Mt Arthur Coal

Annual Review FY23

29 September 2023

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Table 1: Annual Review title block

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<tr><td>Name of Operator</td><td>Hunter Valley Energy Coal Pty Ltd</td></tr>
<tr><td>Project Approvals</td><td>PA 09_0062 (MOD 1)
PA 06_0091</td></tr>
<tr><td>Name of holder of project approvals</td><td>Hunter Valley Energy Coal Pty Ltd</td></tr>
<tr><td>Mining Leases</td><td>CCL 744, CL 396, ML 1358, ML 1487, ML 1548, ML1593, ML1655, ML 1739, ML 1757, MPL 263</td></tr>
<tr><td>Name of holder of mining leases</td><td>Hunter Valley Energy Coal Pty Ltd; Mt Arthur Coal Pty Limited</td></tr>
<tr><td>Water Licences</td><td>WAL 917, WAL 918, WAL 1296, WAL 18141, WAL 18247, WAL 41495, WAL 41556, WAL 41557, WAL 18175</td></tr>
<tr><td>Name of holder of water licences</td><td>Hunter Valley Energy Coal Pty Ltd</td></tr>
<tr><td>Forward Program Commencement Date</td><td>1 August 2022</td></tr>
<tr><td>Forward Program Completion Date</td><td>30 June 2025</td></tr>
<tr><td>Annual Review Commencement Date</td><td>1 July 2022</td></tr>
<tr><td>Annual Review Completion Date</td><td>30 June 2023</td></tr>
<tr><td colspan="2">I, Hannah Farr, certify that this audit report is a true and accurate record of the compliance status of Mt Arthur Coal for the period 1 July 2022 to 30 June 2023 and that I am authorised to make this statement on behalf of Hunter Valley Energy Coal Pty Ltd.

Note.
• 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.
• 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).</td></tr>
<tr><td>Name of authorised reporting officer</td><td>Hannah Farr</td></tr>
<tr><td>Title of authorised reporting officer</td><td>Manager HSE – Mt Arthur Coal</td></tr>
<tr><td>Signature of authorised reporting officer</td><td></td></tr>
<tr><td>Date</td><td>11/09/2023</td></tr>
</table>

1 Statement of Compliance

A statement of Mt Arthur Coal's compliance with its project approvals and mining leases is presented in Table 2 with four identified non-compliances during the reporting period being discussed in Table 3.

Table 2: Statement of compliance

Were all conditions of the relevant approval(s) complied with?	
PA 09_0062	YES
EPL 11457	NO
EPBC 2011/5866	YES
EPBC 2014/7377	YES
ML	YES

Table 3: Non-compliance summary

Relevant approval	Condition	Description Summary	Compliance Status	Comment	Report Reference
EPL 11457	O2.6	Missing quarterly STP records	Non-compliant (Administrative)	Written records of required STP quarterly inspections misplaced.	Section 11
EPL 11457	R4.2	Noise exceedance not reported to EPA	Non-compliant (Administrative)	Misalignment between EPL and PA led to noise exceedance in October 2021 not being reported to EPA.	Section 11
EPL 11457	M2.3	<100% data capture at Discharge Point 6	Non-compliant (Low)	Communication error with device sending data to Water NSW and BHP systems.	Section 11
EPL 11457	M2.3	<100% data capture at Discharge Point 6	Non-compliant (Low)	Communication error with device sending data to Water NSW and BHP systems.	Section 11
EPL 11457	M2.2	<100% data capture at dust Monitoring Points	Non-compliant (Low)	Monitor servicing; technical issues / equipment malfunction; invalid data; and power outages all contributing to minor data loss.	Section 11
EPL11457	L6.3	Blast incident overpressure exceedance	Non-compliant (Low)	Airblast overpressure exceedance of 120.6 dB was recorded at Sheppard Ave. Exceedance was notified to the DPE and EPA. DPE determined no breach of approval occurred.	Section 11

Note: Compliance Status key for Table 3

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 unlikely 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)

Acronyms

Acronyms	
AHMP	Aboriginal Heritage Management Plan
ARA	Annual rapid assessment
BioMP	Biodiversity Management Plan
BMP	Blast Management Plan
CASA	Civil Aviation Safety Authority
CCC	Community Consultative Committee
CCL	Consolidated coal lease
CHPP	Coal handling and preparation plant
CL	Coal lease
CRD	Cumulative rainfall departure
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DoEE	Former Federal Department of the Environment and Energy is now part of DAWE
DPE	NSW Department of Planning and Environment
DRE	Former Division of Resources and Energy
DRG	Former Division of Resources and Geoscience
EA	Environmental assessment
EIS	Environmental impact statement
EL	Exploration licence
EMS	Environmental management system
EPA	NSW Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
FY	Financial year
GPA	Ground pasture assessment
HRSTS	Hunter River Salinity Trading Scheme
HSE	Health, Safety and Environment

HVEC	Hunter Valley Energy Coal (Mt Arthur Coal)
IROC	Integrated Remote Operations Centre
MAC	Mt Arthur Coal
ML	Mining lease
MOP	Mining Operations Plan
MSC	Muswellbrook Shire Council
NGER	*National Greenhouse and Energy Reporting Act 2007*
NRAR	Natural Resources Access Regulator
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PA	Project Approval
RACI	Responsible, accountable, consult and inform
RAW	Rapid assessment walkover
ROM	Run of mine
RR	NSW Resources Regulator
UAV	Unmanned aerial vehicle
VPA	Voluntary Planning Agreement
VWP	Vibrating wire piezometers

2 Introduction

The Mt Arthur Coal Complex is located approximately five kilometres south west of Muswellbrook in the Upper Hunter Valley in New South Wales (NSW) and includes the Mt Arthur Coal Open Cut, the Mt Arthur Coal Underground Project (no underground operations are currently taking place), Coal Handling and Preparation Plant (CHPP), rail loop and rail load out. The Mt Arthur Coal Complex (including biodiversity offset areas) and surrounding region is shown in Figure 1 and Figure 2.

This Annual Review details the environmental and community performance for the period from 1 July 2022 to 30 June 2023 for operations at the Mt Arthur Coal Complex.

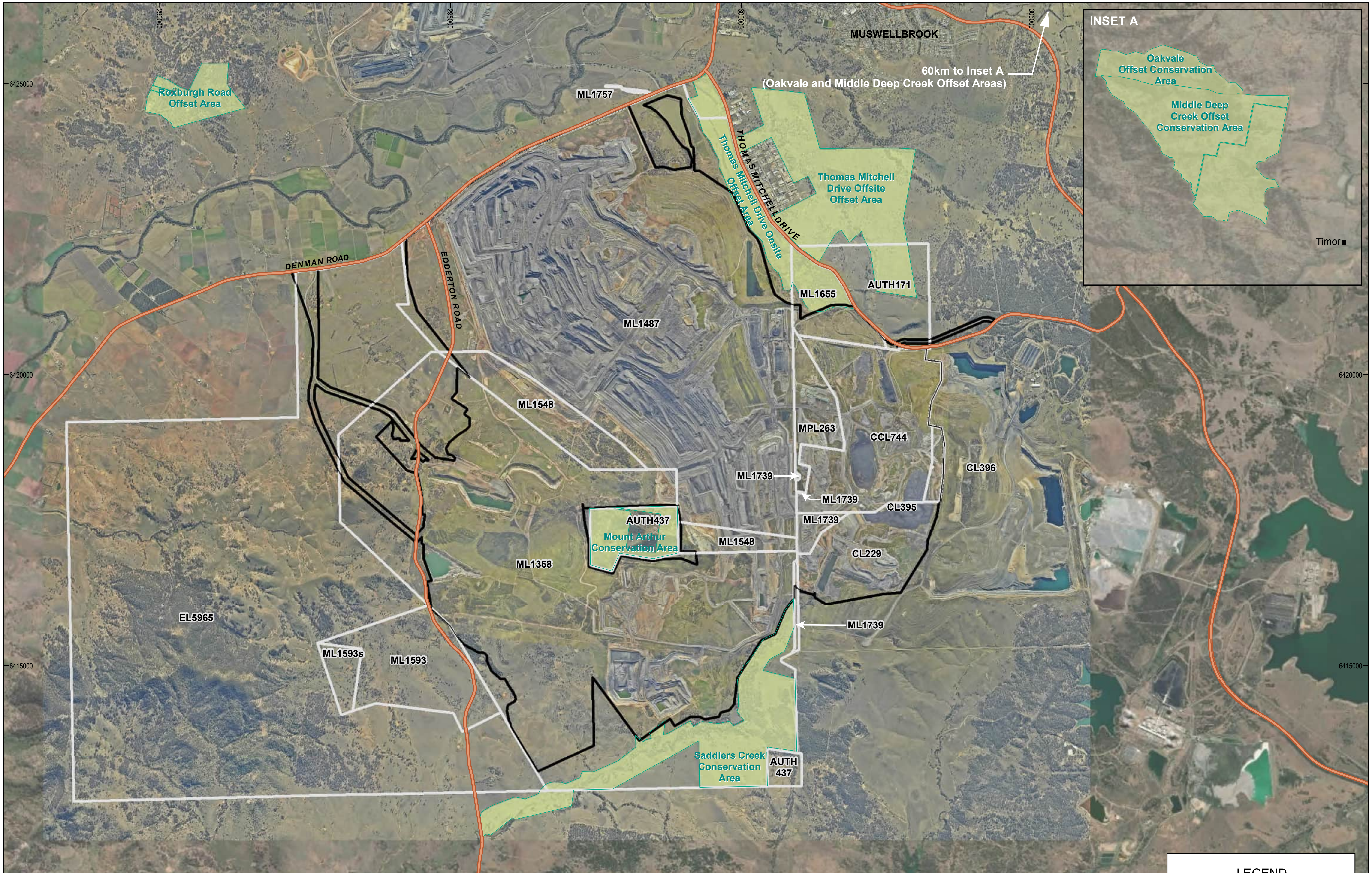
This document has been prepared in accordance with the Annual Review guidelines issued by the NSW Department of Planning and Environment in October 2015 and fulfils statutory reporting requirements required in mining leases and Schedule 5 Condition 3 of the Mt Arthur Coal Mine Open Cut Consolidation Project Approval Modification 1 (09_0062 MOD 1).

This report was prepared in consultation with the NSW Resources Regulator (RR), the Department of Planning and Environment (DPE), NSW Environment Protection Authority (EPA) and the Natural Resources Access Regulator (NRAR). The report is distributed to a range of external stakeholders and is available on the BHP website at https://www.bhp.com/sustainability/environment/regulatory-information/.

Contact details for personnel associated with environmental management at Mt Arthur Coal can be found in Table 4.

Table 4: Mt Arthur Coal management contact details

Name and role	Phone contact details
Grant Clouten, General Manager, BHP Mt Arthur Coal	(02) 6544 5800
Hannah Farr, Manager Health, Safety and Environment, BHP Mt Arthur Coal	(02) 6544 5800



BHP

Spatial Data Team
Brisbane

0 1 2
Kilometres

Projection: GDA94 MGA Zone 56

MT ARTHUR COAL

MINING LEASES, APPROVED DISTURBANCE BOUNDARY AND OFFSET AREAS

Drawn: K.Reedy	Date: 30/07/2020	Revision: 01	FIGURE 1
Checked: M.Gale	Filename: 20191107-3_new		

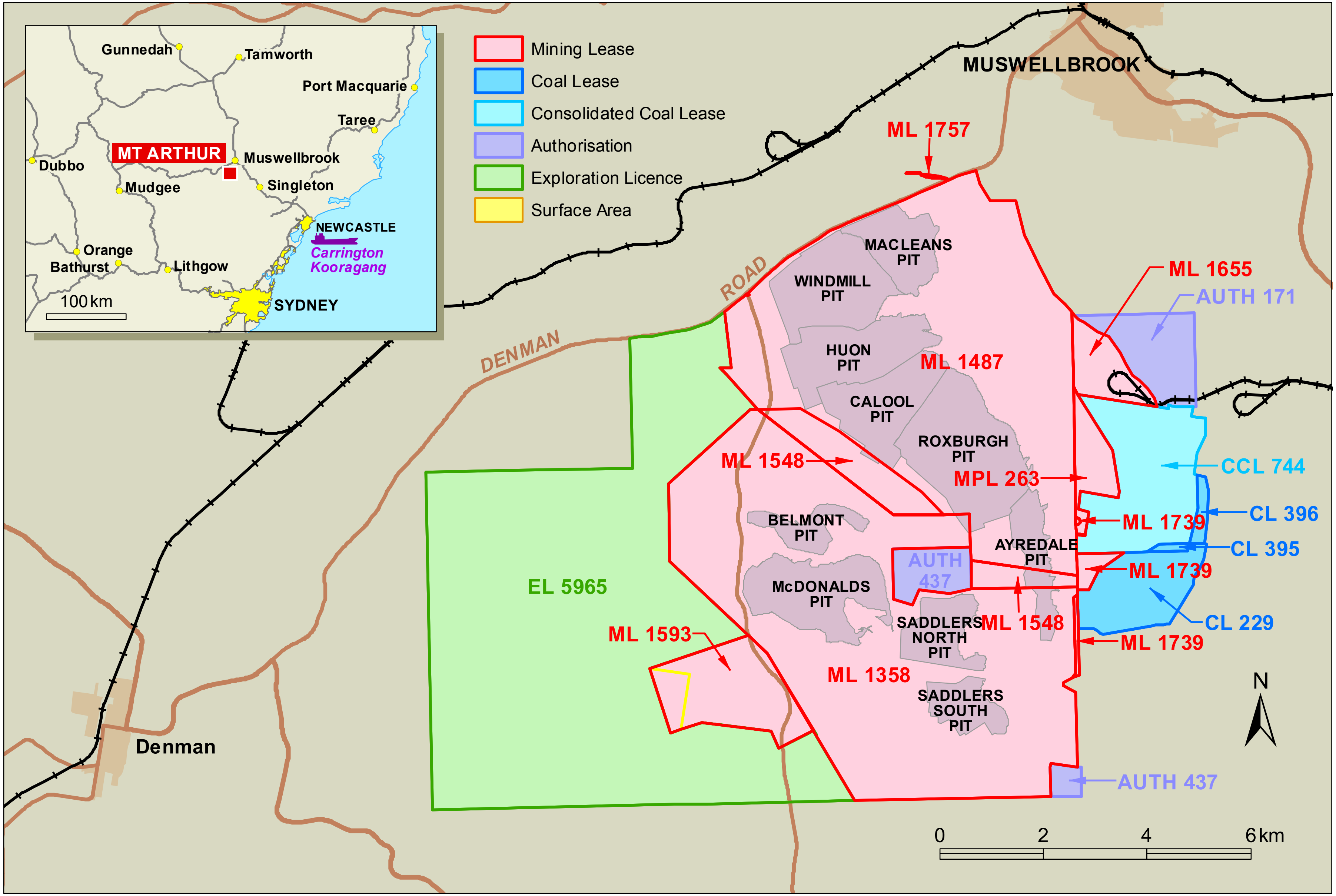


Figure 2: Mt Arthur Coal Locality Plan

Product generated by Mine2Map at 12:11:52 AEST on 11/12/2018

3 Approvals

Mt Arthur Coal has a number of statutory approvals, leases and licences that regulate activities on site. Table 5 shows Mt Arthur Coal's existing statutory approvals as at 30 June 2023.

