before more widespread use on site.

8.4.1 Rehabilitation Trial Results

8.4.1.1 Nutrient Cycling Teabags Trial

In accordance with Schedule 3, Condition 36 of PA 09_0176 ROC implemented a research program to understand mapping and recovery of EECs affected by the project. A PhD study has continued on the site developed for the Hunter Ironbark Research Program (HIRP). This study looks at the ability of the ecosystem to cycle nutrients which will ensure the development of a self-sustaining community.

During the reporting period a decomposition study was performed using tea bags. This novel method is particularly applicable to the mining industry where there may be a range of different flora communities or those communities may be at different successional stages. Using this method then allows for direct comparison of decomposition capacity independently of the vegetation composition. The green tea is more susceptible to leaching through water and showed the highest decomposition from the Spoil OGM treatment. The rooibos tea requires active decomposition and showed near uniform loss from all treatments except for spoil which appeared not to decompose at all.

Recent work has been looking at microorganisms found in the soils of the experiment. Analysis has so far focused on Fungi species using genetic sequencing to determine species. Soil microbes in the spoil were so few in number that they could not be detected using genetic approaches, supporting the lack of decomposition found using the tea bags. For the other treatments, the total number of fungal species is highest in the Subsoil OGM Mulch, all other treatments are significantly lower than the references in species richness. Functionally, there is significantly more decomposing fungi species in the subsoil OGM Mulch than in the spoil OGM treatment however fungal symbionts are generally low throughout all treatments compared to the reference.

8.5 Next Reporting Period

Rehabilitation activities proposed in 2020 include:

- Rehabilitation of 70 Ha across the Eastern Overburden Emplacement;
 - Maintenance works as outlined in section 8.3.3;
 - Ongoing inspections and long-term rehabilitation monitoring;
 - Planting/seeding of the HOA;
 - Repair of erosion in the HOA, subject to approval of the ACHMP;
 - Pest management at site and also in the offset areas. This will include wild dog/fox baiting (in Autumn and Spring), a rabbit control program as well as an ongoing feral pig and kangaroo control program; and
 - Continuation of rehabilitation trial and research; by finalising the microbial study, continued development of a nutrient budget for the study site and completion of the PhD.
-

9 Community Relations

9.1 Employment Status

At the end of the reporting period, the Ravensworth Complex had approximately 539 full time employees.

9.2 Complaints

There were two complaints received during the 2019 reporting period for the Ravensworth Complex. The complaints related to blast events. Both of these complaints were reported via the EPA and DPIE. A complaints register is maintained and available on the [Ravensworth Complex Website](#).

9.2.1 Community Complaints 2019

9.2.1.1 Complaint 1

8 May 2019

An anonymous complaint was received via email to the DPIE on the 8 May 2019. The complaint was received from the Camberwell area regarding a loud blast from a nearby coal mine at approximately 9.08am.

The Environment and Community Manager confirmed that Ravensworth did blast that day at 9.11am. Real time data was checked and reported a blast overpressure of 105.3 dB and vibration of 0.08 m/s. This is below compliance levels.

The wind direction at the time was from the North West (267 degrees) at a speed of 0.7m/s. Ravensworth immediately investigated the complaint and recorded the complaint. The complainant did not request information regarding the outcome of the investigation.

9.2.1.2 Complaint 2

28 August 2019

Ravensworth Complex Environment and Community Manager received an email from the NSW EPA regarding an anonymous complaint received via phone from a resident at Camberwell Village. The complaint was in regard to dust from a blast in the Ravensworth direction at approximately 1:10pm on the 28 August 2019.

The EPA requested results of dust monitoring, confirmation of wind direction and the predicted and actual blast trajectory as well as any other information to demonstrate the blast did not impact Camberwell.

Immediate actions undertaken included review of real time data, confirmed blast was within meteorological restrictions, review of dust levels at Camberwell, camera footage and dust plume modelling.

A response to the complaint was provided to the EPA on the 11 September 2019 followed by a written response to the EPA on the 12 September 2019.

9.2.2 Complaints Trend Analysis

Trend analysis on complaints by year since 2011 shows that complaints as a whole are on the decline (refer to **Table 9-1**).

Table 9-1: Complaints Trend Analysis

Year	Number of Complaints
2011	6
2012	8
2013	3
2014	5
2015	0
2016	3
2017	2
2018	3
2019	2

9.3 Community Engagement

The purpose of the SEP is to provide a structured and accountable plan to ensure the Complex is able to demonstrate commitment to social responsibility and contribute to the sustainability of the local community. The SEP contains a Community Investment Plan which outlines key projects to be undertaken by Ravensworth throughout the year.

Community engagement in 2019 included:

- Community Consultative Committee Meetings;
- Ravensworth Open Day; and
- Distribution of community newsletters.

In 2019, a number of major community investment initiatives were undertaken. These included:

- Over \$150,000 invested in community projects and donations;
- Ravensworth golf charity day raised \$85,000 for prostate cancer;
- Apprentice working bee – installation of irrigation system at St James Primary School, Muswellbrook;
- Major sponsor of Gresford Billy Kart Races;
- Sponsor and participation in National Tree Planting Day;
- Upper Hunter Conservatorium of Music sponsorship;
- Christmas toy and food drive for local charities; and
- Various other site fundraisers.

The Ravensworth Complex operates a website to display key information to the community (www.ravensworthoperations.com.au). Schedule 5, Condition 10 of PA09_0176 and Schedule 2, Condition 43 of DA104/96 requires the following information in **Table 9.2** to be maintained on the website.

Table 9-2: Summary of website reporting requirements

Requirement	Status
The Environmental Assessment (EA)	EAs are available on the website.
All current statutory approvals for the project.	Project approvals / consents and the EPL are available on the website. Other statutory information, such as the MOP, is posted on the website.
Approved strategies, plans and programs required under the conditions of approval.	Approved management plans are available on the website.
A summary of the monitoring results of the project, which have been reported in accordance with the various plans and programs approved under the conditions of this approval.	Annual Review and monthly monitoring results are on the website. The Ravensworth Complex reports monitoring data in accordance with EPA's monitoring reporting requirements.
A complaints register, which is to be updated on a monthly basis.	Complaints register is available on website and updated monthly.
Minutes of CCC meetings.	CCC minutes are available on the website.
The Annual Reviews (over the last five years).	The last five years of AEMRs / Annual Reviews are available on the website.
Any independent environmental audit and the Proponent's response to the recommendations in any audit.	Independent environmental audits and responses to recommendations are available on the website.
Any other matter required by the Secretary.	No other information is currently required by Secretary.

9.4 Community Consultative Committee

The Ravensworth Complex maintains a close partnership with the local community. The Community Consultative Committee (CCC) includes Glencore representatives and local community members. This provides a formal forum for interaction between the community, mine management and relevant government departments. The Ravensworth Complex CCC meets three times a year, with meetings in 2019 held in January, May and September. The community representatives may share information from meetings with the rest of the community and relate any items for discussion at the CCC meetings.

The following key topics were discussed at the CCC meetings:

- Discussion of previous meeting minutes;
- Update on mining and processing activities at the Ravensworth Complex;
- Update on key environment and community aspects, including monitoring results and incidents;
- Update on safety performance; and
- Update on community support programs.

Ravensworth is currently attempting to recruit additional CCC members.

Minutes from the CCC meetings are posted on Ravensworth Complex's website: <https://www.ravensworthoperations.com.au/en/publications/Pages/ccc-minutes.aspx>

9.5 Community Newsletter

The Ravensworth Complex circulates a community newsletter every 6 months to neighbouring residents, its employees, CCC members and other stakeholders and are on the Ravensworth Complex website (www.ravensworthoperations.com.au). The newsletter provides information about the operational progress of the Complex, environmental and safety performance, plus other news of community interest.

10 Independent Audit

An Independent Environmental Audit (IEA) was undertaken in the reporting period in accordance with Schedule 5, Condition 8 of Project Approval 09_0176.

The IEA considered compliance between 31 March 2015 to 2 May 2018. Ravensworth commissioned EMM to complete the IEA, which was undertaken on site from 30 April to 2 May 2018.

The audit included a review of:

- Conditions contained with Project Approval 09_0176 and Development Consent 104/96, including the statement of commitments;
- EPL2652;
- Mining Lease(s);
- Implementation of management plans prepared under Project Approval 09_0176; and
- Water Access Licences.

The IEA report was submitted to the DPIE in July 2018. Correspondence received from the DPIE in January 2019 stated further information was required to complete the audit. The revised IEA was submitted to the DPIE in March 2019 (including an action table addressing the audit findings). The findings and recommendations from the IEA and status of actions is provided in the table below. The IEA Report and Action Plan are uploaded to the Ravensworth website.

Table 10-1: IEA Findings and Status of Actions

Requirement	Ravensworth Operations Response	Completion
Blasting Hours It would be beneficial for the times of each blast to be included in the monthly monitoring reports and the annual review.	Ravensworth will include blasting times in the Annual Review and monthly monitoring reports.	Complete
Biodiversity Management Plan The plan needs to be updated to include a document number referencing the topsoil stripping management plan as currently there are no details in regard to conserving and reusing topsoil (as required).	At the time of the Audit, the Biodiversity Management Plan (BOMP) (Section 7.2) referenced topsoil management/soil resource salvage at Ravensworth. It was recommended that the procedure document ID be included in a future revision of the Biodiversity Management Plan. The Biodiversity Management Plan (BOMP) was last reviewed and approved by the DPE in September 2018. Given the minor nature of this recommendation, it will be included in the next revision of the BOMP.	The BOMP will be reviewed in 2020 and submitted to the DPIE for approval by June 30 2020.
Closure and Rehabilitation The BOMP should include specific references/linkages regarding how the vegetation communities listed in Condition 6.4.2 have been/are to be incorporated into the approach for regeneration and revegetation. At	The Biodiversity Management Plan (BOMP) was last reviewed and approved by the DPE in September 2018. Ravensworth will include specific references regarding how the vegetation communities listed in Condition 6.4.2 have been/are to be	The BOMP will be reviewed in 2020 and submitted to the DPIE for approval by June 30 2020.

Requirement	Ravensworth Operations Response	Completion
present the regeneration and revegetation approach only mentions Endangered Ecological Communities (EECs).	incorporated into the approach for regeneration and revegetation in a future revision of the BOMP.	
Blasting It is noted that Macquarie Generation are no longer relevant to this condition. The Blast Management Plan should be updated to reflect this.	Ravensworth will revise the Blast Management Plan (BMP) to reflect this change and any other relevant changes at the Complex since its last revision in 2017.	The BMP was reviewed in 2019 and submitted to the DPIE for approval. DPIE approved BMP in February 2020. Complete.
Groundwater If mine planning changes in the future, appropriate remedial and recovery plans for identified stands of Eucalyptus camaldulensis along the Hunter River in the southern extent of the Project area will be developed	Noted. Ravensworth will revise the Water Management Plan (WMP) and Biodiversity Management Plan (BOMP) should mine plan changes occur and include appropriate remedial and recovery plans for identified stands of Eucalyptus camaldulensis.	The WMP was submitted to DPIE on 30 September 2019. DPIE approved the WMP in March 2020. Complete. The BOMP will be reviewed in 2020 and submitted to DPIE for approval by June 30 2020.
Aboriginal Heritage The Aboriginal Cultural Heritage Management Plan requires updating to include a salvage recovery procedure.	The 2014 Aboriginal Cultural Heritage Management Plan (ACHMP) included a section (S4 and S8) on <i>salvage, excavation and/or management of Aboriginal sites and potential archaeological deposits within the project disturbance area</i> . Following the complete salvage of all sites within the Project disturbance area, this section of the plan was removed from the 2017 update to the ACHMP. The ACHMP will be revised to include a salvage recovery procedure in accordance with Schedule 3, Condition 42 of Project Approval 09_0176.	The ACHMP was submitted to DPIE and BCD on 30 September 2019. Currently awaiting approval.
Aboriginal Cultural Heritage Management Plan The conditions in Table 2.1 of the Aboriginal Cultural Heritage Management Plan are the conditions for the Open Cut and are for Heritage Protection not Aboriginal Cultural Heritage.	Noted. The Aboriginal Cultural Heritage Management Plan (ACHMP) was approved in 2017. The ACHMP covers the Complex. Notwithstanding, the ACHMP will be revised in 2019	The ACHMP was submitted to DPIE and BCD on 30 September 2019. Currently awaiting approval.
Water Licence (s) The licence holder must develop and implement a methodology to estimate the annual volume of alluvial water inflow (water budget), approved by the Office of Water. Water budgets must be set and approved one month	Ravensworth submitted the letters and a map in anticipation of acknowledgement from DoI Water, however on all occasions DoI Water has not supplied a response. Notwithstanding the above, Ravensworth will re-submit the letters and map and seek confirmation from DoI Water.	Complete. Letters were resent to NRAR 4 April 2019. Response received.

Requirement	Ravensworth Operations Response	Completion
<p>prior to the beginning of each water year to enable implementation.</p> <p>Follow-up and seek confirmation from Dol Water.</p>		
<p>The licence holder must provide the office of water with a map of the licensed site showing areas of alluvial sediments interfered by the mine works.</p> <p>Follow-up and seek confirmation from Dol Water.</p>	<p>Ravensworth submitted the letters and a map in anticipation of acknowledgement from Dol Water, however on all occasions Dol Water has not supplied a response. Notwithstanding the above, Ravensworth will re-submit the letters and map and seek confirmation from Dol Water.</p>	<p>Complete. Letters were resent to NRAR 4 April 2019. Response received.</p>
<p>All excavations must be located outside the alluvial sediments of Bayswater Creek and Davis Creek, unless prior written approval has been obtained from the Office of Water.</p> <p>Follow-up and seek confirmation from Dol Water.</p>	<p>Ravensworth submitted the letters and a map in anticipation of acknowledgement from Dol Water, however on all occasions Dol Water has not supplied a response. Notwithstanding the above, Ravensworth will re-submit the letters and map and seek confirmation from Dol Water.</p>	<p>Complete. Letters were resent to NRAR 4 April 2019. Response received.</p>
<p>The licence holder must implement measures to prevent alluvial groundwater flows from entering the mine pit, with prior approval from the Office of Water.</p> <p>Follow-up and seek confirmation from Dol Water.</p>	<p>Ravensworth submitted the letters in anticipation of acknowledgement from Dol Water, however on all occasions Dol Water has not supplied a response. Notwithstanding the above, Ravensworth will re-submit the letters and map and seek confirmation from Dol Water.</p>	<p>Complete. Letters were resent to NRAR 4 April 2019. Response received.</p>

In accordance with Schedule 5, Condition 8 of Project Approval 09_0176 Ravensworth is required to commission, commence and pay the full cost of the next IEA in 2021.

11 Environmental Incidents and Non-Compliances

All 2019 incidents, non-compliances and exceedances related to PA 09_0176, DA 104/96 and EPL 2652 are summarised in **Table 11-1**.

Table 11-1: Incidents, Non-compliances and Exceedances

Date	Details/Location	Non-Compliance	Action/Response
2 July 2109	Section 240 notice for the WEA.	Section 240B of the <i>Mining Act 1992</i>	Works were undertaken on the WEA to improve erosion and sediment control, in accordance with the Section 240 notice.
Throughout the reporting period (refer to Appendix B for dates of exceedances).	31 exceedances of the PM ₁₀ short term criteria occurred in 2019 (refer to Section 6.4.2.1)	PA 09_0176	Incident reports were provided to the DPIE on each occasion.
Throughout the reporting period	Continuous PM ₁₀ data was not acquired.	EPL 2652	TEOMs were inspected and repaired.

12 Activities Proposed in the Next Annual Review Period

12.1 ROC and RCHPP

Key activities proposed for 2020 at ROC / RCHPP include:

- Continuation of mining operations at Ravensworth North;
- Continued support for key community projects;
- Continued participation in the CCC;
- Review of site management plans (Biodiversity Management Plan, Air Quality and Greenhouse Gas Management Plan and Historic Heritage Management Plan) in accordance with Schedule 5, Condition 4 of PA 09_0176;
- Completion of 70 ha of rehabilitation for ROC;
- Continuation of rehabilitation monitoring;
- Continuation of rehabilitation maintenance;
- Preparation of new MOP;
- Review and update of the Conceptual Mine Closure Plan;
- Infrastructure relocations within existing disturbance; and
- Consultation with all relevant stakeholders.

