PINE DALE MINE
ANNUAL REVIEW 2020

Prepared by Enhance Place Pty Ltd

Revision 1.2 – 12 February 2021

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PINE DALE MINE REHABILITATION AND COMPLETION ASSESSMENT REPORT (REF [7])

TITLE BLOCK

Name of Operation:	Pine Dale Mine
Name of Operator:	Enhance Place Pty Limited
Project Approval Number:	10_0041
Project Approval Holder:	Enhance Place Pty Limited
Mining Lease Numbers:	ML1569, ML1578, ML1664, ML1637
Mining Lease Holder:	Enhance Place Pty Limited
Water Licence Number:	10WA118780
Water Licence Holder:	Enhance Place Pty Ltd
Mining Operations Plan Commencement Date:	15 April 2014
Mining Operations Plan Completion Date:	15 April 2022[1]
Annual Review Start Date:	1 January 2020
Annual Review End Date:	31 December 2020
Annual Review Report Author:	Carmen Rocher (RCA Australia)

I, Graham Goodwin, certify that this audit report is a true and accurate record of the compliance status of Pine Dale Mine, for the period 1 January 2020 to 31 December 2020 and that I am authorised to make this statement on behalf of Enhance Place Pty ltd.

Note.

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

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

Authorised Reporting Officer:	Graham Goodwin
Title:	Mining Engineering Manager
Signature:	
Date:	12.02.2021

[1] A 12-month extension to the Pine Dale Mine Care and Maintenance MOP term was approved by the Resources Regulator on 10 December 2020.

1 STATEMENT OF COMPLIANCE

The Pine Dale Mine (PDM) Annual Review has been prepared to provide a summary of the performance of PDM operations over the period 1 January 2020 – 31 December 2020 (the reporting period). A locality plan is provided in **Plan 1**, **Appendix A**.

This Annual Review has been prepared pursuant to Schedule 5, Condition 3 of the Project Approval 10_0041, and in accordance with the Annual Review Guideline developed by the NSW Department of Planning and Environment (Ref [1]).

A summary of the PDM compliance status during this reporting period is provided in **Table 1-1**. There was one (1) administrative non-compliance (**Section 1**) during the 2020 reporting period relating to groundwater monitoring as detailed in the Pine Dale Mine Water Management Plan which is a requirement under PA 10_0041. A description of the administrative non-compliance is provided in **Table 1-2**. The non-compliance status recorded during the reporting period has been ranked according to the risk included in

Table 1-3.

Table 1-1 *Statement of compliance*

Approval No.	Were all conditions of the approval complied with?
PA 10_0041	No
EPL 4911	Yes
ML1569	Yes
ML1578	Yes
ML1664	Yes
ML1637	Yes
10WA118780	Yes

Table 1-2 *Non-Compliances*

Relevant Approval	Condition #	Condition Description Summary	Compliance Status	Comment	Where Addressed in Annual Review
PA 10_0041	27 (c) Groundwater Management Plan	Groundwater monitoring requirements of Groundwater Management Plan.	Administrative Non-Compliance	Yarraboldy Groundwater monitoring schedule unable to be adhered to due to the State Forest closure and safety risks accessing bores caused by bushfire damage.	**Section 7.5**

Table 1-3 *Compliance status Key for Table 1-2*

Risk Level	Colour Code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: • Potential for serious environmental consequences, but is unlikely to occur; or • Potential for moderate environmental consequences, but is likely to occur.
Low	Non-compliant	Non-compliance with: • Potential for moderate environmental consequences, but is unlikely to occur; or • Potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g., submitting a report to government later than required under approval conditions).

An acceptable standard of environmental performance was achieved during the reporting period as evidenced by the following:

- Air quality monitoring results recorded during the reporting period for depositional dust, total suspended particulates (TSP) and fine particulate matter (PM_{10}) were consistently below the air quality criteria stipulated in the Project Approval 10_0041 at all monitoring locations. Elevated concentrations recorded during January 2020 were attributed to bushfire activity (refer **Section 6.2.2**) and severe drought conditions.
- There were no noise exceedances from mining activities recorded at privately owned properties during the reporting period.
- There were no surface water discharge events during the reporting period.
- There were some intermittent exceedances of surface water trigger values during the reporting period; however, these are considered to be due to activities upstream of PDM and not associated with activities undertaken by PDM during the reporting period (refer **Section 7.2.2**).
- There were some intermittent exceedances of groundwater trigger values during the reporting period; however, these are considered to be primarily due to climatic influences (increased rainfall) and potential ingress of water into the underground workings outside of the control and influence of PDM (refer **Section 7.5.2**).

During the reporting period, an assessment of rehabilitation areas was completed (refer **Appendix B**). Rehabilitation areas are generally stable in both the pasture and treed revegetation areas, whilst weed presence continues to be adequately controlled. It is recommended to continue weed management and the monitoring of performance indicators over the 2021 reporting period.

2 INTRODUCTION

EnergyAustralia (EA) owns Enhance Place Pty Ltd (Enhance Place) which operates PDM. EA acquired PDM in June 2012.

PDM is located at Blackmans Flat in NSW, 17km north of Lithgow off the Castlereagh Highway. The site is approximately 3km via the Castlereagh Highway from the Mt. Piper Power Station (MPPS). A locality plan is provided in **Plan 1**, **Appendix A**.

PDM is authorised by Project Approval (PA) 10_0041, dated 20 February 2011, granted by the former Department of Planning and Infrastructure, currently the Department of Planning, Industry and the Environment (DPIE) under section 75J of the Environmental Planning & Assessment Act 1979 (EP&A Act). The Project Approval provided for the extraction of up to 800,000 tonnes of Run of Mine (ROM) coal from the Yarraboldy Extension at PDM up to 31 December 2014 at a maximum rate of 350,000 tonnes per annum (tpa). Approved mining resources at PDM were exhausted in March 2014. From April 2014 the mine was placed under care and maintenance, with only rehabilitation activities undertaken intermittently at the site from this time.

This Annual Review has been generated to meet:

- The Annual Review (AR) requirements of the NSW DPIE, formerly the NSW Department of Planning and Environment under the conditions of a development consent and/ or project approval.
- The routine reporting expectations of the NSW Resources Regulator (RR).
- The annual reporting requirements of the Environment Protection Authority under the conditions of the site Environmental Protection Licence 4911.

This Annual Review will be distributed to the following stakeholders:

- NSW DPIE – Compliance.
- NSW DPIE – Resources Regulator (RR).
- NSW DPIE – Natural Resources Access Regulator.
- NSW Environment Protection Authority (EPA).
- Lithgow City Council.
- Pine Dale Mine Community Consultative Committee (CCC).

2.1 KEY PERSONNEL

The key personnel for environmental management at the PDM are listed in **Table 2-1**.

Table 2-1 *Key Personnel and contact information*

Contact Person	Position	Telephone	Email
Mr Graham Goodwin	Mining Engineering Manager	(02) 6355 7893	graham.goodwin@energyaustralia.com.au
Mr Mark Frewin	Commercial Manager	0438 338 176	Mark.Frewin@energyaustralia.com.au
Mr Ben Eastwood	NSW Environment Leader	(02) 6354 8350	Ben.Eastwood@energyaustralia.com.au

3 APPROVALS, LEASES AND LICENCES

PDM operates in accordance with a number of relevant licenses and approvals which are summarised in **Table 3-1**. The mining and exploration lease boundaries are shown in **Plan 4**, **Appendix A**.

Table 3-1 *Pine Dale Mine Consents, Leases and Licences*

Permit Type	Permit Number	Relevant Dates	Description
Project Approval	PA 10_0041	Granted 20 Feb 2011 Expired 31 Dec 2014	Granted by Minister of DP&I, Section 75J of the EP&A Act. A modification to PA 10_0041 was granted in March 2012.
Referral Decision	2011/6016	Date of Decision 20 October 2011	Issued by Department of Sustainability, Environment, Water, Population and Communities under section 75 & 77A of the EPBC Act 1999; to avoid impact on Purple Copper Butterfly & Austral toadflax (*Thesium australe*).
Environment Protection Licence	EPL 4911	Review Due Date 13 August 2024	EPL held by Enhance Place Pty Ltd. Licence currently under review by NSW EPA. Licence variation submitted 21/01/2019
Mining Lease	ML1578	Granted 5 November 2013	ML 1578 incorporates 69.4ha of land within the boundary of the Pine Dale Mine site.
Mining Lease	ML1664	Grouped under ML1578, 5 Nov 2013	ML 1664 incorporates 4.1 Hectares of land within the boundary of the Pine Dale Mine site.
Mining Lease	ML1569	Grouped under ML1578, 5 Nov 2013	ML1569 incorporates 161 hectares of land with which the Yarraboldy Extension and a portion of PDM.
Mining Lease	ML1637	Grouped under ML1578, 5 Nov 2013	ML1637 covers an area to the south of PDM for the purpose of proposed rail infrastructure.
Exploration Mining Lease	EL7621	Granted 1 October 2010	EL 7621 incorporates 312 Hectares of land within the north western and central parts of the Wallerawang Colliery.

Permit Type	Permit Number	Relevant Dates	Description
Bore Licence	10BL165933	Issued 22 December 2005	Issued by the Department of Natural Resources (DNR) under Part 5 of the Water Act 1912 for the use of (6) six piezometers for monitoring groundwater levels and quality on the Pine Dale Mine site.
Bore Licence	10BL603588	Issued 17 December 2010	Issued by the DNR under Part 5 of the Water Act 1912 for the use of eight (8) piezometers for monitoring groundwater levels and quality on the Yarraboldy Extension.
Water Access Licence	WAL36480 (approval no 10WA118780)	Dated 1 July 2013 Expires 30 June 2026	This licence was issued by the former Department of Environment, Climate Change and Water, which was superseded by DPIE under Part 5 of the Water Act 1912 for interception and use of up to 200ML of groundwater per year from The Bong.
Flood Control Works Licence	10CW801601 (approval no 10FW119292)	Dated 21 Sept 2015 Expires 21 Sep 2017	Issued by the DNR under Part 8 of the Water Act 1912 for the construction of noise/flood bunding along the boundaries of Mining Areas A, B and C.

4 OPERATIONS SUMMARY

PDM was in care and maintenance during the reporting period, as such, no extractive mining operations were undertaken.

4.1 EXPLORATION

There were no exploration drilling activities carried out at PDM during the reporting period.

4.2 LAND PREPARATION

There were no land preparation activities carried out at PDM during the reporting period.

4.3 CONSTRUCTION

No construction work was undertaken at PDM during the reporting period.

4.4 MINING OPERATIONS

There were no mining activities undertaken at PDM during the reporting period: PDM is currently in care and maintenance. The production and waste summary for 2019, 2020 and forecast for 2021 is provided in **Table 4-1**.

Table 4-1 *Production Summary*

	Approved Limit	Previous Reporting Period (actual)	This Reporting Period (actual)	Next Reporting Period (forecast)
Waste Rock / Overburden	NA	0	0	0
ROM Coal	800,000 t (over life of mine)	0	0	0
Coarse Reject	NA	0	0	0
Fine Reject (Tailings)	NA	0	0	0
Saleable product	350,000 tpa	0	0	0

4.5 COAL PROCESSING

Due to the care and maintenance status of PDM, no coal was processed during the reporting period: the coal crushing plant was decommissioned at the completion of mining extraction in April 2014.

4.6 COAL TRANSPORTING

Due to the care and maintenance status of PDM, no product coal was required to be transported during the reporting period.

4.7 WASTE MANAGEMENT

General waste bins are kept at the site office for the collection of putrescible waste. These bins are inspected and emptied as part of the regular inspection and maintenance programme. Minimal general waste is generated at PDM as the mine in care and maintenance.

Sewage management facilities associated with personnel offices were maintained at the site during the reporting period with regular inspections and pump outs undertaken as required.

4.8 PRODUCT STOCKPILES

All product stockpiles were decommissioned prior to the reporting period.

4.9 HAZARDOUS MATERIAL MANAGEMENT

There are no bulk oils stored on site and none were brought onto site during the reporting period. In the event hazardous materials are to be brought on site, they are to be accompanied by Safety Data Sheets (SDS).

4.10 FORECAST OPERATIONS

There are no operations forecast for PDM during 2021. The mine will continue to remain under care and maintenance.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

There are no actions required from the 2019 Annual Review.

6 ENVIRONMENTAL PERFORMANCE

PDM regards sound environmental performance and community liaison as integral components of its operations.

Environmental monitoring and management at PDM are governed by the requirements of PA 10_0041 and the supporting environmental assessment. The following management plans have been developed for PDM to minimise the potential risk to the surrounding environment.

- Pine Dale Mine Care and Maintenance Mining Operations Plan (MOP)
- Aboriginal Heritage Management Plan.
- Air Quality and Greenhouse Gas Management Plan.
- Blast Management Plan.
- Bushfire Management Plan.
- Waste Management Plan.
- Water Management Plan.
- Noise Management Plan.
- Pollution Incident Response Management Plan.
- Pine Dale Mine Environmental Management Strategy.

These management plans are available on the EnergyAustralia website: https://www.energyaustralia.com.au/about-us/energy-generation/pine-dale-coal-mine/yarraboldy-stage-1

A summary of the environmental performance for noise and air quality monitoring is provided in **Table 6-1**. Applicable approval and Environmental Assessment criteria are also provided in **Table 6-1**. Detailed discussions of the environmental performance is presented further in this section.

Table 6-1 *Summary of Environmental Performance and assessment criteria*

Aspect	Approval Criteria	EA[a] Prediction	Performance during 2020	Trends /Management Implications	Management Actions
Noise	NM1 – NM3 Daytime Criterion 42dB(A) $L_{Aeq(15minute)}$[b]	NM1 41 NM2 32 NM3 39 dB(A) $L_{Aeq(15minute)}$	NM1 Nil detected NM2 Nil detected NM3 Nil detected dB(A) $L_{Aeq(15minute)}$	NA – no operational noise generated	Nil management actions required
	NM4 – NM6 Daytime Criterion 35dB(A) $L_{Aeq(15minute)}$[b]	NM4 34 NM6 <30 dB(A) $L_{Aeq(15minute)}$	NM4 Nil detected NM5 Nil detected NM6 Nil detected dB(A) $L_{Aeq(15minute)}$	NA – no operational noise generated	Nil management actions required

Aspect	Approval Criteria	EA[a] Prediction	Performance during 2020	Trends /Management Implications	Management Actions
Air Quality: Depositional Dust	Maximum total deposited dust 4g/m^2/month	Annual average of 3.2g/m^2/month deposited dust	Annual average range of 1.1 to 1.9g/m^2/month deposited dust	Concentrations during previous five years are considered consistent when taking into account the influence of external factors (climate and bushfires)	Maintain dust suppression measures as required
	Maximum increase in deposited dust 2g/m^2/month	Annual average increase of deposited dust 1.2g/m^2/month	Annual average change of -0.4 to 0.3g/m2/month deposited dust	Annual average dust levels are slightly lower than 2019 and slightly greater than 2016 – 2018. These slight fluctuations are considered attributed to climate and bushfires.	Ensure dust suppression measures are efficiently utilised during extended dry periods, otherwise maintain current measures as required.
Air Quality: High Volume Air Sampling	TSP Annual Average 90 µg/m^3	TSP Annual Average 45 µg/m^3	TSP annual average 24 µg/m^3	Annual average TSP concentrations generally consistent with previous years.	Maintain dust suppression measures as required
	PM10 Annual Average 25 µg/m^3	PM10 Annual Average 18 µg/m^3	PM10 annual average 11 µg/m^3.	Annual average PM_{10} concentrations generally consistent with previous years	Maintain dust suppression measures as required
	PM10 24hr Average Max 50 µg/m^3	PM10 24hr Average Max 45.7 µg/m^3	Max PM10 24hr average result 51 µg/m^3 (bushfire impacted).	Max 24hr PM_{10} concentration above the PM_{10} 24hr criterion; but is considered to be related to bushfire activity and not mine related. 24 hr PM_{10} concentrations not impacted by bushfire were not in excess of EA and Approval criteria	Ensure dust suppression measures are efficiently utilised during extended dry periods, otherwise maintain current measures as required.

[a] Environmental Assessment prediction
[b] The A-weighted, equivalent continuous sound level in decibels measured across 15-minutes

6.1 NOISE

Mining related noise impacts at PDM are managed in accordance with Schedule 3, Condition 1 of PA 10_0041, EPL 4911 and the Noise Management Plan. Noise emissions from PDM operations were monitored on a quarterly basis at six (6) locations surrounding PDM. Although PDM is currently in care and maintenance, rehabilitation maintenance activities were undertaken on the site during the 2020 reporting period. The locations of these noise monitoring locations are shown in **Plan 2a** and **Plan 4**, located in **Appendix A**. The noise monitoring locations are described as:

- NM1 – Noon street, Blackman's Flat.
- NM2 – the Cherry residence, Blackman's Flat.
- NM3 – front of Barnes residence, east of Blackman's Flat along the Castlereagh Highway.
- NM4 – North of View Street, Blackman's Flat.
- NM5 – Wolgan Road, Lidsdale.
- NM6 – Wolgan Road, Lidsdale.

The operational noise assessment criteria are summarised in **Table 6-2**.

Table 6-2 *Noise Impact Assessment Criteria*

Location	Day[a] Period $L_{Aeq\ (15min)}$, dB	Evening[b] Period $L_{Aeq\ (15min)}$, dB
NM1	42	39
NM2	42	35
NM3	42	35
NM4	35	35
NM5	35	35
NM6	35	35

[a] Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and public holidays.

[b] Evening is defined as the period between 6pm and 10pm.

Attended noise monitoring was undertaken quarterly during the reporting period to assess any noise impacts from PDM against the relevant criteria detailed within PA 10_0041 and EPL 4911 (**Table 6-2)** on the following dates:

- Quarter 1 – January to March, monitoring conducted 12 March 2020.
- Quarter 2 – April to June, monitoring conducted 18 and 19 June 2020.
- Quarter 3 – July to September, monitoring conducted on 14 and 15 September 2020.
- Quarter 4 – October to December, monitoring conducted on 22 and 23 December 2020.

The measured L_{Aeq} 15 minutes noise contribution from PDM was below the noise assessment criteria for all 15-minute surveys at all noise monitoring locations measured during the reporting period. Similarly, the measured noise contribution from PDM was below the noise levels predicted in the Environmental Assessment (refer **Table 6-1**). Audible noise emanating from PDM operations have not been detected during noise surveys since the cessation of mining operations in April 2014.

Results for each noise monitoring survey during the 2020 reporting period are presented in full in **Appendix B**.

During the reporting period, no environmental performance or management measures were required to be implemented at the site in respect to noise generation by PDM.

6.2 AIR QUALITY

During care and maintenance, water for dust suppression was sourced from the onsite sediment basins.

Air quality at PDM is managed in accordance with Schedule 3, Condition 18 of PA 10_0041, EPL 4911 and the approved Air Quality and Greenhouse Gas Management Plan (AQGGMP). The scope of air quality monitoring within EPL 4911 was amended in November 2020. Prior to November 2020 air quality monitoring comprised five (5) depositional dust gauges (D1, D3, D4, D5 & D6) and two (2) high volume air samplers for TSP and PM_{10} as shown on **Plan 2a**, **Appendix A**. The November 2020 revision of the EPL removed the requirement to monitor TSP and PM_{10} by HVAS: the AQGGMP was updated accordingly and was endorsed by DPIE on the 4 December 2020.

Four (4) additional dust gauges associated with the Purple Copper Butterfly (PCB) Monitoring Program are located surrounding the Yarraboldy Extension. The PCB Monitoring Program was prepared to address concerns raised by the then Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (now Department of Agriculture, Water and the environment).

Monitoring is undertaken by RCA Australia; a summary report data collected throughout the monitoring period is available in **Appendix B**.

6.2.1 DEPOSITIONAL DUST

All deposited dust results have been compared to the nominated annual average assessment criterion of 4.0g/m^2/month, as stipulated in PA 10_0041. Depositional dust results for the reporting period showed an annual average insoluble solids range of 1.1g/m^2/month to 1.9g/m^2/month across the nine (9) dust gauges.

Comparative annual average depositional data for the previous five-year period is presented in **Table 6-3**. Graphical depositional dust data presented graphically in **Figure 6-1**.

Table 6-3 *Depositional dust monitoring results*

Total insoluble solids (g/m^2/month)									
Date	**D1**	**D3**	**D4**	**D5**	**D6**	**PCB1**	**PCB2**	**PCB3**	**PCB7**
Jan-20	1.6	3.4	4.6	3.3	4.0	6.2	4.5	3.7	4.7
Feb-20	4.4	3.4	4.4	3.5	3.9	5.6	4.4	3.8	4.5
Mar-20	1.5	1.2	1.2	1.6	0.8	1.9	1.2	0.7	0.3
Apr-20	0.4	0.5	0.5	1.2	0.4	1.3	0.3	0.1	0.1
May-20	1.0	0.4	0.1	0.2	0.2	1.3	0.2	0.2	0.1
Jun-20	1.1	0.7	0.4	0.8	1.5	0.8	0.3	0.4	0.5
Jul-20	0.5	0.5	0.1	3.2	0.2	0.5	0.1	0.4	0.2
Aug-20	0.6	0.6	0.4	0.4	0.1	0.6	0.1	0.4	0.2
Sep-20	0.7	0.7	0.5	3.4	0.4	1.3	0.3	0.5	0.4
Oct-20	1.1	1.1	0.6	0.8	0.3	1.2	0.6	0.8	0.8
Nov-20	0.7	0.9	0.5	0.6	0.5	1.0	0.4	0.8	0.4
Dec-20	0.9	1.3	0.8	0.6	0.4	1.3	0.9	1.0	0.7
Annual Averages									
2016	0.5	0.7	0.5	1.1	0.8	0.5	0.4	0.5	0.7
2017	0.6	0.5	0.5	0.5	0.8	0.9	0.6	0.8	0.8
2018	1.3	1.0	1.0	1.3	0.9	1.3	1.2	0.9	1.3
2019	1.3	1.5	1.6	1.3	1.2	1.6	1.4	1.1	1.4
2020	1.2	1.2	1.2	1.6	1.1	1.9	1.1	1.1	1.1
Annual average assessment criterion: 4.0g/m^2/month									

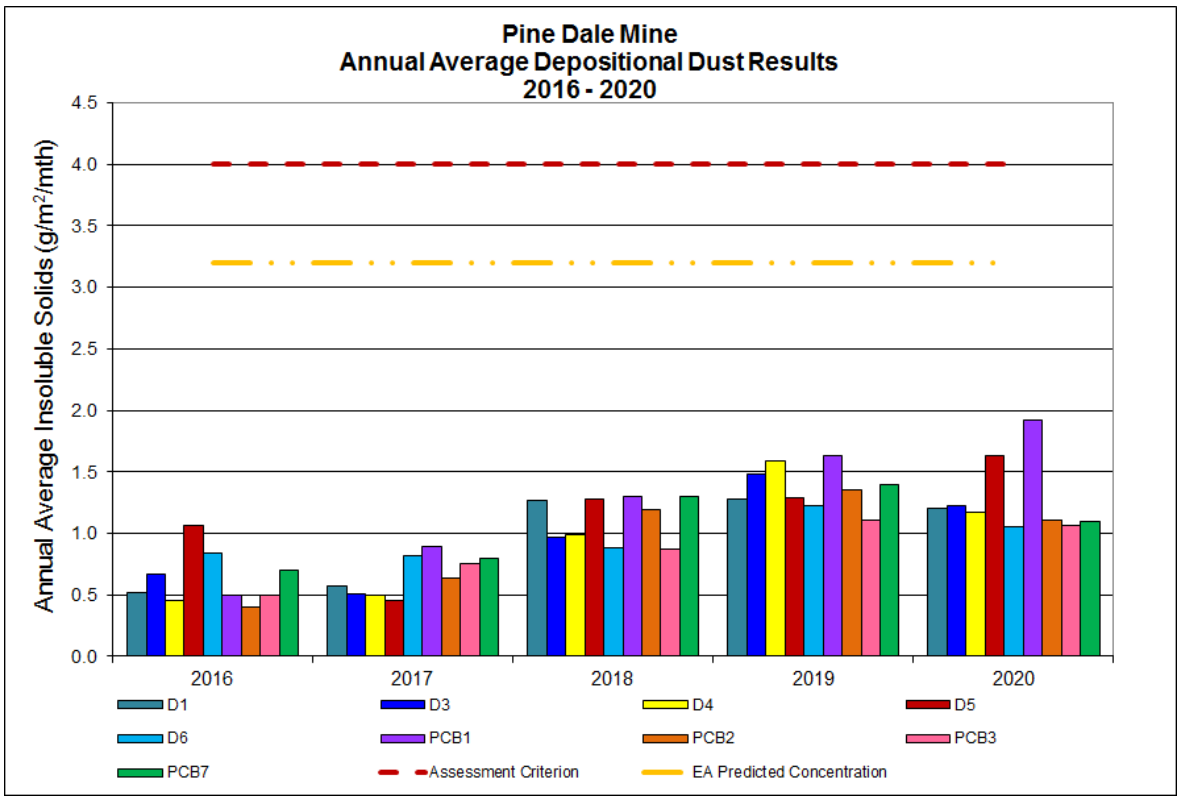


Figure 6-1 *Depositional dust data: 2016 – 2020*

An examination of the historical data (refer **Table 6-3**) indicates most dust monitoring locations show a slight decrease in the 2020 annual averages deposited dust concentrations when compared to the 2019 annual averages. Dust monitoring locations D5 and PCB1 were an exception showing a slight increase (0.3g/m^2/month) and PCB3 which showed no change. Annual average deposited dust concentrations are generally shown to be higher in 2020 than in 2016 and 2017 (refer **Figure 6-1**). This is not considered to be due to a change in site activities at PDM as the mine has been in care and maintenance since 2014, rather it is considered to be influenced by prolonged dry conditions due to below average rainfall (refer **Section 6.3**) resulting in low soil moisture, making the region more prone to dust storms. Dust storms were observed during 2018, 2019 and early 2020. Furthermore, bushfire activity during late 2019 and early 2020 would have also partially influenced the annual average deposited dust concentrations. Increased rainfall during 2020, has resulted in a slight decrease in deposited dust concentrations from the 2019 reporting period. The 2020 annual average deposited dust concentrations are shown to be lower than the concentrations predicted in the site Environmental Assessment annual average criterion of 3.2g/m^2/month annual average (refer **Table 6-1**).

6.2.2 TSP AND PM_{10} MONITORING (HVAS)

Annual average PM_{10}, PM_{10} 24-hour and annual average TSP monitoring results as compared to the assessment criteria are presented in **Table 6-4**. As TSP and PM_{10} monitoring was ceased in November 2020 (in line with the EPL variation), the 2020 annual average concentration is represented by the average for the period January 2020 – October 2020. During the 2020 reporting period, the PM_{10} 24-hour average results were below the 50µg/m^3 criterion with the exception of the run event on the 3 January 2020. This elevated concentration is considered to be influenced by poor air quality generated by the Gospers Mountain fire within the Wollemi National Park which moved through Ben Bull State Forest and PDM during December 2019. The fire activity in the region persisted through to February 2020. The DPIE air quality monitoring station located at Katoomba showed an elevated PM_{10} of 55.3µg/m^3 which is considered consistent with the concentration recorded at PDM.

It is noted that PA 10_0041 stipulates that the PM_{10} 24-hour assessment criterion, the TSP annual average assessment criterion and the PM_{10} annual average assessment criterion excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the Secretary (previously referred to as the Director-General) in consultation with the OEH (now DPIE). As such, it is considered that the PM_{10} concentrations in excess of the 24-hour assessment criterion are not in breach of the air quality acquisition criteria detailed in PA 10_0041.

The annual average (January – October 2020) PM_{10} result recorded in 2020 was 11µg/m³, which is below the long term annual average assessment criterion (30µg/m³). The annual average TSP (January – October 2020) result recorded during 2020 was 24µg/m³, which is below the 90µg/m³ assessment criterion and below the concentrations predicted in the Environmental Assessment.

Table 6-4 *PM_{10} and TSP Summary*

Maximum 24-hour average	PM_{10} (µg/m^3)	TSP (µg/m^3)
Maximum 24h Average result 2016	27	47
Maximum 24h Average result 2017	46	66
Maximum 24h Average result 2018	110[a]	175
Maximum 24h Average result 2019	355[a]	450
Maximum 24h Average result 2020	51[a]	120
24-hour Assessment criterion	50	n/a
Annual Averages		
2016	9	19
2017	10	20
2018	12	26
2019[c]	27	50
2019[d]	10	27
2020[e]	11	24
Annual Average Assessment criteria	**30**	**90**

[a] Result considered affected by external sources (dust storms or bushfire activity) outside of the control of the project.

[b] Air quality assessment criteria listed in Project Approval PA 10_0041.

[c] Result includes bushfire impacted HVAS events.

[d] Result excludes bushfire impacted HVAS events.

[e] refers to the average period 1 January 2020 – 29 October 2020.

Historical daily TSP and PM_{10} concentrations and the rolling annual average for the period January 2016 to October 2020 are presented graphically in **Figure 6-2**. Generally, TSP and PM_{10} concentrations have remained stable during the previous five (5) years, with the exception of elevated daily concentrations due to dust storms or bushfire activity. The Gospers Mountain fire significantly influenced the TSP and PM_{10} concentrations during November 2019 – February 2020. Further detail regarding the elevated particulate concentrations, including concentrations recorded by the DPIE air quality monitoring stations are provided in **Appendix B**. The TSP and PM_{10} rolling annual average values presented for October in **Figure 6-2** represent the November 2019 – October 2020 annual average, as such it captures the elevated TSP and PM_{10} concentrations influenced by Gospers Mountain fire during November 2019 – February 2020.

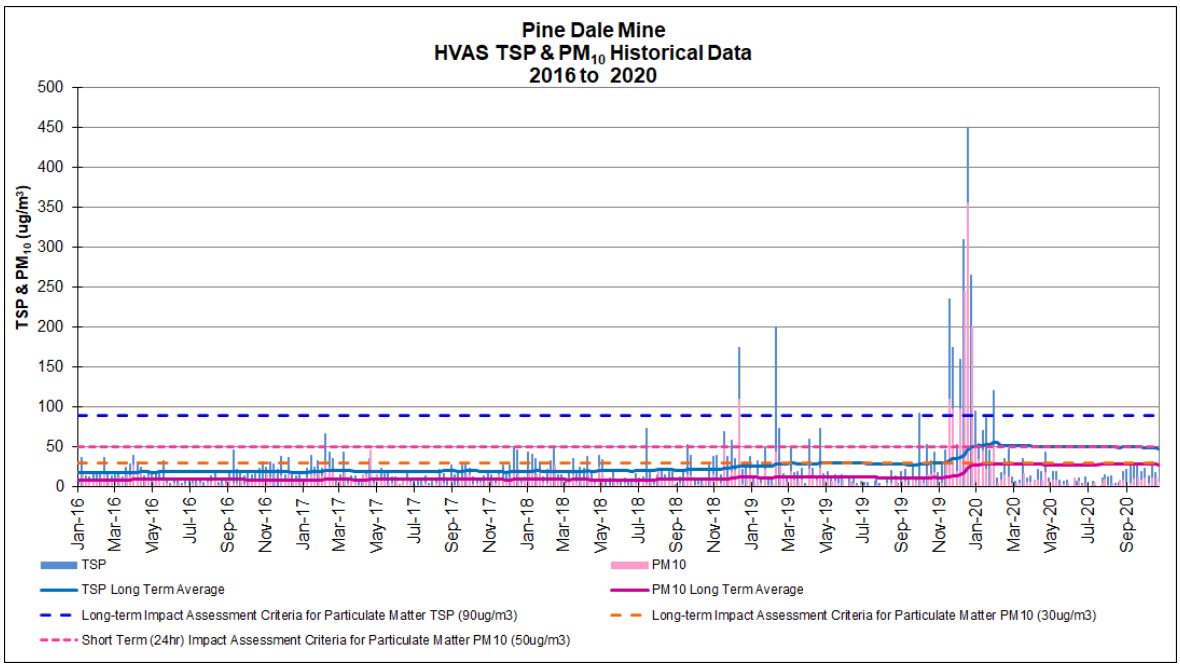


Figure 6-2 *TSP and PM_{10} concentrations: January 2016 – October 2020*

6.3 METEOROLOGICAL MONITORING

In accordance with Schedule 3, Condition 22 of PA 10_0041 and EPL 4911, PDM operates a meteorological monitoring station which measures air temperature, wind direction, wind speed, solar radiation, sigma theta, rainfall, evapotranspiration and relative humidity. A summary of monthly meteorological conditions recorded during the 2020 reporting period are presented in the following sections and **Appendix B**.

The total annual rainfall and the minimum and maximum temperature at 2m is shown graphically in **Figure 6-3**.

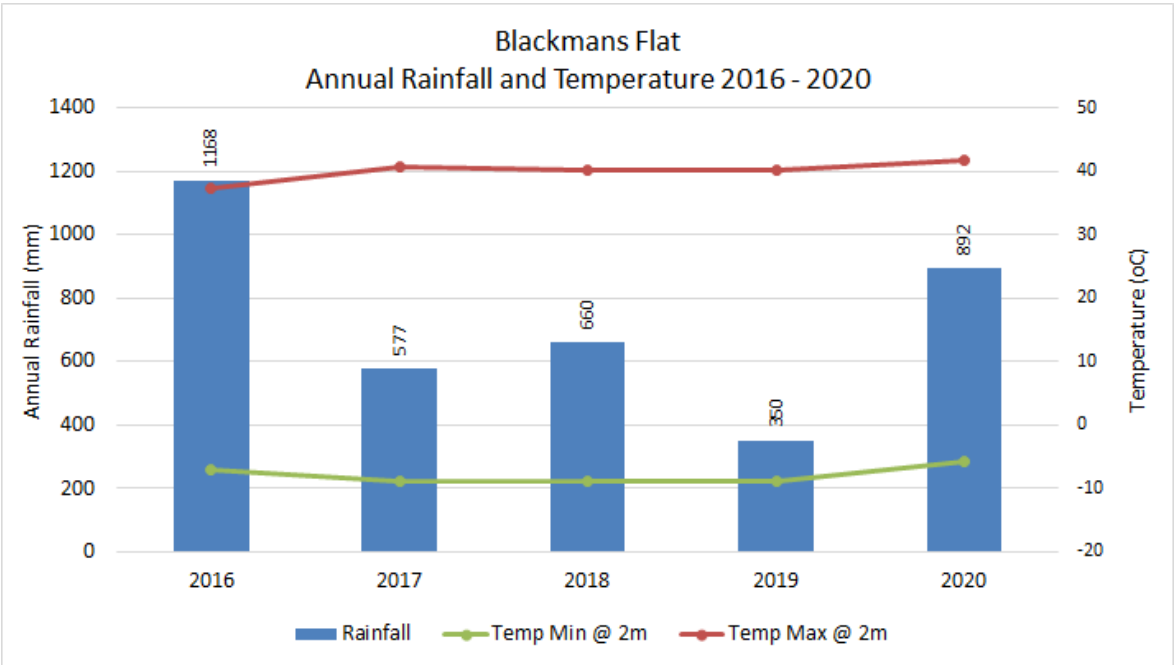


Figure 6-3 *Annual Temperature and Rainfall Summary: 2016 – 2020*

6.3.1 RAINFALL

PDM received 892mm of rainfall across 165 rainfall days during the 2020 reporting period. Rainfall during this reporting period was observed to be greater than the annual rainfall recorded during 2019 (350mm), 2018 (660mm) and 2017 (577mm). The rainfall recorded during 2016 was 1.3 times the amount recorded during 2020.

The Bureau of Meteorology (BoM) weather station located at Cooerwull (approximately 14km from PDM), reported a long-term median[2] annual rainfall total (years 1889 – 1973 and 2007 – 2020) of 769mm and an average annual rainfall total of 774mm. During the previous five (5) years (refer **Figure 6-3**), 2016 and 2020 were the only years that reported total rainfalls greater than the median. The total annual rainfall for 2017 – 2019 was below the median, with 2019 reporting 47% of the median.

The monthly rainfall data for 2020 is summarised in **Table 6-5**.

6.3.2 TEMPERATURE

Temperature is monitored at two (2) heights (2 metres and 10 metres above the ground surface) to account for temperature inversions. The maximum temperatures recorded during the reporting period were 41.8°C at the 2m sensor and 40.1°C at the 10m sensor, during February 2020. The lowest temperatures occurred in July and August, with a recording of -5.8°C at both 2m and 10m in both months. A summary of monthly temperatures for 2020 is included in **Table 6-5**. A graphical presentation of annual temperature variations during the previous five (5) years is presented in **Figure 6-3**.

6.3.3 WIND SPEED AND DIRECTION

Predominant wind direction at PDM during 2020 was observed to be primarily from the north-westerly quadrant. Wind directions were also observed from an easterly direction during the January – March and December 2020 (refer **Table 6-5**).

The maximum wind speed measured at the site was 20.6m/s during January 2020 from a west-north-westerly direction. Sigma theta data was measured continuously throughout the entire 2020 monitoring period. A summary of monthly wind speed, predominant directions and sigma theta recordings in 2020 is included in **Table 6-5**.

6.3.4 RELATIVE HUMIDITY

Relative humidity was measured during the reporting period. The minimum humidity recorded at the site was 11.0% recorded during January. The maximum humidity recorded at the PDM meteorological monitoring was 101.9% during the period February – December 2020. It is noted that a relative humidity greater than 100% is not technically feasible and readings in the range of 100-103% are considered due to condensation forming on the weather station humidity sensor during low wind conditions and do not represent uncertainty with regards to the readings. A summary of monthly humidity variations for 2020 is included in **Table 6-5**.

[2] The use of median value is specified as the preferred measure for 'typical' rainfall from a meteorological perspective as it reduces bias from extreme rainfall events.

Table 6-5 *Pine Dale Mine Meteorological Monitoring Summary 2020*

Month	Rainfall (mm)	Cumulative Rainfall (mm)	No of Rain Days/ Month	Air Temp. @ 2m (°C)			Air Temp. @ 10m (°C)			Sigma theta (º)			Relative Humidity (%)			Wind Speed (m/s)			Modal Wind Direction
				Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Jan	44.6	44.6	15	21.8	10	40.1	21.3	10	37.9	35.7	4.5	101.2	67.3	11.0	101.6	1.9	0.0	20.6	E
Feb	123.2	167.8	18	18.9	4.3	41.8	18.5	4.9	40.1	37.9	6.8	103.2	77.2	11.6	101.9	1.7	0.0	14.7	E
Mar	105.8	273.6	15	15.5	5.2	32.2	15.2	5.6	30.9	38.7	4.0	101.4	80.0	13.0	101.9	1.5	0.0	13.8	ESE
April	99.6	373.2	7	12.4	-0.6	25.8	12.3	-0.8	24.4	33.3	3.7	103.2	79.3	13.4	101.9	1.9	0.0	20.0	WNW
May	29.2	402.4	17	7.3	-4.5	20.8	7.3	-4.7	19.4	35.8	3.6	103.1	86.5	24.8	101.9	1.7	0.0	16.6	WNW
June	34.4	436.8	12	6.5	-5.3	17.8	6.6	-5.3	17.1	36.9	5.1	103.5	87.1	35.8	101.9	1.5	0.0	15.9	WSW
July	65.4	502.2	15	5.5	-5.8	17.3	5.6	-5.8	16.6	38.7	4.0	102.9	87.4	25.9	101.9	1.3	0.0	15.0	WNW
Aug	87.4	589.6	13	5.8	-5.8	20.5	5.7	-5.8	20	30.8	3.3	102.3	81.0	14.2	101.9	2.3	0.0	18.0	W
Sept	54.4	644	11	10.2	-1.9	24.4	10.0	-2	23.2	33.3	4.7	102.5	77.5	21.7	101.9	2.1	0.0	17.5	NW
Oct	71.8	715.8	15	13.6	0.2	27.1	13.3	0.5	25.1	35.6	4.3	102.9	76.8	11.6	101.9	1.8	0.0	14.0	WNW
Nov	69.8	785.6	12	16.7	3.1	34.4	16.3	2.9	33	37.5	2.8	103.6	71.3	12.1	101.9	1.8	0.0	17.4	NW
Dec	106.6	892.2	15	17.0	3.4	36.3	16.6	3.4	35.3	36.0	6.2	103.2	77.1	13.1	101.9	2.0	0.0	15.0	E
Total	892.2	-	165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Min	29.2	-	7	-	-5.8	-	-	-5.8	-	-	2.8	-	-	11.0	-	-	0.0	-	-
Max	123.2	-	18	-	-	41.8	-	-	40.1	-	-	103.6	-	-	101.9	-	-	20.6	-

6.4 EROSION AND SEDIMENT

The erosion and sediment controls for PDM have been implemented to safeguard against soil loss and minimise potential water quality impacts. Erosion control structures have been installed around PDM with the principle aim of containing sediment at its source. All runoff from disturbed areas is contained in temporary pollution control ponds within the open cut mine and surrounding hardstand areas.

Exposed areas which have been disturbed by previous mining operations are controlled though the use of windrows constructed by subsoil and/or clay material. Once vegetation has been cleared and topsoil removed, subsoil and clay material are pushed against the interface between the disturbed and undisturbed area creating a windrow where the potential for erosion impacts exist. Exposed areas are also managed through the use of temporary measures, such as silt fencing, to avoid sedimentation impacts on downstream waterways until the area has been rehabilitated. Additionally, temporary sediment ponds are constructed downslope of disturbed areas to ensure the capture of 'dirty' water and enable treatment prior to discharge into the underground workings. The management measures for the control of erosion described above are also put in place to increase batter and bench stability prior to establishment of permanent rehabilitation measures, where possible.

Erosion control structures at PDM are inspected on a monthly basis by the Mining Engineering Manager, particularly after significant rainfall events and repaired where necessary. Erosion and sediment control works which were undertaken during the reporting period included:

- The inspection and maintenance of windrows and silt fencing to prevent potential surface water impacts and sediment entering Neubeck's Creek.

6.5 CONTAMINATED AND POLLUTED LAND

There was no land identified as being contaminated or polluted during the reporting period. In the unlikely event that contaminated material is identified at the site, the remedial actions taken shall be those outlined in the Mining Operations Plan (MOP), whereby the affected material is either treated on-site or disposed of offsite by a licenced contractor.

6.6 THREATENED FLORA AND FAUNA

Measures for the management and mitigation of flora and fauna impacts at PDM and in the surrounding area are provided in the PDM Care and Maintenance MOP.

6.6.1 PURPLE COPPER BUTTERFLY

The Purple Copper Butterfly (PCB), also known as the Bathurst Copper Butterfly, is listed as an endangered species under the *Biodiversity Conservation Act 2016* and vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The PCB and larvae have been identified adjacent to the eastern boundary of the PDM Yarraboldy Extension within an area of its habitat of native Blackthorn (*Bursaria spinosa subsp. Lasiophylla*). Native Blackthorn vegetation is found throughout the local area, which provides suitable habitat for the PCB noting that they will only reside where there are native Blackthorn vegetation.

To minimise the potential direct and indirect impacts of dust and vibration from the PDM on the PCB, the following mitigation measures have been implemented:

- Maintenance of fencing and earth bunds around the known PCB habitat.

- Mining activity not occurring within 200m of the main habitat area between September through to the end of February, when the flying season of the adult larvae stages of the PCB are apparent (as determined by an independent ecologist).
- Implementation of further management and mitigation measures in accordance with PA 10_004 and Particular Manner Decision 2011/2016 made under Sections 75 and 77a of the *Environment Protection and Biodiversity Conservation Act 1999*.

A PCB monitoring program has been implemented to monitor potential indirect impacts from extractive mining activities (particularity blasting and vibration) on the known populations of the butterfly. The field survey monitoring was conducted to coincide with the adult and larvae stages of the PCB with monitoring being undertaken by ecologists from Eco Logical Australia Pty Ltd. Monitoring was undertaken in a 30m radius of the PCB dust gauge locations PCB1, PCB2 and PCB4. Locations are shown in **Plan 2a** in **Appendix A**.

Two (2) field surveys were conducted during the reporting period in accordance with the Commonwealth Department of Environment and Energy (now known as the Department of Agriculture, Water and the Environment (DAWE)) Notification of Referral Decision measure, as follows:

- 3 March 2020 – field survey of the PCB within adjacent to locations identified in the Notification of Referral Decision to determine the completion of the larval stage.
- 7 and 8 September 2020 and 2 October 2020 – field surveys were undertaken for the PCB within monitoring locations identified in the Notification of Referral Decision, to determine whether the adult feeding stage of PCB lifecycle had commenced.

During the March 2020 survey, it was identified that the Gospers Mountain bushfire which spread through Ben Bullen State Forest and PDM during December 2019 and January 2020, had burnt the PCB habitat area. Only one (1) of the three (3) PCB monitoring sites (PCB1) contained unburnt *Bursaria spinosa ssp. lasiophylla* plants (Blackthorn). While the majority of the habitat was burnt, *Bursaria spinosa ssp. lasiophylla* plants were observed to be regenerating, with juvenile shoots present at PCB1. No larvae were present during the survey, and it was concluded that the PCB larvae had commenced pupation and were no longer active (Ref [2]).

During the September and October 2020 surveys, there were no adult (flying stage) PCB identified within or adjacent to the established monitoring sites. An inspection carried out at two (2) additional small patches of unburnt Blackthorn to the east and west of PDM also identified the absence of adult PCB at both locations. As there were no adult PCB observed during what are ideal conditions for the species it was considered that the PCB population within PDM had perished as a result of the December 2019 bushfires, although it is possible that a portion of the population survived and were not detected during the September and October 2020 surveys. Adult PCB were observed at a nearby site (Neubecks Hill) approximately 2km south-east of PDM during the September and October 2020 surveys (Ref [3]).

A summary of the survey data and results recorded during the period 2015 to 2020 indicates PDM has had minimal impact upon the life cycles of the Purple Copper Butterfly. A summary of the survey results for the previous five years is provided in **Table 6-6**.

Data collected from dust gauges located within the butterfly habitat area is provided in **Table 6-3**.

Table 6-6 *Purple Copper Butterfly Field Survey Summary*

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2015-2016	To confirm commencement of PCB larval feeding season	4 September 2015	No larvae identified; five (5) adult PCB identified	Lack of active larvae observed on the plants inspected suggests that the PCB breeding season had only recently commenced, and the adult individuals observed had only recently emerged.	No mining activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening 22/23 February 2016	No larvae identified; no attendant ants observed near targeted plants.	No larvae detected indicate PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to reappear until Aug / Sep.	Mining activities can recommence within 200m of PCB main habitat area.
2016-2017	To confirm commencement of PCB larval feeding season	29 August 2016	Numerous adult PCB observed; no larvae observed.	Lack of active larvae observed indicates PCB breeding season had only recently commenced.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening of 27 February 2017	No larvae identified on any plants; attendant ants were observed on two (2) plants at site PCB1 and PCB2.	No larvae detected in survey area indicating PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to re-appear until late August / early September.	Mining activities can recommence within 200m of PCB main habitat area.
2017-2018	To confirm commencement of PCB larval feeding season	31 August 2017	Abundant adult PCB observed; no larvae observed.	Absence of larvae observed indicates PCB breeding season had only recently commenced.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening of 1 March 2018.	No larvae identified on any plants. No attendant ants observed.	Absence of larvae during seasonally mild conditions indicates that PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to re-appear until late August / early September.	Mining activities can recommence within 200m of PCB main habitat area.
2018 – 2019	To confirm commencement of PCB larval feeding season	5 September 2018.	Seven (7) PCB (flying stage) identified at PCB1; no larvae observed.	Absence of larvae indicates PCB feeding season has commenced, no further monitoring required.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area.	28 February 2019	No larvae identified on any plants. No attendant ants observed.	Absence of larvae during seasonally mild conditions indicates that PCB larvae have commenced pupation and are no longer active.	Mining activities can recommence within 200m of PCB main habitat area.
2019 – 2020	To confirm commencement of PCB larval feeding season.	5 September 2019	Eight (8) adult PCB (flying stage) identified at PCB1. PCB feeding season has commenced. PCB survey to be undertaken March 2020 to confirm completion of larvae stage.	PCB feeding season has commenced, no further monitoring required.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area.	3 March 2020	No larvae identified on any plants. Attendant ants recorded on eight (8) live Blackthorn plants.	Absence of larvae indicates pupation has commenced and larvae are no longer active. Damage sustained to Blackthorn plants during December 2019 bushfires.	Mining activities can recommence within 200m of PCB main habitat area.

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2020 – 2021	To confirm commencement of PCB larval feeding season	7 and 8 September 2020 2 October 2020	No adult (flying stage) PCB identified.	As no adult PCB were identified it was likely that the PDM PCB population perished during the December 2019 bushfire.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. PCB monitoring should be undertaken if mining or earthwork activities to occur within 200m of PCB main habitat area.

As PDM has been in care and maintenance since April 2014, and mining activities have ceased and will not be undertaken throughout 2021, there are no foreseen impacts upon the PCB. On 30th October 2020, Enhance Place Pty Ltd wrote to the DAWE notifying them of the intention to temporarily cease the annual PCB monitoring until such times as when mining (or the "proposed action" as set out in the Referral) recommences. The DAWE responded to this correspondence on 5th November 2020 and noted that Enhance Place notify them when mining is to recommence on site and also noted that the monitoring for the PCB will recommence when the mine recommences activity outside of the current Care and Maintenance activities.

6.6.2 AUSTRAL TOADFLAX (THESIUM AUSTRALE)

Austral Toadflax is listed as vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*. An erect to scrambling perennial herb, it occurs in small populations, parasitising a range of grass species, which at PDM is Kangaroo Grass. At subalpine and tableland climates the species dies back to rootstock during winter and re-sprouts in spring.

Surveys conducted by Eco Logical Australia in March 2011 identified a total of 260 individual Austral Toadflax plants in three (3) patches located beyond the north-west crest of the Yarraboldy Stage 1 Extension pit.

A Species Management Plan completed in consultation with the Department of Planning and Environment was developed to mitigate the impact of open cut mining on the host habitat within the Austral Toadflax buffer area. This includes:

- Inclusion of a buffer zone from known specimens referred to as the Austral Toadflax buffer area.
- Installation and maintenance of fencing and signage between the open cut boundary and known location of specimens.
- Installation of additional signage and barriers (e.g., tape) when operating in close proximity to the Austral toadflax buffer area.
- Control of noxious weed infestations and feral animals.

During the reporting period, care and maintenance operations did not encroach within the habitat area. Details regarding control of noxious weeds within and surrounding the habitat area for the reporting period is presented in **Section 6.7** and will continue to be undertaken in the next reporting period. The Gospers Mountain bushfire which spread through Ben Bullen State Forest and PDM during December 2019 and January 2020, has burnt out the Austral Toadflax during the 2020 reporting period.

6.7 WEEDS

Weed control activities at PDM are undertaken in accordance with the Care and Maintenance MOP. Weed control methods target four (4) noxious weeds previously identified within PDM and the Yarraboldy Extension area, namely:

- African lovegrass (*Eragrostis curvula*).
- Blackberry (*Rubus fruticosus* aggregate species).
- Briar Rose (*Rosa rubiginosa*).
- St John's Wort (*Hypericum perforatum*).

Weed inspections were undertaken on a regular basis during the reporting period: spraying for the four (4) target species was undertaken during summer (January 2020) in areas of PDM.

The PDM Rehabilitation Monitoring Report (Ref [4]) attached in **Appendix C** indicated African lovegrass was present within the pasture rehabilitation areas (Area 8, Area B and Area C). The presence of African lovegrass comprised of <10% of the pasture area. These outbreaks were subjected to chemical control and were not observed to be growing or producing seeds. The report (Ref [4]) also found the proposed method of African lovegrass control was consistent with legislative requirements.

The control of weeds will be undertaken on an ongoing basis consistent with the Care and Maintenance MOP to ensure noxious species are managed accordingly.

6.8 BLASTING

As PDM is currently in care and maintenance, there were no blasting activities undertaken during the reporting period.

6.9 VISUAL AND STRAY LIGHT

There were no adverse impacts associated with stray light or visual disturbance identified during the reporting period. There were no complaints received during the reporting period regarding visual and stray light impacts.

6.10 ABORIGINAL HERITAGE

There were no artefacts of Aboriginal cultural heritage found at PDM during the reporting period.

6.11 NATURAL HERITAGE

No items or areas of natural heritage significance have been recorded or are considered to occur within the approved disturbance area at PDM.

6.12 SPONTANEOUS COMBUSTION

There were no incidences of spontaneous combustion in or overburden material during the reporting period. The Lithgow Seam is known to have a low propensity for spontaneous combustion. All coal stockpiles have been decommissioned.

6.13 MINE SUBSIDENCE

There were no issues identified regarding mine subsidence during the reporting period.

6.14 BUSHFIRE

Bush fire control strategies for PDM are managed in accordance with Project Approval PA 10_0041 and the approved PDM Bush Fire Management Plan. These strategies are employed for preventing the occurrence and spread of any fire events that may impact on the site or in surrounding lands (i.e., Ben Bullen State Forest). As such, measures are taken at PDM to prevent the occurrence and spread of fire through proper maintenance of machinery and equipment, and the maintenance of access roads.

The PDM Rehabilitation Monitoring Report (Ref [4]), determined fuel loads within rehabilitation areas A, B, C and 8 were low and fuel hazard mitigation activities were not required. The internal access road within PDM provides a firebreak between Area A, and the PDM office and infrastructure to the south. The haul road provides a firebreak to the north of area A, and to the north and west of Areas B, C and 8. Fire-fighting access roads were also considered to be adequate, with all access roads within rehabilitated areas maintained in good condition and suitable for the passage of Category 1 tankers.

During the 2020 reporting period there was one instance (January 2020) where fire impacted the surrounding lands and within PDM. A bushfire started at Gospers Mountain in October 2019 and moved through Wollemi National Park, eventually spreading through Ben Bullen State Forest during December 2019. The fire then entered PDM and impacted the Yarraboldy Extension area and Area A on the 19 December 2019. Fire activity within, and in close proximity to PDM persisted throughout January 2020.

Photograph 6.1 shows fire activity at PDM and **Photograph 6.2** shows the fire activity in the surrounding area. Bushfire activity continued to persist in the region throughout February 2020 and detrimentally influenced air quality (refer **Section 6.2**). Due to bushfire damage in Ben Bullen State Forest, access was prohibited by Forestry Corporation of NSW during period January 2020 – September 2020. The forest was opened in October 2020.

Photograph 6-1 *Gospers Mountain Bushfire impacting PDM*

Photograph 6-2 *Gospers Mountain Bushfire*

6.15 METHANE DRAINAGE AND VENTILATION

The underground workings at the PDM site were closed in 1986 and decommissioned over a period from 1987 to 1990. Methane levels are considered to be negligible at PDM.

6.16 PUBLIC SAFETY

No issues of public safety occurred during the reporting period. The entire perimeter of PDM is fenced, with “No Trespassing” signs displayed at various intervals. “Do Not Enter” and “Danger” signs are also displayed along the fence of the private sealed haul road. Continuation of the control of trespassing during the reporting period has occurred through routine inspection, monitoring, upgrades and repairs of fencing structures. During the care and maintenance term, PDM has continued to be regularly monitored by mine personnel.

7 WATER MANAGEMENT

PDM lies within the Neubecks Creek (also known as Wangcol Creek) catchment which is a sub-catchment of the Upper Coxs River catchment, which in turn is part of the Warragamba Catchment, administered by WaterNSW.

The runoff from the surrounding area flows to the Coxs River via Neubecks Creek (a perennial tributary) which runs into Blue Lake, a former open cut mining void. Neubecks Creek is understood to flow intermittently (noting that many of its tributaries are temporary), with flows influenced by water discharges from other upstream industrial land uses.

Water resources at PDM are managed in accordance with the Water Management Plan (WMP) which was developed under the requirements of project approval PA 10_0041, EPL 4911, respective groundwater bore licences, the water access licence (WAL 36480) and Water Supply Works Approval 10WA118780.

The water management system has been designed as a closed loop system, with all clean water diverted around the mining site where practicable. It is also designed not to discharge any water from PDM into Neubecks Creek unless required to under an emergency. Drainage of surface water within the site’s disturbed areas is generally to the south and southeast following the natural topography for treatment prior to free draining into the underground workings (see **Plan 4**, **Appendix A**). The runoff from the north is captured in temporary sumps and used as dust suppression when required.

Potable water for use in the offices and amenities is sourced from town water mains supply.

7.1 STORED WATER

There are no permanent water storage structures at the PDM. Clean water diversion structures are utilised at the site in conjunction with temporary sediment ponds. Temporary sediment ponds are constructed downslope of disturbed areas to ensure the capture of ‘dirty’ water and enable treatment prior to draining into the underground workings.

7.2 SURFACE WATER MONITORING

Surface water quality at PDM is managed in accordance with the WMP and EPL 4911. Sampling is conducted at a total of eleven (11) locations within and surrounding the mine site (see **Plan 2a**, **Appendix A**). Surface water field data and samples are collected by RCA Australia and analysed at a NATA registered laboratory.

In accordance with EPL 4911 the following locations are required to be monitored at PDM on a quarterly basis for total suspended solids (TSS), sulphate and dissolved iron:

- Point 2 – Upstream of EnergyAustralia flow gauge and upstream of confluence with Lamberts Gully.
- Point 3 – 100m downstream of open cut area of PDM.
- Point 14 – Cox's River downstream of Blue Lake.

In accordance with EPL 4911 and in the event of a discharge to water, via licence discharge point (EPA Point 13), then samples are required to be collected daily during discharge for electrical conductivity (EC), pH, and turbidity and weekly for dissolved iron, oil and grease, sulphate and total suspended solids. EPA Points 2, 3 and 14 are also required to be sampled daily for EC, pH and turbidity. No discharge was made via the licenced discharge point (LDP13) during the reporting period.

The WMP also details monitoring of a further six (6) locations, S1 and S3[3] to S7, on a monthly basis for pH, temperature, EC and turbidity plus a quarterly analysis suite comprising major ions, anions and filtered metals. The description of surface water monitoring sites S1 and S3 to S7 is as follows:

- S1 located within Neubecks Creek upstream of PDM operations.
- S3 and S6 are located within Neubecks Creek downstream of S1 and any PDM operations.
- S4 is located on Coxs River, upstream of the confluence of Neubecks Creek and does not receive water from PDM operations.
- S5 is located within Blue Lake which receives flow from Neubecks Creek and Coxs River.
- S7 located within Coxs River, downstream of Neubecks Creek.

The water level of Neubecks Creek is measured at S2 on a monthly frequency.

The surface water monitoring locations are shown in **Plan 2a**, **Appendix A**.

During the reporting period, all surface water monitoring at PDM was undertaken in accordance with the surface water monitoring program documented in the PDM WMP, and EPL 4911. Results of surface water monitoring are discussed in **Section 7.3.2** and also provided in **Appendix B**.

7.2.1 SURFACE WATER ASSESSMENT CRITERIA

Concentration limits are specified in EPL 4911 for the licenced discharge point LDP13, whilst the remaining water monitoring locations only have water quality trigger values stipulated in the site WMP – surface water section in accordance with Schedule 3, Condition 27(b) of the Project Approval (PA 10_0041). The current approved WMP trigger values are presented in **Table 7-1**.

The WMP details the protocol for the investigation, notification, and mitigation of any identified adverse impacts on surface water quality. The surface water component of the WMP also provides impact assessment criteria, including trigger values for investigating any potentially adverse surface water impacts.

[3] Surface location S3 is the same location as EPA Point 3

Table 7-1 *PDM Approved Surface Water Trigger Values*

Surface Water Site	pH (range)	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Oil and Grease (mg/L)
S1	6.2 – 8.0	2325	30	10
S2	NA	NA	NA	NA
S3	6.4 – 8.0	2223	30	10
S4	7.3 – 8.0	957	30	10
S5	7.0 – 8.0	1013	30	10
S6	6.7 – 8.0	1941	30	10
S7	6.8 – 8.0	1007	30	10
EPA Point 2	7.1 – 8.0	2055	30	NA
EPA Point 3	6.4 – 8.0	2223	30	NA
EPA Point 13	6.5 – 8.0[a]	NA	30*	10*
EPA Point 14	7.5 – 8.0	1166	30	NA

[a] EPL concentration limit only applicable during discharge events.

EnergyAustralia commissioned an investigation of surface water quality at PDM which included identification of factors that influence surface water quality. This investigation was concluded in 2018 and, as a result, new surface water trigger values were proposed. The investigation (Ref [5]) concluded that water quality monitored at EPA Point 2 and S1, which are located within Neubecks Creek, to be primarily influenced by a licence discharge point (not associated with PDM) located between EPA Point 2 and S1. The revised surface water trigger values (Ref [5]) are shown in **Table 7-2**.

Table 7-2 *Revised Surface Water Trigger Values (Ref [5])*

pH trigger level[a]	6.5 – 8.0	6.5 – 8.0
Electrical conductivity (µs/cm)	5592	5592
Total suspended solids (mg/L)	25	25

[a] pH trigger level is exceeded if the pH is outside the nominated range.

The trigger values presented in **Table 7-2** are applicable to all PDM surface water monitoring sites, noting that EPA Point 2, S1 and S4 are not influenced by activities at PDM. At the time of writing this report, the revised trigger values detailed in **Table 7-2** have been utilised alongside the approved trigger values presented in **Table 7-1**; however, an update to the Water Management Plan to include the revised trigger values and submission to the DPIE for endorsement has not yet been undertaken.

7.2.2 SURFACE WATER QUALITY

7.2.2.1 EPA SURFACE WATER MONITORING

During the monitoring period, four (4) quarterly surface water monitoring events were conducted in February, May, August and November 2020 in accordance with the requirements of EPL 4911. These events included EPA specified monitoring Point 2 and Point 3, which are both ambient surface water monitoring locations on Neubecks Creek and Point 14 which is an ambient surface water monitoring point located on the Coxs River and assesses the water quality downstream of PDM. There are no concentration limits stipulated in EPL 4911 for monitoring point 2, 3 and 14. The EPL surface water monitoring locations are shown in **Plan 2a**, **Appendix A**.