Table 5: Mt Arthur Coal's existing statutory approvals as at 30 June 2023

Description	Issue date	Expiry date
Project approvals issued by the DPE		
Mt Arthur Coal Mine Open Cut Consolidation Project Modification 1 (09_0062 MOD 1)	26/09/2014	30/06/2026
Mt Arthur Coal Mine Underground Project (06_0091)	02/12/2008	31/12/2030
Mining leases and exploration licences issued by the DRG		
CCL 744	03/07/1989	21/01/2028
CL 396	23/06/1992	03/02/2045
ML 1358	21/09/1994	21/09/2036
ML 1487	13/06/2001	12/06/2043
ML 1548	31/05/2004	30/05/2025
ML 1593	30/04/2007	29/04/2028
ML 1655	03/03/2011	03/03/2032
ML 1739	25/07/2016	25/07/2037
ML1757	07/07/2017	07/07/2038
MPL 263	17/10/1990	17/10/2032
A 437	04/03/1991	4/3/2024
EL 5965	14/07/2007	15/07/2026
Drayton sublease CL 395	13/04/2006 (registered 14/06/2013)	21/01/2029
Drayton sublease CL 229	13/04/2006 (registered 14/06/2013)	02/02/2045
EPL issued by the EPA		
EPL11457	09/10/2001 (varied on 22/06/2023	Not specified
EPBC approval issued by the DAWE		
EPBC 2011/5866	30/04/2012 (varied on 29/06/2017)	30/06/2026
EPBC 2014/7377	05/12/2016	30/06/2026

4 Operations Summary

4.1 Mining Operations

Mining and processing operations at Mt Arthur Coal continued 24 hours a day, seven days a week during the reporting period. Mining continued within the Ayredale, Calool, Roxburgh, Saddlers Central and Windmill open cut pits. Thiess, a subsidiary of the CIMIC Group, operates under a total services contract to mine the Ayredale and Roxburgh pits, located in the southern areas of the Mt Arthur Coal mine. Overburden and interburden material was removed by excavator / shovel and transported via rear dump truck to overburden emplacements, including visual dumps 4 to 5 (VD4 to VD5), contingency dumps 1 to 5 (CD1 to CD5), Out Of Pit Dump North (OP1N), conveyor corridor dump (CC1) and Saddlers dump. Raw coal was extracted by excavator and transported to the CHPP by rear dump truck.

Raw coal was processed at the CHPP, with approximately 14 million tonnes of product coal being railed to the port of Newcastle for export. Coarse coal waste (rejects) was co-disposed within overburden emplacements and fine coal waste (tailings) was pumped to the tailings storage emplacement in East Pit. Production figures for raw, product and waste materials produced during the reporting period are summarised in Table 6.

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Table 6: Production summary

Material	Unit	Approved limit	Previous reporting period (actual FY22)	This reporting period (actual FY23)	Next reporting period (estimate)
Overburden	bank cubic meters	N/A	117,714,618	123,342,629	133,485,330
Run-of-mine coal	tonnes	32,000,000	19,820,201	20,503,845	21,439,467
Coarse and fine reject	tonnes	N/A	4,951,602	5,206,747	5,834,934
Tailings	tonnes (dry)	N/A	1,699,478	1,793,628	2,010,028
Product (saleable) coal	tonnes	27,000,000 (by rail)	13,700,745	14,172,415	15,029,080

4.2 Other Operations

Other operations at Mt Arthur Coal during the reporting period included:

- *Land Preparation:* During the reporting period approximately 177,000 bcm of topsoil was recovered from 139.3 hectares of clearing ahead of mining and for additional dump space using excavators, dozers and trucks. Material was either stockpiled or placed directly onto reshaped areas to be rehabilitated where able to. The remaining topsoil was placed in stockpiles Between 100 to 300 millimetres of topsoil was recovered during stripping.
- *Infrastructure Construction and Management*: The following major projects that were commenced, progressed or completed during the reporting period:
  - Completed relocation of electrical infrastructure to facilitate the forward mine plan;
  - Continued the construction of the second phase of the Tailings Dam Stage 2 raise project involving the downstream raising of an existing embankment by 10 meters to provide ongoing tailings storage capacity;
  - Establish an out of pit dump (OP1N) to cater for insufficient dump capacity on low wall over five-year plan, particularly with impact of monocline;
  - Old Edderton Road partially removed to facilitate approved extension of Windmill Pit

- Installation of additional water and sediment infrastructure to support ongoing water management strategies.
- Completed Denman Rd and Thomas Mitchell Drive intersection upgrade works
- Continued closure-related works for tailing storage facilities, comprising:
  - Closure of the Northcut TSF through, dewatering, surface capping and construction of a buttress along the western perimeter of the facility to final landform requirements.
  - Planning and works to move toward de-registering and the risk reduction of the Main Dam.
- Ongoing Rehabilitation and Land management Works, comprising:
  - Bulk pushing of overburden to shape the landform
  - Topsoil placement, seeding and land use establishment
  - Ongoing pest management such as dog and pig control programs
  - Weed management program

During the reporting period there were no variations from the current MOP related to construction works on site.

4.3 Employment Details

As of 30 June 2023, Mt Arthur Coal employed 1200 permanent and fixed-term contract employees and approximately 1500 contractors on a full-time equivalent basis. Approximately 50 per cent of Mt Arthur Coal's employees resided in the local government areas of Muswellbrook and Singleton as at 30 June 2023.

4.4 Next Reporting Period

Forecast operations for the next reporting period, in particular significant changes in the mine, include:

- Continue the expansion of the out of pit dump (OP1N) to cater for upper mining material;
- Continue installation of additional water pipelines and associated pumps to support ongoing water management strategies;
- Continue second phase of the Tailings Dam raise project involving the downstream raising of an existing embankment by 10 meters to provide ongoing tailings storage capacity.
- Continued closure-related works for the North Cut tailing storage facility and Main Dam.
- Commissioning of the first phase of the tailings flocculation system.

5 Actions Required from Previous Annual Review

The DPE notified HVEC by letter dated 1 March 2023 that the FY22 Annual Review was considered by the Department to satisfy the requirements of the Project Approval and the Department's Annual Review Guideline, October 2015.

Regulator feedback following review of the FY22 Annual Review is summarised in Table 7. Regulator feedback on additional requirements to be considered during the preparation of the FY23 Annual Review is also summarised in Table 7.

Table 7: Actions required from FY22 Annual Review and additional requirements for FY23 Annual Review

Action required	Requested by	Action taken by HVEC	FY23 Annual Review section
Regulator feedback from FY22 Annual Review			
No specific feedback from FY22 has been provided for consideration in the development of the FY23 Annual Review.	DPE, EPA, RR and NRAR	N/A	N/A
No Regulator feedback on additional requirements for the FY23 Annual Review was received in line with the Annual Review Guideline, October 2015.			

6 Environmental Performance

6.1 Noise

6.1.1 Environmental Management

Noise management at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-032 Noise Management Plan; and
- MAC-ENC-PRO-056 Noise Management Procedure.

The Noise Management Plan (NMP) was prepared to fulfil the requirements of the Project Approval, meet the conditions of Environmental Protection Licence (EPL) 11457, as well as manage and minimise mine noise impact on the community and environment. The NMP was updated in the reporting period and approved by DPE on the 28th April 2023.

Mt Arthur Coal has eight statutory monitoring locations as detailed in the Noise Management Plan and four real-time monitoring locations utilised for internal use. Noise monitoring locations are shown in Figure 3.

6.1.2 Environmental Performance

An analysis of monthly attended noise monitoring results indicates Mt Arthur Coal's operations did not exceed the $L_{Aeq(15min)}$ or the $L_{A1(1min)}$ limits during the reporting period. A summary of results from Mt Arthur Coal's attended noise monitoring in the reporting period is provided in Table 8. Data capture was 100 per cent at all attended noise monitoring sites.

$L_{Aeq(15min)}$ noise level predictions modelled for 2022 and 2026 in the 2013 noise impact assessment were used for comparison with monitoring results for this reporting period, as shown in Table 8. Maximum $L_{Aeq(15min)}$ noise results are below modelled predictions from all noise monitoring sites.

Table 8: Monthly attended night-time noise monitoring results in decibels

Noise Monitoring Location	$L_{Aeq(15min)}$ dB			$L_{A1(1min)}$ dB		Trend / key management implications	Implemented / proposed management actions
	Approval criteria	2022 prediction / 2026 prediction	Reporting period performance (min/ log ave/ max^)	Approval criteria	Reporting period performance (min/log ave/max^)		
NP04	38	38 / 38	25 / 33 / 37	45	28* / 37 / 42	No exceedance reported for the monitoring period	Continuation of management and monitoring in accordance with Noise Management Plan
NP07	39	38 / 37	25* / 34 / 34	45	25* / 36 / 39		
NP10	39	36 / 36	30* / 34 / 34*	45	30* / 35 / 37*		
NP12	39	39 / 40	25* / 35 / 37	45	25* / 37 / 39		
NP13	35	N/A / N/A	20* / 27 / 30*	45	20* / 33 / 35*		
NP14	35	35 / 35	25*/ 27 / 30*	45	29* / 33 / 35*		
NP15	35	36 / 36	28* / 32 / 35	45	34* / 37 / 40		
NP16	37	36 / 37	25* / 34 / 35	45	25* / 35 / 37		

^ Measurable noise levels only – does not include *inaudible* or *not measurable* results
* Noise emission limits do not apply due to winds greater than three metres per second (at a height of 10 metres), or temperature inversion conditions greater than or equal to four degrees Celsius per 100 metres.

A comparison of FY23 noise monitoring results to previous reporting years is assessed and presented in Table 9.

FY23 $L_{Aeq(15min)}$ noise levels were lower than historical results for most noise monitoring locations (NP04, NP07, NP10, NP13 and NP14) with a maximum decrease of 5dB. An increase in the noise levels was observed at three noise monitoring locations, NP12, NP15 and NP16 with a maximum increase of 5dB. On nine occasions noise levels from Mt Arthur Coal were audible but too low to measure at particular sites.

The additional impact of low frequency noise was assessed in accordance with the EPA's 2017 Noise Policy for Industry. None of the noise measurements recorded during the reporting period satisfied the conditions outlined in the Noise Policy for Industry to require assessment of low-frequency noise.

Table 9: Attended noise monitoring results in decibels in comparison to previous years

Noise Monitoring Location	FY23		FY22		FY21	
	Min	Max	Min	Max	Min	Max
$L_{Aeq(15 min)}$ dB						
NP04	IA	37	IA	38	IA	38*
NP07	IA	34	IA	38	IA	37*
NP10	IA	34*	IA	39	IA	38*
NP12	IA	37	IA	35*	IA	36*
NP13	IA	30*	IA	31*	IA	27*
NP14	IA	30*	IA	34*	IA	32*
NP15	IA	35	IA	32*	IA	34*
NP16	IA	35	IA	30	IA	37*
$L_{Aeq(1 min)}$ dB						
NP04	IA	42	IA	47*	IA	46*
NP07	IA	39	IA	41	IA	40*
NP10	IA	37*	IA	41	IA	45*
NP12	IA	39	IA	38*	IA	40*
NP13	IA	35*	IA	33*	IA	30*
NP14	IA	35*	IA	40	IA	37*
NP15	IA	40	IA	42*	IA	39*
NP16	IA	37	IA	34	IA	41*

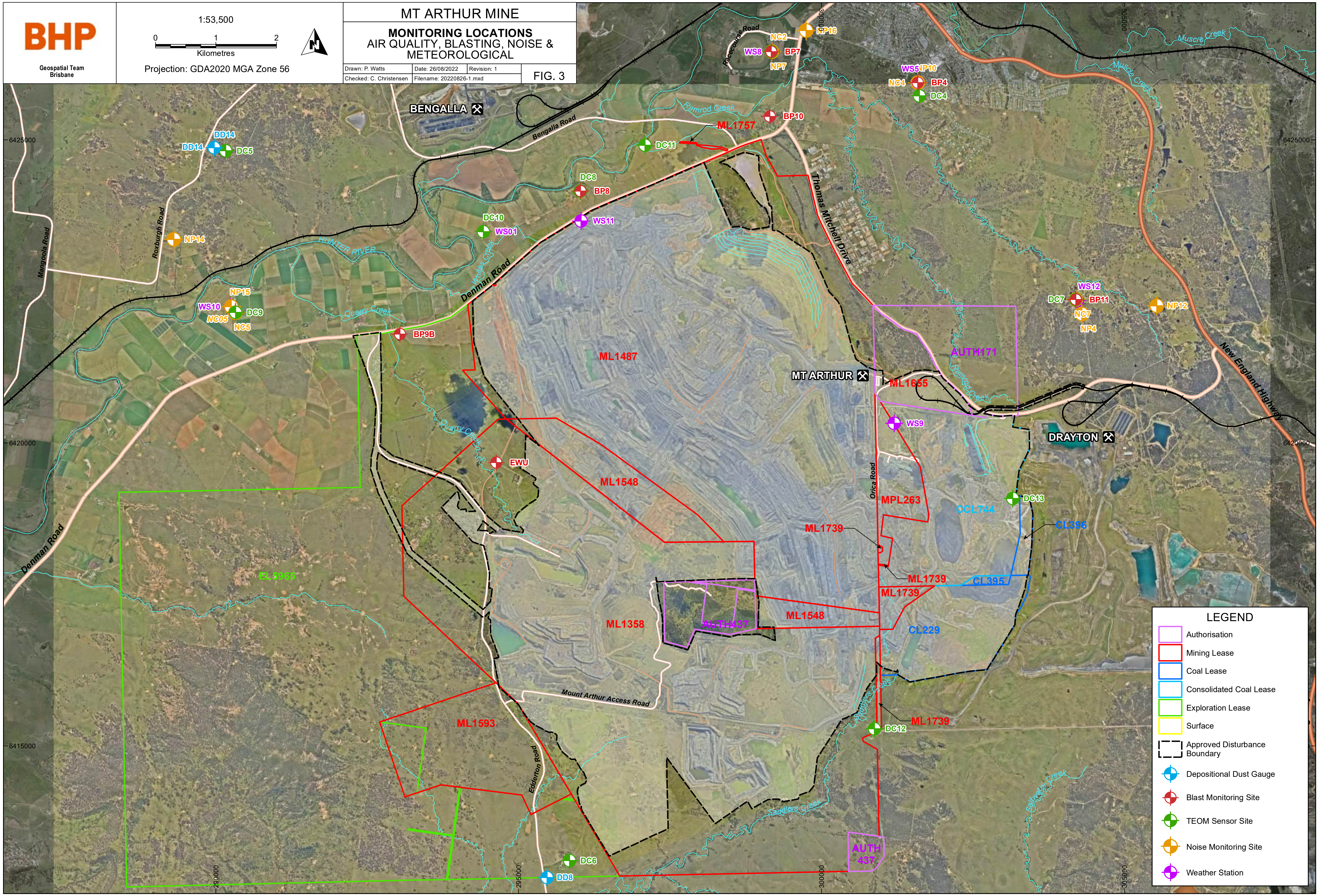
* Noise emission limits do not apply due to winds greater than three metres per second (at a height of 10 metres), or temperature inversion conditions greater than or equal to four degrees Celsius per 100 metres.
IA – Mt Arthur Coal's operations were inaudible.

6.1.3 Complaints and Reportable Incidents

A total of 3 noise complaints were received from one complainant during the reporting period. This is lower than FY22 (7 noise complaints) and FY21 (6 noise complaints). All complaints were investigated, with noise levels generated by Mt Arthur Coal being measured within internal management benchmarks at the nearest real-time monitor, whenever noise data was available. Investigations indicated that the nearest real-time monitor did not record any exceedances or distribute any alerts. Complaints are discussed further in Section 9.

6.1.4 Proposed Improvements

In line with the principles of continuous improvement that are integral to the site Environmental Management System, Mt Arthur Coal upgraded the Dust Control System (DCS) to maximise efficiencies and provide better support for operational dust and noise. Furthermore, Mt Arthur Coal has installed three noise compasses for unattended noise monitoring with improved capability, monitoring and technology that will be incorporated into the real time noise management system in the next reporting period.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MT ARTHUR MINE
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AIR QUALITY, BLASTING, NOISE & METEOROLOGICAL
Drawn: P. Watts
Date: 26/08/2022
Revision: 1
Checked: C. Christensen
Filename: 20220826-1.mxd
FIG. 3
BENGALLA
MT ARTHUR
DRAYTON
Bengalla Road
Denman Road
Thomas Mitchell Drive
Racecourse Road
Roxburgh Road
Mangoola Road
Orica Road
Mount Arthur Access Road
Edderton Road
New England Highway
HUNTER RIVER
Quarry Creek
Muscle Creek
Ramrod Creek
Saddlers Creek
ML1757
ML1487
ML1655
ML1548
ML1739
ML1358
ML1593
MPL263
AUTH171
AUTH437
AUTH 437
CCL744
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DC12
DC6
DD8
6425000
6420000
6415000
290000
295000
300000
305000
LEGEND
Authorisation
Mining Lease
Coal Lease
Consolidated Coal Lease
Exploration Lease
Surface
Approved Disturbance Boundary
Depositional Dust Gauge
Blast Monitoring Site
TEOM Sensor Site
Noise Monitoring Site
Weather Station

6.2 Blasting

6.2.1 Environmental Management

Blasting at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-015 Blast Management Plan.
- MAC-PRD-PRO-106 Pre-Blasting Approval Procedure

The Blast Management Plan details the relevant blast overpressure and vibration impact assessment criteria and compliance procedures and controls related to open cut blasting activities. It includes the blast monitoring program, as well as public infrastructure monitoring requirements, and road closures. It also includes the blast fume management strategy, which aims to minimise visible blast fume and reduce potential for offsite fume migration.