12.2 RUM

Key activities proposed for 2020 at RUM include:

- Undertake care and maintenance activities;
 - Undertake underground dewatering activities;
 - Undertake flaring and gas management;
 - Continuation of rehabilitation monitoring;
 - Continued erosion and sediment control maintenance; and
 - Continued spontaneous combustion monitoring.
-

Appendix A: Train Movement Records

A-1: Train Movement Records

2019 Ravensworth Mining Complex Train Movement Records			
Train Index	Load Finish Date	Load Finish Date	Net Weight (t)
0	01-01-2019	8:22:00 PM	9,047.00
1	03-01-2019	2:45:00 AM	8,876.00
2	03-01-2019	5:35:00 AM	8,901.00
3	03-01-2019	9:22:00 AM	8,795.00
4	03-01-2019	2:39:00 PM	9,183.00
5	03-01-2019	5:20:00 PM	9,329.00
6	03-01-2019	10:04:00 PM	8,747.00
7	04-01-2019	11:21:00 AM	9,173.00
8	06-01-2019	9:46:00 PM	8,880.00
9	07-01-2019	8:45:00 AM	8,891.00
10	08-01-2019	12:25:00 AM	9,045.00
11	08-01-2019	12:45:00 PM	8,901.00
12	09-01-2019	4:35:00 AM	9,118.00
13	09-01-2019	7:46:00 AM	9,284.00
15	10-01-2019	5:40:00 AM	9,330.00
16	10-01-2019	12:12:00 PM	9,028.00
17	11-01-2019	8:49:00 PM	9,017.00
18	12-01-2019	11:21:00 AM	8,911.00
19	14-01-2019	1:26:00 AM	9,193.00
20	14-01-2019	11:11:00 PM	9,522.00
21	15-01-2019	2:15:00 AM	8,793.00
22	15-01-2019	9:54:00 AM	9,132.00
23	15-01-2019	9:42:00 PM	9,066.00
24	16-01-2019	6:02:00 AM	9,292.00

25	16-01-2019	4:56:00 PM	9,169.00
26	17-01-2019	3:45:00 AM	8,662.00
27	17-01-2019	8:12:00 AM	9,358.00
28	17-01-2019	11:05:00 AM	9,062.00
30	19-01-2019	7:07:00 AM	9,137.00
31	19-01-2019	2:57:00 PM	8,727.00
32	19-01-2019	6:56:00 PM	9,015.00
33	21-01-2019	5:49:00 PM	9,107.00
34	21-01-2019	11:31:00 PM	9,335.00
36	22-01-2019	2:21:00 PM	9,017.00
37	22-01-2019	6:33:00 PM	8,919.00
39	22-01-2019	10:53:00 PM	9,089.00
41	24-01-2019	2:14:00 AM	8,556.00
42	24-01-2019	2:24:00 PM	9,073.00
44	24-01-2019	6:20:00 PM	8,927.00
45	24-01-2019	9:38:00 PM	9,015.00
46	25-01-2019	2:03:00 PM	8,405.00
47	26-01-2019	3:30:00 AM	8,989.00
48	26-01-2019	6:46:00 AM	8,911.00
49	26-01-2019	2:52:00 PM	9,047.00
50	27-01-2019	2:39:00 AM	8,772.00
51	28-01-2019	5:56:00 PM	9,292.00
53	29-01-2019	3:18:00 AM	9,220.00
54	29-01-2019	4:15:00 PM	8,963.00
55	30-01-2019	1:27:00 AM	8,678.00
56	31-01-2019	2:06:00 AM	8,932.00
57	31-01-2019	8:45:00 AM	9,171.00
58	01-02-2019	12:01:00 AM	9,083.00

59	02-02-2019	3:57:00 AM	9,193.00
61	02-02-2019	7:34:00 AM	9,222.00
62	02-02-2019	2:51:00 PM	8,749.00
63	02-02-2019	9:08:00 PM	8,913.00
64	03-02-2019	1:49:00 AM	9,135.00
66	03-02-2019	6:44:00 AM	9,403.00
67	03-02-2019	3:53:00 PM	8,749.00
68	04-02-2019	8:23:00 AM	8,680.00
69	06-02-2019	1:14:00 PM	8,928.00
70	07-02-2019	10:03:00 AM	8,838.00
71	08-02-2019	4:24:00 AM	8,928.00
72	08-02-2019	8:58:00 AM	9,434.00
74	08-02-2019	6:16:00 PM	9,378.00
75	09-02-2019	2:51:00 AM	9,294.00
76	09-02-2019	5:59:00 AM	9,429.00
77	09-02-2019	9:21:00 AM	8,842.00
79	09-02-2019	12:29:00 PM	9,513.00
83	09-02-2019	3:48:00 PM	9,333.00
84	09-02-2019	9:45:00 PM	8,329.00
85	10-02-2019	7:30:00 AM	9,322.00
86	10-02-2019	10:54:00 AM	8,846.00
88	10-02-2019	7:52:00 PM	9,279.00
89	10-02-2019	11:24:00 PM	8,798.00
90	11-02-2019	6:16:00 AM	8,749.00
92	11-02-2019	9:32:00 AM	8,931.00
93	11-02-2019	12:48:00 PM	9,434.00
96	11-02-2019	5:09:00 PM	8,885.00
97	12-02-2019	5:00:00 AM	9,328.00

98	12-02-2019	8:28:00 AM	8,781.00
100	12-02-2019	7:57:00 PM	9,247.00
102	13-02-2019	2:45:00 AM	9,299.00
103	13-02-2019	7:35:00 AM	8,735.00
105	14-02-2019	7:05:00 AM	9,255.00
107	14-02-2019	6:48:00 PM	9,283.00
108	15-02-2019	2:39:00 AM	8,505.00
109	15-02-2019	5:33:00 AM	9,097.00
110	15-02-2019	10:00:00 AM	9,336.00
112	16-02-2019	4:50:00 AM	8,735.00
113	16-02-2019	10:04:00 AM	9,109.00
115	17-02-2019	7:22:00 AM	9,013.00
116	17-02-2019	2:51:00 PM	8,709.00
119	18-02-2019	12:45:00 PM	9,239.00
120	18-02-2019	4:54:00 PM	87,01
121	22-02-2019	12:36:00 PM	7,968.00
122	22-02-2019	5:32:00 PM	9,252.00
124	23-02-2019	5:25:00 AM	9,168.00
126	23-02-2019	8:33:00 AM	8,941.00
128	23-02-2019	1:54:00 PM	8,682.00
129	23-02-2019	6:18:00 PM	8,628.00
130	24-02-2019	1:48:00 AM	9,415.00
131	24-02-2019	10:18:00 AM	9,302.00
132	24-02-2019	4:11:00 PM	9,413.00
133	25-02-2019	5:20:00 AM	9,270.00
134	25-02-2019	2:04:00 PM	9,331.00
135	26-02-2019	7:25:00 AM	9,152.00
136	27-02-2019	6:54:00 PM	9,262.00

137	28-02-2019	1:18:00 AM	9,450.00
138	28-02-2019	4:36:00 AM	9,100.00
139	28-02-2019	1:10:00 PM	9,093.00
140	28-02-2019	4:24:00 PM	9,254.00
142	01-03-2019	1:12:00 AM	9,216.00
143	01-03-2019	3:56:00 PM	9,179.00
144	02-03-2019	1:31:00 AM	9,065.00
145	02-03-2019	10:05:00 AM	9,429.00
146	02-03-2019	4:31:00 PM	9,449.00
147	02-03-2019	11:28:00 PM	9,492.00
148	03-03-2019	2:41:00 AM	9,388.00
150	03-03-2019	7:19:00 AM	8,723.00
153	03-03-2019	11:40:00 AM	8,928.00
156	03-03-2019	4:41:00 PM	9,078.00
158	04-03-2019	1:25:00 AM	9,068.00
159	04-03-2019	7:21:00 AM	9,452.00
160	04-03-2019	12:29:00 PM	9,336.00
162	04-03-2019	9:13:00 PM	9,326.00
163	05-03-2019	12:30:00 AM	9,129.00
164	05-03-2019	9:25:00 AM	9,328.00
165	05-03-2019	2:47:00 PM	9,072.00
166	05-03-2019	11:03:00 PM	9,431.00
167	06-03-2019	4:47:00 AM	9,191.00
168	06-03-2019	7:34:00 PM	9,258.00
169	07-03-2019	10:06:00 AM	9,199.00
170	07-03-2019	2:18:00 PM	9,057.00
171	07-03-2019	7:17:00 PM	9,077.00
172	07-03-2019	10:11:00 PM	9,120.00

173	08-03-2019	1:57:00 AM	9,025.00
174	08-03-2019	7:33:00 AM	9,322.00
175	08-03-2019	10:54:00 AM	9,434.00
176	08-03-2019	5:04:00 PM	9,052.00
177	08-03-2019	9:59:00 PM	9,119.00
178	09-03-2019	2:51:00 AM	9,150.00
179	09-03-2019	8:30:00 AM	9,149.00
180	09-03-2019	1:16:00 PM	9,371.00
181	10-03-2019	12:36:00 AM	9,384.00
182	10-03-2019	3:35:00 AM	9,300.00
184	10-03-2019	10:12:00 AM	9,470.00
186	10-03-2019	2:08:00 PM	9,270.00
188	10-03-2019	8:58:00 PM	9,217.00
189	11-03-2019	1:05:00 AM	8,858.00
192	11-03-2019	1:06:00 PM	9,325.00
194	12-03-2019	4:52:00 AM	9,430.00
195	12-03-2019	9:04:00 AM	9,289.00
196	14-03-2019	1:02:00 AM	9,138.00
197	14-03-2019	10:28:00 AM	9,084.00
198	14-03-2019	4:19:00 PM	8,781.00
199	15-03-2019	3:19:00 AM	8,904.00
200	15-03-2019	2:39:00 PM	8,784.00
201	15-03-2019	11:23:00 PM	9,410.00
202	16-03-2019	1:09:00 PM	9,333.00
204	16-03-2019	9:08:00 PM	8,873.00
205	16-03-2019	11:42:00 PM	8,758.00
206	18-03-2019	2:33:00 PM	9,351.00
207	19-03-2019	8:00:00 AM	9,388.00

208	28-03-2019	8:39:00 PM	8,956.00
209	29-03-2019	10:32:00 AM	9,274.00
210	29-03-2019	2:37:00 PM	9,186.00
211	31-03-2019	6:39:00 AM	7,492.00
212	31-03-2019	6:54:00 PM	9,360.00
214	01-04-2019	9:09:00 AM	9,374.00
215	01-04-2019	7:55:00 PM	9,365.00
216	02-04-2019	2:30:00 AM	9,136.00
217	02-04-2019	7:12:00 PM	9,090.00
218	02-04-2019	10:14:00 PM	8,551.00
219	03-04-2019	4:18:00 AM	8,835.00
220	04-04-2019	12:49:00 AM	8,777.00
221	04-04-2019	11:25:00 PM	9,006.00
222	05-04-2019	10:31:00 AM	8,449.00
223	06-04-2019	2:29:00 AM	8,626.00
224	06-04-2019	2:44:00 PM	8,918.00
225	07-04-2019	1:36:00 AM	8,541.00
226	07-04-2019	7:41:00 PM	9,318.00
227	13-04-2019	2:57:00 AM	9,016.00
228	15-04-2019	12:34:00 AM	9,423.00
229	15-04-2019	2:23:00 PM	8,518.00
231	15-04-2019	5:17:00 PM	9,466.00
232	15-04-2019	9:15:00 PM	9,020.00
233	16-04-2019	8:39:00 AM	8,953.00
234	16-04-2019	2:10:00 PM	9,135.00
235	17-04-2019	5:09:00 PM	9,376.00
236	18-04-2019	1:17:00 AM	9,512.00
237	19-04-2019	9:21:00 AM	9,168.00

238	19-04-2019	6:41:00 PM	9,208.00
239	19-04-2019	9:52:00 PM	8,837.00
240	20-04-2019	1:02:00 AM	8,417.00
241	20-04-2019	11:15:00 AM	8,801.00
242	21-04-2019	2:53:00 AM	8,483.00
243	21-04-2019	5:55:00 AM	8,928.00
244	21-04-2019	9:15:00 AM	8,964.00
246	21-04-2019	12:57:00 PM	8,508.00
247	21-04-2019	7:25:00 PM	8,563.00
249	21-04-2019	11:00:00 PM	8,940.00
250	22-04-2019	6:35:00 AM	8,474.00
251	23-04-2019	9:08:00 AM	7,441.00
253	23-04-2019	7:12:00 PM	8,662.00
254	23-04-2019	10:35:00 PM	8,471.00
255	24-04-2019	9:31:00 AM	8,928.00
256	24-04-2019	2:22:00 PM	8,440.00
257	25-04-2019	3:13:00 PM	8,556.00
258	25-04-2019	6:09:00 PM	8,512.00
259	26-04-2019	2:20:00 AM	8,277.00
261	26-04-2019	5:35:00 AM	9,026.00
262	27-04-2019	3:42:00 AM	9,260.00
263	27-04-2019	7:58:00 PM	9,382.00
264	28-04-2019	10:36:00 PM	8,781.00
265	30-04-2019	9:10:00 AM	8,556.00
266	30-04-2019	2:45:00 PM	8,893.00
267	30-04-2019	8:41:00 PM	8,945.00
268	01-05-2019	1:57:00 AM	9,408.00
269	01-05-2019	6:59:00 AM	9,378.00

270	01-05-2019	11:25:00 AM	8,517.00
271	01-05-2019	3:13:00 PM	8,758.00
272	01-05-2019	8:21:00 PM	8,463.00
273	02-05-2019	4:07:00 AM	8,532.00
276	02-05-2019	5:45:00 PM	8,594.00
277	04-05-2019	12:39:00 AM	9,485.00
278	05-05-2019	1:07:00 PM	9,008.00
280	06-05-2019	11:24:00 AM	8,807.00
281	07-05-2019	8:09:00 AM	8,556.00
282	07-05-2019	1:23:00 PM	8,782.00
283	08-05-2019	11:55:00 PM	9,226.00
284	09-05-2019	6:01:00 AM	9,225.00
285	09-05-2019	2:31:00 PM	8,825.00
286	10-05-2019	3:12:00 AM	8,972.00
288	10-05-2019	10:33:00 AM	8,948.00
289	10-05-2019	8:38:00 PM	9,441.00
291	11-05-2019	12:01:00 AM	8,760.00
293	11-05-2019	8:53:00 AM	9,057.00
294	11-05-2019	11:53:00 AM	8,802.00
295	11-05-2019	4:38:00 PM	9,251.00
296	11-05-2019	7:56:00 PM	8,865.00
297	12-05-2019	5:20:00 AM	8,873.00
298	12-05-2019	1:51:00 PM	8,923.00
299	13-05-2019	4:22:00 AM	8,837.00
300	13-05-2019	9:03:00 PM	9,048.00
301	14-05-2019	4:41:00 AM	8,975.00
302	14-05-2019	9:55:00 PM	9,152.00
304	15-05-2019	11:45:00 AM	9,162.00

306	16-05-2019	5:11:00 AM	8,895.00
307	19-05-2019	10:49:00 AM	9,383.00
308	19-05-2019	7:49:00 PM	9,379.00
309	24-05-2019	6:03:00 AM	9,523.00
310	24-05-2019	12:58:00 PM	9,398.00
312	24-05-2019	11:57:00 PM	9,346.00
314	25-05-2019	5:46:00 AM	8,687.00
316	25-05-2019	9:19:00 AM	9,204.00
319	26-05-2019	4:26:00 AM	8,856.00
320	26-05-2019	8:10:00 AM	9,369.00
321	27-05-2019	3:39:00 AM	8,983.00
322	29-05-2019	3:50:00 AM	9,371.00
323	29-05-2019	12:22:00 PM	9,408.00
324	30-05-2019	10:45:00 PM	8,978.00
325	01-06-2019	12:17:00 PM	9,277.00
326	01-06-2019	7:12:00 PM	8,471.00
327	02-06-2019	8:52:00 PM	8,656.00
328	03-06-2019	2:07:00 AM	9,361.00
330	03-06-2019	8:38:00 AM	8,513.00
331	04-06-2019	3:21:00 AM	9,278.00
333	04-06-2019	9:18:00 AM	9,322.00
335	04-06-2019	5:34:00 PM	9,358.00
336	05-06-2019	11:32:00 AM	9,353.00
338	06-06-2019	4:47:00 PM	8,567.00
339	07-06-2019	1:04:00 AM	8,633.00
340	07-06-2019	4:15:00 AM	8,768.00
341	07-06-2019	6:10:00 PM	8,736.00
343	09-06-2019	8:39:00 AM	9,056.00

344	09-06-2019	9:38:00 PM	9,443.00
345	10-06-2019	8:35:00 PM	9,242.00
346	11-06-2019	12:15:00 PM	8,572.00
347	12-06-2019	6:05:00 PM	9,491.00
349	13-06-2019	4:22:00 PM	9,341.00
350	14-06-2019	9:22:00 AM	9,100.00
351	14-06-2019	4:06:00 PM	9,261.00
352	14-06-2019	6:51:00 PM	9,358.00
354	15-06-2019	2:14:00 AM	9,350.00
355	15-06-2019	2:59:00 PM	8,525.00
356	15-06-2019	10:20:00 PM	8,659.00
357	16-06-2019	2:29:00 AM	8,604.00
358	16-06-2019	7:04:00 AM	9,124.00
359	16-06-2019	8:51:00 PM	9,084.00
360	17-06-2019	12:01:00 PM	9,361.00
361	18-06-2019	9:32:00 AM	8,784.00
362	19-06-2019	8:57:00 AM	8,928.00
363	19-06-2019	4:27:00 PM	9,303.00
364	20-06-2019	4:23:00 PM	8,677.00
366	21-06-2019	10:57:00 PM	9,417.00
368	22-06-2019	2:31:00 PM	8,645.00
371	23-06-2019	8:34:00 AM	8,628.00
373	23-06-2019	2:22:00 PM	9,158.00
374	24-06-2019	9:29:00 PM	9,404.00
376	25-06-2019	4:52:00 AM	9,433.00
377	25-06-2019	2:14:00 PM	8,713.00
378	26-06-2019	8:44:00 AM	8,812.00
380	26-06-2019	9:12:00 PM	9,119.00