Surface water samples collected during the 2020 period are compared against the approved surface water trigger values (**Table 7-1**) and the revised surface water trigger values (**Table 7-2**) in **Appendix B**. Results of water quality monitoring were generally compliant with the water quality trigger levels.

pH was within the respective approved site-specific trigger value ranges with the exception of EPA Point 14 which was below the approved lower pH trigger value during three (3) of the four (4) water quality monitoring events (May, August and November). pH was within the specified pH range of the revised surface water trigger values (Ref [5]).

EC was in excess of the approved trigger value at EPA Point 14 during the February 2020 monitoring event only. There was no electrical conductivity value in excess of the revised surface water quality trigger value (Ref [5]).

Total suspended solids (TSS) concentrations were all below the approved trigger values.

The electrical conductivity and pH for the period 2016 – 2020 is shown in **Figure 7-1**; electrical conductivity and rainfall for the same period is shown in **Figure 7-2**.

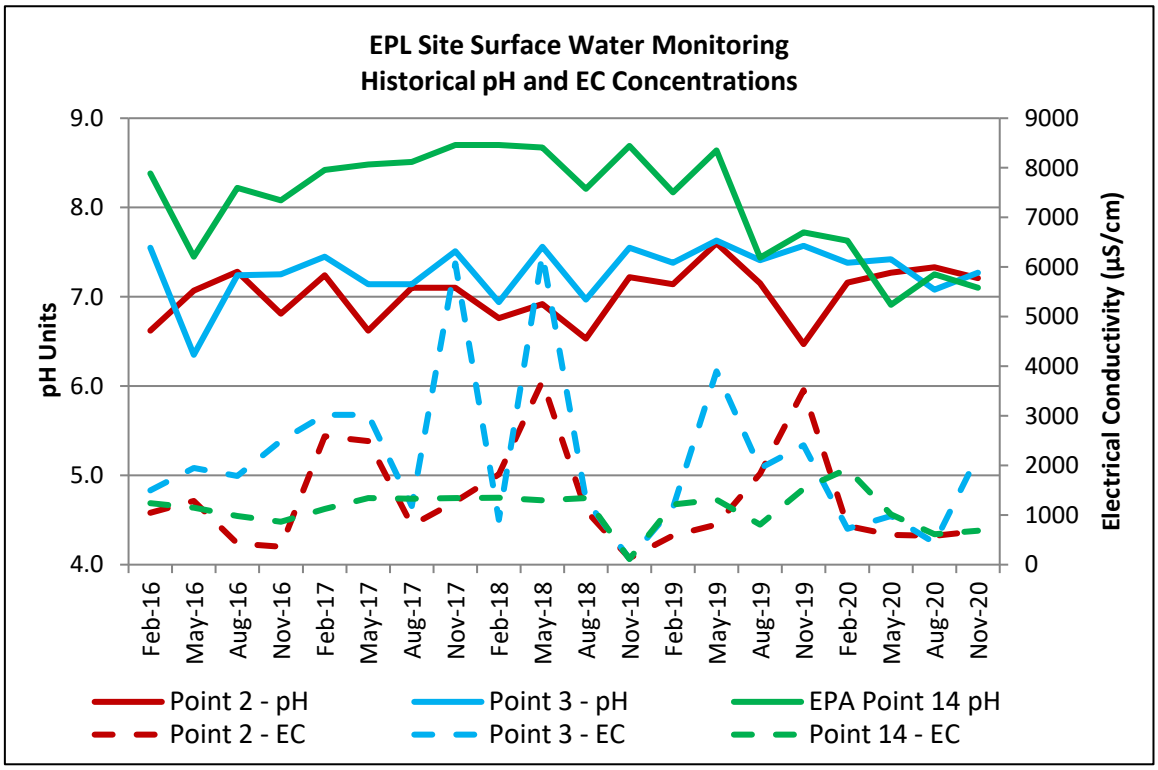


Figure 7-1 *Surface water at EPL monitoring points: pH and Electrical Conductivity*

During the 2016 – 2020 monitoring period, pH has remained generally stable with a slight decreasing trend observable at EPA Point 14 during the period August 2019 – November 2020. Electrical conductivity during the previous five (5) years is generally shown to fluctuate; however the overall trend is generally stable at EPA Point 2 and EPA Point 14, while a slight decreasing trend is observable at EPA Point 3 (refer **Figure 7-1**).

Electrical conductivity within Neubecks Creek is predominantly influenced by a licenced discharge flow entering Neubecks Creek immediately downstream of EPA Point 2. This licence discharge point is not associated with PDM, as such increase in electrical conductivity within Neubecks Creek is considered due to the influence of the licenced discharge flows and not due to activities associated with PDM. EPA Point 3 is located downstream of EPA Point 2 and the licence discharge point. Monitoring results from EPA Point 3 are also influenced by the above-mentioned licenced discharge water quality. It is considered that there is some influence of electrical conductivity at EPA Point 2 from the discharge point due to mixing and the close proximity of the licence discharge point (approximately 50m upstream). The influence of the water quality at the licenced discharge point is minimal at EPA Point 14, as this monitoring location is located 2km from the discharge point and receives water from both Neubecks Creek and Coxs River, as such, significant dilution and mixing has occurred.

Monthly rainfall totals greater than 50mm appear to influence lower electrical conductivity results at EPA Points 2 and 3 presumably through dilution from runoff. (refer **Figure 7-2**). The elevated electrical conductivity at EPA Point 14 which was in excess of the approved trigger value during the February 2020 monitoring event is considered to have been influenced by the elevated electrical conductivity (**refer Figure 7-2**), from the licenced discharge point upstream of PDM. This exceedance is not considered to be attributable to PDM activities.

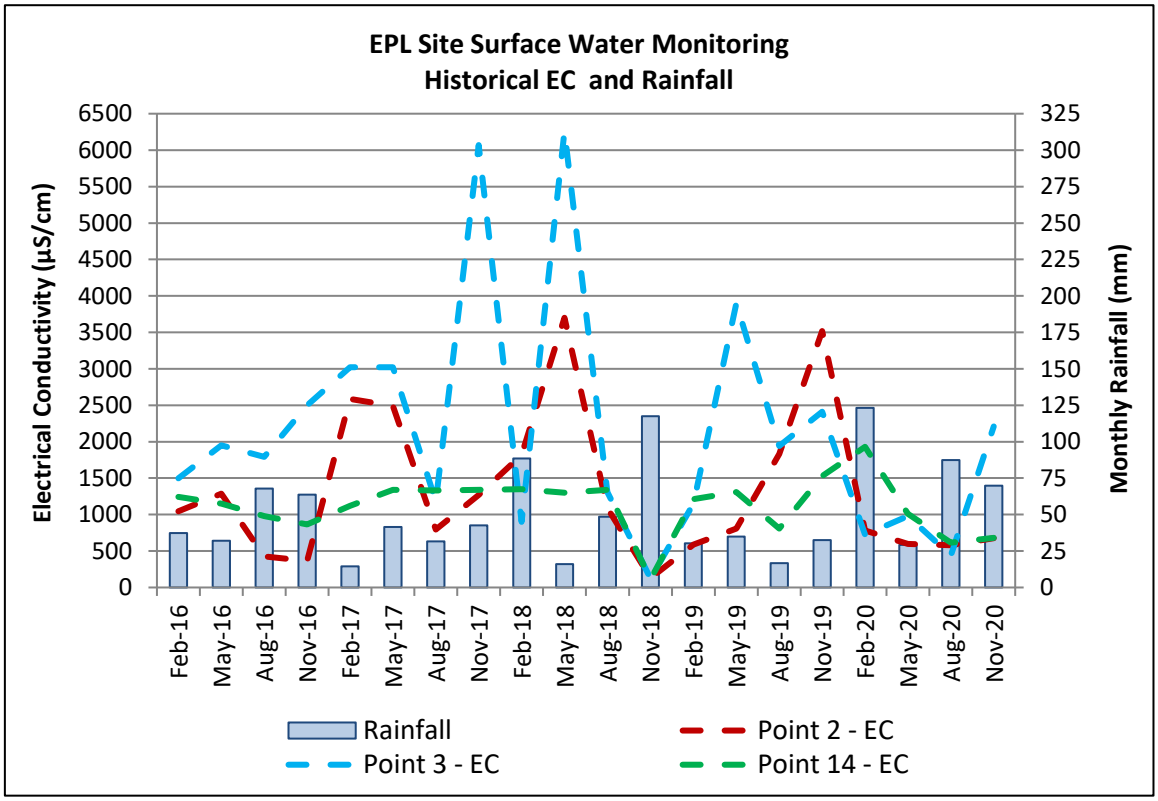


Figure 7-2 *Surface water at EPL monitoring points: Rainfall and (EC)*

The pH results from EPA Point 14 during May, August and November is considered to be due to the influence of the water quality within Coxs River. The pH at the Coxs River background upstream monitoring location, S4 as well as S5, S6 and S7 is shown in **Figure 7-3**.

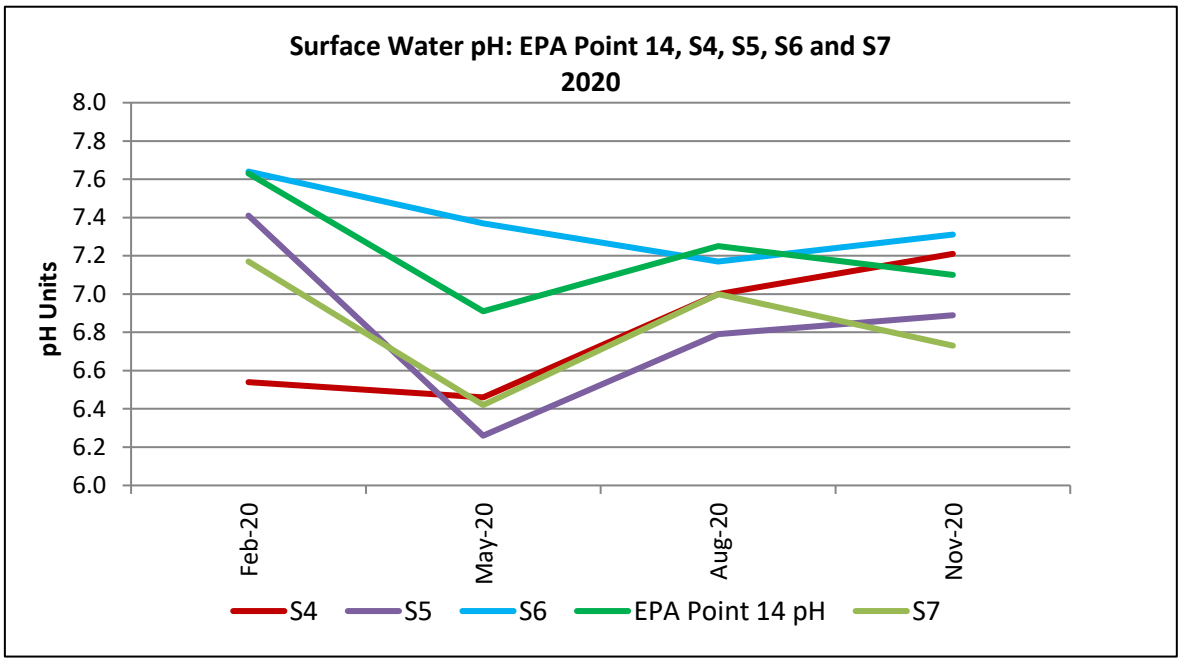


Figure 7-3 *Surface Water pH: 2020*

The last monitoring location within Neubecks Creek prior to mixing of water from Coxs River is S6, the pH at this location is generally higher than EPA Point 14 during the 2020 monitoring period, as such, it is unlikely that PDM activities have influenced the low pH reading at EPA Point 14. The pH at surface water site S4, upstream of PDM is generally lower in pH compared to EPA Point 14, while the pH within the downstream location S5 (Blue Lake) generally reports the lowest pH value (refer **Figure 7-3**). Furthermore, the pH at surface water S7 strongly correlates with the pH behavioural trend at EPA Point 14, albeit, at a lower pH, as such it is considered likely that the low pH is influenced by water quality within Coxs River and/or Blue Lake. As EPA Point 14, is significantly downstream from surface water site S7 there is also potential for the water quality to have been influenced by other activities downstream from S7 (refer to **Plan 2a**, **Appendix A**) for monitoring locations.

7.2.2.2 General Surface Water Monitoring

Surface water monitoring was undertaken on a monthly frequency at six (6) locations during the reporting period at locations S1 and S3 – S7, as per the requirements of the PDM WMP. It is noted that surface water site S3 and EPA Point 3 are the same monitoring location. Results for pH the period 2016 – 2020 are shown graphically in **Figure 7-4** and **Figure 7-5**. The results for electrical conductivity and rainfall for the same period are shown in **Figure 7-6** and **Figure 7-7**.

The complete suite of monitoring results is shown in **Appendix B**. Monitoring locations are shown in **Plan 2a**, **Appendix A**.

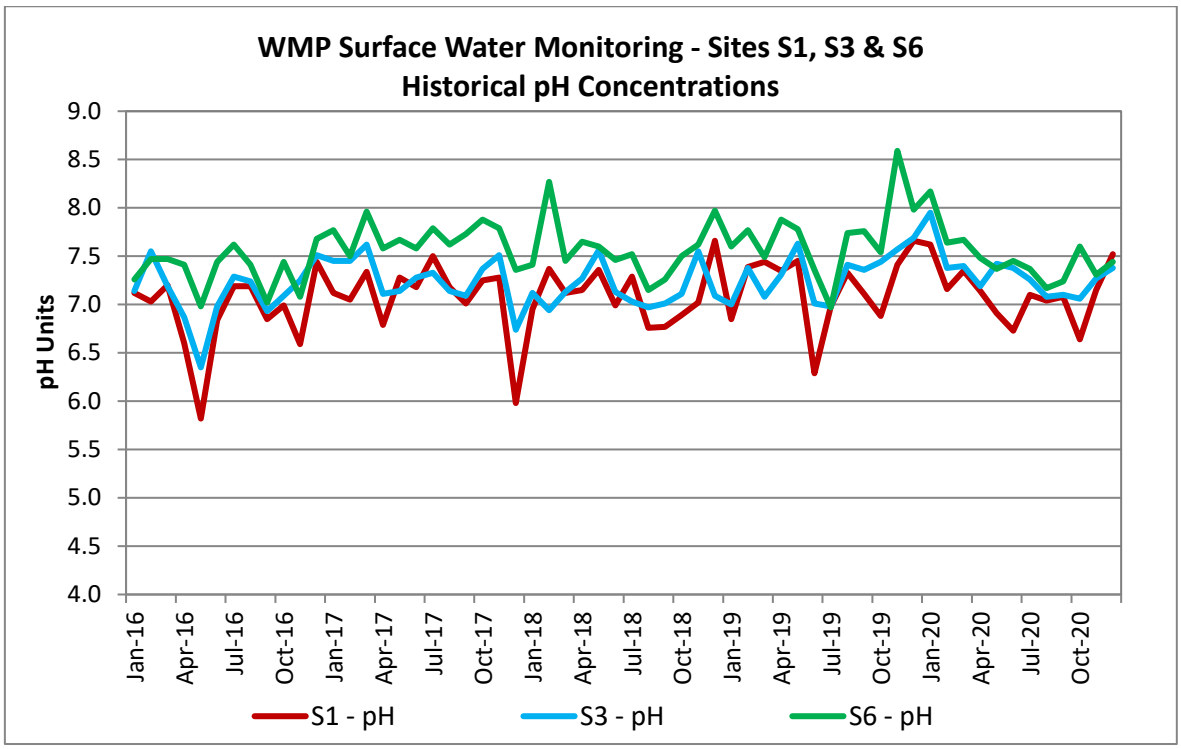


Figure 7-4 *S1, S3 and S6 Historical pH results*

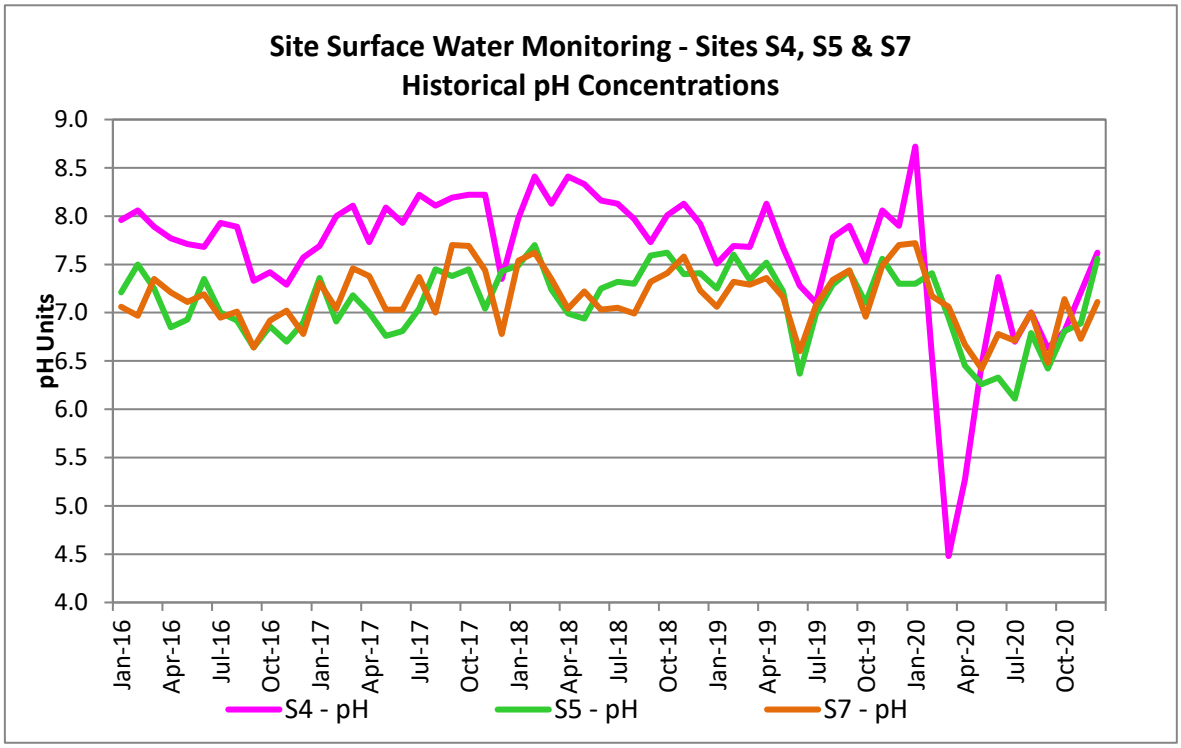


Figure 7-5 *S4, S5 & S6 Historical pH Results*

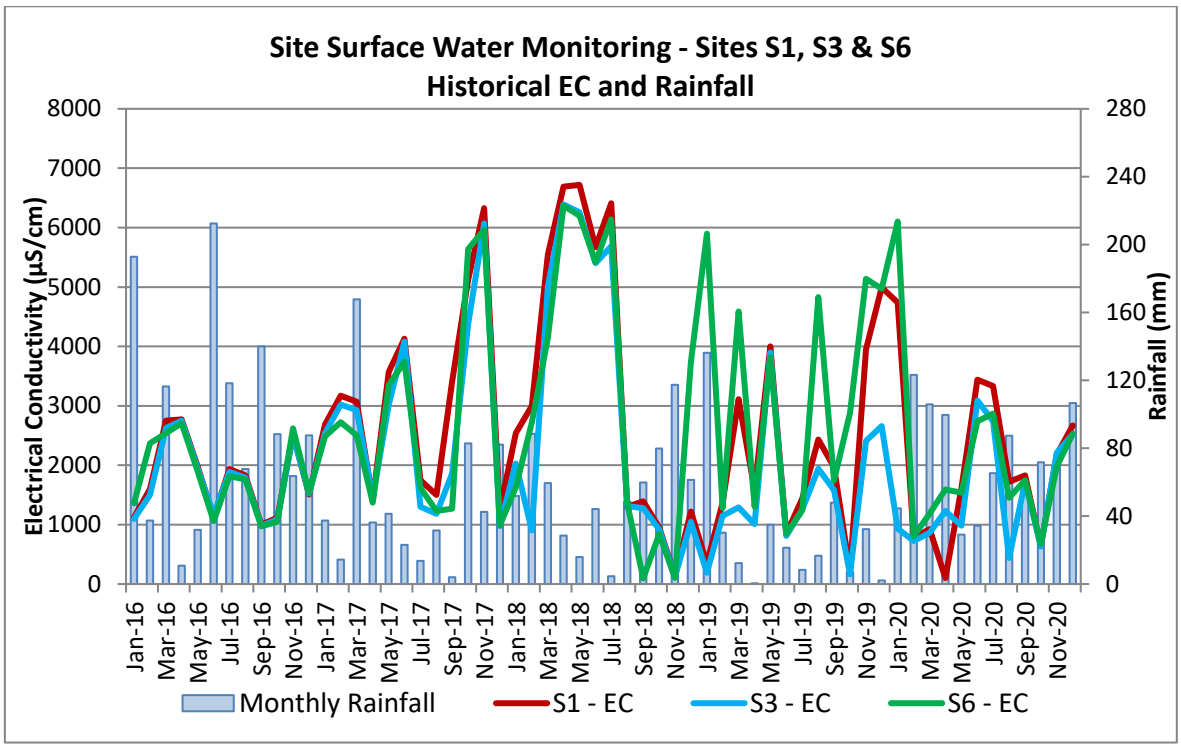


Figure 7-6 *S1, S3 & S6 Historical EC Results & Rainfall*

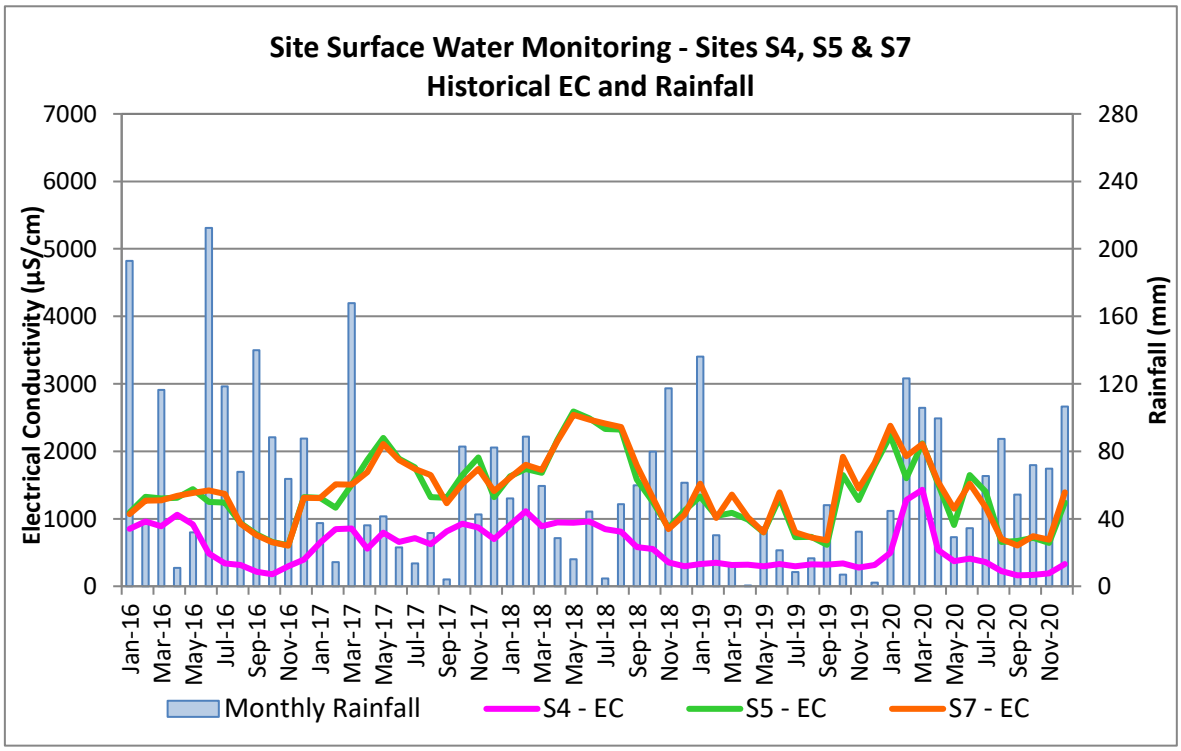


Figure 7-7 *S4, S5 & S6 Historical EC Results & Rainfall*

During the reporting period, pH was generally within the approved trigger values (refer **Table 7-1**) with the exception of the following:

- S4 was above the upper pH trigger value during one (1) of the twelve (12) monitoring events (January 2020) and below the lower pH trigger value during nine (9) of the twelve (12) monitoring events. The lowest value (pH of 4.48) was observed during the March 2020 monitoring event. As presented in Figure 7.5, this result is clearly an outlier.
- S5 was below the lower pH trigger value during eight (8) of the twelve (12) monitoring events. The lowest value (pH of 6.11) was observed during the July 2020 monitoring event.
- S6 was above the upper pH trigger value during one (1) of the twelve (12) monitoring events. A pH of 8.17 was reported during the January 2020 monitoring event.
- S7 was below the lower pH trigger value during five (5) of the twelve (12) monitoring events. The lowest value (pH of 6.42) was observed during May 2020.

Water quality generally reported less frequent exceedances compared to the revised trigger values (refer **Table 7-2**) with the following pH values noted outside the revised trigger value range:

- S4 was above the lower pH trigger value during the March 2020 monitoring event.
- S5 was in excess of the lower pH trigger value for four (4) of the twelve (12) monitoring events undertaken during 2020.
- S7 was below the lower pH trigger value during the May 2020 monitoring event.

Generally, low pH is considered to be influenced by surface water quality from Coxs River upstream of PDM (S4), and Blue Lake (surface water S5). The only instance where the pH was outside the approved trigger value at a monitoring location downstream of PDM was surface water site S6, which reported a pH above the upper pH trigger value. This result is considered to be anomalous as a pH of above 8.0 has been reported a total of three (3) times during the previous five (5) years (refer **Figure 7-4**).

The low pH S4 and S5 is considered to be due to water quality within Coxs River and Blue Lake and is unlikely to be due to activities undertaken at PDM. During the reporting period, there were no discharges made to Neubecks Creek from PDM. The pH below the approved lower pH trigger value at location S7 is considered to be influenced by water quality within Coxs River and Blue Lake.

During the reporting period, electrical conductivity was intermittently above the approved trigger values (refer **Table 7-1**) as presented below:

- S1 was in excess of the trigger value during four (4) of the twelve (12) monitoring events. The greatest electrical conductivity level was 4740µS/cm, observed during January 2020.
- S3 was in excess of the trigger value during three (3) of the twelve (12) monitoring events. The greatest electrical conductivity level was 3090µS/cm, observed during June 2020.
- S4 was in excess of the trigger value during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1430 µS/cm, observed during March 2020.
- S5 was in excess of the trigger value during seven (7) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2230µS/cm, observed during January 2020.

- S6 was in excess of the site-specific trigger value during six (6) of the twelve (12) monitoring events. The greatest electrical conductivity level was 6100 µS/cm, observed during December 2020.
- S7 was in excess of the trigger value during eight (8) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2380 µS/cm, observed during January 2020.

Water quality compared to the revised trigger values (refer **Table 7-2**) was below the electrical conductivity trigger value with the exception of S6 during the January 2020 monitoring event. The source of the saline water is unknown as upstream monitoring locations generally reported a lower electrical conductivity reading (refer **Figure 7-6)**. This result is considered to be anomalous.

An examination of the historical data collected during the previous five (5) years shows fluctuations in pH (refer **Figure 7-4** and **Figure 7-5**); however, the overall trend is generally stable across the six (6) monitoring locations. A significantly low pH was recorded at S4 during March 2020; noting that S4 does not receive water from PDM, the source of the low pH is unknown. During 2020, an overall slightly decreasing pH trend is observable across the six (6) monitoring locations.

Electrical conductivity levels during the previous five (5) years shows fluctuations, with the greatest increases generally observable during periods of low rainfall (refer **Figure 7-6** and **Figure 7-7**). However, electrical conductivity trends within Neubecks Creek (S1, S3 and S6) is considered generally due to saline discharges at a licence discharge point upstream of PDM. Locations S5, and S7 are located downstream of Neubecks Creek, as such are considered to be impacted by discharges upstream of PDM; however, impacts are diluted as water enters Blue Lake.

The water quality from the discharge point entering Neubecks Creek into PDM is monitored voluntarily for the purposes of determining trends within Neubecks Creek; samples are collected from the drainage line prior to the water entering Neubecks creek within the PDM boundary. The electrical conductivity of the discharge drainage line is shown compared to the electrical conductivity of the Neubecks Creek monitoring locations (S1, S3 and S6) during 2020 in **Figure 7-8**. There was no discharge occurring during the January 2020 event, as such electrical conductivity within Neubecks Creek is not considered to be influenced by upstream discharges during January 2020. Generally, the electrical conductivity is shown to be greater within the discharge drainage line than the Neubecks Creek downstream monitoring locations.

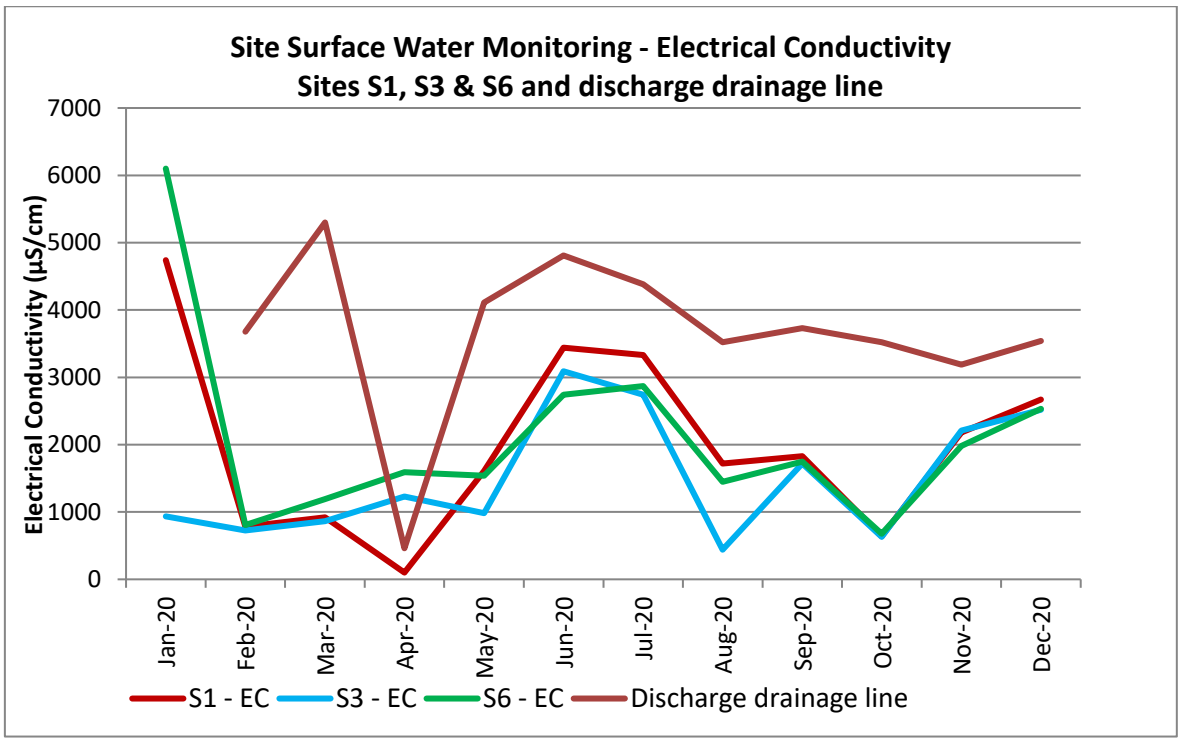


Figure 7-8 *Electrical conductivity (EC): discharge point, S1, S3 and S6*

7.3 CHANNEL STABILITY AND STREAM HEALTH MONITORING

Channel stability and stream health monitoring of Neubecks Creek is conducted on a six-monthly basis in accordance with project approval PA 10_0041 and the WMP. Monitoring was conducted in March and October 2020.

Monitoring is conducted at three (3) monitoring points along Neubecks Creek (SH1, SH2 & SH3A) and one location at Coxs River (SH5), downstream of Blue Lake (refer **Plan 2b**, **Appendix A**). An additional location at Blue Lake (SH4) is also included to allow for visual observation of the condition of the water bodies.

The monitoring involves an observational survey which provides a description of the locations and dimensions of erosive features. Indicators then produce a rating based on a scoring system. The combined total score of the indicators then ranks each monitoring location from very actively eroding through to very stable. This assessment enables determinations to be made as to whether the section of creek has changed over time from the classification derived during the original baseline survey. The criteria and scoring methodology are based on the CSIRO Ephemeral Stream Assessment protocol (Ref [6]).

A baseline assessment of channel stability, stream health and vegetation health of Neubeck's Creek and Coxs River undertaken in 2013 indicated the drainage lines were classified as 'potentially stabilising.'

Follow-up (six-monthly) assessments were conducted at the same monitoring locations, results of which indicated there had been no major change to the Neubecks Creek and Coxs River drainage lines, with each monitoring location classified as 'potentially stabilising'. During the 2017 assessment, the classification of Neubecks Creek did not change, however the particle size of the material on the Coxs River drainage line floor (site SH5) improved and the site was classified as 'stable'; these classifications continued throughout 2018 and March 2019 (refer **Figure 7-9**). During October 2019, there was a loss in vegetation in the drainage line walls which is considered to be due to below average rainfall (drought conditions), as such the classification was decreased to 'potentially stabilising.' During the March and October 2020 assessment, vegetation growth was observed; however, not to the density observed during March 2019.

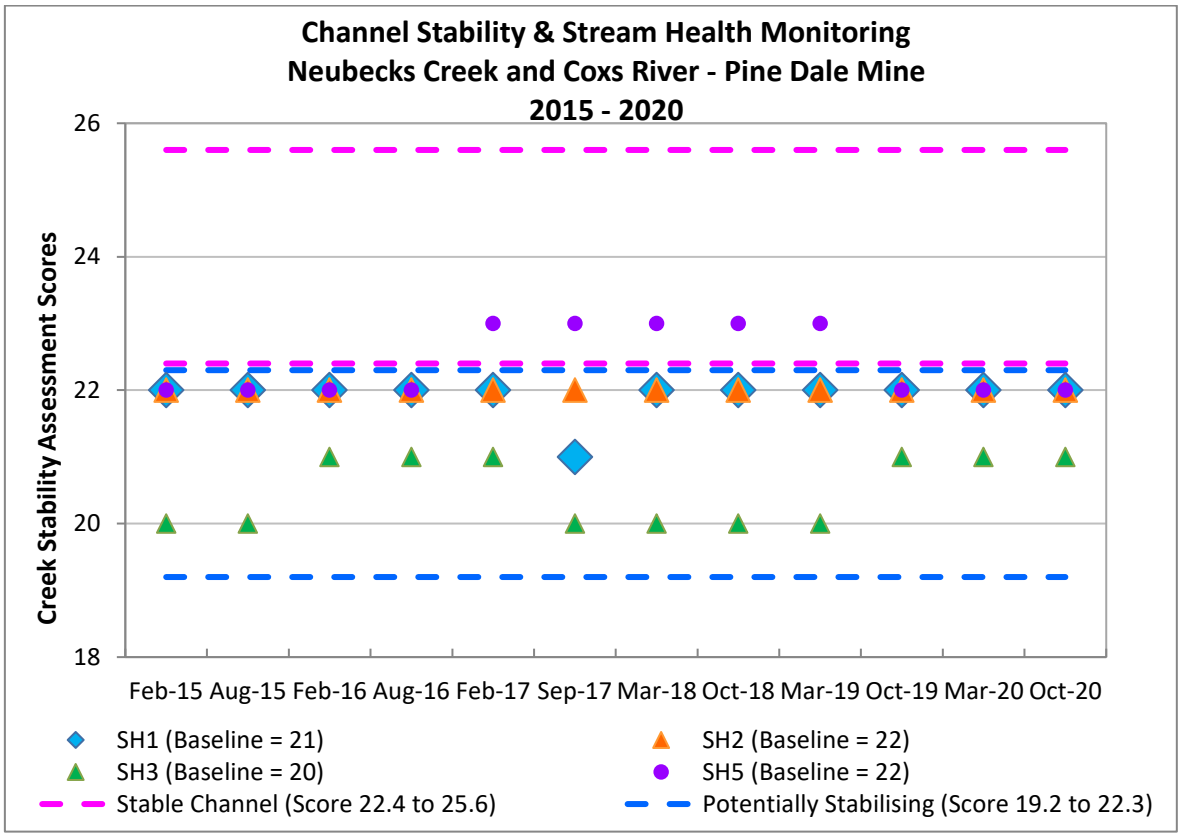


Figure 7-9 *Channel Stability and Stream Health Scores*

Detailed results are presented in **Appendix B**.

7.4 GROUNDWATER

Management of groundwater at PDM is undertaken in accordance with project approval PA 10_0041 and the PDM WMP. PDM has a water access licence (WAL36480) for the extraction and use of groundwater from the underground mine workings; and Bore Licences (10BL165933 & 10BL603588) for the monitoring of groundwater levels and quality. Results of groundwater monitoring are discussed in **Section 7.5**, with the complete results for the reporting period provided in **Appendix B**.

Review of groundwater extraction data is required to be undertaken by a qualified groundwater consultant in accordance with WAL36480 to validate the recorded data against groundwater predictions. As there was no measurable groundwater intercepted from the underground workings during the 2020 reporting period, no review was required.

7.5 GROUNDWATER MONITORING

Groundwater monitoring for PDM is undertaken in accordance with the Groundwater Management Plan detailed within the WMP. Sampling is conducted at four (4) locations within PDM and seven (7) locations offsite. The offsite locations include five (5) monitoring locations surrounding the Yarraboldy Extension and two (2) locations at the former Enhance Place mine site. Monitoring locations are shown in **Plan 2a**, **Appendix A**.

Sampling is conducted monthly at the onsite PDM bores (Old Shaft, P6, P7 and The Bong) for standing water level and physical water quality parameters, and on a quarterly basis for cations, anions and dissolved metals. Bores within the Yarraboldy extension (Bores A, B, C, D and E) are sampled on a monthly basis for standing water level and on a quarterly basis for an extended analytical suite EC, pH, total dissolved solids, cations, anions and metals. The Enhance Place bores (EP PDH3/GW and EP PDH4/GW) are sampled monthly for standing water level only. All parameters analysed are consistent with the requirements of the WMP.

Groundwater from the Bong was historically sampled by pumping water from the underground opening into the Water Cart Dam at PDM (location of Water Cart Dam is shown in **Plan 2a**). The Bong is an opening to the old underground workings; groundwater can no longer be accessed from the Bong as it is under pressure. Water is no longer pumped into the Water Cart Dam during the care and maintenance period; thus, water quality within The Bong (sampled at the Water Cart Dam) is now considered to be representative of surface water runoff rather than groundwater quality from within the Old Wallerawang underground workings. Thus, any results in excess of the trigger values at the Bong are not considered indicative of impacts to groundwater.

Bushfire activity associated with the Gospers Mountain fire during November 2019 – January 2020 caused significant damage to Ben Bullen Forest during December 2019 and access tracks within the forest, resulting in the Forestry Corporation of NSW prohibiting entry for the period January – September 2020; entry was permitted in October 2020. The offsite groundwater bores surrounding the Yarraboldy Extension are located within Ben Bullen State Forest and as such no sampling of these wells was undertaken between January and September 2020.

RCA attempted to access, by vehicle in October 2020 and the Yarraboldy extension area bores; however, was only able to access Bore A during October and November 2020 due to fallen trees and damage to access tracks at the other Yarraboldy bore locations. During November 2020, an assessment of the future accessibility to Bore C and Bore D was undertaken by traversing to each location by foot with an arborist. No sample was able to be obtained as vehicular access is required to transport sampling equipment.

Due to fallen trees and damage to an access bridge, Bore E was not able to be accessed at all during the 2020 reporting period. There was no tree clearing and removal undertaken and upon further risk assessment, access to Bore A, C and D was no longer considered safe and RCA ceased monitoring in December 2020.

7.5.1 GROUNDWATER ASSESSMENT CRITERIA

The approved groundwater trigger values developed for PDM are detailed in the WMP in accordance with Schedule 3, Condition 27(c) of the Project Approval (PA 10_0041). The approved trigger level values are detailed in **Table 7-3**.

Table 7-3 *Approved Groundwater Assessment Criteria*

Groundwater Site	pH (range)	Electrical Conductivity	SWL[a] Trigger
P6	6.2 - 8.0	1180	887.90
P7	6.3 - 8.0	852	883.28
EP DDH4/GW (Bore D)	6.8 - 8.0	608	940.61
EP DDH7/GW (Bore A)	6.5 - 8.0	326	954.40
EP PDH1/GW Bore C)	6.9 - 8.0	490	889.25
EP PDH3/GW (Enhance)	NA	NA	891.06
EP PDH4/GW (Enhance)	NA	NA	890.95
EP PDH7/GW (Bore E)	5.5 - 8.0	151	938.43
Old Ventilation Shaft	6.3 - 8.0	908	888.46
The Bong (at SW	5.8 - 8.0	1157	NA

[a] SWL: standing water level

NA: No trigger value required for these locations

Vibrating wire piezometers are installed within bores B, C, and E at various target aquifers. A summary of the target aquifers and corresponding trigger values for each bore location is shown in **Table 7-4**.

Table 7-4 *Approved Groundwater Trigger Values (vibrating piezometers)*

Groundwater Site	Aquifer	SWL Trigger (m AHD)
Bore B (EP DDH5)	Sandstone	921.23
	Irondale	NA
	Lidsdale	899.23
	Lithgow	No trigger value
Bore C (EP HHD3)	Irondale	909.40
	Lithgow	No trigger value
	Lidsdale	891.78
	Marangaroo	889.76
Bore E (EP DDH6)	Irondale	884.67
	Lithgow	No trigger value

NA: no data, bore is depressurised (water level has dropped below sensor installation height)

The current approved assessment criteria detailed in **Table 7-3** was developed from groundwater quality data collected during the period January 2011 – December 2014. During the 2017 monitoring period, it was observed that intermittent exceedances of the approved trigger values occurred. During the scheduled review of the WMP in 2017 revised trigger levels were proposed which were developed using the entire groundwater quality data set (2005 – 2017), as it was considered that using all available data would provide a robust data set which incorporated diverse climatic influences. These revised trigger values were submitted to the DPIE – Natural Resources Access Regulator (NRAR) (formerly Department of Industries – Water) for approval. These revised trigger values were rejected by DPIE and it was recommended that an investigation be undertaken to determine the cause of the exceedances as a basis for the revision of trigger values.

An investigation was undertaken and the findings indicated that the likely cause of the decreasing pH trend observed in bore P6 and Old Shaft was acid mine drainage from historical underground workings (Ref [5]). The investigation recommended revised trigger values which are summarised in **Table 7-5**.

Table 7-5 *Revised Groundwater Trigger Values*

Monitoring location	P6	P7	Old Shaft
pH trigger level[a]	5.6	6.3	5.4
Water Level (AHD)[b]	--	--	891.54

[a] pH trigger level is exceeded if the pH drops below the nominated value.

[b] Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

At the time of writing of this report, the revised trigger values shown in **Table 7-5** have been utilised alongside the approved trigger values in **Table 7-3** however, an update to the WMP and submission to the DPIE for endorsement has not been undertaken.

7.5.2 GROUNDWATER QUALITY AND SWL

7.5.2.1 ONSITE GROUNDWATER

Groundwater bores P6, Old Shaft and The Bong are located within the old Wallerawang underground workings; whilst P7 is located within the Lithgow seam. A sample was not collected for analysis from The Bong during the January 2020, as the Water Cart Dam sampling location was dry. The full suite of groundwater results for the 2020 reporting period is presented in **Appendix B**.

The onsite groundwater standing water level (SWL) and rainfall for the period 2016 – 2020 is shown in **Figure 7-10** and are compared against the approved groundwater trigger values.

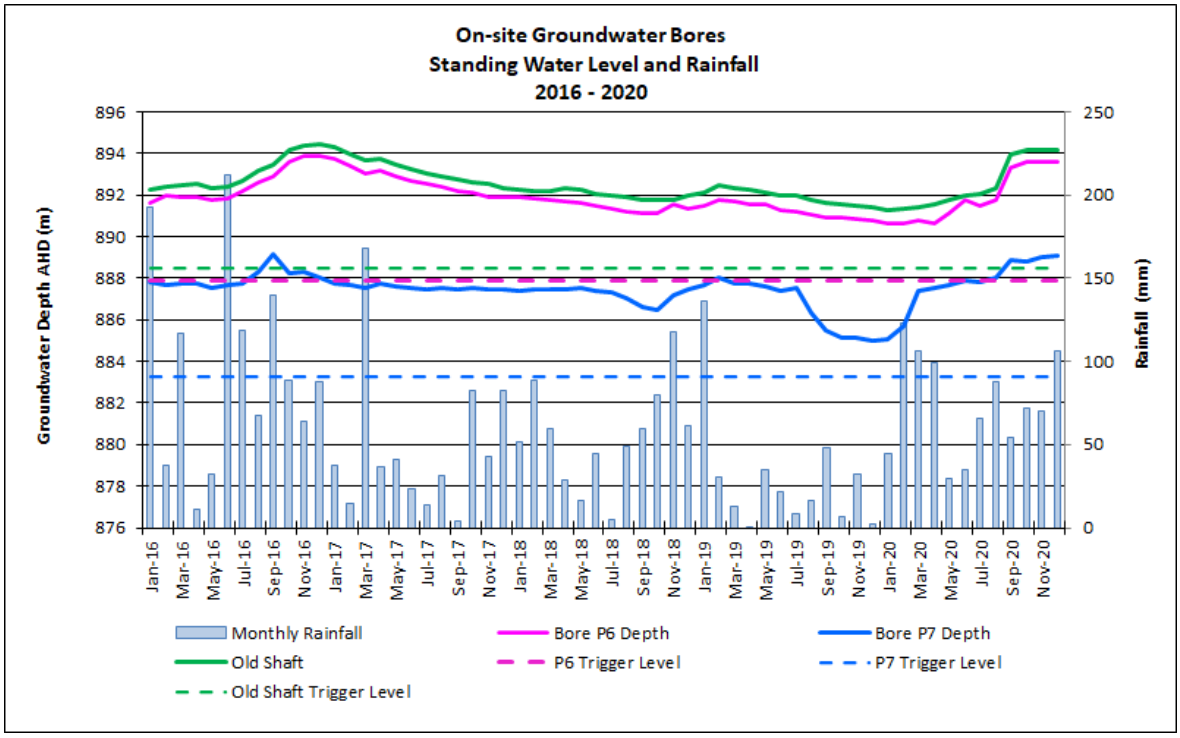


Figure 7-10 *Onsite Groundwater Bores SWL and Rainfall 2016 – 2020*

During the 2020 reporting period there were no instances where the SWL dropped below the respective approved trigger values (refer **Table 7-3**) or the revised trigger values (refer **Table 7-5**). Review of the previous five (5) years of monitoring data indicates that the SWL within bore P6, P7 and Old Shaft increased during the period January – November 2016 before following a decreasing trend for the period December 2016 – July 2019. There is a significant decrease in groundwater level within the Lithgow seam (Bore P7) during the period August 2019 – January 2020, before recovering rapidly during the remainder of 2020. Bores located within the Old Wallerawang underground workings show a similar trend, with a slow increasing SWL observable during the period August 2019 – August 2020, before a rapid increase in SWL during September 2020. The SWL within Bore P6 and Old Shaft have remained generally stable during the period October – December 2020 (refer **Figure 7-10**). There is an overall trend of increasing rainfall during 2020, resulting in increased SWL; however, there is potential for some of the SWL variations within Bore P7 to have been influenced by other factors outside of the control of PDM. Furthermore, there is evidence water ingress from other sources, such as, rainfall runoff entering old adits, to have entered the Old Wallerawang underground workings during September 2020, based on the significantly rapid increase in SWL.

The pH of the onsite groundwater monitoring bores for the period 2016 – 2020 is shown in **Figure 7-11**. Periods of no data (gaps in **Figure 7-11**) are due to the Bong being dry and therefore no sample being collected.

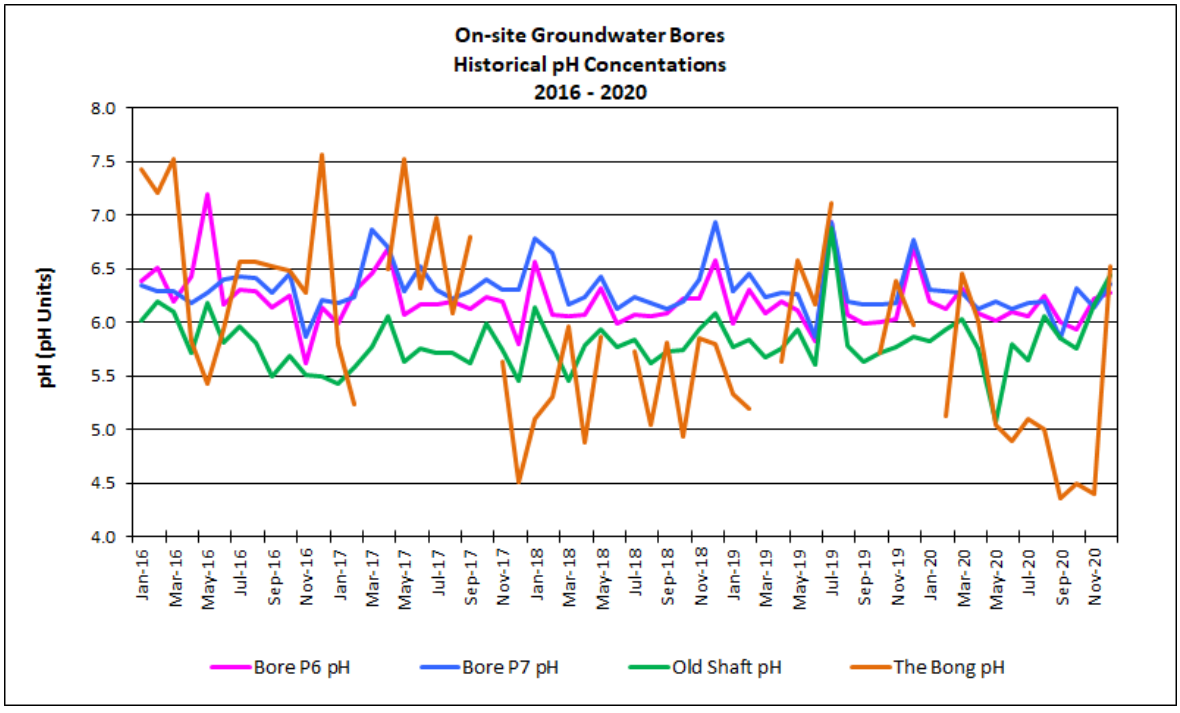


Figure 7-11 *Onsite Groundwater Bores pH: 2016 – 2020*

During the period 2016 – 2020, fluctuations in pH are observable across all four (4) onsite groundwater bores. The pH at bore P6 and P7 has generally decreased, while the pH at Old Shaft shows a generally stable trend, with a marked decrease during May 2020, before increasing for the remainder of 2020. The magnitude of fluctuations is generally greater within Old Shaft and the Bong, noting that the Bong is considered to be representative of rainfall runoff.

During the 2020 reporting period, the pH within the bores were generally shown to be below the lower pH approved groundwater trigger values **Table 7-3**, noting that reported concentrations are rounded to one decimal place when comparing to the trigger values. The pH was below the lower approved trigger value during:

- Seven (7) of the twelve (12) monitoring events at groundwater bore P6. The lowest reported pH was 6.13 during the February 2020 monitoring event.
- Eleven (11) of the twelve (12) monitoring events at Old Shaft. The lowest reported pH was 5.07 during the May 2020 monitoring event.
- Eleven (11) of the twelve (12) monitoring events at Bore P7. The lowest reported pH was 5.85 during the September 2020 monitoring event.
- Nine (9) of the eleven (11) monitoring events the Bong, noting that the Bong is no longer considered indicative of the water quality within the Old Wallerawang underground workings.

During the 2020 reporting period, there were no instances where the upper pH trigger value was exceeded.

Comparison of the pH with the revised trigger values (refer **Table 7-5**) indicates the following:

- The pH at Bore P6 is compliant for all twelve (12) monitoring events.
- The pH trigger value for Bore P7 remains unchanged, thus the pH remained below the lower pH trigger value for seven (7) of the twelve (12) monitoring events.
- The pH at Old Shaft is compliant for eleven (11) of the twelve (12) monitoring events. The May 2020 monitoring event was in excess of the upper pH revised trigger value.

The Bong revised trigger value has not been presented nor used for comparison as this location is no longer considered representative of water within the Old Wallerawang underground workings.

Although the pH at Bore P7 is intermittently below the revised trigger level value, current activities undertaken at PDM during care and maintenance are not considered to be the cause of the low pH value. It is noted that the pH at P7 is not trending downwards and continues to be stable throughout 2020. It is considered that the increase in rainfall observed during 2020 following a prolonged dry period has resulted in an increased flow which has the potential to mobilise stagnant low pH water may have accumulated during drought conditions.

The electrical conductivity of the onsite groundwater monitoring bores for the period 2016 – 2020 is shown in **Figure 7-12**. Periods of no data (gaps in **Figure 7-11**) are due to the Bong being dry and therefore no sample being collected. The Bong and bore P7 did not exhibit any concentrations in excess of the approved trigger value.

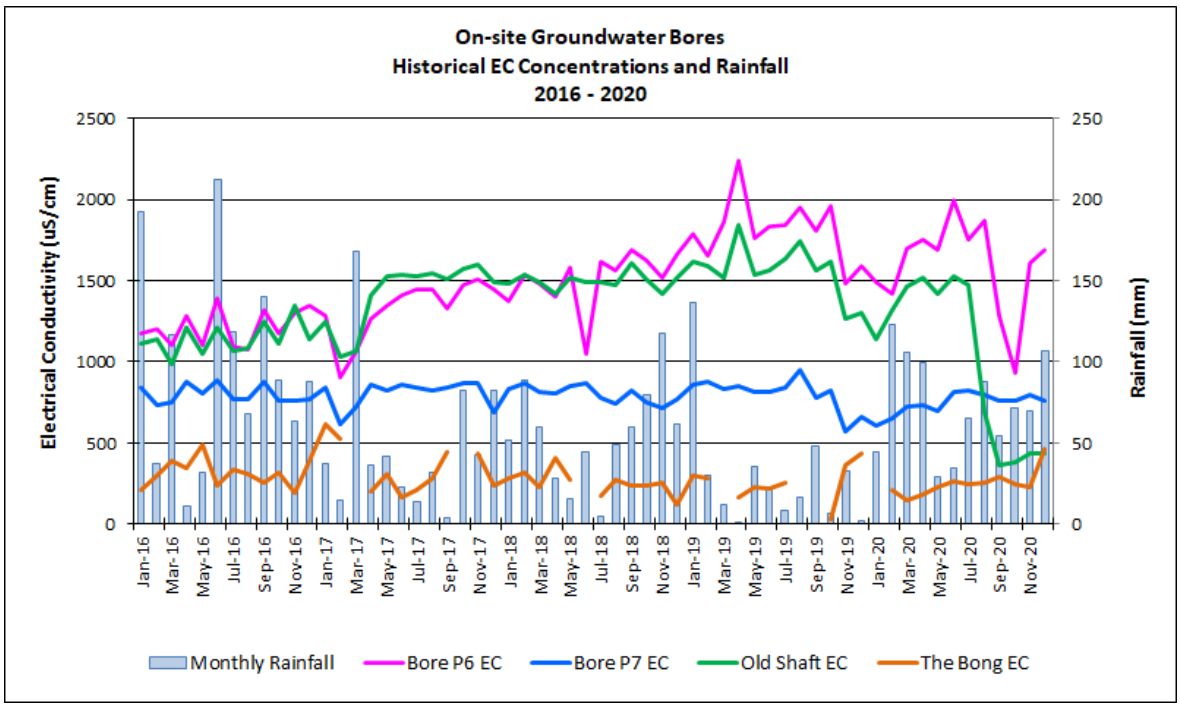


Figure 7-12 *Onsite Groundwater Bores Electrical Conductivity: 2016 – 2020*

During the 2016 – 2020 period the electrical conductivity within Bore P6 and Old Shaft follow a similar trend: increasing during the period January 2016 – April 2019, decreasing during May 2019 – January 2020 and increasing during February – July 2020. The increases in electrical conductivity within bore P6 and Old Shaft generally correspond to periods of decreased rainfall, while the decreases correspond to increased rainfall (refer **Figure 7-12**).

There is a sharp decrease in electrical conductivity during August 2020 at Old Shaft, which continues to decrease in September 2020, before stabilising for the remainder of 2020. A decrease is observed at bore P7 during September and October 2020, before a marked increase occurs during the November 2020 monitoring event. These significant increases and decreases in electrical conductivity are not considered to be attributable rainfall. There were no activities undertaken at PDM which extracted or discharged water into the Old Wallerawang underground workings, as such, the factors causing the increase or decrease of the electrical conductivity are considered outside the control of PDM.

The electrical conductivity within bore P7 shows two (2) periods of stable trends, these include: January 2016 – August 2019 and December 2019 – December 2020. The previous twelve (12) months of electrical conductivity readings are generally lower than the previous four (4) years. The electrical conductivity within the Bong is generally low and stable.

During the 2020 reporting period, the electrical conductivity within the bore P6 and Old Shaft intermittently exceeded the approved trigger values (refer **Table 7-3**). The electrical conductivity was in excess of the approved trigger values during:

- Eleven (11) of the twelve (12) monitoring events at bore P6: a maximum electrical conductivity of 2000µS/cm was recorded in June 2020.
- Seven (7) of the twelve (12) monitoring events at Old Shaft: a maximum concentration of 1530µS/cm was recorded during June 2020.

7.5.2.2 YARRABOLDY GROUNDWATER (OFFSITE)

Groundwater bores located offsite and associated with the Yarraboldy Extension include Bores A, B, C, D and E. Bore B is not a groundwater quality monitoring location and consists of a vibrating piezometer for the purposes of monitoring groundwater levels only. Monitoring bores A, D and E are located within the Middle River seam and bore C within the Lithgow seam.

Groundwater quality monitoring was only able to be undertaken at Bore A during October and November 2020 due to bushfire damage and safety risks posed by fallen trees (refer **Section 7.5**). Access to bore C and D was gained by traversing via foot during November 2020 as such groundwater level data was downloaded from these bores however no samples could be obtained.

The monthly standing water level measurements compared with rainfall is shown in **Figure 7-13**. The quarterly pH and electrical conductivity measurements for the period 2016 – 2020 are shown in **Figure 7-14** and **Figure 7-15**. The gaps in the graph indicate that the bore was unable to be sampled because it was dry, or it was inaccessible.

The results of limited water quality monitoring within Bore A shows that results are compliant with the approved trigger values.

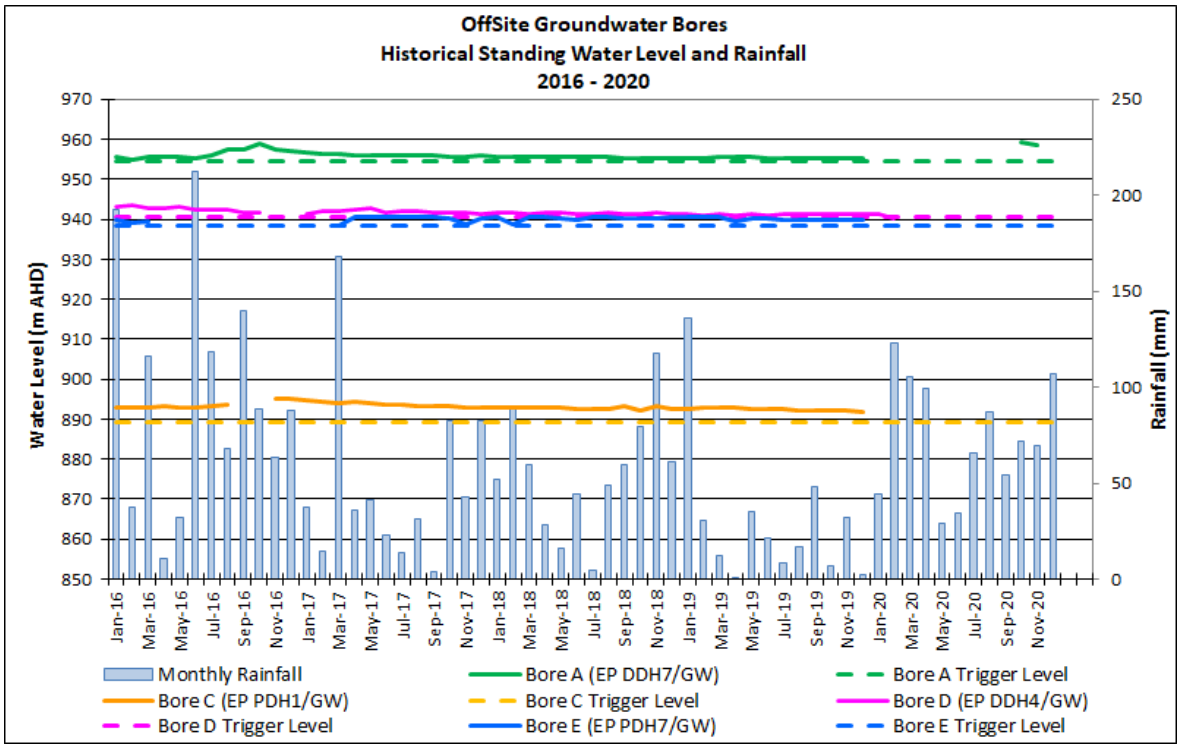


Figure 7-13 *Yarraboldy Groundwater Bores Standing Water Level: 2016 – 2020*

During the 2016 – 2019 monitoring period, the standing water levels within the Yarraboldy groundwater bores show varying levels of response to rainfall fluctuations, with a slight decreasing trend observed from November 2016 – December 2019. The standing water level recorded at bore A during October and November 2020, has increased when compared to the 2019 levels.