Mt Arthur Coal has five statutory blast monitors:

- BP04 (South Muswellbrook);
- BP07 (Sheppard Avenue);
- BP09B (Denman Road West);
- BP10 (Yammanie North); and
- BP11 (Balmoral Road).

Blast monitoring locations are shown in Figure 3.

The modification project approval states a ground vibration limit for public infrastructure of 50 millimetres per second (mm/s) unless Mt Arthur Coal has a written agreement with the relevant owner of the public infrastructure to exceed these criteria and advised the DPE in writing of the terms of the agreement. Written agreements with Roads and Maritime Services (RMS), Telstra and Ausgrid are in place allowing increases in the ground vibration blast impact assessment criteria as follows:

- 150 mm/s with no allowable exceedances (RMS, Ausgrid);
- 10 per cent of the total number of blasts over a period of 12 months are allowed to exceed 100 mm/s (Telstra, Ausgrid); and
- Notification prior to blasting for blasts predicted to exceed 100 mm/s at Denman Road (RMS).

6.2.2 Environmental Performance

During the reporting period 173 blasts were undertaken. Blast data capture rates for the reporting period were 100 per cent at all statutory sites.

Blasting was undertaken between 8 am and 5 pm Monday to Saturday, with no blasts being undertaken on Sundays or public holidays. No blasts recorded ground vibration above the maximum 10 mm/s limit. One blast recorded an airblast overpressure result above the maximum 120dBL limit on 26 July 2022 recording 120.6dBL at the Sheppard Avenue monitor (BP07). Investigations determined that the overpressure level was not a valid result as the result was impacted by wind-gust and the accurate result would have been 96.5dBL. No valid results were reported above the airblast overpressure maximum 120dBL limit.

Of the 173 blast events fired during the reporting period, no events exceeded the ground vibration criteria of 5mm/s. Three blasts (1.73 per cent) resulted in an exceedance of the airblast overpressure criteria of 115dBL, remaining below the five per cent allowable exceedance limits. One other blast event recorded a result above the 115dBL (115.9dBL at North Yammanie (BP10)), however following investigation the result reduced to 96.0dBL due to impact from wind gust.

Results reflect predictions made in the 2014 modification environmental assessment and do not show a significant difference in average or maximum results compared to previous reporting periods. A summary of the results and comparison of FY23 blast monitoring results with previous years is provided in Table 10.

In accordance with the Blast Management Plan, the requirements for monitoring ground vibrations at public infrastructure were not triggered during the reporting period.

Table 10: Summary of blast monitoring results

Parameter	Statistic	FY23	FY22	FY21
Ground vibration (mm/s)	Average	0.20	0.24	0.24
	Maximum valid result	4.78 (at BP09B)	13.50 (at BP09B)	8.55 (at BP09B)
	Valid blasts above 5 mm/s threshold	0	4	4
Airblast overpressure (dBL)	Average	95.67	95.5	94.6
	Maximum valid result	117.1 (BP08)	118.8 (at BP10)	119.6 (at BP09B)
	Valid blasts above 115dBL threshold	3	3	6

6.2.3 Complaints and Reportable Incidents

During the reporting period, 12 blast complaints were recorded, which is slightly higher than the 9 blast complaints recorded in FY22. Complaints are discussed further in Section 9. One reportable blast incident (26 July 2022) is discussed further in Section 11. In addition to this a property inspection and investigation was triggered in negotiation with a landholder, outside of Schedule 3 Condition 14 of PA09_0062. The investigation determined that the blast results were compliant and that there were no impacts to the property.

6.2.4 Proposed Improvements

The blast monitoring system will be reviewed for compatibility with 4G Network during FY24 with view to upgrade the network in the future and a blast monitoring site will look to be relocated to a more representative location.

6.3 Meteorological Data

6.3.1 Environmental Management

Meteorological monitoring at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-040 Air Quality Management Plan.
- MAC-ENC-PRO-083 Air Quality Data Validation Procedure

Mt Arthur Coal's primary statutory real-time meteorological station located at the mine's industrial area (WS09) is an essential component of the operation's environmental monitoring system. Wind speed, wind direction, temperature, rainfall, solar radiation and humidity data is collected at 15-minute intervals and relayed using radio telemetry.

A secondary statutory real-time meteorological station, located off site to the north-west of the mine at Wellbrook (WS10), also provides representative weather data for the mine site, including prevailing wind conditions, and is used in conjunction with WS09 to determine the presence and strength of temperature inversions in the local atmosphere as part of the pre-blast environmental assessment and for noise compliance monitoring. These meteorological stations are shown on Figure 3.

Both statutory meteorological stations comply with the Australian Standard 2923-1987 *Ambient Air – Guide for measurement of horizontal wind for air quality applications* and the EPA's 2017 Noise Policy for Industry.

6.3.2 Environmental Performance

Meteorological data capture rate for the reporting period was 98.11 per cent at WS09 and 97.07 percent at WS10.

Total rainfall for the reporting period was around 700.8 mm, which is approximately 13 per cent higher than the long-term average of 619 mm. Wind direction at Mt Arthur Coal (WS09) during the reporting period was predominantly to south-east and north to north-west (Winter/Spring); and to south-east (Summer/Autumn).

6.3.3 Proposed Improvements

To improve meteorological data capturing, new loggers and sophisticated 2D ultrasonic wind speed sensors have been installed at all environmental monitoring locations including at the meteorological stations WS09 and WS10. Mt Arthur Coal will continue to record and utilise meteorological data from its two statutory monitors during the next reporting period.

6.4 Air Quality

6.4.1 Environmental Management

Air quality at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-040 Air Quality Management Plan.

Mt Arthur Coal operates an air quality monitoring network consisting of:

- Two statutory dust deposition gauges recording dust deposition, which are derived from mining and non-mining activities. These provide a measure of changing air quality;
- Six statutory real-time dust monitors, referred to as tapered element oscillating microbalance samplers (TEOMs), which record PM_{10} levels on a continuous basis;
- Five additional TEOMs, which also record continuous PM_{10} levels are included in the monitoring network. These are non-statutory and are used for proactive internal management purposes; and
- A Dust Control System (DCS), which is monitored 24 hours a day, seven days a week by the onsite Dispatch team who contact in field personnel to activate the Dust Trigger Action Response Plan (TARP) when dust trigger levels are exceeded. Operational responses are recorded in the DCS.

Air Quality monitoring locations are shown in Figure 3.

Mt Arthur Coal utilises a predictive dust model that predicts meteorological conditions and PM_{10} concentrations up to 72 hours in advance. This tool is used for operational dust management planning and notification of mining supervisors when adverse weather conditions are predicted.

6.4.2 Environmental Performance

Air dispersion modelling completed for the 2022 and 2026 representative mining scenarios, as part of the 2013 environmental assessment, has been used to evaluate monitoring results for the reporting period.

Depositional Dust Gauges

The results from the statutory depositional dust monitoring results are summarised in Table 11. Depositional dust gauge data capture rates for the reporting period were 100 per cent at all statutory sites.

For the reporting period, no statutory depositional dust gauges exceeded the annual average assessment criteria, as shown in Table 11.

Monitoring results for the reporting period is similar to FY22, indicating that the wet conditions experienced throughout the reporting period may have had an influence on monitoring results.

Table 11: Comparison of annual average deposited dust results

Monitor Location	Approval criteria (annual average)	Annual average depositional dust (g/m^2/month)			Trend / key managemen t implications	Implemented / proposed management actions
		FY23	FY22	FY21		
Edderton Homestead (DD08)		1.0	1.1	1.7		

Monitor Location	Approval criteria (annual average)	Annual average depositional dust (g/m²/month)			Trend / key management implications	Implemented / proposed management actions
		FY23	FY22	FY21		
Roxburgh Road (DD14)	4 g/m²/ month	2.1	2.2	2.7	No exceedances	Continue dust management in accordance with AQMP

Tapered Element Oscillating Microbalance Samplers

A summary of the results from the statutory real-time TEOM PM_{10} monitoring sites for the reporting period is provided in Table 12.

The data capture for all monitors were above the 90 percent target, as shown below:

- DC02 – 97.8%
- DC04 – 99.2%
- DC05 – 97.4%
- DC06 – 98.0%
- DC07 – 99.4%
- DC08 – 98.0%
- DC09 – 99.3%
- DC10 – 99.0%
- DC11 – 98.4%
- DC12 – 92.2%
- DC13 – 96.3%

During the reporting period, the short term 24-hour cumulative impact assessment criteria (50 μg/m³) was exceeded 11 times at statutory TEOM monitoring sites over a total of 10 days. All exceedances of the cumulative criteria were reported to the DPE, as recorded in Table 13. For the recorded exceedances it was determined that the incremental increase in concentrations due to the Mt Arthur Coal project was less than 50 μg/m³.

The long-term annual average slightly increased in comparison to concentrations recorded during FY22 and FY21 except at the monitoring sites Sheppard Avenue DC02 and South Muswellbrook DC04. However, concentrations from all Mt Arthur Coal's statutory TEOM monitoring sites remained below the long-term annual impact assessment criteria of 30 μg/m³.

Air dispersion modelling predictions for the 2022 & 2026 mining scenarios have been used to evaluate annual average TEOM PM_{10} results for the reporting period, as summarised in Table 12. PM_{10} results are within the modelled predictions from all TEOM monitoring sites

Table 12: Summary of TEOM PM_{10} monitoring results using validated data

Monitor location	Approval criteria (µg/m³)	2022 – predicted cumulative (µg/m³) +	2026 – predicted cumulative (µg/m³) +	TEOM PM_{10} monitoring results (µg/m³)						Trend / key management implications	Implemented / proposed management actions
				FY23		FY22		FY21			
				Max 24-hour avg	Annual Ave µg/m³	Max 24-hour avg	Annual Ave µg/m³	Max 24-hour avg	^Annual Ave µg/m³		
Sheppard Avenue (DC02)	Short term 24-hour average: 50 Long term annual average: 30	18	19	72	17	50	16	63	20	No valid exceedances of the incremental impact assessment criteria due to the Mt Arthur Coal project.	Continue dust management in accordance with AQMP
South Muswellbrook (DC04)		19	19	47	17	42	17	79	19		
Roxburgh Road (DC05)		19	19	74	19	43	14	43	11		
Edderton Homestead (DC06)		N/A	N/A	44	14	35	11	36	11		
Antiene (DC07)		18	18	56	17	37	14	52	15		
Wellbrook (DC09)		17	19	61	19	45	15	53	15		

+ these predictions were modelled in 2013, Emissions from Bengalla Mine are not included in these cumulative predictions as detailed emissions information for the Bengalla Continuation Project were not publicly available for inclusion in the modelling for 2022 & 2026. This has led to the predicted cumulative levels being potentially artificially low.

Table 13: 24-hour PM_{10} exceedances and calculated Mt Arthur Coal incremental impact for statutory TEOMs

Date of event	Monitor location	24-hour PM_{10} result ($\mu g/m^3$)	Mt Arthur Coal contribution ($\mu g/m^3$) (Incremental impact)
06/12/2022	Shephard Avenue DC02	50.3	21.3
18/01/2023	Roxburgh Rd DC05	51.2	28.4
16/02/2023	Roxburgh Rd DC05	51.7	27.0
17/02/2023	Roxburgh Rd DC05	53.6	25.8
08/03/2023	Shephard Avenue DC02	71.6	24.2
09/03/2023	Antiene DC07	55.7	16.9
17/03/2023	Roxburgh Rd DC05	58.2	32.6
20/03/2023	Wellbrook DC09	51.5	13.6
20/03/2023	Roxburgh- Rd DC05	73.5	34.8
23/05/2023	Wellbrook DC09	60.7	23.1
22/06/2023	Roxburgh Rd DC05	51.2	17.8

Note: The results reported in this table are based on data as reported to regulators.

Total Suspended Particulates

TEOM PM_{10} monitoring data is used to calculate annual average total suspended particulate (TSP) levels. TSP results were calculated by multiplying the annual average PM_{10} results by 2.5, in accordance with the approved AQMP. During the reporting period, TSP annual average at each of the monitoring locations were generally greater than the reported values for FY22 and FY21 except for Sheppard Avenue DC02 and South Muswellbrook DC04. However, TSP remained below the long-term annual impact assessment criteria at all statutory sites, as shown in Table 14. Generally, low TSP levels recorded can primarily be attributed to the increased rainfall in this monitoring period which was approximately 13% above the long-term average, see Section 6.3.

Table 14: Summary of total suspended particulate results

Site name	Approval criteria	TSP annual average monitoring results ($\mu g/m^3$)			Trend / key management implications	Implemented / proposed management actions
		FY23	FY22	FY21		
Sheppard Avenue (DC02)	Long term annual average: 90 $\mu g/m^3$	43	41	50	No exceedances	Continue dust management in accordance with AQMP
South Muswellbrook (DC04)		43	43	47		
Roxburgh Road (DC05)		49	34	27		
Edderton Homestead (DC06)		35	28	27		
Antiene (DC07)		42	34	38		
Wellbrook (DC09)		47	37	38		

6.4.3 Complaints and Reportable Incidents

Two dust-related complaints were received from one complainant during the reporting period. Investigations indicated that real-time dust levels and 24-hour averages remained within regulatory limits at the monitoring location nearest to the complainant. Complaints are discussed further in Section 9.

The Mt Arthur Dust Control System (DCS), implemented in 2019 and redesigned and rebuilt on a new platform in 2022, has improved the site's capability to better monitor and manage its dust performance, which is evidenced in the reduction in the number of dust related complaints during this and the previous reporting periods.

6.4.4 Continuous Improvements

In line with the principles of continuous improvement that are integral to the site Environmental Management System, Mt Arthur Coal upgraded the DCS to maximise efficiencies and provide better support for operational dust and noise management. Furthermore, Mt Arthur Coal completed a project to significantly improve the uptime and reliability of all environment monitoring stations for operational dust and noise. This included the installation of seven new TEOMs, eleven UPS battery units with remote notification capability, new wind speed sensors & communication loggers during the reporting period.

6.5 Biodiversity

6.5.1 Environmental Management

Flora and fauna at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-047 Rehabilitation Strategy;
- MAC-ENC-MTP-050 Biodiversity Management Plan (BioMP);
- MAC-ENC-PRO-012 Land Management (internal document);
- MAC-ENC-PRO-080 Rehabilitation and Ecological Monitoring Procedure (REMP, internal document); and
- MAC-HSE-PRO-002 Pest Animal Management Procedure (internal document).

The BioMP outlines Mt Arthur Coal's biodiversity management and monitoring approach, addressing both State and Commonwealth approval conditions in relation to biodiversity management.

The biodiversity offset areas managed by Mt Arthur Coal, as per the BioMP, are as follows:

- Mt Arthur Conservation Area (100.8 hectares);
- Saddlers Creek Conservation Area (431.3 hectares);
- Thomas Mitchell Drive Offset Area (on-site) (219.4 hectares);
- Thomas Mitchell Drive Offset Area (off-site) (492 hectares);
- Roxburgh Road 'Constable' Offset Area (109 hectares); and
- Middle Deep Creek Offset Area (1257 hectares).

In accordance with the modification project approval, long-term security for the Mt Arthur Coal biodiversity offset areas is provided through conservation agreements, formally registered on title.