381	27-06-2019	9:12:00 AM	9,386.00
382	27-06-2019	12:53:00 PM	8,701.00
383	27-06-2019	4:46:00 PM	9,077.00
384	27-06-2019	7:49:00 PM	9,077.00
385	28-06-2019	5:52:00 AM	8,814.00
386	28-06-2019	1:55:00 PM	8,908.00
387	28-06-2019	7:29:00 PM	9,121.00
388	29-06-2019	3:14:00 AM	8,657.00
389	29-06-2019	10:50:00 AM	9,239.00
390	29-06-2019	10:43:00 PM	9,163.00
391	30-06-2019	1:36:00 AM	9,156.00
392	30-06-2019	9:47:00 AM	9,022.00
393	30-06-2019	4:33:00 PM	9,051.00
394	30-06-2019	8:37:00 PM	9,262.00
395	30-06-2019	11:22:00 PM	9,322.00
396	01-07-2019	3:22:00 AM	9,062.00
397	01-07-2019	8:02:00 AM	7,335.00
398	01-07-2019	11:09:00 AM	8,893.00
399	01-07-2019	5:00:00 PM	8,798.00
401	01-07-2019	11:58:00 PM	9,076.00
402	02-07-2019	10:48:00 AM	9,217.00
403	04-07-2019	2:02:00 AM	8,910.00
404	04-07-2019	5:14:00 AM	9,350.00
405	06-07-2019	4:49:00 AM	9,290.00
406	06-07-2019	12:03:00 PM	9,432.00
407	06-07-2019	3:43:00 PM	9,544.00
408	07-07-2019	3:52:00 AM	9,196.00
409	07-07-2019	8:33:00 AM	8,784.00

410	07-07-2019	5:03:00 PM	9,374.00
412	08-07-2019	4:20:00 AM	8,886.00
413	08-07-2019	7:33:00 AM	9,408.00
414	08-07-2019	3:30:00 PM	9,000.00
415	08-07-2019	8:43:00 PM	8,842.00
416	09-07-2019	4:41:00 AM	8,135.00
417	09-07-2019	8:47:00 PM	8,806.00
418	10-07-2019	1:52:00 PM	9,042.00
419	10-07-2019	8:07:00 PM	9,371.00
420	11-07-2019	1:42:00 AM	9,370.00
421	11-07-2019	5:28:00 AM	8,781.00
422	11-07-2019	8:54:00 AM	8,675.00
423	12-07-2019	1:54:00 AM	9,035.00
424	12-07-2019	9:59:00 AM	9,387.00
425	12-07-2019	11:07:00 PM	9,139.00
426	13-07-2019	4:49:00 AM	8,905.00
427	13-07-2019	12:13:00 PM	9,542.00
428	13-07-2019	6:59:00 PM	8,754.00
429	14-07-2019	7:09:00 AM	8,726.00
430	14-07-2019	2:23:00 PM	9,331.00
431	14-07-2019	8:42:00 PM	9,247.00
432	15-07-2019	8:41:00 AM	9,185.00
433	16-07-2019	1:23:00 AM	9,124.00
434	16-07-2019	4:48:00 AM	8,741.00
435	17-07-2019	12:35:00 PM	9,275.00
436	17-07-2019	9:50:00 PM	8,336.00
437	18-07-2019	1:02:00 AM	9,045.00
438	18-07-2019	6:14:00 AM	8,715.00

439	18-07-2019	8:08:00 PM	9,619.00
440	19-07-2019	2:47:00 AM	9,352.00
441	20-07-2019	3:45:00 AM	9,306.00
442	21-07-2019	3:56:00 AM	9,368.00
443	21-07-2019	9:34:00 AM	8,847.00
446	21-07-2019	1:05:00 PM	8,798.00
447	21-07-2019	9:20:00 PM	8,556.00
449	22-07-2019	3:34:00 AM	9,390.00
451	22-07-2019	10:29:00 AM	9,447.00
453	22-07-2019	4:35:00 PM	9,098.00
454	24-07-2019	3:35:00 AM	8,388.00
455	24-07-2019	9:30:00 AM	8,896.00
456	24-07-2019	6:18:00 PM	9,032.00
458	24-07-2019	10:54:00 PM	9,289.00
459	25-07-2019	9:00:00 AM	9,314.00
460	25-07-2019	3:39:00 PM	9,367.00
461	26-07-2019	3:42:00 AM	9,342.00
462	26-07-2019	10:15:00 AM	9,420.00
463	26-07-2019	8:09:00 PM	9,064.00
464	27-07-2019	12:02:00 AM	9,252.00
465	27-07-2019	8:06:00 AM	9,453.00
466	27-07-2019	4:26:00 PM	9,068.00
467	27-07-2019	7:57:00 PM	9,264.00
468	27-07-2019	11:02:00 PM	8,670.00
469	28-07-2019	3:27:00 AM	9,005.00
470	28-07-2019	1:10:00 PM	9,363.00
471	28-07-2019	9:59:00 PM	9,471.00
472	29-07-2019	1:31:00 AM	9,397.00

473	29-07-2019	1:24:00 PM	8,888.00
474	30-07-2019	3:52:00 AM	8,979.00
475	30-07-2019	7:24:00 AM	8,950.00
476	30-07-2019	4:02:00 PM	8,962.00
478	30-07-2019	11:30:00 PM	9,239.00
480	31-07-2019	12:45:00 PM	9,337.00
481	31-07-2019	6:05:00 PM	6,647.00
483	31-07-2019	10:29:00 PM	8,839.00
484	01-08-2019	4:55:00 AM	9,128.00
487	01-08-2019	9:04:00 AM	9,088.00
488	01-08-2019	10:35:00 PM	9,072.00
489	02-08-2019	3:16:00 AM	9,258.00
490	02-08-2019	8:46:00 PM	9,207.00
491	02-08-2019	11:32:00 PM	9,001.00
493	03-08-2019	4:56:00 AM	9,267.00
494	03-08-2019	9:57:00 AM	9,210.00
495	03-08-2019	2:01:00 PM	9,315.00
496	04-08-2019	8:24:00 AM	9,092.00
497	05-08-2019	2:05:00 AM	9,197.00
498	05-08-2019	5:15:00 PM	9,391.00
499	09-08-2019	6:59:00 PM	9,258.00
503	10-08-2019	12:54:00 AM	9,214.00
504	10-08-2019	5:20:00 AM	8,652.00
505	10-08-2019	4:46:00 PM	9,306.00
506	11-08-2019	2:16:00 AM	9,536.00
507	11-08-2019	2:58:00 PM	9,415.00
508	11-08-2019	9:52:00 PM	9,033.00
509	12-08-2019	7:33:00 PM	8,834.00

510	13-08-2019	8:24:00 AM	9,108.00
511	13-08-2019	2:22:00 PM	9,081.00
512	14-08-2019	9:28:00 AM	9,474.00
513	14-08-2019	2:38:00 PM	8,933.00
514	15-08-2019	6:25:00 PM	9,369.00
515	16-08-2019	1:27:00 AM	9,356.00
516	16-08-2019	8:14:00 AM	9,248.00
517	16-08-2019	2:36:00 PM	9,109.00
518	16-08-2019	11:25:00 AM	9,010.00
519	16-08-2019	5:42:00 PM	9,022.00
520	16-08-2019	8:53:00 PM	8,926.00
521	17-08-2019	2:42:00 AM	9,014.00
522	17-08-2019	2:25:00 PM	8,909.00
523	17-08-2019	10:00:00 PM	8,910.00
524	18-08-2019	1:45:00 AM	9,066.00
525	18-08-2019	3:59:00 PM	9,367.00
526	18-08-2019	7:25:00 PM	8,287.00
527	19-08-2019	2:31:00 AM	9,075.00
528	19-08-2019	10:49:00 AM	9,388.00
530	19-08-2019	2:36:00 PM	9,428.00
531	20-08-2019	4:14:00 AM	9,373.00
532	20-08-2019	10:25:00 AM	8,574.00
533	20-08-2019	1:46:00 PM	9,306.00
534	20-08-2019	4:38:00 PM	9,358.00
537	20-08-2019	9:02:00 PM	8,463.00
538	21-08-2019	12:59:00 AM	9,367.00
539	21-08-2019	8:38:00 AM	9,033.00
540	21-08-2019	2:56:00 PM	8,909.00

544	22-08-2019	9:31:00 AM	8,623.00
546	23-08-2019	2:53:00 AM	8,463.00
548	23-08-2019	10:17:00 AM	9,204.00
550	24-08-2019	3:36:00 AM	8,463.00
551	24-08-2019	3:42:00 PM	9,099.00
552	24-08-2019	11:33:00 PM	9,018.00
553	25-08-2019	10:27:00 PM	8,778.00
554	26-08-2019	2:53:00 AM	8,777.00
555	26-08-2019	7:59:00 AM	9,000.00
556	26-08-2019	3:59:00 PM	8,866.00
557	27-08-2019	1:41:00 PM	9,028.00
558	27-08-2019	7:39:00 PM	9,122.00
560	28-08-2019	2:27:00 AM	9,345.00
561	03-09-2019	7:42:00 AM	9,369.00
562	03-09-2019	11:26:00 AM	9,094.00
563	03-09-2019	3:34:00 PM	9,374.00
564	04-09-2019	4:07:00 AM	9,414.00
565	04-09-2019	6:07:00 PM	8,818.00
566	05-09-2019	6:37:00 AM	8,987.00
567	05-09-2019	11:21:00 AM	8,681.00
568	06-09-2019	9:21:00 AM	8,720.00
569	07-09-2019	2:04:00 AM	9,404.00
570	07-09-2019	4:44:00 PM	9,046.00
571	08-09-2019	12:33:00 AM	9,273.00
573	08-09-2019	5:41:00 AM	9,250.00
574	08-09-2019	9:05:00 AM	9,408.00
577	08-09-2019	1:27:00 PM	9,368.00
579	09-09-2019	10:09:00 AM	9,256.00

581	10-09-2019	4:17:00 PM	9,285.00
582	11-09-2019	7:12:00 AM	9,264.00
583	11-09-2019	10:58:00 AM	9,294.00
584	11-09-2019	10:58:00 AM	9,334.00
585	11-09-2019	10:57:00 PM	8,459.00
586	12-09-2019	1:58:00 AM	9,414.00
587	12-09-2019	11:05:00 PM	9,305.00
588	13-09-2019	4:33:00 AM	9,259.00
589	13-09-2019	8:32:00 PM	9,371.00
590	14-09-2019	3:03:00 AM	9,064.00
591	14-09-2019	6:42:00 AM	8,936.00
592	14-09-2019	9:32:00 AM	8,931.00
593	14-09-2019	1:24:00 PM	9,198.00
594	14-09-2019	6:14:00 PM	9,292.00
595	15-09-2019	4:50:00 AM	9,075.00
596	15-09-2019	8:42:00 AM	9,068.00
597	15-09-2019	3:42:00 PM	4,260.00
598	15-09-2019	6:47:00 PM	8,813.00
599	15-09-2019	9:51:00 PM	9,274.00
600	16-09-2019	3:31:00 AM	9,125.00
602	16-09-2019	1:07:00 PM	9,353.00
603	17-09-2019	3:24:00 AM	8,791.00
604	17-09-2019	6:35:00 AM	8,718.00
605	17-09-2019	9:56:00 AM	8,840.00
606	17-09-2019	5:25:00 PM	8,716.00
607	18-09-2019	10:08:00 PM	9,424.00
608	19-09-2019	2:44:00 AM	9,231.00
609	19-09-2019	5:13:00 PM	9,166.00

611	20-09-2019	9:07:00 AM	9,296.00
612	20-09-2019	6:25:00 PM	8,691.00
613	21-09-2019	3:21:00 AM	8,645.00
614	21-09-2019	9:43:00 PM	9,603.00
615	22-09-2019	1:43:00 AM	9,528.00
616	22-09-2019	5:43:00 AM	9,315.00
618	22-09-2019	9:43:00 AM	9,414.00
619	22-09-2019	5:13:00 PM	9,419.00
621	23-09-2019	6:02:00 AM	8,765.00
622	23-09-2019	11:43:00 AM	9,372.00
623	27-09-2019	10:50:00 AM	9,035.00
624	28-09-2019	9:05:00 AM	9,524.00
626	28-09-2019	1:02:00 PM	8,682.00
628	28-09-2019	5:42:00 PM	8,351.00
629	29-09-2019	1:21:00 AM	9,497.00
630	29-09-2019	4:49:00 AM	9,364.00
631	29-09-2019	8:23:00 AM	9,422.00
632	29-09-2019	6:17:00 PM	8,784.00
634	30-09-2019	4:21:00 AM	9,235.00
635	30-09-2019	1:50:00 PM	9,200.00
636	30-09-2019	4:39:00 PM	9,309.00
638	30-09-2019	11:46:00 PM	9,400.00
639	01-10-2019	4:29:00 AM	9,226.00
640	01-10-2019	2:28:00 PM	9,265.00
641	02-10-2019	5:03:00 AM	9,127.00
642	02-10-2019	5:35:00 PM	8,841.00
643	03-10-2019	10:34:00 AM	9,102.00
644	05-10-2019	12:47:00 AM	9,195.00

646	08-10-2019	2:42:00 AM	9,218.00
647	10-10-2019	12:43:00 AM	9,429.00
648	10-10-2019	9:39:00 PM	9,169.00
649	12-10-2019	12:55:00 PM	8,955.00
650	13-10-2019	12:22:00 PM	8,994.00
653	13-10-2019	3:19:00 PM	8,968.00
654	13-10-2019	10:38:00 PM	8,918.00
655	14-10-2019	4:30:00 AM	9,487.00
656	14-10-2019	10:31:00 AM	9,103.00
657	15-10-2019	2:02:00 AM	9,207.00
658	16-10-2019	3:26:00 AM	9,416.00
659	16-10-2019	7:33:00 AM	9,128.00
660	16-10-2019	10:26:00 AM	9,522.00
661	16-10-2019	8:13:00 PM	9,299.00
663	17-10-2019	12:39:00 AM	9,419.00
664	17-10-2019	9:52:00 AM	9,279.00
665	17-10-2019	1:46:00 PM	9,333.00
667	18-10-2019	7:49:00 AM	8,942.00
668	18-10-2019	11:39:00 AM	8,881.00
669	19-10-2019	3:15:00 AM	9,415.00
670	19-10-2019	7:03:00 AM	9,176.00
671	19-10-2019	11:26:00 AM	9,380.00
672	20-10-2019	3:21:00 AM	9,106.00
673	20-10-2019	7:15:00 AM	9,116.00
674	20-10-2019	4:15:00 PM	9,053.00
675	20-10-2019	8:53:00 PM	9,068.00
676	21-10-2019	12:16:00 AM	8,878.00
677	21-10-2019	4:57:00 AM	8,690.00

679	21-10-2019	6:26:00 PM	9,099.00
680	22-10-2019	3:05:00 AM	8,999.00
681	22-10-2019	6:25:00 AM	9,083.00
682	22-10-2019	3:48:00 PM	9,299.00
683	22-10-2019	8:34:00 PM	9,113.00
685	23-10-2019	1:02:00 AM	7,922.00
686	23-10-2019	2:28:00 PM	8,455.00
687	24-10-2019	1:02:00 AM	9,124.00
688	24-10-2019	8:19:00 PM	8,927.00
689	25-10-2019	5:43:00 AM	8,798.00
691	25-10-2019	6:30:00 PM	8,194.00
692	25-10-2019	10:19:00 PM	9,503.00
693	26-10-2019	4:50:00 AM	9,396.00
694	26-10-2019	3:01:00 PM	8,836.00
695	26-10-2019	7:23:00 PM	8,298.00
696	27-10-2019	8:19:00 AM	8,186.00
697	27-10-2019	11:30:00 AM	9,079.00
698	27-10-2019	8:41:00 PM	8,667.00
699	28-10-2019	12:53:00 AM	8,700.00
700	28-10-2019	8:17:00 AM	9,027.00
701	28-10-2019	6:55:00 PM	9,016.00
702	30-10-2019	10:20:00 AM	8,390.00
703	30-10-2019	2:18:00 PM	9,322.00
704	31-10-2019	2:42:00 PM	8,631.00
705	01-11-2019	4:46:00 AM	9,521.00
706	01-11-2019	7:51:00 AM	8,643.00
707	03-11-2019	4:31:00 AM	8,911.00
708	03-11-2019	7:12:00 AM	9,020.00

709	03-11-2019	8:26:00 PM	9,050.00
710	04-11-2019	1:08:00 AM	9,063.00
711	04-11-2019	5:00:00 AM	8,918.00
712	04-11-2019	10:46:00 AM	9,080.00
713	04-11-2019	6:35:00 PM	9,256.00
714	04-11-2019	9:14:00 PM	9,393.00
715	05-11-2019	1:08:00 AM	8,873.00
716	05-11-2019	12:59:00 PM	8,892.00
717	05-11-2019	4:38:00 PM	9,389.00
718	06-11-2019	6:10:00 AM	9,423.00
719	06-11-2019	7:27:00 PM	9,459.00
720	07-11-2019	12:08:00 AM	9,275.00
721	07-11-2019	8:48:00 AM	9,078.00
722	07-11-2019	1:21:00 PM	9,432.00
723	07-11-2019	11:48:00 PM	8,994.00
724	08-11-2019	6:45:00 AM	8,842.00
725	08-11-2019	11:05:00 AM	8,898.00
726	08-11-2019	10:23:00 PM	9,014.00
727	09-11-2019	6:10:00 AM	8,773.00
728	10-11-2019	5:29:00 AM	8,990.00
729	10-11-2019	9:14:00 PM	8,291.00
730	11-11-2019	1:59:00 PM	8,329.00
731	13-11-2019	9:07:00 PM	8,638.00
732	14-11-2019	12:07:00 AM	8,714.00
733	14-11-2019	8:20:00 AM	8,717.00
734	14-11-2019	6:00:00 PM	8,810.00
735	17-11-2019	2:20:00 AM	8,968.00
736	17-11-2019	9:23:00 AM	9,356.00