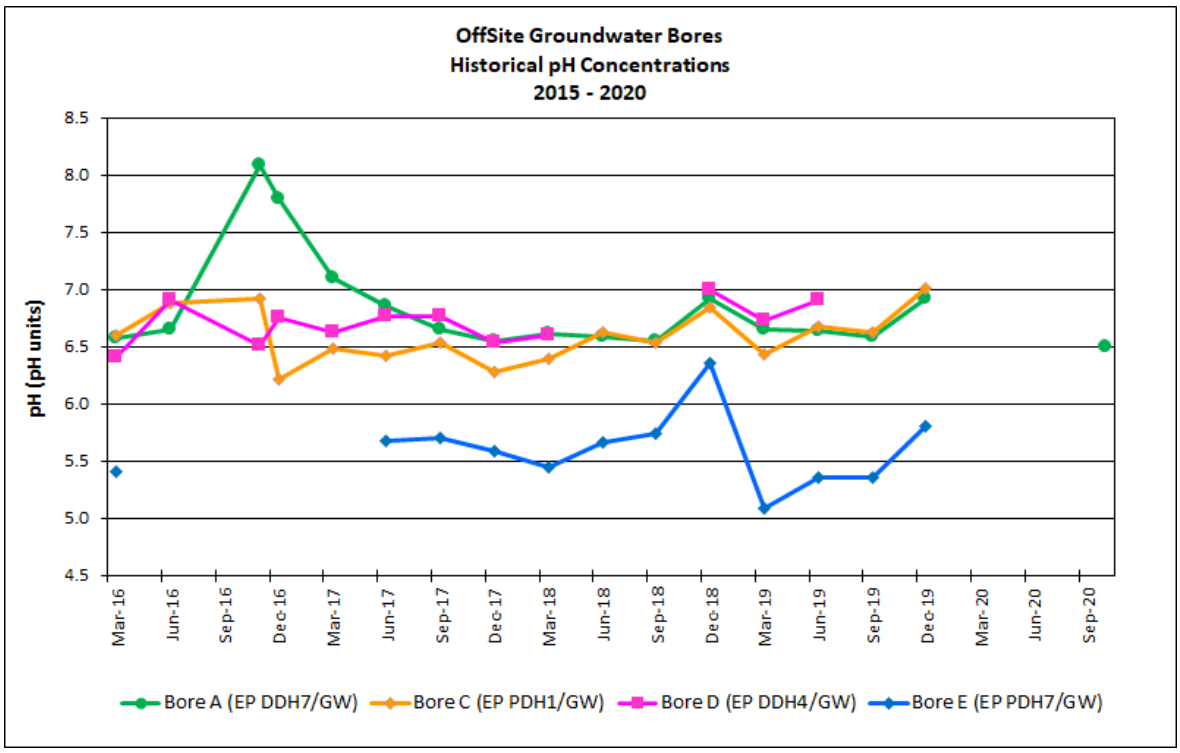


Figure 7-14 *Yarraboldy Groundwater Bores pH: 2016 – 2020*

During the 2016 – 2019 monitoring periods, the pH is generally stable in bore A, following a sharp change in pH between June 2016 and September 2017. The pH has generally stabilised at bore A for the period January 2018 – December 2019; however, the pH reading taken during the October 2020 monitoring event is lower than the pH reported during the 2019 monitoring events. Bore C shows a decreasing trend in pH during January 2015 – December 2017, followed by a slight increasing trend for the period January 2019 – December 2019. The pH trend at bore D shows a slight increasing trend during the 2016 – 2019 monitoring period, noting that at times bore D was dry and unable to be sampled. Bore E shows a period of increasing pH during June 2017 – October 2018, followed by a sharp decrease in March 2019. The pH continues to increase throughout the remainder of 2019. It is noted that concentrations of sulphate and iron are generally low within Bores A, C and D and as such it is considered unlikely that pyrite oxidation and acid mine drainage are influencing pH. There are some elevated levels of iron and low pH values within bore E during the 2019 monitoring period; however, this is unaccompanied by sulphate concentrations. As such, it remains unclear if the impacts of acid mine drainage from the Wallerawang underground workings have spread to Bore E (Middle River seam).

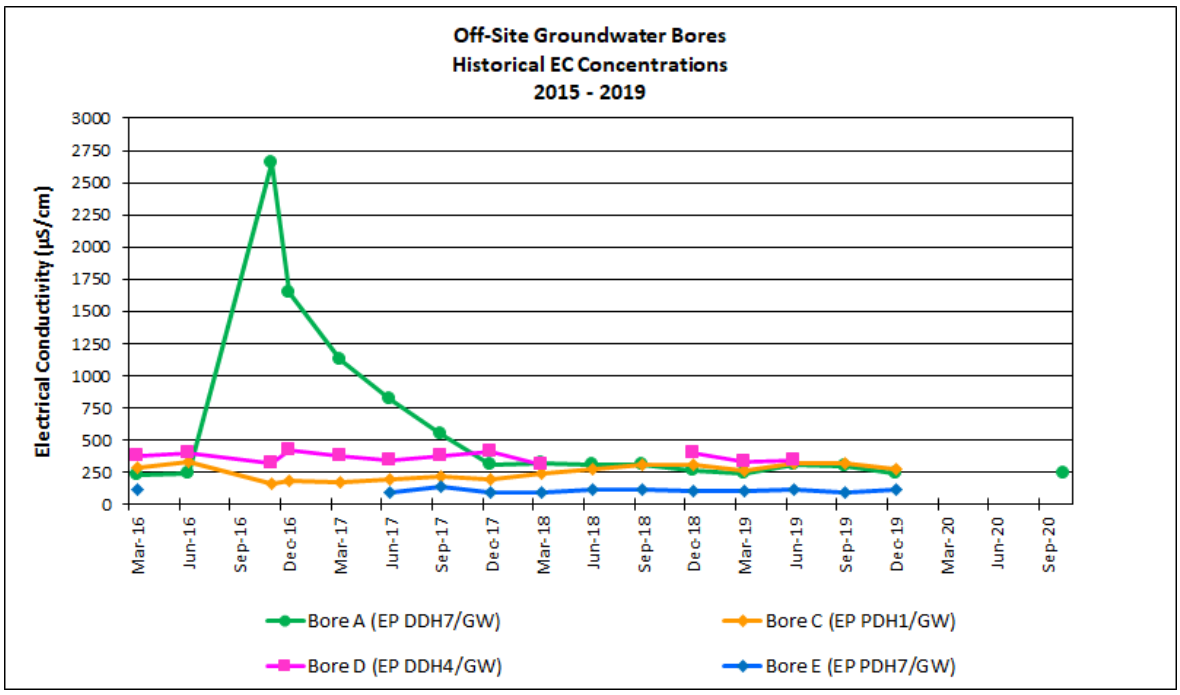


Figure 7-15 *Yarraboldy Groundwater Bores Electrical Conductivity: 2016 – 2020*

During the 2016 – 2019 monitoring period, electrical conductivity is generally shown to be stable within bores C, D and E. The EC reading at bore A shows that the EC has remained stable during the October 2020 monitoring event (when compared to the January 2019 – December 2019 readings Bore A, shows a marked increase in electrical conductivity during November 2016. This marked increase also coincides with an increase in pH and water level (refer **Figure 7-13** and **Figure 7-14**). The cause of this anomalous pH and electrical conductivity is unknown; however, Bore A was vandalised in October 2016. It is unknown if the bore was tampered with, and the integrity of this data is unknown.

Groundwater level hydrographs and rainfall for the 2015 – 2020 period are shown in **Figure 7-16** and **Figure 7-17** noting the last successful download was November 2020 for Bore C. Bore E was inaccessible for the full 2020 reporting period and as such the groundwater level hydrographs and rainfall in **Figure 7-18** is for the 2015 – 2019 period only. There was no data available at Bore B for the period 19/10/2017 – 1/2/2018 and Bore C for the period 11/5/2017 – 1/2/2018 due to connectivity issues with the vibrating wire piezometer loggers. The loggers were removed from site and new loggers installed on 2/2/2018.

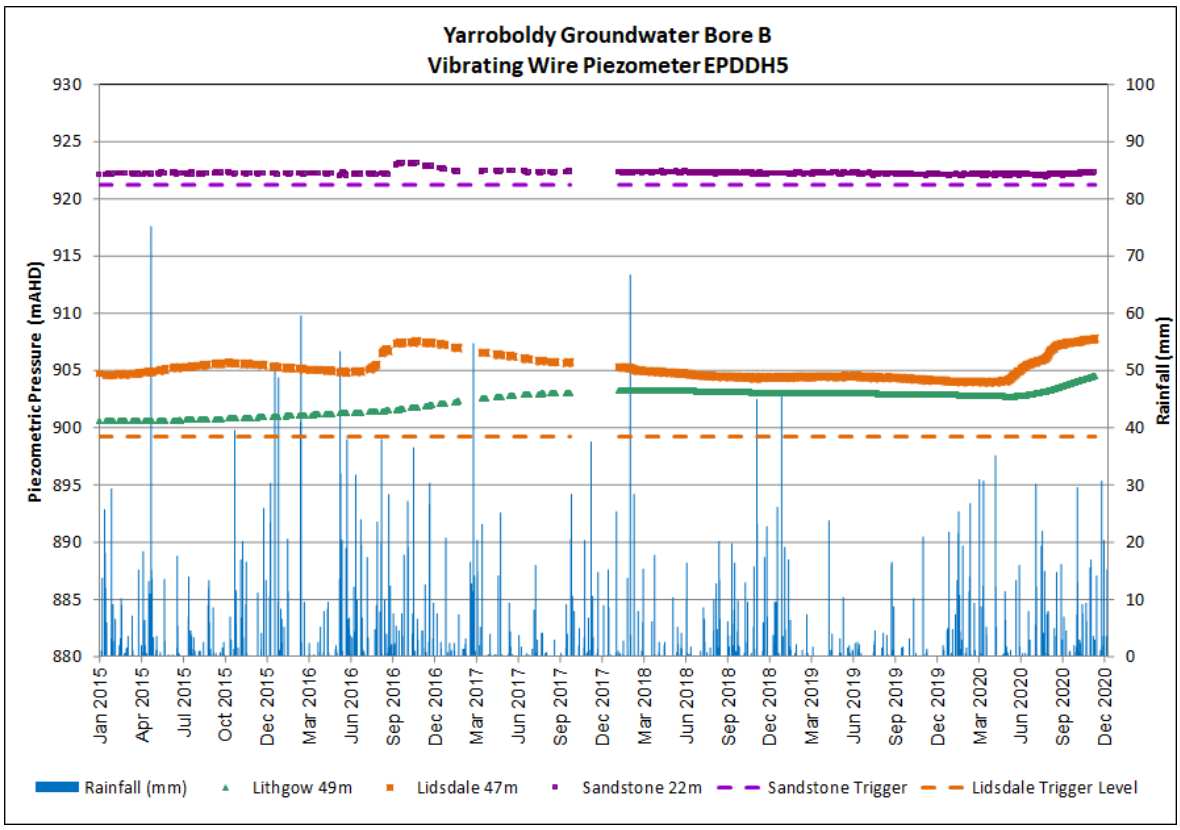


Figure 7-16 *Yarraboldy Bore B Hydrograph and Rainfall*

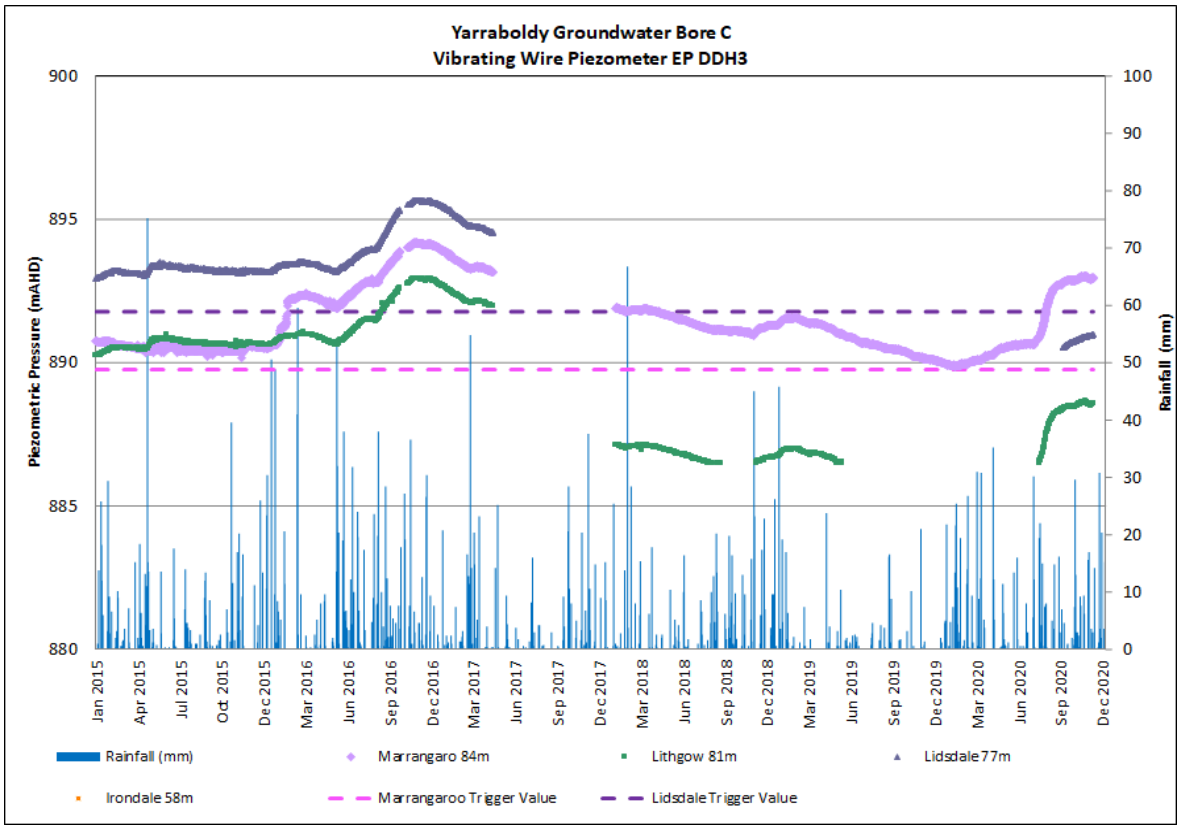


Figure 7-17 *Yarraboldy Bore C Hydrograph and Rainfall*

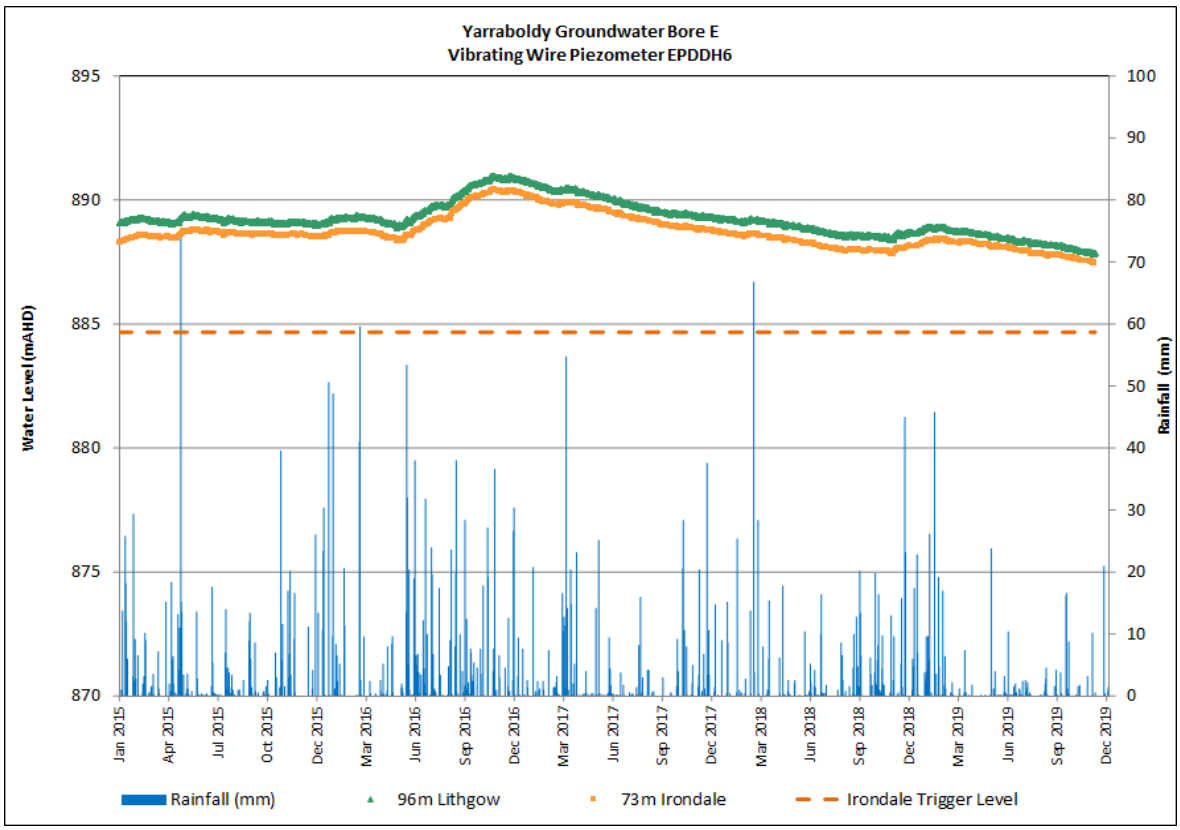


Figure 7-18 *Yarraboldy Bore E Hydrograph and Rainfall*

The groundwater levels at Bore B at the various aquifers have shown some variation in response to rainfall trends, however the response is generally minimal during the period January 2015 – March 2019. Following increased rainfall during the 2020 reporting period, the Lidsdale and Lithgow seam show an increase in water level. The water levels have not fallen below the groundwater trigger levels (refer **Figure 7-16**). There is no data available for the Irondale seam as the water level has fallen below the sensor height.

The groundwater levels at Bore C show a general decreasing trend since January 2017 which is considered likely due to decreased rainfall during 2017 and 2019. There is no data available for the Lidsdale seam from February 2018 as the water level has fallen below the sensor height. Similarly, there is no data available for the Lithgow seam from June 2019 as the water level has fallen below the sensor height. An increase in water level is evident during August 2020, with a sharp increase noted at the Marrangaroo seam and the water level increasing to above the sensor height with an increasing trend noted for the remainder of 2020. The water level within the Lidsdale seam has also increased to above the sensor height during September 2020 and continues to show an increasing trend (refer **Figure 7-17**). This increase in groundwater levels is considered to be due to increased rainfall during the 2020 reporting period, when compared to the rainfall during 2017 – 2019.

The groundwater levels at Bore E also show a general decreasing trend during January 2017 – December 2019 which is attributed to the decreased rainfall since early 2017. The water level within the Irondale aquifer remains above the trigger level during the 2015 – 2019 period. As Bore E was unable to be accessed during 2020, it is unknown if the water level has responded to rainfall in a similar manner to bores B and C.

7.5.2.3 ENHANCE PLACE GROUNDWATER

Two (2) monitoring bores are located within the former Enhance Place Mine and are measured monthly for standing water level. The standing water level for the period January 2015 – December 2020 is shown in **Figure 7-19**.

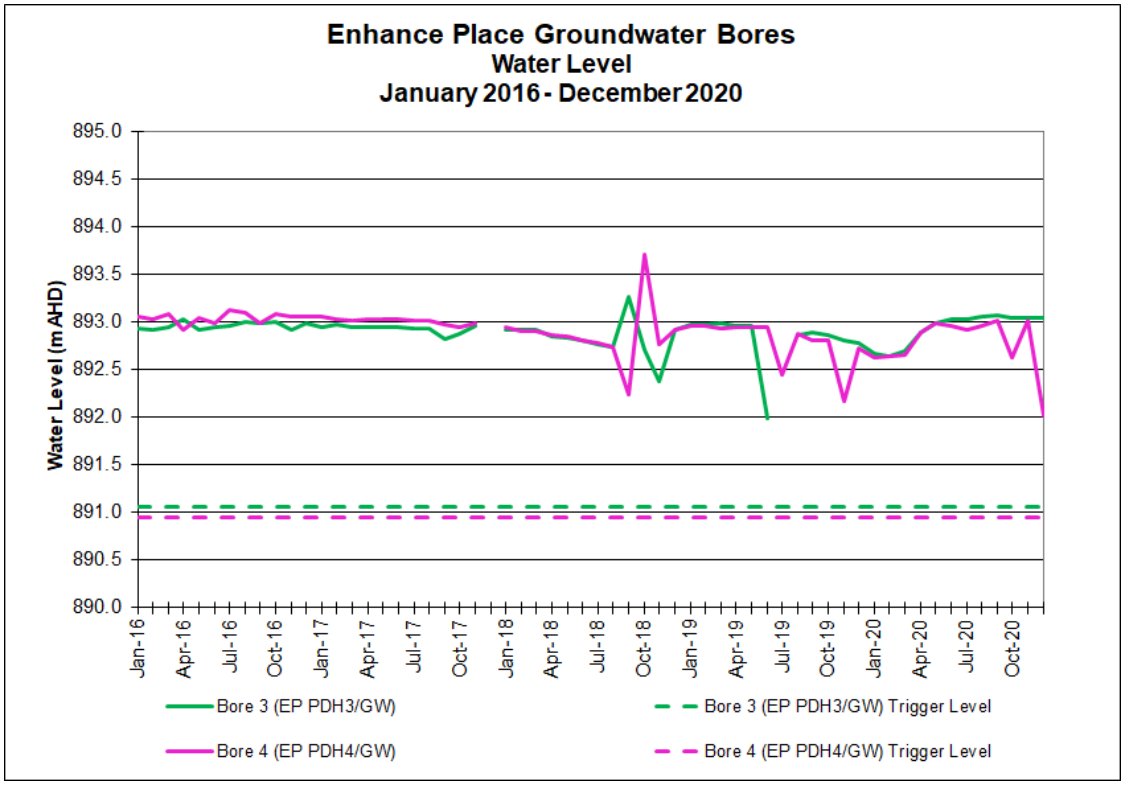


Figure 7-19 *Enhance Place Standing water levels 2016 – 2020*

There are some fluctuations in water level observed at the Enhance Place bores during 2018, late 2019 and late 2020. Otherwise, water levels are generally consistent within only a slight decreasing trend evident from January 2018, which is considered likely due to reduced rainfall. An increasing trend is observable at both bore 3 and bore 4 during March – July 2020, considered likely due to increased rainfall. The water level generally remains stable for the remainder of 2020 at Bore 3 however fluctuates significantly within Bore 4, with the lowest water level recorded in December 2020. The groundwater level at both bores has remained above the water level trigger values during the 2016 – 2020 monitoring period.

A detailed summary of the Enhance Place groundwater bore standing water levels can be found in **Appendix B**.

8 REHABILITATION

Rehabilitation works at PDM are conducted in accordance with rehabilitation objectives in the approved Care and Maintenance MOP. Rehabilitation performance criteria documented in the MOP define the performance indicators, measuring criteria, status and progress of rehabilitation at PDM.

PDM is made up of a series of rehabilitation areas, comprising a series of parcels of land which are at various stages of being progressively rehabilitated back to the agreed post rehabilitation land use (acceptable post-mining land use and capability). This includes Areas A, B, C and 8. As the Yarraboldy Extension may form part of future mining operations (Stage 2 Project), only temporary maintenance activities have and will be undertaken within this area until such time as the Stage 2 Project is determined. The location of each rehabilitation domain is depicted in **Plan 3**, **Appendix A.**

The principal revegetation technique currently employed is direct seeding using native tree and shrub species for areas intended as woodland communities and pasture species for areas intended for agricultural activities.

The proposed final landform aims to emulate the pre-mining environment and to enhance local and regional ecological linkages across the site and surrounding areas.

8.1 REHABILITATION PERFORMANCE DURING THE REPORTING PERIOD

8.1.1 AGREED POST REHABILITATION LAND USE

Areas of privately owned land within PDM (Area B, C & 8) have been returned to pasture for agricultural purposes, including grazing, as per the approved rehabilitation strategy and landholder preferences.

The principal aim for the final land use of the Yarraboldy Extension rehabilitation area (including Area A) is for native vegetation conservation and for the use of Forests NSW. The Rehabilitation domains are shown in **Plan 3**, **Appendix A**.

8.1.2 REHABILITATION STATUS SUMMARY

A summary of the rehabilitation status for the previous (2019), current (2020) and future (2021) reporting periods are presented in **Table 8-1**.

Table 8-1 *Rehabilitation Area Summary*

Mine Area Type	Area Affected/Rehabilitated (ha)		
	2019 reporting period (actual)	2020 reporting period (Actual)	2021 reporting period (Forecast)
A. Total Mine Footprint	98.1	98.1	98.1
B. Total active disturbance	56.8	56.8	56.8
C. Land being prepared for Rehabilitation	0	0	0
D. Land under active rehabilitation	7	7	7
E. Completed Rehabilitation	25.4	25.4	25.4

An annual rehabilitation status survey and monitoring report (Ref [4]) which provides an overview of the rehabilitation status of PDM and recommendations for the improvement of rehabilitation outcomes in reference to the approved completion criteria. The 2020 Rehabilitation Monitoring Report (Ref [4]) is provided in **Appendix C**. The rehabilitation report includes a survey of six (6) previously established monitoring transects: four (4) transects are located within rehabilitated pastures and two (2) transects are within treed rehabilitation areas. An additional two (2) transects exist as analogue sites in grazed pasture and undisturbed naturally vegetative areas to provide benchmarks against the pasture and treed rehabilitation areas. Refer to Figure 1 of the FirstField Environmental report (Ref [4]) located in **Appendix C**, for the location of the transects.

The 2020 rehabilitation status as compared against the performance indicators and completion criteria as defined in the PDM Care and Maintenance MOP (Ref [8]) is reproduced from the 2020 Rehabilitation Monitoring Report (Ref [4]) in **Table 8-2**.

Table 8-2 *Rehabilitation Status Summary: 2020*

Performance indicator	Completion Criteria	Current Status (2020 Reporting Period)
Feral animal and noxious weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.	**Satisfactory** – continue to monitor.
Feral animal and noxious weed control	Feral animals and noxious weeds are controlled in accordance with legislation.	**Satisfactory** – continue to monitor.
Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	**Satisfactory** – continue to monitor.
Access	Adequate access for firefighting is maintained on rehabilitation areas.	**Satisfactory** – continue to monitor.
Habitat features	Habitat features are installed on native forest rehabilitation areas including: • Nesting boxes and salvaged hollows • Crushed timber spread over native forest rehab areas • Rock pile clusters.	**Ongoing** - nesting boxes to be installed once trees are established.
Vegetation health	More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	**Satisfactory** – continue to monitor.
	Native forest indicator species tree height and girth is within the range of analogue sites.	**Ongoing** – continue to monitor.
Soil loss	Net annual soil loss is comparable to analogue sites at year 10.	**Ongoing** – continue to monitor.

Performance indicator	Completion Criteria	Current Status (2020 Reporting Period)
Erosion	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunnelling).	**Satisfactory –** continue to monitor.
Woodland birds present	Evidence of woodland birds utilising rehabilitation areas.	**Satisfactory** – continue to monitor.
Evidence of mammals	Evidence of target mammal species present in rehabilitation areas.	**Satisfactory** – continue to monitor.
Natural regeneration	Evidence of second generation of native forest indicator species from desired vegetation community.	**Ongoing** – continue to monitor.
	Evidence of natural regeneration of at least four (4) pasture species at year 5.	**Satisfactory** – continue to monitor.
Structure	Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.	**Ongoing** – continue to monitor.
Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	**Satisfactory** – continue to monitor.
Rural land capability	Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	**Satisfactory** – continue to monitor.
Species composition	Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites.	**Ongoing** – continue to monitor.
	Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix.	**Satisfactory** – continue to monitor.
	Approved pasture species mix is sown at the specified rate per hectare.	**Satisfactory** – continue to monitor.
Weed presence	Weeds including African Lovegrass to comprise <10% of the pasture sward.	**Satisfactory** – continue to monitor.
Ground cover	Ground cover (vegetation, leaf litter, mulch) >70% at year 5.	**Satisfactory** – continue to monitor.

8.1.3 YARRABOLDY EXTENSION REHABILITATION PERFORMANCE

To minimise dust dispersion and soil erosion, overburden stockpiles located within the northern area of the Yarraboldy Extension have been re-contoured and seeded with pasture species.

The amenity bund located along the southern boundary of the Yarraboldy Extension was re-profiled in 2014, with the southern batter having a gradient of 18° to minimise erosion and enhance establishment of seedlings. Following the application and tilling of topsoil, a native species grass and tree species seed mix was applied followed by mulch (refer **Photograph 8-1**).

Photograph 8-1 *Amenity Bund looking east following application of mulch and native mix 2015*

During the reporting period, maintenance works was not required to be undertaken in the Yarraboldy Extension. No rehabilitation maintenance activities were undertaken. Current vegetative cover on the bund (photo taken October 2020) is shown in **Photograph 8-2**.

Photograph 8-2 *Amenity Bund looking north October 2020*

8.1.4 AREA A REHABILITATION PERFORMANCE

Area A is a treed rehabilitation area located in the southern area of PDM, south-east of the Yarraboldy Extension (refer to **Plan 3**, **Appendix A**). During 2008, seeding was commenced in Area A (8 ha) and 1500 trees were planted. In 2010, an additional 400 trees were planted. Further direct seeding and application of an organic mulch layer and lime occurred in October 2013; however, drought conditions late in 2013 limited the outcomes of this work.

A soil assessment and revised rehabilitation strategy was developed in 2014 by an agronomist (SLR). The recommendations of the revised rehabilitation strategies (Ref [9]) were incorporated into the PDM Care and Maintenance MOP. Recommendations from this soil assessment are summarised **Table 8-3**. Rehabilitation monitoring reports developed from the annual rehabilitation surveys also provide recommendations for the improvement of the rehabilitation within Area A. Recommendations from the 2016 – 2020 annual surveys as well as the rehabilitation activities undertaken are summarised in **Table 8-3**.

Table 8-3 *Recommended and Completed Rehabilitation Actions in Area A*

Recommended Rehabilitation Actions - Area A		Actions Completed (2014 – 2019)	Undertaken in 2020
SLR Soil Assessment Report (Ref [7])	Continue control of Biddy Bush with current spot spraying regime.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes
	Continue with further application of mushroom compost, lime & gypsum (10:3:2 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required
	Increase potassium by application of Muriate of Potash or similar (0.25tonnes/ha).	Application of Muriate of Potash at recommended rate.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [10])	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Coarse woody debris placed along contours above rills to reduce runoff rate and volume.	No – not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed surfaces ripped and re-sown with locally sourced seed mix.	No – not required
	Install nesting boxes in close proximity treed rehabilitation area.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
2015 Rehabilitation Monitoring Report (Ref [11])	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
	Re-apply a mixture of mushroom compost, lime and gypsum to treed rehabilitation areas as per the recommendations of SLR (2014) report.	Application of fertiliser and compost at recommended rates.	No – not required
	Increase canopy cover of tall herbs and shrubs at treed rehabilitation Area A to 75% with 80% groundcover of grasses and broadleaf herbs.	Exposed surfaces ripped and re-sown with fast growing herbs and grasses.	No – not required
	Concentrate tube stock planting in benches of treed rehabilitation areas to take advantage of run-on from banks.	Tree planting undertaken in addition to direct seeding.	No – not required
	Place additional coarse woody debris along contours above rills to reduce runoff rate and volume at treed rehabilitation areas.	Woody mulch placed along contours above rills to reduce runoff rate and volume.	No – not required
	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Coarse woody debris placed along contours above rills to reduce runoff rate and volume.	No – not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed surfaces ripped and re-sown with locally sourced seed mix.	No – not required

Recommended Rehabilitation Actions - Area A		Actions Completed (2014 – 2019)	Undertaken in 2020
2016 Rehabilitation Monitoring Report (Ref [12])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (Section 6.7).	Yes
	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
	Place additional coarse woody debris along contours above rills to reduce runoff rate and volume at treed rehabilitation areas.	Woody mulch placed along contours above rills to reduce runoff rate and volume.	No – not required
2017 – 2020 Rehabilitation Monitoring Reports (Ref [13-14, 4])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (Section 6.7)	Yes
	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.

The PDM 2020 Rehabilitation Monitoring report (Ref [4], attached in **Appendix C**) indicated that the total living groundcover within the monitoring transects in Area A (transect 5 and transect 6) has increased compared to the 2019 survey. Total living cover within the transect 5 area has increased form 70% in 2019 to 80% in 2020 due to an increase in perennial groundcover. The total living cover at transect 6 has increased from 20% in 2019 to 80% in 2020 due to decreases in both litter cover and bare surface. The total vegetation cover at Area A during October 2020 is shown in **Photograph 8-3**.

Photograph 8-3 *Area A: Vegetation Cover: October 2020*

There was some evidence of bushfire affecting the treed rehabilitation areas, as previously fallen trees were observed to be burnt and some residual mulch has been lost (Ref [4]), refer **Photograph 8-4**; however, these areas are showing evidence of regeneration.

Photograph 8-4 *Evidence of burnt trees: Transect 5: looking west October 2020*

8.1.5 AREA B AND C REHABILITATION PERFORMANCE

Rehabilitation Areas B and C are located in the eastern area of PDM; the locations are shown in **Plan 3**, **Appendix A**. Area B and C cover an area of approximately 25ha in total and have been rehabilitated as pasture. The final landform and water management structures have been completed and the areas seeded for pasture in accordance with Planning Approval 10_0041 and the requirements of the landowner.

The rehabilitation activities undertaken in Areas B and C during the reporting period are presented in **Table 8-4**, along with the actions recommended for improved rehabilitation, as presented in the 2014 Soil Assessment and Recommendations for Rehabilitation Report (Ref [7]). An annual rehabilitation survey was undertaken by FirstField Environmental in Area B and C, at transects 1, 2 and 3, as well as an analogue pasture transect. The location of each transect is shown in the PDM 2020 Rehabilitation Monitoring report (Ref [4], attached in **Appendix C**. The results of the annual survey for the period 2014 – 2020, as well as the actions undertaken is shown in **Table 8-4**.

Table 8-4 *Recommended and Completed Rehabilitation Actions in Area B and C*

Recommended Rehabilitation Actions Area B & C		Actions Completed (2014 to 2019)	Undertaken in 2020
SLR Soil Assessment. Report, 2014 (Ref [7])	Control of African Lovegrass prior to pasture establishment works.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes
	Ripping with a plough to create furrows, followed by application of pasture seed mix.	Furrows created along pasture poor areas and contour banks, seed, fertiliser & compost applied.	No – not required
	Application of Muriate of Potash (0.25tonnes/ha) and Di-ammonium phosphate 0.20 tonnes/ha).	MAP and DAP applied at recommended rates.	No – not required.
	Application of mushroom compost, lime & gypsum (10:4:1 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [10])	Continue to implement integrated weed management control methods for noxious weeds.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes
2015 Rehabilitation Monitoring Report (Ref [11])	Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Cover with a mixture of mushroom compost, lime and gypsum as per the recommendations of SLR (2014) report.	Poorly established pasture areas and drainage lines mechanically ripped prior to re-sowing with pasture species.	No – not required
	Increase and maintain groundcover in pasture rehabilitation Areas B and C and in Area 8 to at least 95%.	Application of fertiliser and compost at recommended rates.	No – not required.
2016 Rehabilitation Monitoring Report (Ref [12])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**)	Yes
	Continue to monitor pest animal numbers.	Pest and animal monitoring not required to be undertaken.	No – not required
2017 Rehabilitation Monitoring Report (Ref [13])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes

Recommended Rehabilitation Actions Area B & C		Actions Completed (2014 to 2019)	Undertaken in 2020
2018 Rehabilitation. Monitoring Report (Ref [14])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**)	Yes
	Repair soil cracking along contours in Area B (transect 3).	Not applicable, cracking occurred in 2018.	No
2019 Rehabilitation Monitoring Report (Ref [15])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes
2020 Rehabilitation Monitoring Report (Ref [4])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes

There were no rehabilitation maintenance works required to be undertaken during 2020.

The 2020 Rehabilitation Monitoring Report (Ref [4]) documented the following findings for Area B and C (transects 1, 2 and 3):

- Rehabilitated pasture surfaces in the three (3) transect areas support living groundcover of approximately 90%.
- Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.
- Weeds including African lovegrass comprise <10% of the pasture sward.
- Rehabilitated pasture areas are considered satisfactory with Rural Land Capability Class VI and are suitable for grazing.

The groundcover at Area C is shown in **Photograph 8-5**, this groundcover is also considered representative of Area B.

Photograph 8-5 *Area B Groundcover October 2020 looking east.*

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [7]) indicated that rehabilitation has been successfully completed in Area B and C and all completion criteria defined in the PDM MOP (Ref [8]) had been met. The Rehabilitation and Completion Assessment Report Ref [8]) is located in **Appendix D**.

8.1.6 AREA 8 REHABILITATION PERFORMANCE

Area 8 is a pasture rehabilitation area located in the south-eastern area of PDM, immediately south of Area B. The location of Area 8 is shown in **Plan 3**, **Appendix A**. The vegetation communities prior to mining include a mixture of cleared land, pasture, pines and eucalyptus. Seeding of Area 8 (10 ha) commenced in 2008, with a pasture mixture known as 'Coxs River Mix'.

The rehabilitation activities undertaken in Area 8 during the reporting period are presented in **Table 8-5**, along with the actions recommended for improved rehabilitation, as presented in the 2014 Soil Assessment and Recommendations for Rehabilitation Report (Ref [7]). An annual rehabilitation survey was undertaken by FirstField Environmental in Area 8, at transect 4. The location of transect 4 is shown in the PDM 2020 Rehabilitation Monitoring report (Ref [4], attached in **Appendix C**. The results of the annual rehabilitation survey for the period 2014 – 2020, as well as the actions undertaken is also shown in **Table 8-5**.

Table 8-5 *Recommended and Completed Rehabilitation Actions in Area 8*

Recommended Rehabilitation Actions – Area 8		Actions Completed (2014 to 2019)	Undertaken in 2020
SLR Soil Assessment. Report, 2014 (Ref [7])	Control of African Lovegrass prior to pasture establishment works.	Weed spraying as per Weed Management	Yes
	Ripping with a plough to create furrows, followed by application of pasture seed mix.	Furrows created along poorly vegetated areas followed by direct seeding.	No – not required
	Application of Muriate of Potash (0.25tonnes/ha) and Di-ammonium phosphate 0.20 tonnes/ha).	MAP and DAP applied at recommended rates.	No – not required.
	Application of mushroom compost, lime & gypsum (10:4:1 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [10])	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Drainage lines re-shaped with rock placement in erosion channels.	No, not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed areas re-sown with pasture seed mix.	No – not required
	Install nesting boxes in close proximity treed rehabilitation area.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
2015 Rehabilitation Monitoring Report (Ref [11])	Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Cover with a mixture of mushroom compost, lime and gypsum as per the recommendations of SLR (2014) report.	Furrows created over the land, pasture seed mix applied, followed by fertiliser and compost.	No – not required.
	Increase and maintain groundcover in pasture rehabilitation Areas B and C and in Area 8 to at least 95%.	Application of fertiliser and compost at recommended rates.	No – not required
2016 Rehabilitation Monitoring Report (Ref [12])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule.	Yes
	Continue to monitor pest animal numbers.	Pest and animal monitoring not required to be undertaken.	No – not required
2017 – 2020 Rehab Monitoring Reports (Ref [13-15, 4])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes

The 2020 Rehabilitation Monitoring Report (Ref [4]) indicates that transect 4 had greater than 90% of total living cover, which is similar to the previous reporting period (90% total living groundcover). African lovegrass was noted to comprise <10% of the pasture sward.

The groundcover at Area 8 during 2020 is shown in **Photograph 8-6**.

Photograph 8-6 *Area 8 groundcover: October 2020*

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [7]) indicates that rehabilitation has been successfully completed in Area 8 and all completion criteria defined in the PDM MOP (Ref [8]) have been met. The Rehabilitation and Completion Assessment Report (Ref [7]) is located in **Appendix D**.

8.1.7 Additional Rehabilitation Maintenance works

There were no additional rehabilitation or maintenance works undertaken or required to be undertaken during the reporting period.

8.1.8 Renovation/Removal of Buildings

There were no buildings that were required to be removed or constructed during the reporting period.

8.1.9 Rehabilitation Formal Sign Off

There were no areas of rehabilitation which acquired formal sign of from the RR during the reporting period.

8.1.10 Rehabilitation Trials and Research

There were no rehabilitation trials or research undertaken during the reporting period.

8.1.11 THREATS TO REHABILITATION SUCCESS

Significant threats to rehabilitation at PDM have been identified in the PDM Care and Maintenance MOP (Ref [8]). These threats and mitigation measures have been reproduced in **Table 8-6**. PDM successfully maintained the mitigation and management measures during the 2020 reporting period.

Table 8-6 *Threats to Rehabilitation Success*

Secondary Domains (Post Mining Land Use)	Potential Threat(s)	Mitigation & Management Measures
Infrastructure (A) Water Management Structure (B)	Engineering design failure	Any infrastructure remaining in place post mining would be inspected and approved by a suitably qualified person (if required) and agreed by relevant stakeholders.
	Water damage (erosion, flooding etc.)	Infrastructure and water management structures would be constructed in accordance with relevant guidelines and to ensure erosion and damage from floods is minimised.
Rehabilitation - Pasture (C) Rehabilitation - Native Forest (D) Rehabilitation – Pine Plantation (E)	Adverse soil chemistry	Soil testing and amelioration
	Erosion	Design to relevant guidelines, regular maintenance as required
	Seed germination failure	Seed treatment, soil amelioration, annual monitoring
	Species diversity and density	Annual monitoring and supplementary tree planting and seeding as required
	Weed presence	Inspections and weed control (herbicide application).
	Drought	Drought tolerant species selection, timing seeding to coincide with appropriate soil moisture.
	Grazing	Restrict grazing particularly in early years to rehabilitated areas
	Bushfire	Maintain low fuel loads, emergency preparedness and response

Bushfire was the dominant threat during late 2019 and early January 2020; a survey of the fuel loads (Ref [4]) undertaken in late 2020 indicated that fuel loads within all rehabilitation areas were low and fuel hazard mitigation activities were not required. Details regarding firefighting access tracks, fire breaks and emergency response measures are detailed in **Section 6.14**.

8.2 ACTIONS FOR THE 2021 REPORTING PERIOD

Maintenance and rehabilitation activities recommended in the Care and Maintenance MOP will continue on areas not directly impacted by future mining operations throughout 2021(sediment fences, fertilising, re-seeding, weed control etc), where required and as conditions allow.

As per the recommendations made in the Rehabilitation Monitoring Report (Ref [4]), located in **Appendix C**, further weed spraying is proposed in addition to the installation of nesting boxes once the treed area contains adequate structure to support nesting birds. It is noted that due to the bushfires it is not considered likely that nesting boxes will be able to be installed during the 2021 period.

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [7]) confirms that rehabilitation has been successfully completed in Areas B, C and 8 and all completion criteria defined in the PDM MOP (Ref [8]) has been successfully achieved. During the 2021 reporting period PDM will seek to relinquish rehabilitation responsibilities of Areas B, C and 8.

9 COMMUNITY RELATIONS

9.1 ENVIRONMENTAL COMPLAINTS

All stakeholder and community complaints, enquiries and notifications regarding PDM are documented, with appropriate actions taken as soon as possible to determine the likely cause of the incident and all possible corrective actions to resolve the problem and prevent its recurrence. Complaints, enquiries and notifications are recorded and retained at the site office in addition to monthly publication on the EnergyAustralia website. During the 2020 reporting period, there were no complaints received, enquiries or notifications received as summarised by **Table 9-1**.

Table 9-1 *Community Complaints, Incidents and Notifications*

Incident Type	Incidents Received 2020
Noise	0
Air Quality	0
Blasting	0
Traffic	0
Water	0
Other	0
Total Complaints Received	**0**
Enquiries/Notifications Received	**0**

Details of the complaints, enquiries and notifications received during the previous 5 years (2016 – 2020) are presented in **Table 9-2**.

Table 9-2 *Historical Community Complaints, Incidents and Notifications*

Complainant[a]	Item No.	Date Received	Nature (Enquiry / Notification or Complaint)	Issue(s)	Comment on nature of complaint in relation to approved parametric limits	Corrective Action Required? Y/N	Response / Action	
							Y/N	Date Completed
7	001-18	22/05/18	Notification	White residue observed within Neubecks Creek	An inspection of Neubecks creek at Pine Dale Mine conducted on the 22nd May 2018. White residue was observed to have originated upstream outside of the Pine Dale Mine boundary. Investigation completed; white residue considered to be an ionic compound (salt).	Yes	Yes	22/06/18
7	002-17	26/05/17	Notification	Operations adjacent to Private Property	Notification from neighbouring resident that he did not want remediation activities occurring near his residential boundary.	Yes	Yes	10/11/17
6	001-17	28/02/17	Complaint	CCC Minutes on EA Website	Minutes of December 2015 CCC meeting were not able to be viewed on the website due to a problem with the link. The June and December 2016 minutes and the December 2015 minutes (when visible) were still shown in Draft format.	Yes	Yes	1/03/17
7	002-16	23/12/16	Complaint	Operations adjacent to Private Property	Energy Australia received an email from the office of the Member for Bathurst regarding a complaint they had received from a neighbouring PDM resident regarding rehabilitation activities undertaken at the mine during December within close proximity to the residential boundary without prior notification to the resident.	No	Yes	12/01/17
6	001-16	28/04/16	Complaint	Community Consultation	Email to DRE indicating lack of community consultation concerning renewal of Exploration Licence EL7621.	No	Yes	6/05/16

[a] complainants are referred to with a number to maintain anonymity

9.2 COMMUNITY

9.2.1 COMMUNITY CONSULTIVE COMMITTEE

PDM Community Consultative Committee (CCC) commenced in January 2012 and comprises representatives from the local community and PDM. During 2017, the DPIE (formerly DPE) approved an amalgamation of the PDM CCC and the regional EnergyAustralia CCC into one. The amalgamated CCC meets on a quarterly basis to discuss matters relating to PDM and meeting minutes are made publicly available via the EnergyAustralia website. During the 2020 reporting period the CCC meetings were held on 2 March, 1 June, 7 September and 7 December.

9.2.2 WEBSITE INFORMATION

A website has been established to keep the broader community up to date with recent activities at the Pine Dale Mine in accordance with Schedule 5, Condition 10 of the PA 10_0041; and EPL 4911. Copies of the following documents are made publicly available on the EnergyAustralia Website:

- EPL 4911.
- Environmental Assessment.
- Project Approval 10_0041.
- Environment Protection and Biodiversity Conservation Act 1999 Referral Decision 2011/6016.
- The Care and Maintenance Mining Operation Plan.
- Environmental Management Plans for Pine Dale Mine.
- AEMR Reports / Annual Review.
- Pollution Incident Response Management Plan.
- Independent Environmental Audits (refer **Section 10**).
- Community Consultative Committee minutes.
- Community Complaints (Enquiries & Notifications).
- Blasting information.
- Monthly Environmental Performance reports.

9.2.3 SOCIAL AND ECONOMIC CONTRIBUTIONS

PDM has contributed to the economy of the district and NSW by providing direct employment and indirect employment through the purchase of services and materials from regional suppliers. Coal supplies to Mount Piper Power Station provide competitively priced energy for the NSW electricity market which ultimately flows through to provide economic benefit to electricity consumers.

Additionally, EnergyAustralia undertakes a community grants programme which provides funding for local initiatives that will deliver sustainable benefits for the Lithgow region. The two (2) priority areas for funding are education and social inclusion. Details of the community grants programme is provided on the EnergyAustralia website.

10 INDEPENDENT ENVIRONMENTAL AUDIT

There was no requirement within the Project Approval 10_0041 for an Independent Environmental Audit (IEA) to be conducted at PDM while PDM is in care and maintenance: as such none was undertaken during the 2020 reporting period.

The last IEA was undertaken in August 2014. Copies of the audit report, the audit Action Plan and the auditor's recommendations and proposed actions by PDM are provided on the company website.

As per the conditions of Project Approval 10_0041, no further IEA's are required at PDM providing the care and maintenance status is maintained.

11 INCIDENTS AND NON-COMPLIANCES

During the 2020 reporting period, there was one instance of non-compliance in relation to the requirements of the Groundwater Management Plan. Refer to **Section 1** for details of the non-compliance(s).

There were no reportable incidents, official cautions, warning letters, penalty notices or prosecution proceedings by any regulatory body during the reporting period.

There were several exceedances of the water quality triggers for surface water and groundwater during the reporting period. As discussed in **Section 7.2** exceedances of surface water triggers are considered to be due to upstream influences in Neubecks and Coxs River outside of the control of PDM. As discussed in **Section 7.5.2** intermittent exceedances of the groundwater trigger values are not considered to be due to activities undertaken by PDM, rather external factors such as climate.

12 PROPOSED ACTIVITIES IN THE NEXT REPORTING PERIOD

The activities proposed for the 2021 reporting period are consistent with the Care & Maintenance MOP. General maintenance will be undertaken at the site in addition to rehabilitation activities including weed management and fertilising as required.

12.1 MINING

All recoverable coal within the approved mining area was extracted during early 2014. No mining activities are proposed during 2021.

12.2 FUTURE MINING DEVELOPMENT

Subject to market conditions, in order to maintain supply of commercial coal to Mount Piper Power Station, Enhance Place intends to lodge an application with the DPIE to extend the existing mining operations. A request to update the Secretary's Environmental Assessment Requirements (SEARs) was lodged by the company in late 2016. Engagement with regulators and other key stakeholders will continue to be undertaken throughout 2021 as appropriate.

12.3 DOCUMENT REVIEWS

The Pine Dale Mine Water Management Plan is intended to be reviewed during the 2021 reporting period.

REFERENCES

[1] NSW Government, *Annual Review Guideline,* October 2015.

[2] Ecological Australia, *Purple Copper Butterfly March 2020 Survey [Letter],* March 2020.

[3] Ecological Australia, *Purple Copper Butterfly Spring 2020 Survey [Letter],* October 2020.

[4] FirstField Environmental, *Pine Dale Mine 2020 Rehabilitation Monitoring Report*, November 2020.

[5] GHD, *Pine Dale Groundwater and Surface Water Investigation Trigger Value Review Report*, September 2018.

[6] CSIRO, Ecosystem Function Analysis – Ephemeral Stream Assessment Protocol.

[7] SLR, *Pine Dale Mine Rehabilitation Completion Assessment*, SLR ref 630.12362-R01, 2018.

[8] EnergyAustralia, *Pine Dale Mine Care and Maintenance Mining Operations Plan,* February 2019.

[9] SLR, *Soil Assessment and Recommendations for Rehabilitated Areas: Pine Dale Mine and Enhance Place,* November 2014.

[10] FirstField Environmental, *Pine Dale Mine 2014 Rehabilitation Monitoring Report*, June 2014.

[11] FirstField Environmental, *Pine Dale Mine 2015 Rehabilitation Monitoring Report*, November 2015.

[12] FirstField Environmental, *Pine Dale Mine 2016 Rehabilitation Monitoring Report*, November 2016.

[13] FirstField Environmental, *Pine Dale Mine 2017 Rehabilitation Monitoring Report*, October 2017.

[14] FirstField Environmental, *Pine Dale Mine 2018 Rehabilitation Monitoring Report*, October 2018.

[15] FirstField Environmental, *Pine Dale Mine 2019 Rehabilitation Monitoring Report*, October 2019.

Appendix A

Site Plans

ENHANCE PLACE MINE
REGIONAL LOCALITY PLAN

PLAN: 1

LEGEND

Pine Dale Mine

Mine Lease Number

1569

1578

1664

Aerial Image Dated 3/10/2015
Coordinate System MGA Zone 56

0 162.5 325 650 975 1,300
metres

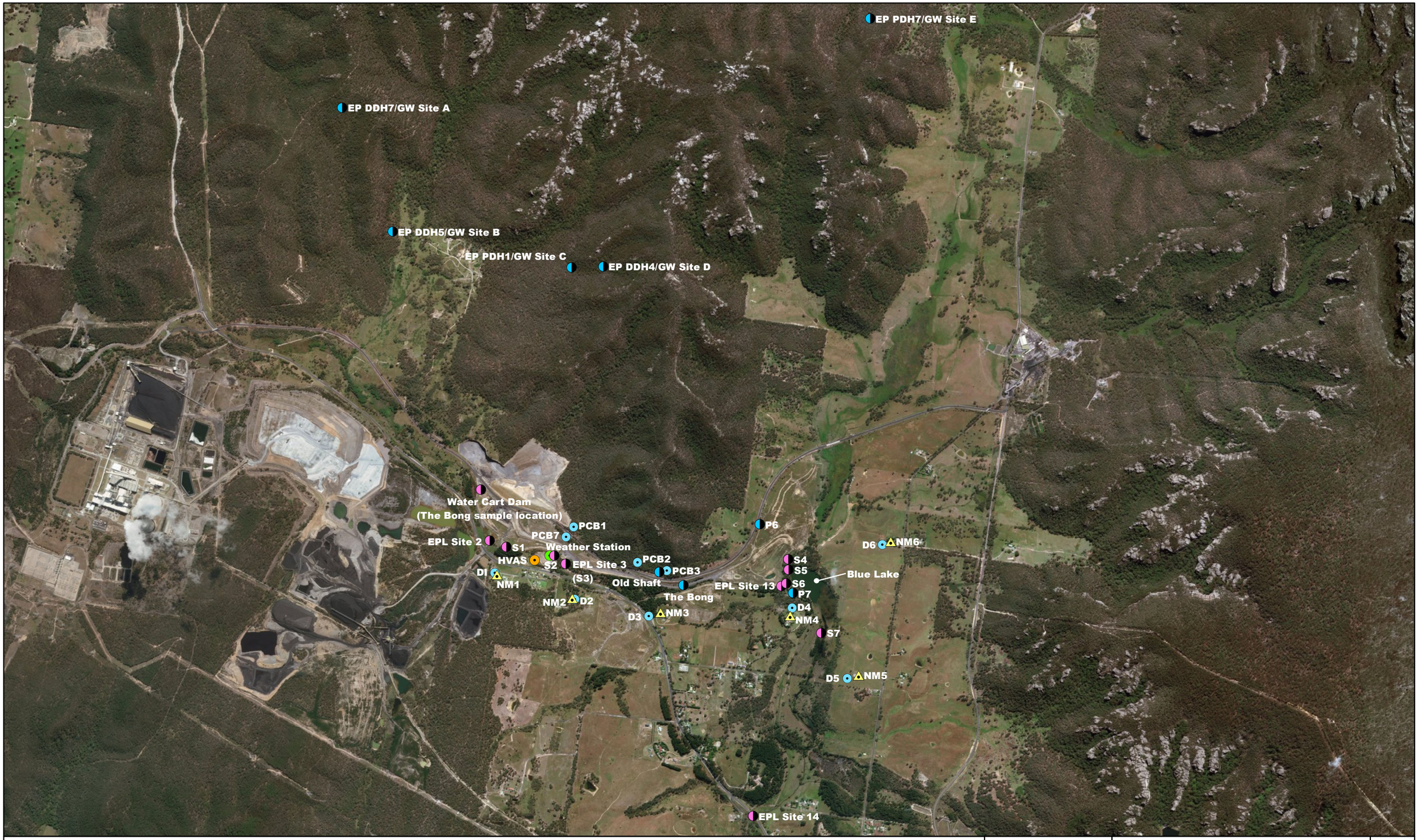
N

EnergyAustralia
LIGHT THE WAY

DRAWN BY : C. Rocher

SCALE: 1:24,000 (A3)

DATE: 21/01/2021



LEGEND

- Noise monitoring location
- Depositional dust monitoring location
- Groundwater monitoring location
- High volume air sampling location
- Metorological monitoring location
- Surface water monitoring location

0 175 350 700 1,050 1,400
metres

N

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE ENVIRONMENTAL MONITORING LOCATION PLAN

PLAN: 2a

DRAWN BY : C. Rocher

SCALE: 1:24,000 (A3)

DATE: 1/02/2019

LEGEND

- Monitoring location
- Licence discharge point location
- Clean water diversion location

0 37.5 75 150 225 300
metres

N

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE
ENVIRONMENTAL MONITORING
CHANNEL STABILITY, STREAM AND
VEGETATIVE HEALTH
MONITORING SITES

PLAN: 2b

DRAWN BY : C. Rocher

SCALE: 1:5,000 (A3)

DATE: 1/02/2019

LEGEND

- Yarraboldy Extension Area (21.9ha)
- Rehabilitation Area - Native Forest (7.1ha)
- Rehabilitation Area - Pasture (25.4ha)
- Dams
- Bund Wall
- Road

NOTE: Drawing adapted from plan supplied by
Craven, Ellistion & Hayes (Lithgow) Pty Ltd
Drawing No. PINE AEMR13
Dated 31/12/2013

0 100 200 300 400 500
metres

N

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE
REHABILITATION DOMAINS
DECEMBER 2018

PLAN: 3

DRAWN BY : C.Rocher

SCALE: 1 : 8000 (A3)

DATE: 1/02/2019

CDT-DWG-A3H-001/1

EP PDH7/GW (Site E)

EP DDH7/GW (Site A)

EL7621

EL7621

EP DDH5/GW (Site B)

EP PDH/GW (Site C)

EP DDH4/GW (Site D)

N

MT. PIPER

ANGUS PLACE

BEN BULLEN STATE FOREST

ML 1569

ML1664

ML 1578

ML1578

ML1637

ML 6

ML 5

ML 19

Pt Por.55

POR.53

POR. 15

LOT 1 D.P.597541

POR.41

POR.38

POR.39

Pt Por.291

POR.35

POR.29

POR.37

POR.38

POR.21

POR.27

Pt Por.20

Water Cart Dam

PCB1

PCB7

PCB2

PCB3

Weather Station

S1

S2

S3

S4

S5

S6

S7

P6

P7

ELP Point 2

ELP Point 3/S3

ELP point 13

EPL Point 14

CASTLEREAGH HIGHWAY

HAUL ROAD

Old Shaft

The Bong

WALLERAWANG COLLIERY RAILWAY

PML 11

D1

NM1

D2

NM2

D3

NM3

NM4

D5

NM5

D6

NM6

LEGEND

- Limit of underground workings
- Metorological monitoring location
- Air quality monitoring location
- Noise monitoring location
- Groundwater bore location
- Surface water location
- ML1569
- ML1578
- ML1637
- ML1664
- EL7621

NOTE: Drawing adapted from plan supplied by Craven, Ellistion & Hayes (Lithgow) Pty Ltd
Drawing No.3-1656
Dated 6/7/2011

0 200 300 400 500
metres

EnergyAustralia LIGHT THE WAY

PINE DALE MINE
MINING AND EXPLORATION LEASES

PLAN: 4

DRAWN BY : C.Rocher

SCALE : 1 : 2000 (A3)

DATE : 1/02/2019

CDT-DWG-A3H-001/1

Appendix B

Environmental Monitoring Summary Report

ANNUAL REVIEW ENVIRONMENTAL SUMMARY 2020

PINE DALE MINE

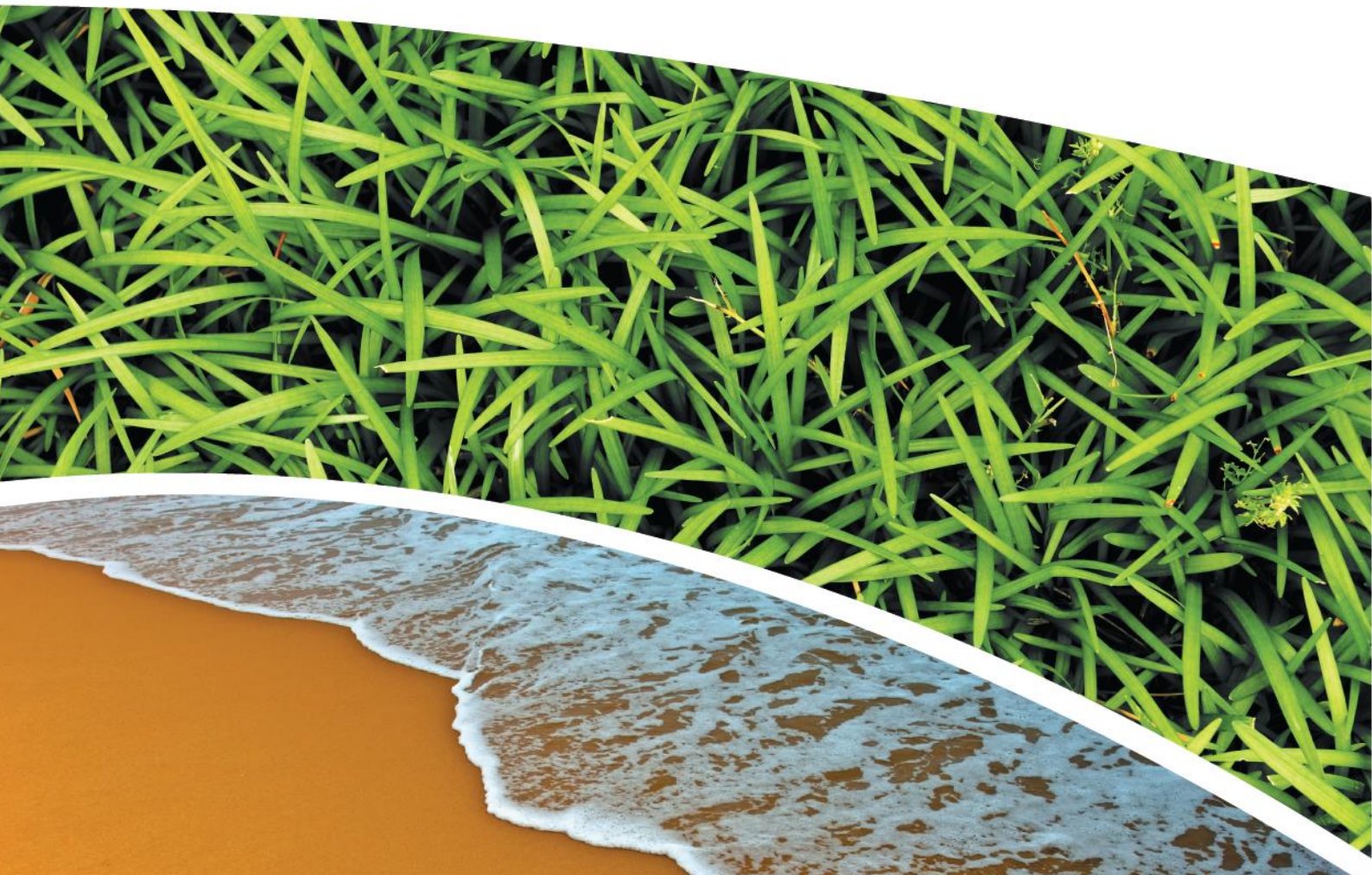
Prepared for ENHANCE PLACE PTY Limited

Prepared by RCA Australia

RCA ref 6880-1842a/0

February 2021

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL



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Rev No	**Comment**	**Author**	**Reviewer**	**Approved for Issue (Project Manager)**		
				Name	**Signature**	**Date**
/0	Final	C Rocher	F Brooker	C Rocher		3.02.2021

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Rev No	**Copies**	**Format**	**Issued to**	**Date**
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/0	1	Electronic (email)	Energy Australia – Mark Frewin mark.frewin@energyaustralia.com.au	3.02.2021
/0	1	Electronic report	RCA – job archive	3.02.2021

RCA ref 6880-1842a/0

3 February 2021

Enhance Place Pty Limited
PO Box 202
WALLERAWANG NSW 2845

Attention: Mr Graham Goodwin

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Sound & Vibration
Occupational Hygiene

ANNUAL REVIEW ENVIRONMENTAL SUMMARY 2020 COMPILED FOR PINE DALE MINE JANUARY – DECEMBER 2020

EXECUTIVE SUMMARY

Pine Dale Mine achieved an acceptable standard of environmental performance during the 2020 reporting period, as evidenced by the following:

- Air quality monitoring results recorded during the reporting period for depositional dust and total suspended particulate matter (TSP) were below the Project Approval (PA 10_0041) and Environment Protection Authority assessment criteria in Blackmans Flat and other privately owned properties adjacent to the Mining Leases.
- Concentrations of fine particulate matter (PM_{10}) were below the Project Approval with the exception of:
  - The 24-hour average concentration on the 3 January 2020. This considered to be due to bushfire activity. PM_{10} concentrations are considered to be influenced by bushfire activity during January and February 2020.
  - Concentrations were in excess of the 24-hour short term criterion on the 3 January; however, this is considered to be due to bushfire activity. PM_{10} concentrations during January and February 2020 are considered to be influenced by bushfire activity.
- There were no noise exceedances from mining activities recorded at privately owned properties recorded during the reporting period.
- There were no surface water discharge events during the reporting period; and monitoring was conducted in accordance with EPL 4911 and the site Water Management Plan.
- Surface water and groundwater quality was generally below the trigger values with intermittent exceedances observed.