Mt Arthur Coal undertakes annual flora and fauna monitoring to track progress against the BioMP and RMP objectives. The monitoring program tracks the condition of habitat areas over time and ensures that the BioMP's established performance indicators and project approval requirements are being met. The program includes monitoring sites throughout site woodland rehabilitation areas and remnant vegetation areas onsite and within offset areas. Remnant vegetation monitoring sites are used to assess mine impact and natural regeneration, as well providing reference data for comparative assessment of rehabilitation monitoring sites.

Weed Assessment and Treatment

Mt Arthur Coal conducted an annual weed assessment in FY23. A site weed action plan was used to inform weed treatment works.

Mt Arthur Coal's weed treatment programs are guided by the Hunter Regional Strategic Weed Management Plan 2017 – 2022 (Hunter Local Land Services, 2017). Mt Arthur Coal primarily targets Weeds of National Significance, as well as State Priority weeds and Regional Priority weeds for the Hunter Region, declared under the Biosecurity Act 2015.

Pest Animal Control

Feral animal presence is continually monitored through scheduled inspections and workforce feedback. Information from these sources is used to plan the feral animal control programs across the mine site and all biodiversity offset and conservation areas.

The vertebrate pest management program continued during the reporting period, with the annual campaign utilising 1080 baiting to target wild dogs (Canis lupus familiaris) and foxes (Vulpes vulpes). Wild pig (Sus scrofa) trapping was also conducted

6.5.2 Environmental Performance

The annual ecological development monitoring program, consisting of vegetation community assessment and fauna surveys, was undertaken in November and December 2022 by independent consultants. The REMP monitoring schedule identifies a total of 5 monitoring sites scheduled to be monitored in FY23. Those sites are listed in Table 15.

Table 15 FY23 rehabilitation monitoring sites

Site Name	Site Location	Easting (MGA56)	Northing (MGA56)	Vegetation Type (PCT No.)	Reference site	First Year of Monitoring
MA4	Mt Arthur Conservation Area	298750	6417578	Woodland (1604)	Reference Site	2019 (FY20)
MA6	Mt Arthur Conservation Area	297830	6416775	Woodland (1606)	Reference Site	2019 (FY20)
MA8	Mt Arthur Conservation Area	297538	6417357	Woodland (1608)	Reference Site	2019 (FY20)
MA10	Mt Arthur Conservation Area	297964	6417116	Woodland (1691)	Reference Site	2019 (FY20)
SC9	Saddlers Creek Conservation Area	299272	6413895	Woodland (1608)	Reference Site	2019 (FY20)
TMON2	Thomas Mitchell Onsite Conservation Area	301503	6421602	Woodland (1691)	Reference Site	2019 (FY20)
TMOF2	Thomas Mitchell Offsite Conservation Area	301903	6423266	Woodland (1691)	Reference Site	2019 (FY20)
RX1	Roxburgh Conservation Area	290579	6424655	Woodland (1691)	Reference Site	2019 (FY20)
MA11	Mt Arthur Conservation Area	298736	6416927	Woodland (1691)	Future Woodland Rehabilitation	2019 (FY20)
SC8	Saddlers Creek Conservation Area	297492	6412976	Woodland (1608)	Active Revegetation	2019 (FY20)
TMOF1	Thomas Mitchell Offsite Conservation Area	300957	6422542	Woodland (1691)	Active Revegetation	2019 (FY20)
MS1	Woodland Corridor Near McDonalds Void	295668	6416100	Woodland (1604)	Active Revegetation	2022 (FY23)
VB6	Woodland Corridor Near Box Gum Woodland Establishment Area	299775	6421654	Woodland (1691)	Active Revegetation	2022 (FY23)
VB4	Visual Bund - Box Gum Woodland Establishment Area	297078	6424075	Box Gum Woodland (1606)	Active Revegetation	2022 (FY23)
VB5	Visual Bund - Box Gum Woodland Establishment Area	298829	6422634	Box Gum Woodland (1606)	Active Revegetation	2022 (FY23)
RX2	Roxburgh Conservation Area	289983	6424618	Woodland (1691)	Natural Regeneration	2019 (FY20)

Biodiversity Monitoring Results

Results of flora and vertebrate fauna species for the monitoring sites are provided in Table 16, along with a condition assessment score, which indicates ecological health based on condition attributes such as dieback, canopy health, erosion, vegetation patch shape, epicormic growth, weed invasion, mid strata native density, ground strata native density and connectivity of vegetation.

Results for the one rehabilitation site, a new monitoring area brought online this reporting period after reaching the requisite 3m in growth.

Table 16: Summary of native and introduced flora species within 20 x 20 m plots and condition scores across FY23 rehabilitation sites

Item	MS1	VB6	VB4*	VB5*
Native species (No.)	27	25	15	14
Native species (% of total)	59%	64%	43%	45%
Native species % cover	117%	94%	28%	60%
Introduced species (No.)	19	14	20	17
Introduced species (% of total)	41%	36%	57%	55%
Introduced species % cover	9.60%	65.80%	105.80%	66%
Total species	46	39	35	31
Total condition score out of 32	28	25	23	21

* = site with higher % introduced species cover than % native species cover

MS1

Monitoring site MS1 is an active regeneration site located to the south of MacDonald's Void within the Rehabilitation Woodland Corridor. The vegetation present is considered to be 'best-fit' to PCT 1604 Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass open forest of the central and lower Hunter. The vegetation present includes a canopy dominated by Corymbia maculata (Spotted Gum) with Eucalyptus albens (White Box) and Eucalyptus blakelyi (Blakely's Red Gum). Shrub species present include Acacia decora (Western Silver Wattle), Acacia parvipinnula (Silver-stemmed Wattle) and Eremophila debilis (Amulla). Native groundcovers include Bothriochloa decipiens (Pitted Bluegrass), Aristida ramosa (Purple Wire Grass), Chloris ventricosa (Tall Chloris), Microlaena stipoides var. stipoides (Weeping Grass), Cymbopogon refractus (Barbed Wire Grass), Panicum effusum (Hairy Panic), Dichondra repens (Kidney Weed) and Sida corrugata (Corrugated Sida). The total number of native species recorded at MS1 is 27, with an estimated cover of 117%.

Weed cover is low with minor occurrences of *Chloris gayana* (Rhodes Grass), *Cirsium vulgare* (Spear Thistle), *Paspalum dilatatum* (Paspalum) and *Sida rhombifolia* (Paddy's Lucerne). The total number of exotic species recorded at MS1 is 19, with an estimated cover of 9.6%. Assessment of MS1 against reference sites, phase and domain specific criteria draft completion criteria are presented in Table 17 to Table 19.

Table 17 MS1: Comparison between reference site and benchmark values

Site ID (Year)	Tree Richness	Shrub Richness	Grass and Grass like Richness	Forb Richness	Fern Richness	Other Richness	Tree Cover	Shrub Cover	Grass and Grass Like Cover	Forb Cover	Fern Cover	Other Cover	Litter Cover
Benchmark values	6	13	10	13	2	5	68	49	30	8	1	3	50
MA4 (FY23)	3	7	19	24	1	3	45.3	4.8	56.6	5.7	0.1	0.3	78
MS1 (FY23)	4	3	13	5	0	2	42.5	1.7	71.9	1	0	0.2	72

Table 18 MS1 assessment against phase and domain specific criteria

Domain Specific Rehabilitation Objectives	MS1	Compliance Assessment
Phase – 4. Ecosystem and Landuse Establishment		
Rehabilitation species composition (seed mix or tubestock) drawn from the species list in Table 12 of the REMP.	A total of 19 species identified in Table 12 of the RMP were recorded at MS1 in FY23.	Compliant
All structural dominant species represented compared with analogue site.	MS1's canopy is dominated by *Corymbia maculata* which is the dominant canopy species at reference site MA4. MS1's shrub layer includes only one of the seven (7) species recorded at MA4 (*Eremophila debilis*). The dominant groundcover species recorded at MA4 were *Austrostipa scabra* (30% cover) and *Aristida ramosa* (10% cover). Only *Aristida ramosa* was recorded at MS1.	Partially compliant
The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is comparable to that of the local remnant vegetation.	The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm at MS1 is considered to be comparable to MA4.	Compliant
The total number of native plant species is comparable to the local remnant vegetation.	The total number of native plant species at MS1 is 27, while 57 native species were recorded at MA4 in FY23.	Partially compliant
The number of tree, shrub and sub-shrub species is comparable to that of the local remnant vegetation.	The total number of tree, shrub and sub-shrub species recorded at MS1 was seven (7), while ten (10) were recorded at MA4 in FY23. This is considered to be comparable.	Compliant
Species composition for revegetation will be aimed at establishing a complex community structure consisting of groundcover, understory and canopy according to Table 8 of the REMP	MS1 includes a canopy, understorey and groundcover layers that include species identified in Table 12 of the REMP. All three layers are also within the community structure cover ranges (canopy up to 30%, understorey between 1-10%, and ground over up to 70%) identified in Table 8 of the RMP.	Compliant

Domain Specific Rehabilitation Objectives	MS1	Compliance Assessment
Nesting boxes (various bird, squirrel glider, possum and bat) and natural habitat features (including large rocks, logs/coarse woody debris, hollow bearing timber) are placed in established native woodland rehabilitation.	No nesting boxes were recorded, but natural habitat features are present.	Partially compliant
Number of weed species and surface area comparable to reference sites.	A total of 19 exotic species with an estimated cover of 9.6% was recorded at MS1. A total of 15 exotic species with an estimated cover of 2.1% was recorded at MA4. Although number of weed species and total coverage is higher at MS1, these numbers are not considered to be significantly higher and are therefore considered to be comparable.	Compliant
Site is considered to be partially compliant with rehabilitation objectives as seven (7) objectives are 'compliant', three (3) objectives are 'partially compliant' and no objectives are 'not compliant'.		

Table 19 MS1 data comparison to draft completion criteria

Completion Criteria	Completion Assessment (Yes=met, No=not met
1. Is there an average native canopy cover of 10-40% or 1 – 6 stems (40-160 stems/ha)?	Yes, canopy cover of 42.5% present.
2. Does the canopy include Corymbia maculata as well as at least on or more of the following species: Eucalyptus crebra, Eucalyptus albens x moluccana, Eucalyptus albens, Eucalyptus moluccana or Brachychiton populneus?	Yes, canopy includes Corymbia maculata and Eucalyptus albens.
3. Does the shrub layer contain at least one of the following species: Allocasuarina luehmannii, Bursaria spinosa or Olearia elliptica?	No, none of these species are present in the shrub layer.
4. Is the shrub layer <10% dover or <10 stems (<250 stems/ha)?	Yes, shrub cover of 1.7% present.
5. Is there an average native ground cover layer of ≥40%?	Yes, native ground cover layer is >40%.

<u>VB6</u>

Monitoring site VB6 is an active regeneration site located to the south of the Box Gum Rehabilitation Area within the Rehabilitation Woodland Corridor. The vegetation present is considered to be 'best-fit' to PCT 1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter. The vegetation present includes a canopy co-dominated by *Eucalyptus dawsonii* (Slaty Gum) and *Corymbia maculata* (Spotted Gum), with *Eucalyptus albens* (White Box) and *Eucalyptus camaldulensis* (River Red Gum) also present. Shrub species present include *Acacia salicina* (Cooba), *Dodonaea viscosa* (Sticky Hop-bush), *Myoporum montanum* (Western Boobialla) and *Enchylaena tomentosa* (Ruby Saltbush). Native groundcovers include *Sporobolus creber* (Slender Rat's Tail Grass), *Cynodon dactylon* (Common Couch), *Chloris ventricosa* (Tall Chloris), *Eriochloa pseudoacrotricha* (Early Spring Grass), *Panicum effusum* (Hairy Panic) and *Sida corrugata* (Corrugated Sida). The total number of native species recorded at VB6 is 25, with an estimated cover of 94%.

Weed cover is high with dense areas of *Chloris gayana* (Rhodes Grass) covering over 50% of the plot. Other weeds present include *Megathyrsus maximus*, *Setaria parviflora*, *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Lycium ferocissimum* (African Boxthorn). The total number of exotic species recorded at VB6 is 14, with an estimated cover of 65.8%. Assessment of VB6 against reference sites, phase and domain specific criteria draft completion criteria are presented in Table 20 to Table 22.

Table 20 VB6: Comparison between historic data, reference site and benchmark values

Site ID (Year)	Tree Richness	Shrub Richness	Grass and Grass like Richness	Forb Richness	Fern Richness	Other Richness	Tree Cover	Shrub Cover	Grass and Grass Like Cover	Forb Cover	Fern Cover	Other Cover	Litter Cover
1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter													
Benchmark values	6	13	10	13	2	5	68	49	30	8	1	3	50
MA10 (FY23)	6	6	17	22	1	1	48.1	16.7	86.5	4.2	0.2	0.1	47
VB6 (FY23)	5	4	11	5	0	0	37	10.9	46	1	0	0	41

Table 21 VB6 data comparison to draft completion criteria

Completion Criteria	Completion Assessment (Yes=met, No=not met)
1. Is there an average native canopy cover of 10-40% or 1-6 stems (40-160 stems/ha)?	Yes, canopy cover of 37% present.
2. Does the canopy include Eucalyptus crebra and Callitris endlicheri, and one or more of the following species*: Eucalyptus albens x moluccana, Eucalyptus moluccana, Allocasuarina luehmannii, Angophora floribunda or Brachychiton populneus*?	No, RW1 does not include any of the species listed.
3. Is there an average native shrub cover of 1-10% or 1-10 stems (1-250 Stems/ha)?	No, shrub cover of 10.9% is present.
4. Is Notelaea macrocarpa present in the shrub layer?	No, Notelaea macrocarpa is not present.
5. Is there an average native ground cover layer of ≥40%?	Yes, native ground cover layer of >40%.

Table 22 VB6 assessment against phase and domain specific criteria

Domain Specific Rehabilitation Objectives	VB6 (Domain D)	Compliance Assessment
Phase – 4. Ecosystem and Landuse Establishment		
Rehabilitation species composition (seed mix or tubestock) drawn from the species list in Table 12 of the RMP.	A total of 18 species identified in Table 12 of the RMP were recorded at VB6 in FY23.	Compliant

Domain Specific Rehabilitation Objectives	VB6 (Domain D)	Compliance Assessment
All structural dominant species represented compared with analogue site.	VB6's canopy is co-dominated by *Eucalyptus dawsonii* and *Corymbia maculata*. Neither of these species are present at reference site MA10. VB6's shrub layer includes one (1) of the six (6) shrub species recorded at MA10 (*Myoporum montanum*). The dominant groundcover species recorded at MA10 were *Austrostipa scabra* (30% cover) and *Aristida ramosa* (25% cover). Both of these species were recorded at VB6.	Partially compliant
The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is comparable to that of the local remnant vegetation.	The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm at VB6 is considered to be comparable to MA10.	Compliant
The total number of native plant species is comparable to the local remnant vegetation.	The total number of native plant species at VB6 is 25, while 53 native species were recorded at MA10 in FY23.	Partially compliant
The number of tree, shrub and sub-shrub species is comparable to that of the local remnant vegetation.	The total number of tree, shrub and sub-shrub species recorded at VB6 was nine (9), while 12 were recorded at MA10 in FY23. This is considered to be comparable.	Compliant
Species composition for revegetation will be aimed at establishing a complex community structure consisting of groundcover, understory and canopy according to Table 8 of the RMP	VB6 includes a canopy, understorey and groundcover layers that include species identified in Table 12 of the REMP. The canopy and understorey layers are slightly higher than the community structure cover ranges (canopy up to 30%, understorey between 1-10%) identified in Table 8 of the RMP. The ground cover layer is within the community structure cover range (up to 70%) identified in Table 8 of the RMP.	Compliant
Nesting boxes (various bird, squirrel glider, possum and bat) and natural habitat features (including large rocks, logs/coarse woody debris, hollow bearing timber) are placed in established native woodland rehabilitation.	No nesting boxes were recorded, but natural habitat features are present.	Partially compliant
Number of weed species and surface area comparable to reference sites.	A total of 14 exotic species with an estimated cover of 65.8% was recorded at VB6. A total of 17 exotic species with an estimated cover of 2.5% was recorded at MA10. The number of weed species present at VB6 is considered to be comparable to MA10, but the total weed cover present is not considered to be comparable due to elevated weed coverage at VB6.	Partially compliant
Pest animal infestation comparable to reference sites.	No feral species were recorded at VB6.	Compliant
Rehabilitated native vegetation distribution will link areas of onsite and near-site native vegetation, and be consistent with the biodiversity corridors consistent with the latest version of the DRG Synoptic Plan.	Although not within a biodiversity corridor identified in the DRG Synoptic Plan, VB6 forms part of a rehabilitation corridor that will link to the biodiversity corridors identified in the DRG Synoptic Plan.	Compliant

Domain Specific Rehabilitation Objectives	VB6 (Domain D)	Compliance Assessment
Site is considered to be partially compliant with rehabilitation objectives as five (5) objectives are 'compliant', five (5) objectives are 'partially compliant' and no objectives are 'not compliant'.		