737	17-11-2019	12:45:00 PM	9,334.00
738	17-11-2019	8:52:00 PM	8,950.00
739	22-11-2019	4:48:00 PM	9,032.00
740	24-11-2019	7:33:00 PM	9,349.00
741	26-11-2019	8:37:00 PM	8,947.00
742	28-11-2019	5:09:00 AM	9,648.00
743	28-11-2019	8:49:00 AM	9,453.00
744	28-11-2019	2:14:00 PM	9,923.00
745	28-11-2019	7:12:00 PM	8,946.00
746	29-11-2019	9:20:00 AM	9,465.00
747	29-11-2019	7:09:00 PM	9,462.00
748	30-11-2019	2:32:00 AM	9,539.00
749	30-11-2019	9:49:00 AM	9,470.00
750	30-11-2019	7:11:00 PM	8,413.00
751	30-11-2019	11:27:00 PM	9,466.00
752	01-12-2019	9:30:00 AM	9,546.00
753	02-12-2019	8:38:00 AM	9,292.00
754	03-12-2019	6:34:00 AM	8,932.00
755	03-12-2019	12:30:00 PM	8,997.00
756	03-12-2019	3:49:00 PM	9,535.00
757	04-12-2019	5:03:00 AM	8,921.00
758	04-12-2019	9:51:00 AM	9,520.00
759	05-12-2019	12:33:00 AM	9,288.00
760	05-12-2019	3:24:00 AM	9,318.00
761	05-12-2019	11:27:00 AM	9,482.00
762	05-12-2019	4:30:00 PM	9,224.00
763	05-12-2019	11:38:00 PM	9,471.00
764	06-12-2019	2:54:00 AM	9,386.00

765	06-12-2019	12:17:00 PM	9,412.00
766	06-12-2019	10:22:00 PM	9,247.00
767	07-12-2019	6:14:00 AM	9,523.00
768	07-12-2019	4:15:00 PM	9,188.00
769	07-12-2019	7:29:00 PM	9,018.00
770	08-12-2019	3:04:00 PM	9,532.00
771	09-12-2019	10:38:00 AM	9,543.00
772	10-12-2019	12:28:00 AM	8,875.00
773	10-12-2019	5:00:00 AM	8,897.00
774	10-12-2019	8:27:00 PM	9,304.00
775	11-12-2019	9:08:00 PM	9,433.00
776	12-12-2019	3:53:00 PM	9,429.00
777	13-12-2019	1:26:00 AM	9,018.00
778	13-12-2019	11:47:00 AM	9,237.00
779	15-12-2019	5:00:00 AM	9,630.00
780	15-12-2019	9:39:00 PM	8,871.00
781	16-12-2019	1:28:00 AM	9,084.00
782	16-12-2019	5:23:00 AM	9,073.00
783	16-12-2019	10:59:00 AM	9,329.00
784	16-12-2019	2:25:00 PM	9,111.00
785	16-12-2019	5:42:00 PM	9,427.00
786	17-12-2019	2:37:00 AM	9,130.00
787	17-12-2019	6:03:00 AM	9,469.00
788	17-12-2019	8:18:00 PM	8,343.00
789	18-12-2019	5:18:00 AM	8,832.00
790	18-12-2019	10:01:00 AM	9,392.00
791	18-12-2019	7:34:00 PM	9,430.00
792	18-12-2019	11:21:00 PM	8,908.00

793	19-12-2019	3:25:00 AM	8,844.00
794	20-12-2019	9:15:00 AM	9,206.00
795	20-12-2019	5:44:00 PM	9,021.00
796	21-12-2019	8:49:00 AM	9,085.00
797	21-12-2019	5:46:00 PM	8,818.00
798	21-12-2019	10:43:00 PM	9,190.00
799	23-12-2019	1:47:00 AM	9,495.00
800	23-12-2019	5:28:00 PM	8,914.00
801	24-12-2019	9:05:00 AM	9,282.00
802	27-12-2019	2:14:00 AM	9,448.00
803	27-12-2019	11:35:00 AM	9,399.00
804	27-12-2019	4:32:00 PM	9,380.00
805	28-12-2019	1:46:00 AM	9,169.00
806	28-12-2019	10:45:00 AM	9,288.00
807	28-12-2019	1:32:00 PM	9,381.00
808	28-12-2019	6:39:00 PM	9,220.00
809	28-12-2019	9:55:00 PM	9,371.00
810	29-12-2019	7:16:00 PM	8,746.00
811	30-12-2019	12:16:00 AM	9,557.00
812	30-12-2019	7:07:00 AM	9,193.00
813	30-12-2019	10:12:00 AM	9,346.00
814	30-12-2019	6:22:00 PM	9,399.00
815	31-12-2019	1:51:00 AM	8,893.00
816	31-12-2019	6:14:00 AM	9,134.00
817	31-12-2019	4:37:00 PM	9,120.00
818	31-12-2019	10:24:00 PM	9,347.00

Appendix B: Air Quality Results

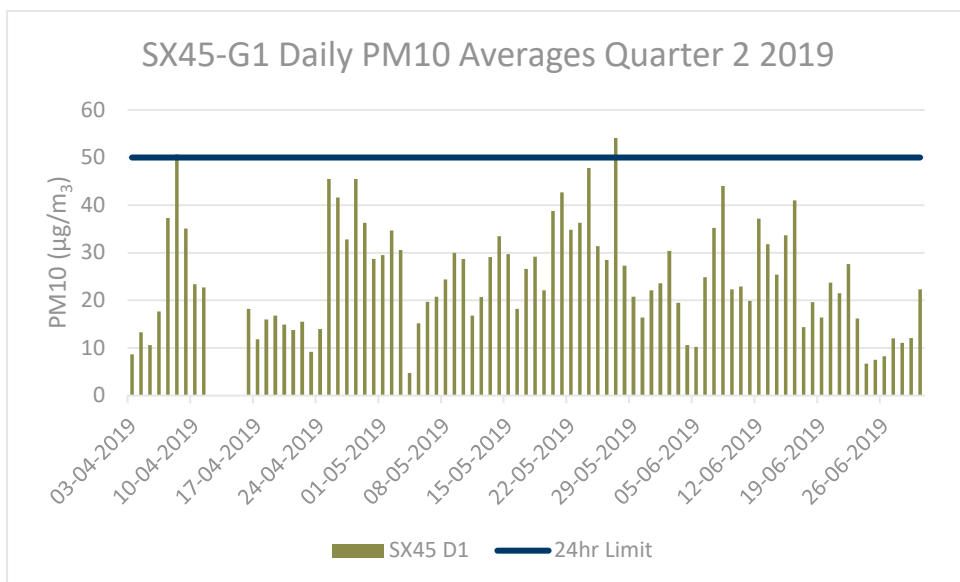
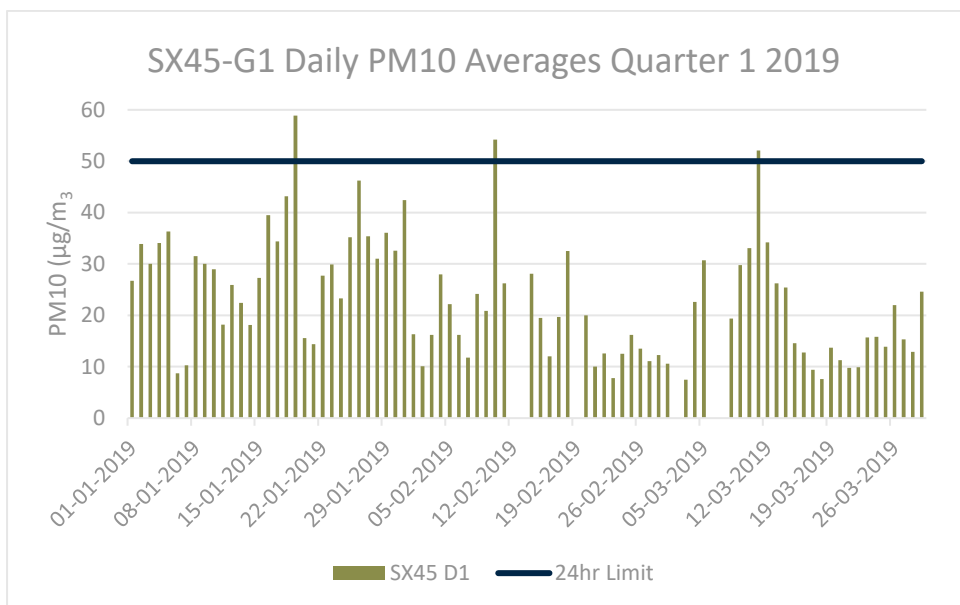
Table B1: Air Quality – 24hr TEOM (PM₁₀) Exceedances

PM ₁₀ Exceedances		
<i>Date</i>	<i>TEOM Unit</i>	<i>Result (µg/m³)</i>
16-01-2019	SX45-G2	51.9
19-01-2019	SX45-G1	58.9
10-02-2019	SX45-G2	51.9
10-02-2019	SX45-G1	54.2
12-02-2019*	SX45-G1	60.5
13-02-2019*	SX45-G2	67.8
13-02-2019*	SX45-G1	53.0
19-02-2019*	SX45-G2	67.2
06-03-2019*	SX45-G2	68.0
11-03-2019	SX45-G2	50.2
11-03-2019	SX45-G1	52.1
31-03-2019*	SX45-G2	59.6
08-04-2019	SX45-G1	50.7
02-05-2019	SX45-G2	53.3
27-05-2019	SX45-G1	54.1
16-06-2019	SX45-G2	50.4
23-06-2019	SX45-G2	55.4
21-07-2019	SX45-G1	52.0
08-08-2019	SX45-G1	54.7
09-08-2019	SX45-G1	66.5
24-08-2019	SX45-G1	64.6
06-09-2019*	SX45-G2	80.8
06-09-2019*	SX45-G1	96.2
12-09-2019	SX45-G1	56.6
13-09-2019	SX45-G1	52.8
15-09-2019	SX45-G1	52.6
16-09-2019	SX45-G1	76.1
03-10-2019	SX45-G2	52.0
03-10-2019	SX45-G1	72.0
04-10-2019	SX45-G1	60.4
07-10-2019*	SX45-G2	57.9
07-10-2019*	SX45-G1	65.6
15-10-2019	SX45-G2	51.8
19-10-2019	SX45-G1	50.8
24-10-2019	SX45-G1	54.0
25-10-2019	SX45-G2	57.9

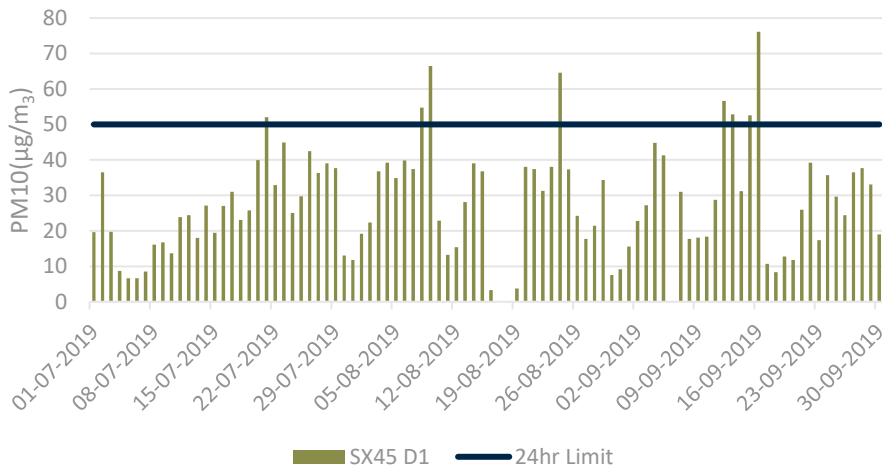
PM ₁₀ Exceedances		
25-10-2019	SX45-G1	63.5
26-10-2019*	SX45-G2	104.0
27-10-2019*	SX45-G2	68.6
28-10-2019*	SX45-G2	59.3
30-10-2019*	SX45-G2	105.8
30-10-2019*	SX45-G1	87.3
31-10-2019*	SX45-G2	77.9
31-10-2019*	SX45-G1	83.7
01-11-2019*	SX45-G2	73.8
01-11-2019*	SX45-G1	65.9
03-11-2019	SX45-G2	51.7
07-11-2019*	SX45-G2	76.0
07-11-2019*	SX45-G1	78.8
08-11-2019*	SX45-G2	70.0
08-11-2019*	SX45-G1	74.1
12-11-2019*	SX45-G2	102.7
12-11-2019*	SX45-G1	128.0
17-11-2019*	SX45-G2	64.7
17-11-2019*	SX45-G1	63.5
18-11-2019	SX45-G2	53.8
19-11-2019*	SX45-G2	53.1
19-11-2019*	SX45-G1	77.3
21-11-2019*	SX45-G2	114.3
21-11-2019*	SX45-G1	99.2
22-11-2019*	SX45-G2	111.0
22-11-2019*	SX45-G1	117.4
23-11-2019*	SX45-G2	53.9
25-11-2019	SX45-G2	53.0
26-11-2019*	SX45-G2	251.4
26-11-2019*	SX45-G1	180.6
27-11-2019*	SX45-G2	65.5
28-11-2019*	SX45-G2	91.8
28-11-2019*	SX45-G1	70.3
29-11-2019*	SX45-G2	135.9
29-11-2019*	SX45-G1	131.5
30-11-2019*	SX45-G2	66.1
01-12-2019*	SX45-G2	62.3
02-12-2019*	SX45-G2	74.0
03-12-2019*	SX45-G2	56.9

PM ₁₀ Exceedances		
03-12-2019*	SX45-G1	57.8
05-12-2019*	SX45-G1	67.3
06-12-2019*	SX45-G2	70.0
06-12-2019*	SX45-G1	73.7
07-12-2019*	SX45-G2	97.7
07-12-2019*	SX45-G1	100.9
09-12-2019*	SX45-G2	84.7
09-12-2019*	SX45-G1	67.4
10-12-2019*	SX45-G2	96.4
10-12-2019*	SX45-G1	96.0
11-12-2019*	SX45-G2	109.8
11-12-2019*	SX45-G1	116.4
14-12-2019*	SX45-G2	57.5
14-12-2019*	SX45-G1	60.7
15-12-2019*	SX45-G2	59.0
16-12-2019*	SX45-G2	89.8
16-12-2019*	SX45-G1	78.8
19-12-2019*	SX45-G2	112.1
19-12-2019*	SX45-G1	109.6
21-12-2019*	SX45-G2	94.1
21-12-2019*	SX45-G1	87.5
28-12-2019*	SX45-G2	60.9
29-12-2019	SX45-G2	85.1
30-12-2019*	SX45-G2	113.2
30-12-2019*	SX45-G1	57.6
31-12-2019*	SX45-G2	82.6
31-12-2019*	SX45-G1	87.2

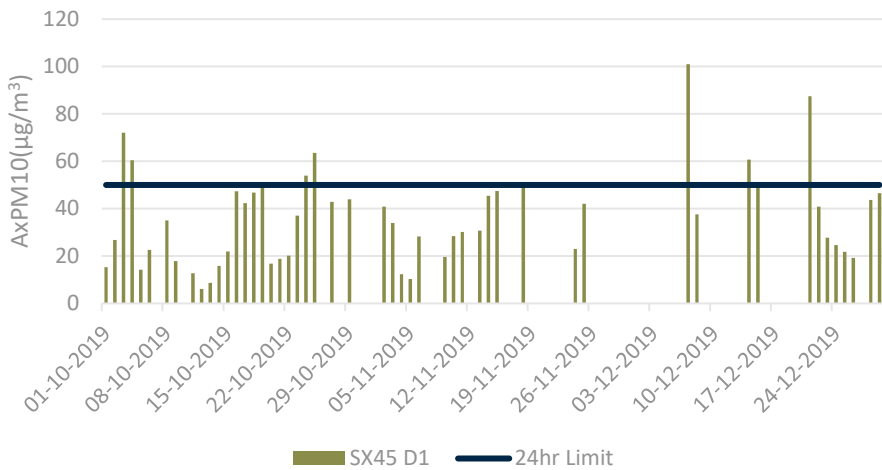
Note: *Are extraordinary days identified by DPIE.