Contents

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Attachments

ATTACHMENT 1

1 INTRODUCTION

The following report provides a summary of monthly environmental monitoring data for Pine Dale Mine (PDM) for the period January – December 2020. The 2020 environmental summary data includes:

- High Volume Air Samples: total suspended particulates (TSP) and (particulate matter less than or equal to 10 micrometres (PM_{10}).
- Depositional dust.
- Surface water.
- Groundwater.
- Channel stability and stream health monitoring.
- Noise monitoring.

This report satisfies the requirements to monitor environmental parameters as presented in the PDM Environment Protection Licence (EPL 4911, Ref [1]) and Project Approval (PA 10_0041, (Ref [2]). Monitoring is undertaken in accordance with the PDM: Water Management Plan (Ref [3]); Air Quality and Greenhouse Gas Management Plan (Ref [4]; Purple Copper Butterfly Monitoring Program (Ref [5]); and Noise Management Plan (Ref [6]).

A compliance assessment of each environmental monitoring parameter is made in accordance with the relevant assessment criteria outlined in Project Approval (Ref [2]), the PDM Management Plans (Ref [3] to [6]) and EPL 4911 (Ref [1]).

2 AIR QUALITY MONITORING

2.1 DEPOSITIONAL DUST AND HVAS PARTICULATE MATTER ASSESSMENT CRITERIA

The PDM Project Approval (Schedule 3 Condition 18, Ref [2]) and Air Quality and Greenhouse Gas Management Plan (Ref [4]) stipulates that dust emissions generated by the project must not cause additional exceedances of the long-term impact assessment criteria listed in **Table 1**.

Table 1 *Air Quality Assessment Criteria*

Pollutant	Average Period	Assessment Criteria	
Total suspended particulate (TSP) matter	Annual	[a]90µg/m^3	
Particulate matter < 10µm (PM_{10})	Annual	[a,e]25µg/m^3	
	24 Hours	[a]50µg/m^3	
[c] Deposited dust	Annual	**Maximum increase in deposited dust level**	**Maximum total deposited dust level**
		[b]2 g/m^2.month	[a]4g/m^2.month

[a] Total impact (incremental increase in concentrations due to the project plus background concentrations due to other sources)

[b] Incremental impact (incremental increase in concentrations due to the project on its own);

[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS3580.10.1 (Ref [7])

[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed to by the Director-General in consultation with Department of Planning, Industry and Environment (DPIE)

[e] PA 10_0041 stipulates the annual average PM_{10} assessment criterion at 30µg/m^3; however, National Environment Protection (Ambient Air Quality) Measure was amended in 2016 and stipulates the PM_{10} annual average assessment criterion at 25µg/m^3.

2.2 AIR MONITORING RESULTS – DEPOSITIONAL DUST GAUGE DATA SUMMARY

Depositional dust monitoring is undertaken at nine (9) locations across PDM.

A total of five (5) depositional dust gauges are monitored in accordance with the Air Quality and Green House Gas Management Plan (Ref [4]) and EPL 4911 (Ref [1]). One (1) dust gauge is located within the settlement of Blackmans Flat (gauge D1) and one (1) is located to the east of Blackmans Flat (gauge D3). The remaining three (3) gauges (D4, D5 & D6) were installed in November 2006 to coincide with the commencement of mining in Areas B & C. Gauge D4 is located to the north of View St, Blackmans Flat. Gauges D5 & D6 are located to the east of Mining Areas B & C, along Wolgan Road, Lidsdale (refer **Drawing 1**, **Appendix 1**).

The remaining four (4) depositional dust gauges are monitored in accordance with the Purple Copper Butterfly Monitoring Program (Ref [5]). These gauges are: PCB1, PCB2, PCB3 and PCB7. Three (3) of the dust gauges are located within the major butterfly population to the east of the mine workings in the Yarraboldy Extension (PCB1, PCB2 and PCB3); whilst the fourth dust gauge (PCB7) is located to the south west of the butterfly habitat area (refer Drawing 1, **Appendix 1**).

Depositional dust summary results for the period January – December 2020 are shown in **Tables 2** to **10**. Graphical presentations are shown in **Figures 1** and **2**. A discussion of results is presented in **Section 2.3**.

Table 2 *Depositional Dust Data Summary Dust Gauge D1 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	1.6	1.1	0.5
Feb-20	4.4	3.3	1.1
Mar-20	1.5	1.0	0.5
Apr-20	0.4	0.1	0.3
May-20	1.0	0.3	0.7
Jun-20	1.1	0.1	1.0
Jul-20	0.5	0.1	0.4
Aug-20	0.6	0.1	0.5
Sep-20	0.7	0.3	0.4
Oct-20	1.1	0.5	0.6
Nov-20	0.7	0.3	0.4
Dec-20	0.9	0.3	0.6
ANNUAL AVERAGE	*1.2*	*0.6*	*0.6*

Table 3 *Depositional Dust Data Summary Dust Gauge D3 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	3.4	2.7	0.7
Feb-20	3.4	2.7	0.7
Mar-20	1.2	0.9	0.3
Apr-20	0.5	0.2	0.3
May-20	0.4	0.2	0.2
Jun-20	0.7	0.4	0.3
Jul-20	0.5	0.3	0.2
Aug-20	0.6	0.3	0.3
Sep-20	0.7	0.4	0.3
Oct-20	1.1	0.4	0.7
Nov-20	0.9	0.5	0.4
Dec-20	1.3	0.8	0.5
ANNUAL AVERAGE	*1.2*	*0.8*	*0.4*

Table 4 *Depositional Dust Data Summary Gauge D4 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	4.6	3.6	1.0
Feb-20	4.4	3.6	0.8
Mar-20	1.2	0.8	0.4
Apr-20	0.5	0.1	0.4
May-20	0.1	<0.1	0.1
Jun-20	0.4	0.2	0.2
Jul-20	0.1	<0.1	0.1
Aug-20	0.4	0.1	0.3
Sep-20	0.5	0.3	0.2
Oct-20	0.6	0.1	0.5
Nov-20	0.5	0.2	0.3
Dec-20	0.8	0.4	0.4
ANNUAL AVERAGE[a]	*1.2*	*0.8*	*0.4*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 5 *Depositional Dust Data Summary Gauge D5 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	3.3	2.8	0.5
Feb-20	3.5	2.9	0.6
Mar-20	1.6	1.2	0.4
Apr-20	1.2	0.8	0.4
May-20	0.2	<0.1	0.2
Jun-20	0.8	0.2	0.6
Jul-20	3.2	2.4	0.8
Aug-20	0.4	0.1	0.3
Sep-20	3.4	2.4	1.0
Oct-20	0.8	0.3	0.5
Nov-20	0.6	0.3	0.3
Dec-20	0.6	0.2	0.4
ANNUAL AVERAGE[a]	*1.6*	*1.1*	*0.5*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 6 *Depositional Dust Data Summary Gauge D6 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	4.0	3.1	0.9
Feb-20	3.9	3.2	0.7
Mar-20	0.8	0.5	0.3
Apr-20	0.4	0.1	0.3
May-20	0.2	<0.1	0.2
Jun-20	1.5	1.2	0.3
Jul-20	0.2	0.1	0.1
Aug-20	0.1	<0.1	0.1
Sep-20	0.4	0.2	0.2
Oct-20	0.3	0.1	0.2
Nov-20	0.5	0.2	0.3
Dec-20	0.4	0.1	0.3
ANNUAL AVERAGE[a]	*1.1*	*0.7*	*0.3*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 7 *Depositional Dust Data Summary Gauge PCB1 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	6.2	3.7	2.5
Feb-20	5.6	3.6	2.0
Mar-20	1.9	1.0	0.9
Apr-20	1.3	0.3	1.0
May-20	1.3	<0.1	1.3
Jun-20	0.8	0.2	0.6
Jul-20	0.5	<0.1	0.5
Aug-20	0.6	<0.1	0.6
Sep-20	1.3	0.3	1.0
Oct-20	1.2	0.1	1.1
Nov-20	1.0	0.2	0.8
Dec-20	1.3	0.1	1.2
ANNUAL AVERAGE[a]	*1.9*	*0.8*	*1.1*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 8 *Depositional Dust Data Summary Gauge PCB2 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	4.5	2.9	1.6
Feb-20	4.4	3.2	1.2
Mar-20	1.2	0.6	0.6
Apr-20	0.3	0.1	0.2
May-20	0.2	<0.1	0.2
Jun-20	0.3	<0.1	0.3
Jul-20	0.1	<0.1	0.1
Aug-20	<0.1	<0.1	<0.1
Sep-20	0.30	<0.1	0.3
Oct-20	0.6	<0.1	0.6
Nov-20	0.4	0.1	0.3
Dec-20	0.9	0.1	0.8
ANNUAL AVERAGE[a]	*1.1*	*0.6*	*0.5*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 9 *Depositional Dust Data Summary Gauge PCB3 Jan – Dec 2020*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-20	3.7	2.8	0.9
Feb-20	3.8	2.7	1.1
Mar-20	0.7	0.3	0.4
Apr-20	0.1	<0.1	0.1
May-20	0.2	<0.1	0.2
Jun-20	0.4	0.1	0.3
Jul-20	0.4	<0.1	0.4
Aug-20	0.4	0.1	0.3
Sep-20	0.5	0.3	0.2
Oct-20	0.8	0.2	0.6
Nov-20	0.8	0.3	0.5
Dec-20	1.0	0.1	0.9
ANNUAL AVERAGE[a]	*1.1*	*0.6*	*0.5*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 10 *Depositional Dust Data Summary Gauge PCB7 Jan – Dec 2020*

Month	Insoluble Solids (g/m².month)	Ash Residue (g/m².month)	Combustible Matter (g/m².month)
Jan-20	4.7	3.6	1.1
Feb-20	4.5	3.1	1.4
Mar-20	0.3	0.1	0.2
Apr-20	0.1	<0.1	0.1
May-20	0.1	<0.1	0.1
Jun-20	0.5	0.2	0.3
Jul-20	0.2	0.1	0.1
Aug-20	0.2	<0.1	0.2
Sep-20	0.4	0.1	0.3
Oct-20	0.8	0.3	0.5
Nov-20	0.4	0.2	0.2
Dec-20	0.7	0.2	0.5
ANNUAL AVERAGE[a]	*1.1*	*0.7*	*0.4*

[a] Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

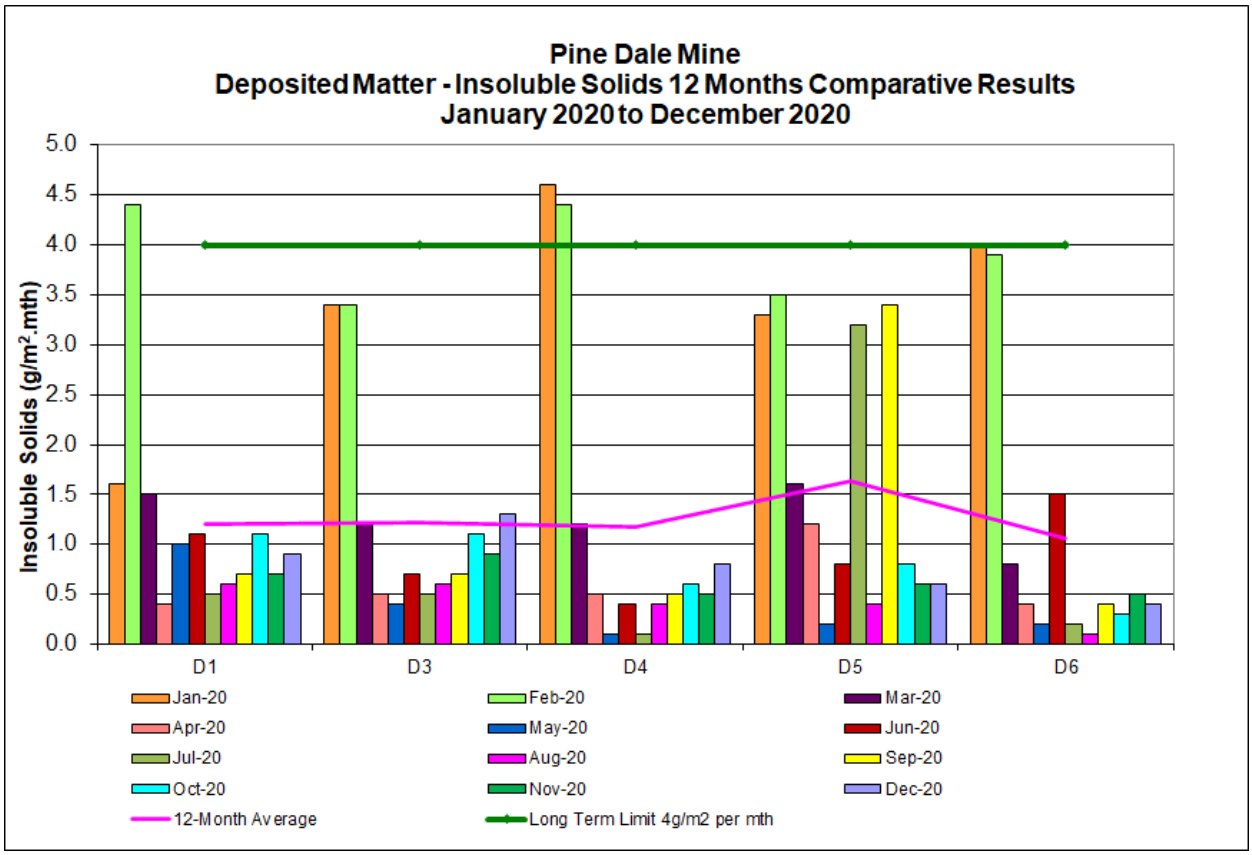

Figure 1 *Depositional Dust Results - Gauges D1, D3 to D6*

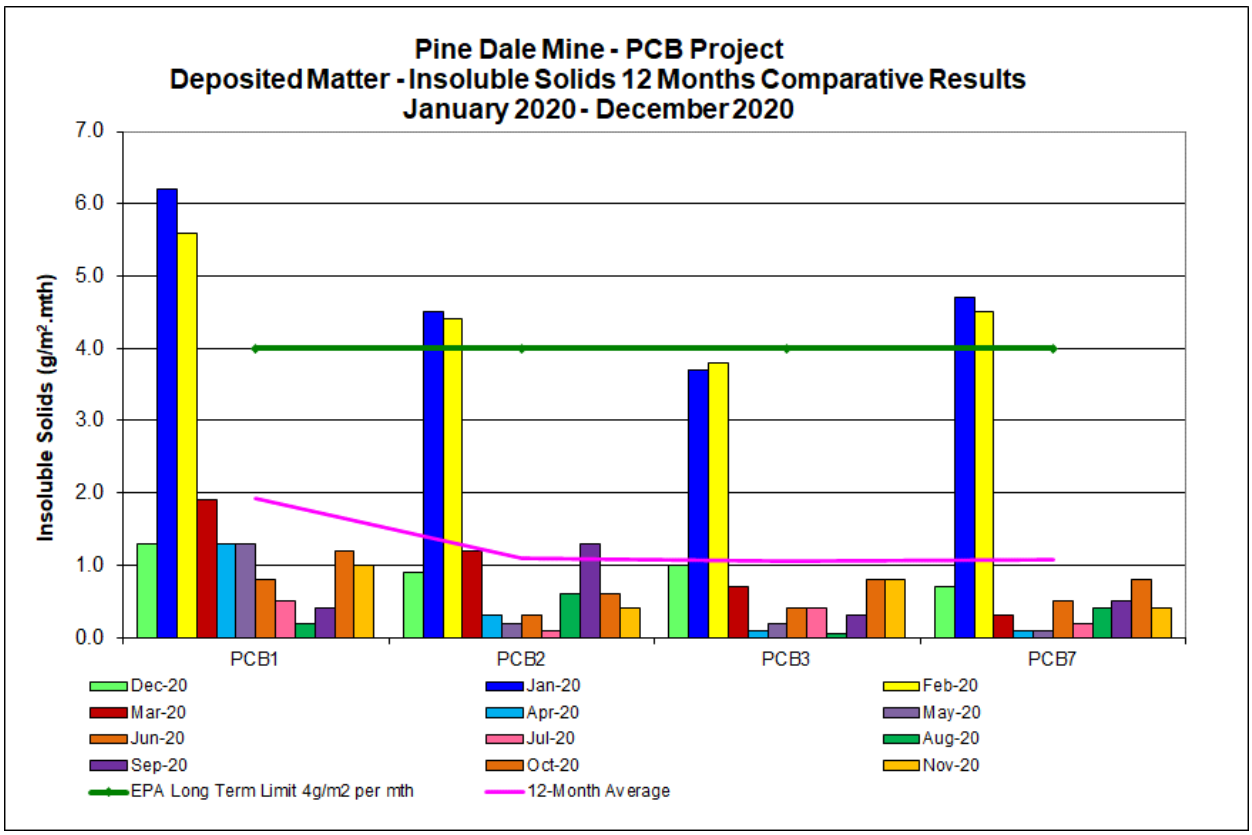

Figure 2 *Depositional Dust Results – Gauges PCB1 to PCB3 & PCB7*

2.3 AIR MONITORING RESULTS – HVAS PARTICULATE MATTER DATA SUMMARY

PDM monitors TSP and PM_{10} concentrations using HVAS on a 24-hour, one-in-six day sampling sequence. Monitoring is undertaken at one (1) location in accordance with Air Quality and Green House Gas Management Plan (Ref [4] and EPL 4911 (Ref [1]. The HVAS TSP and PM_{10} units are both located adjacent to the mine office at PDM, Blackmans Flat (refer **Drawing 1**, **Appendix 1**).

Monitoring for TSP and PM_{10} using high volume air samplers (HVAS) was removed from EPL 4911 in November 2020. The PDM Air Quality and Greenhouse Gas Management Plan (Ref [4]) was reviewed and updated to reflect this change. The updated Air Quality and Greenhouse Gas Management Plan was submitted to the Department of Planning, Industry and Environment (DPIE) for endorsement and was approved by the DPIE on the 4 December 2020. Monitoring for TSP and PM_{10} ceased on the 1 November 2020.

HVAS TSP summary results for the period January – October 2020 are shown in **Table 13** and the PM_{10} summary results in **Table 14**. Graphical presentations are shown in **Figure 3**.

During the 2020 monitoring period, intermittent issues associated with the TSP HVAS monitor resulted in the following HVAS run events outside the one-in-six day sampling sequence:

- 15 July 2020: scheduled run date was 7 July 2020;
- 27 July 2020: scheduled run date was 19 July 2020;
- 29 July 2020: scheduled run date was 25 July 2020;

During the 2020 monitoring period, intermittent issues associated with the PM_{10} HVAS monitor timer resulted in the following HVAS run events outside the one-in-six day sampling sequence:

- 8 August 2020: scheduled run date was 31 July 2020.

- 21 August 2020: scheduled run date was 6 August 2020.
- 28 August 2020: scheduled run dates was 12 August 2020.

The PM_{10} HVAS run event undertaken on the 30 August 2020 HVAS was greater than the 24 ± 1 hour run time as stipulated in AS/NZS 3580.9.6:2015 due to equipment malfunction. No re-run was able to be undertaken in August and the total run time was 62 hours.

Table 11 *HVAS TSP Summary January – October 2020*

Run Date	HVAS TSP (µg/m³)	Run Date	HVAS TSP (µg/m³)	Run Date	HVAS TSP (µg/m³)
03-Jan-20	95	14-Apr-20	22	29-Jul-20	11
09-Jan-20	54	20-Apr-20	20	31-Jul-20	16
15-Jan-20	71	26-Apr-20	44	6-Aug-20	13
21-Jan-20	87	02-May-20	11	12-Aug-20	14
27-Jan-20	46	08-May-20	19	18-Aug-20	5
02-Feb-20	120	14-May-20	19	24-Aug-20	6
08-Feb-20	12	20-May-20	8	30-Aug-20	19
14-Feb-20	18	26-May-20	7	5-Sep-20	22
20-Feb-20	36	01-Jun-20	8	11-Sep-20	28
26-Feb-20	48	13-Jun-20	5	17-Sep-20	30
03-Mar-20	13	16-Jun-20	7	23-Sep-20	27
09-Mar-20	7	19-Jun-20	11	29-Sep-20	20
15-Mar-20	9	25-Jun-20	5	5-Oct-20	23
21-Mar-20	36	1-Jul-20	13	11-Oct-20	14
27-Mar-20	11	13-Jul-20	7	17-Oct-20	31
02-Apr-20	14	15-Jul-20	6	23-Oct-20	18
08-Apr-20	8	27-Jul-20	2	29-Oct-20	14
Annual Average (November 2019 – October 2020)			*48.4 µg/m³*		

Results shown in **bold shading** are in excess of the assessment criteria

Table 12 *HVAS TSP Summary January – October 2020*

Run Date	HVAS TSP (µg/m^3)	Run Date	HVAS PM_{10} (µg/m^3)	Run Date	HVAS PM_{10} (µg/m^3)
03-Jan-20	**51**	14-Apr-20	9	25-Jul-20	9
09-Jan-20	34	20-Apr-20	8	08-Aug-20	10
15-Jan-20	45	26-Apr-20	18	18-Aug-20	1
21-Jan-20	22	02-May-20	6	21-Aug-20	5
27-Jan-20	25	08-May-20	8	24-Aug-20	0.5
02-Feb-20	50	14-May-20	9	28-Aug-20	9
08-Feb-20	5	20-May-20	3	30-Aug-20	8
14-Feb-20	9	26-May-20	3	5-Sep-20	4
20-Feb-20	15	01-Jun-20	5	11-Sep-20	4
26-Feb-20	13	07-Jun-20	12	17-Sep-20	10
03-Mar-20	5	13-Jun-20	2	23-Sep-20	13
09-Mar-20	4	19-Jun-20	7	29-Sep-20	8
15-Mar-20	4	25-Jun-20	1	5-Oct-20	12
21-Mar-20	17	01-Jul-20	5	11-Oct-20	5
27-Mar-20	6	07-Jul-20	4	17-Oct-20	12
02-Apr-20	6	13-Jul-20	3	23-Oct-20	11
11-Apr-20	9	19-Jul-20	5	29-Oct-20	6
Annual Average (November 2019 – October 2020)			***28.2 µg/m^3***		

Results shown in **bold shading** are in excess of the assessment criteria

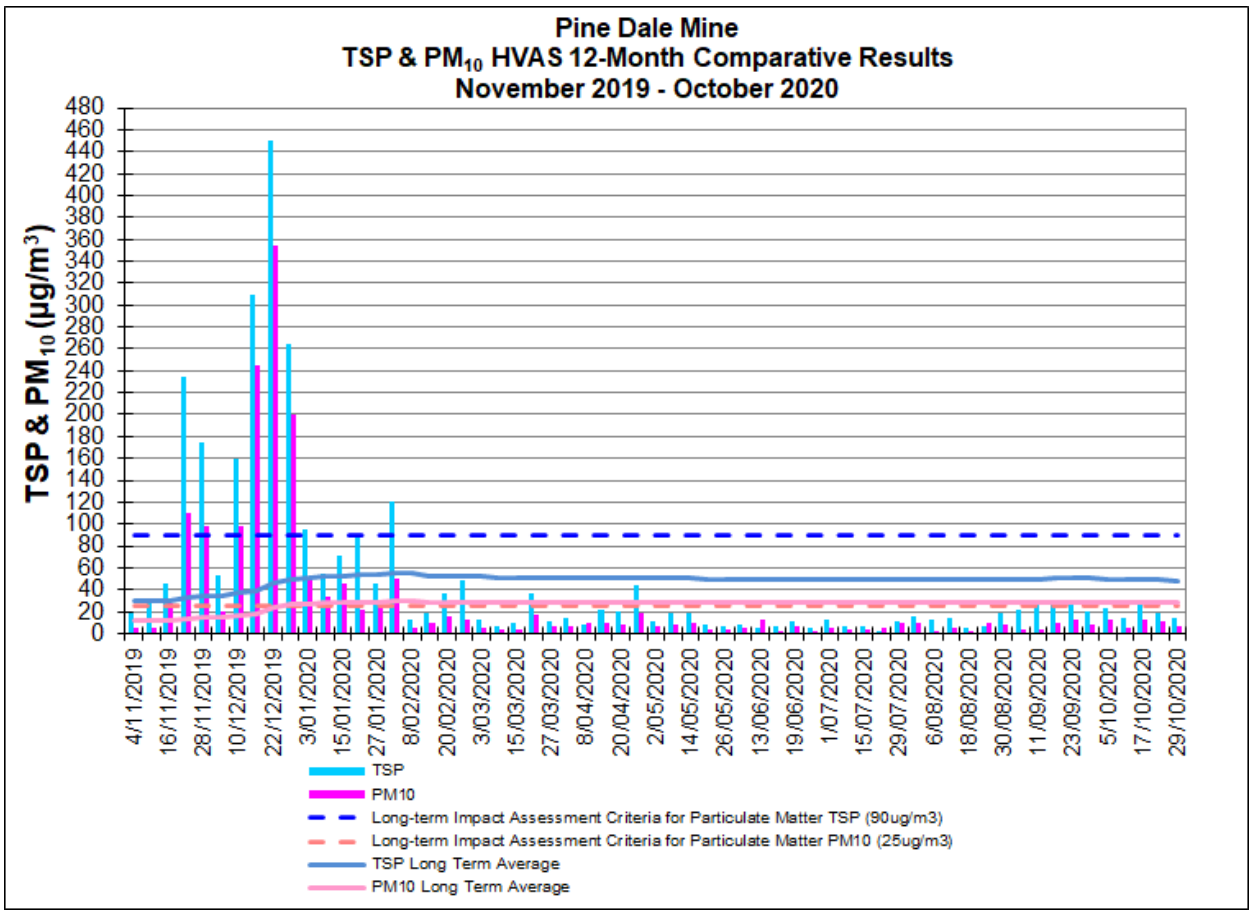

Figure 3 *HVAS TSP & PM_{10} Particulate Matter Summary Nov 2019 – Oct 2020*

2.4 REVIEW & INTERPRETATION OF AIR MONITORING RESULTS

2.4.1 DEPOSITIONAL DUST RESULTS

The average insoluble solids within depositional dust results for the period January – December 2020 range from 1.1g/m^2 per month to 1.6g/m^2 per month for dust gauges D1 and D3 to D6. These results are well below the long-term assessment criteria detailed in **Table 3**.

A review of historical data captured over the previous five (5) years including the 2020 monitoring period indicate there were no instances where the dust gauges showed results which were greater than the allowable maximum annual average increase of 2g/m^2 per month deposited matter **Table 1**.

It is noted that dust gauges PCB1, PCB2, PCB3 and PCB7 are located in a bushland setting under the canopy of tall trees and as such, these gauges do not conform to the siting requirements of AS/NZS 3580.1.1 (Ref [8]). The purpose of these gauges is to determine the level of dust present at each location to aid in the study of the Purple Copper Butterfly population. The average insoluble solids within depositional dust results for the period January – December 2020 range from 1.1g/m^2 per month to 1.9g/m^2 per month for dust gauges within the Purple Copper Butterfly (PCB1, PCB2, PCB3 and PCB7). A review of historical indicates there were no instances where the dust gauges showed results which were greater than the allowable maximum annual average increase of 2g/m^2 (refer **Table 1**)

2.4.2 HVAS PARTICULATE MATTER RESULTS

Annual average TSP and PM_{10} results have been presented for the period November 2019 – October 2020 as monitoring ceased on the 1 November 2020, noting that this represents the use of two (2) months of data in the calculation of two (2) annual averages (2019 and 2020). The annual average of the HVAS TSP results for the period November 2019 – October 2020 is 48.4µg/m^3, which is well below the long-term assessment criterion of 90µg/m^3 (refer **Table 1**) for TSP. During the reporting period the TSP HVAS recorded 100% data capture, with sampling undertaken in accordance with AS/NZS 3580.9.3 (Ref [9]). There were instances where the one-in-six day sampling sequence were not adhered to, as detailed in **Section 3.3**.

The HVAS PM_{10} annual average result was 28.2µg/m^3, above the long-term assessment criterion of 25µg/m^3 (refer **Table 1**). Noting that this is below the assessment criterion of 30µg/m^3 in the PA 00_

During 2020, all HVAS results were below the short term 24-hour maximum assessment criterion of 50µg/m^3 with the exception of the PM_{10} concentration recorded on the 3 January 2020: a concentration of 51µg/m^3 was recorded.

During November 2019, December 2019 and January 2020, the air quality in the Lithgow area was impacted by bushfires, predominantly the Gospers Mountain fire which originated within Wollemi National Park and moved through to Ben Bullen State forest and PDM during December 2019. Some bushfire activity persisted in January 2020. Air quality data from the DPIE air quality monitoring stations situated at Katoomba 46km south-east of PDM) and Bathurst (46km south-west of PDM) indicate that air quality in the region was impacted by bushfire activity (refer **Table 13**).

Table 13 *DPIE Bathurst and Richmond 24-hour average PM_{10} data*

Run date	Katoomba (µg/m^3)	Bathurst PM_{10} (µg/m^3)
22 November 2019	58.2	200.0
28 November 2019	42.3	40.6
10 December 2019	84.9	77.3
16 December 2019	72.3	106.2
22 December 2019	34.4	355.0
28 December 2019	ND	200.0
3 January 2020	55.3	26.6

ND – no data available.

The DPIE air quality data and observations by mining personnel who were at the site during November 2019-January 2020 are considered to indicate that the air quality parameters at PDM were adversely impacted by bushfire activity in the region. The significantly elevated PM_{10} concentrations recorded during November 2019, December 2019 and January 2020 have caused the long-term annual average to exceed the criterion (refer **Table 1**) and whilst the TSP annual average was below the criterion it is elevated from the previous year due to high readings in these months. As the affected months are within the time period where the region was affected by bushfire activity it is considered that the elevated annual average PM_{10} is not directly related to PDM activities.

During the 2020 monitoring period the PM_{10} HVAS recorded 100% data capture. Sampling during 2020 was undertaken in accordance with AS/NZS 3580.9.6 (Ref [10]); There were instances where the one-in-six day sampling sequence were not adhered to, as detailed in **Section 2.3.**

3 GROUNDWATER QUALITY MONITORING

3.1 GROUNDWATER ASSESSMENT CRITERIA

Groundwater monitoring is undertaken at PDM to monitor for any potential impacts on local groundwater due to past mining operations. Site specific trigger values for standing water level (SWL) and water quality parameters pH and electrical conductivity were developed for the PDM, as stipulated in the Water Management Plan (Ref [3]) in accordance with Schedule 3, Condition 27(c) of the Project Approval (PA 10_0041). The groundwater trigger values (Ref [3]) are shown in **Table 14**.

Table 14 *Groundwater Trigger Values*

Bore	pH (range)	Electrical Conductivity (µS/cm)	SWL Trigger (m, AHD)
P6	6.2 - 8.0	1180	887.90
P7	6.3 - 8.0	852	883.28
EP DDH4/GW (Bore D)	6.8 - 8.0	608	940.61
EP DDH7/GW (Bore A)	6.5 - 8.0	326	954.40
EP PDH1/GW Bore C)	6.9 - 8.0	490	889.25
EP PDH3/GW (Enhance)	NA	NA	891.06
EP P H4/GW (Enhance)	NA	NA	890.95
EP PDH7/GW (Bore E)	5.5 - 8.0	151	938.43
Old Ventilation Shaft	6.3 - 8.0	908	888.46
The Bong (at SW location)	5.8 - 8.0	1157	NA

NA – no trigger value required for these locations.

3.2 GROUNDWATER MONITORING DATA SUMMARY

Groundwater monitoring for the PDM is undertaken in accordance with the Water Management Plan (Ref [3]). Sampling is conducted at four (4) locations within the mine site; seven (7) locations surrounding the Yarraboldy Extension area (four (4) sampling wells and three (3) vibrating wire piezometer wells); and two (2) locations at the former Enhance Place Mine site (refer **Drawing 1**, **Appendix 1**). Groundwater monitoring is not a requirement of EPL 4911.

Groundwater from the Bong was historically sampled by pumping water from the underground opening into the Water Cart Dam at PDM. Water is no longer pumped into the Water Cart Dam during the care and maintenance period; thus, water quality within The Bong is now considered to be representative of surface water runoff rather than groundwater quality from within the Old Wallerawang underground workings. Thus, any results reported in excess of the trigger values shown in **Table 16** at the Bong are not considered indicative of impacts to groundwater.

Bushfire activity associated with the Gospers Mountain fire during November 2019 – January 2020 caused significant damage to Ben Bullen Forest during December 2019 and access tracks within the forest, resulting in the Forestry Corporation of NSW prohibiting entry into for the period January – September 2020; entry was permitted in October 2020. The offsite groundwater bores surrounding the Yarraboldy Extension are located within Ben Bullen State Forest and as such no sampling of these wells was undertaken between January and September 2020. RCA attempted to access, by vehicle in October 2020 and the Yarraboldy extension area bores; however, was only able to access Bore A during October and November 2020 due to fallen trees and damage to access tracks at the other Yarraboldy bores locations. During November 2020, an assessment of the future accessibility to Bore C and Bore D was undertaken by traversing to each location by foot with an arborist. No sample was able to be obtained as vehicular access is required transport sampling equipment. Due to fallen trees and damage to an access bridge, Bore E was not able to be accessed at all during the 2020 reporting period. There was no tree clearing and removal undertaken and upon further risk assessment, access to Bore A, C and D was no longer considered safe and RCA ceased monitoring a December 2020.

Groundwater summary results for the period January – December 2020 are shown in **Tables 17** to **23**. Graphical presentations of standing water levels are shown in **Figure 4** and **Figure 5**.

Table 15 *Groundwater Monitoring Bore P6 Results January - December 2020*

Location	Site Bore P6												Trigger Value
Sample Number	0120688009	02206880011	03206880009	04206880009	05206880011	06206880009	07206880009	08206880011	09206880009	10206880009	11206880011	12206880009	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	14/01/20	11/02/20	10/03/20	08/04/20	06/05/20	03/06/20	03/07/20	04/08/20	04/09/20	02/10/20	03/11/20	03/12/20	
Time Sampled	15:43	15:00	15:20	7:30	8:55	14:43	7:26	6:55	7:15	7:12	10:38	15:00	
Standing Water Level (m)	27.21	27.19	27.08	26.95	26.45	25.85	26.16	25.86	24.28	24.05	24.00	24.04	
Standpipe Height (m)	0.90	0.90	0.90	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	
Relative Water Level (m)	26.31	26.29	26.18	26.29	25.79	25.19	25.50	25.20	23.62	23.39	23.34	23.38	
Water Level AHD (m)	890.64	890.66	890.77	890.66	891.16	891.76	891.45	891.75	893.33	893.56	893.61	893.57	**887.90#**
Temperature (°C)	20.1	19.4	19.7	15.6	13.4	14.2	15.6	11.1	16.3	12.7	16.9	19.4	
pH	6.19	6.13	6.32	6.09	6.02	6.10	6.05	6.25	6.00	5.94	6.22	6.27	**6.2 to 8.0***
Conductivity (µS/cm)	1490	1420	1700	1750	1690	2000	1750	1870	1280	932	1610	1690	**1180**
Turbidity (NTU)	64	<1	63	106	162	78	54	52	17	79	70	28	
Dissolved Oxygen (mg/L)	2.0	3.0	2.0	2.0	4.0	2.4	3.5	4.9	4.5	1.6	6.9	1.8	
TSS (mg/L)	112	70	67	110.0	117	79.0	31	43.0	37.0	48.0	106.0	41.0	
Oil & Grease (mg/L)	<5	<5	<5	<5	<5	<5	<5	6	<5	<5	<5	<5	
Bicarbonate Alkalinity (mg/L)	38	44	60	61	67	88	92	102	30	44	60	93	
Total Alkalinity (mg/L)	38	44	60	61	67	88	92	102	30	44	60	93	
Sulphate (mg/L)	695	642	752	850	801	1050	862	829	217	385	687	748	
Chloride (mg/L)	59	48	60	56	61	72	57	60	12	26	49	57	
Calcium (mg/L)	154	152	168	146	161	172	154	171	28	77	142	155	
Magnesium (mg/L)	79	73	79	69	82	83	77	87	17	35	64	72	
Sodium (mg/L)	84	83	87	79	93	94	90	172	30	49	76	85	
Potassium (mg/L)	22	21	22	20	22	23	21	25	6	10	18	20	
Cobalt (dissolved) (mg/L)	0.063	0.06	0.059	0.054	0.056	0.052	0.046	0.051	0.034	0.026	0.041	0.046	
Manganese (dissolved) (mg/L)	3.45	3.26	3.32	2.85	3.11	3.25	2.96	3.32	1.94	1.22	2.44	2.65	
Nickel (dissolved) (mg/L)	0.128	0.128	0.127	0.116	0.114	0.111	0.099	0.108	0.078	0.064	0.096	0.099	
Zinc (dissolved) (mg/L)	0.064	0.2	0.073	0.168	0.149	0.016	0.031	0.016	0.2	0.207	0.126	0.04	
Iron (dissolved) (mg/L)	43.8	40.3	42.8	30.3	37.2	49.4	44.8	45.6	26.9	2.43	32.2	39.6	

Shaded Cells- Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 16 *Groundwater Monitoring Bore P7 Results January - December 2020*

Location	Site Bore P7												Trigger Value
Sample Number	01206880010	02206880012	03206880010	04206880008	05206880008	06206880010	07206880010	08206880012	09206880010	10206880010	11206880012	12206880010	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	14/01/20	11/02/20	10/03/20	08/04/20	06/05/20	03/06/20	03/07/20	04/08/20	04/09/20	02/10/20	03/11/20	03/12/20	
Time Sampled	16:30	16:10	16:10	8:20	10:11	15:24	8:05	7:56	8:00	9:02	11:38	16:03	
Standing Water Level (m)	10.31	9.65	7.96	7.83	7.72	7.50	7.55	7.37	6.48	6.57	6.38	6.28	
Standpipe Height (m)	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	
Relative Water Level (m)	9.35	8.69	7.00	6.87	6.76	6.54	6.59	6.41	5.52	5.61	5.42	5.32	
Water Level AHD (m)	885.05	885.71	887.40	887.53	887.64	887.86	887.81	887.99	888.88	888.79	888.98	889.08	**883.28#**
Temperature (°C)	19.3	20.1	17.4	14.6	15.2	14.5	13.1	10.7	14.3	14.3	16.7	16.4	
pH (pH units)	6.30	6.29	6.28	6.12	6.20	6.12	6.18	6.20	5.85	6.32	6.14	6.36	**6.3 to 8.0***
Conductivity (µS/cm)	607	653	721	733	700	813	825	800	764	763	793	763	**852**
Bicarbonate Alkalinity (mg/L)	--	194	--	--	213	--	--	219	--	--	239	--	
Total Alkalinity (mg/L)	--	194	--	--	213	--	--	219	--	--	239	--	
Sulphate (mg/L)	--	34	--	--	40	--	--	39	--	--	57	--	
Chloride (mg/L)	--	108	--	--	124	--	--	117	--	--	111	--	
Calcium (mg/L)	--	42	--	--	40	--	--	42	--	--	46	--	
Magnesium (mg/L)	--	44	--	--	43	--	--	43	--	--	44	--	
Sodium (mg/L)	--	49	--	--	49	--	--	54	--	--	48	--	
Potassium (mg/L)	--	8	--	--	8	--	--	8	--	--	8	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	<0.05	--	--	2.02	--	--	0.56	--	

Shaded Cells - Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 17 *Groundwater Monitoring Bore Old Shaft Results January - December 2020*

Location	Site Bore 'Old Shaft'												Trigger Value
Sample Number	1206880013	02206880015	03206880013	04206880013	05206880015	06206880013	07206880013	08206880015	09206880013	10206880013	11206880015	12206880013	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	15/01/20	11/02/20	10/03/20	8/04/20	6/05/20	3/06/20	2/07/20	3/08/20	3/09/20	1/10/20	3/11/20	4/12/20	
Time Sampled	8:15	14:18	15:05	15:00	7:52	14:11	15:19	15:13	16:03	16:20	9:36	9:29	
Standing Water Level (m)	13.50	13.45	13.37	13.19	12.98	12.82	12.73	12.45	10.82	10.61	10.57	10.63	
Standpipe Height (m)	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	
Relative Water Level (m)	11.78	11.73	11.65	11.47	11.26	11.10	11.01	10.73	9.10	8.89	8.85	8.91	
Water Level AHD (m)	891.26	891.31	891.39	891.57	891.78	891.94	892.03	892.31	893.94	894.15	894.19	894.13	**888.46#**
Temperature (°C)	17.0	21.8	17.5	16.2	13.9	14.4	14.4	14.0	16.8	16.4	14.5	18.6	
pH	5.82	5.94	6.03	5.75	5.07	5.80	5.65	6.05	5.85	5.75	6.16	6.44	**6.3 to 8.0***
Conductivity (µS/cm)	1140	1320	1460	1520	1420	1530	1470	687	362	383	435	438	**908**
Turbidity (NTU)	24	<1	27	23	85	8	62	35	19	47	43	60	
Dissolved Oxygen (mg/L)	--	3	--	--	4.3	--	--	4.5	--	--	9.9	--	
TSS (mg/L)	--	47	--	--	29	--	--	36	--	--	4	--	
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	6	--	--	<5	--	
Bicarbonate Alkalinity (mg/L)	--	43	--	--	49	--	--	76	--	--	65	--	
Total Alkalinity (mg/L)	--	43	--	--	49	--	--	76	--	--	65	--	
Sulphate (mg/L)	--	649	--	--	732	--	--	282	--	--	112	--	
Chloride (mg/L)	--	27	--	--	28	--	--	27	--	--	27	--	
Calcium (mg/L)	--	161	--	--	155	--	--	59	--	--	27	--	
Magnesium (mg/L)	--	76	--	--	72	--	--	30	--	--	18	--	
Sodium (mg/L)	--	69	--	--	53	--	--	22	--	--	18	--	
Potassium (mg/L)	--	23	--	--	21	--	--	10	--	--	6	--	
Cobalt (dissolved) (mg/L)	--	0.118	--	--	0.119	--	--	0.028	--	--	0.012	--	
Manganese (dissolved) (mg/L)	--	3.64	--	--	3.14	--	--	1.38	--	--	0.812	--	
Nickel (dissolved) (mg/L)	--	0.211	--	--	0.208	--	--	0.047	--	--	0.025	--	
Zinc (dissolved) (mg/L)	--	0.328	--	--	0.359	--	--	0.07	--	--	0.046	--	
Iron (dissolved) (mg/L)	--	41.6	--	--	31.2	--	--	20.3	--	--	8.9	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 18 *Groundwater Monitoring Location 'The Bong' Results January – December 2020*

Location	Site Bore 'The Bong'												Trigger Value
Sample Number	01206880001	02206880001	03206880001	04206880001	05206880001	06206880001	07206880001	08206880001	09206880001	10206880001	11206880001	12206880001	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	14/1/2020	11/02/2020	10/03/2020	7/04/2020	6/5/2020	3/06/20	2/07/2020	3/08/2020	3/09/2020	1/10/2020	3/11/2020	3/12/2020	
Time Sampled		14:40	14:20	15:11	8:21	14:25	15:19	15:30	16:15	16:24	7:59	16:26	
Temperature (°C)		24.4	20.4	15.3	9.8	11.0	10.9	11.8	16.3	17.4	13.0	24.7	
pH		5.12	6.46	6.02	5.05	4.89	5.10	5.00	4.36	4.50	4.40	6.52	**5.8 – 8.0***
Conductivity (µS/cm)		210	144	181	226	263	249	259	289	250	231	462	**1157**
Turbidity (NTU)		<1	19	31	3	1	2	4	<1	<1	32	22	
Bicarbonate Alkalinity (mg/L)		1	--	--	5	--	--	<1	--	--	2	--	
Total Alkalinity (mg/L)		1	--	--	5	--	--	<1	--	--	2	--	
Sulphate (mg/L)		90	--	--	83	--	--	115	--	--	97	--	
Chloride (mg/L)		2.00	--	--	2.00	--	--	2.00	--	--	2	--	
Calcium (mg/L)		19	--	--	19	--	--	23	--	--	20	--	
Magnesium (mg/L)	Dry	8	--	--	7	--	--	9	--	--	7	--	
Sodium (mg/L)		3	--	--	2	--	--	3	--	--	2	--	
Potassium (mg/L)		6	--	--	3	--	--	4	--	--	4	--	
Arsenic (dissolved) (mg/L)		<0.001	--	--	<0.001	--	--	<0.001	--	--	<0.001	--	
Cadmium (dissolved) (mg/L)		0.0002	--	--	0.0002	--	--	0.0002	--	--	0.0002	--	
Chromium (dissolved) (mg/L)		<0.001	--	--	<0.001	--	--	<0.001	--	--	<0.001	--	
Copper (dissolved) (mg/L)		<0.001	--	--	<0.001	--	--	<0.001	--	--	<0.001	--	
Lead (dissolved) (mg/L)		<0.001	--	--	<0.001	--	--	<0.001	--	--	<0.001	--	
Nickel (dissolved) (mg/L)		0.034	--	--	0.03	--	--	0.042	--	--	0.037	--	
Zinc (dissolved) (mg/L)		0.07	--	--	0.06	--	--	0.094	--	--	0.062	--	
Iron (dissolved) (mg/L)		0.14	--	--	<0.05	--	--	<0.05	--	--	0.07	--	

Shaded Cells - Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Table 19 *Groundwater Monitoring Bore A (EP DDH7/GW) Results: October and November 2020*

Location	Off-Site Bore A (EP DDH7/GW)		Trigger Value
Sample Number	10206880016	11206880018	
Sampling Month	Oct	Nov	
Date Sampled	1/10/2020	2/11/2020	
Time Sampled			
Standing Water Level (m)	65.24	66.14	
Standpipe Height (m)	0.75	0.75	
Relative Water Level (m)	64.49	65.39	
Water level AHD (m)#	959.31	958.41	**954.40#**
pH	6.49	--	**6.5 to 8.0***
Conductivity (µS/cm)	240	--	**326**
Temperature (°C)	17.7	--	
TDS (mg/L)	87	--	
Bicarbonate Alkalinity (mg/L)	<1	--	
Total Alkalinity (mg/L $CaCO_3$)	<1	--	
Sulphate (mg/L)	10	--	
Chloride (mg/L)	10	--	
Calcium (mg/L)	16	--	
Magnesium (mg/L)	7	--	
Sodium (mg/L)	6	--	
Potassium (mg/L)	13	--	
Arsenic (dissolved) (mg/L)	<0.001	--	
Cadmium (dissolved) (mg/L)	<0.0001	--	
Chromium (dissolved) (mg/L)	<0.001	--	
Copper (dissolved) (mg/L)	<0.001	--	
Lead (dissolved) (mg/L)	<0.001	--	
Nickel (dissolved) (mg/L)	0.004	--	
Zinc (dissolved) (mg/L)	0.024	--	
Iron (dissolved) (mg/L)	1.75	--	

Shaded Cells - Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 20 *Groundwater Monitoring Bore - EP PDH3/GW Results January - December 2020*

Location	Enhance Place Bore EP PDH3/GW												Trigger Value
Sample Number	01206880011	02206880013	03206880011	0420688011	05206880013	06206880011	07206880011	08206880013	09206880011	10206880011	11206880013	12206880011	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	14/01/2020	12/05/2020	10/03/2020	8/04/2020	6/05/2020	3/06/2020	3/07/2020	4/08/2020	4/09/2020	2/10/2020	3/11/2020	4/12/2020	
Standing Water Level (m)	24.1	24.13	24.08	23.88	23.79	23.74	23.74	23.72	23.7	23.73	23.73	23.73	
Standpipe Height	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	
Relative Water Level (m)	23.33	23.36	23.31	23.11	23.02	22.97	22.97	22.95	22.93	22.96	22.96	22.96	
Water Level AHD (m)#	892.67	892.64	892.69	892.89	892.98	893.03	893.03	893.05	893.07	893.04	893.04	893.04	**891.06**

Shaded Cells - Indicates results are outside of the nominated Trigger Level.

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 21 *Groundwater Monitoring Bore - EP PDH4/GW Results January – December 2020*

Location	Enhance Place Bore EP PDH4/GW												Trigger Value
Sample Number	01206880012	02206880014	03206880012	0420688012	05206880014	06206880012	07206880012	08206880014	09206880012	10206880012	11206880014	12206880012	
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	14/01/2020	12/02/2020	10/03/2020	8/04/2020	6/05/2020	3/06/2020	3/07/2020	4/08/2020	4/09/2020	2/10/2020	03/11/2020	4/12/2020	
Standing Water Level (m)	23.62	23.6	23.59	23.35	23.26	23.28	23.32	23.28	23.23	23.62	23.23	23.29	
Standpipe Height	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	
Relative Water Level (m)	23.46	23.44	23.43	23.19	23.10	23.12	23.16	23.12	23.07	23.46	23.07	24.07	
Water Level AHD (m)#	892.62	892.64	892.65	892.89	892.98	892.96	892.92	892.96	893.01	892.62	893.01	892.01	**890.95**

Shaded Cells - Indicates results are outside of the nominated Trigger Level.

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

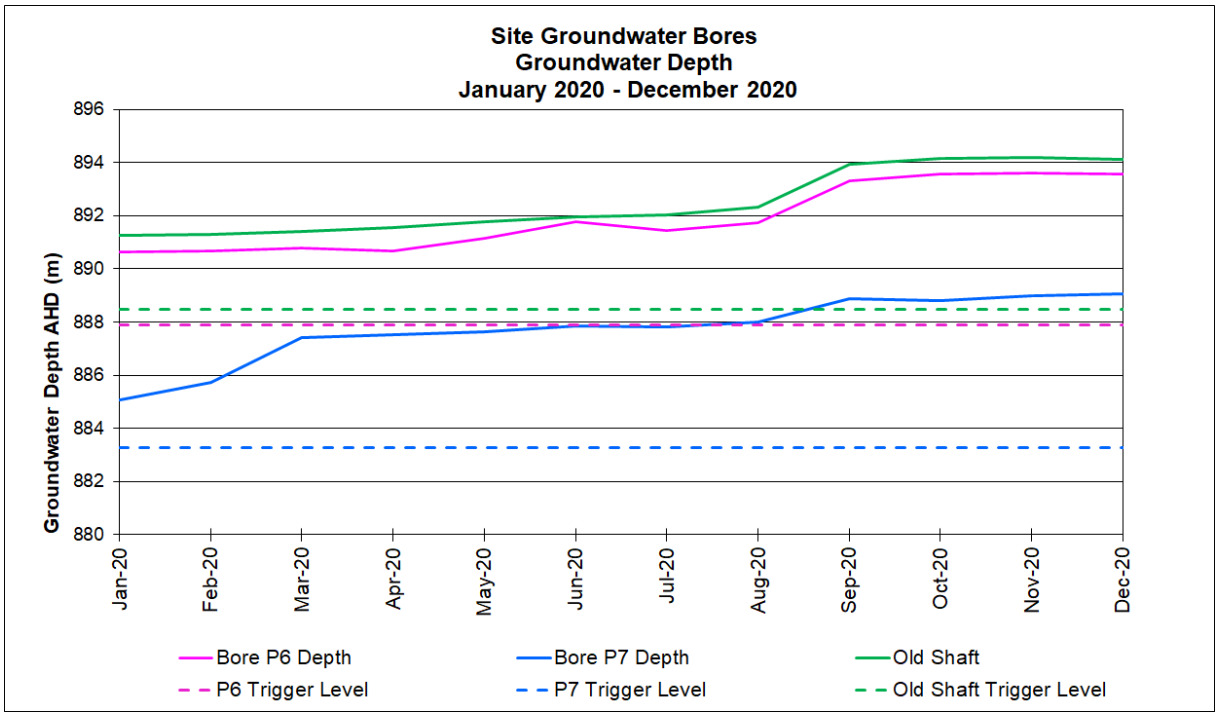

Figure 4 *Onsite Groundwater Standing Water Level 2020*

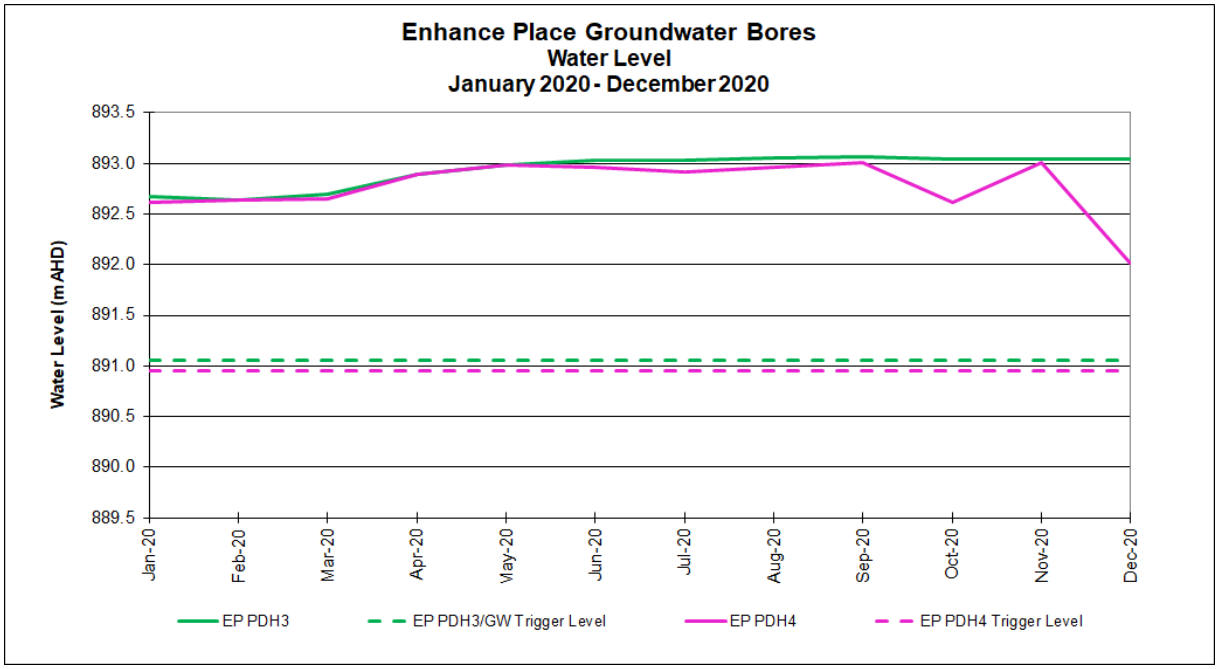

Figure 5 *Enhance Place Groundwater Standing Water Level 2020*

3.3 REVIEW & INTERPRETATION OF GROUND WATER MONITORING

3.3.1 SITE GROUNDWATER BORES

Groundwater monitoring is conducted on a monthly frequency at the on-site groundwater bores.

Groundwater samples collected from the on-site groundwater bores (P6, P7 and Old Shaft) during the January – December 2020 period generally indicate water quality results which are consistent throughout the 2020 monitoring period with the exception of the following:

- Electrical conductivity within Old Shaft decreased from 1470µS/cm in July to 687µS/cm in August and 362µS/cm in September. The electrical conductivity generally remained stable between October and December.
- Electrical conductivity within Bore P6 exhibited a notable decrease during September and October (refer **Table 17**).
- Elevated dissolved iron within Bore P7 was 2.02mg/L during August 2020: concentrations are generally below laboratory detection limits. A detected concentration was also reported during November.
- Dissolved iron concentration within Old Shaft during November 2020 was considerably lower (8.9mg/L) with concentrations generally reported between 20 – 40mg/L.

There were no instances during the 2020 monitoring period where the standing water level dropped below the respective water level triggers (refer **Figure 4**). A slight increasing trend in standing water level was observed at P6, P7 and Old Shaft during the period January – August 2020. A sharp increase in standing water level was observed across these three (3) bores during September 2020. Between October and December 2020 the water level within Bore P6 and Old Shaft remains relatively stable, while the water level within Bore P7 indicates a slight increasing trend.

The pH within the on-site bores were generally below the site-specific lower pH trigger values, noting that reported concentrations are rounded to one decimal place when comparing to the site-specific trigger values. The pH was below the site-specific lower pH trigger value during seven (7) of the twelve (12) monitoring events at groundwater bore P6 and P7 and eleven (11) of the twelve (12) monitoring events at Old Shaft. The pH was below the site-specific trigger value in nine (9) of the eleven (11) monitoring events undertaken at The Bong, noting that this is not indicative of groundwater quality. During 2020, there were no instances where the upper pH trigger levels (8.0 pH units) were exceeded.

The electrical conductivity at the site bores have also intermittently exceeded their respective conductivity trigger values throughout the 2020 monitoring period with the exception of Bore P7 and the Bong which was compliant throughout the year. Bore P6 exceeded the conductivity trigger value during eleven (11) of the twelve (12) monitoring events: a maximum concentration of 2000µS/cm was recorded in June 2020. The Old Shaft exceeded the trigger value during seven (7) of the twelve (12) monitoring events: a maximum concentration of 1530µS/cm was recorded during June 2020.

3.3.1.1 REVIEW OF SITE-SPECIFIC TRIGGER VALUES

The current approved site-specific trigger values detailed in the Water Management Plan (Ref [3]) and as presented in **Table 14** are derived from monitoring data collected in the period January 2011 – December 2014. Electrical conductivity and pH intermittently exceed the site-specific trigger values during the 2017 monitoring period; these were attributed to the below average rainfall observed during that year. A scheduled review of the groundwater monitoring data undertaken in accordance with the Water Management Plan (Ref [3]) recommended that the entire monitoring data set should be utilised in the derivation of the trigger values, which includes up to 12 years of data (2005 – 2017) for some monitoring locations, rather than be restricted to 2011-2014. The rationale for including all available data was that it provided robust data sets which were more representative of site conditions including varying climatic

influences. Revised trigger values based on all available monitoring data were derived and submitted to the DPIE – Natural Resources Access Regulator (NRAR) (formerly Department of Industries – Water) for approval. In March 2018, DPIE – NRAR rejected the request to revise the trigger values and recommended an investigation to be undertaken to determine the cause of the exceedances as a basis for the revision of the trigger values.