VB4

Monitoring site RW4 is an active regeneration site located in the north of the Box Gum Rehabilitation Area. The vegetation present is considered to be 'best-fit' to PCT 1606 White Box – Narrow-leaved Ironbark – Blakely's Red Gum shrubby open forest of the central and upper Hunter. The vegetation present includes the canopy species *Eucalyptus blakelyi* (Blakely's Red Gum). Shrub species present include *Acacia implexa* (Hickory Wattle), *Acacia falcata* and *Atriplex semibaccata* (Creeping Saltbush). Native groundcovers include *Cynodon dactylon* (Common Couch), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Panicum effusum* (Hairy Panic), *Geranium solanderi* (Native Geranium), *Einadia trigonos* (Fishweed) and *Dichondra repens* (Kidney Weed). The total number of native species recorded at VB4 is 15, with an estimated cover of 28%.

Weed cover is high with dense areas of *Verbena bonariensis* (Purpletop) covering 70% of the plot. Other weeds present include *Megathyrsus maximus*, *Galenia pubescens* (Galenia), *Rapistrum rugosum* (Turnip Weed) and *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush). The total number of exotic species recorded at VB4 is 20, with an estimated cover of 105.8%. Assessment of VB4 against reference sites, phase and domain specific criteria draft completion criteria are presented in Table 23 to Table 25.

Table 23 VB4: Comparison between historic data, reference site and benchmark values

Site ID/ Year	Tree Richness	Shrub Richness	Grass and Grass like Richness	Forb Richness	Fern Richness	Other Richness	Tree Cover (%)	Shrub Cover (%)	Grass and Grass Like Cover (%)	Forb Cover (%)	Fern Cover (%)	Other Cover (%)	Large Tree Threshold Size (cm)
1606 White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter													
Bench-mark values	6	13	10	13	2	5	68	49	30	8	1	3	50
MA6 (FY23)	4	7	10	25	1	7	50.4	12.2	96.5	5.7	0.3	1	22
VB4 (FY23)	1	3	6	5	0	0	0.8	5.1	21.4	0.6	0	0	10

Table 24 VB4 data comparison to draft completion criteria

Completion Criteria	**Completion Assessment** **(Yes=met, No=not met**
1. Is there an average native canopy cover of 10-40% or 1-6 stems (40-160 stems/ha)?	No, canopy cover of 0.8% present.
2. Does the canopy include *Eucalyptus albens or Eucalyptus moluccana* and *Eucalyptus blakelyi?.*	No, VB4 only includes the canopy species *Eucalyptus blakelyi*.

Completion Criteria	Completion Assessment (Yes=met, No=not met
3. Does the shrub layer contain two or more of the following species: *Olearia elliptica, Notelaea macrocarpa, Acacia decora, Myoporum montanum* and *Pandorea pandorana*?	No, VB4 does not include any of these shrub species.
4. Is there an average native ground cover layer of ≥40%?	No, native ground cover layer of <40%.
5*. Is there a continuous shrub layer of less than 30% cover or <30 stems (<750 stems/ha)?	No, no continuous shrub layer present.
6*. Is there less than 60% exotic weed cover?	No, exotic weed cover is >60% cover.
7*. Are there at least 12 non-grass perennial species in a 50 x 20m plot?	No, only five (5) non-grass perennial species recorded in 20 x 20m plot.

Table 25 VB4 assessment against phase and domain specific criteria

Domain Specific Rehabilitation Objectives	VB4 (Domain E)	Compliance Assessment
Phase – 4. Ecosystem and Landuse Establishment		
Rehabilitation species composition (seed mix or tubestock) drawn from the species list in Table 12 of the RMP.	A total of 10 species identified in Table 13 of the RMP were recorded at VB6 in FY23.	Compliant
All structural dominant species represented compared with analogue site.	VB4's lacks a developed canopy, but does include small *Eucalyptus blakelyi*, which is also present at reference site MA6, but is not the dominant species present. VB4's shrub layer does not include any of the seven (7) shrub species recorded at MA6. The dominant groundcover species recorded at MA6 were *Microlaena stipoides* (50% cover) and *Rytidosperma setaceum* (30% cover). Only *Microlaena stipoides* was recorded at VB4.	Not Compliant
The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is comparable to that of the local remnant vegetation.	The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is not considered to be comparable to MA6.	Not Compliant
The total number of native plant species is comparable to the local remnant vegetation.	The total number of native plant species at VB4 is 15, while 54 native species were recorded at MA6 in FY23.	Partially compliant
The number of tree, shrub and sub-shrub species is comparable to that of the local remnant vegetation.	The total number of tree, shrub and sub-shrub species recorded at VB4 was four (4), while 11 were recorded at MA6 in FY23. This is not considered to be comparable.	Not Compliant
Species composition for revegetation will be aimed at establishing a complex community structure consisting of groundcover, understory and canopy according to Table 8 of the REMP	Species composition of the ground and shrub stratum at VB4 appears to be aimed at establishing a complex community structure as native groundcovers and shrub species characteristic of species identified in Table 13 of the RMP have been planted. However, only one canopy species (*Eucalyptus blakelyi*) has been planted.	Partially compliant

Domain Specific Rehabilitation Objectives	VB4 (Domain E)	Compliance Assessment
Nesting boxes (various bird, squirrel glider, possum and bat) and natural habitat features (including large rocks, logs/coarse woody debris, hollow bearing timber) are placed in established native woodland rehabilitation.	Nesting boxes were recorded in the surrounding areas and natural habitat features are present.	Compliant
Number of weed species and surface area comparable to reference sites.	A total of 20 exotic species with an estimated cover of 105.8% was recorded at VB4. A total of 13 exotic species with an estimated cover of 3.1% was recorded at MA6. The number of weed species present at VB4 is considered to be comparable to MA6, but the total weed cover present is not considered to be comparable due to elevated weed coverage at VB4.	Partially compliant
Pest animal infestation comparable to reference sites.	No feral species were recorded at VB4.	Compliant
Rehabilitated native vegetation distribution will link areas of onsite and near-site native vegetation, and be consistent with the biodiversity corridors consistent with the latest version of the DRG Synoptic Plan.	Although not within a biodiversity corridor identified in the DRG Synoptic Plan, VB4 forms part of a rehabilitation corridor that will link to the biodiversity corridors identified in the DRG Synoptic Plan.	Compliant
Site is considered to be partially compliant with rehabilitation objectives as four (4) objectives are 'compliant', three (3) objectives are 'partially compliant' and three (3) objectives are 'not compliant'.		

VB5

Monitoring site VB5 is an active regeneration site located in the centre of the Box Gum Rehabilitation Area. The vegetation present is considered to be 'best-fit' to PCT 1606 White Box – Narrow-leaved Ironbark – Blakely's Red Gum shrubby open forest of the central and upper Hunter. The vegetation present includes the canopy species of *Eucalyptus dawsonii* (Slatey Gum), *Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus crebra* (Narrow-leaved Ironbark). Shrub species present include *Acacia salicina* (Cooba), *Acacia implexa* (Hickory Wattle), *Acacia falcata* and *Acacia decora* (Western Silver Wattle). Native groundcovers include *Dichanthium sericeum* (Queensland Bluegrass), *Cynodon dactylon* (Common Couch), *Bothriochloa decipiens* (Pitted Bluegrass), *Panicum effusum* (Hairy Panic), *Austrostipa aristiglumis* (Plains Grass), *Euphorbia drummondii* (Caustic Weed), and *Dichondra repens* (Kidney Weed). The total number of native species recorded at VB5 is 15, with an estimated cover of 60%.

Weed cover is high with dense areas of *Megathyrsus maximus* covering 45% of the plot. Other weeds present include *Chloris gayana* (Rhodes Grass), *Setaria parviflora*, *Galenia pubescens* (Galenia), *Lysimachia arvensis* (Scarlet Pimpernel) and *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush). The total number of exotic species recorded at VB5 is 17, with an estimated cover of 66%. Assessment of VB5 against reference sites, phase and domain specific criteria draft completion criteria are presented in Table 26 to Table 28.

Table 26 VB5: Comparison between historic data, reference site and benchmark values

Site ID (Year)	Tree Richness	Shrub Richness	Grass and Grass like Richness	Forb Richness	Fern Richness	Other Richness	Tree Cover	Shrub Cover	Grass and Grass Like Cover	Forb Cover	Fern Cover	Other Cover	Litter Cover
1606 White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter													
Bench-mark values	**6**	**13**	**10**	**13**	**2**	**5**	**68**	**49**	**30**	**8**	**1**	**3**	**50**
MA6 (FY23)	4	7	10	25	1	7	50.4	12.2	96.5	5.7	0.3	1	22
VB5 (FY23)	4	3	5	2	0	0	7.7	1.4	50.2	0.2	0	0	9.4

Table 27 VB5 data comparison to draft completion criteria

Completion Criteria	**Completion Assessment** **(Yes=met, No=not met**
1. Is there an average native canopy cover of 10-40% or 1-6 stems (40-160 stems/ha)?	No, canopy cover of 7.7% present.
2. Does the canopy include *Eucalyptus albens or Eucalyptus moluccana* and *Eucalyptus blakelyi*?.	No, VB5 includes the canopy species *Eucalyptus blakelyi,* but lacks either *Eucalyptus albens* or *Eucalyptus moluccana*.
3. Does the shrub layer contain two or more of the following species: *Olearia elliptica, Notelaea macrocarpa, Acacia decora, Myoporum montanum* and *Pandorea pandorana*?	No, VB5 includes only *Acacia decora*.
4. Is there an average native ground cover layer of ≥40%?	Yes, native ground cover layer of >40%.
5*. Is there a continuous shrub layer of less than 30% cover or <30 stems (<750 stems/ha)?	No, no continuous shrub layer present.
6*. Is there less than 60% exotic weed cover?	No, exotic weed cover is >60% cover.
7*. Are there at least 12 non-grass perennial species in a 50 x 20m plot?	No, only two (2) non-grass perennial species recorded in 20 x 20m plot.

Table 28 VB5 assessment against phase and domain specific criteria

Domain Specific Rehabilitation Objectives	**VB6 (Domain E)**	**Compliance Assessment**
Phase – 4. Ecosystem and Landuse Establishment		
Rehabilitation species composition (seed mix or tubestock) drawn from the species list in Table 13 of the REMP.	A total of nine (9) species identified in Table 13 of the RMP were recorded at VB6 in FY23.	Compliant

Domain Specific Rehabilitation Objectives	VB6 (Domain E)	Compliance Assessment
All structural dominant species represented compared with analogue site.	VB5's lacks a developed canopy, but does include small *Eucalyptus blakelyi*, which is also present at reference site MA6, but is not the dominant species present. VB5's shrub layer does not include any of the seven (7) shrub species recorded at MA6. The dominant groundcover species recorded at MA6 were *Microlaena stipoides* (50% cover) and *Rytidosperma setaceum* (30% cover). Neither of these species were recorded at VB5.	Not Compliant
The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is comparable to that of the local remnant vegetation.	The diversity, percentage and density of shrubs and juvenile trees with a stem diameter <5cm is not considered to be comparable to MA6.	Not Compliant
The total number of native plant species is comparable to the local remnant vegetation.	The total number of native plant species at VB5 is 14, while 54 native species were recorded at MA6 in FY23.	Partially compliant
The number of tree, shrub and sub-shrub species is comparable to that of the local remnant vegetation.	The total number of tree, shrub and sub-shrub species recorded at VB5 was seven (7), while 11 were recorded at MA6 in FY23. This is considered to be comparable.	Compliant
Species composition for revegetation will be aimed at establishing a complex community structure consisting of groundcover, understory and canopy according to Table 8 of the REMP	Species composition of the ground and shrub stratum at VB5 appears to be aimed at establishing a complex community structure as native groundcovers and shrub species characteristic of species identified in Table 13 of the RMP have been planted. However, only two canopy species (*Eucalyptus blakelyi* and *Eucalyptus crebra*) have been planted.	Partially compliant
Nesting boxes (various bird, squirrel glider, possum and bat) and natural habitat features (including large rocks, logs/coarse woody debris, hollow bearing timber) are placed in established native woodland rehabilitation.	Nesting boxes were recorded in the surrounding areas and natural habitat features are present.	Compliant
Number of weed species and surface area comparable to reference sites.	A total of 17 exotic species with an estimated cover of 66% was recorded at VB5. A total of 13 exotic species with an estimated cover of 3.1% was recorded at MA6. The number of weed species present at VB5 is considered to be comparable to MA6, but the total weed cover present is not considered to be comparable due to elevated weed coverage at VB5.	Partially compliant
Pest animal infestation comparable to reference sites.	No feral species were recorded at VB5.	Compliant
Rehabilitated native vegetation distribution will link areas of onsite and near-site native vegetation, and be consistent with the biodiversity corridors consistent with the latest version of the DRG Synoptic Plan.	Although not within a biodiversity corridor identified in the DRG Synoptic Plan, VB5 forms part of a rehabilitation corridor that will link to the biodiversity corridors identified in the DRG Synoptic Plan.	Compliant
Site is considered to be partially compliant with rehabilitation objectives as five (5) objectives are 'compliant', three (3) objectives are 'partially compliant' and two (2) objectives are 'not compliant'.		

Weed Control

FY23 weed assessment work consisted of the following elements

- Biodiversity monitoring weed assessment work completed by independent consultants as part of the Rehabilitation and Ecological Monitoring Program and Conservation Agreement monitoring; and
- A whole of site weed survey.

The following weed species were targeted during the reporting period:

- African boxthorn (*Lycium ferocissimum*);
- African Olive (*Olea europaea Cuspidate*)
- Blue heliotrope (*Heliotropium amplexicaule*);
- Coolatai Grass (*Hyparrhenia hirta*)
- Distaff Thistle (*Carthamus sp*)
- Fireweed (*Senecio madagascariensis*)
- Flax Leaf Flea Bane (*Conyza bonariensis*)
- Galenia (*Galenia pubescens*)
- Golden wreath wattle (*Acacia saligna*)
- Inkweed (*Phytolacca octandra*)
- Kikuyu (*Cenchrus clandestinus*)
- Mallow (*Malva sp.*)
- Noogoora Burr (*Xanthium Occidentale*)
- Onion Weed (*Asphodelus fistulosus*)
- Paddys Lucern (*Sida rhombifolia*)
- Paterson Curse (*Echium plantagineum*)
- Prickly Pear (*Opuntia stricta*);
- Purple Top (*Verbena bonariensis*)
- Rhodes Grass (*Chloris gayana*)

Mt Arthur Coal targeted the following areas of operational land for weed treatment during the reporting period:

- *VDs 1, 4 and 5;*
- *CD1;*
- *Drayton Void;*
- *Saddlers South;*
- *McDonald's South;*
- *Dump 11;*
- *Western boundary Adjacent the Core Shed and EME pad;*
- *Adjacent the Environment and Dirty Water Dams; and*
- *Rail loop.*

Weed treatment for Biodiversity Offset Areas included slashing and spraying of weeds across all areas.

Pest Animal Control

During the reporting period Mt Arthur conducted the following pest animal control programs:

- Wild dog and fox control programs were conducted during February to March and May and June 2023. The programs utilised 1080 baiting and were completed across the Mt Arthur Coal mine site operational areas and biodiversity offset areas.
- Wild pig trapping program was conducted in the across the southern Mt Arthur Coal mine site operational areas and biodiversity offset areas.