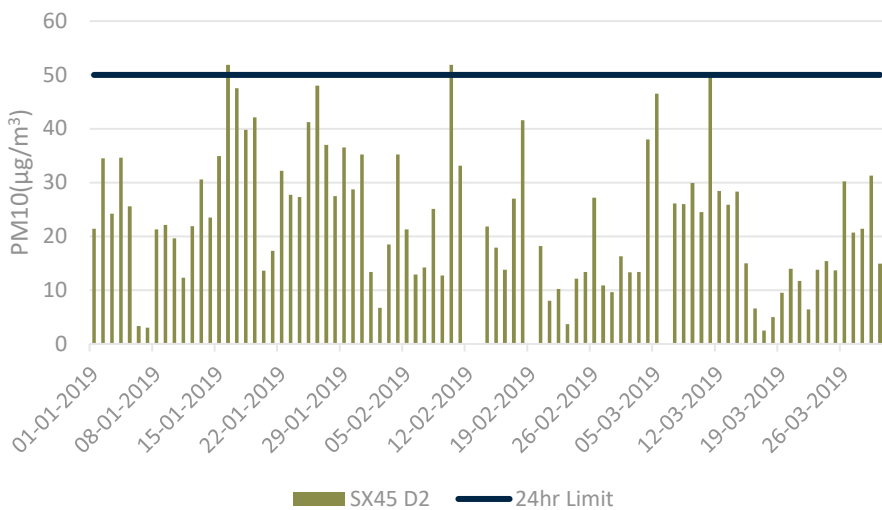
SX45-G1 PM10 Averages Quarter 3 2019



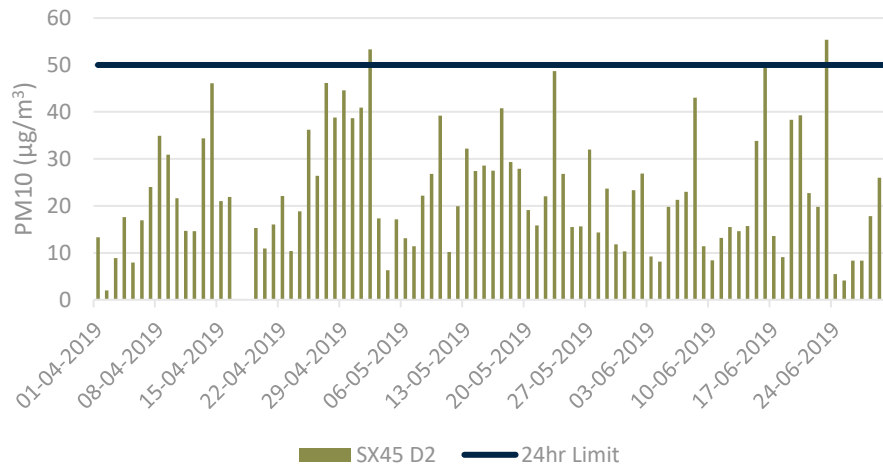
SX45-G1 PM10 Averages Quarter 4 2019



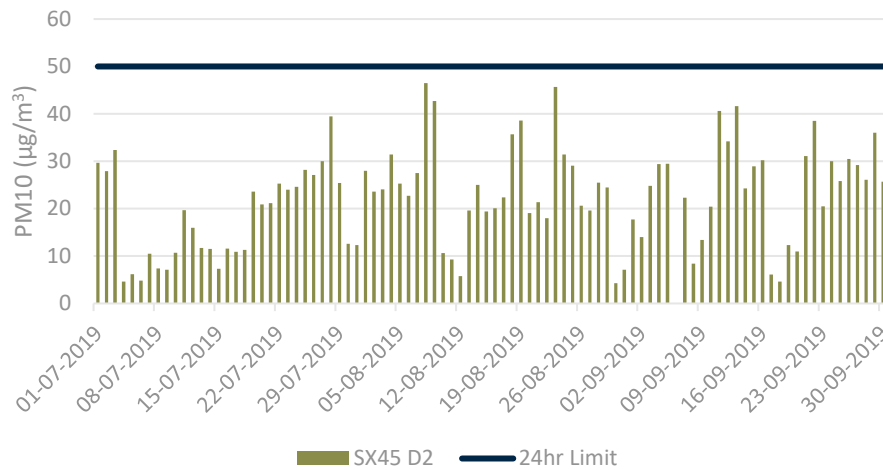
SX45 - G2 Averages Quarter 1 2019



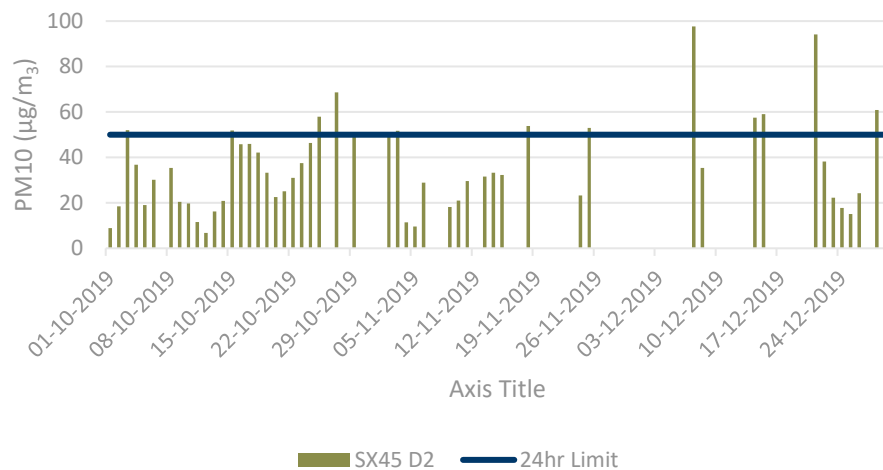
SX45-G2 Averages Quarter 2 2019



SX45-G2 Averages Quarter 3 2019



SX45-G2 Averages Quarter 4 2019



Appendix C: Noise Monitoring Results

January 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	30/01/2019 10:02	28	<30-33	Yes	35	Yes	31	45	Yes	28	40	Yes
R3 (Site 3) W. Bowman	30/01/2019 10:53	26	<30-34	Yes	35	Yes	29	45	Yes	26	40	Yes
R3 (Site 5) Camberwell Sth	30/01/2019 11:15	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	30/01/2019 11:33	<20	<30-34	Yes	35	Yes	<20	45	Yes	34	40	Yes

February 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	14/02/2019 9:11	26	<30-33	Yes	35	Yes	29	45	Yes	26	40	Yes
R3 (Site 3) W. Bowman	12/02/2019 10:40	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R3 (Site 5) Camberwell Sth	12/02/2019 11:03	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	12/02/2019 11:24	<20	<30-34	Yes	35	Yes	<20	45	Yes	32	40	Yes

March 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	20/03/2019 9:50	<20	<30-33	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R3 (Site 3) W. Bowman	20/03/2019 10:41	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

R3 (Site 5) Camberwell Sth	20/03/2019 11:02	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	20/03/2019 11:33	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

April 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	10/04/2019 10:17	<20	<30-33	Yes	35	Yes	<20	45	Yes	20	40	Yes
R3 (Site 3) W. Bowman	10/04/2019 11:16	<20	<30-34	Yes	35	Yes	<20	45	Yes	22	40	Yes
R3 (Site 5) Camberwell Sth	10/04/2019 11:29	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	10/04/2019 11:48	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

May 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	7/05/2019 9:49	26	<30-33	Yes	35	Yes	29	45	Yes	30*	40	Yes
R3 (Site 3) W. Bowman	6/05/2019 10:41	26	<30-34	Yes	35	Yes	29	45	Yes	26	40	Yes
R3 (Site 5) Camberwell Sth	6/05/2019 11:06	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

R4 (Site 6) Camberwell Nt	6/05/2019 11:28	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
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*Recorded on the 6 May 2019.

June 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	27/06/2019 10:06	28	<30-33	Yes	35	Yes	30	45	Yes	28	40	Yes
R3 (Site 3) W. Bowman	27/06/2019 10:49	<20	<30-34	Yes	35	Yes	<20	45	Yes	22	40	Yes
R3 (Site 5) Camberwell Sth	27/06/2019 11:08	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	27/06/2019 11:26	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

July 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	22/07/2019 9:38	28	<30-33	Yes	35	Yes	31	45	Yes	28	40	Yes
R3 (Site 3) W. Bowman	22/07/2019 10:27	29	<30-34	Yes	35	Yes	41	45	Yes	30	40	Yes
R3 (Site 5) Camberwell Sth	22/07/2019 10:48	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	22/07/2019 11:06	<20	<30-34	Yes	35	Yes	<20	45	Yes	30	40	Yes

August 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
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		Contribution (dB)					Contribution (dB)					
R2 (Site 2) A. Bowman	28/08/2019 9:36	<20	<30-33	Yes	35	Yes	<20	45	Yes	30	40	Yes
R3 (Site 3) W. Bowman	30/08/2019 11:01	<20	<30-34	Yes	35	Yes	<20	45	Yes	32	40	Yes
R3 (Site 5) Camberwell Sth	28/08/2019 10:56	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	28/08/2019 11:18	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

September 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	19/09/2019 9:33	<20	<30-33	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R3 (Site 3) W. Bowman	19/09/2019 10:25	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R3 (Site 5) Camberwell Sth	19/09/2019 10:47	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	19/09/2019 11:07	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

October 2019 Noise Monitoring Results

Site	Date / Time	Ravensworth LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensworth Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	21/10/2019 9:44	30	<30-33	Yes	35	Yes	33	45	Yes	30	40	Yes
R3 (Site 3) W. Bowman	21/10/2019 10:30	28	<30-34	Yes	35	Yes	33	45	Yes	28	40	Yes
R3 (Site 5) Camberwell Sth	21/10/2019 10:51	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	21/10/2019 11:15	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes

November 2019 Noise Monitoring Results

Site	Date / Time	Ravensthorpe LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensthorpe Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	11/11/2019 9:14	<20	<30-33	Yes	35	Yes	<20	45	Yes	34*	40	Yes
R3 (Site 3) W. Bowman	14/11/2019 10:47	25	<30-34	Yes	35	Yes	27	45	Yes	34	40	Yes
R3 (Site 5) Camberwell Sth	11/11/2019 10:33	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	11/11/2019 10:55	<20	<30-34	Yes	35	Yes	<20	45	Yes	35	40	Yes

*Recorded on 14 November 2019

December 2019 Noise Monitoring Results

Site	Date / Time	Ravensthorpe LAeq Contribution (dB)	EA Prediction	Within Predicted Levels	Compliance Limit	Compliant	LA1min Ravensthorpe Contribution (dB)	LA1min criterion (dB)	Compliant	Cumulative Noise LAeq (dB)	Criteria	Compliant
R2 (Site 2) A. Bowman	18/12/2019 9:52	22	<30-33	Yes	35	Yes	25	45	Yes	22	40	Yes
R3 (Site 3) W. Bowman	18/12/2019 10:45	<20	<30-34	Yes	35	Yes	<20	45	Yes	20	40	Yes
R3 (Site 5) Camberwell Sth	18/12/2019 11:08	<20	<30-34	Yes	35	Yes	<20	45	Yes	<20	40	Yes
R4 (Site 6) Camberwell Nt	18/12/2019 11:26	<20	<30-34	Yes	35	Yes	<20	45	Yes	21	40	Yes

Table 02.0-1 Definition of acoustical terms

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).

Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.
IA	Inaudible (audio < 20 dB)

Appendix D: Blast Monitoring Results

The annual average blasting results are presented in **Table D-1:** and **Table D-2:** **Note: EA predictions from Ravensworth Operations Project Environmental Assessment (Umwelt, 2010)**

Table D-2:

Table D-1: Annual blast overpressure monitoring results and percentage above criteria

Overpressure (dBL)							
	Camberwell Church	Camberwell Village	Bowmans	Chain of Ponds	REA 86 Grinding Grooves	Ravensworth School	Ravensworth Homestead
Limit	120	120	120	133	N/A	133	126
Limit 5% up to 120 dBL	115	115	115	N/A	-	N/A	N/A
EA Prediction	N/A	115	115	N/A	N/A	N/A	115
Min	74.0	77.3	69.7	84.2	-	83.7	70.9
Mean	94.7	92.6	96.2	97.8	-	99.7	97.6
Max	113.4	115.3	112.7	113.3	-	115.5	114.4
Blast events exceeding limit	0	0	0	0	-	0	0
Blast events exceeding 115 dBL	0	1	0	N/A	N/A	N/A	N/A
% > 115 dBL up to 120 dBL	0	0.398	0	N/A	N/A	N/A	N/A

Note: EA predictions from Ravensworth Operations Project Environmental Assessment (Umwelt, 2010)

Table D-2: Annual blast vibration monitoring results and percentage above criteria

Vibration (mm/s)								
	Camberwell Church	Camberwell Village	Bowmans	Chain of Ponds	Ravensworth West – HVO Conveyor	REA 86 Grinding Grooves	Ravensworth School	Ravensworth Homestead
Limit	10	10	10	10	100	175	10	10
Limit 5% up to 10 mm/s	5	5	5	N/A	N/A	N/A	N/A	N/A
EA Prediction	5	5	5	10	100	30	10	10
Min	0	0	0	0	0.1	0	0	0
Mean	0.05	0.07	0.10	0.18	4.9	0.40	0.22	0.07
Max	0.28	0.36	0.54	0.63	111.66	2.29	1.68	0.34
Blast events exceeding limit	0	0	0	0	2	0	0	0
Blast events exceeding 5 mm/s	0	0	0	N/A	N/A	N/A	N/A	N/A
% > 5 mm/s up to 10 mm/s	0	0	0	N/A	N/A	N/A	N/A	N/A

Note: EA predictions from Ravensworth Operations Project Environmental Assessment (Umwelt, 2010)