An investigation (Ref [11]) was undertaken by an external consultant and indicated that the likely cause of the decreasing pH trend observed in bore P6 and Old Shaft was likely to due to acid mine drainage. A decrease in groundwater levels at P6 and Old Shaft was observed from early 2010, with groundwater levels recovering in 2012. The increasing groundwater level interacted with exposed pyrite, generating acid. Increasing trends in dissolved cobalt, manganese, iron, nickel and zinc at Old Shaft and dissolved iron at P6 commenced in conjunction with recovering water levels in 2012 (Ref [11]). Revised site-specific trigger values were also provided and are summarised in **Table 22**. It is noted that the investigation recommended the removal of electrical conductivity as a trigger value.

Table 22 *Revised Trigger Values (Ref [11])*

Monitoring location	P6	P7	Old Shaft
pH trigger level[a]	5.6	6.3	5.4
Water Level (AHD)[b]	--	--	891.54

DPIE – NRAR advised that clarification be sought from the NSW EPA on the acceptance of the revised trigger values. At the time of writing this report, the revised trigger values shown in **Table 22** have been utilised alongside the approved trigger values in **Table 14**; however, an update to the Water Management Plan and submission to the DPIE for endorsement has not been undertaken.

Comparison of the groundwater quality of the onsite bores to the trigger values presented in **Table 22** indicates the following:

- The pH at Bore P6 is compliant for all twelve (12) monitoring events.
- The pH trigger value for Bore P7 remains unchanged, thus the pH remained below the lower pH trigger value for seven (7) of the twelve (12) monitoring events.
- The pH at Old Shaft is compliant for eleven (11) of the twelve (12) monitoring events.

Although the pH at Bore P7 remains consistently below the trigger level value, current activities undertaken at PDM are not considered to be the cause of the low pH value. It is noted that the pH at P7 is no longer trending downwards and continues to be stable throughout 2020. It is considered that the increase in rainfall observed during 2020 following a prolonged dry period has resulted in an increased flow which has the potential to mobilise stagnant low pH water which has accumulated during drought conditions. **Figure 4** illustrates the increase in standing water level during 2020 which is considered to be due to the increased rainfall (refer **Section 6** for a review of the rainfall during the 2020 monitoring period).

3.3.2 OFF-SITE GROUNDWATER BORES

Standing water level measurements and water quality monitoring was limited to Bore A during the 2020 monitoring period due to accessibility and safety issues from bushfire damage within Ben Bullen State forest. The results of limited water quality monitoring within Bore A shows that results are compliant with the respective water quality and water level trigger values.

3.3.3 ENHANCE PLACE GROUNDWATER BORES

Standing water level measurements at the two (2) monitoring bores located at the former Enhance Place Mine site are required to be measured on a monthly frequency. During 2020, the standing water level within the former Enhance Place Mine site shows a slight increasing trend during the period January – May 2020. Standing water levels within bore EP PDH3 then generally remain stable during the remainder of 2020 and levels within bore EP PDH4 indicate a slight decreasing trend with marked fluctuations during October and December 2020. The water level remains above the water trigger level value at both bores.

4 SURFACE WATER QUALITY MONITORING

4.1 SURFACE WATER ASSESSMENT CRITERIA

The purpose of surface water monitoring is to ensure that any impact of the mining operations on surface water bodies and streams can be identified, and to show compliance with relevant legislative requirements. Site specific trigger values for water quality parameters pH and electrical conductivity for PDM are stipulated in the PDM Water Management Plan (Ref [3]) in accordance with Schedule 3, Condition 27(c) of the Project Approval (Pa 10_0041). Trigger values for oil and grease and total suspended solids are not site specific and are uniform across all surface water sites. Surface water assessment criteria (Ref [3]) are presented in **Table 23**.

Table 23 *Surface Water Trigger Values*

Surface Water Site	pH (range)	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Oil and Grease (mg/L)
S1	6.2 – 8.0	2325	30	10
S2	NA	NA	NA	NA
S3	6.4 – 8.0	2223	30	10
S4	7.3 – 8.0	957	30	10
S5	7.0 – 8.0	1013	30	10
S6	6.7 – 8.0	1941	30	10
S7	6.8 – 8.0	1007	30	10
EPA Point 2	7.1 – 8.0	2055	30	NA
EPA Point 3	6.4 – 8.0	2223	30	NA
EPA Point 13	6.5 – 8.0^	NA	30^	10
EPA Point 14	7.5 – 8.0	1166	30	NA

NA – no trigger value required for these locations.

^refers to maximum concentration limits applicable during discharge events as detailed in EPL 4911 section L2.

4.2 SURFACE WATER MONITORING DATA SUMMARY

Surface water monitoring for the Pine Dale Mine was undertaken in accordance with the Water Management Plan (Ref [3]) and EPL 4911 (Ref [1]) at twelve (12) monitoring locations within and surrounding the mine site (refer **Drawing 1**, **Appendix 1**). Frequency is on a monthly and quarterly basis for routine samples depending on location in accordance with the Water Management Plan (Ref [3]) and EPL.

No samples were collected at EPL Point 13 (discharge to concrete lined section of Neubecks Creek), as there was no discharge from the mine during the 2020 monitoring period.

Surface water summary results for the period January – December 2020 are shown in **Tables 26** to **35**. Graphical presentations are shown in **Figures 6** to **10**.

Table 24 *Surface Water Monitoring Location EPL Point 2 Results 2020*

Location	**EPL Point 2**				**Trigger Value**
Sample No	02206880009	5206880009	08206880009	1120688009	
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	11/02/2020	6/05/2020	3/08/2020	3/11/2020	
Time Sampled	15:52	08:35	15:45	07:52	
pH (pH units)	7.16	7.27	7.33	7.21	**7.1 – 8.0**
Conductivity (µS/cm)	783	598	581	676	**2055**
Sulphate (mg/L)	337	158	178	145	
Iron filterable (mg/L)	0.05	0.06	0.06	0.1	
TSS (mg/L)	16	5	<5	<5	**30**
Turbidity (NTU)	<1	2	4	3	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 25 *Surface Water Monitoring Location EPL Point 3 Results 2020*

Location	EPL Point 3				Trigger Value
Sample No	02206880004	05206880004	8206880004	11206880004	
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	11/02/2020	6/05/2020	3/08/2020	3/11/2020	
Time Sampled	16:30	10:31	15:55	09:20	
pH (pH units)	7.38	7.42	7.08	7.27	**6.4 – 8.0**
Conductivity (µS/cm)	724	981	440	2210	**2223**
Sulphate (mg/L)	318	400	586	842	
Iron filterable (mg/L)	0.06	0.18	0.62	0.3	
TSS (mg/L)	16	9	7	7	**30**
Turbidity (NTU)	<1	2	4	11	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 26 *Surface Water Monitoring Location EPL Point 14 Results 2020*

Location	EPL Point 14				Trigger Value
Sample No	02206880010	05206880010	8206880010	11206880010	
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	11/02/2020	7/05/2020	3/08/2020	2/11/2020	
Time Sampled	16:41	07:03	15:55	09:32	
pH (pH units)	7.63	6.91	7.25	7.10	**7.5 – 8.0**
Conductivity (µS/cm)	**1930**	1010	614	681	**1166**
Sulphate (mg/L)	819	473	1730	226	
Iron filterable (mg/L)	<0.05	0.07	<0.05	0.11	
TSS (mg/L)	7	7	<5	10	**30**
Turbidity (NTU)	<1	3	10	3	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 27 *Surface Water Monitoring Location S1 Results 2020*

Location	Surface Water S1												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880002	02206880002	03206880002	04206880002	05206880002	06206880001	07206880002	08206880002	09206880002	10206880002	11206880002	12206880002	
Date Sampled	14/01/20	11/02/20	10/03/20	7/04/20	6/05/20	3/06/20	2/07/20	3/08/20	3/09/20	1/10/20	3/11/20	3/12/20	
Time Sampled	16:53	14:40	14:35	15:18	8:30	14:35	15:35	15:34	16:25	16:31	7:41	16:26	
Temperature (°C)	22.0	23.9	18.9	14.7	9.6	10.9	11.3	10.1	15.1	15.8	12.8	22.5	
pH	7.62	7.16	7.35	7.14	6.91	6.73	7.10	7.04	7.08	6.64	7.15	7.52	**6.2 – 8.0**
Conductivity (µS/cm)	4740	783	921	100	1610	3440	3330	1720	1830	638	2180	2670	**2325**
Turbidity (NTU)	15	<1	3	14	2	<1	2	2	<1	<1	3	21	
Dissolved Oxygen (mg/L)	--	6.0	--	--	10.0	--	--	8.1	--	--	8.0	--	
TSS (mg/L)	--	14	--	--	7	--	--	6	--	--	5	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	35	--	--	57	--	--	61	--	--	89	--	
Total Alkalinity (mg/L)	--	35	--	--	57	--	--	61	--	--	89	--	
Sulphate (mg/L)	--	322	--	--	629	--	--	619	--	--	858	--	
Chloride (mg/L)	--	36	--	--	117	--	--	81	--	--	131	--	
Calcium (mg/L)	--	52	--	--	73	--	--	64	--	--	86	--	
Magnesium (mg/L)	--	33	--	--	56	--	--	46	--	--	63	--	
Sodium (mg/L)	--	76	--	--	226	--	--	209	--	--	288	--	
Potassium (mg/L)	--	10	--	--	17	--	--	16	--	--	22	--	
Cobalt (dissolved) (mg/L)	--	0.006	--	--	0.005	--	--	0.002	--	--	0.006	--	
Manganese(dissolved) (mg/L)	--	0.51	--	--	0.436	--	--	0.208	--	--	0.44	--	
Nickel (dissolved) (mg/L)	--	0.046	--	--	0.078	--	--	0.048	--	--	0.099	--	
Zinc (dissolved) (mg/L)	--	0.034	--	--	0.025	--	--	0.01	--	--	0.024	--	
Iron (dissolved) (mg/L)	--	0.06	--	--	0.07	--	--	0.10	--	--	0.06	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

Table 28 *Surface Water Monitoring Location S2 Results 2020*

Location	Surface Water Site S2											
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sample Number	01206880003	02206880003	03206880003	04206880002	05206880003	06206880003	07206880003	08206880003	09206880003	10206880003	11206880003	12206880003
Date Sampled	14/01/2020	11/02/2020	10/03/2020	7/04/2020	6/05/2020	3/06/2020	2/07/2020	3/08/2020	3/09/2020	1/10/2020	3/11/2020	3/12/2020
Time Sampled	17:00	13:58	14:10	14:30	7:19	13:47	14:49	14:46	16:30	15:08	7:31	14:53
Depth to Surface from Top of Rail Bridge (m)	3.77	3.70	3.74	3.75	3.71	3.73	3.75	3.74	3.71	3.73	3.73	3.75

Table 29 *Surface Water Monitoring Location S3 Results 2020*

Location	Surface Water S3												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880004	02206880004	03206880004	04206880004	05206880004	06206880004	07206880004	08206880004	09206880004	10206880004	11206880004	12206880004	
Date Sampled	14/01/20	11/02/20	10/03/20	7/04/20	6/05/20	3/06/20	2/07/20	3/08/20	3/09/20	2/10/20	3/11/20	3/12/20	
Time Sampled	17:02	16:30	14:40	15:30	10:31	15:51	15:45	15:55	16:35	6:48	9:20	14:46	
Temperature (°C)	24.5	23.8	19.7	14.9	12.1	11.5	10.2	9.9	15.0	11.4	12.2	24.5	
pH	7.95	7.38	7.40	7.19	7.42	7.38	7.26	7.08	7.10	7.06	7.27	7.38	**6.4 – 8.0**
Conductivity (µS/cm)	936	724	863	1230	981	3090	2740	440	1720	632	2210	2520	**2223**
Turbidity (NTU)	17	<1	5	11	2	1	3	4	3	3	11	<1.0	
Dissolved Oxygen (mg/L)	--	6.0	--	--	9.0	--	--	8.0	--	--	4.8	--	
TSS (mg/L)	--	16	--	--	9	--	--	7	--	--	7	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	35	--	--	58	--	--	51	--	--	87	--	
Total Alkalinity (mg/L)	--	35	--	--	58	--	--	51	--	--	87	--	
Sulphate (mg/L)	--	318	--	--	400	--	--	586	--	--	842	--	
Chloride (mg/L)	--	36	--	--	61	--	--	75	--	--	127	--	
Calcium (mg/L)	--	52	--	--	48	--	--	62	--	--	85	--	
Magnesium (mg/L)	--	32	--	--	35	--	--	43	--	--	62	--	
Sodium (mg/L)	--	74	--	--	132	--	--	183	--	--	281	--	
Potassium (mg/L)	--	9	--	--	10	--	--	14	--	--	22	--	
Cobalt (dissolved) (mg/L)	--	0.006	--	--	0.005	--	--	0.01	--	--	0.009	--	
Manganese(dissolved) (mg/L)	--	0.58	--	--	0.502	--	--	0.993	--	--	0.772	--	
Nickel (dissolved) (mg/L)	--	0.044	--	--	0.045	--	--	0.055	--	--	0.094	--	
Zinc (dissolved) (mg/L)	--	0.029	--	--	0.024	--	--	0.04	--	--	0.036	--	
Iron (dissolved) (mg/L)	--	0.06	--	--	0.18	--	--	0.62	--	--	0.30	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

Table 30 *Surface Water Monitoring Location S4 Results 2020*

Location	Surface Water S4												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880005	02206880005	03206880005	04206880005	05206880005	06206880005	07206880005	08206880005	09206880005	10206880005	11206880005	12206880005	
Date Sampled	14/01/20	11/02/20	10/03/20	8/04/20	6/05/20	3/06/20	3/07/20	4/08/20	4/09/20	2/10/20	3/11/20	3/12/20	
Time Sampled	16:30	16:00	16:00	8:10	10:00	15:20	8:15	7:45	7:54	8:52	11:30	15:52	
Temperature (°C)	26.0	24.3	19.6	12.9	12.8	9.1	8.6	4.2	11.8	11.2	17.0	23.2	
pH	8.72	6.54	4.48	5.27	6.46	7.37	6.70	7.00	6.63	6.81	7.21	7.62	**7.3 – 8.0**
Conductivity (µS/cm)	494	1280	1430	540	371	412	360	223	162	167	192	330	**957**
Turbidity (NTU)	41	<1	1	2	2	1	28	3	5	6	3	8	
Dissolved Oxygen (mg/L)	--	4.0	--	--	7.0	--	--	7.6	--	--	5.5	--	
TSS (mg/L)	--	22	--	--	<5	--	--	<5	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	9	--	--	9	--	--	17	--	--	51	--	
Total Alkalinity (mg/L)	--	9	--	--	9	--	--	17	--	--	51	--	
Sulphate (mg/L)	--	602	--	--	152	--	--	61	--	--	23	--	
Chloride (mg/L)	--	9	--	--	13	--	--	11	--	--	6	--	
Calcium (mg/L)	--	129	--	--	20	--	--	8	--	--	8	--	
Magnesium (mg/L)	--	52	--	--	10	--	--	5	--	--	5	--	
Sodium (mg/L)	--	90	--	--	33	--	--	17	--	--	12	--	
Potassium (mg/L)	--	34	--	--	9	--	--	6	--	--	2	--	
Cobalt (dissolved) (mg/L)	--	0.025	--	--	0.001	--	--	<0.001	--	--	<0.001	--	
Manganese(dissolved) (mg/L)	--	4.25	--	--	0.361	--	--	0.012	--	--	0.021	--	
Nickel (dissolved) (mg/L)	--	0.016	--	--	0.002	--	--	<0.001	--	--	0.001	--	
Zinc (dissolved) (mg/L)	--	0.362	--	--	0.072	--	--	0.008	--	--	<0.005	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	0.09	--	--	0.08	--	--	0.2	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

Table 31 *Surface Water Monitoring Location S5 Results 2020*

Location	Surface Water S5												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880006	02206880006	03206880006	04206880006	05206880006	06206880006	07206880006	08206880006	09206880006	10206880006	11206880006	12206880006	
Date Sampled	14/01/20	11/02/20	10/03/20	8/04/20	6/05/20	3/06/20	3/07/20	4/08/20	4/09/20	2/10/20	3/11/20	3/12/20	
Time Sampled	16:26	16:05	16:05	8:15	9:58	15:26	8:10	7:41	7:51	8:50	11:30	15:55	
Temperature (°C)	24.0	25.0	21.1	15.1	13.0	10.9	8.7	6.1	12.7	12.1	20.4	25.0	
pH	7.30	7.41	6.95	6.45	6.26	6.33	6.11	6.79	6.42	6.81	6.89	7.56	**7.0 – 8.0***
Conductivity (µS/cm)	2230	1600	2120	1520	906	1650	1400	658	672	717	642	1240	**1013**
Turbidity (NTU)	13	<1	4	37	6	19	21	18	12	6	29	2	
Dissolved Oxygen (mg/L)	--	6.0	--	--	6.0	--	--	7.8	--	--	4.9	--	
TSS (mg/L)	--	9	--	--	11	--	--	6	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	6	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	70	--	--	29	--	--	34	--	--	54	--	
Total Alkalinity (mg/L)	--	70	--	--	29	--	--	34	--	--	54	--	
Sulphate (mg/L)	--	618	--	--	401	--	--	218	--	--	232	--	
Chloride (mg/L)	--	101	--	--	50	--	--	32	--	--	34	--	
Calcium (mg/L)	--	96	--	--	55	--	--	28	--	--	29	--	
Magnesium (mg/L)	--	68	--	--	36	--	--	18	--	--	20	--	
Sodium (mg/L)	--	204	--	--	111	--	--	62	--	--	68	--	
Potassium (mg/L)	--	21	--	--	14	--	--	9	--	--	7	--	
Cobalt (dissolved) (mg/L)	--	0.013	--	--	0.017	--	--	0.005	--	--	0.004	--	
Manganese(dissolved) (mg/L)	--	1.19	--	--	1.23	--	--	0.379	--	--	0.316	--	
Nickel (dissolved) (mg/L)	--	0.101	--	--	0.057	--	--	0.025	--	--	0.029	--	
Zinc (dissolved) (mg/L)	--	0.04	--	--	0.09	--	--	0.025	--	--	0.014	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	0.07	--	--	0.09	--	--	0.16	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required during particular period.

Table 32 *Surface Water Monitoring Location S6 Results 2020*

Location	Surface Water S6												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880007	02206880007	03206880007	04206880007	05206880007	06206880007	07206880007	08206880007	09206880007	10206880007	11206880007	12206880007	
Date Sampled	14/01/20	11/02/20	10/03/20	8/04/20	6/05/20	3/06/20	3/07/20	4/08/20	4/09/20	2/10/20	3/11/20	3/12/20	
Time Sampled	16:25	15:45	16:00	8:05	9:51	15:12	8:00	7:36	7:46	8:46	11:20	15:50	
Temperature (°C)	28.4	23.8	20.4	13.5	11.0	10.5	8.0	4.6	12.7	11.0	18.9	24.1	
pH	8.17	7.64	7.67	7.48	7.37	7.45	7.37	7.17	7.24	7.60	7.31	7.44	**6.7 – 8.0**
Conductivity (µS/cm)	6100	805	1190	1590	1540	2740	2870	1450	1750	677	1980	2530	**1941**
Turbidity (NTU)	23	<1	1	3	2	<1	2	1	2	4	<1	17	
Dissolved Oxygen (mg/L)	--	5.0	--	--	7.0	--	--	9.9	--	--	5.5	--	
TSS (mg/L)	--	11	--	--	6	--	--	<5	--	--	6	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	38	--	--	61	--	--	50	--	--	80	--	
Total Alkalinity (mg/L)	--	38	--	--	61	--	--	50	--	--	80	--	
Sulphate (mg/L)	--	329	--	--	590	--	--	583	--	--	822	--	
Chloride (mg/L)	--	40	--	--	109	--	--	75	--	--	121	--	
Calcium (mg/L)	--	54	--	--	69	--	--	64	--	--	83	--	
Magnesium (mg/L)	--	34	--	--	53	--	--	44	--	--	61	--	
Sodium (mg/L)	--	79	--	--	213	--	--	180	--	--	266	--	
Potassium (mg/L)	--	10	--	--	16	--	--	14	--	--	21	--	
Cobalt (dissolved) (mg/L)	--	0.004	--	--	0.008	--	--	0.008	--	--	0.006	--	
Manganese(dissolved) (mg/L)	--	0.4	--	--	0.711	--	--	0.89	--	--	0.578	--	
Nickel (dissolved) (mg/L)	--	0.043	--	--	0.08	--	--	0.055	--	--	0.086	--	
Zinc (dissolved) (mg/L)	--	0.017	--	--	0.035	--	--	0.033	--	--	0.013	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	<0.05	--	--	0.06	--	--	<0.05	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

Table 33 *Surface Water Monitoring Location S7 Results 2020*

Location	Surface Water S7												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Sample Number	01206880008	02206880008	03206880008	04206880008	05206880008	06206880008	07206880008	08206880008	09206880008	10206880008	11206880008	12206880008	
Date Sampled	14/01/20	11/02/20	10/03/20	8/04/20	6/05/20	3/06/20	3/07/20	4/08/20	4/09/20	2/10/20	3/11/20	3/12/20	
Time Sampled	16:08	15:38	15:45	8:00	9:32	15:05	7:50	7:26	7:40	8:40	11:08	15:38	
Temperature (°C)	26.0	23.9	20.4	14.8	11.5	10.5	9.7	6.3	12.9	11.8	17.9	23.8	
pH	7.72	7.17	7.06	6.67	6.42	6.78	6.71	7.00	6.48	7.14	6.73	7.11	**6.8 – 8.0***
Conductivity (µS/cm)	2380	1930	2110	1550	1150	1520	1170	697	606	740	692	1390	**1007**
Turbidity (NTU)	13	<1	2	11	6	2	5	10	6	2	1	18	
Dissolved Oxygen (mg/L)	--	5.0	--	--	6.0	--	--	6.9	--	--	5.6	--	**10**
TSS (mg/L)	--	6	--	--	<5	--	--	<5	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	
Bicarbonate Alkalinity (mg/L)	--	91	--	--	40	--	--	39	--	--	58	--	
Total Alkalinity (mg/L)	--	91	--	--	40	--	--	39	--	--	58	--	
Sulphate (mg/L)	--	691	--	--	480	--	--	234	--	--	245	--	
Chloride (mg/L)	--	122	--	--	62	--	--	33	--	--	35	--	
Calcium (mg/L)	--	111	--	--	65	--	--	30	--	--	32	--	
Magnesium (mg/L)	--	81	--	--	44	--	--	20	--	--	21	--	
Sodium (mg/L)	--	252	--	--	133	--	--	65	--	--	70	--	
Potassium (mg/L)	--	26	--	--	15	--	--	10	--	--	8	--	
Cobalt (dissolved) (mg/L)	--	0.007	--	--	0.012	--	--	0.003	--	--	0.001	--	
Manganese(dissolved) (mg/L)	--	1.05	--	--	1.38	--	--	0.376	--	--	0.198	--	
Nickel (dissolved) (mg/L)	--	0.111	--	--	0.075	--	--	0.026	--	--	0.026	--	
Zinc (dissolved) (mg/L)	--	0.024	--	--	0.091	--	--	0.019	--	--	0.016	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	0.19	--	--	0.28	--	--	0.22	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required during particular period.

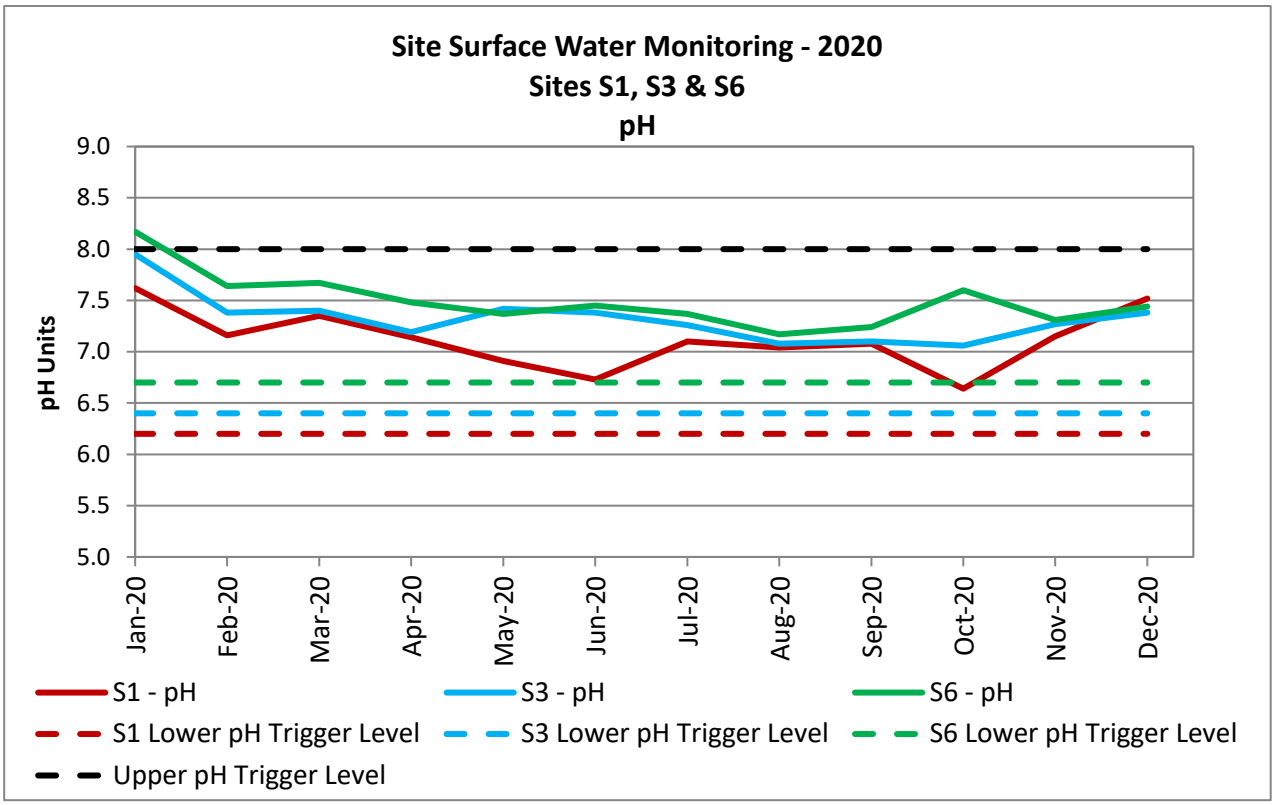

Figure 6 *Site Surface Water S1, S3 & S6 pH Results 2020*

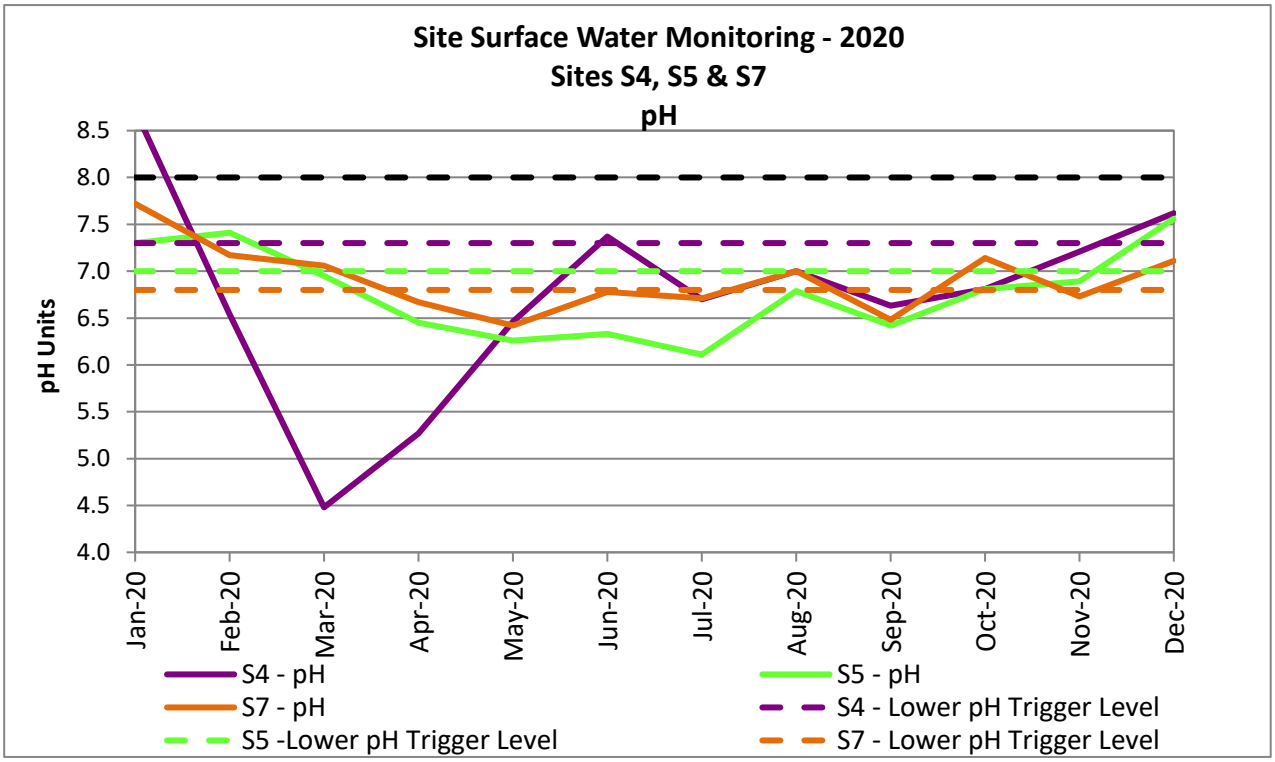

Figure 7 *Site Surface Water S4, S5 & S7 pH Results 2020*

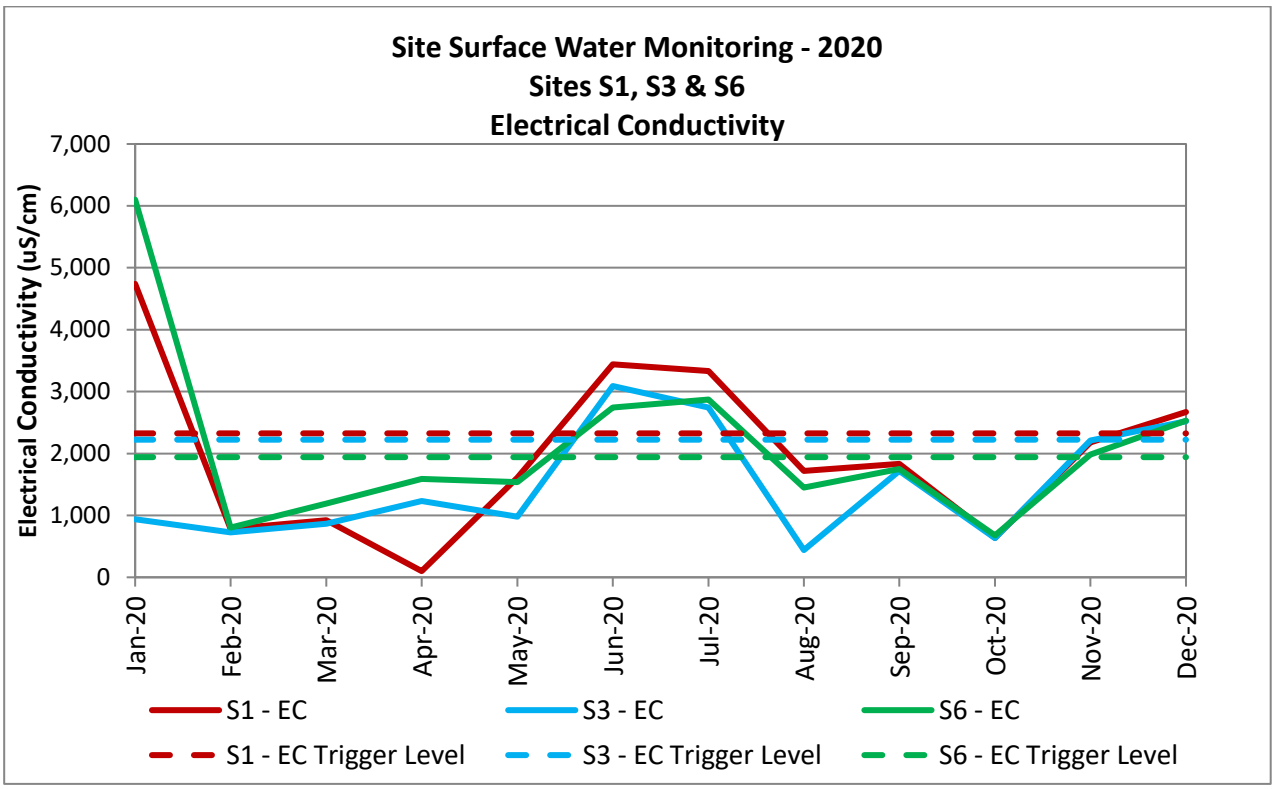

Figure 8 *Site Surface Water S1, S3 & S6 Electrical Conductivity Results 2020*

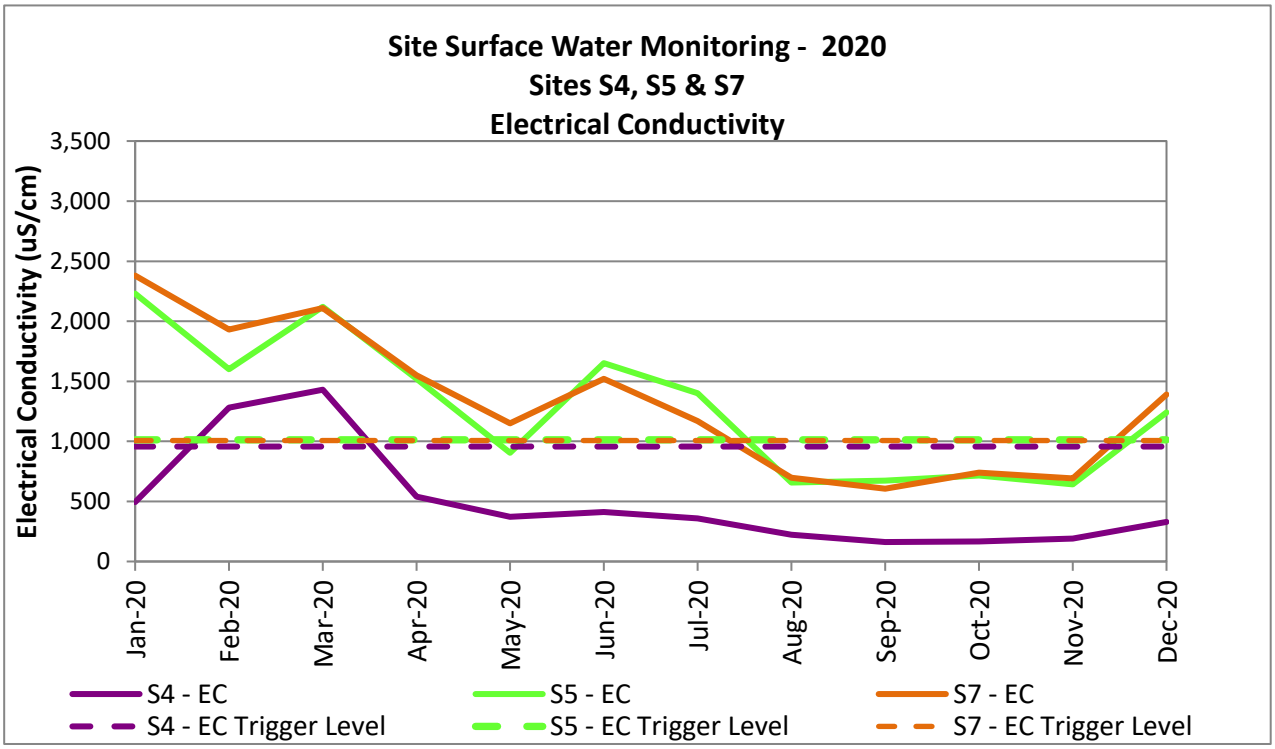

Figure 9 *Site Surface Water S4, S5 & S7 Electrical Conductivity Results 2020*

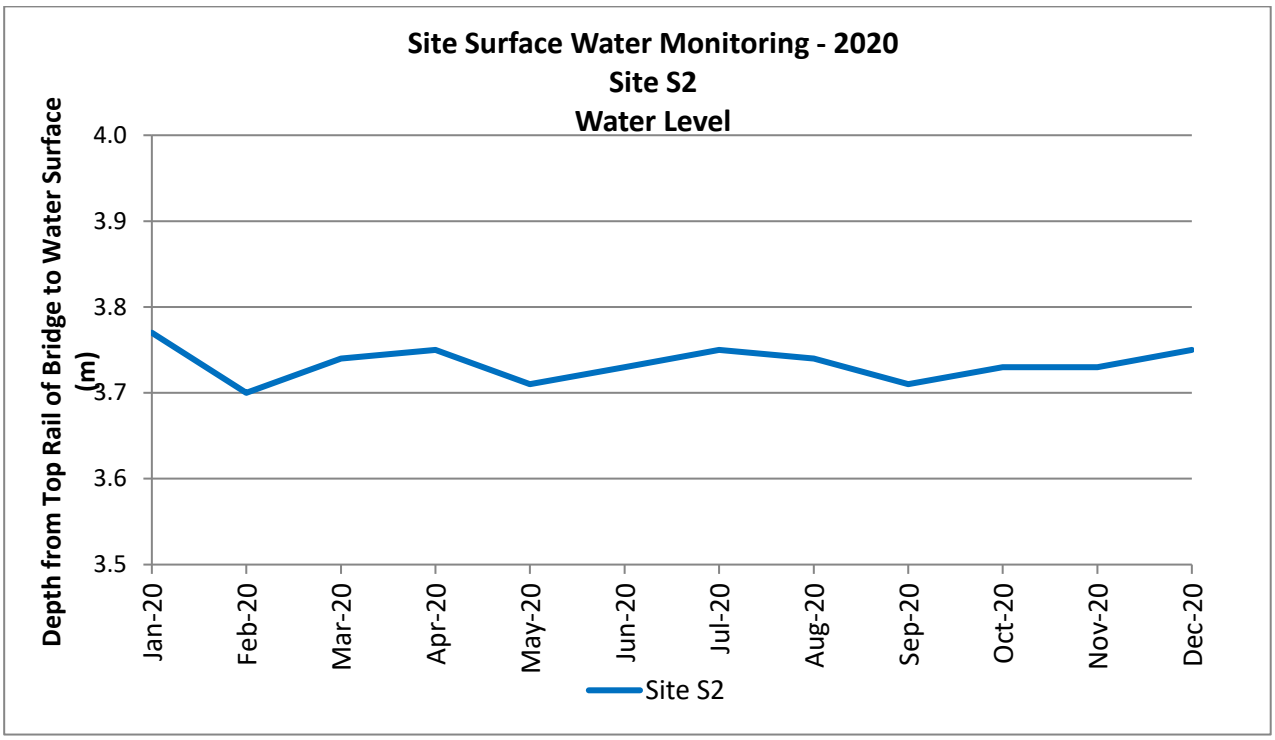

Figure 10 *Site Surface Water S2 – 2020 Water Level*

4.3 REVIEW & INTERPRETATION OF SURFACE WATER MONITORING RESULTS

4.3.1 EPL SURFACE WATER

Surface water monitoring is required to be undertaken at four (4) surface water monitoring locations as detailed in EPL 4911. These monitoring points are:

- EPA Point 2: ambient water monitoring point.
- EPA Point 3: ambient water monitoring point.
- EPA Point 14: ambient water monitoring point.
- EPA Point 13: discharge quality monitoring point.

Water quality monitoring is required to be undertaken at EPA Point 13 daily during discharge; there were no discharge events during the 2020 monitoring period, therefore, no sampling or analysis was undertaken at EPA Point 13 during the 2020 monitoring period.

EPL 4911 stipulates maximum concentrations limits applicable to EPA Point 13 discharge events as detailed in **Table 26**. No concentration limits are detailed in EPL 4911 for EPA Points 2, 3 and 14.

The PDM Water Management Plan (Ref [3]) stipulates monitoring of EPA Point 2, 3, 14 is to be undertaken on a quarterly basis for pH, electrical conductivity, turbidity, total suspended solids, sulfate and filterable (dissolved) iron. Trigger values for these quarterly monitoring events are detailed in the Water Management Plan (Ref [3]); however, compliance with these trigger values are not an EPL requirement.

During the 2020 monitoring period, four (4) quarterly surface water monitoring events were conducted at EPA Point 2, 3 and 14. These events were conducted during February, May, August and November 2020. The results of the water quality monitoring were generally compliant with respective water quality trigger levels. pH was compliant with the respective site-specific trigger values with the exception of the following:

- EPA Point 14 was below the lower pH trigger level value during three (3) of the four (4) water quality monitoring events.

Electrical conductivity was compliant with the respective trigger values at all locations during all monitoring events with the exception of the February 2020 results at EPA Point 14.

All EPL locations exhibited total suspended solids (TSS) concentrations below the trigger value during all monitoring events.

4.3.2 SITE SURFACE WATER

Site surface water samples were collected monthly during the January to December 2020 monitoring period.

During the 2020 monitoring period, pH was generally compliant with the site-specific trigger values with the exception of the following surface water locations:

- S4 was above the upper pH trigger value during one (1) of the twelve (12) monitoring events (January 2020) and below the lower pH trigger value during nine (9) of the twelve (12) monitoring events.
- S5 was below the lower pH trigger value during eight (8) of the twelve (12) monitoring events.
- S6 was above the upper pH trigger value during one (1) of the twelve (12) monitoring events.
- S7 was below the lower pH trigger value during five (5) of the twelve (12) monitoring events.

During the 2020 monitoring period, electrical conductivity intermittently exceeded the site specific trigger values:

- S1 during four (4) of the twelve (12) monitoring events. The greatest electrical conductivity level was 4740 µS/cm, observed during January 2020.
- S3 during three (3) of the twelve (12) monitoring events. The greatest electrical conductivity level was 3090 µS/cm, observed during June 2020.
- S4 during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1430 µS/cm, observed during March 2020.
- S5 during seven (7) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2230 µS/cm, observed during January 2020.
- S6 during six (6) of the twelve (12) monitoring events. The greatest electrical conductivity level was 6100 µS/cm, observed during December 2020.
- S7 during eight (8) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2380 µS/cm, observed during January 2020.

Historically, conductivity generally increases in response to decreased rainfall. This trend was generally observable during 2020 as shown in **Figure 11**. Historically, water monitoring locations in Neubecks Creek (surface water sites S1, S3 and S6) indicate larger increases in electrical conductivity due to decreased rainfall than the surface water sites located at Blue Lake (S5) and Coxs River (S4, upstream of Blue Lake and S7, downstream of Blue Lake). A review of the surface water data (Ref [11]) indicated that increases in electrical conductivity at surface water sites S1, S3 and S6 is attributable to the increase in electrical conductivity upstream of PDM. A licence discharge point (not associated with PDM or EPL 4911) is located at the confluence of EPL Point 2 and it is considered that the volume and conductivity concentration of the discharge located upstream of PDM has the greatest influence upon electrical conductivity within Neubecks Creek.

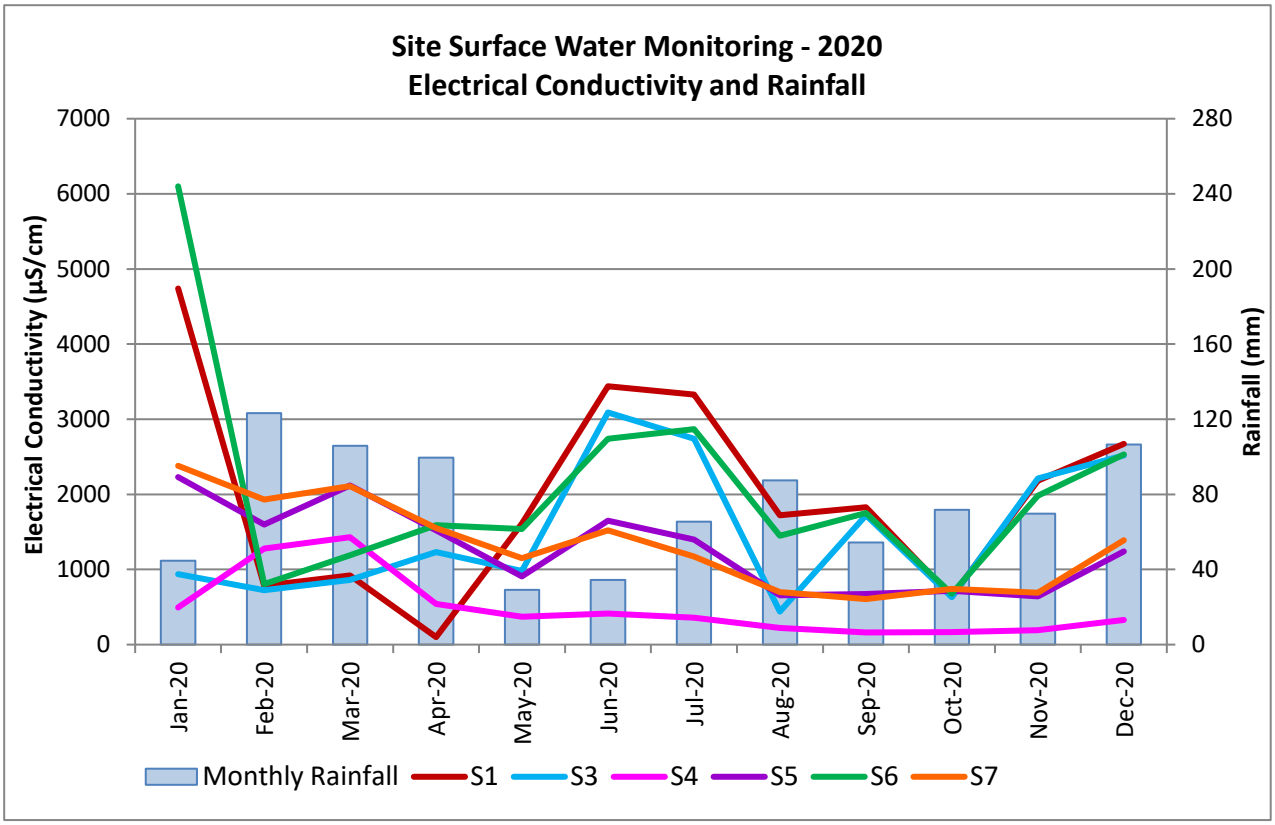

Figure 11 *Site Surface Water Electrical Conductivity and Monthly Rainfall*

The GHD report (Ref [11]) also proposed revised trigger levels for surface water. The investigation indicated that surface water sites EPA Point 2, S1 are considered appropriate background sites for the purpose of assessing influences of PDM on water quality. Surface water site S4 is located within Coxs River, upstream of the confluence of Neubecks Creek and also does not receive any water from PDM. The revised trigger values (Ref [11]) are shown in **Table 34**.

Table 34 *Revised Surface Water Trigger Values (Ref [11])*

pH trigger level[a]	6.5 – 8.0	6.5 – 8.0
Electrical conductivity (µs/cm)	5592	5592
TSS (mg/L)	25	25

[a] pH trigger level is exceeded if the pH is outside the nominated range.

The trigger values presented in **Table 34** are applicable to all PDM surface water monitoring sites, noting that EPA Point 2, S1 and S4 are not influenced by activities at PDM.

At the time of writing of this report, the revised trigger values shown in **Table 34** have been utilised alongside the approved trigger values in **Table 23**; however, an update to the Water Management Plan (Ref [3]) and submission to the DPIE for endorsement has not yet been undertaken.

Water quality within Neubecks Creek and Coxs River was generally within the revised surface water trigger values (refer **Table 34**) with the exception of the following:

- S4 was above the lower pH trigger level during the March 2020 monitoring event.
- S5 was in excess of the lower pH trigger for four (4) of the twelve monitoring events undertaken during 2020.
- S6 was in excess of the electrical conductivity trigger level during January 2020.
- S7 was below the lower pH trigger level during the May 2020 monitoring event.

5 METEOROLOGICAL MONITORING

5.1 METEOROLOGICAL MONITORING REQUIREMENTS

PDM records meteorological data continuously via an on-site meteorological monitoring station in accordance with the requirements of EPL 4911. The meteorological monitoring requirements of EPL 4911 are presented in **Table 35**.

Table 35 *EPL Meteorological Monitoring Requirements*

Parameter	Units of Measure	Frequency	Averaging Period
Air temperature	°C	Continuous	1 hour
Wind direction	°	Continuous	15 minute
Wind speed	m/s	Continuous	15 minute
Sigma theta	°	Continuous	15 minute
Rainfall	mm	Continuous	15 minute
Relative humidity	%	Continuous	1 hour

5.2 METEOROLOGICAL MONITORING RESULTS

Meteorological monitoring Parameters recorded at the PDM Meteorological Monitoring Station include wind speed, wind direction, temperature at 10m height, temperature at 2m height, rainfall, humidity, solar radiation, sigma theta and evapotranspiration. Details of weather data recorded for the period January to December 2020 are summarised in **Table 36**.

Table 36 *Meteorological Monitoring Summary Data 2020*

Month (2020)	Rainfall (mm)	Cumulative Rainfall (mm)	No. of Rain Days/ Month	Air Temp. @ 2m (°C)			Air Temp. @ 10m (°C)			Sigma theta (º)			Relative Humidity (%)			Wind Speed (m/s)			Modal Wind Direction
				Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Jan	44.6	44.6	15	21.8	10	40.1	21.3	10	37.9	35.7	4.5	101.2	67.3	11.0	101.6	1.9	0.0	20.6	E
Feb	123.2	167.8	18	18.9	4.3	41.8	18.5	4.9	40.1	37.9	6.8	103.2	77.2	11.6	101.9	1.7	0.0	14.7	E
Mar	105.8	273.6	15	15.5	5.2	32.2	15.2	5.6	30.9	38.7	4.0	101.4	80.0	13.0	101.9	1.5	0.0	13.8	ESE
April	99.6	373.2	7	12.4	-0.6	25.8	12.3	-0.8	24.4	33.3	3.7	103.2	79.3	13.4	101.9	1.9	0.0	20.0	WNW
May	29.2	402.4	17	7.3	-4.5	20.8	7.3	-4.7	19.4	35.8	3.6	103.1	86.5	24.8	101.9	1.7	0.0	16.6	WNW
June	34.4	436.8	12	6.5	-5.3	17.8	6.6	-5.3	17.1	36.9	5.1	103.5	87.1	35.8	101.9	1.5	0.0	15.9	WSW
July	65.4	502.2	15	5.5	-5.8	17.3	5.6	-5.8	16.6	38.7	4.0	102.9	87.4	25.9	101.9	1.3	0.0	15.0	WNW
Aug	87.4	589.6	13	5.8	-5.8	20.5	5.7	-5.8	20	30.8	3.3	102.3	81.0	14.2	101.9	2.3	0.0	18.0	W
Sept	54.4	644	11	10.2	-1.9	24.4	10.0	-2	23.2	33.3	4.7	102.5	77.5	21.7	101.9	2.1	0.0	17.5	NW
Oct	71.8	715.8	15	13.6	0.2	27.1	13.3	0.5	25.1	35.6	4.3	102.9	76.8	11.6	101.9	1.8	0.0	14.0	WNW
Nov	69.8	785.6	12	16.7	3.1	34.4	16.3	2.9	33	37.5	2.8	103.6	71.3	12.1	101.9	1.8	0.0	17.4	NW
Dec	106.6	892.2	15	17.0	3.4	36.3	16.6	3.4	35.3	36.0	6.2	103.2	77.1	13.1	101.9	2.0	0.0	15.0	E
TOTAL	***892.2***	**-**	***165***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-
Minimum	***29.2***	**-**	***7***	**-**	***-5.8***	**-**	**-**	***-5.8***	**-**	**-**	***2.8***	**-**	**-**	***11.0***	**-**	**-**	***0.0***	**-**	-
Maximum	***123.2***	**-**	***18***	**-**	**-**	***41.8***	**-**	**-**	***40.1***	**-**	**-**	***103.6***	**-**	**-**	***101.9***	**-**	**-**	***20.6***	-

5.3 REVIEW OF METEOROLOGICAL MONITORING RESULTS

PDM received 892.2mm of rainfall across 165 days during the 2020 monitoring period. Rainfall during this period was observed to be greater than the 2019 (350.2mm), 2018 (660.4mm) and 2017 2017 (577.0mm) annual rainfall amounts. The maximum 2m and 10m temperatures recorded during the reporting period were 41.8°C and 40.1°C respectively; both occurred in February 2020. The lowest temperature was observed during both July and August with -5.8°C recorded at both 2m and 10m. Predominant wind directions at the PDM during 2020 were observed to generally be from a west-north westerly direction.

6 STREAM HEALTH & CHANNEL STABILITY MONITORING

6.1 STREAM HEALTH & CHANNEL STABILITY MONITORING SUMMARY

Schedule 3 Condition 27(b) of Project Approval PA 10_0041 requires performance criteria and a programme to monitor the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially be affected by the PDM. As defined in Schedule 3 Condition 27(b) of the Project Approval, the creeks and other water bodies that could potentially be affected by the project include Neubecks Creek, the Blue Lake and Coxs River.

A Channel Stability and Stream Health Monitoring programme is outlined in Section 4.6.5 of the PDM Water Management Plan (Ref [3]) for the purpose of monitoring channel stability and stream health and vegetation health of Neubecks Creek. In addition to the requirements of the Channel Stability and Stream Health Monitoring programme, the water bodies of Blue Lake and Coxs River have also been included in the monitoring programme, to satisfy the conditions outlined in the Project Approval (Ref [2]).

In accordance with the Channel Stability and Stream Health Monitoring programme, routine six-monthly assessments of Neubecks Creek, Blue Lake and Coxs River were undertaken in March and October 2020. The performance criteria utilised for the stream health assessment of each monitoring point is derived from the CSIRO Ephemeral Stream Assessment protocol (Ref [12]) which is reproduced in **Table 39**.

Visual assessments and photographic documentation of each site are also undertaken on a monthly basis detailing evidence of erosion, newly exposed soils, and vegetation disturbance (refer to monitoring field sheets presented in **Appendix 2**). Results of the routine six-monthly assessments are presented in **Tables 40** to **46**. The locations of stream health monitoring sites are presented in **Drawing 2**, **Appendix 1**.

A stream health assessment of the Blue Lake site was not undertaken, as the site does not fit the requirements of the Ephemeral Stream Assessment protocol (Ref [12]), which has been developed for streams and drainage lines. Nevertheless, the Blue Lake is still included in monthly erosion and vegetation disturbance observation inspections.

Table 37 *Classification of Different Drainage Line States (CSIRO)*

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

Table Source: CSIRO Ephemeral Stream Assessment (CSIRO, undated)

Table 38 *Classification of Different Drainage Line State – Site SH1*

Location:		**SH1**	
Assessment Date:		**11 March 2020 & 2 October 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake and/or disperse are exposed on less than 0.3m of wall height.
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland: low inflow rate, mostly diffuse.
2020 Overall Scores			
Classification of Drainage Line March 2020 survey		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.
Classification of Drainage Line October 2020 survey		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 39 *Classification of Different Drainage Line State – Site SH2*

Location:		**SH2**	
Assessment Date:		**11 March 2020 & 2 October 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/ riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake and/or disperse are exposed on less than 0.3m of wall height.
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
2020 Overall Scores			
Classification of Drainage Line March 2020 survey		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.
Classification of Drainage Line October 2020 survey		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 40 *Classification of Different Drainage Line State – Site SH3: March*

Location:		SH3	
Assessment Date:		**11 March 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/ riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	2	Flat, continuous, loose sediment with signs of recent/frequent movement.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake or disperse are exposed on greater than 0.3m and less than 1m of vertical height (the sum of multiple layers if present).
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
March 2020 Overall Score			
Classification of Drainage Line March 2020 survey		21/32 **65%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 41 *Classification of Different Drainage Line State – Site SH3 October*

Location:		SH3	
Assessment Date:		**2 October 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/ riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	2	Actively eroding: slight undercutting, near vertical walls fans also eroding: depth = width
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake or disperse are exposed on greater than 0.3m and less than 1m of vertical height (the sum of multiple layers if present).
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
October 2020 Overall Score			
Classification of Drainage Line		21/32 **65%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 42 *Classification of Different Drainage Line State – Site SH3A*

Location:		SH3A	
Assessment Date:		**11 March 2020 & 2 October 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	1	Little or no vegetation growing on drainage line walls.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	NA	This section of drainage line coated with spray-concrete.
	Longitudinal Morphology of Drainage Line	NA	
	Particle Size of Materials on Drainage Line Floor	NA	
Wall Materials	Nature of Drainage Line Materials	NA	
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
Classification of Drainage Line		NA	Drainage line is considered stabile due to spray-concrete lining.

Table 43 *Classification of Different Drainage Line State – Site SH5*

Location:		SH5	
Assessment Date:		**10 March 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	2	Any vegetation present is annual or short-lived: partial burial of plants by recently deposited sediment is evident.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	4	Stabilising: wall angle less than 65°, small inactive alluvial fan at foot of side walls: width > depth.
	Longitudinal Morphology of Drainage Line	2	Flat with a cohesive fine textured "soil like" bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/or denser than material on walls: surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	4	Materials that do not slake or disperse are exposed on wall surface.
Bank Edge	Shape of Stream Bordering Slopes	3	Moderately sloped bank, 5-10º
	Nature of Lateral Flow Regulation	3	Sparse grassland / woodland with bare soil bank lip. Moderate flow rate, some highly focused inflow locations.
March 2020 Overall Score			
Classification of Drainage Line		22/32 69%	Drainage line is stable. This site has remained stable.

Table 44 *Classification of Different Drainage Line State – Site SH5*

Location:		SH5	
Assessment Date:		**2 October 2020**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	2	Any vegetation present is annual or short-lived: partial burial of plants by recently deposited sediment is evident.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	4	Materials that do not slake or disperse are exposed on wall surface.
Bank Edge	Shape of Stream Bordering Slopes	3	Moderately sloped bank, 5- 10°.
	Nature of Lateral Flow Regulation	3	Sparse grassland / woodland with bare soil bank lip. Moderate flow rate, some highly focused inflow locations.
October 2020 Overall Score			
Classification of Drainage Line		22/32 69%	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

6.2 REVIEW & INTERPRETATION OF STREAM HEALTH MONITORING RESULTS

The routine six-monthly assessment of channel stability, stream health and vegetation health of the Neubecks Creek monitoring locations (SH1, SH2, SH3 and SH3A) at PDM indicates the drainage line classification is potentially stabilising at locations SH1, SH2 and SH3. The drainage line at location SH3a is considered stable as this section of the creek is lined with spray concrete. An assessment of the Coxs River monitoring site (SH5) indicated the drainage line is also considered to be potentially stabilising. It is noted that previously the Coxs River monitoring site was classified as stable; however, during the October 2019 assessment a loss in vegetation in the drainage line walls was observed, this is considered to be attributed to the drought conditions during 2019 (refer to 2019 low rainfall total in **Section 6**). During the March and October 2020 assessment, vegetation growth was observed; however, not the to the density observed during March 2019.

The CSIRO Ephemeral Stream Assessment protocol Ref [12]) indicates ongoing monitoring of Neubecks Creek drainage line and Coxs River is required; however, rehabilitation works are not required in the immediate future.

In accordance with the PDM Water Management Plan (Ref [3]), monitoring of the six (6) stream health assessment locations was conducted on a monthly basis throughout 2020. The ongoing monitoring encompasses monthly visual assessments and photographic documentation of each site over time. Results of this monthly monitoring indicate no evidence of erosion, newly exposed soils, or vegetation disturbance.

7 NOISE MONITORING

7.1 NOISE ASSESSMENT CRITERIA

The purpose of noise monitoring is to ensure that any impact of operations on the surrounding sensitive receivers can be identified; and to show compliance with relevant legislative requirements. The conditional requirements within Project Approval 10_0041 (Schedule 3, Condition 1, Ref [2]) and EPL 4911 (Ref [1]) are presented in **Table 45**. As PDM is currently in care and maintenance, rehabilitation activities are considered to be the primary noise source.

Table 45 *Noise Assessment Criteria (Ref [1])*

Location		Noise Monitoring Location	Day LAeq (15 min) dBA	Evening LAeq (15 min) dBA
Residences 18, 32 and 33		NM1 - (EPL Ref No.33)	42	39
Residences 20-23, 25 and 27-29		N/A	42	36
Residences 8, 10-12 and14		NM2 - (EPL Ref No.14) NM3 - (EPL Ref No.10)	42	35
Residences 2, 5-7 and 35		NM4 - (EPL Ref No.5) NM6 - (EPL Ref No.2)	35	35
All other residences		NM5 - (EPL Ref No.4)	35	35
During construction and removal of the amenity bund	Residences 8, 10-12, 14, 18, 20-23, 25, 27-29 and 32 - 33	N/A	46	N/A

Noise generated by the project should not exceed the above criteria at any residence on privately-owned land or on more than 25% of any privately-owned land.

Day: The period from 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays and Public Holidays

Evening: The period from 6:00pm to 10:00pm Monday to Sunday

7.2 NOISE MONITORING DATA SUMMARY

In accordance with the PDM Noise Management Plan (Ref [6]), EPL (Ref [1]) and Project Approval (Ref [2]) conditions attended noise surveys are undertaken on a quarterly basis.

Quarterly monitoring was undertaken at the following intervals during the 2020 period:

- Quarter 1 – January to March, monitoring conducted 12 March 2020.
- Quarter 2 – April to June, monitoring conducted 18 and 19 June 2020.
- Quarter 3 – July to September, monitoring conducted on 14 and 15 September 2020.
- Quarter 4 – October to December, monitoring conducted on 22 and 23 December 2020.

The purpose of the attended noise survey is to record any impact of operational noise on the surrounding community. Two (2) consecutive 15-minute surveys are conducted at each of the six (6) monitoring locations. Results of attended noise surveys carried out during the 2020 monitoring period are presented in **Tables 48** to **51**. Meteorological conditions recorded during each noise survey are presented in **Table 52**; the 10m data has been sourced from the PDM on-site meteorological station subsequent to the completion of the noise surveys. Noise survey locations are presented in **Drawing 1**, **Appendix 1**.