Table 29 shows the breakdown of species humanely destroyed during pest control programs.

Table 29 Pest animal control program results for FY23

Species	Count
Fox	4
Wild Dog	37
Wild Pigs	72
Cats	1
Deer	25
Unknown 1080 bait takes	33

6.5.3 Complaints and Reportable Incidents

There were no biodiversity complaints received in FY23. Mt Arthur Coal did not receive any government fines or penalties related to flora and fauna during the reporting period and there were no related reportable incidents.

6.5.4 Proposed Improvements

Mt Arthur Coal will continue to implement the REMP and action recommendations as required during the next reporting period, with monitoring of woodland rehabilitation, remnant woodland community sites and revegetation/regeneration areas within conservation areas. Mt Arthur Coal will also continue to implement annual landform stability assessments of existing rehabilitation in the next reporting period. Investigate the use of remote sensing in the assessment of landform stability as part of the review of the REMP and complete the review of the aerial weed assessment.

Mt Arthur Coal will continue removing waste items and repairing sections of fence that require maintenance in conservation and biodiversity offset areas during the next reporting period.

During the next reporting period, Mt Arthur Coal will also implement another vertebrate pest management program on site. Improvements in the management of additional pest animal species will be a particular focus, with expanded shooting, trapping and baiting programs to be completed to include rabbits, goats and pigs.

6.6 Visual Amenity and Lighting

6.7.2 Environmental Management

Visual amenity and lighting management at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-080 Rehabilitation and Ecological Monitoring;
- MAC-PRD-PRO-073 Procedure for Lighting Plant Movement and Setup; and
- MAC-ENC-PRO-077 Light Management Procedure.

Mt Arthur Coal’s visual assessment procedure ensures overburden emplacement development is monitored and assessed against modelled predictions in the environmental assessment.

Management measures presented in the Light Management Procedure aim to control and reduce the impact of lighting on the surrounding area. The procedure is used in conjunction with the procedure for lighting plant movement and setup, which advises operational staff on correct alignment of lights to avoid offsite impact.

6.6.2 Environmental Performance

Visual impact inspections were completed in October 2022. The inspection indicated that viewpoint locations to the east of Mt Arthur Coal have extensive views of rehabilitated overburden dumps, with reduced visual contrast to surrounding non-mined landforms and peripheral visual impact from active mining activities. Viewpoint locations to the north and west of MAC recorded that a distinct visual contrast between mining activity and the surrounding non-mined landscape is evident due to exposure to low wall overburden dumps. For all locations the shape and size of the overburden dumps are within the predicted model shown in the environmental assessment.

Management measures designed to reduce the visual impact created by the overburden emplacement have been incorporated into the mine plan. Such measures include:

- The integration of tree corridors on overburden emplacements as part of progressive rehabilitation;
- Incorporating micro relief features (stag trees, ripping, rock features and habitat trees) throughout overburden emplacements to provide an enhanced naturally appearing landform and fauna habitat;
- The practical consideration of geomorphic designs on emplacements to sustainably manage water and create a natural looking and stable landform;
- The strategic design and rehabilitation of overburden emplacements for increased visual shielding of operations;
- Establishing visual and ecological planting patterns of native trees to achieve landscape patterns that complement the existing spatial distribution of tree and grass cover in a grazing landscape; and
- Minimising exposure of work areas to sensitive receivers where possible, largely through the timely rehabilitation of visible overburden emplacements.

6.6.3 Complaints and Reportable Incidents

During the reporting period, 26 lighting complaints were received, which is higher than FY22 (18 complaints). On notification of the complaints, action was taken to locate and redirect the offending lights to address complainant's concerns with one exception. On 20 July 2022 (6:39PM) there was a fault with the phone line carrier which prevented MAC to be notified of the issue. The issue with the phone carrier was rectified as soon as practicable. The complainant made another complaint later in the night (10:50PM) which was actioned immediately. Complaints are discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to lighting or visual amenity during the reporting period and there were no related reportable incidents.

6.6.4 Proposed Improvements

During the reporting period Mt Arthur Coal continued to incorporate fluvial geomorphic principles into the design of overburden emplacements. Rehabilitated landforms were reshaped to facilitate natural surface flow processes, resulting in a final shape that more closely mimics the adjacent non-mined landscape and reduces visual impact. This process will be developed further in subsequent reporting periods.

Lighting from Mt Arthur Coal will continue to be implemented in accordance with the Light Management Procedure and managed to minimise impacts on the local community whilst maintaining the minimum level necessary for operational and safety needs. Screen planting for visual amenity will be reviewed and planned in FY24.

6.7 Aboriginal Cultural Heritage

6.7.2 Environmental Management

Aboriginal cultural heritage at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-042 Aboriginal Heritage Management Plan.

Mt Arthur Coal has implemented a management plan that provides the framework to identify, assess, monitor, protect and manage Aboriginal cultural heritage. The management plan assists Mt Arthur Coal to mitigate the impacts of its operations on Aboriginal cultural heritage, comply with the requirements of the *National Parks and Wildlife Act 1974*, *Environmental Planning and Assessment Act 1979* and the modification project approval and continue its active partnership with the Aboriginal community.

A major review of the Mt Arthur Coal Aboriginal Heritage Management Plan was approved in February 2022 by DPE following consultation with the Registered Aboriginal Parties (RAP).

6.7.2 Environmental Performance

Minor survey and / or salvage activities and due diligence assessments were also completed and recorded during the reporting period for the following site works in accordance with the methodology detailed in the Aboriginal Heritage Management Plan:

- Areas required for future mining and overburden emplacement;
- Exploration Drill Sites; and
- Minor changes to roads, access tracks and powerlines

All site cards required by section 89A of the National Parks and Wildlife Act are being prepared to be lodged with Heritage NSW.

Grinding grooves and Scar trees within the Site boundary and Biodiversity Offset areas were audited by an archologist and RAPs as required by the Aboriginal Heritage Management Plan.

6.7.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to Aboriginal cultural heritage during the reporting period and there were no related reportable incidents.

6.7.4 Proposed Improvement

All measures to protect Aboriginal Cultural Heritage described in the approved Aboriginal Heritage Management are planned to continue along with continued consultation with our key Aboriginal stakeholders.

6.8 European Cultural Heritage

6.8.1 Environmental Management

European cultural heritage at Mt Arthur Coal is managed in accordance with the:

- MAC-ENC-MTP-046 European Heritage Management Plan;
- MAC-ENC-MTP-048 Edinglassie and Rous Lench Conservation Management Plan - Volume 1;
- MAC-ENC-MTP-049 Edinglassie and Rous Lench Conservation Management Plan - Volume 2; and

Mt Arthur Coal owns and manages five heritage-listed homesteads as follows:

- Edinglassie Homestead (state significance);
- Rous Lench Homestead (state significance);
- Edderton Homestead Complex (local significance);
- Belmont Homestead Complex (local significance); and
- Balmoral Homestead (local significance).

The two State-significant historic heritage items with possible impacts from the Mt Arthur Coal operation are the Edinglassie and Rous Lench homesteads.

The European Heritage Management Plan assists Mt Arthur Coal to coordinate and manage the European heritage items affected or potentially affected by its operations, comply with the requirements of the *Heritage Act 1977* and the modification project approval and mitigate impacts of its operations on European cultural heritage.

6.8.2 Environmental Performance

Edinglassie and Rouse Lench Complex

During the reporting period, Mt Arthur Coal inspected Edinglassie and, Rouse Lench and related buildings to ensure properties were maintained to an acceptable standard.

Annual actions described in the Conservation Management Plan were undertaken such as pest control, ground maintenance, annual inspections, fire protection and check of sewerage system.

Following on from last year's major restoration work at Edinglassie, the top story has been refurbished including interior painting, new floor coverings and interior fittings.

6.8.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to European cultural heritage during the reporting period and there were no related reportable incidents.

6.8.4 Proposed Improvements

All heritage structures are planned to remain in situ during the next reporting period with no impacts predicted from the current mine plan. Inspections and maintenance measures will continue to be implemented during the next reporting period to conserve all historic homesteads and related buildings. MAC continues to invest in restoration of its heritage properties with large scale works being undertaken in the past year and planned into the next financial year.

6.9 Contaminated Land and Hydrocarbon Contamination

6.9.1 Environmental Management

Contaminated land at Mt Arthur Coal is managed in accordance with the following internal documents:

- MAC-ENC-PRO-029 Spill Response;
- MAC-ENC-PRO-074 Contaminated Land Management; and
- MAC-STE-PRO-013 Hazardous Materials Management Procedure.

Hydrocarbons and other hazardous substances are kept in designated storage compounds designed and managed in accordance with relevant standards and procedures. Monitoring and inspection programs are maintained for these facilities to ensure hazardous materials and wastes are being adequately stored and disposed of and that any spills or leaks are promptly reported and managed in line with site procedures.

Mt Arthur Coal successfully phased out PFAS firefighting foams in line with the requirements under the Protection of the Environment Operations (General) Amendment (PFAS Firefighting Foam) Regulation 2021. As part of the phase out, PFAS firefighting foams were registered as a banned substance from 26th September 2021 on the site register (MAC-STE-015-Restricted and Banned tools, Equipment and Activities).

6.9.2 Environmental Performance

During the reporting period, all spills were controlled and contained using emergency spill kits or earthmoving equipment to form a temporary bund. Spills were managed in line with site procedures.

6.9.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to contaminated land or hydrocarbon contamination during the reporting period and there were no related reportable incidents.

6.9.4 Proposed Improvements

Mt Arthur Coal continues to make improvements to the onsite contaminated site management area. Mt Arthur will continue to manage contaminated land and hydrocarbon contamination in accordance with legislative requirements.

6.10 Spontaneous Combustion

6.10.1 Environmental Management

Spontaneous combustion at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRG-002 Spontaneous Combustion Control Program.

Mt Arthur Coal has implemented a spontaneous combustion control program to prevent, monitor, control and report outbreaks of spontaneous combustion.

6.10.2 Environmental Performance

Spontaneous combustion at Mt Arthur Coal is predominantly confined to old mining areas at Bayswater No. 2 and the Drayton sublease area. This is a result of the higher levels of carbon and sulphuric material in the coal seams mined in these Greta measures in comparison to those mined in current active mining areas.

At the end of the reporting period, there was a total of 8365.3 m^2 of area affected by spontaneous combustion. This is an increase to the 7461.0 m^2 reported in FY22. A total of 11,340.4 m^2 of land was treated for spontaneous combustion in the reporting period which is higher than FY22 (2412.0 m^2). A summary of spontaneous combustion in the reporting period is shown in Table 30.

Table 30: Summary of spontaneous combustion at Mt Arthur Coal in FY23

Month	Total area affected at start of month (m^2):	Area naturally extinguished in month (m^2):	Area treated in month (m^2):	New areas discovered in month (m^2):	Total area remaining at end of month (m^2):
Jul-22	7461.3	0.0	225.1	269.5	7505.7
Aug-22	7505.7	0.0	68.7	0.0	7437.0
Sep-22	7437.0	0.0	0.0	429.3	7866.2
Oct-22	7866.2	0.0	77.9	34.4	7822.8
Nov-22	7822.8	0.0	156.7	1206.1	8872.2
Dec-22	8872.2	86.2	0.0	258.8	9044.8
Jan-23	9044.8	0.0	610.7	513.6	8947.6
Feb-23	8947.6	0.0	92.7	1608.1	10463.0
Mar-23	10463.0	0.0	246.1	108.6	10325.6
Apr-23	10325.6	0.0	320.1	724.7	10730.1
May-23	10730.1	0.0	0.0	7097.6	17827.7
Jun-23	17827.7	0.0	9542.4	79.9	8365.3
Total		86.2	11340.4	12330.6	

6.10.3 Complaints and Reportable Incidents

During the reporting period there was one complaint related to spontaneous combustion which is an increase from FY22 (no complaints received). The complaint is discussed further in Section 9.

Mt Arthur Coal did not receive any government fines or penalties related to spontaneous combustion during the reporting period.

6.10.4 Proposed Improvements

Mt Arthur Coal will continue to monitor spontaneous combustion during the next reporting period, and cap readily accessible areas.

6.11 Bushfire

6.11.1 Environmental Management and Performance

Bushfire at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-076 Bushfire Prevention Procedure (internal document); and
- MAC-STE-PRO-010 Emergency Procedure – Bushfires (internal document).

Specific prevention and fire suppression control measures are implemented in order to protect remnant vegetation communities as well as Mt Arthur Coal infrastructure. Preventative measures include fuel load assessment and reduction programs, the establishment and maintenance of fire breaks and the prevention of ignition sources. Fire suppression and control is achieved through on-site fire-fighting equipment, including a rescue truck and water carts, facilitated by a network of roads and vehicle access trails, which provide access to all areas of Mt Arthur Coal owned land. Mt Arthur Coal also maintained a trained emergency response team on each shift. Fire extinguishers are fitted in vehicles and buildings.

No major grass or bushfires occurred on site or at the conservation or offset areas during the reporting period.

6.11.2 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to bushfire during the reporting period and there were no related reportable incidents.

6.11.3 Proposed Improvements

During the next reporting period Mt Arthur Coal will continue to manage bushfire risk in accordance with relevant procedures.

6.12 Greenhouse Gas and Energy

6.12.1 Environmental Management

Greenhouse gas and energy at Mt Arthur Coal are managed in accordance with the MAC-ENC-MTP-040 Air Quality Management Plan.

Mt Arthur Coal undertakes regular reviews and monitoring of greenhouse gas emissions and energy efficiency initiatives to ensure that greenhouse gas emissions per tonne of product coal are kept to the minimum practicable level. During the reporting period Mt Arthur Coal continued greenhouse gas and energy consumption monitoring with the use of a centralised database to assist with monthly tracking and reporting of key emission sources. A key focus during the reporting period was to ensure the operation complied with the regulations under the *National Greenhouse and Energy Reporting* (NGER) *Act 2007*.

6.12.2 Environmental Performance

Total emissions were 602 kt CO2-e in the FY23 reporting period, of which direct (scope 1) emissions accounted for 88 per cent, and scope 2 emissions from the use of grid-based electricity accounted for the remaining 12 per cent. As in the previous reporting period, Mt Arthur Coal used NGER Method 2 measurement of its open fugitive emissions, which reduced slightly in absolute terms (to 36 kt CO2-e) and as a proportion of total scope 1 emissions (7 per cent). Nevertheless, fugitive emissions are expected to increase over time as mining progresses into areas with higher in-situ methane contents.

Fuel combustion will continue to constitute the bulk of emissions from Mt Arthur Coal, accounting for 93 per cent of scope 1 emissions and 82 per cent of total emissions in the reporting period. Energy use was similarly dominated by diesel fuel (94 per cent), with other fuels accounting for just under two per cent and electricity making up the balance.

6.12.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to greenhouse gas or energy during the reporting period and there were no related reportable incidents.

6.12.4 Proposed Improvements

BHP is committed to reducing its operational emissions globally. The company has set a medium-term goal to reduce its operational emissions by at least 30% by 2030 on the way towards its longer-term commitment to achieve net-zero operational GHG emissions by 2050, consistent with the Paris Agreement. Mt Arthur Coal will continue to investigate and, where feasible, implement projects to reduce fossil fuel energy consumption and greenhouse gas emissions in accordance with BHP's sustainability commitments, including the company's greenhouse gas emission targets.

6.13 Waste Management

6.13.1 Environmental Management

Waste at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-033 Waste Handling and Disposal (internal document).

6.13.2 Environmental Performance

During the reporting period, Mt Arthur Coal's activities generated approximately 8,442 tonnes of both recycled and non-recycled waste that was sent off-site for management. This an increase of approximately 8% per cent from the FY22 total of 7,815 tonnes. During the reporting period, approximately 85% (7,148 tonnes) of the total waste produced and sent off site for management was recycled. This is an increase from the FY22 percentage of 82% (6,378 tonnes) that was recycled off-site. Waste disposal amounts for the reporting period are shown in Figure 4 below.