Appendix E: Meteorological Monitoring Results

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
01-01-2019	57.20	28.85	28.62	2.20	194.48		0.12
02-01-2019	53.29	29.22	29.08	2.15	170.18		18.12
03-01-2019	52.78	28.80	28.54	2.46	154.88		0.00
04-01-2019	57.03	29.95	29.57	1.87	157.84		0.00
05-01-2019	46.21	32.35	31.98	3.98	268.21		0.00
06-01-2019	86.04	21.45	21.13	3.91	137.59		0.00
07-01-2019	93.00	21.73	21.42	3.58	139.98		118.60
08-01-2019	64.76	27.81	27.18	2.39	159.96		1.00
09-01-2019	61.77	27.42	27.03	2.90	206.17		52.20
10-01-2019	84.34	25.00	24.57	3.22	133.34		121.20
11-01-2019	79.31	26.16	25.68	2.82	136.77		104.40
12-01-2019	65.96	28.41	28.01	1.98	208.48		25.00
13-01-2019	71.83	26.10	25.78	3.92	153.62		0.20
14-01-2019	67.10	27.44	26.94	2.28	132.46		0.00
15-01-2019	53.22	31.04	30.72	1.86	173.77		5.60
16-01-2019	56.18	31.86	31.70	2.21	147.23		0.20
17-01-2019	51.82	32.15	31.66	2.42	118.07		0.00
18-01-2019	42.61	33.01	32.61	2.24	208.42		0.00
19-01-2019	50.06	31.20	31.12	3.45	183.03		0.00
20-01-2019	85.66	24.42	24.03	3.39	135.25		18.40
22-01-2019	69.35	27.72	27.50	1.55	173.01		400.4
23-01-2019	64.77	28.48	28.35	2.63	224.08		430.00
24-01-2019	75.82	26.70	26.26	3.24	135.17		15.20
25-01-2019	64.05	30.05	29.68	1.61	153.70		0.00
26-01-2019	50.55	33.43	33.54	2.16	228.17		0.00
27-01-2019	57.55	32.15	31.74	2.91	178.44		301.40
28-01-2019	76.34	27.70	27.29	3.25	140.94		17.60
29-01-2019	60.21	30.36	29.91	2.04	148.30		0.00
30-01-2019	51.93	31.30	31.06	1.67	193.88		0.00
31-01-2019	50.36	30.54	30.69	2.60	249.46		0.00
01-02-2019	82.03	21.36	21.04	4.05	146.34		0.00
02-02-2019	87.32	24.02	23.68	3.53	146.58		181.80
03-02-2019	67.06	27.12	26.75	2.32	135.35		1.80
04-02-2019	53.97	29.33	28.97	2.18	203.36		0.00
05-02-2019	57.48	28.27	27.81	3.40	126.12		0.00
06-02-2019	62.83	26.84	26.45	3.35	132.04		0.00
07-02-2019	60.37	27.32	26.89	2.34	137.28		0.00
08-02-2019	65.17	26.57	26.36	2.14	196.70		102.60
09-02-2019	60.19	26.69	26.44	2.80	284.45		241.40
10-02-2019	47.27	22.97	22.95	1.85	182.91		1.80
11-02-2019	53.16	25.10	25.34	1.47	232.78		0.00
12-02-2019	41.87	27.50	28.09	2.12	245.29		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
13-02-2019	52.65	24.69	24.55	3.57	143.30		0.00
14-02-2019	53.14	22.78	22.36	3.78	123.08		0.00
15-02-2019	58.33	22.36	22.03	3.89	135.50		0.00
16-02-2019	62.04	23.39	23.05	3.19	134.15		0.00
17-02-2019	57.35	25.83	25.61	1.66	155.43		0.00
18-02-2019	49.73	28.99	28.98	1.59	169.20		0.00
19-02-2019	51.24	29.17	29.03	2.95	214.42		0.00
20-02-2019	74.33	24.84	24.14	4.33	150.75		0.00
21-02-2019	80.31	22.91	22.73	4.38	139.70		151.40
22-02-201	78.59	21.77	21.45	3.86	142.63		2.20
24-02-2019	97.6	17.08	17.48	1.24	160.9		34.81
25-02-2019	69.37	20.80	20.56	3.02	141.99		1.60
26-02-2019	64.34	22.45	22.35	1.81	150.45		0.00
27-02-2019	61.73	23.74	23.39	3.54	127.58		0.00
28-02-2019	63.04	23.98	23.72	2.58	109.94		0.00
01-03-2019	62.28	24.24	23.91	3.14	127.14		0.00
02-03-2019	62.53	24.02	23.58	3.59	132.68		0.00
03-03-2019	67.43	24.55	24.22	2.19	142.63		0.00
04-03-2019	91.57	20.45	21.06	1.53	168.67		0.00
05-03-2019	62.85	26.71	26.24	1.63	214.29		0.00
06-03-2019	47.61	28.52	28.50	3.42	239.83		5.00
07-03-2019	65.03	20.16	19.94	4.10	131.85		0.20
08-03-2019	63.18	24.77	24.44	1.73	123.66		0.00
09-03-2019	67.28	26.91	26.74	2.46	264.66		23.80
10-03-2019	68.65	26.20	26.18	1.57	222.77		23.80
11-03-2019	55.51	26.63	26.71	2.24	147.74		0.00
12-03-2019	54.66	27.87	27.53	2.27	241.41		0.00
13-02-2019	71.26	23.68	23.32	4.31	129.83		0.00
14-03-2019	70.33	25.50	25.21	1.96	164.41		0.00
15-03-2019	69.53	22.42	22.03	4.14	131.90		0.00
16-03-2019	89.80	19.95	19.79	2.32	127.80		7.62
17-03-2019	98.95	19.43	19.30	1.29	212.37		14.92
18-03-2019	88.17	20.63	20.56	1.88	285.49		8.62
19-03-2019	90.13	20.84	20.75	1.24	177.55		32.60
20-03-2019	81.09	22.60	22.46	1.41	122.58		46.60
21-03-2019	80.89	22.70	22.59	1.96	141.15		0.40
22-03-2019	81.11	23.32	23.02	1.91	133.25		15.00
23-03-2019	77.93	22.85	22.78	1.15	205.89		21.20
24-03-2019	74.13	25.99	25.88	1.51	206.60		6.20
25-03-2019	81.73	24.14	24.13	2.79	261.67		166.00
26-03-2019	59.60	22.45	22.34	2.50	271.60		2.20
27-03-201	61.72	20.34	20.20	2.92	134.76		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
28-03-2019	70.00	20.51	20.59	2.07	145.28		0.00
29-03-2019	74.95	21.09	21.41	1.02	179.30		0.00
30-03-2019	73.67	19.31	19.16	2.92	253.02		47.41
31-03-2019	49.18	16.16	16.15	3.04	291.79		59.40
01-04-2019	81.70	15.70	15.70	2.22	138.68		3.20
02-04-2019	92.36	18.48	18.32	2.14	139.61		27.80
03-04-2019	80.54	19.26	19.23	1.70	144.78		0.20
04-04-2019	83.07	18.96	19.06	1.87	150.83		0.00
05-04-2019	88.37	19.51	19.42	2.30	148.95		0.00
06-04-2019	72.20	21.94	22.24	1.44	250.34		0.00
07-04-2019	56.47	23.96	24.72	1.58	248.46		0.00
08-04-2019	51.26	23.92	24.92	1.39	244.07		0.00
09-04-2019	50.61	23.44	24.14	2.46	226.60		0.00
10-04-2019	65.63	17.03	16.97	3.02	139.84		0.00
11-04-2019	73.38	17.01	17.05	2.17	134.11		0.00
12-04-2019	77.60	18.52	18.39	2.05	134.71		0.00
13-04-2019	72.20	18.92	19.16	1.25	203.31		0.00
14-04-2019	83.88	17.47	17.71	1.31	187.27		0.00
15-04-2019	80.47	17.20	17.53	1.35	152.75		0.00
16-04-2019	85.07	17.69	18.02	1.67	154.22		0.00
17-04-2019	82.22	18.31	18.44	1.82	137.94		0.00
18-04-2019	80.77	19.35	19.47	1.54	163.17		0.00
19-04-2019	86.19	20.38	20.29	2.39	133.54		0.00
20-04-2019	88.05	20.73	20.53	2.10	139.21		0.00
21-04-2019	84.24	20.70	20.70	1.62	157.80		0.00
22-04-2019	82.91	19.90	20.20	1.31	151.32		0.00
23-04-2019	81.77	19.93	19.94	2.01	141.30		17.00
24-04-2019	78.61	20.17	20.25	1.53	143.19		0.20
25-04-2019	72.56	20.00	20.51	1.18	235.50		0.00
26-04-2019	58.01	21.71	22.23	2.10	262.56		0.00
27-04-2019	65.81	15.22	15.97	1.63	151.19		0.00
28-04-2019	59.21	16.46	16.95	2.21	283.02		0.00
29-04-2019	78.44	15.83	16.14	2.04	150.76		0.00
30-04-2019	83.70	16.72	17.18	1.00	168.32		0.00
01-05-2019	84.80	18.02	18.29	0.99	185.88		0.00
02-05-2019	88.56	19.46	19.93	0.77	153.58		0.00
03-05-2019	87.93	19.06	19.17	1.58	241.91		49.80
04-05-2019	88.87	17.90	18.19	1.13	179.43		454.20
05-05-2019	78.03	13.69	14.47	1.29	204.12		3.80
06-05-2019	75.31	14.12	14.75	1.44	270.98		12.00
07-05-2019	97.68	9.70	11.67	1.35	232.96		0.20
09-05-2019	99.8	7.363956	8.931876	0.771	182.3		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
10-05-2019	79.02	11.20	11.65	2.14	247.49		229.60
11-05-2019	58.28	14.23	14.10	3.91	313.63		2.60
12-05-2019	67.83	13.09	13.57	1.51	231.42		0.00
13-05-2019	82.27	14.42	14.80	0.83	153.70		0.00
14-05-2019	73.96	17.13	17.75	1.48	229.46		0.00
15-05-2019	81.45	14.85	15.31	1.56	140.31		0.00
16-05-2019	80.75	14.98	15.36	1.39	116.65		0.00
17-05-2019	80.44	15.61	16.22	1.07	163.07		0.00
18-05-2019	83.04	15.41	15.76	1.41	140.85		0.00
19-05-2019	83.24	15.42	15.77	1.39	160.72		19.80
20-05-2019	80.03	15.42	16.03	1.04	213.67		0.20
21-05-2019	68.62	17.26	18.03	1.54	256.57		0.00
22-05-2019	71.66	16.98	17.98	1.06	203.43		0.00
23-05-2019	80.95	16.50	16.97	1.03	157.48		0.00
24-05-2019	73.32	15.64	16.61	1.13	240.73		0.00
25-05-2019	66.84	14.82	16.12	1.35	230.74		0.00
26-05-2019	64.46	15.50	16.32	1.71	242.07		0.00
27-05-2019	53.76	14.04	14.03	4.43	310.23		7.40
28-05-2019	57.94	8.98	9.15	3.36	319.86		0.20
29-05-2019	50.10	14.51	14.37	5.38	313.94		0.00
30-05-2019	49.59	11.49	11.39	3.00	311.85		0.00
31-05-2019	58.94	10.56	11.00	2.69	310.84		0.00
01-06-2019	79.44	11.48	11.89	1.12	197.20		0.00
02-06-2019	88.94	13.70	13.98	0.62	152.67		0.00
03-06-2019	78.2	12.7	12.7	2.6	306.7		54.2
04-06-2019	63.61	11.24	11.19	3.34	246.15		13.40
05-06-2019	68.45	11.61	12.14	1.64	172.32		0.20
06-06-2019	69.53	10.22	11.16	1.28	241.87		0.00
07-06-2019	82.20	11.02	11.36	1.21	170.90		0.00
08-06-2019	99.01	11.61	12.02	0.57	138.44		0.00
09-06-2019	82.06	14.96	15.37	1.51	290.85		0.00
10-06-2019	76.02	15.28	15.75	2.07	253.36		0.00
11-06-2019	71.42	17.47	18.01	1.60	239.37		0.00
12-06-2019	72.73	14.81	15.66	1.60	235.34		0.00
13-06-2019	55.67	18.56	18.74	2.49	266.81		0.00
14-06-2019	74.01	12.53	13.28	0.99	227.36		0.00
15-06-2019	74.01	9.11	10.04	0.75	145.01		0.00
16-06-2019	89.09	8.77	9.50	0.62	170.26		0.00
17-06-2019	80.94	13.50	13.73	1.22	170.23		0.00
18-06-2019	92.40	14.19	14.11	1.49	304.46		54.80
19-06-2019	66.59	10.96	11.79	1.45	216.09		0.60
20-06-2019	81.07	7.93	8.63	1.05	138.26		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
21-06-2019	64.09	8.15	8.75	1.35	239.60		0.00
22-06-2019	76.94	6.99	7.75	1.32	175.84		0.00
23-06-2019	83.05	9.27	9.76	1.46	185.66		10.20
24-06-2019	97.84	11.41	11.60	1.65	149.55		286.20
25-06-2019	99.48	12.89	13.03	1.38	138.02		418.20
26-06-2019	99.90	11.75	12.17	1.31	138.80		5.40
27-06-2019	91.15	13.39	13.59	1.86	135.10		8.60
28-06-2019	92.34	11.82	12.26	0.87	116.49		21.00
29-06-2019	83.26	11.39	11.95	0.93	144.80		17.80
30-06-2019	59.38	14.09	14.61	1.94	272.43		0.20
01-07-2019	72.10	8.44	9.50	0.64	157.72		0.00
02-07-2019	73.63	10.36	11.38	1.00	206.80		0.00
03-07-2019	86.67	10.57	10.91	1.88	129.04		34.40
04-07-2019	99.77	13.61	13.61	2.19	153.25		366.80
05-07-2019	92.86	13.63	13.72	1.77	130.83		44.20
06-07-2019	96.18	13.82	13.84	2.11	135.40		19.00
07-07-2019	90.33	13.36	13.55	1.16	130.08		0.20
08-07-2019	98.89	12.62	12.82	1.38	247.72		199.80
09-07-2019	75.56	12.95	13.30	2.15	293.30		35.20
10-07-2019	66.14	11.19	11.61	2.43	286.63		0.40
11-07-2019	53.20	14.40	14.41	3.64	289.54		0.00
12-07-2019	50.61	15.24	15.23	4.17	311.78		0.00
13-07-2019	42.41	14.07	14.01	3.95	298.28		0.00
14-07-2019	48.99	10.81	10.70	4.45	319.95		0.00
15-07-2019	48.12	13.22	13.08	4.01	297.27		0.00
16-07-2019	53.81	12.88	12.92	3.49	314.61		0.00
17-07-2019	54.84	12.99	12.92	3.44	322.49		0.00
18-07-2019	48.75	13.80	13.73	3.47	322.57		0.00
19-07-2019	54.79	11.45	11.79	2.26	284.79		0.00
20-07-2019	69.05	8.83	9.91	0.73	191.59		0.00
21-07-2019	60.14	12.49	13.34	2.40	247.52		0.00
22-07-2019	61.67	13.92	15.00	0.90	178.99		0.00
23-07-2019	37.28	13.04	15.22718	0.179	188.9		0.00
24-07-2019	36.86	15.96	16.35	2.25	272.52		0.00
25-07-2019	68.04	11.41	11.92	1.23	151.89		0.00
26-07-2019	67.44	12.47	12.88	1.53	250.35		0.00
27-07-2019	66.43	12.64	13.35	1.13	180.96		0.00
28-07-2019	71.95	11.86	12.46	0.99	131.50		0.00
29-07-2019	65.47	13.09	13.53	1.47	214.61		0.60
30-07-2019	84.00	12.70	12.95	2.06	146.66		47.80
31-07-2019	77.57	12.89	12.87	1.93	140.59		0.40
01-08-2019	77.01	13.23	13.33	1.22	123.45		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
02-08-2019	82.96	11.24	11.67	1.13	130.09		0.00
03-08-2019	59.87	13.03	13.80	1.94	263.43		20.40
04-08-2019	55.77	11.37	11.90	1.25	153.94		0.20
05-08-2019	64.44	12.32	12.99	1.18	214.65		0.00
06-08-2019	34.32	13.44	14.53	1.75	218.99		0.00
07-08-2019	36.87	13.22	14.12	1.86	238.39		0.00
08-08-2019	42.63	14.57	15.02	2.70	252.09		0.00
09-08-2019	41.53	14.19	14.05	5.47	309.88		0.00
10-08-2019	52.73	10.22	10.12	4.41	308.38		19.20
11-08-2019	65.78	9.03	8.89	4.90	310.01		154.20
12-08-2019	57.37	11.20	11.09	2.80	319.30		3.00
13-08-2019	54.38	10.99	11.73	1.68	259.94		0.00
14-08-2019	55.98	9.40	10.16	1.27	226.79		0.00
15-08-2019	45.18	10.27	11.47	1.43	239.91		0.00
16-08-2019	39.73	13.02	14.42	1.49	233.16		0.00
17-08-2019	38.91	15.64	16.11	2.24	183.16		0.00
18-08-2019	66.35	13.58	14.24	1.08	131.19		0.00
19-08-2019	33.76	14.38	14.24	3.07	292.82		0.00
20-08-2019	39.00	13.18	12.97	3.97	318.60		0.00
21-08-2019	44.85	15.56	15.28	4.72	313.75		0.00
22-08-2019	46.31	16.08	15.89	3.86	242.02		0.00
23-08-2019	59.78	10.53	11.30	0.94	147.51		0.00
24-08-2019	48.48	15.02	15.55	2.91	285.75		0.00
25-08-2019	36.12	18.47	18.67	2.28	257.64		0.00
26-08-2019	67.23	16.38	15.96	2.74	137.50		0.00
27-08-2019	67.89	16.26	15.87	2.49	127.36		0.00
28-08-2019	58.46	16.41	16.34	1.41	205.03		0.00
29-08-2019	70.74	11.75	12.06	2.58	158.93		0.00
30-08-2019	89.51	11.81	11.72	2.06	161.50		467.20
31-08-2019	89.06	13.55	13.45	1.90	145.95		664.60
01-09-2019	75.74	15.77	15.93	1.02	140.47		21.20
02-09-2019	64.11	15.92	16.31	1.99	196.32		0.20
03-09-2019	54.74	17.64	17.77	1.97	268.69		16.80
04-09-2019	50.22	18.56	19.34	1.82	219.17		0.20
05-09-2019	57.94	17.56	17.93	1.89	149.49		0.00
06-09-2019	52.97	21.34	20.97	3.42	264.45		0.00
07-09-2019	44.00	14.20	13.93	5.55	306.16		0.00
08-09-2019	36.58	15.42	15.12	3.58	296.52		0.00
09-09-2019	36.93	13.96	13.64	3.20	246.53		0.00
10-09-2019	55.33	11.99	12.32	2.26	132.71		0.00
11-09-2019	68.02	13.90	13.96	1.25	126.98		0.00
12-09-2019	43.59	17.41	17.77	2.15	256.86		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
13-09-2019	43.55	17.70	18.15	1.54	183.10		0.00
14-09-2019	99.86	9.15	10.92	0.69	132.94		0.00
17-09-2019	99.90	13.54	13.71	2.94	157.20		15.40
18-09-2019	99.34	14.55	14.49	3.66	165.12		499.20
19-09-2019	84.94	17.61	17.34	2.35	130.92		18.40
20-09-2019	78.43	18.64	18.51	1.97	112.34		0.20
21-09-2019	69.04	19.76	20.04	1.33	176.41		0.00
22-09-2019	71.04	20.22	20.34	2.76	250.57		0.00
23-09-2019	52.63	16.86	17.09	2.10	230.63		0.00
24-09-2019	47.90	13.98	14.34	1.41	221.03		0.00
25-09-2019	63.98	14.49	14.66	1.52	149.20		0.00
26-09-2019	75.52	17.05	16.96	1.53	171.91		0.00
27-09-2019	50.34	20.23	20.10	2.19	289.15		0.00
28-09-2019	38.74	18.73	18.97	2.92	222.96		0.00
29-09-2019	63.38	16.70	16.68	1.90	196.72		0.00
30-09-2019	75.52	16.46	16.21	2.91	130.98		0.00
01-10-2019	65.47	17.14	16.88	2.63	135.64		0.00
02-10-2019	59.31	18.39	18.42	1.76	187.84		0.00
03-10-2019	46.79	20.95	21.40	1.46	177.93		0.00
04-10-2019	40.61	23.68	23.85	2.95	234.58		0.00
05-10-2019	75.19	18.18	17.90	3.03	124.21		0.00
06-10-2019	68.95	20.98	20.91	1.64	217.20		0.00
07-10-2019	57.98	23.98	24.51	2.35	183.64		0.00
08-10-2019	60.02	19.42	19.24	2.49	227.42		0.00
09-10-2019	50.06	14.80	14.81	2.20	147.78		0.00
10-10-2019	62.95	15.18	15.15	2.25	141.51		0.00
11-10-2019	69.62	15.54	15.26	3.29	128.97		14.20
12-10-2019	84.74	13.46	13.34	3.15	129.64		35.60
13-10-2019	73.43	14.67	14.68	1.77	125.86		0.40
14-10-2019	63.17	18.16	17.99	1.66	172.04		0.00
15-10-2019	60.61	21.52	21.57	1.69	150.89		0.00
16-10-2019	62.65	22.64	22.75	1.81	183.09		0.00
17-10-2019	53.26	21.99	21.70	2.93	255.08		0.00
18-10-2019	21.39	20.20	20.10	2.52	298.57		0.00
19-10-2019	23.08	20.88	21.50	2.25	235.82		0.00
20-10-2019	39.53	17.86	17.87	2.13	136.39		0.00
21-10-2019	58.37	18.36	18.08	2.34	128.21		0.00
22-10-2019	53.04	20.48	20.21	2.11	140.84		0.00
23-10-2019	51.77	23.49	23.16	1.94	212.54		0.00
24-10-2019	34.14	25.82	26.14	1.87	198.78		0.00
25-10-2019	28.68	27.39	27.65	3.34	284.39		0.00
26-10-2019	21.49	27.95	27.73	5.09	303.62		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
27-10-2019	26.83	20.29	20.39	2.14	191.97		0.00
28-10-2019	56.67	18.34	18.31	2.78	137.57		0.00
29-10-2019	60.90	21.39	21.11	1.92	146.48		0.00
30-10-2019	49.97	23.64	23.78	1.39	213.58		0.00
31-10-2019	47.48	24.77	24.83	2.30	155.17		0.00
01-11-2019	56.21	24.03	23.83	1.92	134.03		0.00
02-11-2019	52.91	25.49	25.33	1.95	202.55		0.00
03-11-2019	64.82	24.11	24.11	2.68	266.94		239.20
04-11-2019	63.47	22.73	22.32	2.70	289.31		219.80
05-11-2019	59.79	17.49	17.25	2.54	206.00		146.4
06-11-2019	47.45	20.21	20.06	2.93	283.32		1.20
07-11-2019	20.70	26.04	25.88	3.79	295.76		0.00
08-11-2019	26.62	25.06	24.76	3.50	288.71		0.00
09-11-2019	27.55	18.49	18.13	2.46	258.67		0.00
10-11-2019	33.49	20.49	20.00	3.34	261.18		0.00
11-11-2019	47.64	21.26	21.27	1.73	227.98		0.00
12-11-2019	26.68	26.68	26.86	3.30	229.92		0.00
13-11-2019	32.00	22.02	21.53	2.69	233.61		0.00
14-11-2019	31.44	21.36	21.51	1.88	272.90		0.00
15-11-2019	21.79	26.22	26.24	3.02	288.78		0.00
16-11-2019	46.90	21.72	21.69	2.86	153.00		0.00
17-11-2019	62.27	20.53	20.23	2.98	187.08		0.00
18-11-2019	48.62	22.97	22.81	1.83	215.73		0.00
19-11-2019	26.07	26.71	27.21	2.35	267.83		0.00
20-11-2019	55.98	22.98	22.43	4.03	129.27		0.00
21-11-2019	56.24	26.53	26.22	1.82	192.16		0.00
22-11-2019	52.00	28.12	28.10	3.24	216.05		0.00
23-11-2019	71.24	23.34	22.91	3.33	139.21		0.00
24-11-2019	74.32	21.09	20.67	3.56	135.10		0.00
25-11-2019	60.95	24.77	24.39	2.45	231.31		0.00
26-11-2019	42.56	26.64	26.55	4.29	272.87		0.00
27-11-2019	33.60	20.53	20.29	2.25	151.88		0.00
28-11-2019	49.73	22.95	22.69	2.23	142.12		0.00
29-11-2019	49.07	26.42	26.06	2.41	224.89		0.00
30-11-2019	40.64	27.19	27.32	3.38	223.45		0.00
01-12-2019	47.91	24.05	23.54	3.13	213.15		0.00
02-12-2019	37.81	19.70	19.26	4.94	295.95		0.00
03-12-2019	27.91	22.53	22.02	4.23	311.22		0.00
04-12-2019	20.73	25.97	25.56	3.29	306.30		0.00
05-12-2019	19.78	27.11	27.24	2.53	291.78		0.00
06-12-2019	16.14	29.48	29.49	2.35	264.75		0.00
07-12-2019	49.02	24.52	24.14	2.61	146.82		0.00