Table 46 *Attended Noise Survey – Quarter 1, March 2020*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
12/03/2020	14:33	NM 1	59	63	43	NIL	42	59	Pine Dale Mine NIL* Road Traffic 43 to 74 Birds & Other 34
12/03/2020	14:48	NM 1	59	62	47	NIL	42	59	Pine Dale Mine NIL* Road Traffic 47 to 72 Birds & Other N/A
12/03/2020	15:11	NM 2	55	58	43	NIL	42	55	Pine Dale Mine NIL* Road Traffic 43 to 66 Birds & Other 38 to 39
12/03/2020	15:26	NM2	55	58	44	NIL	42	55	Pine Dale Mine NIL* Road Traffic 44 to 67 Birds & Other 37 to 43
12/03/2020	15:48	NM 3	59	63	37	NIL	42	59	Pine Dale Mine NIL* Road Traffic 37 to 73 Birds & Other N/A
12/03/2020	16:03	NM 3	59	62	41	NIL	42	59	Pine Dale Mine NIL* Road Traffic 41 to 76 Birds & Other N/A
12/03/2020	16:24	NM 4	48	50	26	NIL	42	48	Pine Dale Mine NIL* Road Traffic N/A Birds & Other 27 to 63
12/03/2020	16:39	NM 4	50	53	29	NIL	42	50	Pine Dale Mine NIL* Road Traffic 36 to 65 Birds & Other 33 to 41
13/03/2020	9:12	NM 5	54	52	31	NIL	42	54	Pine Dale Mine NIL* Road Traffic 68 to 72 Birds & Other 39 to 72
13/03/2020	9:27	NM 5	53	49	27	NIL	42	53	Pine Dale Mine NIL* Road Traffic 66 to 71 Birds & Other 37 to 53
12/03/2020	17:08	NM 6	52	43	25	NIL	42	52	Pine Dale Mine NIL* Road Traffic 30 to 73 Birds & Other 26 to 45
12/03/2020	17:23	NM 6	50	45	25	NIL	42	50	Pine Dale Mine NIL* Road Traffic 63 to 72 Birds & Other 30 to 48

* Nil – Noise source not audible during survey session

Table 47 *Attended Noise Survey – Quarter 2, June 2020*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
18/6/2020	15:02	NM 1	59	63	47	NIL	42	59	Pine Dale Mine NIL* Road Traffic 43 to 70 Birds & Other 35
18/6/2020	15:18	NM 1	61	64	50	NIL	42	61	Pine Dale Mine NIL* Road Traffic 47 to 74 Birds & Other N/A
18/6/2020	15:46	NM 2	67	72	43	NIL	42	67	Pine Dale Mine NIL* Road Traffic 43 to 80 Birds & Other 38 to 35
18/6/2020	16:01	NM2	69	74	47	NIL	42	69	Pine Dale Mine NIL* Road Traffic 44 to 78 Birds & Other 37 to 43
18/6/2020	16:25	NM 3	60	64	40	NIL	42	60	Pine Dale Mine NIL* Road Traffic 37 to 67 Birds & Other N/A
18/6/2020	16:41	NM 3	62	66	35	NIL	42	62	Pine Dale Mine NIL* Road Traffic 41 to 77 Birds & Other N/A
19/6/2020	10:13	NM 4	60	51	36	NIL	42	60	Pine Dale Mine NIL* Road Traffic 50 to 59 Birds & Other 27 to 59
19/6/2020	10:29	NM 4	57	49	32	NIL	42	57	Pine Dale Mine NIL* Road Traffic 36 to 72 Birds & Other 33 to 45
19/6/2020	8:31	NM 5	47	50	41	NIL	42	47	Pine Dale Mine NIL* Road Traffic 40 to 47 Birds & Other 39 to 48
19/6/2020	8:47	NM 5	46	48	41	NIL	42	46	Pine Dale Mine NIL* Road Traffic 40 to 48 Birds & Other 37 to 48
19/6/2020	9:22	NM 6	60	57	32	NIL	42	60	Pine Dale Mine NIL* Road Traffic 30 to 73 Birds & Other 26 to 45
19/6/2020	9:53	NM 6	59	51	28	NIL	42	59	Pine Dale Mine NIL* Road Traffic 63 to 77 Birds & Other 30 to 45

* Nil – Noise source not audible during survey session

Table 48 *Attended Noise Survey – Quarter 3, September 2020*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
14/09/2020	14:41	NM 1	57	61	36	NIL	42	57	Pine Dale Mine NIL* Road Traffic 43 to 64 dB Neighbour noise 60 dB
14/09/2020	14:58	NM 1	59	63	45	NIL	42	59	Pine Dale Mine NIL* Road Traffic 44 to 74 dB Neighbour noise 38 to 57 dB
14/09/2020	14:00	NM 2	49	52	40	NIL	42	49	Pine Dale Mine NIL* Road Traffic 40 to 65 dB Birds & Other 40 to 50 dB
14/09/2020	14:16	NM 2	49	52	41	NIL	42	49	Pine Dale Mine NIL* Road Traffic 40 to 60 dB Birds & Other 50 dB
14/09/2020	15:30	NM 3	59	63	42	NIL	42	59	Pine Dale Mine NIL* Road Traffic 38 to 67 dB Birds 50 to 65 dB
14/09/2020	15:46	NM 3	60	63	39	NIL	42	60	Pine Dale Mine NIL* Road Traffic 40 to 79 dB Birds & Dogs 33 to 65 dB
14/09/2020	16:16	NM 4	47	38	30.7	NIL	35	47	Pine Dale Mine NIL* Trucks and Cars 40 to 75 dB Distant Road Traffic 33 to 43 dB Birds & Other 43 to 58 dB
14/09/2020	16:32	NM 4	41	39	31.3	NIL	35	41	Pine Dale Mine NIL* Road Traffic 33 to 36 dB Birds & Other 40 to 64 dB
15/09/2020	8:39	NM 5	63	57	32.7	NIL	35	63	Pine Dale Mine NIL* Trucks and cars passing by 59 to 85 dB Birds & Other 40 to 55 dB
15/09/2020	8:55	NM 5	64	57	34.2	NIL	35	64	Pine Dale Mine NIL* Trucks and cars passing by 54 to 82 dB Birds & Other 30 to 45 Wind 39 to 43 dB
15/09/2020	7:59	NM 6	55	50	30.3	NIL	35	55	Pine Dale Mine NIL* Distant Road Traffic 35 to 40 dB Trucks and cars passing by 43 to 76 dB Birds & Other 40 to 45 dB
15/09/2020	8:15	NM 6	52	47	29.5	NIL	35	52	Pine Dale Mine NIL* Hiss from wind 33 dB Trucks and cars passing by 44 to 78 dB Birds & Other 33 to 61 dB

Nil – Noise source not audible during survey session

Table 49 *Attended Noise Survey – Quarter 4, December 2020*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			L_{Aeq} 15min	L_{A10} 15min	L_{A90} 15min				
23/12/2020	8:22	NM 1	52	56	41	NIL	42	52	Pine Dale Mine NIL* Road Traffic 50 to 58 dB Birds & Other 45 to 50 dB Truck pass by 68 dB
23/12/2020	8:37	NM 1	54	57	42	NIL	42	54	Pine Dale Mine NIL* Road Traffic 50 to 60 dB Birds & Other 45 to 50 dB
23/12/2020	9:06	NM 2	47	51	38	NIL	42	47	Pine Dale Mine NIL* Road Traffic 40 to 57 dB Birds & Other 33 to 42 dB
23/12/2020	9:21	NM 2	49	52	38	NIL	42	49	Pine Dale Mine NIL* Road Traffic 45 to 57 dB Birds & Other 37 to 41 dB
23/12/2020	9:43	NM 3	63	65	41	NIL	42	63	Pine Dale Mine NIL* Road Traffic 43 to 72 dB Birds & Other 36 to 40 dB
23/12/2020	9:58	NM 3	64	65	45	NIL	42	64	Pine Dale Mine NIL* Road Traffic 68 to 80 dB
23/12/2020	10:21	NM 4	42	46	34	NIL	35	42	Pine Dale Mine NIL* Distant Road Traffic 43 to 47 dB Birds around 38 dB
23/12/2020	10:36	NM 4	42	45	30	NIL	35	42	Pine Dale Mine NIL* Road Traffic 33 to 44 dB Birds & Other around 44 dB Plane pass by 57 dB
22/12/2020	16:00	NM 5	64	62	40	NIL	35	64	Pine Dale Mine NIL* Wind Noise 44 to 61 dB Cars pass by 75 to 80 dB Birds 40 to 44 dB
22/12/2020	16:15	NM 5	62	57	43	NIL	35	62	Pine Dale Mine NIL* Wind noise 48 to 60 dB Cars 52 dB Birds & Other 40 to 64 dB
22/12/202020	16:00	NM 6	59	55	37	NIL	35	59	Pine Dale Mine NIL* Trucks and cars passing by 44 to 79 dB Birds around 46 dB
22/12/2020	16:15	NM 6	55	54	44	NIL	35	55	Pine Dale Mine NIL* Trucks and cars passing by 74 to 79 dB Birds & Other 53 to 59

Nil – Noise source not audible during survey session

Table 50 *Meteorological Conditions during Attended Noise Surveys*

Survey Date	Start Time	Location	Temp at 10m (°C)	Average Wind Speed (m/s)	Average Wind Direction (degrees)
12/03/2020	14:33	NM 1	20	3.0	72
12/03/2020	14:48	NM 1	20	1.5	76
12/03/2020	15:11	NM 2	20	2.0	88
12/03/2020	15:26	NM 2	20	2.0	71
12/03/2020	15:48	NM 3	22	2.0	69
12/03/2020	16:03	NM 3	21	1.5	50
12/03/2020	16:24	NM 4	18	2.5	82
12/03/2020	16:39	NM 4	18	2.5	80
13/03/2020	9:12	NM 5	16	2.5	323
13/03/2020	9:27	NM 5	16	3.0	350
12/03/2020	17:08	NM 6	20	2.5	92
12/03/2020	17:23	NM 6	19	3.5	70
18/06/2020	15:02	NM 1	12	1.8	350
18/06/2020	15:18	NM 1	14	1.8	42
18/06/2020	15:46	NM 2	13	1.5	17
18/06/2020	16:01	NM 2	13	1.5	58
18/06/2020	16:25	NM 3	11	2.0	54
18/06/2020	16:41	NM 3	10	1.5	34
19/06/2020	10:13	NM 4	13	1	253
19/06/2020	10:29	NM 4	13	0.8	300
19/06/2020	8:31	NM 5	5	0.4	29
19/06/2020	8:47	NM 5	7	0.1	78
19/06/2020	9:22	NM 6	9	0.6	20
19/06/2020	9:53	NM 6	12	0.4	198
14/09/2020	14:00	NM 2	19.9	2.12	235.4
14/09/2020	14:16	NM 2	19.7	2.65	255.4
14/09/2020	14:41	NM 1	20.5	1.67	190.3
14/09/2020	14:58	NM 1	20.5	2.39	184.8
14/09/2020	15:30	NM 3	20.6	1.94	209.5
14/09/2020	15:46	NM 3	20.2	1.87	215.9
14/09/2020	16:16	NM 4	20.4	1.49	196.6
14/09/2020	16:32	NM 4	19.5	2.13	258.5
15/09/2020	7:59	NM 6	12.1	0.61	308.4
15/09/2020	8:15	NM 6	14.3	1.47	14.3
15/09/2020	8:39	NM 5	14.3	1.69	356.9
15/09/2020	8:55	NM 5	14.4	2.6	358.1

Survey Date	Start Time	Location	Temp at 10m (°C)	Average Wind Speed (m/s)	Average Wind Direction (degrees)
23/10/2020	8:22	NM 1	15.7	1.95	211
23/10/2020	8:37	NM 1	15.5	2.63	227
23/12/2020	9:06	NM 2	16.6	2.24	168
23/12/2020	9:21	NM 2	18	1.63	187
23/12/2020	9:43	NM 3	17.8	1.8	144
23/12/2020	9:58	NM 3	18.6	1.56	99
23/12/2020	10:21	NM 4	19.4	1.33	168
23/12/2020	10:36	NM 4	20.5	1.52	102
22/12/2020	16:00	NM 5	18.2	5	254
22/12/2020	16:15	NM 5	19.2	4.5	249
22/12/2020	16:00	NM 6	18.2	5	254
22/12/2020	16:15	NM 6	19.2	4.5	249

The Industrial Noise Policy states “Wind can also create extraneous noise on noise-monitoring equipment; an upper limit of 5 m/s at the microphone position is commonly applied during noise measurement to reduce this effect”

7.3 REVIEW & INTERPRETATION OF OPERATIONAL NOISE MONITORING RESULTS

Attended noise surveys of PDM for the 2020 monitoring period were undertaken during the care and maintenance period. The conditions and operations during noise surveys were considered to be representative of those undertaken on a normal daily basis.

Time based source coding was used during the attended noise surveys to record the overall noise levels and identify the sound sources that contributed to the sound environment at each of the six (6) noise monitoring locations. Sound sources audible during the attended surveys were classified into three (3) categories, mine noise (from PDM); birds; traffic and other noise sources. Contributions from these sources were determined by analysis of the time coded survey data using the sound level meter manufacturer’s proprietary software. The software analysis determines the overall L_{Aeq} and L_n statistical values for the entire survey, as well as identifying the individual sound sources that were coded during the attended surveys and shows the energy average contribution and L_{min} and L_{max} values, for each source, for each of the 15 minute survey periods.

7.3.1 FIRST QUARTER 2020

Attended noise surveys for the January to March 2020 quarter were undertaken on the 12 and 13 March at the six (6) PDM noise monitoring locations. During each survey, PDM was observed to be non-operational. No traffic was observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys conducted for this assessment period showed nil $L_{Aeq,\ 15min}$ noise contributions from PDM at the six (6) noise monitoring locations.

The surveys conducted at NM1, NM2, NM3, NM5, and NM6 indicated that road traffic along the Castlereagh Highway was the dominant noise source with bird calls, aircraft and wind intermittently contributing to the acoustic climate. The survey conducted at NM4 indicated that bird calls were the dominant noise source with road traffic intermittently contributing to

the acoustic climate. There were nil $L_{Aeq, 15min}$ noise contributions from PDM at the six (6) noise monitoring locations.

7.3.2 SECOND QUARTER 2020

Attended noise surveys for the April to June 2020 quarter were undertaken on the 18 and 19 June. During each survey, PDM was observed to be non-operational. No traffic was observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys conducted at the six (6) monitoring locations, indicated that road traffic was the dominant noise source with bird calls, wind and aircraft intermittently contributing to the acoustic climate. There were nil $L_{Aeq, 15min}$ noise contributions from PDM at the six (6) noise monitoring locations.

7.3.3 THIRD QUARTER 2020

Attended noise surveys for the July to September 2020 quarter were undertaken on the 14 and 15 September. During each survey, PDM was observed to be non-operational. No traffic observed to be using the privately owned Angus Place haul road located within PDM.

The surveys conducted at the six (6) locations indicated that road traffic along Castlereagh Hwy was the dominant noise source with bird calls, wind and vehicles intermittently contributing to the acoustic climate. There were nil $L_{Aeq, 15min}$ noise contributions from PDM at the six (6) noise monitoring locations.

7.3.4 FOURTH QUARTER 2020

Attended noise surveys of the Pine Dale mine operations for the October to December 2020 quarter were undertaken on the 22 and 23 December. During each survey, PDM was observed to be non-operational. No traffic observed to be using the privately owned Angus Place haul road located within PDM.

The surveys conducted at the six (6) locations indicated that road traffic along Castlereagh Hwy was the dominant noise source with bird calls, wind and vehicles intermittently contributing to the acoustic climate. There were nil $L_{Aeq, 15min}$ noise contributions from PDM at the six (6) noise monitoring locations.

7.3.5 OVERALL ASSESSMENT FOR 2020

The assessable sound levels from Pine Dale Mine were below the assessment criteria at the six (6) locations during the 2020 monitoring period.

It is a requirement under AS 1055 that the noise surveys also document levels of ambient sound resulting from non PDM sources. In the surveys conducted for PDM, traffic and natural sounds, which are represented by the "Overall" $L_{Aeq\ 15\ minute}$ noise levels (refer **Tables 48** to **52**), were observed to be a significant contributor to the acoustic climate.

8 BLAST MONITORING

8.1 BLASTING OPERATIONS ASSESSMENT CRITERIA

The purpose of blast monitoring is to ensure that any impact of blasting operations on the surrounding land and nearby sensitive locations can be identified, and to show compliance with relevant legislative requirements. Conditional requirements within Project Approval

10_0041 (Schedule 3, Condition 8) and Environment Protection License (EPL 4911) are presented in **Table 53**.

Table 51 *Blasting Operations: Compliance Requirements*

Location	Airblast overpressure (dB (Lin Peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately-owned land	115	5	5% of the total number of blasts over a period of 12 months
	120	10	0%

8.2 BLASTING OPERATIONS MONITORING DATA SUMMARY

Throughout the 2020 monitoring period there were nil blast events conducted at the site as a result of the mine being in care and maintenance.

9 LIMITATIONS

This report has been prepared for Enhance Place Pty Limited n accordance with an agreement with RCA Australia (RCA). The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Enhance Place Pty Limited. The report may not contain sufficient information for purposes of other uses or for parties other than Enhance Place Pty Limited. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA Australia.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation.

Environmental conditions including analyte concentrations can change in a limited period of time. This should be considered if the report is used following a significant period of time after the date of issue.

Yours faithfully

RCA AUSTRALIA

Carmen Rocher
Environmental Engineer

REFERENCES

[1] NSW EPA, *Environment Protection Licence 4911,* 22 March 2013.

[2] NSW Department of Planning, *Project Approval Application Number 10_0041.*

[3] Enhance Place Pty Ltd, *Water Management Plan for the Pine Dale Coal Mine,* August 2015.

[4] Enhance Place Pty Ltd, *Air Quality and Greenhouse Gas Management Plan for the Pine Dale Coal Mine,* November 2020.

[5] Enhance Place Pty Ltd, *Purple Copper Butterfly Monitoring Program for the Pine Dale Coal Mine,* August 2015.

[6] Enhance Place Pty Ltd, *Noise Management Plan for the Pine Dale Coal Mine,* August 2015.

[7] Standards Australia, *AS/NZS 3580.10.1:2016: Methods for sampling and analysis of ambient air: Determination of particulate matter – Deposited matter – Gravimetric Method*, 2016.

[8] Standards Australia, *AS/NZS 3580.1.1:2007: Methods for sampling and analysis of ambient air: Guide to siting air monitoring equipment*, 2007.

[9] Standards Australia, *AS/NZS 3580.9.3:2015: Methods for sampling and analysis of ambient air: Determination of suspended particulate matter (TSP) – High volume sampler gravimetric method,* 2015.

[10] Standards Australia, *AS/NZS 3580.9.6:2015: Methods for sampling and analysis of ambient air: Determination of suspended particulate matter (PM10) – High volume sampler air sampler with size selective inlet – gravimetric method,* 2015.

[11] GHD, *Pine Dale Groundwater and Surface Water Investigation Trigger Value Review Report,* September 2018.

[12] CSIRO, *Ecosystem Function Analysis – Ephemeral Stream Assessment*.

GLOSSARY

AHD	Australian height datum, based on a mean sea level.
ANZECC	Australian and New Zealand Environmental Conservation Council.
dB	Unit of sound pressure level
DPIE	Department of Planning, Industry and Environment – preceded by Department of Planning and Environment (2014 – 2019), Department of Industry (2015 – 2019) and the Office of Environment and Heritage (2011 – 2019).
EPL	Environmental Protection Licence
EPL	Environment Protection Licence
kg	kilogram, 1000 gram.
L_{A90}	Average A-weighted minimum noise level in a measurement period

L_{Aeq}	Average acoustic energy over the duration of the measurement, represented using the A-weighting filter.
L_{Aeqmax}	Maximum A-weighted noise level in a measurement period.
mg	milligram, 1/1000 gram.
NEPC	National Environment Protection Council.
NSW EPA	NSW Environment Protection Authority – formerly a component of DECC, DECCW, OEH but made a separate entity in 2011 to regulates the contaminated land industry.
NTU	Nephelometric Turbidity Units: unit for the measurement of turbidity.
OEH	NSW Office of Environment and Heritage.
PDM	Pine Dale Mine
Weathering	All physical and chemical changes produced by atmospheric agents.
µg	microgram, 1/1000 milligram.
Chemical Compounds	
EC	Electrical conductivity: a measure of the ability of a solution to conduct electricity.
Hardness	Content of metallic ions that react with sodium soaps. The hardness of the water impacts on the way metals behave.
PM_{10}	particulate matter less than or equal to 10 micrometres.
TSP	Total suspended Particulates
TSS	Total suspended solids.
Turbidity	Cloudiness of fluid.

Attachment 1

Drawing 1 - Environmental Monitoring Locations

Drawing 2 - Stream Health & Channel Stability Monitoring Locations

EP PDH7/GW Site E

EP DDH7/GW Site A

EP DDH5/GW Site B

EP PDH1/GW Site C

EP DDH4/GW Site D

Water Cart Dam
(The Bong sample location)

PCB1

PCB7

Weather Station

EPL Site 2

S1

HVAS

S2

EPL Site 3
(S3)

PCB2

PCB3

DI

NM1

Old Shaft

The Bong

NM2

D2

D3

NM3

P6

D6

NM6

S4

S5

S6

P7

D4

NM4

S7

EPL Site 13

Blue Lake

D5

NM5

EPL Site 14

Locality Plan
N.T.S.

LEGEND

- Noise monitoring location
- Depositional dust monitoring location
- Groundwater monitoring location
- High volume air sampling location
- Metorological monitoring location
- Surface water monitoring location

0 175 350 700 1,050 1,400
metres

N

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PINE DALE MINE
ENVIRONMENTAL MONITORING LOCATION PLAN

CLIENT	Pine Dale Mine			RCA Ref	6880-1842a
DRAWN BY	CR	SCALE	1:24,000 (A3)	DRAWING 1	REV 0
APPROVED BY	CR	DATE	3/02/2021	OFFICE	NEWCASTLE

LEGEND

- Monitoring location
- Licence discharge point location
- Clean water diversion location

0 37.5 75 150 225 300
metres

N

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PINE DALE MINE
CHANNEL STABILITY, STREAM AND VEGETATIVE HEALTH MONITORING SITES

CLIENT	Pine Dale Mine			RCA Ref	6880-1842a
DRAWN BY	CR	SCALE	1:5,000 (A3)	DRAWING 2	REV 0
APPROVED BY	CR	DATE	23/02/2021	OFFICE	NEWCASTLE

Appendix C

2020 Rehabilitation Monitoring Report (Ref [4])

Pine Dale Mine

Rehabilitation Monitoring Report 2020

Report prepared by First Field Environmental
on behalf of EnergyAustralia

9 November 2020

Revision history		
Version	Date	Author
Draft	22 October 2020	Michelle Evans
Final	9 November 2020	Michelle Evans

Cover image: Tree analogue site 2020

This report has been prepared by First Field Environmental for EnergyAustralia. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

First Field Environmental

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Contents

Appendices

Figures

Tables

1. Introduction

Pine Dale Mine is located in the Western Coalfields of NSW at Blackmans Flat, 15 km north of Lithgow on the northern side of Castlereagh Highway. The property is approximately 3 km east of Mount Piper Power Station.

Pine Dale Mine is managed in accordance with Project Approval 10_0041 and relevant subsidiary licenses and approvals. The *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2014) has been prepared in accordance with the above approval documentation and describes the following rehabilitation objectives:

- *"The rehabilitated landform is safe, stable, non-polluting and sustainable;*
- *Rehabilitation maintains or improves species diversity and habitat values of the Yarraboldy Extension Area, particularly the former Yarraboldy Open Cut Mine; and*
- *The agreed post mining land use is compatible with the surrounding land fabric and land use requirements."*

The preparation of this Rehabilitation Monitoring Report has been prepared to satisfy Schedule 3, Condition 55 of Project Approval 10_0041.

This report aims to identify successes and failures in rehabilitation in regard to agreed performance indicators and completion criteria. Recommendations are made in areas that could be improved.

2. Performance indicators

Table 1 identifies the performance indicators and completion criteria for Pine Dale Mine as determined by the *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2014).

Table 1 Performance indicators and completion criteria

Performance indicator	Completion criteria
Feral animal and priority weed presence	• Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.
Feral animal and priority weed control	• Feral animals and priority weeds are controlled in accordance with legislation.
Fuel loads	• Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.
Access	• Adequate access for fire-fighting is maintained on rehabilitation areas.
Habitat features	• Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.
	• Native forest indicator species tree height and girth is within the range of analogue sites.

Performance indicator	Completion criteria
Soil loss	• Net annual soil loss is comparable to analogue sites at year 10.
Erosion	• There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).
Woodland birds present	• Evidence of woodland birds utilising rehabilitation areas.
Evidence of mammals	• Evidence of target mammal species presence in rehabilitation areas.
Natural regeneration	• Evidence of second generation of native forest indicator species from desired vegetation community. • Evidence of natural regeneration of at least four pasture species at year 5.
Structure	• Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.
Management inputs	• Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. • Vegetation within the treed rehabilitation areas are established in accordance with the approved species mix. • Approved pasture species mix is sown at the specified rate per hectare.
Weed presence	• Weeds including African Lovegrass to comprise <10% of the pasture sward.
Ground cover	• Ground cover (vegetation, leaf litter, mulch) >70% at year 5.

Source: Care and Maintenance Mining Operations Plan for Pine Dale Mine (Enhance Place Pty Ltd, 2014)

3. Weather conditions

The three months leading up to the survey were consistent with average temperatures (over a 15-year period of observations). The area received significantly higher than average rainfall in the three months leading up to the survey with winter rainfall of 220.6 mm compared with the average of 162.5 mm in the months of June – August (Bureau of Meteorology 2020). Table 2 presents regional rainfall data for the period commencing 2013.

Table 2 Rainfall (in mm) recorded January 2013 – September 2020

Year	Average	2013	2014	2015	2016	2017	2018	2019	2020
January	80.2	87.4	9.2	156.2	142.0	37.2	49.0	154.6	46.8
February	60.2	149	85	21.2	28.8	12.2	65.2	21.4	131.6
March	84.2	43.2	155	39.4	69.6	141.4	56.6	84.2	115.0
April	48.2	26.8	63	158.2	6.2	21.2	13.6	1.0	93.6
May	22.3	23.6	14	25.2	26.0	32.6	12.6	37.2	47.8
June	63.8	87	43.2	24.8	173.4	19.6	34.6	16.2	39.0
July	32.2	19.6	25.6	44.6	91.4	6.6	5.4	10.8	77.8
August	42.4	22.4	56.4	43.8	52.2	41.8	38.0	18.0	103.8
September	42.4	44	35.2	9.8	118.6	4.2	67.6	52.0	-
October	61.6	20.8	51.6	58.0	71.4	106.0	79.8	9.4	-
November	51.2	68.6	36.8	63.6	58.4	28.8	124.6	35.8	-
December	83.8	38.4	160.4	58.6	86.4	75.2	80.6	2.8	-
Annual	**762.1**	**630.8**	**735.4**	**703.4**	**924.4**	**526.8**	**627.6**	**443.4**	-

Source: Bureau of Meteorology (2020)

4. Survey methodology

4.1 Rehabilitation monitoring

Monitoring locations - Previous studies have seen the establishment of six monitoring transects; four transects are located within rehabilitated pastures while the remaining two transects are within treed rehabilitation areas. Additional transects exist as analogue sites in grazed pasture and an undisturbed naturally vegetated area of the property to provide benchmarks against which the pasture and treed rehabilitation areas are assessed. Monitoring locations are shown in Figure 1.

Photopoint monitoring - Coordinates for each transect and analogue site are provided in Appendix A. Each transect area contains previously established photo monitoring points. Photos taken from these points enable a visual comparison to photos from previous surveys and are provided in Appendix E.

4.2 Erosion and sedimentation

Evidence of erosion and sedimentation along and within the vicinity of each transect has been determined in accordance with *Best Practice Erosion and Sediment Control* (IECA 2006).

4.3 Soil loss

The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014) recommends that net soil loss be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method has been found to be inadequate for determining soil loss in comparison with the widely used *RUSLE* (IEAC Australasia 2012). An estimation of soil loss at each transect site has been calculated using the *Revised Universal Soil Loss Equation* (RUSLE) (IEAC Australasia 2012). Values used for these calculations are presented in Appendix C.

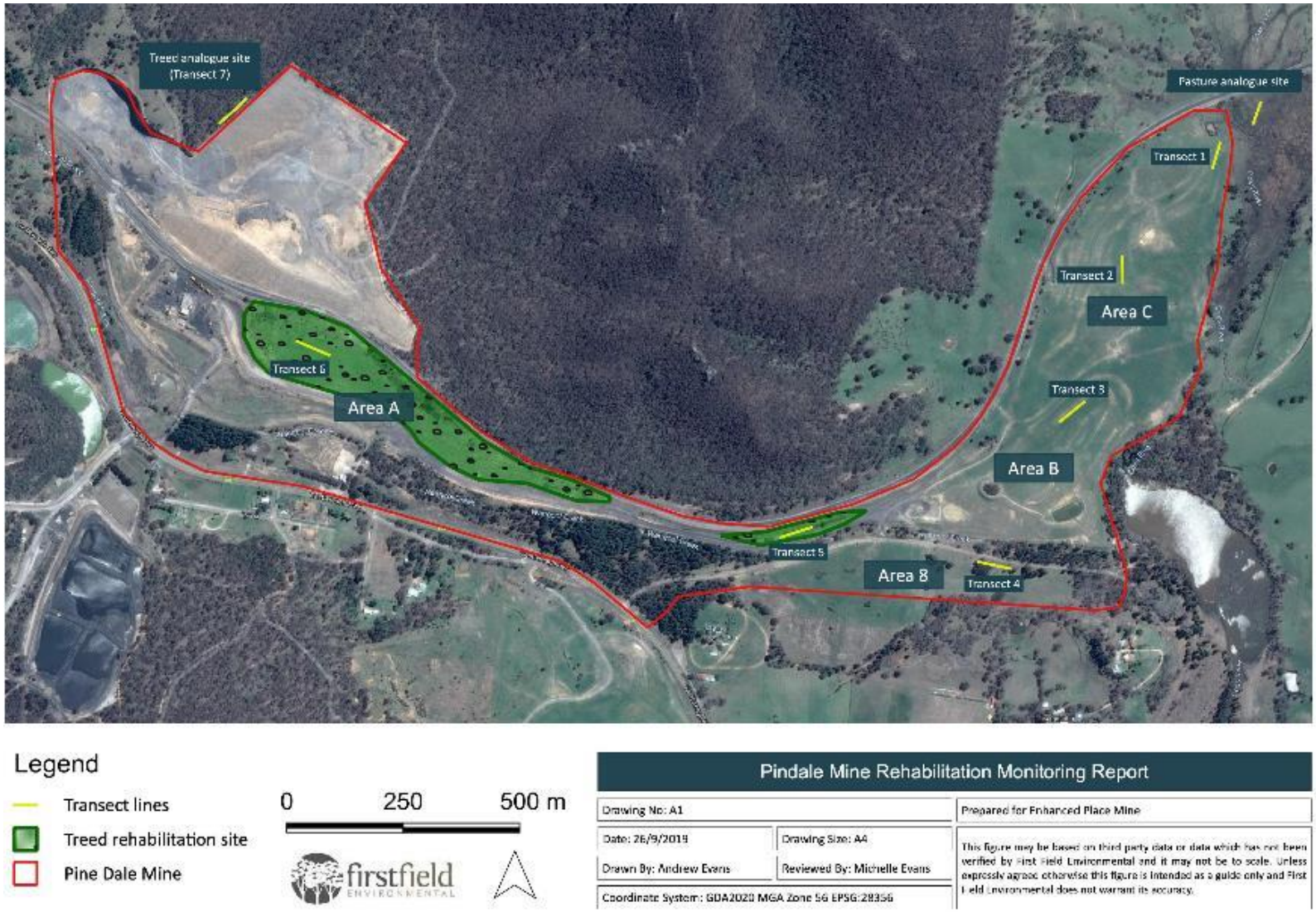

Figure 1 Monitoring locations

4.4 Vegetation assessment

Pasture rehabilitation areas – Cox's River seed mix was sown in 2010-2011 at Areas B, C and Area 8 at the following rates:

- 40% Fescue *(Festuca spp.)*
- 25% Cocksfoot *(Dactylis glomerata)*
- 20% Subterranean clover *(Trifolium subterranean)*
- 6% Perennial rye grass *(Lolium perene)*
- 5% White clover *(Trifolium repens)*
- 4% Phalaris *(Phalaris aquatica)*

The proportion of perennial grasses and annual legumes currently in evidence at pasture transects has been recorded and compared with the proportion at which these species were initially sown.

Tree rehabilitation areas – The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014) recommends that vegetation structure be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method does not adequately enable the identification of all completion criteria as required by the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014). Vegetation health, natural regeneration, structure and species composition have instead been determined in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO 2009).

4.5 Evidence of fauna and habitat features

Fauna - Evidence of woodland birds and native fauna utilising rehabilitated areas has been recorded through the observation of scats and tracks and sightings.

Habitat features - The presence of nesting boxes, crushed timber piles and rock pile clusters within the rehabilitation areas is noted.

4.6 Pest animal and weed survey

Pest animal presence - Evidence of feral animal presence across the rehabilitation areas has been determined through scat and trail identification.

Priority weeds - The location and extent of priority weeds as declared for the Central Tablelands Region (Central Tablelands Local Land Services 2019) have been recorded. Target weed species, particularly African Lovegrass were identified in accordance with field guides and botanical keys.

4.7 Fuel loads and fire-fighting access

Fuel loads - Fuel loads within and adjacent to rehabilitation areas have been assessed in accordance with the *Overall Fuel Hazard Assessment Guide* (Department of Sustainability 2010).

Fire-fighting access - Access trails within rehabilitated areas have been assessed in accordance with *Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007).

4.8 Rural land capability assessment

Pasture rehabilitation areas have been assessed in accordance with the *Land and Soil Capability Assessment* (OEH 2007).

4.9 Management input assessment

Land management activities - Land management and soil amelioration activities conducted in the past year have been identified through discussions with the land manager.

Feral animal and weed management - Evidence of feral animal and priority weed control activities have been sought from the land manager and audited against relevant legislative requirements.

5. Field survey results

Field survey was conducted on 2 September 2020 by a qualified ecologist. The survey revisited six transects representing rehabilitated pasture and treed areas as well as pasture and treed analogue sites.

5.1 Erosion and sedimentation

There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling) within the rehabilitation areas. The presence and extent of active surface erosion within transect areas is recorded in Appendix A.

Pasture rehabilitation areas - The pasture rehabilitation areas support evidence of minor wind erosion where groundcover is poorly established or absent.

Treed rehabilitation areas - Minor wind and rill erosion is occurring at treed rehabilitation areas.

Analogue sites - No active erosion is evident at the pasture analogue site. Minor surface erosion is occurring within the treed analogue site.

5.2 Soil loss

Rehabilitation activities commenced less than 10 years ago, and it is not yet possible to determine whether net soil loss is comparable to analogue sites at year 10. Estimated annual soil loss at rehabilitated transects is summarised in Table 3. Full calculations are provided in Appendix C.

Table 3 Estimated soil loss due to erosion

Estimated annual soil loss t/ha	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
	0.09 t/ha	0.09 t/ha	0.09 t/ha	0.18 t/ha	0.03 t/ha	0.36 t/ha	0.36 t/ha	1.10 t/ha

5.3 Vegetation assessment

Flora species identified along and within the vicinity of transects are listed in Appendix D.

Species composition at pasture rehabilitation areas – Pasture rehabilitation areas are established with a mix of ~70% perennial grasses and ~20% annual legumes and are consistent with species composition at the analogue pasture site. Examples of analogue pasture and Transect 1 pasture are shown in Figure 2 and Figure 3.

Figure 2 Pasture composition at the Pasture Analogue site

Figure 3 Typical pasture composition at Transect 1

Groundcover at pasture rehabilitation areas – Rehabilitated pasture surfaces in each of the transect areas support living groundcover of approximately 90%.

Areas currently exist within each pasture rehabilitation area where groundcover is sparse or absent. It is estimated that these areas account for less than 10% of each pasture area.

Natural regeneration at pasture rehabilitation areas – Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.

Species composition at treed rehabilitation areas – Treed rehabilitation areas are established in accordance with an approved species mix representing local native species.

Structure of vegetation at treed rehabilitation areas – Structural layers of vegetation at treed rehabilitation areas are not comparable to those of the treed analogue site.

In 2019 the treed analogue site was characterised by a canopy to 14 m height with 20% canopy cover over a sparse shrubby mid-storey to 3 m height and isolated shrubs to 1.5 m height in the understorey. Groundcover consisted of grasses and herbs with a cover of >95% (Figure 4).

Figure 5 shows the vegetation structure at the treed analogue site in 2020. Many of the standing trees are showing evidence of new growth however the presence of epicormic growth is not an indicator of long-term survival of the tree. Recently fallen timber is contributing to ground cover. The trees are providing no appreciable canopy cover. The shrub layer is very sparse. Ground cover is actively growing. Regeneration of woody plants is occurring across the site.

Figure 4 Vegetation structure of treed analogue site (Transect 7) in 2019

Figure 5 Vegetation structure at Transect 7 in 2020

Canopy cover is sparse in treed rehabilitation areas. A sparse mid-storey of isolated juvenile trees and shrubs exists over a sparse, low, shrubby understorey. Groundcover is a mix of broadleaf herbs and grasses. Changes in vegetation structure over time (as shown in Appendix B) are not considered significant.

Groundcover at treed rehabilitation areas – Total living cover within the Transect 5 area has increased from 70% in 2019 to 80% cover in 2020 due to an increase in perennial groundcover.

Total living cover at Transect 6 has increased from 20% in 2019 to 80% in 2020 due to decreases in both litter cover and bare surface.

Vegetation health at treed rehabilitation areas – Native forest indicator species are those that occur both in treed rehabilitation areas and the treed analogue site and provide an opportunity for comparison of growth between natural and rehabilitation conditions. Indicator species include native trees, shrubs and groundcovers.

More than 20% of native species recorded within the treed analogue site in 2019 are actively growing in the treed rehabilitation areas. These species are dominated by trees and shrubs and it is expected that groundcovers and herbaceous species will be able to colonise the treed rehabilitation areas once sufficient canopy cover is established. Trees and shrubs at transects 5 and 6 are increasing in height and spread.

Natural regeneration of treed rehabilitation areas - There is no evidence of second-generation native forest indicator tree or shrub species on treed rehabilitation areas.

5.4 Evidence of fauna and habitat features

Habitat features – Habitat features were previously installed and were evident in treed rehabilitation areas prior to 2020. These included timber and rock pile clusters. Nesting boxes have not been installed in treed rehabilitation areas. The 2020 showed evidence of bushfire affecting the treed rehabilitation areas. Some previously installed fallen timber has been burned (see Figure 6) and some residual mulch has been lost.

Fauna – Macropod and rabbit scats and tracks were evident throughout the property. Numerous unidentified fauna scratchings were observed within soils of the treed analogue site.

Native woodland birds were observed landing within the treed vegetation areas and in the treed analogue site. Magpies were observed on the ground within pasture areas A, B and C and within Area 8.

Figure 6 Burned log in transect 5

5.5 Feral animals and weeds

Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use. Feral animals and priority weeds are controlled in accordance with legislation. Weeds including African Lovegrass comprise <10% of the pasture sward. The presence or evidence of pests and weeds within and in the vicinity of each transect is recorded in Appendix A.

Pest animal presence – Rabbit and fox scats were observed across the property. Rabbit and fox density is considered low, with some evidence of shallow soil scraping and scats across each of the monitoring locations. No holes, burrows or dens were observed.

Priority and targeted weed species – Priority weeds observed during field survey are listed in Table 4.

Table 4 Feral animal and priority weed presence

Common name *Species name*	Location	Treatment
European Red Fox *Vulpes vulpes*	All locations	Landholders are obliged to control populations on their land.
European rabbit *Oryctolagus cuniculus*		
African lovegrass *Eragrostis curvula*	All locations	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The presence of African lovegrass was noted at all locations and occurred across less than 10% of the pasture area. These outbreaks have been subjected to ongoing chemical control and were not observed to be growing or producing seed.

5.6 Fuel loads and fire-fighting access

Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan, and adequate access for firefighting is maintained on rehabilitation areas.

Fuel loads – Fuel loads within Areas A, B and C and Area 8 are low and fuel hazard mitigation activities are not required at this time.

Firebreaks - The internal road provides a mineral earth firebreak between Area A and Pine Dale Mine infrastructure to the south, while the Coal Haul Road provides a mineral earth firebreak immediately to the north of Area A. The Coal Haul Road and internal road provide a mineral earth firebreak to the north and west of Areas B and C and Area 8. Private grazing land is located immediately adjacent to the east and south of Areas B and C and Area 8. The majority of this interface supports mature Pine and Eucalypt trees which would provide a barrier to wind-borne embers spreading to private grazing land during a fire event.

Fire-fighting access - Access to each of the rehabilitation areas is considered to be adequate. The Coal Haul Road is a private road located immediately to the north of Areas A, B and C and Area 8 and allows movement from within the former Wallerawang Power Station site, through Pine Dale Mine and to Mount Piper Power Station. An internal road is located immediately to the south of Areas A and B and to the north of Area 8. This road connects to Castlereagh Highway through the administration area of Pine Dale Mine. Area C is accessible by following the internal road through Area B. All access roads within rehabilitated areas are maintained in good condition and are suitable for the passage of Category 1 tankers, having a vertical clearance of >4 m and a width of >2.8 m (*Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007)).

5.7 Rural land capability assessment

Pasture rehabilitation areas are assessed as being Land and Soil Capability Class V and are suitable for grazing. The limiting factors for land use are generally related to wind erosion hazard. Note that the area of Transect 4 is also subject to soil acidification hazard due to soil texture (Table 5).

Table 5 Rural land capability assessment of pasture areas

Class	Transect 1	Transect 2	Transect 3	Transect 4
Water erosion hazard class	2 1 - <3% slope	3 3 - <10% slope	4 10 - <20% slope, no gully erosion present	2 1 - <3% slope
Wind erosion hazard class	5 Moderate wind erodibility class of surface soil, high winds erosive power, high exposure to wind, average annual rainfall >500 mm			
Soil structural decline class	4 Fragile light textured soil - hardsetting			
Soil acidification hazard class	4 Very low texture /buffering capacity, pH 6.7 – 7.5 ($CaCl_2$)			5 Very low texture /buffering capacity, pH 4.0 – 4.7 ($CaCl_2$)
Salinity hazard class	1 Moderate to high recharge potential, low discharge potential, low salt store			
Waterlogging hazard class	2 0 – 0.25 months typical waterlogging duration, moderately well drained soils			

Class	Transect 1	Transect 2	Transect 3	Transect 4
Shallow soils and rockiness hazard class	1 Nil rocky outcrop, soil depth >100 cm			
Mass movement hazard class	1 No mass movement present			

5.8 Management input assessment

Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.

Control of priority and targeted weed species has been undertaken across all rehabilitation areas as required and in accordance with the recommendations of the *Pine Dale Mine Rehabilitation Monitoring Report 2014* (First Field Environmental 2014).

6. Rehabilitation status

The status of performance indicators and completion criteria are summarised in Table 6.

Table 6 Status of completion criteria

Performance indicator	Completion criteria	Status
Feral animal and priority weed presence	• Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.	• **Satisfactory** – continue to monitor
Feral animal and priority weed control	• Feral animals and priority weeds are controlled in accordance with legislation.	• **Satisfactory** – continue to monitor
Fuel loads	• Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	• **Satisfactory** – continue to monitor
Access	• Adequate access for firefighting is maintained on rehabilitation areas.	• **Satisfactory** – continue to monitor
Habitat features	• Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.	• **Ongoing** - nesting boxes to be installed once trees are established
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	• **Satisfactory** – continue to monitor
	• Native forest indicator species tree height and girth is within the range of analogue sites.	• **Ongoing** – continue to monitor

Performance indicator	Completion criteria	Status
Soil loss	• Net annual soil loss is comparable to analogue sites at year 10.	• **Ongoing** – continue to monitor
Erosion	• There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).	• **Satisfactory** – continue to monitor
Woodland birds present	• Evidence of woodland birds utilising rehabilitation areas.	• **Satisfactory** – continue to monitor
Evidence of mammals	• Evidence of target mammal species presence in rehabilitation areas.	• **Satisfactory** – continue to monitor
Natural regeneration	• Evidence of second generation of native forest indicator species from desired vegetation community.	• **Ongoing** – continue to monitor
	• Evidence of natural regeneration of at least four pasture species at year 5.	• **Satisfactory** – continue to monitor
Structure	• Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.	• **Ongoing** – continue to monitor
Management inputs	• Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	• **Satisfactory** – continue to monitor
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	• **Satisfactory** – continue to monitor
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites.	• **Ongoing** – continue to monitor
	• Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix.	• **Satisfactory** – continue to monitor
	• Approved pasture species mix is sown at the specified rate per hectare.	• **Satisfactory** – continue to monitor
Weed presence	• Weeds including African lovegrass to comprise <10% of the pasture sward.	• **Satisfactory** – continue to monitor
Ground cover	• Ground cover (vegetation, leaf litter, mulch) >70% at year 5.	• **Satisfactory** – continue to monitor

7. Key findings

- Rainfall preceding the September surveys was higher than the mean rainfall (June-August) for the area.
- No significant surface soil erosion is occurring within the pasture and treed sites (including analogue sites).
- No significant change in % total living ground cover has occurred in the last 12 months at pasture transects.
- Increases in % perennial cover (and an associated decrease in % annual cover) have occurred in each of the rehabilitated pasture transects.
- Total living cover has increased at both treed rehabilitation areas, corresponding to increases in perennial living cover.
- There is no evidence of second-generation establishment at treed rehabilitation areas.
- Shrubs within Transects 5 and 6 are increasing in height and spread.
- Juvenile trees within Transect 6 are producing mature leaf forms, increasing in height and spread and are beginning to flower.
- Nesting boxes are not installed in or adjacent to the treed rehabilitation areas.
- The treed analogue and rehabilitation areas have undergone disturbance due to recent bushfire.
- The treed analogue and rehabilitation areas are each showing evidence of regeneration.
- Fuel loads across the property do not pose a hazard to assets or access.

8. Recommendations

The following recommendations for mitigation and management are consistent with intervention and adaptive management measures contained within the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014).

- Continue to monitor performance indicators;
- Continue to spot-spray outbreaks of African lovegrass;
- Install nesting boxes once the treed rehabilitation areas contain adequate structure to support nesting woodland birds; and
- Consider reinstating fences to prevent motorbike entry to treed analogue site.

9. References

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SLR (2014) *Soil Assessment and Recommendations for Rehabilitation Areas*, NSW

Appendix A
Survey data 2020

Pasture analogue site (Pine Dale Mine)	
Easting	Northing
228300	6304880
228317	6304925
Landform and soils	
Slope	1 - <3% slope inclining to the northwest.
Erosion	Not observed.
Cracking soils	Not observed.
Surface drainage impediments	No significant drainage impediments.
Vegetation	
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.
Species richness	>30 herb and 15 grass species identified.
Cover classification	
Total living cover	90%
Annual living cover	20%
Perennial living cover	70%
Litter cover	-
Bare surface	10%

Transect 1 Pasture rehabilitation area							
Easting			Northing				
228621			6305093				
228594			6305048				
Landform and soils							
Slope	Transect located along a contour. 1 - <3% slope inclining to the northwest.						
Erosion	Minor wind erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.						
Species richness	>30 herbs and grasses identified, dominated by exotic species.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	80%	95%	90%	90%	90%	90%
Annual living cover	-	40%	47.5%	40%	40%	40%	20%
Perennial living cover	-	50%	47.5%	50%	50%	50%	70%
Litter cover	10%	-	-	<10%	10%	-	-
Bare surface	-	20%	5%	<10%	10%	10%	10%
Target weed presence							
African Lovegrass (*Eragrostis curvula)*	<10%						

Transect 2 Pasture rehabilitation area							
Easting			Northing				
228454			6304718				
228400			6304744				
Landform and soils							
Slope	Transect located along a contour. 3 - <10% slope inclining to the west.						
Erosion	Minor wind erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.						
Species richness	>30 herbs and grasses identified, dominated by exotic species.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	80%	90%	90%	90%	90%	90%
Annual living cover	-	40%	42%	40%	40%	40%	20%
Perennial living cover	-	50%	48%	50%	50%	50%	70%
Litter cover	10%	-	-	<10%	10%	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%
Target weed presence							
African Lovegrass (*Eragrostis curvula)*	<10%						

Transect 3 Pasture rehabilitation area							
Easting	Northing						
228267	6304532						
228306	6304560						
Landform and soils							
Slope	Transect located along a contour. 10 - <20% slope declining to the northwest.						
Erosion	Minor wind erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.						
Species richness	>30 herbs and grasses recorded, dominated by exotic species.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	80%	90%	90%	90%	90%	90%
Annual living cover	-	40%	46%	40%	40%	40%	20%
Perennial living cover	-	50%	44%	50%	50%	50%	70%
Litter cover	10%	-	-	<10%	10%	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%
Target weed presence							
African Lovegrass (*Eragrostis curvula)*	<10%						

Transect 4 Pasture rehabilitation area							
Easting	Northing						
228318	6304224						
228249	6304227						
Landform and soils							
Slope	Transect located along a contour. 1 - <3% slope declining to the west.						
Erosion	Minor wind erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.						
Species richness	Diverse groundcover with >35 exotic herb and grass species recorded.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	80%	90%	90%	90%	90%	>90%
Annual living cover	-	40%	42%	30%	30%	40%	20%
Perennial living cover	-	50%	48%	60%	60%	50%	70%
Litter cover	10%	-	-	<10%	10%	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%
Target weed presence							
African Lovegrass (*Eragrostis curvula)*	>10%						

Transect 5 Treed rehabilitation area							
Easting	Northing						
227846	6304272						
227787	6304251						
Landform and soils							
Slope	Transect located along contour of mid slope inclining 10-20% to the north.						
Erosion	Minor wind and rill erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Sparse tree layer to 3 m height with isolated juvenile trees and sparse mixed native shrub species. Moderately dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.						
Species richness	Shrub layer consists of native species and juvenile trees. Groundcover dominated by exotic grasses. >15 species recorded.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	50%	75%	70%	70%	70%	80%
Annual living cover	-	20%	12%	10%	10%	10%	10%
Perennial living cover	-	30%	63%	60%	60%	60%	60%
Litter cover	10%	10%	10%	10%	10%	15%	10%
Bare surface	-	40%	15%	20%	20%	15%	10%
Target weed presence							
None observed.							

Transect 6 Treed rehabilitation area							
Easting	Northing						
226604	6304724						
226647	6304706						
Landform and soils							
Slope	Transect located along contour of mid slope inclining 10-20% to the northeast.						
Erosion	Minor wind and rill erosion observed on exposed soils.						
Cracking soils	Not observed.						
Surface drainage impediments	No significant drainage impediments.						
Vegetation							
Vegetation structure	Sparse tree layer to 5 m height with isolated juvenile trees and sparse mixed native shrub species. Moderately dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.						
Species richness	Shrub layer consists of native species and juvenile trees. Groundcover dominated by exotic grasses. >20 species recorded.						
Cover classification	% cover at each observation						
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020
Total living cover	90%	70%	80%	80%	70%	70%	80%
Annual living cover	-	10%	12%	10%	10%	10%	10%
Perennial living cover	-	60%	68%	70%	60%	60%	70%
Litter cover	10%	10%	10%	10%	10%	15%	10%
Bare surface	-	20%	10%	10%	20%	15%	10%
Target weed presence							
None observed.							

Treed analogue site (transect 7)	
Easting	Northing
226801	6305097
226838	6305039
Landform and soils	
Slope	Transect located along contour of mid slope gently inclining to the north.
Erosion	Minor wind and rill erosion observed on exposed soils.
Cracking soils	Not observed.
Surface drainage impediments	No drainage impediments.
Vegetation	
Vegetation structure	Eucalyptus dominated canopy to 14 m high. No appreciable canopy cover due to recent fire. Very sparse shrub layer to 3 m height. 70% groundcover to 0.5 m height, dominated by native grasses with mixed native herbs.
Species richness	More than 10 tree species, dominated by *Eucalyptus* spp. Shrub layer of >14 native species. Diverse groundcover dominated by *Poa* spp. with mixed native herbs.
Cover classification	
Total living cover	70%
Annual living cover	10%
Perennial living cover	60%
Litter cover	20%
Bare surface	10
Target weed presence	
None observed.	

Appendix B
Vegetation assessment of treed areas

Vegetation assessment treed areas 2020

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>5	>10	>20
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. No significant canopy cover not assessable due to recent fire.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse. <10 species, 1-3 m height, No significant cover due to recent fire.
Groundcover	90% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 90% cover.	70% cover. Mixed native herbs and grasses.
Non-native species	>5	>10	<5
Recruitment	Observed.	Observed.	Regeneration observed.
Organic litter	Thin, sparse.	Thin, sparse.	Thin, sparse.
Logs	Large logs placed along contours on upper slope. Some burned.	Large logs placed along contours on upper slope.	Sparse fallen timber from burned trees.

Vegetation assessment treed areas 2019

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>10	>15	>25
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>14 species, 1-3 m height, 10% cover
Groundcover	80% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	>10 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2018

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>14 species, 1-3 m height, 10% cover
Groundcover	70% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	>10 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2017

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	70% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2016

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	75% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>15	>13, including *Senecio madagascariensis.*	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2015

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	>7 species, 1-2 m height, 10% cover
Groundcover	<40%. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 20% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10, including *Rubus fruticosus.*	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2014

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3m height.	Sparse. To 3m height.	>5 species, 12-14 m height. 40% canopy cover.
Understorey	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	>7 species, 1.5 - 3 m height, 35% cover
Groundcover	Sparse. Mix of exotic grasses, native and exotic herbs.	Sparse. Mix of exotic grasses, native and exotic herbs.	70% cover. Dominated by *Poa* spp. with mixed native herbs.
Non-native species	>10	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to >2cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Appendix C
Estimation of annual soil loss

Annual soil loss factors	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
Annual rainfall erosivity factor **(R)**	**1365** Bathurst							
Soil erodibility factor **(K)**	**0.03** Sandy loam /fine sandy loam				**0.025** Sandy clay-loam			**0.03** Sandy loam /fine sandy loam
Topographic factor **(LS)**	**0.17** 3% gradient, 5 m slope length			**0.34** 8% gradient, 5 m slope length	**0.09** 1% gradient, 5 m slope length	**0.89** 20% gradient, 5 m slope length		**0.52** 12% gradient, 5 m slope length
Cover and management factor **(C)**	**0.01** No appreciable canopy cover, 80-95% grassy groundcover					**0.01** 25% canopy cover of tall weeds or short brush, 80-95% grassy groundcover	**0.01** 25% canopy cover of tall weeds or short brush, 80-95% grassy groundcover	**0.04** No appreciable cover, 60-80% grassy groundcover
Erosion control practice factor **(P)**	**1.3** Compacted					**1.2** Consistent with trackwalking along contour		**1.3** Compacted
Annual soil loss due to erosion **(A)**	**0.09 t/ha**	**0.09 t/ha**	**0.09 t/ha**	**0.18 t/ha**	**0.03 t/ha**	**0.36 t/ha**	**0.36 t/ha**	**1.10 t/ha**

Appendix D
Species list

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Acacia dealbata subsp. *dealbata*					X	X	X
Acacia nana					X	X	
Acacia parramattensis						X	
Acacia rubida					X	X	X
Acacia sp.					X	X	X
Acacia spectabilis						X	
Acacia ulcifolia							X
Acaena novae-zelandiae							X
Amaranthus sp.	X	X	X	X			
Anagalis arvensis	X	X	X	X			
Brassica spp.	X	X	X	X	X	X	
Bursaria spinosa subsp. *lasiophylla*					X	X	X
Cassinia arcuata						X	
Chenopodium sp.						X	
Cirsium vulgare				X	X	X	
Conyza bonariensis	X	X	X	X	X	X	
Cortaderia sp.						X	
Cymbonotis lawsonianus				X	X	X	
Dactylis glomerata	X	X	X	X			
Eragrostis sp.	X	X	X	X			
Erodium cicutarium				X			
Eucalyptus bensonii							X
Eucalyptus cypellocarpa						X	

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Eucalyptus dalrympleana subsp. *dalrympleana*							X
Eucalyptus dealbata						X	
Eucalyptus dives					X	X	X
Eucalyptus machrorhyncha subsp. *cannonii*							X
Eucalyptus mannifera subsp. *Mannifera*							X
Eucalyptus melliodora						X	
Eucalyptus pulverulenta						X	
Eucalyptus radiata subsp. *radiata*						X	X
Eucalyptus rubida subsp. *rubida*							X
Euphorbia sp.	X	X	X	X			
Exocarpos cuppressiformis							X
Festuca sp.	X	X	X	X			
Gamochaeta sp.	X	X	X	X			
Geranium sp.	X	X	X	X			
Gnaphalium sphaericum	X	X	X	X			
Helminthotheca echioides				X	X		
Hypochaeris radicata	X	X	X	X	X	X	
Juncus spp.		X					
Lepidium sp.	X	X	X	X			
Leptorhynchos sp.				X			
Leucopogon sp.							X
Lissanthe strigose subsp. *subulata*							X
Lysimachia arvensis							X

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Malva neglecta	X	X	X	X			
Malva sp.	X	X	X	X	X	X	
Marrubium vulgare							X
Medicago sp.	X	X	X	X			
Oxalis corniculata	X	X	X	X			
Paspalum sp.	X	X	X	X			
Persoonia laurina							X
Persoonia mollis subsp. mollis							X
Persoonia spp.							X
Phalaris aquatica	X	X	X	X			
Plantago lanceolata	X	X	X	X	X	X	
Poa labillardierei							X
Poa spp.	X	X	X	X			X
Romulea minutiflora	X	X	X	X			
Ranunculus sp.	X	X	X	X			
Rorippa sp.	X	X	X	X			
Rumex acetosella	X	X	X	X			
Solanum sp.	X	X	X	X			
Sonchus oleraceus	X	X	X	X			
Sida sp.					X	X	
Taraxacum officinale				X			
Themeda australis							X
Trifolium arvense	X	X	X	X			
Trifolium repens	X	X	X	X			

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Trifolium subterraneum	X	X	X	X			
Vulpia sp.	X	X	X	X			

Appendix E
Photopoint monitoring to 2020

Transect 1 looking south 2014

Transect 1 looking south 2015

Transect 1 looking south 2016

Transect 1 looking south 2017

Transect 1 looking south 2018

Transect 1 looking south 2019

Transect 1 looking south 2020

Transect 2 looking southeast 2014

Transect 2 looking southeast 2015

Transect 2 looking southeast 2016

Transect 2 looking southeast 2017

Transect 2 looking southeast 2018

Transect 2 looking southeast 2019

Transect 2 looking southeast 2020

Transect 3 looking southwest 2014

Transect 3 looking southwest 2015

Transect 3 looking southwest 2016

Transect 3 looking southwest 2017

Transect 3 looking southwest 2018

Transect 3 looking southwest 2019

Transect 3 looking southwest 2020

Transect 4 looking west 2014

Transect 4 looking west 2015

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Transect 6 looking east 2015

Transect 6 looking east 2016

Transect 6 looking east 2017

Transect 6 looking east 2018

Transect 6 looking east 2019

Transect 6 looking east 2020

Transect 7 looking east 2014

Transect 7 looking east 2015

Transect 7 looking east 2016

Transect 7 looking east 2017

Transect 7 looking east 2018

Transect 7 looking east 2019

Transect 7 looking east 2020

Quadrat 1 February 2010 (Cunningham 2012)

Quadrat 1 September 2011 (Cunningham 2012)

Quadrat 1 November 2012 (Cunningham 2012)

Quadrat 1 April 2014

Quadrat 1 September 2015

Quadrat 1 September 2016

Quadrat 1 September 2017

Quadrat 1 September 2018

Quadrat 1 September 2019

Quadrat 1 September 2020

Appendix D

Pine Dale Mine Rehabilitation and Completion Assessment Report (Ref [7])

PINE DALE MINE

Rehabilitation and Completion Assessment

Prepared for:

Enhance Place Pty Ltd
PO Box 202
Wallerawang NSW 2790

SLR Ref: 630.12362-R01
Version No: -v1.0
December 2018

PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Enhance Place Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12362-R01-v1.0	20 December 2018	Nathan Archer	Murray Fraser	Nathan Archer

EXECUTIVE SUMMARY

Energy Australia (EA) owns Enhance Place Pty Limited (Enhance Place) which owns and operates the Pine Dale Mine and Enhance Place Mine near Lithgow in the Western Coalfields of New South Wales (NSW).

The Pine Dale Mine has been under care and maintenance since approved mining resources were exhausted in 2014. Since that time, extensive work has been undertaken to rehabilitate the degraded former mining areas back to an approved final land use which is commensurate with the surrounding area. Enhance Place has rehabilitated Areas C and 8 at the Pine Dale Mine back to pasture for agricultural purposes, including grazing. Enhance Place has undertaken a strategic approach to the rehabilitation of the Pine Dale Mine, consistent with NSW Government recommendations and best practice environmental management.

In 2014, Enhance Place engaged SLR to undertake an assessment of the status of rehabilitated pasture areas to identify measures required to improve the productivity of pasture areas. The assessment identified appropriate soil amelioration and management measures would improve soil quality and rehabilitation performance over the long term. Based on the findings and recommendations of the assessment Enhance Place developed and implemented a targeted rehabilitation works and monitoring program which was incorporated into the *Pine Dale Care and Maintenance Mining Operations Plan* (MOP) (Enhance Place, 2017).