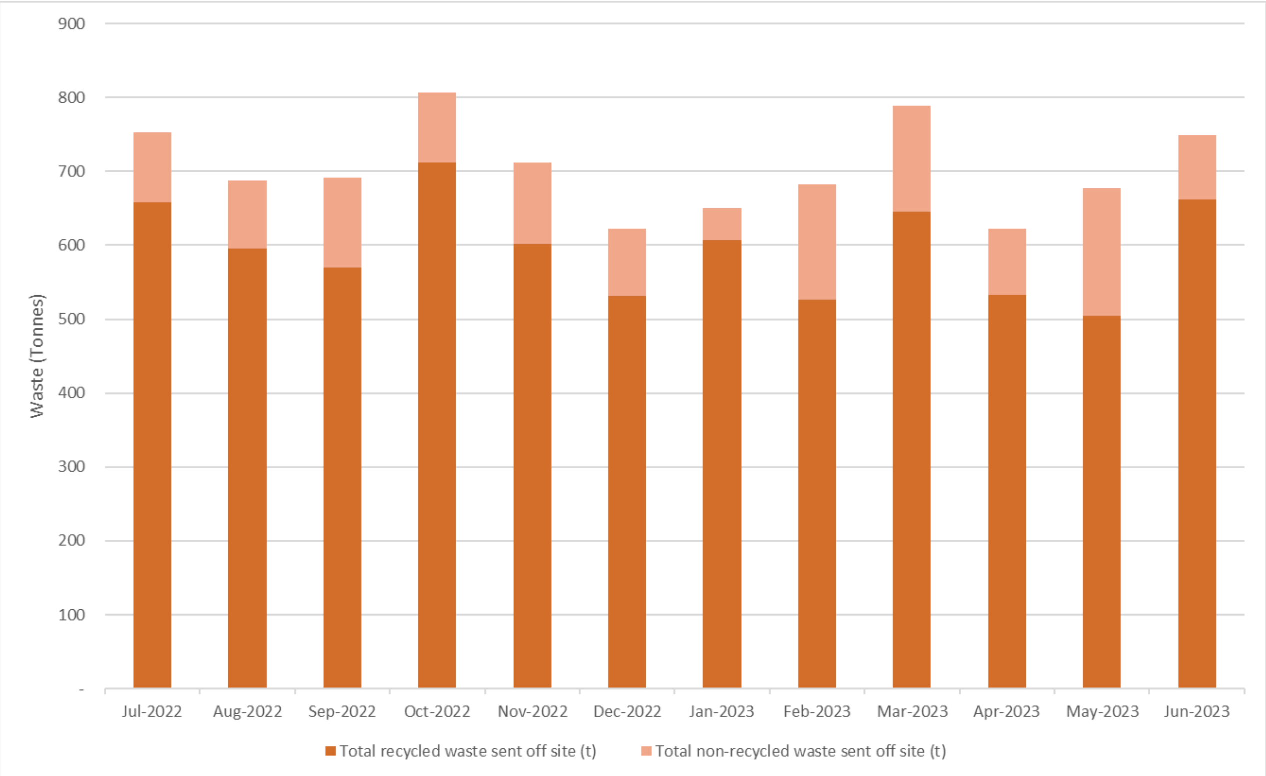


Figure 4: Waste disposal from Mt Arthur Coal FY23

6.13.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to waste during the reporting period and there were no related reportable incidents.

6.13.4 Proposed Improvements

During the next reporting period Mt Arthur Coal will continue to manage waste in accordance with relevant procedures.

6.14 Public Safety

6.14.1 Environmental Management / Performance

During the reporting period Mt Arthur Coal maintained a boundary security fence around much of the perimeter of its site to ensure no unauthorised access to mining areas. A number of boom gates also exist to restrict unauthorised or unintentional access to the active mining and infrastructure areas. Routine patrols of these boundaries and access points are conducted through the engagement of third-party security specialists and by internal statutory compliance personnel with no identified security or access breaches occurring during the reporting period.

During the reporting period Mt Arthur Coal maintained a permanent emergency response team consisting of BHP Emergency Services Officers and Paramedics. These personnel, along with the existing emergency response team, provide a professional emergency response service to site. The team are dedicated to ongoing continuous improvement, standardisation, and preventative work. An audit of the site perimeter fence was completed by the Environment Team in FY23 with new locks and signage installed.

6.14.2 Complaints and Reportable Incidents

Mt Arthur Coal did not receive any complaints, government fines or penalties related to public safety during the reporting period and there were no related reportable public safety incidents.

6.14.3 Proposed Improvements

Mt Arthur Coal will continue to maintain and monitor site security and ensure public safety during the next reporting period.

7 Water Management

Water at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-034 Site Water Management Plan (WMP);
- MAC-ENC-PRO-060 Erosion and Sediment Control Plan;

- MAC-ENC-PRO-084 Water Monitoring Procedure (internal document); and
- MAC-ENC-PRO-032 Water Management (internal document).

7.1 Water Balance

7.1.1 Environmental Management / Performance

Mt Arthur Coal maintains a site water balance model incorporating surface and groundwater inputs and outputs. The model is used to interpret current conditions and forecast future mine water inventories and use. The model build generally aligns to the Minerals Council of Australia Water Accounting Framework.

Mt Arthur Coal discharges water into the Hunter River from its licensed discharge point under the Hunter River Salinity Trading Scheme (HRSTS). There was 2,644.69ML of water discharged during FY23 under the HRSTS.

Water use totaled 9850ML during the reporting period. The use is a total of model outputs including evaporation, product entrainment and task loss. This is an increase in water usage compared to the 8,597ML reported in FY22. Review of consumption throughout the reporting period has established that the increase is not attributable to an actual increase in the physical consumption of water but rather improvements in the monitoring and modeling of water at Mt Arthur. During the reporting period a major update of the site water model was undertaken, this led to significant improvements to both the Goldsim model used for surface water modeling and improvement in the accuracy of water data. This has been completed as part of the ongoing improvement program for Water Accounting and is Audited annually as part of the BHP Sustainability reporting assurance program.

The largest input to site is typically rainfall as outlined in the modification project environmental assessment.

Mt Arthur Coal did not extract any water from the Hunter River under water extraction licence, shown in Table 31.

Mt Arthur Coal continued to source water from the Muswellbrook Shire Council treated effluent scheme to reduce the demand from other external sources, 868ML of recycled effluent was brought onto site for reuse in site operations.

Table 31: Water take for FY23

Water Licence number	Water sharing plan, source and management zone	Entitlement (Unit Shares)	Passive take / inflows (ML)	Active pumping (ML)	Total (ML)
WAL 917 20AL201126	Hunter Regulated River Water Source (High Security), Zone 1A Management Zone	2,197	-	0	0
WAL 918 20AL201127	Hunter Regulated River Water Source (General Security), Zone 1A Management Zone	3,564	-	0	0
WAL 1296	Hunter Regulated River Water Source (Supplementary), Zone 1A Management Zone	301	-	0	0
WAL 18141	Hunter Regulated River Alluvial Water Source, U/S Glennies Creek Management Zone	104	50*	-	50*
WAL 18247	Hunter Regulated River Alluvial Water Source, U/S Glennies Creek Management Zone	247	191*	-	191*
WAL 41495	Sydney Basin-North Coast Groundwater Source	750	750^	-	750^
WAL 41556	Sydney Basin-North Coast Groundwater Source	250	58^	-	58^

* Alluvial inflow has been calculated, based on predicted flux to and from alluvium (ML/day) as reported in the EIS, to be a total of 241 ML, which has been allocated across the two alluvial licences.

^ Groundwater seepage has been calculated, based on predicated average inflow to the pits (ML/day) as reported in the EIS, to be a total of 808 ML, which has been allocated across the two groundwater licences.

7.1.2 Proposed Improvements

Mt Arthur Coal will continue to use site water collected in both in-pit and out-of-pit storages prior to the use of water from the Hunter River. Where plans indicate that there would be sufficient water stored on site, water allocations for the Hunter River will continue to be offered to leaseholders and near neighbours as a temporary transfer.

In the coming year an additional 10 water meters will be added to the sites water network, these will improve the understanding of water movement on site and consumption. The data will improve water model accuracy and allow for improved planning strategies and efficiencies in the water management system.

During the FY23 and FY24 period Mt Arthur is undertaking major infrastructure improvement projects for the water management network. The expansion of the water management network will provide improved connectivity of water storages, active mining areas and infrastructure across the site. The improvements will allow more effective operation in all weather extremes from flood to drought. Increasing the ability to reuse water stored onsite leading to reduction in reliance on the Hunter River licence intake, reducing compliance risks and also improve pit dewatering activities enabling more efficient mining activities. As part of the water management network improvement program, during FY23 period Mt Arthur Coal has installed approximately 20km of pipelines and associated pumps and is planning to install an additional 14km of pipeline and associated pumps in FY24.

7.2 Erosion and Sediment

7.2.1 Environmental Management

Erosion and sediment at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-PRO-060 Erosion and Sediment Control Plan;
- MAC-ENC-MTP 034 Site Water Management Plan

7.2.2 Environmental Performance

Total suspended solids (TSS) results remained low during the reporting period at the majority of statutory sites. The TSS results were mostly consistent compared with results from previous financial years. TSS results are summarised in Table 33, with further results presented in Appendix 1 - Surface Water Quality Monitoring Results. Water management structures were also routinely inspected after rain events > 25mm and maintained to ensure they are performing to design and prevent impacts on downstream waters.

In December 2022 the annual monitoring of riparian vegetation was undertaken as part of the annual riparian vegetation and channel stability assessment, in accordance with the Water Management Plan. The riparian vegetation and channel stability assessment methodology was reviewed to attempt to provide further guidance and improve on the assessment methodology. A new methodology adopted was the Rapid Appraisal of Riparian Condition methodology (RARC) to integrate geophysical and biological values to allow a reliable estimation of the ecological condition in the riparian ecosystems and the CSIRO Ephemeral Stream Assessment methodology to assess the channel stability of the creeks and to enable comparison with previous stability assessments.

RARC Methodology

The RARC method is composed of five sub-indices, each with several indicator variables as follows:

- Habitat continuity and extent
- Vegetation and structural complexity
- Native vegetation dominance versus exotics
- Standing dead trees, leaf litter, fallen logs
- Indicative features like native vegetation regeneration and presence of native tussock grasses and reeds

These indicator values are recorded along a transect at predetermined sites using the RARC site assessment sheet proposed by Jansen et al. (2005). The indicator values are tallied to provide a score indicating riparian health. These scores enable the ranking of each site from either 'Very Poor' through to 'Excellent'. The collected information is useful to compare this total score over time to see how the biodiversity and functionality of the riparian zone is progressing at each of the transects.

CSIRO Methodology

The CSIRO assessment uses four main classes of indicators to evaluate the condition of the stream bed and banks:

- The type and condition of the vegetation present, if any;
- The shape and profile of the drainage line and type of materials on the drainage line floor;
- The nature of the drainage line wall materials; and

- The nature of the stream bank bordering flats and/or slopes and regulation of lateral flow into the drainage line.

The indicators produce a rating based on a scoring system, and the combined total of the indicators rank each location from very actively eroding through to very stable.

The assessment was completed on the four areas as per previous years (SW03, SW04, SW12 and SW15) and was split up into 30 sites along the transect to allow for more accurate monitoring across the transect. Refer to Figure 5 below for the site locations.

Table 32 below outlines the results of the RARC and CSIRO assessments for each Creek within the assessment.

Table 32: Riparian vegetation assessment – FY23 RARC and CSIRO Assessment Results

Site	SW03 (Saddlers Creek)	SW04 (Quarry Creek)	SW12 (Ramrod Creek)	SW15 (White's Creek Diversion)
RARC Assessment Score	2 / 12 sites – average 5 / 12 sites – poor 5 / 12 sites – very poor	7 / 7 sites – very poor	2 / 7 sites – poor 5 / 7 sites – very poor	4 / 4 sites – poor
CSIRO Assessment Score	7 / 12 sites – potentially stabilising 4 / 12 sites – stable 1 / 12 sites – very stable	1 / 7 sites – active 3 / 7 sites – potentially stabilising 2 / 7 sites – stable 1 / 7 sites – very stable	3 / 7 sites – potentially stabilising 2 / 7 sites – stable 2 / 7 sites – very stable	2 / 4 sites – stable 2 / 4 sites – very stable
Recommendations	Consider traversing QC4 to QC6 prior to 2023 monitoring round to review condition of key active erosion sites identified. If repairs seem necessary at any sites, MAC should action restoration works. Consider installing fencing along the riparian zone to exclude grazing cattle. Include treatment of priority weeds in future land management work.	Revegetation program to increase native vegetation canopy and midstory cover. Include treatment of priority weeds in future land management work.	Consider examining creek sections from SC1 to SC6 prior to 2023 monitoring round for ongoing/developing erosion. If repairs seem necessary at any sites, MAC should action restoration works. Include treatment of priority weeds in future land management work.	Include treatment of priority weeds in future land management work.

The application of the RARC method to streams within the study area shows the condition of the streams to ranged from "average" to "very poor" condition. Most streams that recorded scores of "average" were in areas where minimal disturbance has occurred and generally in areas close or connected to larger patches of native vegetation with wider canopy widths. Those sites that recorded scores of "very poor" or "poor" were consistent with areas where creek diversion works have occurred or areas where the riparian vegetation had been cleared for past and current grazing practices. Such low condition scores are not unexpected given the land use history within the study area, which has included a range of historic agricultural practices and, more recently, mining.

The CSIRO ratings for the 30 monitoring locations along the creeks ranged from 'active' to 'very stable'. In summary, the initial condition assessment showed:

- Quarry Creek consists of stable or potentially stabilising monitoring sites, with exception of QC2. Actively eroding channel walls are apparent at/near QC2, and multiple locations between monitoring points along Quarry Creek are noted as active erosion sites.
- Ramrod Creek has generally good channel stability and only a handful of locations between monitoring sites were identified for continued monitoring.

- Saddlers Creek channel condition differs markedly upstream and downstream along the monitored section. The majority of the downstream section is in stable condition, whereas upstream Saddlers Creek contains an array of actively eroding locations (between monitoring points).
- Whites Creek diversion channel condition appears excellent with little to no erosion was observed at or between monitoring sites.

Weed management practices at MAC will continue to be reviewed to ensure that the presence of priority weed species do not continue to have a negative effect on the overall condition of riparian areas and stream health.

Stream health and channel stability monitoring at MAC will continue in 2023 adopting the new monitoring methodology to allow identification of any channel degradation, and any necessary response actions to ensure the integrity of watercourses around site.

No active remediation or treatment was recommended except for control of priority weeds in future land management work, review revegetation programs to increase vegetation in Ramrod Creek, and considering the exclusion of stock on lands owned by Mt Arthur Coal.