Date / Time Sampled	Relative Humidity (%)	Mean Air Temperature @ 2m (°C)	Mean Air Temperature @ 10m (°C)	Mean Wind Speed @10m (m/s)	Mean Wind Direction (°)	Sigma Theta @ 10m (°)	24Hr Rainfall (mm)
08-12-2019	62.97	23.80	23.31	4.00	137.85		0.00
09-12-2019	59.53	25.51	25.09	2.48	137.40		0.00
10-12-2019	49.31	29.87	29.55	2.53	231.65		0.00
11-12-2019	60.13	22.66	22.12	4.49	126.30		0.00
12-12-2019	62.76	21.64	21.12	3.89	114.26		0.00
13-12-2019	59.85	21.98	21.49	3.40	120.21		0.00
14-12-2019	52.60	25.31	24.74	2.63	200.89		0.00
15-12-2019	52.70	27.11	26.80	2.06	194.48		0.00
16-12-2019	54.96	22.85	23.06	3.84	152.27		0.00
17-12-2019	56.19	21.89	21.41	3.58	124.91		0.00
18-12-2019	54.12	23.95	23.58	2.43	139.52		0.00
19-12-2019	37.63	29.23	29.41	2.60	241.94		0.00
20-12-2019	53.35	24.81	24.26	3.90	122.17		0.00
21-12-2019	53.79	29.84	29.68	2.77	241.83		0.00
22-12-2019	56.61	21.89	21.40	5.40	120.01		0.00
23-12-2019	71.19	20.83	20.40	3.50	133.31		0.00
24-12-2019	71.27	25.00	24.48	3.94	125.95		0.00
25-12-2019	67.14	25.06	24.58	3.78	125.53		0.00
26-12-2019	52.86	25.92	25.52	2.77	125.40		0.00
27-12-2019	49.30	25.91	25.42	3.46	125.84		0.00
28-12-2019	47.80	27.60	27.39	1.96	170.10		0.00
29-12-2019	35.74	30.86	30.86	2.10	173.09		0.00
30-12-2019	32.63	31.73	31.68	1.77	197.41		0.00
31-12-2019	25.31	33.68	33.70	3.51	263.74		0.00

Appendix F: Surface Water Quality Monitoring Results

Table A3.1 2019 Surface Water Quality Summary (pH and TSS)

Water Course	Monitoring Location	pH			TSS (mg/L)			No. Samples
		Min	Max	Mean	Min	Max	Mean	
Bowmans Creek	EPL3	-	-	-	-	-	-	0
	EPL4	7.4	9.2	8.3	4	263	51.3	12
Bayswater	W114							0
	W115	7.1	8.3	7.6	63	87	74	4
Emu Creek	W163	8.6	9.2	8.9	2	8	5.1	12
	W122	7.2	7.6	7.4	37	851	444	2
Davis Creek	W152	-	-	-	-	-	-	0
	W164	-	-	-	-	-	-	0
Pikes Creek	W135	7	7	7	17	17	17	1
	W136	7.3	7.3	7.3	7	7	7	1
	W137	-	-	-	-	-	-	0

Table A3.2 2019 Surface Water Quality Summary (EC and TDS)

Water Course	Monitoring Location	Electrical Conductivity (µS/cm)			TDS (mg/L)			No. Samples
		Min	Max	Mean	Min	Max	Mean	
Bowmans Creek	EPL3	-	-	-	-	-	-	0
	EPL4	5230	14220	8982	3160	9660	6115	12
Bayswater	W114							0
	W115	815	1055	943	645	706	681	4
Emu Creek	W163	4050	7090	4735	2520	4910	3072	12
	W122	437	645	541	341	702	522	2
Davis Creek	W152	-	-	-	-	-	-	0
	W164	-	-	-	-	-	-	0
Pikes Creek	W135	839	839	839	685	685	685	1
	W136	3680	3680	3680	2710	2710	2710	1
	W137	-	-	-	-	-	-	0

The 2019 surface water monthly water quality monitoring results for pH, EC, TSS and TDS for surface waters are presented in **Tables A3.3 to A3.6** respectively. These tables identify when sampling was not undertaken due to the monitoring location being dry (not flowing), or due to two monthly sampling regimes. **Tables A3.3 to A3.6** also indicate when monitoring results are higher than the adopted impact assessment criteria values for surface water using the legend included below.

Tables A3.3 to A3.6 contain the following formatting:

	Indicates monitoring location was dry
	Indicates a non-sampling month
x	Indicates result exceeds the adopted impact assessment criteria

Table A3.3 2019 pH Data for Watercourse Monitoring Locations

Site	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
EPL3 - Bowmans Creek Upstream												
EPL4 - Bowmans Creek Downstream	8.4	8.3	9.2	7.4	8.1	8.3	8.4	8.3	7.9	8.3	8.4	8.5
W114 - Bayswater Creek Upstream												
W115 - Bayswater Creek Downstream				7.1	7.5	7.5	8.3					
W163 - Emu Creek Up	8.9	8.7	8.8	8.6	8.9	9.0	9.0	9.1	8.9	9.2	9.1	8.7
W122 - Emu Creek Downstream				7.2	7.6							
W152 - Davis Creek 2												
W164 - Davis Creek Down												
W135 - Pikes Gully Upstream				7.0								
W136 - Pikes Gully @ New England Highway				7.3								
W137 - Pikes Gully Road @ CHPP Culvert												

Table A3.4 2019 TSS Data (mg/L) for Watercourse Monitoring Locations

Site	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
EPL3 - Bowmans Creek Upstream												
EPL4 - Bowmans Creek Downstream	4.0	13.0	55.0	15.0	24.0	263.0	11.0	81.0	20.0	15.0	23	91.0
W114 - Bayswater Creek Upstream												
W115 - Bayswater Creek Downstream				87.0	73.0	73.0	63.0					
W163 - Emu Creek Up	2.0	2.0	5.0	8.0	6.0	5.0	5.0	5.0	4.0	4.0	7.0	8.0
W122 - Emu Creek Downstream				37.0	851.0							
W152 - Davis Creek 2												
W164 - Davis Creek Down												
W135 - Pikes Gully Upstream				17.0								
W136 - Pikes Gully @ New England Highway				7.0								
W137 - Pikes Gully Road @ CHPP Culvert												

Table A3.5 2019 EC Data (µS/cm) for Watercourse Monitoring Locations

Site	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
EPL3 - Bowmans Creek Upstream												
EPL4 - Bowmans Creek Downstream	6950	7090	8600	5230	8380	8550	8220	9240	9520	10190	11590	14220
W114 - Bayswater Creek Upstream												
W115 - Bayswater Creek Downstream				815	920	983	1055					
W163 - Emu Creek Up	5060	4990	5350	4050	4180	4150	4170	4350	4490	4420	4520	7090
W122 - Emu Creek Downstream				437	645							
W152 - Davis Creek 2												
W164 - Davis Creek Down												
W135 - Pikes Gully Upstream				839								
W136 - Pikes Gully @ New England Highway				3680								
W137 - Pikes Gully Road @ CHPP Culvert												

Table A3.6 2019 TDS Data (mg/L) for Watercourse Monitoring Locations

Site	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
EPL3 - Bowmans Creek Upstream												
EPL4 - Bowmans Creek Downstream	4430	4990	5560	3160	5840	5960	5760	6360	6610	6960	8090	9660
W114 - Bayswater Creek Upstream												
W115 - Bayswater Creek Downstream				645	672	706	702					
W163 - Emu Creek Up	3130	3440	3510	2520	2630	2730	2870	2810	2760	2690	2860	4910
W122 - Emu Creek Downstream				341	702							
W152 - Davis Creek 2												
W164 - Davis Creek Down												
W135 - Pikes Gully Upstream				685								
W136 - Pikes Gully @ New England Highway				2710								
W137 - Pikes Gully Road @ CHPP Culvert												

2019 monthly water quality monitoring results for pH, TSS, EC and TDS are shown for the following waterways in the charts below; Bowmans Creek **Charts A3.1 to A3.4**, Bayswater Creek **Charts A3.5 to A3.8**, Emu Creek **Charts A3.9 to A3.12**, Davis Creek **Charts A3.13 to A3.16** and Pikes Creek **Charts A3.17 to A3.22**.

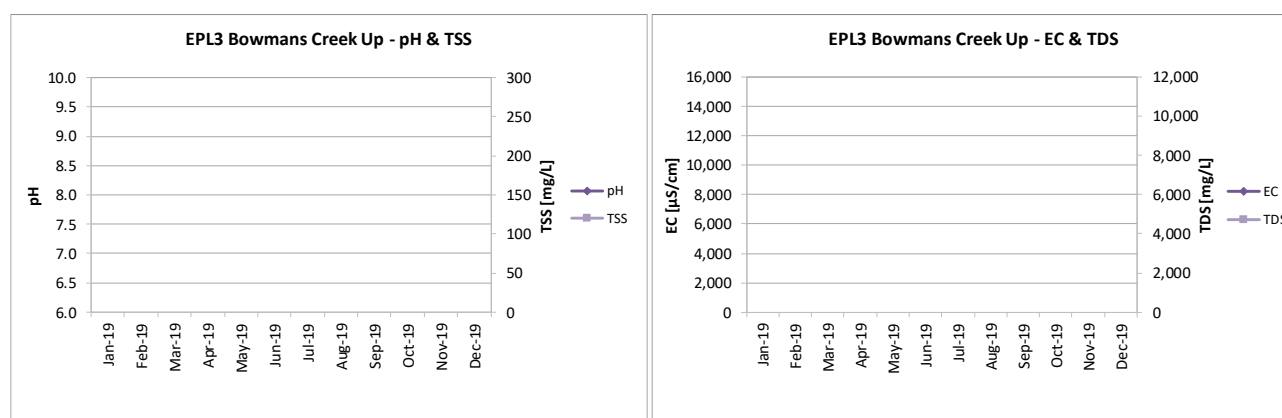


Chart A3.1 EPL3 Upstream pH and TSS results

Chart A3.2 EPL3 Upstream EC and TDS results

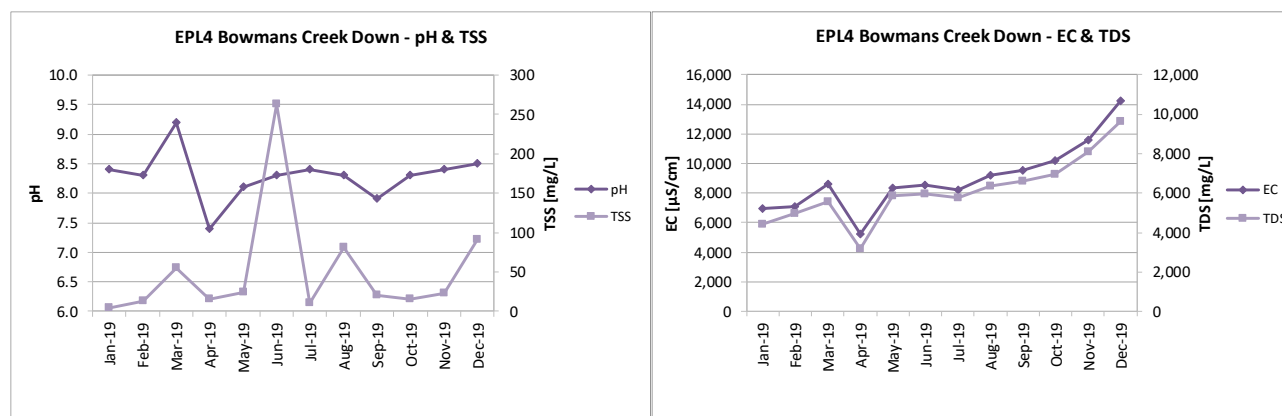


Chart A3.3 EPL4 Downstream pH and TSS results

Chart A3.4 EPL4 Downstream EC and TDS results

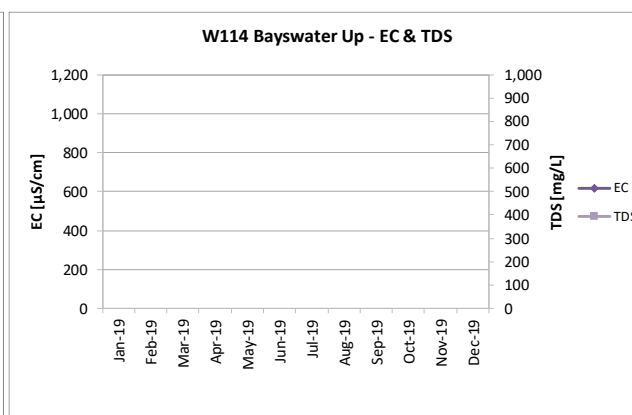
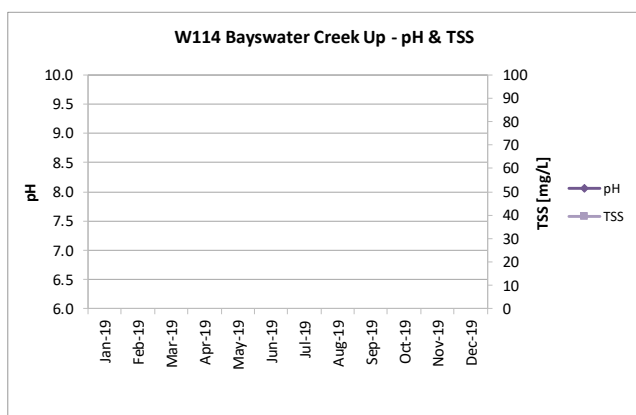


Chart A3.5 W114 Upstream pH and TSS results

Chart A3.6 W114 Upstream EC and TDS results

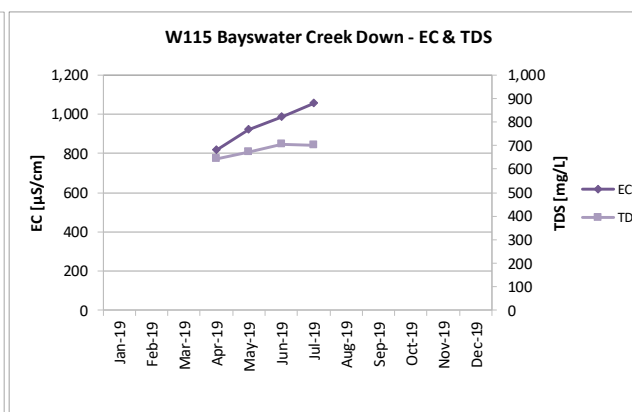
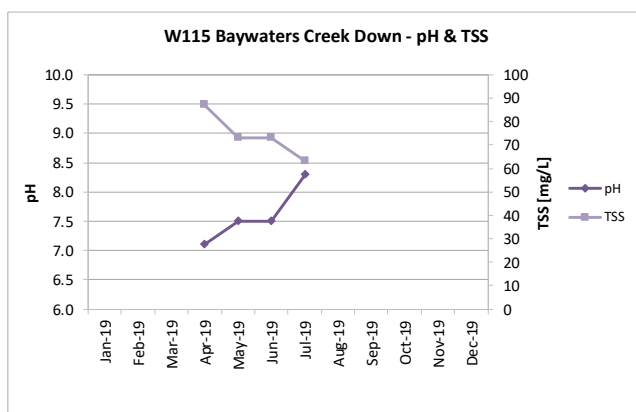