In addition, Enhance Place has engaged FirstField Environmental to undertake annual rehabilitation monitoring and to make further recommendations for improving rehabilitation performance. The results of the rehabilitation monitoring have been reported in the Annual Review for the site with an ongoing works program being implemented by Enhance Place to incorporate the additional recommendations.

Rehabilitation works undertaken at the Pine Dale Mine have included:

- Construction of final landform and water management / erosion and sediment control structures;
- Seeding with approved pasture mixture known as '*Cox's River Mix*':
- Lime amelioration to raise soil pH and provide improved soil conditions to promote pasture growth;
- Application of Muriate of Potash (MOP) at 0.25 tonnes/ha and di-ammonium phosphate (DAP) at 0.20 tonnes/ha;
- Weed spraying to control noxious weeds including African Lovegrass;
- Ripping of furrows along poorly vegetated areas followed by direct reseeding;
- Reseeding of exposed areas with pasture seed mix; and
- Application of additional seed, fertiliser and compost at recommended rates, where required;

These works have improved soil nutrient parameters, ground cover and pasture composition within the rehabilitation areas whilst also reducing erosion and weed presence. Rehabilitation monitoring results and soil nutrient analysis have shown that the rehabilitation within all the areas has now been completed to a standard where the approved rehabilitation objectives and completion criteria specified in the MOP have been achieved. As such, Enhance Place is seeking to partially relinquish the relevant mining leases covering these areas and seeks confirmation that rehabilitation has been successfully completed to the satisfaction of the Department.

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APPENDICES

1 Introduction

Energy Australia (EA) owns Enhance Place Pty Limited (Enhance Place) which owns and operates the Pine Dale Mine and Enhance Place Mine near Lithgow in the Western Coalfields of New South Wales (NSW).

The Pine Dale Mine has been under care and maintenance since approved mining resources were exhausted in 2014. Since that time, extensive work has been undertaken to rehabilitate the degraded former mining areas back to an approved final land use which is commensurate with the surrounding area. Works undertaken by Pine Dale Mine have improved soil nutrient parameters, ground cover and pasture composition within the rehabilitation areas whilst also reducing erosion and weed presence. Rehabilitation has been completed to a standard where the completion criteria approved within the *Pine Dale Care and Maintenance Mining Operations Plan* (MOP) (Enhance Place, 2017) have been met and rehabilitation is considered complete. As such Enhance Place is seeking to partially relinquish the mining lease covering these areas.

This report has been prepared to support an application to the Department of Planning and Environment – Resource Regulator (DPE-RR) for the partial relinquishment of Mining Lease 1578. This report confirms that the rehabilitation objectives approved under the MOP have been achieved. Pine Dale Mine therefore seek confirmation that rehabilitation has been successfully completed to the satisfaction of the Department.

The report has been prepared in accordance with the requirements of *Form ESF2: Rehabilitation Completion and/or Review of Rehabilitation Cost Estimate* (DRE 2017). It includes a description of the rehabilitation activities undertaken and evidence of meeting the approved rehabilitation objectives and completion criteria specified in the MOP.

2 Background and Justification for Relinquishment

Pine Dale Mine operates under Project Approval (PA) 10_0041, dated 20 February 2011 granted by the then Department of Planning and Infrastructure (DP&I) under Section 75J of the Environmental Planning and Assessment Act 1979 (EP&A Act). The PA provided for the extraction of up to 800,000 tonnes (t) of Run-of-Mine (ROM) coal from the Yarraboldy Extension at Pine Dale Mine through to 31 December 2014 at a maximum rate of 350,000 tonnes per annum (tpa).

Approved mining resources at the Pine Dale Mine were exhausted in March 2014. The mine has been under care and maintenance since April 2014 with only rehabilitation activities undertaken at the site. Rehabilitation activities have been undertaken with the intention of improving rehabilitation areas to an appropriate standard to be relinquished. Enhance Place has undertaken a strategic approach to the rehabilitation of the Pine Dale Mine, consistent with NSW Government recommendations and best practice environmental management.

In 2014, an assessment of the status of rehabilitation was undertaken by SLR to identify measures improve the productivity of pasture areas and to progress towards the desired objective of establishing sustainable grazing to a standard appropriate to relinquish the mining lease. The assessment identified appropriate soil amelioration and management measures would improve soil quality and rehabilitation performance over the long term. Additionally the assessment established soil performance indicators using site specific characteristics and baseline data from undisturbed analogue sites.

The results and recommendations of the assessment were presented in the *Soil Assessment and Recommendations for Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2014). Based on the findings and recommendations of the assessment Enhance Place developed and implemented a targeted rehabilitation works and monitoring program which was incorporated into the MOP (Enhance Place, 2017).

Enhance Place engaged FirstField Environmental to undertake annual monitoring of the progress of rehabilitation and to make further recommendations for improving rehabilitation performance. The results of the rehabilitation monitoring have been reported in the Annual Review for the site with an ongoing works program being implemented by Enhance Place to incorporate any additional recommendations. The findings of the 2017 Annual Rehabilitation Monitoring Report (FirstField Environmental, 2017) are included as **Appendix A** and are summarised in **Section 8.1** of this report.

A further rehabilitation assessment and soil sampling program was undertaken by SLR in March 2018 to determine if the site had progressed to a relinquishable standard. The findings of the inspection are presented in *Assessment of Rehabilitated Areas – Pine Dale and Enhance Place Mine,* (SLR 2018) (**Appendix B**) and are summarised in **Section 8.2** of this report. The inspection showed that works undertaken have improved soil nutrient parameters, ground cover and pasture composition within the rehabilitation areas whilst also reducing erosion and weed presence.

As presented in this report, through the implementation of all appropriate recommendations, Enhance Place has rehabilitated Areas C and 8 at the Pine Dale Mine back to pasture for agricultural purposes, including grazing. Rehabilitation monitoring results and soil nutrient analysis has shown that the rehabilitation within all the areas has met or exceeded the approved rehabilitation objectives and completion criteria specified in the MOP.

3 Reference Documents

The following documents have been referred to in the preparation of this report:

- Pine Dale Care and Maintenance MOP (Enhance Place 2017);
- Pine Dale Mine Annual Reviews (2011 to 2017);
- Rehabilitation Monitoring Reports (FirstField Environmental 2014 to 2017);
- Soil Assessment and Recommendations for Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine (SLR, 2014); and
- Assessment of Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine (SLR, 2018).

4 Regulatory Requirements and Rehabilitation Objectives

Pine Dale is managed in accordance with Project Approval 10_0041 and relevant licences and mining leases. The MOP has been prepared in accordance with the relevant regulatory requirements with the approved rehabilitation objectives for the site as follows:

- The rehabilitated landform is safe, stable, non-polluting and sustainable;
- Rehabilitation maintains or improves species diversity and habitat values of the Yarraboldy Extension Area, particularly the former Yarraboldy Open Cut Mine; and

- The agreed post mining land use is compatible with the surrounding land fabric and land use requirements.

The approved rehabilitation objectives specific to the pasture rehabilitation areas at the Pine Dale Mine are:

- Establish approximately 21 ha of sustainable pasture on areas disturbed by mining;
- Pasture areas to be compatible with surrounding undisturbed land;
- Appropriate topsoil or topsoil substitutes will be spread and ameliorated (as required) to produce a growth media capable of sustaining pasture growth;
- Pasture areas are revegetated with a mix of native and exotic perennial pasture species; and

Maintenance needs / management inputs to be no greater than those of surrounding land.

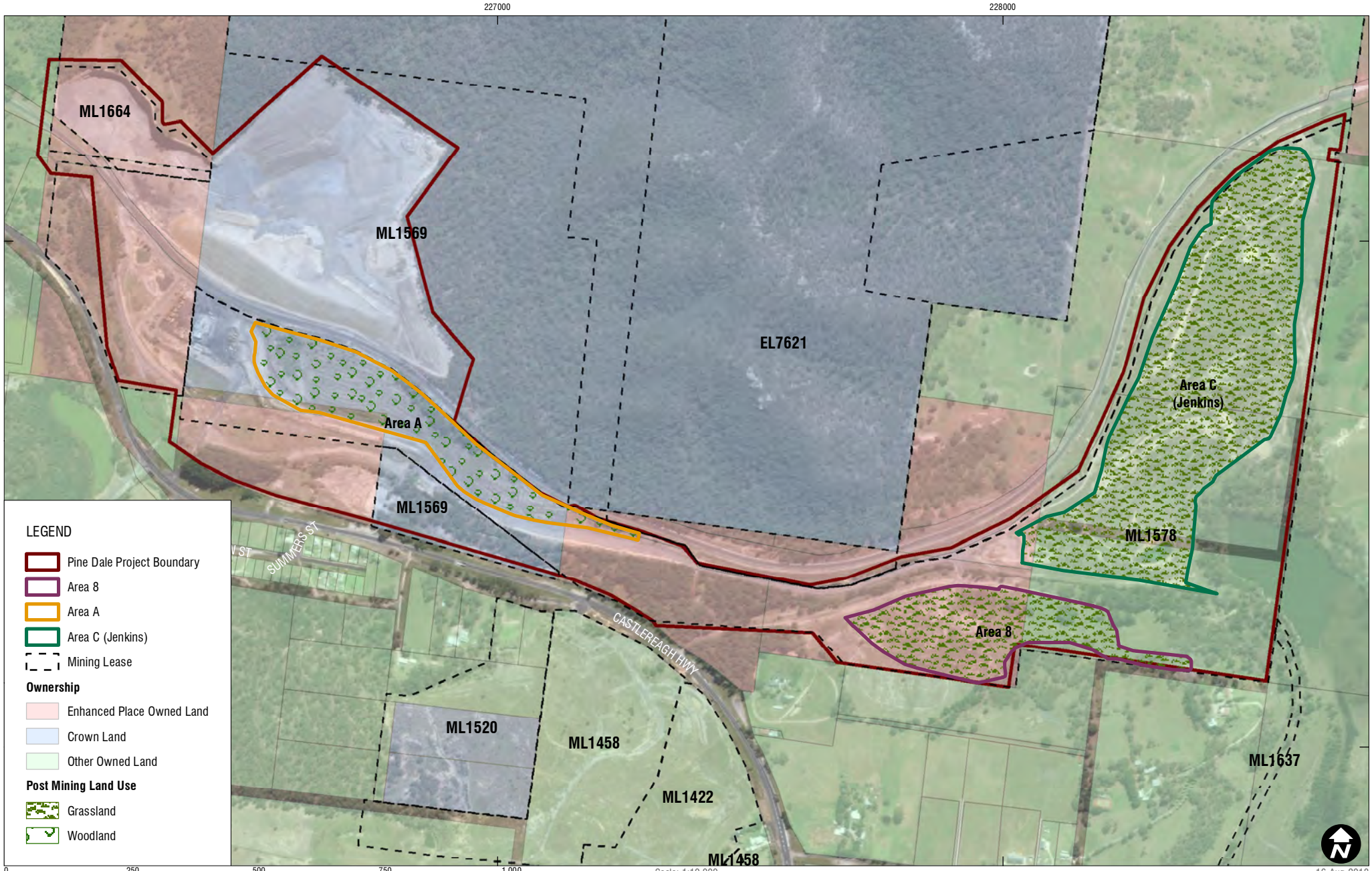
5 Rehabilitation Areas and Post Mining Land Use

Rehabilitation at Pine Dale Mine has been undertaken in a series of rehabilitation areas, comprising parcels of land which are at various stages of being progressively rehabilitated back to a self-sustaining post mining land use.

The locations of the rehabilitation areas at Pine Dale Mine are shown in **Figure 1** along with the final land use and the applicable land ownership. The rehabilitation areas comprise:

- **Area A** - Area A has been reseeded to rehabilitate the area to a native woodland vegetation community. Enhance Place are not seeking to relinquish Area A at this time and therefore it is not mentioned further in this report;
- **Area C** – Area C is located entirely on privately owned land and has been returned to pasture for agricultural purposed, including grazing, as per the approved rehabilitation strategy and landholder preferences; and
- **Area 8** – Area 8 is predominantly owned by Enhance Place with the eastern portion privately owned. Area 8 has also been returned to pasture for agricultural purposed, including grazing, as per the approved rehabilitation strategy and landholder preferences.

Enhance Place seeks to relinquish rehabilitation Area C and Area 8 at the Pine Dale Mine as they are considered to have met the nominated rehabilitation objectives. The following sections presents a summary of the rehabilitation completed at Pine Dale Mine along with rehabilitation monitoring results which demonstrates the successful achievement of the approved rehabilitation completion criteria specified in the MOPs.



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630.12362

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Pine Dale
Rehabilitation Areas

Figure 1

6 Rehabilitation Activities Completed

Rehabilitation works at Pine Dale Mine within Area C and 8 have been conducted in accordance with rehabilitation objectives in the approved MOP (Enhance Place, 2017). Enhance Place has undertaken works to improve pasture rehabilitation outcomes in accordance with recommendations documented in the *Soil Assessment and Recommendations for Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2014)). Additional rehabilitation and maintenance activities have been conducted, as required, to action any recommendations of annual rehabilitation monitoring undertaken as part of the annual review process.

The specific rehabilitation activities undertaken at the Pine Dale Mine are summarised in the following sections.

6.1 Area C

Rehabilitation Area C covers an area of approximately 25 ha and has been rehabilitated to pasture. The final landform and water management structures have been completed and the areas seeded with pasture in accordance with Project Approval 10_0041 and the requirements of the landowner.

Shaping and seeding of Area C commenced in 2010 and was completed in 2011. The area was seeded with a pasture mixture known as '*Cox's River Mix*' and comprised:

- 40% Fescue (*Festuca spp.*);
- 25% Cocksfoot (*Dactylis glomerata*);
- 20% Subterranean Clover (*Trifolium subterranean*);
- 6% Perennial Ryegrass (*Lolium perene*);
- 5% White Clover (*Trifolium repens*); and
- 4% Phalaris (*Phalaris aquatica*).

Contour drains and catchment dams were constructed in 2012 within the rehabilitated Area C as reported in the 2012 Annual Review (Enhance Place 2013). In addition, erosion and sediment controls (including sediment fences and rock lined drains) have been installed and maintained, as required, throughout the rehabilitation of Area C.

Area C had lime applied in October 2013 to raise soil pH and provide improved soil conditions to promote pasture growth (refer 2013 Annual Review (Enhance Place 2014)).

As reported in the 2015 Annual Review (Enhance Place 2016), the following rehabilitation works were undertaken at Area C during 2015:

- Tilling of the drainage lines;
- Application of hydro-mulch containing a seed mix comprising Kasbah Cocksfoot, Atlas Phalaris, Zulu Arrowleaf Clover and Goulburn Sub Clover; with follow-up watering;
- Application of a lime, gypsum and mushroom compost mixture (10:4:1 tonnes/ha);
- Application of Muriate of Potash (MOP) at 0.25 tonnes/ha and di-ammonium phosphate (DAP) at 0.20 tonnes/ha; and

- Intensive weed spraying.

In 2016 and 2017, continued rehabilitation maintenance and improvement activities were undertaken within Area C, as reported in the 2016 and 2017 Annual Reviews (Enhance Place 2017, 2018). Activities included:

- Weed spraying to control noxious weeds including African Lovegrass;
- Removal of rocks and fallen trees from pasture;
- Ripping of furrows along poor pasture establishment areas and contour banks/drainage lines prior to reseeding; and
- Application of additional seed, fertiliser and compost at recommended rates, where required.

6.2 Area 8

Rehabilitation Area 8 is approximately 10 ha and has been rehabilitated with the same pasture mixture used in Area C known as '*Cox's River Mix*'. Seeding of Area 8 commenced in 2008 after the final landform was established. The vegetation communities prior to mining include a mixture of cleared land, pasture, pines and eucalyptus.

Following seeding, rehabilitation activities at Area 8 generally comprised of additional maintenance activities in the form of erosion control, fertilizing and weed management.

As reported in the 2015 Annual Review (Enhance Place 2016), the following rehabilitation works were undertaken at Area 8 during 2015:

- the application of a lime, gypsum and mushroom compost mixture a rate of 10:1:3 tonnes/ha;
- re-shaping of drainage lines within the area and rock placement in erosion channels.
- intensive weed spraying was undertaken;
- application of pasture seed mix along with MOP at 0.25 tonnes/ha and DAP at 0.20 tonnes/ha.

In 2016 and 2017, continued rehabilitation maintenance and improvement activities were undertaken within Area 8, as reported in the 2016 and 2017 Annual Reviews (Enhance Place 2017, 2018). Activities included:

- Weed spraying to control noxious weeds including African Lovegrass;
- Ripping of furrows along poorly vegetated areas followed by direct reseeding;
- Reseeding of exposed areas with pasture seed mix; and
- Application of additional seed, fertiliser and compost at recommended rates, where required.

7 Completion Criteria

Table 1 presents the approved rehabilitation completion criteria relevant to the pasture rehabilitation areas in Areas C and 8 at Pine Dale Mine. The rehabilitation completion criteria were developed in accordance with the requirements of PA 10_0041, relevant mining leases and *ESG3: Mining Operations Plan (MOP) Guidelines* dated September 2013 and were approved by the DPE on 12 April 2017. **Table 1** also presents the completion status of each of the criteria as well as the section of this report where further evidence is provided.

Table 2 presents the specific soil nutrient completion targets required to meet the desired objective of establishing sustainable grazing pasture that will require ongoing management inputs that are consistent with comparable pasture and grazing practices.

Table 1 Pine Dale Mine Performance Indicators and Completion / Relinquishment Criteria

Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes / No)	Evidence / Section of report addressed
Phase – Growth media development					
Domain – Rehabilitation Area Pasture					
Growth media is suitable for establishing the desired vegetation community	Soil characterisation	Topsoil and subsoil has been tested to assess suitability for intended post mining land use.	Soil Assessment Results and Rehabilitation Monitoring Reports	Yes	Table 2 and *Soil Assessment and Recommendations for Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2014)
	Topsoil and subsoil depth	≥ 250 mm of subsoil material e.g. clay ≥ 50mm of topsoil	Soil Assessment Results and Rehabilitation Monitoring Reports	Yes	Available soil materials have been spread where available. Where limited topsoil resources have been available, appropriate ameliorants have been applied to assist in microbial activity and the "making" of topsoil.
	Amelioration	Topsoils and subsoils are ameliorated in accordance with the recommendations of the soil characterisation (including application of boiler ash, fertilisers and organics as required).	Soil Assessment Results and Rehabilitation Monitoring Reports	Yes	Section 6; and *Assessment of Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2018) (**Appendix B**)
	Deep ripping	Rehabilitation area deep ripped on contour.	Rehabilitation Monitoring Reports	Yes	Section 6; and 2015-2017 Annual Reviews

Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes / No)	Evidence / Section of report addressed
Erosion hazards are minimised	Temporary ESC	Erosion and sediment controls are installed prior to topsoil respreading.	From Managing Urban Stormwater: Soils & Construction	Yes	Section 6; and 2015-2017 Annual Reviews
Phase – Ecosystem and land use establishment					
Domain – All Domains					
Weed species and feral animals are controlled and do not significantly impact the desired final land use	Feral animal and noxious weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use	Rehabilitation Monitoring Reports	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
	Feral animal and noxious weed control	Feral animals and noxious weeds are controlled in accordance with legislation	Rehabilitation Monitoring Reports	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Bushfire risk is managed on rehabilitation areas.	Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	Bushfire Management Plan	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
	Access	Adequate access for firefighting is maintained on rehabilitation areas.	Bushfire Management Plan	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Erosion does not compromise public safety or the post mining land capability	Erosion	No evidence of significant erosion.	Rehabilitation Monitoring Reports	Yes	Section 8.1; and Annual Rehabilitation Monitoring Reports

Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes / No)	Evidence / Section of report addressed
Soil profile is developing appropriate for the intended post mining land use.	Soil quality	Soil chemical characteristics including: pH, EC, major cations (K, Na, Al, Ca, Zn), sulfur and nitrate are comparable with analogue site (PD3) (refer **Table 2**).	Soil Assessment Results / MOP Appendix D	Yes	Section 8.2; and *Assessment of Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2018) (**Appendix B**)
	Ground cover	Ground cover (vegetation, leaf litter, mulch) greater than 70% at Year 5.	Ecosystem Function Analysis. (CSIRO 2008)	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Domain – Rehabilitated area (pasture)					
Pasture rehabilitation areas will be established comparable to surrounding undisturbed pasture lands.	Pasture species	Approved pasture species mix is sown at the specified rate per hectare.	Rehabilitation Monitoring Reports / MOP Appendix D	Yes	Section 6; and 2015-2017 Annual reviews.
	Species composition	Established pasture mix comprises approximately 70% perennial grasses and 20% annual legumes, representative of species at analogue sites.	Rehabilitation Monitoring Reports/MOP Appendix D	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
	Weed presence	Weeds including African Lovegrass comprise less than 10% of the total pasture sward.	Rehabilitation Monitoring Reports / MOP Appendix D	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Phase – Ecosystem and land use sustainability					
Domain – All Domains					
Erosion does not present a safety hazard or compromise the post mining land capability.	Soil loss	Net annual soil loss is comparable to analogue sites at Year 10.	Ecosystem Function Analysis. (CSIRO 2008)	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)

Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes / No)	Evidence / Section of report addressed
	Erosion features	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunnelling)	From Managing Urban Stormwater: Soils & Construction	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Soil profile is developing appropriate for the intended post mining land use.	Soil quality	Soil chemical characteristics including: pH, EC, major cations (K, Na, Al, Ca, Zn), sulfur and nitrate are comparable with analogue site (PD3) (refer **Table 2**).	Soil Assessment Results / MOP Appendix D	Yes	Section 8.2; and *Assessment of Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine* (SLR, 2018) (**Appendix B**)
	Ground cover	Ground cover (vegetation, leaf litter, mulch) greater than 70% at Year 5.	Ecosystem Function Analysis. (CSIRO 2008)	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
Domain – Rehabilitated area (pasture)					
Pasture rehabilitation areas are self-sustaining.	Natural regeneration	Evidence of natural regeneration of at least four pasture species at Year 5.	*Ecosystem Function Analysis.* (CSIRO 2008)	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
	Rural land capability	Pasture Rehabilitation Areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	*Ecosystem Function Analysis.* (CSIRO 2008)	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)
	Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	Rehabilitation Monitoring Reports & MOP Appendix D	Yes	Section 8.1; and 2017 Annual Rehabilitation Monitoring Report (**Appendix A**)

Table 2 Soil Nutrient Level Completion Targets

Soil Element	Measure & Test	Site PD3 Soil Test	Ideal Soil Element Range[1]	Completion Target Measure
pH	1:5 $CaCl_2$	4.94	Between 5.2 – 8.0	Greater than 4.9
Potassium	% of Total CEC	3.17	Greater than 2%	Greater than 2%
Sodium	% of Total CEC	1.90	Less than 3%	Less than 3%
Aluminium	% of Total CEC	0.53	Less than 5%	Less than 5%
Sulfur	mg/kg KCl 40 S	6.8	Greater than 8	Greater than 5.4[2]
Nitrogen	mg/kg Water Extract	4.6	Greater than 10	Greater than 4.6
Zinc	mg/kg DTPA	0.7	Greater than 1	Greater than 0.7
Calcium	Calcium to Magnesium Ratio	2.14	Greater than 3	Greater than 2.1

1 - Ideal soil element ranges were derived from Lines-Kelly R (1994) *Soil Sense: Soil Management for North Coast Farmers* and Peverill K.I. Sparrow L.A. Reuter D.J. (1999) *Soil Analysis: An Interpretation Manual*

2 - Upon analysis of soil samples taken from analogue sites in March 2018, the sulfur levels at PD3 in September 2014 appear to be unusually high, with all analogue sites (including PD3) having sulfur levels significantly lower than 6.8, with an average across the five analogue sites of 5.4,. Considering these results a sulfur completion target measure of greater than 5.4 is considered a more realistic representation of baseline conditions.

8 Assessment of Rehabilitation Areas

8.1 Rehabilitation Monitoring Results

Annual rehabilitation monitoring is undertaken by FirstField Environmental and is reported in the Pine Dale Mine Annual Review, available on the Enhance Place website. Rehabilitation monitoring has assessed the status of the rehabilitation against the *ecosystem and land use establishment* and *ecosystem and land use sustainability* completion criteria presented in **Table 1**.

The findings of the *2017 Annual Rehabilitation Monitoring Report* (FirstField Environmental, 2017) (**Appendix A**) showing the assessed status of the rehabilitation in the pasture rehabilitation areas at Pine Dale Mine are summarised in **Table 3**.

Table 3 2017 Rehabilitation Monitoring Results

Performance Indicator	Completion Criteria	2017 Annual Rehabilitation Monitoring Findings	Status of Completion Criteria
Phase – Ecosystem and land use establishment			
Feral animal and noxious weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use	Feral animal and noxious weed species are controlled in accordance with legislation and are not considered to adversely impact the intended final land use. Weeds including African lovegrass comprise <10% of the pasture sward. African lovegrass has been subjected to ongoing chemical treatment and were not observed to be growing or producing seed. Rabbit and fox numbers are considered low and do not require population reduction measures. Some scats were observed across the property but no holes, burrows or dens were observed.	**Satisfactory**
Feral animal and noxious weed control	Feral animals and noxious weeds are controlled in accordance with legislation		
Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	Fuel loads are low and fuel hazard mitigation is not required at this time. Fire breaks are maintained in accordance with the Bushfire Management Plan.	**Satisfactory**
Access	Adequate access for firefighting is maintained on rehabilitation areas.	Access to each of the rehabilitation areas is considered adequate. All access roads within rehabilitated areas are maintained in good condition and are suitable for the passage of Category 1 tankers having a vertical clearance of >4m and width >2.8m.	**Satisfactory**
Erosion	No evidence of significant erosion.	There are no significant erosion features that compromise landform stability or public safety. Pasture areas support evidence of minor wind erosion where groundcover is poorly established or absent.	**Satisfactory**
Soil quality	Soil chemical characteristics including: pH, EC, major cations (K, Na, Al, Ca, Zn), sulfur and nitrate are comparable with analogue site (PD3) (refer **Table 2**).	Not assessed by FirstField Environmental (refer **Section 8.2**)	Refer **Section87.2**

Performance Indicator	Completion Criteria	2017 Annual Rehabilitation Monitoring Findings	Status of Completion Criteria
Ground cover	Ground cover (vegetation, leaf litter, mulch) greater than 70% at Year 5.	Rehabilitated pasture surfaces in each of the transect areas support living groundcover of approximately 90%. Areas where groundcover is sparse or absent is estimated to account for <10% of each rehabilitation pasture area.	**Satisfactory**
Pasture species	Approved pasture species mix is sown at the specified rate per hectare.	Cox's River Mix was sown in 2010-2011 (refer **Section 6**).	**Satisfactory**
Species composition	Established pasture mix comprises approximately 70% perennial grasses and 20% annual legumes, representative of species at analogue sites.	Pasture rehabilitation areas are established with a mixture of 70% perennial grasses and 20% annual legumes and are representative of the species composition at the analogue pasture site.	**Satisfactory**
Weed presence	Weeds including African Lovegrass comprise less than 10% of the total pasture sward.	Weeds including African lovegrass comprise <10% of the pasture sward. African lovegrass has been subjected to ongoing chemical treatment and were not observed to be growing or producing seed.	**Satisfactory**
Phase - Ecosystem and Land Use Sustainability			
Soil loss	Net annual soil loss is comparable to analogue sites at Year 10.	Given that rehabilitation commenced <10 years ago it is not yet possible to determine whether net soil loss is comparable to analogue sites at Year 10. Estimated soil loss in pasture rehabilitation areas is estimated to be between 0.03 and 0.18 t/ha, whilst estimated soil loss at the pasture analogue site is estimated to be 0.09 t/ha. Estimated soil loss in each transect is considered adequate and is comparable to the analogue site.	**Ongoing**
Erosion features	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunnelling)	There are no significant erosion features that compromise landform stability or public safety. Pasture areas support evidence of minor wind erosion where groundcover is poorly established or absent.	**Satisfactory**

Performance Indicator	Completion Criteria	2017 Annual Rehabilitation Monitoring Findings	Status of Completion Criteria
Soil quality	Soil chemical characteristics including: pH, EC, major cations (K, Na, Al, Ca, Zn), sulfur and nitrate are comparable with analogue site (PD3) (refer **Table 2**).	Not assessed by FirstField Environmental (refer **Section 8.2**)	Refer **Section 8.2**
Ground cover	Ground cover (vegetation, leaf litter, mulch) greater than 70% at Year 5.	Rehabilitated pasture surfaces in each of the transect areas support living groundcover of approximately 90%. Areas where groundcover is sparse or absent is estimated to account for <10% of each rehabilitation pasture area.	**Satisfactory**
Natural regeneration	Evidence of natural regeneration of at least four pasture species at Year 5.	Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.	**Satisfactory**
Rural land capability	Pasture Rehabilitation Areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	Pasture rehabilitation areas are assessed as being Land and Soil Capability Class V and are suitable for grazing.	**Satisfactory**
Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	Management inputs are within the range of analogue sites. Control of noxious and targeted weeds has been undertaken across all areas as required.	**Satisfactory**

As presented in **Table 2**, the status of all completion criteria was determined to be satisfactory during the 2017 Annual Rehabilitation Monitoring with the exception of estimated soil loss. Estimated soil loss is considered to be in the range of the analogue site; however given that the rehabilitation is less than 10 years old an assessment of the soil loss at year 10 could not be made. Given pasture groundcover is greater than 70% along with the application of mushroom compost it is unlikely that net soil loss would be occurring in the rehabilitated areas.

8.2 Rehabilitation Inspection and Soil Nutrient Sampling Results

In March 2018 SLR completed a detailed walk through inspection to assess the current status of the mining lease and to determine whether rehabilitation objectives had been met in Area C and Area 8. During the inspection soil samples were taken from the topsoil (0-10 cm) at each inspection site and analysed for soil chemical characteristics including pH, EC, major cations (K, Na, Al, Ca, Zn), sulfur and nitrate for comparison with the analogue site and the completion criteria presented in **Table 2**.

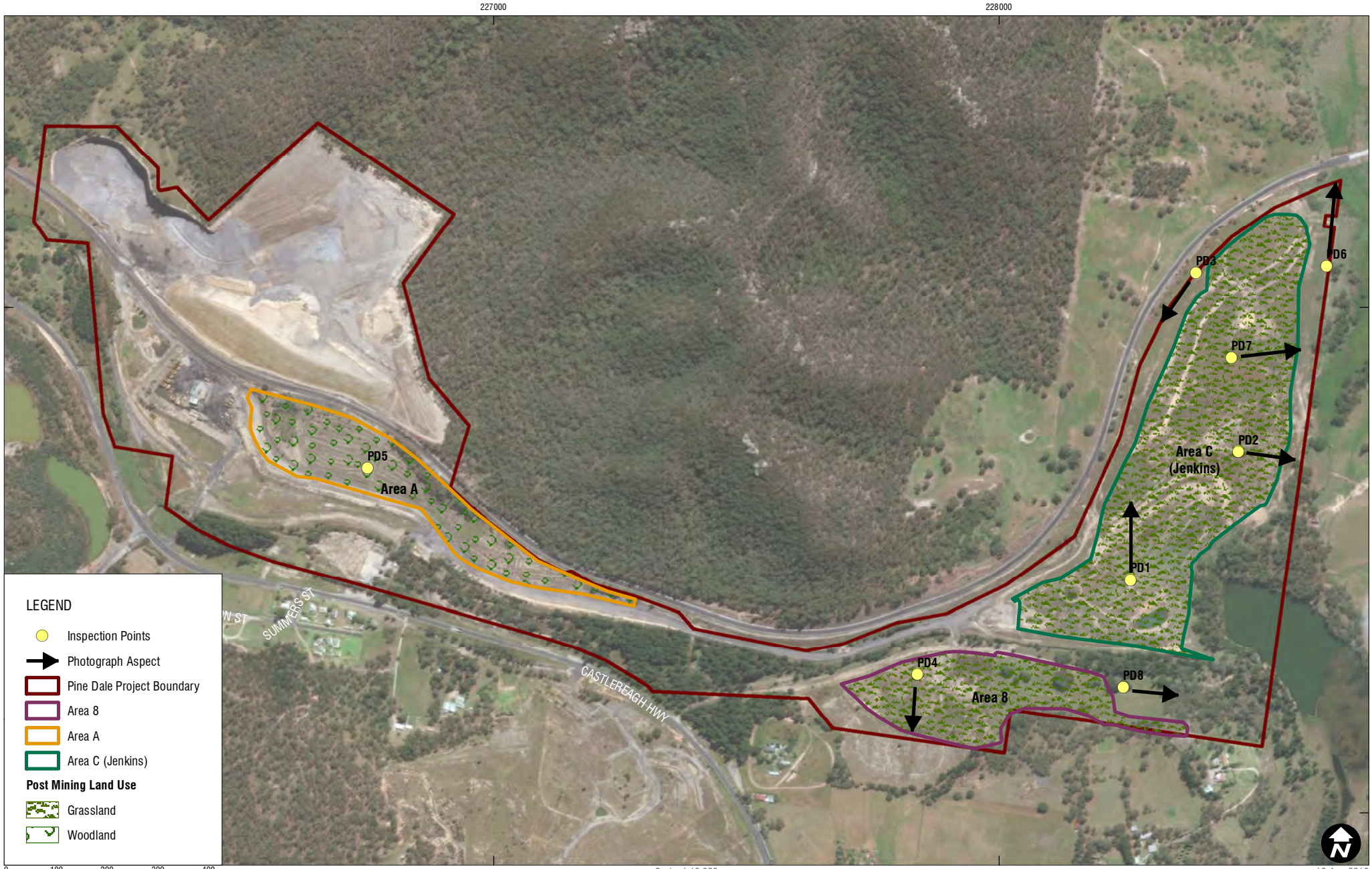
The findings of the inspection are presented in *Assessment of Rehabilitated Areas – Pine Dale and Enhance Place Mine,* (SLR 2018) (**Appendix B**) and are summarised below.

Results are summarised for each of the sites inspected at Pine Dale Mine in 2018 alongside comparisons made with 2014 inspection results. It is intended to show the general condition of each site at the time of the inspection as well as document any further identified constraints which may be limiting desirable plant establishment and growth. A traffic light risk rating was used to describe any soil nutrient deficiencies/toxicities which may be limiting plant establishment and production as outlined in **Table 4**.

Table 4 Soil Nutrient Descriptors

Rating	Descriptor
	Soil nutrient is present in levels that are deficient /toxic and are highly likely to be impacting optimum plant growth.
	Soil nutrient is present in levels that are marginally deficient /toxic and may be impacting optimum plant growth.
	Soil nutrient is present in levels which are ideal for optimum plant growth.

The location of each inspection site is shown in **Figure 2** along with the location and aspect of all photographs provided in the discussion below.



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Pine Dale
Inspection Points and Photo Locations

Figure 2

8.2.1 Area C

8.2.1.1.1 Analogue Sites

Analogue sites PD3 and PD6 have not been disturbed by mining activity and have not been rehabilitated. These sites are considered to be representative of pre-mining grazing land use conditions in regards to soil profile and vegetation cover for this area. They are considered appropriate analogue sites for Area C for comparison with rehabilitated areas.

Analogue Site PD3

Table 5 below shows a comparison of soil nutrient levels at Site PD3 from the 2014 and 2018 inspections. Grazing completion targets were developed from the 2014 results at Site PD3. Sulfur has dropped from 6.8 mg/kg to 5.3 mg/kg, an unexpected change which also occurred at several of the analogue sites.

Site PD3 underwent the same treatments as other rehabilitated sites within Area C.

Table 5 Soil Nutrient Levels Site PD3 (Analogue Site)

Soil Element	Measure & Test	Site PD3 2014	Completion Target	Site PD3 2018
pH	1:5 $CaCl_2$	4.9	Greater than 4.9	6.6
Potassium	% of Total CEC	3.8	Greater than 2%	4.4
Sodium	% of Total CEC	1.9	Less than 3%	0.2
Aluminium	% of Total CEC	0.5	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.8	Greater than 5.4	5.3
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	9.2
Zinc	mg/kg DTPA	0.7	Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio	2.1	Greater than 2.1	2.8

Photo 1 and **Photo 2** show the general landscape setting for site PD3 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Topsoil consists of a sandy clay loam over a medium clay subsoil. This area supports a perennial grass and clover pasture, including cocksfoot, tall fescue, phalaris, sub clover, with some annual ryegrass. These pasture species have a winter and spring growth habit, with the difference in pasture mass clearly evident between the 2014 (September) and 2018 (March) inspections.

Photo 1 Analogue Site PD3 – September 2014

Photo 2 Analogue Site PD3 March 2018

Analogue Site PD6

Table 6 below shows soil nutrient levels at Site PD6 from the 2018 inspection. Site PD6 was chosen as an additional analogue site for Area C.

Table 6 Soil Nutrient Levels Site PD6 (Analogue Site)

Soil Element	Measure & Test	Site PD6 2014	Completion Target	Site PD6 2018
pH	1:5 $CaCl_2$	New Site Not Tested 2014	Greater than 4.9	5.2
Potassium	% of Total CEC		Greater than 2%	3.2
Sodium	% of Total CEC		Less than 3%	0.2
Aluminium	% of Total CEC		Less than 5%	0.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.2
Nitrogen	mg/kg Water Extract		Greater than 4.6	18.4
Zinc	mg/kg DTPA		Greater than 0.7	1.0
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	2.5

Photo 3 shows the general landscape setting for Site PD6 within Area C at Pine Dale Mine during the 2018 inspection. Pasture at Site PD6 is dominated by the perennial grasses phalaris and fescue.

Photo 3 Analogue Site PD6 March 2018

8.2.1.1.2 Rehabilitated Sites

Rehabilitated Site PD1

Table 7 shows a comparison of soil nutrient levels at Site PD1 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements and were comparable to or exceeded those at the analogue sites PD3 and PD6.

Table 7 Soil Nutrient Levels Site PD1 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD1 2014	Completion Target	Site PD1 2018
pH	1:5 $CaCl_2$	6.6	Greater than 4.9	6.5
Potassium	% of Total CEC	1.7	Greater than 2%	3.5
Sodium	% of Total CEC	2.5	Less than 3%	0.2
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	5.4	Greater than 5.4	6.3
Nitrogen	mg/kg Water Extract	6.9	Greater than 4.6	27.6
Zinc	mg/kg DTPA	0.7	Greater than 0.7	1.0
Calcium	Calcium:Magnesium Ratio	1.6	Greater than 2.1	2.7

Photo 4 and **Photo 5** show the general landscape setting for Site PD1 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD1 is dominated by perennial cocksfoot and paspalum grass pasture with some sub clover and arrowleaf clover present in the sward, with greater than 90% groundcover. There is no African lovegrass present. The difference in pasture growth between autumn and spring can clearly be seen.

Photo 4 Rehabilitated Site PD1 September 2014

Photo 5 Rehabilitated Site PD1 March 2018

Rehabilitated Site PD2

Table 8 below shows a comparison of soil nutrient levels at Site PD2 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements and were comparable to or exceeded those at analogue sites PD3 and PD6.

Table 8 Soil Nutrient Levels Site PD2 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD2 2014	Completion Target	Site PD2 2018
pH	1:5 $CaCl_2$	4.6	Greater than 4.9	5.9
Potassium	% of Total CEC	1.7	Greater than 2%	4.4
Sodium	% of Total CEC	2.3	Less than 3%	0.3
Aluminium	% of Total CEC	4.5	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.0	Greater than 5.4	7.7
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	46.0
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio	1.8	Greater than 2.1	2.3

Photo 5 and **Photo 6** show the general landscape setting for Site PD2 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD2 is dominated by perennial cocksfoot and paspalum grass pasture with the herb plantain and some arrowleaf clover present in the sward, with greater than 80% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward. Significant increase in perennial grass groundcover can be seen between the two inspection periods.

Photo 6 Rehabilitated Site PD2 September 2014

Photo 7 Rehabilitated Site PD2 March 2018

Rehabilitated Site PD7

Table 9 below shows nutrient levels at Site PD7 from the 2018 inspection. Site PD7 was chosen as an additional rehabilitation site for Area C. Grazing completion targets were met for all soil elements and were comparable to or exceeded those at analogue sites PD3 and PD6

Table 9 Soil Nutrient Levels Site PD7 (Rehabilitated)

Soil Element	Measure & Test	Site PD7 2014	Completion Target	Site PD7 2018
pH	1:5 $CaCl_2$	New Site Not Tested 2014	Greater than 4.9	5.3
Potassium	% of Total CEC		Greater than 2%	5.2
Sodium	% of Total CEC		Less than 3%	0.3
Aluminium	% of Total CEC		Less than 5%	0.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.5
Nitrogen	mg/kg Water Extract		Greater than 4.6	9.2
Zinc	mg/kg DTPA		Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	2.7

Photo 8 shows the general landscape setting for Site PD7 within Area C at Pine Dale Mine during the 2018 inspection. Pasture at Site PD6 is dominated by perennial grasses phalaris, fescue and paspalum along with the herb plantain and arrowleaf clover. There is greater than 90% groundcover with only isolated tussocks of African lovegrass, which comprises less than 5% of the pasture sward.

Photo 8 Rehabilitated Site PD7 March 2018

8.2.2 Area 8

8.2.2.1.1 Analogue Site PD8

Table 10 below shows soil nutrient levels at Site PD8 from the 2018 inspection. Site PD8 was chosen as an analogue site for Area 8 as it is undisturbed by mining and did not receive any of the Area 8 treatment, being located between pine trees and not accessed by fertiliser spreading equipment.

Table 10 Soil Nutrient Levels Site PD8 (Analogue Site)

Soil Element	Measure & Test	Site PD8 2014	Completion Target	Site PD8 2018
pH	1:5 $CaCl_2$	New Analogue Site Not Tested 2014	Greater than 4.9	5.0
Potassium	% of Total CEC		Greater than 2%	2.5
Sodium	% of Total CEC		Less than 3%	0.9
Aluminium	% of Total CEC		Less than 5%	2.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.0
Nitrogen	mg/kg Water Extract		Greater than 4.6	2.3
Zinc	mg/kg DTPA		Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	1.7

Photo 9 shows the general landscape setting for Site PD8 within Area 8 at Pine Dale Mine during the 2018 inspection. Pasture at Site PD8 is dominated by perennial phalaris and fescue with some arrowleaf clover present in the sward, with greater than 90% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward.

Photo 9 Analogue Site PD8 March 2018

8.2.2.1.2 Rehabilitated Site PD4

Table 11 below shows a comparison of soil nutrient levels at Site PD4 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements. Soil nutrient levels are comparable to or exceed those at analogue site PD8.

Table 11 Soil Nutrient Levels Site PD4 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD4 2014	Completion Target	Site PD4 2018
pH	1:5 $CaCl_2$	5.7	Greater than 4.9	6.1
Potassium	% of Total CEC	3.5	Greater than 2%	4.4
Sodium	% of Total CEC	1.4	Less than 3%	0.3
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	7.4	Greater than 5.4	8.9
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	36.8
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio	2.7	Greater than 2.1	3.7

Photo 10 and **Photo 11** show the general landscape setting for Site PD4 within Area 8 at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD4 is dominated by perennial grasses cocksfoot, fescue and paspalum with some arrowleaf clover present in the sward, and greater than 90% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward. Significant increase in perennial grass groundcover can be seen between the two inspection periods.

Photo 10 Rehabilitated Site PD4 September 2014

Photo 11 Rehabilitated Site PD 4 March 2018

APPENDIX A

2017 Annual Rehabilitation Monitoring Report

Pine Dale Mine

Rehabilitation Monitoring Report 2017

Report prepared by First Field Environmental
on behalf of EnergyAustralia

6 October 2017

Revision history		
Version	Date	Author
Draft	22 September 2017	Michelle Evans
Final	6 October 2017	Michelle Evans

This report has been prepared by First Field Environmental for EnergyAustralia. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

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1. Introduction

Pine Dale Mine is located in the Western Coalfields of NSW at Blackmans Flat, 15km north of Lithgow on the northern side of Castlereagh Highway. The property is approximately 3km east of Mount Piper Power Station.

Pine Dale Mine is managed in accordance with Project Approval 10_0041 and relevant subsidiary licenses and approvals. The *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2014) has been prepared in accordance with the above approval documentation and describes the following rehabilitation objectives:

- *"The rehabilitated landform is safe, stable, non-polluting and sustainable;*
- *Rehabilitation maintains or improves species diversity and habitat values of the Yarraboldy Extension Area, particularly the former Yarraboldy Open Cut Mine; and*
- *The agreed post mining land use is compatible with the surrounding land fabric and land use requirements."*

The preparation of this Rehabilitation Monitoring Report has been prepared to satisfy Schedule 3, Condition 55 of Project Approval 10_0041.

This report aims to identify successes and failures in rehabilitation in regard to agreed performance indicators and completion criteria. Recommendations are made in areas that could be improved.

2. Performance indicators

Table 1 identifies the performance indicators and completion criteria for Pine Dale Mine as determined by the *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2014).

Table 1 Performance indicators and completion criteria

Performance indicator	Completion criteria
Feral animal and noxious weed presence	• Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.
Feral animal and noxious weed control	• Feral animals and noxious weeds are controlled in accordance with legislation.
Fuel loads	• Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.
Access	• Adequate access for fire-fighting is maintained on rehabilitation areas.
Habitat features	• Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.

Performance indicator	Completion criteria
	• Native forest indicator species tree height and girth is within the range of analogue sites.
Soil loss	• Net annual soil loss is comparable to analogue sites at year 10.
Erosion	• There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).
Woodland birds present	• Evidence of woodland birds utilising rehabilitation areas.
Evidence of mammals	• Evidence of target mammal species presence in rehabilitation areas.
Natural regeneration	• Evidence of second generation of native forest indicator species from desired vegetation community. • Evidence of natural regeneration of at least four pasture species at year 5.
Structure	• Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.
Management inputs	• Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. • Vegetation within the treed rehabilitation areas are established in accordance with the approved species mix. • Approved pasture species mix is sown at the specified rate per hectare.
Weed presence	• Weeds including African Lovegrass to comprise <10% of the pasture sward.
Ground cover	• Ground cover (vegetation, leaf litter, mulch) >70% at year 5.

Source: *Care and Maintenance Mining Operations Plan for Pine Dale Mine* (Enhance Place Pty Ltd, 2014)

3. Weather conditions

Winter of 2017 was characterised by sustained warmer weather. Average monthly rainfall leading up to the survey was variable, with June and July being unusually dry receiving significantly lower rainfall than the statistical average for that month.

The area received light rain (between 2 and 6 mm per day) during the week leading up to the survey work on the 25th of August (Bureau of Meteorology 2017).

Table 2 presents regional rainfall data for the period commencing 2010.

The area received light rain (between 2 and 6 mm per day) during the week leading up to the survey work on the 25th of August (Bureau of Meteorology 2017).

Table 2 Rainfall (in mm) recorded at Lidsdale (Maddox Lane) January 2011 - August 2017

Year	Average	2011	2012	2013	2014	2015	2016	2017
Month								
January	77.6	63	48.2	87.4	9.2	156.2	142.0	37.2
February	76.8	68.2	173.8	149	85	21.2	28.8	12.2
March	101.9	78	187	43.2	155	39.4	69.6	141.4
April	47.2	23.8	31.6	26.8	63	158.2	6.2	21.2
May	29.2	42.4	40.6	23.6	14	25.2	26.0	32.6
June	65.6	41.2	70.6	87	43.2	24.8	173.4	19.6
July	36.4	18.2	48.8	19.6	25.6	44.6	91.4	6.6
August	42.0	54.8	23.2	22.4	56.4	43.8	52.2	41.8
September	52.2	65.4	40.4	44	35.2	9.8	118.6	-
October	42.5	36.8	16.6	20.8	51.6	58.0	71.4	-
November	70.7	158	39	68.6	36.8	63.6	58.4	-
December	81.8	86	61.2	38.4	160.4	58.6	86.4	-
Annual	**762.1**	**735.8**	**781**	**630.8**	**735.4**	**703.4**	**924.4**	**-**

Source: Bureau of Meteorology (2017)

4. Survey methodology

4.1 Rehabilitation monitoring

Monitoring locations - Previous studies have seen the establishment of six monitoring transects; four transects are located within rehabilitated pastures while the remaining two transects are within treed rehabilitation areas. Additional transects exist as analogue sites in grazed pasture and an undisturbed naturally vegetated area of the property to provide benchmarks against which the pasture and treed rehabilitation areas are assessed. Monitoring locations are shown in Figure 1.

Photopoint monitoring - Coordinates for each transect and analogue site are provided in Appendix A. Each transect area contains previously established photo monitoring points. Photos taken from these points enable a visual comparison to photos from previous surveys and are provided in Appendix E.

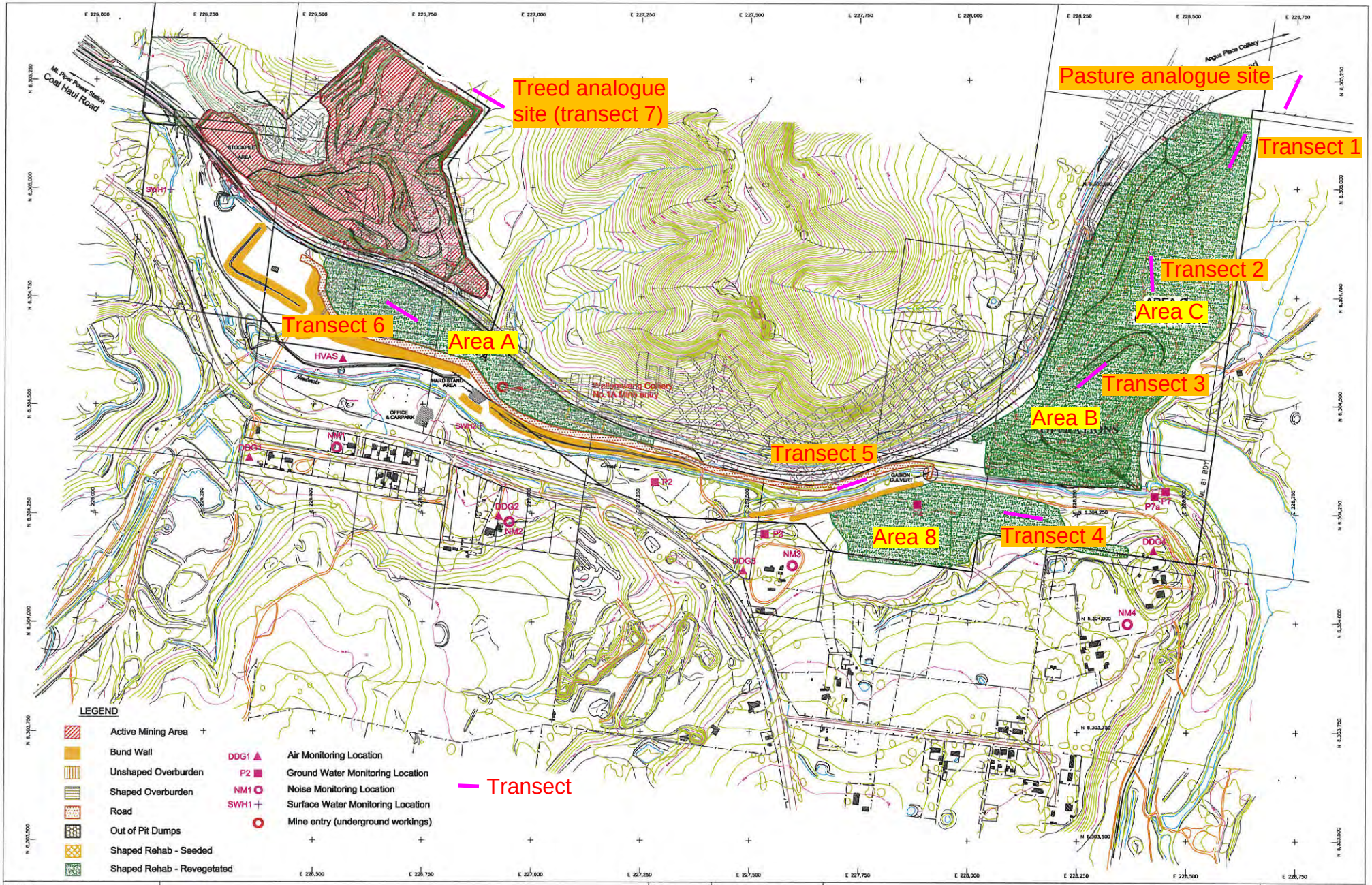
4.2 Erosion and sedimentation

Evidence of erosion and sedimentation along and within the vicinity of each transect has been determined in accordance with *Best Practice Erosion and Sediment Control* (IECA 2006).

4.3 Soil loss

The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014) recommends that net soil loss be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method has been found to be inadequate for determining soil loss in comparison with the widely used *RUSLE* (IEAC Australasia 2012).

An estimation of soil loss at each transect site has been calculated using the *Revised Universal Soil Loss Equation* (RUSLE) (IEAC Australasia 2012). Values used for these calculations are presented in Appendix C.



NOTES:

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DATE	31-12-12
AMENDED	
SURVEYOR	AERIAL PHOTO/TE/TH
DRAWN	K.L.F.
CHECKED	

PINEDALE MINE
AEMR PLAN
END DECEMBER 2012
SCALE - 1 : 4000 (A1 Sheet)

DWG No
PINE-AEMR12

4.4 Vegetation assessment

Pasture rehabilitation areas – Cox's River seed mix was sown in 2010-2011 at Areas B, C and Area 8 at the following rates:

- 40% Fescue *(Festuca spp.)*
- 25% Cocksfoot *(Dactylis glomerata)*
- 20% Subterranean clover *(Trifolium subterranean)*
- 6% Perennial rye grass *(Lolium perene)*
- 5% White clover *(Trifolium repens)*
- 4% Phalaris *(Phalaris aquatica)*

The proportion of perennial grasses and annual legumes currently in evidence at pasture transects has been recorded and compared with the proportion at which these species were initially sown.

Tree rehabilitation areas – The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014) recommends that vegetation structure be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method does not adequately enable the identification of all completion criteria as required by the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014). Vegetation health, natural regeneration, structure and species composition have instead been determined in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO 2009).

4.5 Evidence of fauna and habitat features

Fauna - Evidence of woodland birds and native fauna utilising rehabilitated areas has been recorded through the observation of scats and tracks and sightings.

Habitat features - The presence of nesting boxes, crushed timber piles and rock pile clusters within the rehabilitation areas is noted.

4.6 Pest animal and weed survey

Pest animal presence - Evidence of feral animal presence across the rehabilitation areas has been determined through scat and trail identification.

Noxious weeds - The location and extent of noxious weeds (as declared for the Upper Macquarie County Council area (NSW DPI, 2017) have been recorded. Target weed species, particularly African Lovegrass were identified in accordance with field guides and botanical keys.

4.7 Fuel loads and fire-fighting access

Fuel loads - Fuel loads within and adjacent to rehabilitation areas have been assessed in accordance with the *Overall Fuel Hazard Assessment Guide* (Department of Sustainability 2010).

Fire-fighting access - Access trails within rehabilitated areas have been assessed in accordance with *Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007).

4.8 Rural land capability assessment

Pasture rehabilitation areas have been assessed in accordance with the *Land and Soil Capability Assessment* (OEH 2007).

4.9 Management input assessment

Land management activities - Land management and soil amelioration activities conducted in the past year have been identified through discussions with the land manager.

Feral animal and weed management - Evidence of feral animal and noxious weed control activities have been sought from the land manager and audited against relevant legislative requirements.

5. Field survey results

Field survey was conducted on 25th August 2017 by a qualified ecologist. The survey revisited six transects representing rehabilitated pasture and treed areas as well as pasture and treed analogue sites.

5.1 Erosion and sedimentation

There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling) within the rehabilitation areas. The presence and extent of active surface erosion within transect areas is recorded in Appendix A.

Pasture rehabilitation areas - The pasture rehabilitation areas support evidence of minor wind erosion where groundcover is poorly established or absent.

Treed rehabilitation areas - Minor wind and rill erosion is occurring at treed rehabilitation areas.

Analogue sites - No active erosion is evident at the pasture and treed analogue sites.

5.2 Soil loss

Rehabilitation activities commenced less than 10 years ago, and it is not yet possible to determine whether net soil loss is comparable to analogue sites at year 10. Estimated annual soil loss at rehabilitated transects is summarised in Table 3. Full calculations are provided in Appendix C.

Table 3 Estimated soil loss due to erosion

Estimated annual soil loss t/ha	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
	0.09 t/ha	0.09 t/ha	0.09 t/ha	0.18 t/ha	0.03 t/ha	1.46 t/ha	0.36 t/ha	0.0 t/ha

5.3 Vegetation assessment

Flora species identified along and within the vicinity of transects are listed in Appendix D.

Species composition at pasture rehabilitation areas – Pasture rehabilitation areas are established with a mix of 70% perennial grasses and 20% annual legumes and are representative of species composition at the analogue pasture site. An example of transect 1, 2 and 3 pasture is shown in Figure 2 and Figure 3.

Figure 2 Typical pasture composition of transects 1, 2 and 3

Figure 3 Pasture composition representative of transect 4

Groundcover at pasture rehabilitation areas – Rehabilitated pasture surfaces in each of the transect areas support living groundcover of approximately 90%.

Areas currently exist within each pasture rehabilitation area where groundcover is sparse or absent. It is estimated that these areas account for less than 10% of each pasture area.

Natural regeneration at pasture rehabilitation areas – Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.

Species composition at treed rehabilitation areas – Treed rehabilitation areas are established in accordance with an approved species mix representing local native species.

Structure of vegetation at treed rehabilitation areas – Structural layers of vegetation at treed rehabilitation areas are not comparable to those of the treed analogue site.

The treed analogue site is characterised by a canopy to 12m height with 40% canopy cover over a sparse shrubby mid-storey to 3m height and isolated shrubs to 1.5m height in the understorey. Groundcover consists of grasses and herbs with a cover of >95% (Figure 4).

Figure 4 Vegetation structure of treed analogue site (transect 7)

Figure 5 Transect 6 vegetation structure

Canopy cover is absent in treed rehabilitation areas. A sparse mid-storey of isolated juvenile trees and shrubs exists over a sparse, low, shrubby understorey (seen in Figure 6). Groundcover is a sparse mix of broadleaf herbs and grasses. Changes in vegetation structure over time (as shown in Appendix B) are not considered significant.

Groundcover at treed rehabilitation areas – Transect 5 supports a total living groundcover of 70%. Total living cover within the transect 5 area has fluctuated from 90% in 2014, 50% in 2015 and 75% cover in 2017. Annual cover has decreased slowly from 20% in 2015 to 10% in 2017, while perennial living cover has increased from 30% to 60% in the same period. Litter cover appears to be stable at 10% and the area of bare surface along the transect has decreased from 40% in 2015 to 20% in 2017.

Groundcover at transect 6 is 80%. Total living cover has fluctuated from 90% in 2014 to 70% in 2015 and 80% in 2016 and 2017. Annual and perennial living cover is generally stable at around 10% for annual cover and 70% for perennial cover. Litter cover has been stable at 10% from 2015 to 2017 and bare surface has decreased from 20% in 2015 to 10% in 2016 and 2017.

See Appendix E for a visual comparison of cover at 2014 and 2017.

Vegetation health at treed rehabilitation areas – Native forest indicator species are those that occur both in treed rehabilitation areas and the treed analogue site and provide an opportunity for comparison of growth between natural and rehabilitation conditions. Indicator species include native trees, shrubs and groundcovers.

More than 20% of native species recorded within the treed analogue site are actively growing in the treed rehabilitation areas. These species are dominated by trees and shrubs and it is expected that groundcovers and herbaceous species will be able to colonise the treed rehabilitation areas once sufficient canopy cover is established.

It is difficult to determine whether native forest indicator tree species on treed rehabilitation areas are within the height and girth measurements of trees on the treed analogue site. While there is evidence of recruitment on the treed analogue site it is not possible to determine the whether the age of juvenile trees is comparable to those establishing on the treed rehabilitation areas.

Natural regeneration of treed rehabilitation areas - There is no evidence of second generation native forest indicator tree or shrub species on treed rehabilitation areas; however natural regeneration of groundcover species is evident.

5.4 Evidence of fauna and habitat features

Field surveys recorded evidence of woodland birds utilising rehabilitation areas. Habitat features are installed on native forest rehabilitation areas including crushed timber rock pile clusters. Nesting boxes have not been installed in treed rehabilitation areas.

Fauna – Macropod, wombat, fox and rabbit scats and tracks were evident throughout the property. Evidence of foraging was observed as shallow diggings in both pasture and treed rehabilitation areas. Logs within the treed analogue and rehabilitation areas showed evidence of scratching. The remains of a rabbit kill were observed within Transect 6.

Native woodland birds were observed landing on trees and foraging within mulch in each of the treed vegetation areas and in the treed analogue site. Generalist birds including Currawong, Magpie and Noisy Miner were observed on the ground within pasture areas A and B and Area 8.

Habitat features – Crushed timber piles and rock pile clusters were observed within the treed rehabilitation areas of transects 5 and 6. Habitat features at the treed analogue site include fallen trees and scattered piles of fallen vegetation (visible in Figure 6).

Figure 6 An active burrow in an equipment storage area

5.5 Feral animals and weeds

Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use. Feral animals and noxious weeds are controlled in accordance with legislation. Weeds including African Lovegrass comprise <10% of the pasture sward. The presence or evidence of pests and weeds within and in the vicinity of each transect is recorded in Appendix A.

Pest animal presence – Rabbit and fox scats were observed across the property. Rabbit and fox numbers are considered low and do not require population reduction measures.

The European rabbit and European red fox are declared pests under the Local Land Services Act 2013. Rabbit and fox density is considered low, with some evidence of shallow soil scraping and scats across each of the monitoring locations. No holes, burrows or dens were observed.

Noxious and targeted weed species – Noxious weeds observed during field survey are listed in Table 4.