Chart A3.7 W115 Upstream pH and TSS results

Chart A3.8 W115 Upstream EC and TDS results

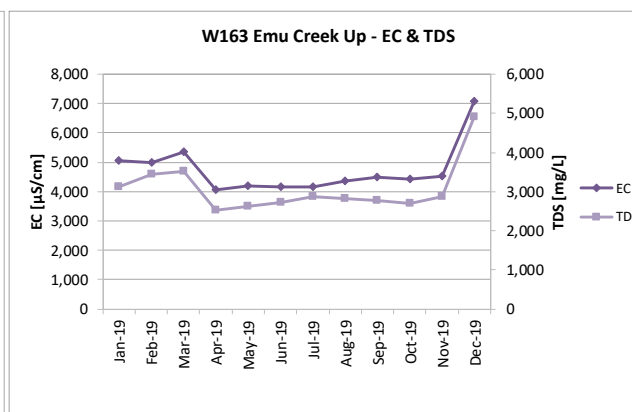
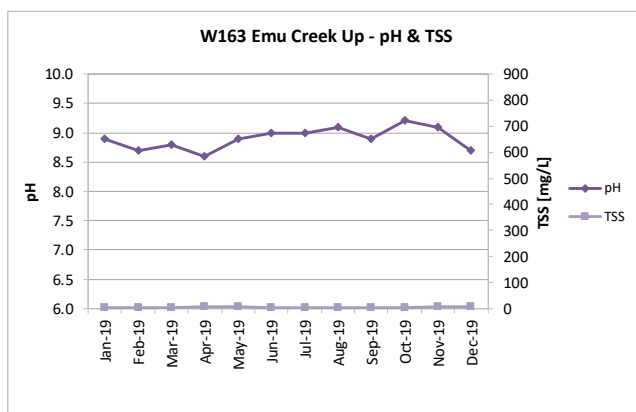


Chart A3.9 W163 Upstream pH and TSS results

Chart A3.10 W163 Upstream EC and TDS results

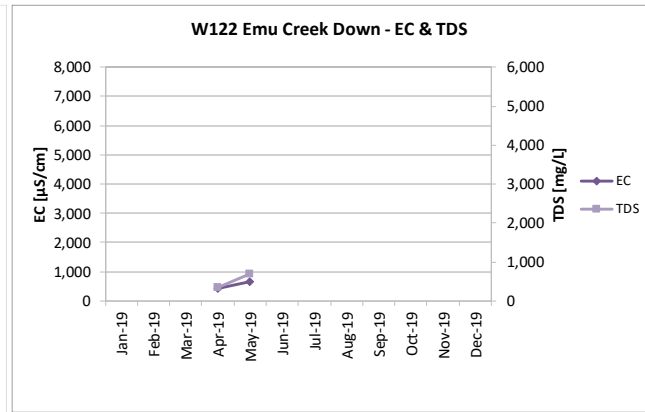
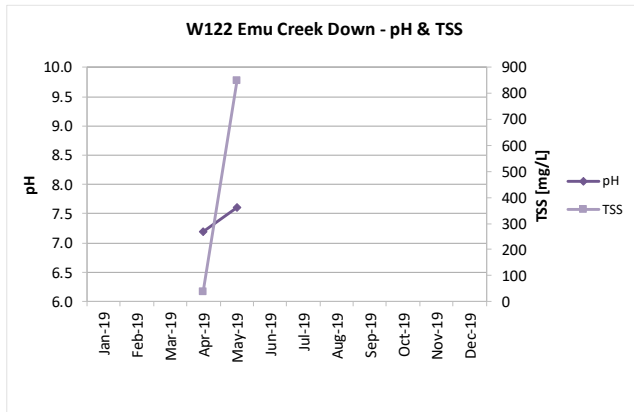


Chart A3.11 W122 Upstream pH and TSS results

Chart A3.12 W122 Upstream EC and TDS results

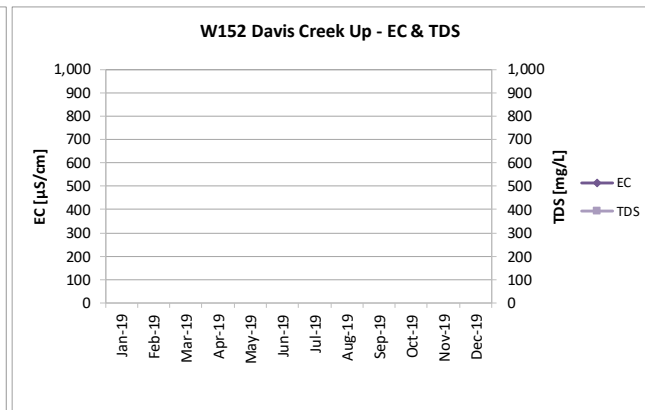
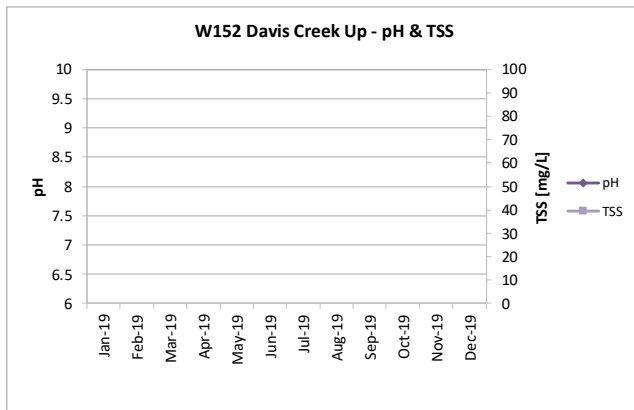


Chart A3.13 W152 Upstream pH and TSS results

Chart A3.14 W152 Upstream EC and TDS results

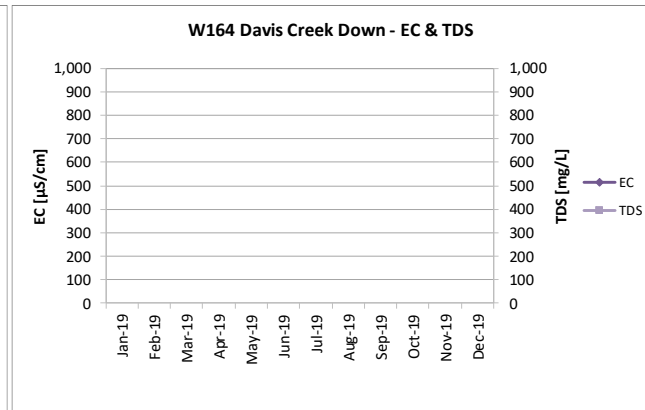
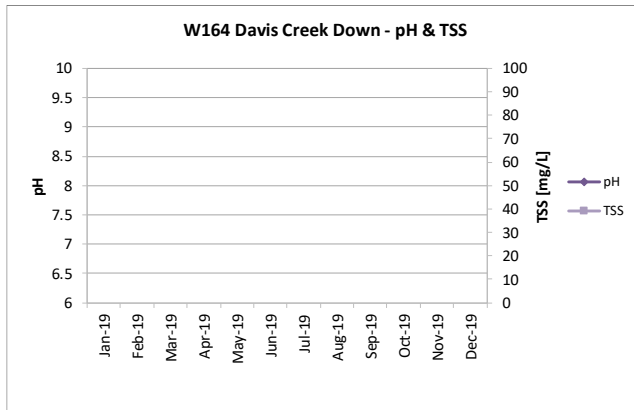


Chart A3.15 W164 Upstream pH and TSS results

Chart A3.16 W164 Upstream EC and TDS results

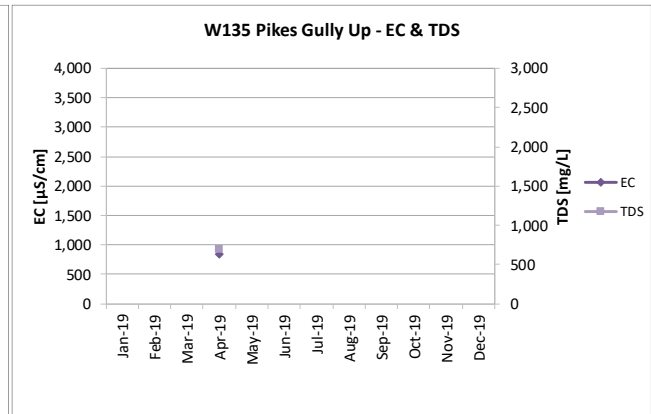
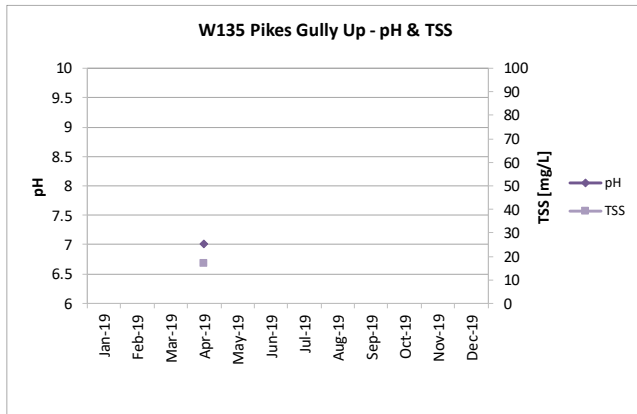


Chart A3.17 W135 Upstream pH and TSS results

Chart A3.18 W135 Upstream EC and TDS results

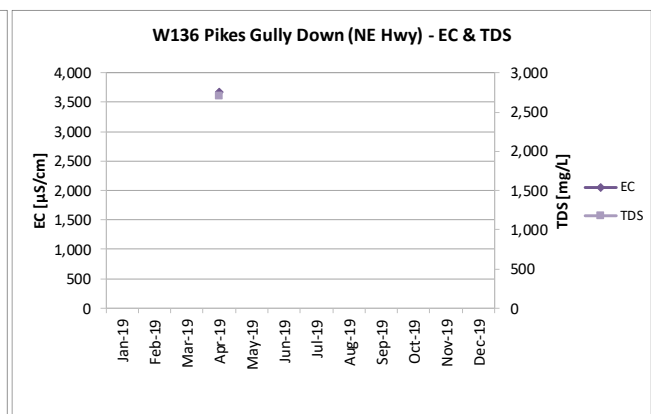
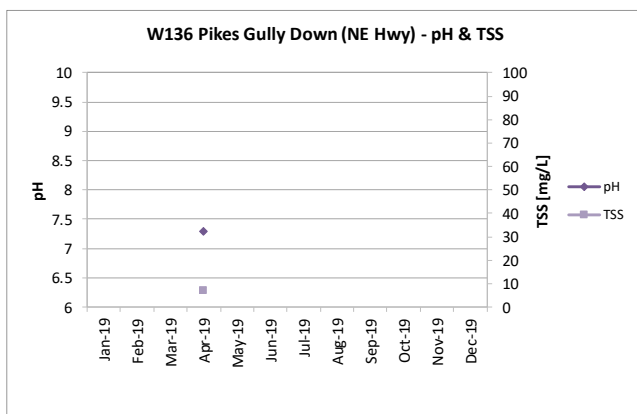


Chart A3.19 W136 Downstream pH and TSS results

Chart A3.20 W136 Downstream EC and TDS results

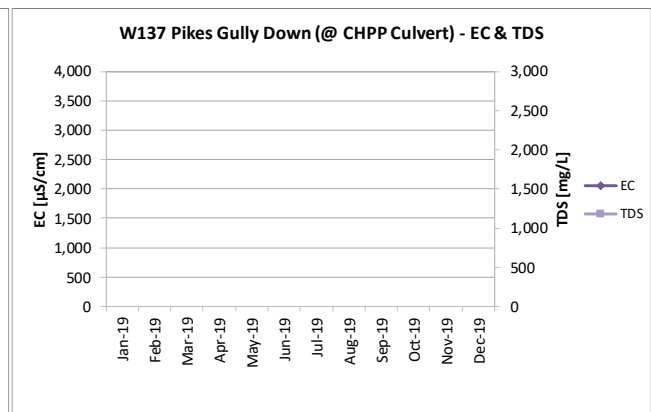
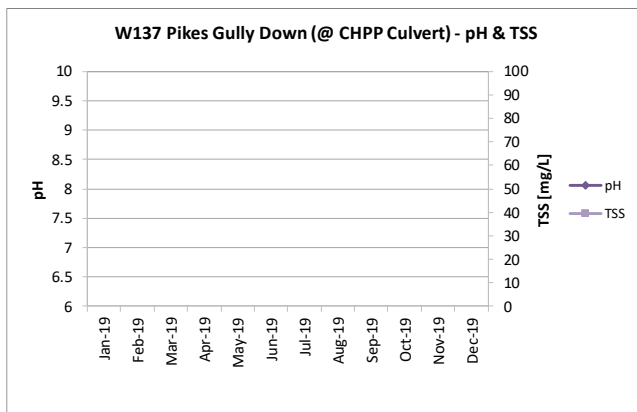


Chart A3.21 W137 Downstream pH and TSS results

Chart A3.22 W137 Downstream EC and TDS results

Appendix G: Groundwater Quality Monitoring Results

Table A5.1 Ravensworth Mining Complex Groundwater Levels for 2019

BOREHOLE	Coffey Dam Borehole		CS4539A (S2)		CS4545 (S4)		CS4545B (Tall)		CS4545B (Small)		CS4641C		NPZ1 Tall		NPZ2 Tall		NPZ6 Tall	
COLLAR LEVEL (RL)	100.35		135.32		82.65		82.65		82.65		81.64		91.43		100.86		76.32	
DATE	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL
Jan-19	43.84	56.51	115.36	19.96							99.92	-18.28	57.89	33.54	67.52	33.34		
Feb-19	43.91	56.44	118.75	16.57							100.08	-18.44	58.48	32.95	67.58	33.28		
Mar-19	43.95	56.40									100.27	-18.63	58.68	32.75	67.43	33.43		
Apr-19	44.02	56.33									100.29	-18.65	59.14	32.29	67.15	33.71		
May-19	44.10	56.25									100.46	-18.82	58.10	33.33	67.54	33.32		
Jun-19	44.12	56.23									100.46	-18.82	59.26	32.17	67.15	33.71		
Jul-19	44.18	56.17									100.52	-18.88	59.63	31.80	67.50	33.36		
Aug-19	44.26	56.09									100.60	-18.96	60.23	31.20	67.62	33.24		
Sep-19	44.28	56.07									100.63	-18.99	60.53	30.90	67.64	33.22		
Oct-19	44.35	56.00									100.62	-18.98	58.62	32.81	67.59	33.27		
Nov-19	44.40	55.95									100.59	-18.95	60.05	31.38	67.30	33.56	11.18	65.14
Dec-19	44.46	55.89									100.66	-19.02	59.90	31.53	67.76	33.10	11.44	64.88

Table A5.2 Ravensworth Mining Complex Groundwater Levels for 2019

BOREHOLE	NPZ5B P1		WPPP1		WPPP2		NPZ7 Tall		NPZ7 Mid		NPZ7 Small		MW01		MW02		SDH16	
COLLAR LEVEL (RL)	76.00		108.00		110.00		62.00		62.00		62.00		72.00		76.00		96.90	
DATE	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL
Jan-19	16.90	59.10	3.54	104.46	5.61	104.39	26.13	35.78	14.04	47.87	27.81	34.10					79.67	17.23
Feb-19	17.16	58.84	3.68	104.32	5.76	104.24	25.03	36.88	14.10	47.81	28.04	33.87					80.10	16.80
Mar-19	17.16	58.84	3.55	104.45	5.64	104.36	26.32	35.59	14.13	47.78	28.47	33.44					80.37	16.53
Apr-19	16.64	59.36	2.85	105.15	5.01	104.99	26.32	35.59			28.64	33.27					80.46	16.44
May-19	16.47	59.53	3.14	104.86	5.18	104.82	26.50	35.41			28.63	33.28					80.82	16.08
Jun-19	16.38	59.62	3.16	104.84	5.34	104.66	26.64	35.27			28.83	33.08					81.04	15.86
Jul-19	15.33	60.67	3.41	104.59	5.47	104.53	25.31	36.60			29.38	32.53					81.25	15.65
Aug-19	16.43	59.57	3.63	104.37	5.65	104.35	27.36	34.55			30.00	31.91					81.43	15.47
Sep-19	16.59	59.41	3.67	104.33	5.74	104.26	27.66	34.25			30.55	31.36					81.36	15.54
Oct-19	15.68	60.32	3.77	104.23	5.84	104.16	27.77	34.14			30.74	31.17					81.78	15.12
Nov-19	16.96	59.04	3.87	104.13	5.97	104.03	29.79	32.12			27.78	34.13					82.00	14.90
Dec-19	17.13	58.87	3.99	104.01	6.09	103.91	28.22	33.69			31.54	30.37					82.12	14.78

Table A5.3 Ravensworth Mining Complex Groundwater Levels for 2019

BOREHOLE	MW1		MW2		MW3		MW4		MW5		MW6		MW9		MW10		MW12		Borehole P	
COLLAR LEVEL (RL)	86.76		87.25		86.58		86.75		86.50		82.08		77.29		81.47		79.75		82.06	
DATE	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL	DEPTH	RL
Jan-19	19.68	67.08	24.10	63.15	23.97	62.61	23.68	63.07	23.42	63.08	6.52	75.56	19.65	57.46	15.42	66.04	12.60	67.06	77.62	4.44
Feb-19												82.08							79.02	3.04
Mar-19												82.08							77.52	4.54
Apr-19	19.37	67.39	24.00	63.25	23.89	62.69	23.53	63.22	23.38	63.12		82.08	19.75	57.36	14.34	67.12	12.35	67.31	79.08	2.98
May-19																			78.70	3.36
Jun-19																			79.38	2.68
Jul-19	19.82	66.94	24.13	63.12	23.81	62.77	23.69	63.06	22.71	63.79	5.48	76.60	19.81	57.30	14.36	67.10	12.71	66.95	78.64	3.42
Aug-19																			79.45	2.61
Sep-19																			77.88	4.18
Oct-19	20.14	66.62	24.01	63.24	23.89	62.69	23.53	63.22	23.32	63.18	6.13	75.95	19.86	57.25	14.67	66.79	13.18	66.48	79.57	2.49
Nov-19																			78.21	3.85
Dec-19																			78.78	3.28