Table 4 Feral animal and noxious weed presence

Common name *Species name*	Location	Treatment
European Red Fox *Vulpes vulpes*	All locations	Landholders are obliged to control populations on their land.
European rabbit Oryctolagus cuniculus		
African Lovegrass *Eragrostis curvula*	Transects 1, 2, 3 and 4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continually inhibits its reproduction. Not notifiable.

The presence of African Lovegrass was noted at transects 1, 2, 3 and 4 and occurred across less than 10% of the pasture area. These outbreaks have been subjected to ongoing chemical control and were not observed to be growing or producing seed.

5.6 Fuel loads and fire-fighting access

Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan, and adequate access for firefighting is maintained on rehabilitation areas.

Fuel loads – Fuel loads within Areas A, B and C and Area 8 are low and fuel hazard mitigation activities are not required at this time.

Firebreaks - The internal road provides a mineral earth firebreak between Area A and Pine Dale Mine infrastructure to the south, while the Coal Haul Road provides a mineral earth firebreak immediately to the north of Area A. The Coal Haul Road and internal road provide a mineral earth firebreak to the north and west of Areas B and C and Area 8. Private grazing land is located immediately adjacent to the east and south of Areas B and C and Area 8. The majority of this interface supports mature Pine and Eucalypt trees which would provide a barrier to wind-borne embers spreading to private grazing land during a fire event.

Fire-fighting access - Access to each of the rehabilitation areas is considered to be adequate. The Coal Haul Road is a private road located immediately to the north of Areas A, B and C and Area 8 and allows movement from within Wallerawang Power Station, through Pine Dale Mine and to Mount Piper Power Station. An internal road is located immediately to the south of Areas A and B and to the north of Area 8. This road connects to Castlereagh Highway through the administration area of Pine Dale Mine. Area C is accessible by following the internal road through Area B. All access roads within rehabilitated areas are maintained in good condition and are suitable for the passage of Category 1 tankers, having a vertical clearance of >4m and a width of >2.8m (*Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007)).

5.7 Rural land capability assessment

Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).

Pasture rehabilitation areas are assessed as being Land and Soil Capability Class V and are suitable for grazing. The limiting factors for land use are generally related to wind erosion hazard. Note that the area of transect 4 is also subject to soil acidification hazard due to soil texture (Table 5).

Table 5 Rural land capability assessment of pasture areas

Class	Transect 1	Transect 2	Transect 3	Transect 4
Water erosion hazard class	2 1 - <3% slope	3 3 - <10% slope	4 10 - <20% slope, no gully erosion present	2 1 - <3% slope
Wind erosion hazard class	5 Moderate wind erodibility class of surface soil, high winds erosive power, high exposure to wind, average annual rainfall >500mm			
Soil structural decline class	4 Fragile light textured soil - hardsetting			
Soil acidification hazard class	4 Very low texture /buffering capacity, pH 6.7 – 7.5 ($CaCl_2$)			5

Class	Transect 1	Transect 2	Transect 3	Transect 4
				Very low texture /buffering capacity, pH 4.0 – 4.7 ($CaCl_2$)
Salinity hazard class	1 Moderate to high recharge potential, low discharge potential, low salt store			
Waterlogging hazard class	2 0 – 0.25 months typical waterlogging duration, moderately well drained soils			
Shallow soils and rockiness hazard class	1 Nil rocky outcrop, soil depth >100cm			
Mass movement hazard class	1 No mass movement present			

5.8 Management input assessment

Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.

Control of noxious and targeted weed species has been undertaken across all rehabilitation areas as required and in accordance with the recommendations of the *Pine Dale Mine Rehabilitation Monitoring Report 2014* (First Field Environmental 2014).

6. Rehabilitation status

The status of performance indicators and completion criteria are summarised in Table 6.

Table 6 Status of completion criteria

Performance indicator	Completion criteria	Status
Feral animal and noxious weed presence	• Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.	• **Satisfactory** – continue to monitor
Feral animal and noxious weed control	• Feral animals and noxious weeds are controlled in accordance with legislation.	• **Satisfactory** – continue to monitor
Fuel loads	• Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	• **Satisfactory** – continue to monitor
Access	• Adequate access for firefighting is maintained on rehabilitation areas.	• **Satisfactory** – continue to monitor
Habitat features	• Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.	• **Ongoing** - nesting boxes to be installed once trees are established

Performance indicator	Completion criteria	Status
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	• **Ongoing** – continue to monitor
	• Native forest indicator species tree height and girth is within the range of analogue sites.	• **Ongoing** – continue to monitor
Soil loss	• Net annual soil loss is comparable to analogue sites at year 10.	• **Ongoing** – continue to monitor
Erosion	• There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).	• **Satisfactory** – continue to monitor
Woodland birds present	• Evidence of woodland birds utilising rehabilitation areas.	• **Satisfactory** – continue to monitor
Evidence of mammals	• Evidence of target mammal species presence in rehabilitation areas.	• **Satisfactory** – continue to monitor
Natural regeneration	• Evidence of second generation of native forest indicator species from desired vegetation community.	• **Ongoing** – continue to monitor
	• Evidence of natural regeneration of at least four pasture species at year 5.	• **Satisfactory** – continue to monitor
Structure	• Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.	• **Ongoing** – continue to monitor
Management inputs	• Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	• **Satisfactory** – continue to monitor
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	• **Satisfactory** – continue to monitor
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. • Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix. • Approved pasture species mix is sown at the specified rate per hectare.	• **Satisfactory** – continue to monitor
Weed presence	• Weeds including African Lovegrass to comprise <10% of the pasture sward.	• **Satisfactory** – continue to monitor
Ground cover	• Ground cover (vegetation, leaf litter, mulch) >70% at year 5.	• **Satisfactory** – continue to monitor

7. Key findings

General

- Estimated soil loss in each of the transect areas is considered acceptable. Heightened soil loss calculated for the treed rehabilitation areas is consistent with the structural complexity differences between the rehabilitation and analogue sites.

Treed rehabilitation areas

- Nesting boxes are not installed in or adjacent to the treed rehabilitation areas.
- There is no evidence of second generation establishment at treed rehabilitation areas.
- Structural vegetation layers at treed rehabilitation areas are not comparable to the vegetation structure at the treed analogue site.

8. Recommendations

The following recommendations for mitigation and management are consistent with intervention and adaptive management measures contained within the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014).

- Continue to monitor performance indicators, in particular:
- Continue to spot-spray outbreaks of African Lovegrass; and
- Install nesting boxes once the treed rehabilitation areas contain adequate structure to support nesting woodland birds.

9. References

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Appendix A
Survey data 2017

Pasture analogue site	
Easting	Northing
228300	6304880
228317	6304925
Landform and soils	
Slope	1 - <3% slope inclining to the northwest.
Erosion	Not observed.
Cracking soils	Not observed.
Surface drainage impediments	No significant drainage impediments.
Vegetation	
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.
Species richness	>30 herb and 15 grass species identified.
Cover classification 2015	
Total living cover	>90%
Annual living cover	40%
Perennial living cover	50%
Litter cover	<10%
Bare surface	-

Transect 1 Pasture rehabilitation area				
Easting	Northing			
228621	6305093			
228594	6305048			
Landform and soils				
Slope	Transect located along a contour. 1 - <3% slope inclining to the northwest.			
Erosion	Minor wind erosion observed on exposed soils.			
Cracking soils	Not observed.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.			
Species richness	>30 herbs and grasses identified, dominated by exotic species.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	80%	95%	90%
Annual living cover	-	40%	47.5%	40%
Perennial living cover	-	50%	47.5%	50%
Litter cover	10%	-	-	<10%
Bare surface	-	20%	5%	<10%
Target weed presence				
African Lovegrass (*Eragrostis curvula)*	<10%			

Transect 2 Pasture rehabilitation area				
Easting	Northing			
228454	6304718			
228400	6304744			
Landform and soils				
Slope	Transect located along a contour. 3 - <10% slope inclining to the west.			
Erosion	Minor wind erosion observed on exposed soils.			
Cracking soils	Not observed.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.			
Species richness	>30 herbs and grasses identified, dominated by exotic species.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	80%	90%	90%
Annual living cover	-	40%	42%	40%
Perennial living cover	-	50%	48%	50%
Litter cover	10%	-	-	<10%
Bare surface	-	20%	10%	<10%
Target weed presence				
African Lovegrass (*Eragrostis curvula)*	<10%			

Transect 3 Pasture rehabilitation area				
Easting	Northing			
228267	6304532			
228306	6304560			
Landform and soils				
Slope	Transect located along a contour. 10 - <20% slope declining to the northwest.			
Erosion	Minor wind erosion observed on exposed soils.			
Cracking soils	Not observed.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.			
Species richness	>30 herbs and grasses recorded, dominated by exotic species.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	80%	90%	90%
Annual living cover	-	40%	46%	40%
Perennial living cover	-	50%	44%	50%
Litter cover	10%	-	-	<10%
Bare surface	-	20%	10%	<10%
Target weed presence				
African Lovegrass (*Eragrostis curvula)*	<10%			

Transect 4 Pasture rehabilitation area				
Easting		Northing		
228318		6304224		
228249		6304227		
Landform and soils				
Slope	Transect located along a contour. 1 - <3% slope declining to the west.			
Erosion	Minor wind erosion observed on exposed soils.			
Cracking soils	Not observed.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.			
Species richness	Diverse groundcover with >30 exotic herb and grass species recorded.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	80%	90%	90%
Annual living cover	-	40%	42%	30%
Perennial living cover	-	50%	48%	60%
Litter cover	10%	-	-	<10%
Bare surface	-	20%	10%	<10%
Target weed presence				
African Lovegrass (*Eragrostis curvula)*	<10%			

Transect 5 Treed rehabilitation area				
Easting	Northing			
227846	6304272			
227787	6304251			
Landform and soils				
Slope	Transect located along contour of mid slope inclining 10-20% to the north.			
Erosion	Minor wind and rill erosion observed on exposed soils.			
Cracking soils	Not present.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Sparse tree layer to 3m height with scattered juvenile trees and sparse mixed native shrub species. Dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.			
Species richness	Shrub layer is dominated by native species and juvenile trees. Groundcover dominated by exotic broadleaf herbs and grasses. >15 species recorded.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	50%	75%	70%
Annual living cover	-	20%	12%	10%
Perennial living cover	-	30%	63%	60%
Litter cover	10%	10%	10%	10%
Bare surface	-	40%	15%	20%
Target weed presence				
None observed.				

Transect 6 Treed rehabilitation area				
Easting	Northing			
226604	6304724			
226647	6304706			
Landform and soils				
Slope	Transect located along contour of mid slope inclining 10-20% to the northeast.			
Erosion	Minor wind and rill erosion observed on exposed soils.			
Cracking soils	Not observed.			
Surface drainage impediments	No significant drainage impediments.			
Vegetation				
Vegetation structure	Sparse tree layer to 3m height with scattered juvenile trees and sparse mixed native shrub species. Moderately dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.			
Species richness	Shrub layer is dominated by native species and juvenile trees. Groundcover dominated by exotic broadleaf herbs and grasses. >15 species recorded.			
Cover classification	% cover at each observation			
	April 2014	September 2015	September 2016	September 2017
Total living cover	90%	70%	80%	80%
Annual living cover	-	10%	12%	10%
Perennial living cover	-	60%	68%	70%
Litter cover	10%	10%	10%	10%
Bare surface	-	20%	10%	10%
Target weed presence				
None observed.				

Treed analogue site (transect 7)	
Easting	Northing
226801	6305097
226838	6305039
Landform and soils	
Slope	Transect located along contour of mid slope gently inclining to the north.
Erosion	No erosion observed.
Cracking soils	Not observed.
Surface drainage impediments	No drainage impediments.
Vegetation	
Vegetation structure	Eucalyptus dominated canopy to 12m high with a canopy cover of 40%. Sparser shrub layer to 3m height with isolated shrubs to 1.5m height. >90% groundcover to 0.5m height, dominated by native grasses with mixed native herbs.
Species richness	More than 10 tree species, dominated by *Eucalyptus* spp. Shrub layer of >9 native species. Diverse groundcover dominated by *Poa* spp. with mixed native herbs.
Cover classification	
Total living cover	90%
Annual living cover	10%
Perennial living cover	80%
Litter cover	10%
Bare surface	-
Target weed presence	
None observed.	

Appendix B
Vegetation assessment of treed areas

Vegetation assessment treed areas 2017

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	70% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2016

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	75% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>15	>13, including *Senecio madagascariensis.*	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2015

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	>7 species, 1-2 m height, 10% cover
Groundcover	<40%. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 20% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10, including *Rubus fruticosus.*	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2014

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3m height.	Sparse. To 3m height.	>5 species, 12-14 m height. 40% canopy cover.
Understorey	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	>7 species, 1.5 - 3 m height, 35% cover
Groundcover	Sparse. Mix of exotic grasses, native and exotic herbs.	Sparse. Mix of exotic grasses, native and exotic herbs.	70% cover. Dominated by *Poa* spp. with mixed native herbs.
Non-native species	>10	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to >2cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Appendix C
Estimation of annual soil loss in pastures

Annual soil loss factors	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
Annual rainfall erosivity factor **(R)**	**1365** Bathurst							
Soil erodibility factor **(K)**	**0.03** Sandy loam /fine sandy loam				**0.025** Sandy clay-loam			**0.03** Sandy loam /fine sandy loam
Topographic factor **(LS)**	**0.17** 3% gradient, 5m slope length			**0.34** 8% gradient, 5m slope length	**0.09** 1% gradient, 5m slope length	**0.89** 20% gradient, 5m slope length		**0.52** 12% gradient, 5m slope length
Cover and management factor **(C)**	**0.01** No appreciable canopy cover, 80-95% grassy groundcover					**0.04** 25% canopy cover of tall weeds or short brush, 60-80% grassy groundcover	**0.01** 25% canopy cover of tall weeds or short brush, 80-95% grassy groundcover	**0.00** Consistent with 75% canopy cover of trees and 95% grassy groundcover
Erosion control practice factor **(P)**	**1.3** Compacted					**1.2** Consistent with trackwalking along contour		**1.3** Compacted
Annual soil loss due to erosion **(A)**	**0.09 t/ha**	**0.09 t/ha**	**0.09 t/ha**	**0.18 t/ha**	**0.03 t/ha**	**1.46 t/ha**	**0.36 t/ha**	**0.0 t/ha**

Appendix D
Species list

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Acacia dealbata subsp. *dealbata*					X	X	X
Acacia nana					X	X	
Acacia rubida					X	X	X
Acacia sp.					X	X	X
Acacia ulcifolia							X
Ajuga australis							X
Amaranthus sp.	X	X	X	X	X	X	
Brassica juncea	X	X	X	X	X	X	
Bursaria spinosa subsp. *lasiophylla*					X	X	X
Calandrinia calyptrata							X
Cirsium vulgare	X	X	X	X			
Conyza bonariensis	X	X	X	X	X	X	
Crassula sp.					X		
Dactylis glomerata	X	X	X	X			
Desmodium varians							X
Dillwynia phylicoides							X
Eragrostis sp.	X	X	X	X			
Eucalyptus dalrympleana subsp. *dalrympleana*							X
Eucalyptus dives					X	X	X
Eucalyptus mannifera subsp. *mannifera*							X
Eucalyptus radiata subsp. *radiata*						X	
Eucalyptus rubida subsp. *rubida*							X

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Festuca arundinacea	X	X	X	X			
Festuca sp.	X	X	X	X			
Gamochaeta sp.	X	X	X	X			
Geranium sp.				X			X
Gompholobium huegelii							X
Goodenia hederacea							X
Hibbertia aspera subsp. *aspera*							X
Hibbertia obtusifolia							X
Hypochaeris radicata	X	X	X	X	X	X	
Juncus spp.		X					
Leucopogon sp.							X
Lissanthe strigose subsp. *subulata*							X
Lomandra filiformis							X
Medicago sp.	X	X	X	X			
Oxalis corniculata	X	X	X				
Paspalum sp.				X	X		
Persoonia laurina							X
Phalaris aquatica	X	X	X	X			
Pinus sp.							X
Plantago lanceolata	X	X	X	X	X	X	
Poa annua	X	X	X	X			X
Poa labillardierei							X
Poa spp.	X	X	X	X	X	X	X
Ranunculus lappaceus							X

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Ranunculus sp.	X	X	X	X	X	X	
Rumex acetosella	X	X			X	X	
Sonchus oleraceus	X	X	X	X			
Taraxacum officinale				X			
Themeda australis							X
Trifolium arvense	X	X	X	X			
Trifolium repens	X	X	X	X			
Trifolium subterraneum	X	X	X	X			
Veronica calycina							X
Vicia sp.					X	X	
Vulpia sp.	X	X	X	X			

Appendix E
Photopoint monitoring to 2017

Transect 1 looking south 2014

Transect 1 looking south 2015

Transect 1 looking south 2016

Transect 1 looking south 2017

Transect 2 looking southeast 2014

Transect 2 looking southeast 2015

Transect 2 looking southeast 2016

Transect 2 looking southeast 2017

Transect 3 looking southwest 2014

Transect 3 looking southwest 2015

Transect 3 looking southwest 2016

Transect 3 looking southwest 2017

Transect 4 looking west 2014

Transect 4 looking west 2015

Transect 4 looking west 2016

Transect 4 looking west 2017

Transect 5 looking west 2014

Transect 5 looking west 2015

Transect 5 looking west 2016

Transect 5 looking west 2017

Transect 6 looking east 2014

Transect 6 looking east 2015

Transect 6 looking east 2016

Transect 6 looking east 2017

Transect 7 looking east 2014

Transect 7 looking east 2015

Transect 7 looking east 2016

Transect 7 looking east 2017

Quadrat 1 February 2010 (Cunningham 2012)

Quadrat 1 September 2011 (Cunningham 2012)

Quadrat 1 November 2012 (Cunningham 2012)

Quadrat 1 April 2014

Quadrat 1 September 2015

Quadrat 1 September 2016

Quadrat 1 September 2017

APPENDIX B

Assessment of Rehabilitated Areas – Pine Dale Mine and Enhance Place Mine

global environmental solutions

Assessment of Rehabilitated Areas

Pine Dale Mine and Enhance Place Mine

Report Number 630.12362

July 2018

for Enhance Place Pty Ltd

Version: Final Draft

Assessment of Rehabilitated Areas

Pine Dale Mine and Enhance Place Mine

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
630.12362	Final Draft	July 2018	Murray Fraser	Andrew Hutton	Andrew Hutton

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TABLES

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1 INTRODUCTION

Enhance Place Pty Ltd (Enhance Place) owns and operates the Pine Dale Mine and Enhance Place Mine in accordance with Project Approval (PA) 10_0041 and PA 451_01 respectively, granted by the Minister for the Department of Planning and Environment.

SLR was engaged by Enhance Place to conduct an assessment of rehabilitated areas of Pine Dale Mine and Enhance Place for possible relinquishment of the mining lease, having met rehabilitation commitments and completion criteria.

Previously (September, 2014) SLR was engaged by Enhance Place to:

- Undertake soil analysis and any other assessment as required, to inform development of quantitative rehabilitation completion criteria for Growth Media Development phase of rehabilitation; and
- Provide advice and recommendations for pasture improvement strategies required to achieve the agreed rehabilitation completion criteria as described in the relevant Mining Operations Plan.

In total, five sites have been rehabilitated between Pine Dale Mine and Enhance Place Mine. These sites are shown in **Figure 1** and **Figure 2** and are identified as the following:

Pine Dale Mine

- Area A;
- Area C (Jenkins Property); and
- Area 8.

Enhance Place

- Morris Property; and
- Crown Land block.

2 METHODOLOGY

A detailed walk-through inspection of these five areas was undertaken by Murray Fraser (SLR Associate Agronomist) and Graham Goodwin (Manager Mining Engineering) on 12th March 2018. The objective of this inspection was to assess the current condition of these rehabilitated areas, particularly the extent African lovegrass (*Eragrostis curvula*), to determine whether rehabilitation objectives have been met.

Soil samples were taken from the topsoil (0-10 cm) at each inspection site and sent to Soiltec Laboratories for nutrient testing and further analysis.

A traffic light risk rating has been used to describe any soil nutrient deficiencies/toxicities which may be limiting plant establishment and production in the rehabilitation areas at each of the sites. **Table 1** below outlines the meaning of each rating as per the traffic light methodology. Detailed soil test results are contained in **Appendix A**.

Table 2 Soil Nutrient Descriptors

Rating	Descriptor
	Soil nutrient is present in levels that are deficient /toxic and are highly likely to be impacting optimum plant growth.
	Soil nutrient is present in levels that are marginally deficient /toxic and may be impacting optimum plant growth.
	Soil nutrient is present in levels which are ideal for optimum plant growth.

2.1 Grazing Pasture Completion Criteria

Enhance Place proposed the following completion criteria for the grazing areas at Enhance Place Mine and Pine Dale Mine to be achieved within five years:

- Establishment of a vigorous perennial grass and annual legume pasture, comprising approximately 70% perennial grass and 20% annual legume.
- Obtain a year round pasture groundcover of greater than 70%.
- African lovegrass to comprise less than 10% of the pasture sward.
- Soil nutrient levels tested to meet the minimum completion targets shown in **Table 2**.

Soil element completion target measures were developed using a combination of the ideal range for soil elements and those measured at the undisturbed (analogue) Site PD3 in Area C (**Appendix B**) during the 2014 inspections, where there was a vigorous perennial grass and annual clover based pasture established.

Rainfall data obtained from the Lidsdale Bureau of Meteorology Station (063132) show that for the three months preceding the 2014 (153.2 millimetres) and the 2018 (210.8 millimetres) inspections cumulative rainfall was 30% less than the long term average, giving similar climatic conditions to make a comparable comparison in nutrient levels and pasture groundcover between these years.

Table 2 Soil Nutrient Level Completion Targets

Soil Element	Measure & Test	Site PD3 Soil Test	Ideal Soil Element Range	Completion Target Measure
pH	1:5 $CaCl_2$	4.94	Between 5.2 – 8.0	Greater than 4.9
Potassium	% of Total CEC	3.17	Greater than 2%	Greater than 2%
Sodium	% of Total CEC	1.90	Less than 3%	Less than 3%
Aluminium	% of Total CEC	0.53	Less than 5%	Less than 5%
Sulfur	mg/kg KCl 40 S	6.8	Greater than 8	Greater than 6.8
Nitrogen	mg/kg Water Extract	4.6	Greater than 10	Greater than 4.6
Zinc	mg/kg DTPA	0.7	Greater than 1	Greater than 0.7
Calcium	Calcium to Magnesium Ratio	2.14	Greater than 3	Greater than 2.1

Upon analysis of soil samples taken from analogue sites in March 2018, the sulfur levels at PD3 in September 2014 appear to be unusually high, with all analogue sites (including PD3) having sulfur levels significantly lower than 6.8, with an average across the five analogue sites of 5.4, as shown in **Table 3** below. Considering these results, a sulfur completion target measure of greater than 5.4 is considered a more realistic representation of baseline conditions.

Table 3 Analogue Site 2018 Sulfur Levels

Soil Element	PD3	PD6	PD8	EP4	EP6	Average
Sulfur	5.3	5.2	5.0	6.0	5.7	**5.4**

2.2 Recommended Agronomic Treatments 2014

The following agronomic recommendations were made by SLR in November 2014 in order for Pine Dale Mine and Enhance Place Mine to achieve the nominated rehabilitation criteria.

Pine Dale Mine – Area A

Table 4 Area A Fertiliser Application

Site	Fertiliser Requirement	Tonnes/ha	Total tonnes
Area A Approx. 7 hectares	MOP	0.25	1.75
	Mushroom compost	10	70
	Lime	3	21
	Gypsum	2	14

Pine Dale Mine – Area C (Jenkins Property)

Area C requires a boom spray application of *Taskforce* for the control of African Lovegrass prior to any pasture establishment works being undertaken.

Table 5 Area C Fertiliser Application

Site	Fertiliser Requirement	Tonnes/ha	Total tonnes
Area C Approx. 14 hectares	MOP	0.25	3.5
	DAP	0.20	2.8
	Mushroom compost	10	140
	Lime	4	56
	Gypsum	1	14

Pine Dale Mine – Area 8

Area 8 requires a boom spray application of *Taskforce* for the control of African Lovegrass prior to any pasture establishment works being undertaken.

Table 6 Area 8 Fertiliser Application

Site	Fertiliser Requirement	Tonnes/ha	Total tonnes
Area 8 Approx. 7 hectares	DAP	0.20	1.4
	Mushroom compost	10	70
	Lime	1	7
	Gypsum	3	21

Enhance Place Mine – Morris Property

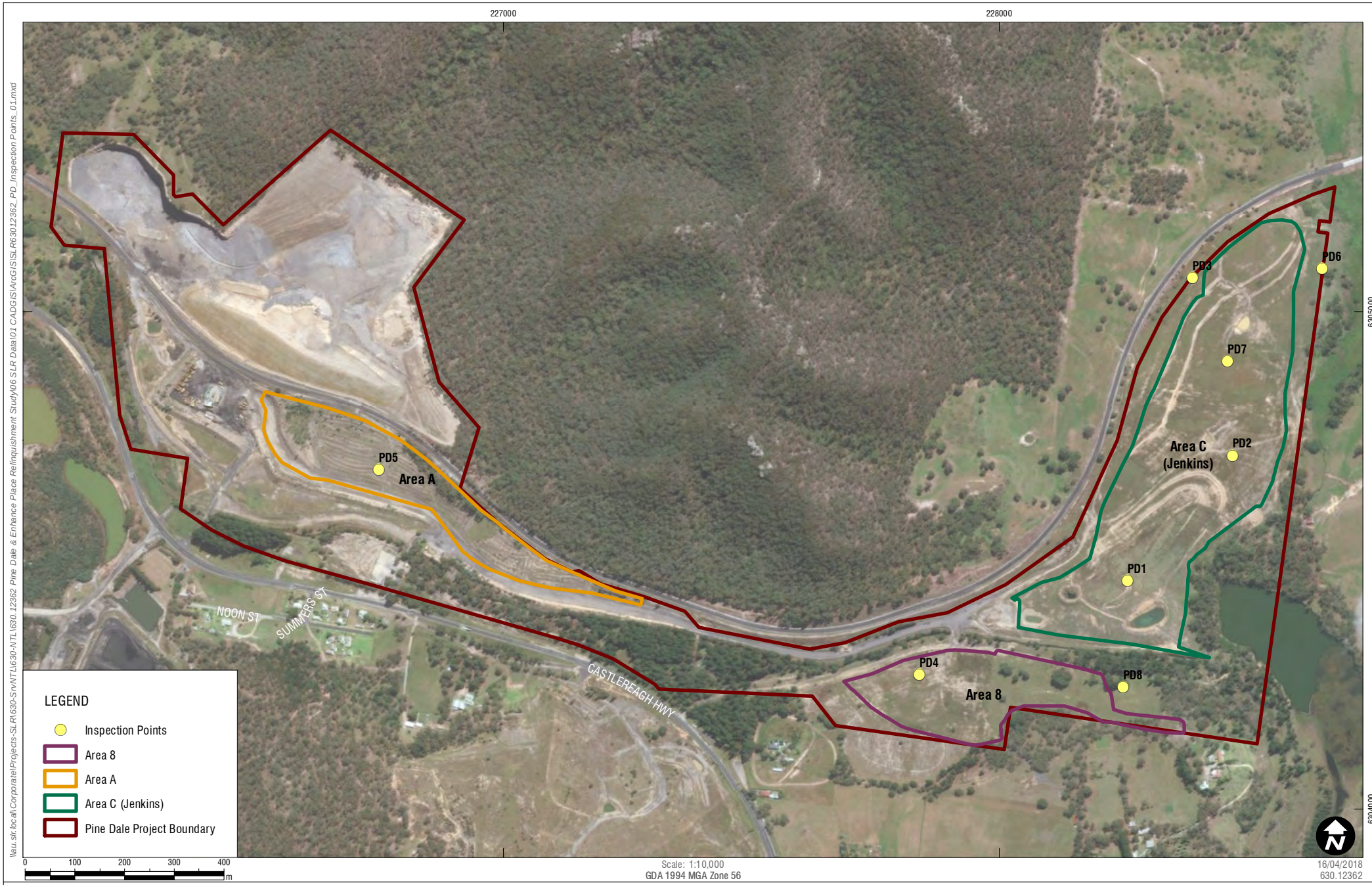
The Morris property requires a boom spray application of *Taskforce* to control African lovegrass and also broadleaf weed control prior to any pasture renovation being undertaken.

Table 7 Morris Property Fertiliser Application

Site	Fertiliser Requirement	Tonnes/ha	Total tonnes
Morris Property Approx. 23 hectares	DAP	0.20	4.6
	MOP	0.25	5.75
	Gypsum	3	69

Enhance Place Mine – Crown Land

The Crown Land (EP 2) Block does not require any remedial action as it has satisfactory pasture groundcover and appears to be only grazed by kangaroos. It is recommended that this area continues to be monitored against agreed rehabilitation completion criteria



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Pine Dale
Inspection Points

FIGURE 1

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Enhance Place
Inspection Points

FIGURE 2

3 INSPECTION RESULTS

The following section summarises the results for each of the sites inspected at both Pine Dale Mine and Enhance Place Mine in 2018 alongside comparisons made with 2014 inspection results. It is intended to show the general condition of each site at the time of the inspection as well as document any further identified constraints which may be limiting desirable plant establishment and growth.

3.1 Pine Dale Mine

3.1.1 Area A

Rehabilitated Site PD5

The rehabilitation objective for Area A, incorporating Site PD5 is return to a native woodland vegetation community. **Table 8** below shows a comparison of soil nutrient levels between the 2014 and 2018 inspections. All completion targets have been achieved at Site PD5.

Table 8 Soil Nutrient Levels Site PD5 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD5 2014	Completion Target	Site PD5 2018
pH	1:5 $CaCl_2$	4.1	Greater than 4.9	6.6
Potassium	% of Total CEC	2.7	Greater than 2%	3.1
Sodium	% of Total CEC	7.1	Less than 3%	0.1
Aluminium	% of Total CEC	6.2	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.3	Greater than 5.4	9.0
Nitrogen	mg/kg Water Extract	6.9	Greater than 4.6	13.8
Zinc	mg/kg DTPA	0.9	Greater than 0.7	1.0
Calcium	Calcium:Magnesium Ratio	1.6	Greater than 2.1	2.3

Plate 1 and **Plate 2** show the general landscape setting for site PD5 within Area A at Pine Dale Mine during the 2014 and 2018 inspections. The rehabilitation objective for PD5 is a native woodland vegetation community.

Increased growth of eucalypts can clearly be seen while groundcover consists of couch, phalaris and fescue perennial grasses with greater than 80% groundcover.

Plate 1: Rehabilitated Site PD5 September 2014

Plate 2: Rehabilitated Site PD5 March 2018

3.1.2 Area C (Jenkins Property)

Analogue Site PD3

Table 9 below shows a comparison of soil nutrient levels at Site PD3 from the 2014 and 2018 inspections. Grazing completion targets were developed from the 2014 results at Site PD3. Sulfur has dropped from 6.8 mg/kg to 5.3 mg/kg, an unexpected change which also occurred at several of the analogue sites.

Site PD3 underwent the same treatments as other rehabilitated sites within Area C.

Table 9 Soil Nutrient Levels Site PD3 (Analogue Site)

Soil Element	Measure & Test	Site PD3 2014	Completion Target	Site PD3 2018
pH	1:5 $CaCl_2$	4.9	Greater than 4.9	6.6
Potassium	% of Total CEC	3.8	Greater than 2%	4.4
Sodium	% of Total CEC	1.9	Less than 3%	0.2
Aluminium	% of Total CEC	0.5	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.8	Greater than 5.4	5.3
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	9.2
Zinc	mg/kg DTPA	0.7	Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio	2.1	Greater than 2.1	2.8

Plate 3 and **Plate 4** show the general landscape setting for site PD3 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Site PD3 has not been disturbed by mining activity and has not been rehabilitated. Site PD3 is considered to be representative of pre-mining grazing land use conditions in regards to soil profile and vegetation cover for this area. It is considered an analogue site for Area C.

Topsoil consists of a sandy clay loam over a medium clay subsoil. This area supports a perennial grass and clover pasture, including cocksfoot, tall fescue, phalaris, sub clover, with some annual ryegrass. These pasture species have a winter and spring growth habit, with the difference in pasture mass clearly evident between the 2014 (September) and 2018 (March) inspections.

Plate 3: Analogue Site PD3 September 2014

Plate 4: Analogue Site PD3 March 2018

Rehabilitated Site PD1

Table 10 below shows a comparison of soil nutrient levels at Site PD1 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 10 Soil Nutrient Levels Site PD1 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD1 2014	Completion Target	Site PD1 2018
pH	1:5 $CaCl_2$	6.6	Greater than 4.9	6.5
Potassium	% of Total CEC	1.7	Greater than 2%	3.5
Sodium	% of Total CEC	2.5	Less than 3%	0.2
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	5.4	Greater than 5.4	6.3
Nitrogen	mg/kg Water Extract	6.9	Greater than 4.6	27.6
Zinc	mg/kg DTPA	0.7	Greater than 0.7	1.0
Calcium	Calcium:Magnesium Ratio	1.6	Greater than 2.1	2.7

Plate 5 and **Plate 6** show the general landscape setting for Site PD1 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD1 is dominated by perennial cocksfoot and paspalum grass pasture with some sub clover and arrowleaf clover present in the sward, with greater than 90% groundcover. There is no African lovegrass present. Again the difference in pasture growth between autumn and spring can clearly be seen.

Plate 5: Rehabilitated Site PD1 September 2014

Plate 6: Rehabilitated Site PD1 March 2018

Rehabilitated Site PD2

Table 11 below shows a comparison of soil nutrient levels at Site PD2 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 11 Soil Nutrient Levels Site PD2 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD2 2014	Completion Target	Site PD2 2018
pH	1:5 $CaCl_2$	4.6	Greater than 4.9	5.9
Potassium	% of Total CEC	1.7	Greater than 2%	4.4
Sodium	% of Total CEC	2.3	Less than 3%	0.3
Aluminium	% of Total CEC	4.5	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.0	Greater than 5.4	7.7
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	46.0
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio	1.8	Greater than 2.1	2.3

Plate 7 and **Plate 8** show the general landscape setting for Site PD2 within Area C at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD2 is dominated by perennial cocksfoot and paspalum grass pasture with the herb plantain and some arrowleaf clover present in the sward, with greater than 80% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward. Significant increase in perennial grass groundcover can be seen between the two inspection periods.

Plate 7: Rehabilitated Site PD2 September 2014

Plate 8: Rehabilitated Site PD2 March 2018

Analogue Site PD6

Table 12 below shows soil nutrient levels at Site PD6 from the 2018 inspection. Site PD6 was chosen as an additional analogue site for Area C.

Table 12 Soil Nutrient Levels Site PD6 (Analogue Site)

Soil Element	Measure & Test	Site PD6 2014	Completion Target	Site PD6 2018
pH	1:5 $CaCl_2$	New Site Not Tested 2014	Greater than 4.9	5.2
Potassium	% of Total CEC		Greater than 2%	3.2
Sodium	% of Total CEC		Less than 3%	0.2
Aluminium	% of Total CEC		Less than 5%	0.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.2
Nitrogen	mg/kg Water Extract		Greater than 4.6	18.4
Zinc	mg/kg DTPA		Greater than 0.7	1.0
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	2.5

Plate 9 shows the general landscape setting for Site PD6 within Area C at Pine Dale Mine during the 2018 inspection. Pasture at Site PD6 is dominated by the perennial grasses phalaris and fescue

Rehabilitated Site PD7

Table 13 below shows nutrient levels at Site PD7 from the 2018 inspection. Site PD7 was chosen as an additional rehabilitation site for Area C. Grazing completion targets were met for all soil elements.

Table 13 Soil Nutrient Levels Site PD7 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD7 2014	Completion Target	Site PD7 2018
pH	1:5 $CaCl_2$	New Site Not Tested 2014	Greater than 4.9	5.3
Potassium	% of Total CEC		Greater than 2%	5.2
Sodium	% of Total CEC		Less than 3%	0.3
Aluminium	% of Total CEC		Less than 5%	0.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.5
Nitrogen	mg/kg Water Extract		Greater than 4.6	9.2
Zinc	mg/kg DTPA		Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	2.7

Plate 10 shows the general landscape setting for Site PD7 within Area C at Pine Dale Mine during the 2018 inspection. Pasture at Site PD6 is dominated by perennial grasses phalaris, fescue and paspalum along with the herb plantain and arrowleaf clover. There is greater than 90% groundcover with only isolated tussocks of African lovegrass, which comprises less than 5% of the pasture sward.

Plate 9: Analogue Site PD6 March 2018

Plate 10: Rehabilitated Site PD7 March 2018

3.1.3 Area 8

Rehabilitated Site PD4

Table 14 below shows a comparison of soil nutrient levels at Site PD4 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 14 Soil Nutrient Levels Site PD4 (Rehabilitated Site)

Soil Element	Measure & Test	Site PD4 2014	Completion Target	Site PD4 2018
pH	1:5 $CaCl_2$	5.7	Greater than 4.9	6.1
Potassium	% of Total CEC	3.5	Greater than 2%	4.4
Sodium	% of Total CEC	1.4	Less than 3%	0.3
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	7.4	Greater than 5.4	8.9
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	36.8
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio	2.7	Greater than 2.1	3.7

Plate 11 and **Plate 12** show the general landscape setting for Site PD4 within Area 8 at Pine Dale Mine during the 2014 and 2018 inspections.

Pasture at Site PD4 is dominated by perennial grasses cocksfoot, fescue and paspalum with some arrowleaf clover present in the sward, and greater than 90% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward. Significant increase in perennial grass groundcover can be seen between the two inspection periods.

Plate 11: Rehabilitated Site PD4 September 2014

Plate 12: Rehabilitated Site PD4 March 2018

Analogue Site PD8

Table 15 below shows soil nutrient levels at Site PD8 from the 2018 inspection. Site PD8 was chosen as an analogue site for Area 8 as it is undisturbed by mining and did not receive any of the Area 8 treatment, being located between pine trees and not accessed by fertiliser spreading equipment.

Table 15 Soil Nutrient Levels Site PD8 (Analogue Site)

Soil Element	Measure & Test	Site PD8 2014	Completion Target	Site PD8 2018
pH	1:5 $CaCl_2$	New Analogue Site Not Tested 2014	Greater than 4.9	5.0
Potassium	% of Total CEC		Greater than 2%	2.5
Sodium	% of Total CEC		Less than 3%	0.9
Aluminium	% of Total CEC		Less than 5%	2.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.0
Nitrogen	mg/kg Water Extract		Greater than 4.6	2.3
Zinc	mg/kg DTPA		Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	1.7

Plate 13 shows the general landscape setting for Site PD8 within Area 8 at Pine Dale Mine during the 2018 inspection. Pasture at Site PD8 is dominated by perennial phalaris and fescue with some arrowleaf clover present in the sward, with greater than 90% groundcover. There are isolated African lovegrass tussocks present which comprise less than 5% of the pasture sward.

Plate 13: Analogue Site PD8 March 2018

3.2 Enhance Place Mine

3.2.1 Morris Property

Analogue Site EP4

Table 16 below shows soil nutrient levels at Site EP4 from the 2018 inspection. Site EP4 was chosen as an analogue site for the Morris Property as it is undisturbed by mining did not receive any of the Morris Property treatment, being located between eucalypt trees and not accessed by fertiliser spreading equipment. **Plate 14** shows the general landscape setting for analogue Site EP4

Table 16 Soil Nutrient Levels Site EP4 (Analogue Site)

Soil Element	Measure & Test	Site EP4 2014	Completion Target	Site EP4 2018
pH	1:5 $CaCl_2$	New Analogue Site Not Tested 2014	Greater than 4.9	4.8
Potassium	% of Total CEC		Greater than 2%	3.7
Sodium	% of Total CEC		Less than 3%	0.2
Aluminium	% of Total CEC		Less than 5%	2.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	6.0
Nitrogen	mg/kg Water Extract		Greater than 4.6	4.6
Zinc	mg/kg DTPA		Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	2.6

Analogue Site EP6

Table 17 below shows soil nutrient levels at Site EP6 from the 2018 inspection. Site EP6 was chosen as an analogue site for the Morris Property as it is undisturbed by mining and also located in a roadside reserve and not accessed by fertiliser spreading equipment. **Plate 15** shows the general landscape setting for analogue Site EP6.

Table 17 Soil Nutrient Levels Site EP6 (Analogue Site)

Soil Element	Measure & Test	Site EP6 2014	Completion Target	Site EP6 2018
pH	1:5 $CaCl_2$	New Analogue Site Not Tested 2014	Greater than 4.9	4.6
Potassium	% of Total CEC		Greater than 2%	4.0
Sodium	% of Total CEC		Less than 3%	1.3
Aluminium	% of Total CEC		Less than 5%	6.2
Sulfur	mg/kg KCl 40 S		Greater than 5.4	5.7
Nitrogen	mg/kg Water Extract		Greater than 4.6	4.6
Zinc	mg/kg DTPA		Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	1.8

Plate 14: Analogue Site EP4 March 2018

Plate 15: Analogue Site EP6 March 2018

Rehabilitated Site EP1

Table 18 below shows a comparison of soil nutrient levels at Site EP1 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 18 Soil Nutrient Levels Site EP1 (Rehabilitated Site)

Soil Element	Measure & Test	Site EP1 2014	Completion Target	Site EP1 2018
pH	1:5 $CaCl_2$	7.2	Greater than 4.9	5.1
Potassium	% of Total CEC	3.0	Greater than 2%	5.2
Sodium	% of Total CEC	1.8	Less than 3%	0.4
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	7.0	Greater than 5.4	6.2
Nitrogen	mg/kg Water Extract	2.3	Greater than 4.6	46.0
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio	2.7	Greater than 2.1	3.3

Plate 16 and **Plate 17** show the general landscape setting for Site EP1 within the Morris Property at Enhance Place Mine during the 2014 and 2018 inspections.

Pasture at Site EP1 is dominated by perennial grasses phalaris and cocksfoot, the herb plantain with some medic present in the sward, and greater than 80% groundcover. Significant increase in perennial grass groundcover can be seen between the two inspection periods.

Overgrazing is still a major land management issue here, however increase in perennial grass pasture density have been achieved nonetheless.

Plate 16: Rehabilitated Site EP1 September 2014

Plate 17: Rehabilitated Site EP1 March 2018

Rehabilitated Site EP3

Table 19 below shows a comparison of soil nutrient levels at Site EP3 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 19 Soil Nutrient Levels Site EP3 (Rehabilitated Site)

Soil Element	Measure & Test	Site EP3 2014	Completion Target	Site EP3 2018
pH	1:5 $CaCl_2$	6.8	Greater than 4.9	5.3
Potassium	% of Total CEC	2.4	Greater than 2%	3.5
Sodium	% of Total CEC	3.7	Less than 3%	0.3
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	5.9	Greater than 5.4	7.8
Nitrogen	mg/kg Water Extract	2.3	Greater than 4.6	115.0
Zinc	mg/kg DTPA	0.8	Greater than 0.7	0.9
Calcium	Calcium:Magnesium Ratio	1.6	Greater than 2.1	2.3

Plate 18 and **Plate 19** show the general landscape setting for Site EP3 within the Morris Property at Enhance Place Mine during the 2014 and 2018 inspections.

Pasture at Site EP3 is dominated by perennial grasses fescue and cocksfoot, the herb plantain with some medic present in the sward, and greater than 80% groundcover. Significant increase in perennial grass groundcover can be seen between the two inspection periods. There are areas of *Brassica* weed species which are being grazed by horses and cattle.

Overgrazing is still a major land management issue here, however increase in perennial grass pasture density have been achieved nonetheless.

Plate 18: Rehabilitated Site EP3 September 2014

Plate 19: Rehabilitated Site EP3 March 2018

Rehabilitated Site EP5

Table 20 below shows soil nutrient levels at Site EP5 from the 2018 inspection. Grazing completion targets were met for all soil elements.

Table 20 Soil Nutrient Levels Site EP5 (Rehabilitated Site)

Soil Element	Measure & Test	Site EP5 2014	Completion Target	Site EP5 2018
pH	1:5 $CaCl_2$	New Site Not Tested 2014	Greater than 4.9	6.1
Potassium	% of Total CEC		Greater than 2%	4.3
Sodium	% of Total CEC		Less than 3%	0.3
Aluminium	% of Total CEC		Less than 5%	0.0
Sulfur	mg/kg KCl 40 S		Greater than 5.4	7.5
Nitrogen	mg/kg Water Extract		Greater than 4.6	73.6
Zinc	mg/kg DTPA		Greater than 0.7	0.8
Calcium	Calcium:Magnesium Ratio		Greater than 2.1	3.1

Plate 20 shows the general landscape setting for Site EP5 within the Morris Property at Enhance Place Mine during the 2018 inspections. Pasture at Site EP5 is dominated by perennial grasses fescue and phalaris, the herb plantain with some medic present in the sward, and greater than 90% groundcover.

Plate 20: Rehabilitated Site EP5 March 2018

3.2.2 Crown Land Block

Rehabilitated Site EP2

Table 21 below shows a comparison of soil nutrient levels at Site EP3 from the 2014 and 2018 inspections. Grazing completion targets were met for all soil elements.

Table 21 Soil Nutrient Levels Site EP2 (Rehabilitated Site)

Soil Element	Measure & Test	Site EP2 2014	Completion Target	Site EP2 2018
pH	1:5 $CaCl_2$	7.1	Greater than 4.9	6.3
Potassium	% of Total CEC	4.0	Greater than 2%	4.1
Sodium	% of Total CEC	2.1	Less than 3%	0.4
Aluminium	% of Total CEC	0.0	Less than 5%	0.0
Sulfur	mg/kg KCl 40 S	6.5	Greater than 5.4	5.4
Nitrogen	mg/kg Water Extract	4.6	Greater than 4.6	13.8
Zinc	mg/kg DTPA	0.7	Greater than 0.7	0.7
Calcium	Calcium:Magnesium Ratio	2.1	Greater than 2.1	2.9

The Crown Land Block adjacent to the Morris property is grazed only by kangaroos with domestic stock being excluded. In 2014 EP2 had sufficient groundcover and a desirable pasture species composition with no further remediation work recommended.

Plate 21 and **Plate 22** show the general landscape setting for Site EP2 within the Morris Property at Enhance Place Mine during the 2014 and 2018 inspections, with greater than 80% groundcover.

Plate 21: Rehabilitated Site EP2 September 2014

Plate 22: Rehabilitated Site EP2 March 2018

4 SUMMARY

All rehabilitated sites at Pine Dale Mine and Enhance Place Mine showed improved levels of soil fertility from 2014. Additionally, desirable perennial pasture content had increased and African lovegrass populations had significantly decreased.

SLR is of the opinion that Enhance Place Pty Ltd. has met (and exceeded) the Grazing Pasture Completion Criteria stated in **Section 2.1** at the Pine Dale Mine and Enhance Place sites.

Appendix A

2018 All Sites Laboratory Soil Test Results

SOILTEC *SOIL AND PLANT ANALYSIS*

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (8)

Client: ***SLR***
Account: **PD1**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.12	<0.15
pH	(1:5 $CaCl_2$)		6.50	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	11.27	See Percentage
Magnesium:		(Mg)(meq/100g)	4.11	See Percentage
Potassium:		(K)(meq/100g)	0.56	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**15.97**	
Exchangeable Cations (as a % of Total)				
Calcium:			70.57	65-80%
Magnesium:			25.74	15-20%
Potassium:			3.51	2-5%
Sodium:			0.19	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	15.7	
Sulphur	(mg/kg)	(KCl 40 S)	6.3	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	27.6	At least 10
Organic Carbon	(%)	(Walkely & Black)	4.0	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.3	
Zinc		(mg/kg) (DTPA)	1.0	
Manganese		(mg/kg) (DTPA)	56.3	
Iron		(mg/kg) (DTPA)	60.3	
Boron		(mg/kg) (Hot CaCl)	1.0	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.74	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (9)

Client: ***SLR***
Account: **PD2**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.10	<0.15
pH	(1:5 $CaCl_2$)		5.85	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	6.59	See Percentage
Magnesium:		(Mg)(meq/100g)	2.93	See Percentage
Potassium:		(K)(meq/100g)	0.44	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**9.99**	
Exchangeable Cations (as a % of Total)				
Calcium:			65.97	65-80%
Magnesium:			29.33	15-20%
Potassium:			4.40	2-5%
Sodium:			0.30	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	35.9	
Sulphur	(mg/kg)	(KCl 40 S)	7.7	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	46.0	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.9	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.0	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	40.3	
Iron		(mg/kg) (DTPA)	46.9	
Boron		(mg/kg) (Hot CaCl)	0.7	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.25	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (10)

Client: ***SLR***
Account: **PD3**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)			0.08	<0.15
pH	(1:5 $CaCl_2$)		6.60	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	7.54	See Percentage
Magnesium:		(Mg)(meq/100g)	2.67	See Percentage
Potassium:		(K)(meq/100g)	0.47	0.5-1.0
Sodium:		(Na)(meq/100g)	0.02	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**10.70**	
Exchangeable Cations (as a % of Total)				
Calcium:			70.47	65-80%
Magnesium:			24.95	15-20%
Potassium:			4.39	2-5%
Sodium:			0.19	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	13.6	
Sulphur	(mg/kg)	(KCl 40 S)	5.3	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	9.2	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.4	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.2	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	44.3	
Iron		(mg/kg) (DTPA)	48.2	
Boron		(mg/kg) (Hot CaCl)	0.8	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.82	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (11)

Client: ***SLR***
Account: **PD4**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)			0.29	<0.15
pH	(1:5 $CaCl_2$)		6.11	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	6.53	See Percentage
Magnesium:		(Mg)(meq/100g)	1.79	See Percentage
Potassium:		(K)(meq/100g)	0.38	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**8.73**	
Exchangeable Cations (as a % of Total)				
Calcium:			74.80	65-80%
Magnesium:			20.50	15-20%
Potassium:			4.35	2-5%
Sodium:			0.34	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	46.0	
Sulphur	(mg/kg)	(KCl 40 S)	8.9	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	36.8	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.6	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.0	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	43.7	
Iron		(mg/kg) (DTPA)	40.3	
Boron		(mg/kg) (Hot CaCl)	0.7	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			3.65	3-5

SOILTEC *SOIL AND PLANT ANALYSIS*

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (12)

Client: ***SLR***
Account: **PD5**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.21	<0.15
pH	(1:5 $CaCl_2$)		6.55	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	12.21	See Percentage
Magnesium:		(Mg)(meq/100g)	5.26	See Percentage
Potassium:		(K)(meq/100g)	0.56	0.5-1.0
Sodium:		(Na)(meq/100g)	0.02	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**18.05**	
Exchangeable Cations (as a % of Total)				
Calcium:			67.65	65-80%
Magnesium:			29.14	15-20%
Potassium:			3.10	2-5%
Sodium:			0.11	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	45.2	
Sulphur	(mg/kg)	(KCl 40 S)	9.0	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	13.8	At least 10
Organic Carbon	(%)	(Walkely & Black)	6.1	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.2	
Zinc		(mg/kg) (DTPA)	1.0	
Manganese		(mg/kg) (DTPA)	58.8	
Iron		(mg/kg) (DTPA)	72.4	
Boron		(mg/kg) (Hot CaCl)	1.1	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.32	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (13)

Client: ***SLR***
Account: **PD6**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.08	<0.15
pH	(1:5 $CaCl_2$)		5.16	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	8.53	See Percentage
Magnesium:		(Mg)(meq/100g)	3.37	See Percentage
Potassium:		(K)(meq/100g)	0.40	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**12.33**	
Exchangeable Cations (as a % of Total)				
Calcium:			69.18	65-80%
Magnesium:			27.33	15-20%
Potassium:			3.24	2-5%
Sodium:			0.24	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	10.0	
Sulphur	(mg/kg)	(KCl 40 S)	5.2	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	18.4	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.7	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.1	
Zinc		(mg/kg) (DTPA)	1.0	
Manganese		(mg/kg) (DTPA)	43.9	
Iron		(mg/kg) (DTPA)	63.1	
Boron		(mg/kg) (Hot CaCl)	0.7	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.53	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (14)

Client: ***SLR***
Account: **PD7**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.03	<0.15
pH	(1:5 $CaCl_2$)		5.29	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	4.67	See Percentage
Magnesium:		(Mg)(meq/100g)	1.74	See Percentage
Potassium:		(K)(meq/100g)	0.35	0.5-1.0
Sodium:		(Na)(meq/100g)	0.02	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**6.78**	
Exchangeable Cations (as a % of Total)				
Calcium:			68.88	65-80%
Magnesium:			25.66	15-20%
Potassium:			5.16	2-5%
Sodium:			0.29	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	11.2	
Sulphur	(mg/kg)	(KCl 40 S)	5.5	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	9.2	At least 10
Organic Carbon	(%)	(Walkely & Black)	2.3	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.9	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	36.2	
Iron		(mg/kg) (DTPA)	45.8	
Boron		(mg/kg) (Hot CaCl)	0.6	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.68	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (15)

Client: ***SLR***
Account: **PD8**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)			0.03	<0.15
pH	(1:5 $CaCl_2$)		4.95	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	7.05	See Percentage
Magnesium:		(Mg)(meq/100g)	4.21	See Percentage
Potassium:		(K)(meq/100g)	0.30	0.5-1.0
Sodium:		(Na)(meq/100g)	0.11	Zero
Aluminium:		(Al)(meq/100g)	0.24	Zero
Total Cation Exchange Capacity (CEC):			**11.91**	
Exchangeable Cations (as a % of Total)				
Calcium:			59.19	65-80%
Magnesium:			35.35	15-20%
Potassium:			2.52	2-5%
Sodium:			0.92	<3%
Aluminium:			2.02	<5%
Phosphorus:	(mg/kg)	(Bray-1)	6.9	
Sulphur	(mg/kg)	(KCl 40 S)	5.0	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	2.3	At least 10
Organic Carbon	(%)	(Walkely & Black)	1.9	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.0	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	46.6	
Iron		(mg/kg) (DTPA)	49.7	
Boron		(mg/kg) (Hot CaCl)	0.7	
Calculations:				
Lime Requirement (Cregan)			0.31	(see notes on page 2)
Calcium/Magnesium Ratio:			1.67	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (1)

Client: ***SLR***
Account: **EP1**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.14	<0.15
pH	(1:5 $CaCl_2$)		5.11	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	5.93	See Percentage
Magnesium:		(Mg)(meq/100g)	1.78	See Percentage
Potassium:		(K)(meq/100g)	0.42	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**8.16**	
Exchangeable Cations (as a % of Total)				
Calcium:			72.67	65-80%
Magnesium:			21.81	15-20%
Potassium:			5.15	2-5%
Sodium:			0.37	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	15.8	
Sulphur	(mg/kg)	(KCl 40 S)	6.2	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	46.0	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.4	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.8	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	35.6	
Iron		(mg/kg) (DTPA)	51.2	
Boron		(mg/kg) (Hot CaCl)	0.7	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			3.33	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (2)

Client: ***SLR***
Account: **EP2**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.06	<0.15
pH	(1:5 $CaCl_2$)		6.34	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	6.68	See Percentage
Magnesium:		(Mg)(meq/100g)	2.34	See Percentage
Potassium:		(K)(meq/100g)	0.39	0.5-1.0
Sodium:		(Na)(meq/100g)	0.04	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**9.45**	
Exchangeable Cations (as a % of Total)				
Calcium:			70.69	65-80%
Magnesium:			24.76	15-20%
Potassium:			4.13	2-5%
Sodium:			0.42	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	6.8	
Sulphur	(mg/kg)	(KCl 40 S)	5.4	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	13.8	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.1	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.9	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	39.3	
Iron		(mg/kg) (DTPA)	53.8	
Boron		(mg/kg) (Hot CaCl)	0.72	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.85	3-5

SOILTEC *SOIL AND PLANT ANALYSIS*

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (3)

Client: ***SLR***
Account: **EP3**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.32	<0.15
pH	(1:5 $CaCl_2$)		5.32	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	8.92	See Percentage
Magnesium:		(Mg)(meq/100g)	3.88	See Percentage
Potassium:		(K)(meq/100g)	0.47	0.5-1.0
Sodium:		(Na)(meq/100g)	0.04	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**13.31**	
Exchangeable Cations (as a % of Total)				
Calcium:			67.02	65-80%
Magnesium:			29.15	15-20%
Potassium:			3.53	2-5%
Sodium:			0.30	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	50.0	
Sulphur	(mg/kg)	(KCl 40 S)	7.8	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	115.0	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.8	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.1	
Zinc		(mg/kg) (DTPA)	0.9	
Manganese		(mg/kg) (DTPA)	45.4	
Iron		(mg/kg) (DTPA)	63.2	
Boron		(mg/kg) (Hot CaCl)	0.79	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			2.30	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (4)

Client: ***SLR***
Account: **EP4**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.06	<0.15
pH	(1:5 $CaCl_2$)		4.84	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	7.54	See Percentage
Magnesium:		(Mg)(meq/100g)	2.86	See Percentage
Potassium:		(K)(meq/100g)	0.41	0.5-1.0
Sodium:		(Na)(meq/100g)	0.02	Zero
Aluminium:		(Al)(meq/100g)	0.22	Zero
Total Cation Exchange Capacity (CEC):			**11.05**	
Exchangeable Cations (as a % of Total)				
Calcium:			68.24	65-80%
Magnesium:			25.88	15-20%
Potassium:			3.71	2-5%
Sodium:			0.18	<3%
Aluminium:			1.99	<5%
Phosphorus:	(mg/kg)	(Bray-1)	15.0	
Sulphur	(mg/kg)	(KCl 40 S)	6.0	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	4.6	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.6	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	1.0	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	42.1	
Iron		(mg/kg) (DTPA)	60.8	
Boron		(mg/kg) (Hot CaCl)	0.74	
Calculations:				
Lime Requirement (Cregan)			0.29	(see notes on page 2)
Calcium/Magnesium Ratio:			2.64	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (5)

Client: ***SLR***
Account: **EP5**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	***OPTIMAL***
Conductivity (dS/m)(1:5 water)			0.26	<0.15
pH	(1:5 $CaCl_2$)		6.11	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	6.37	See Percentage
Magnesium:		(Mg)(meq/100g)	2.04	See Percentage
Potassium:		(K)(meq/100g)	0.38	0.5-1.0
Sodium:		(Na)(meq/100g)	0.03	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			**8.82**	
Exchangeable Cations (as a % of Total)				
Calcium:			72.22	65-80%
Magnesium:			23.13	15-20%
Potassium:			4.31	2-5%
Sodium:			0.34	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	47.2	
Sulphur	(mg/kg)	(KCl 40 S)	7.5	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	73.6	At least 10
Organic Carbon	(%)	(Walkely & Black)	5.1	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.9	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	38.7	
Iron		(mg/kg) (DTPA)	54.6	
Boron		(mg/kg) (Hot CaCl)	0.77	
Calculations:				
Lime Requirement (Cregan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio:			3.12	3-5

SOILTEC SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s18-0307 (6)

Client: ***SLR***
Account: **EP6**
10 Kings rd
New lambton NSW

Sample Received: 16.4.2018 Report Reply: 24.4.2018
SAMPLE I.D: 0-10cm **INTENDED USE:**

			RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)			0.04	<0.15
pH	(1:5 $CaCl_2$)		4.56	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	3.96	See Percentage
Magnesium:		(Mg)(meq/100g)	2.17	See Percentage
Potassium:		(K)(meq/100g)	0.28	0.5-1.0
Sodium:		(Na)(meq/100g)	0.09	Zero
Aluminium:		(Al)(meq/100g)	0.43	Zero
Total Cation Exchange Capacity (CEC):			**6.93**	
Exchangeable Cations (as a % of Total)				
Calcium:			57.14	65-80%
Magnesium:			31.31	15-20%
Potassium:			4.04	2-5%
Sodium:			1.30	<3%
Aluminium:			6.20	<5%
Phosphorus:	(mg/kg)	(Bray-1)	14.1	
Sulphur	(mg/kg)	(KCl 40 S)	5.7	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	4.6	At least 10
Organic Carbon	(%)	(Walkely & Black)	2.0	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.9	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	33.6	
Iron		(mg/kg) (DTPA)	40.3	
Boron		(mg/kg) (Hot CaCl)	0.6	
Calculations:				
Lime Requirement (Cregan)			0.56	(see notes on page 2)
Calcium/Magnesium Ratio:			1.82	3-5

Appendix B

2014 EP3 Analogue Laboratory Soil Test Results

SOILTEC

SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s14-0897 (6)

Client: ***SLR***
Account: **Pdk 3**

Sample Received: 3.10.2014 Report Reply: 9.10.2014
SAMPLE I.D: 0-10cm **INTENDED USE:**
TEXTURE

			RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)			0.06	<0.15
pH	(1:5 $CaCl_2$)		4.94	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium		(Ca)(meq/100g)	6.08	See Percentage
Magnesium:		(Mg)(meq/100g)	2.84	See Percentage
Potassium:		(K)(meq/100g)	0.30	0.5-1.0
Sodium:		(Na)(meq/100g)	0.18	Zero
Aluminium:		(Al)(meq/100g)	0.05	Zero
Total Cation Exchange Capacity (CEC):			**9.45**	
Exchangeable Cations (as a % of Total)				
Calcium:			64.34	65-80%
Magnesium:			30.05	15-20%
Potassium:			3.17	2-5%
Sodium:			1.90	<3%
Aluminium:			0.53	<5%
Phosphorus:	(mg/kg)	(Bray-1)	14.7	
Sulphur	(mg/kg)	(KCl 40 S)	6.8	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	4.6	At least 10
Organic Carbon	(%)	(Walkely & Black)	1.5	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.8	
Zinc		(mg/kg) (DTPA)	0.7	
Manganese		(mg/kg) (DTPA)	19.3	
Iron		(mg/kg) (DTPA)	30.8	
Boron		(mg/kg) (Hot CaCl)	0.8	
Calculations:				
Lime Requirement (Cregan)			0.07	(see notes on page 2)
Calcium/Magnesium Ratio:			2.14	3-5

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