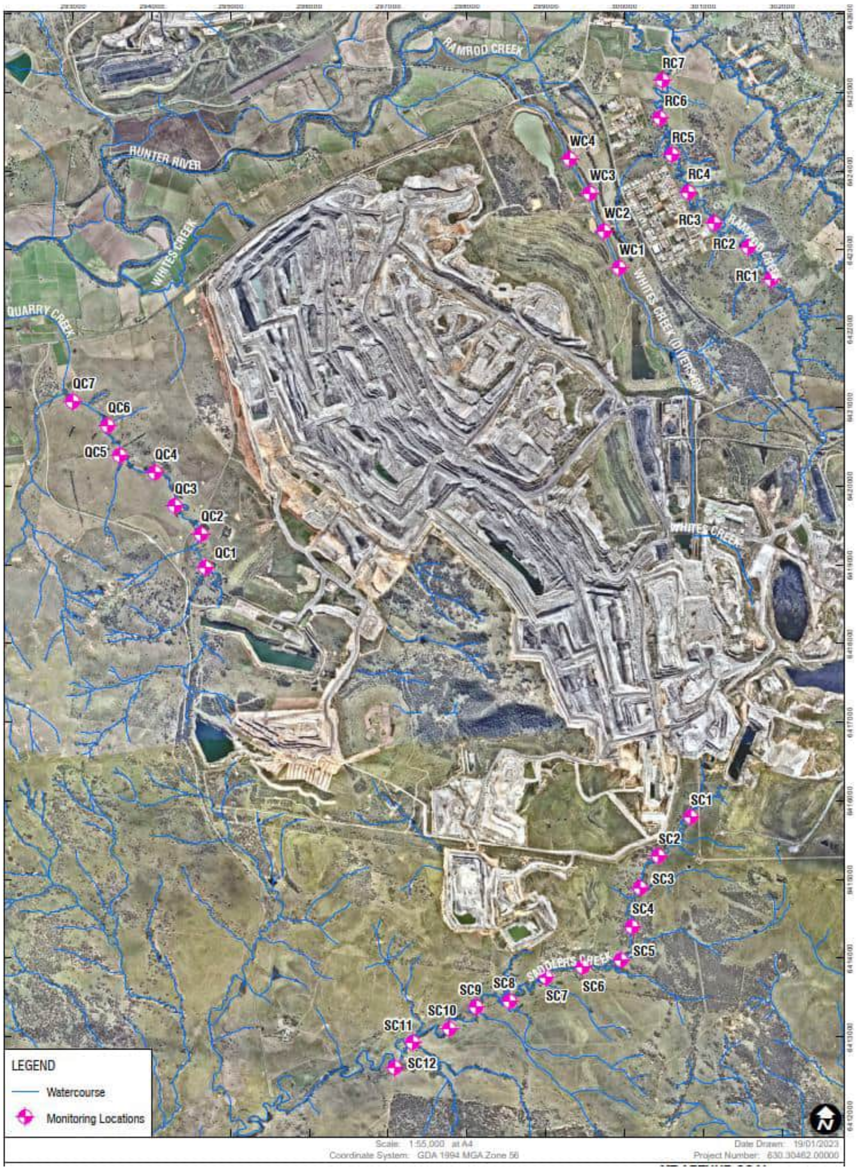


Figure 5 Riparian Vegetation and Channel Stability Monitoring Locations

7.2.3 Complaints and Reportable Incidents

Mt Arthur Coal did not record any erosion or sediment control complaints or incidents during the reporting period.

7.2.4 Proposed Improvements

Improvements that occurred during the reporting period include:

- Adopted new improved methodology for Riparian Vegetation and Channel Stability monitoring to provide a step change in monitoring data quality.
- Completed a review of the MAC catchment to ensure adequate sediment controls are in place.
- Completed a catchment review and assessments of the VD5 area and Denman Rd sediment Dams.
- Completed clean out of key sediment dams.

In the next reporting period inspections will continued to be completed of sediment dams post storm events to ensure appropriate management and pump out strategies are in place and erosion and sediment controls will be implemented as part of the Permit to Disturb process and inspected on an as needed basis.

7.3 Surface Water

7.3.1 Environmental Management

Surface water at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-034 Site Water Management Plan (WMP);
- MAC-ENC-PRO-084 Water Monitoring Procedure (internal document); and
- MAC-ENC-PRO-032 Water Management (internal document).

The MAC-ENC-MTP-034 Site Water Management Plan (WMP) was revised during the reporting period, approved by DPE on 29 March 2023. The revised WMP incorporates the site water management documents referenced above into a single consolidated WMP and includes revised trigger levels for groundwater and surface water sites based developed by specialist independent third parties.

Water quality downstream of Mt Arthur Coal's operation is currently monitored by an independent consultant at six statutory monitoring sites, plus Mt Arthur Coal's licensed discharge point as well as one upstream monitoring site in the Hunter River.

Mt Arthur Coal's WMP outlines measures for managing water on site, while the Surface Water Monitoring Program establishes impact assessment criteria against which monitoring results are compared. Impact assessment criteria are presented as trigger values which, if exceeded, lead to a response such as more intensive monitoring, investigation and if required, remedial action.

Mt Arthur has just completed a Pollution Reduction Program as required by EPL 11457. The Program was focussed on reducing risk of offsite water discharge by realigning and improving mine water pipelines.

7.3.2 Environmental Performance

A summary of the surface water quality data for statutory sites during the reporting period is provided in Table 33, with further results provided in Appendix 1 - Surface Water Quality Monitoring Results.

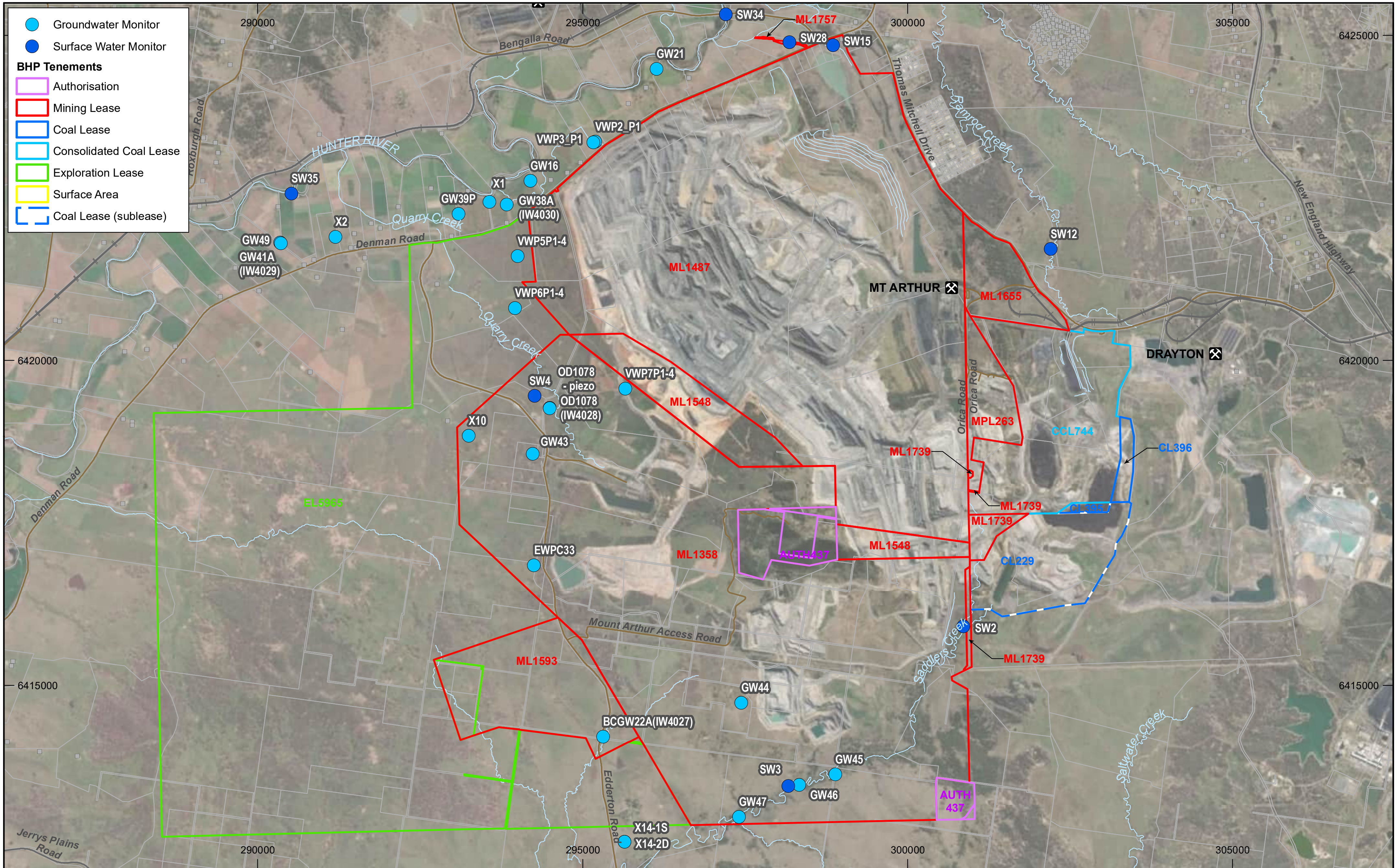
Water quality parameters in natural watercourses surrounding the mine including Saddlers Creek (SW02 and SW03), Quarry Creek (SW04), Ramrod Creek (SW12) and Whites Creek (SW15) were subject to normal variations in response to the ephemeral nature of the creeks, local geology and weather conditions. Water quality parameters are recorded at the HRSTS discharge point (SW28) during an active discharge.

HRSTS discharges occurred during the reporting period throughout July – November 2023. A total of 2,644.69ML was discharged from site in accordance with the Hunter River Salinity Trading Scheme Regulations with reports provided to the EPA as required.

Surface water pH measured at individual statutory sites remained relatively constant during the reporting period and within the impact assessment trigger levels of 6.5-9.0 at all times. Surface water EC measured at individual statutory sites remained below impact assessment trigger levels during the reporting period with the exception of SW12 which recorded elevated results in April 2023 and SW35 which recorded elevated results in April and May 2023, the results from both sites were triggers of the Stage 1 criteria, therefore did not trigger an investigation as per the Surface Water and Groundwater Response Plan in the WMP. Both sites then recorded EC values below the criteria the following month. Surface water TSS measured at individual statutory sites remained below trigger levels during the reporting period with the exception of SW04 which exceeded the Stage 2 trigger in November 2022, this did not trigger the reporting protocol in the Surface Water and Groundwater Response Plan. Results are summarised in Table 33.

SW02 was dry for ten months and had restricted access due to heavy rainfall for two months. SW03 access was restricted due to heavy rainfall for three months. SW15 was too low to sample for three months and dry for three months.

Surface water monitoring locations are shown in Figure 6.



Geospatial Team
Brisbane

0 1,000 2,000 m

Transverse Mercator Projection
GDA 1994 MGA Zone 56

MT. ARTHUR MINE
Surface Water and Groundwater
Monitoring Locations

Drawn: B. Lang	Date: 13/01/2023	Revision: 1
Checked: C. Christensen	Filename: 20230113-1.mxd	

Table 33: Summary of statutory surface water quality monitoring results

Site	Impact Assessment Criteria Trigger Values			Monitoring Results			Trend/ key management implications
				min	ave	max	
SW02	pH	6.5 – 9.0		-	-	-	No assessment criteria triggered. Dry during the reporting period
	EC (µS/cm)	Stage 1	12,365	-	-	-	
		Stage 2	13,900				
	TSS (mg/L)	Stage 1	219	-	-	-	
		Stage 2	277				
SW03	pH	6.5 – 9.0		7.55	7.73	8.02	No assessment criteria triggered
	EC (µS/cm)	Stage 1	10,133	1,591	7,503	9,020	
		Stage 2	11,402				
	TSS (mg/L)	Stage 1	37	<5	8	20	
		Stage 2	46				
SW04	pH	6.5 – 9.0		7.51	7.91	8.15	No assessment criteria triggered
	EC (µS/cm)	Stage 1	13,959	258	6,441	8,660	
		Stage 2	15,509				
	TSS (mg/L)	Stage 1	82	<5	19	127*	Stage 2 assessment criteria triggered in November 2022. No report to DPE required. See note below.
		Stage 2	104				
SW12	pH	6.5 – 9.0		7.57	7.92	8.46	No assessment criteria triggered
	EC (µS/cm)	Stage 1	6,659	1,086	4,454	7,120	Stage 1 assessment criteria triggered in April 2023. First stage 1 trigger, no report to DPE required.
		Stage 2	7,153				
	TSS (mg/L)	Stage 1	555	<5	16	45	No assessment criteria triggered
		Stage 2	708				
SW15	pH	6.5 – 9.0		7.48	7.88	8.21	No assessment criteria triggered
	EC (µS/cm)	Stage 1	7,128	442	984	2,347	
		Stage 2	8,262				
	TSS (mg/L)	Stage 1	103	<5	19	70	
		Stage 2	130				
SW34	pH	N/A		7.97	8.09	8.27	No assessment criteria triggered
	EC (µS/cm)	N/A		512	955	1,212	
	TSS (mg/L)	N/A		16	18	22	
SW35	pH	7.8 – 8.5		8.18	8.26	8.33	No assessment criteria triggered
	EC (µS/cm)	Stage 1	893	497	963	1,250	Stage 1 assessment criteria was triggered in April and May. Two stage 1 triggers, no report to DPE required.
	TSS (mg/L)	Stage 1	54	17	20	24	No assessment criteria triggered

*TSS exceeded the trigger level in November 2022 at SW04 however the version of the Surface and Groundwater Response Plan (2021 WMP) that was in place at the time did not include requirement to report any TSS exceedances. This has been updated in the new WMP with TSS triggers included in the Response Plan (2023 WMP)

7.3.3 Complaints and Reportable Incidents

Mt Arthur Coal did not receive complaints relating to surface water during the reporting period.

Mt Arthur Coal recorded two communication errors during an active discharge during the reporting period, further information can be found in Section 11.

7.3.4 Proposed Improvements

Mt Arthur Coal will continue to implement the PRP as required in EPL 11457.

Mt Arthur Coal will continue to use site water collected in both in-pit and out-of-pit storages prior to the use of water from the Hunter River.

7.4 Ground Water

7.4.1 Environmental Management

Groundwater at Mt Arthur Coal is managed in accordance with:

- MAC-ENC-MTP-034 Site Water Management Plan; and
- MAC-ENC-PRO-084 Water Monitoring Procedure

The MAC-ENC-MTP-034 Site Water Management Plan (WMP) was revised during the reporting period, approved by DPE on 29 March 2023. The revised WMP incorporates the site water management documents referenced above into a single consolidated WMP and includes revised trigger levels for groundwater and surface water sites based developed by specialist independent third parties.

The (WMP) aims to minimise any adverse impacts on aquifers in proximity to the operation, including the two major aquifer areas, the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River.

The WMP includes a Groundwater Monitoring Program, in accordance with Schedule 3 Condition 29 and 33 of Development Consent 09_0062. The Groundwater Monitoring Program outlined in Section 9.3 of the WMP details the monitoring methodology, monitoring locations, frequency impact assessment criteria (water levels and quality), mine inflows/licensing, impacts to private bores and groundwater dependent ecosystems (GDEs), cut-off wall and flood levee monitoring and monitoring records.

7.4.2 Environmental Performance

A groundwater review was undertaken by an external specialist consultant for the reporting period. The scope of work included:

- Comparison between modelled and observed water levels to June 2023;
- Compare monitoring data to drawdown predictions for the Mt Arthur Coal Consolidation Project Environmental Assessment and the current modelling for the approved operations;
- Review site water quality monitoring data, field reports and laboratory reports and check performance;
- Review of groundwater triggers and report on any trigger exceedances, where review will be based on both the current established groundwater triggers for the site; and
- Review performance of the cut-off wall using available data.

The full Annual Groundwater assessment report is included as Appendix 2.

Drawdown performance

There has generally been a negligible change in water levels within the Hunter River alluvium, as shown in Figure 4.1 of Appendix 2. However, the change in total drawdown did vary spatially, with bores GW16 and GW21 recording a minor decline in levels, while bores further to the west (GW38A (IW4030), GW41A (IW4029), X1MB and X2MB) recorded a slight increase in water levels. However, it should be noted that the total drawdown recorded in bores GW16 and GW21 covers a much larger time frame (24 years) compared to bores GW38A (IW4030) and GW41A (IW4029) (seven years) and X1MB and X2MB (three years). The amount of drawdown recorded is in line with climatic variations.

Groundwater levels in the alluvial bores along Saddlers Creek have fluctuated over time, potentially in response to rainfall trends, with an overall increasing trend in groundwater levels since the end of 2020. However, since monitoring began in 2016 there has been an overall minor decline in water levels (drawdown) within the Saddlers

Creek alluvium (Figure 4.1) but less than predicted by the 2020 groundwater model. Total drawdown varied spatially, with bore GW45, located in the upper reaches of Saddlers Creek, recording the most drawdown in the Saddlers Creek alluvium. The model predicted drawdown for of 2.41 m between 2016 and 2023 for GW45; however, the total measured drawdown over the same period was 0.99 m. Therefore, the model predicted more drawdown than has occurred. The total drawdown between July 2022 and June 2023 was 0.15 m, with levels fluctuating slightly in response to climatic conditions.

There has been a decline in groundwater levels within the Saddlers Creek shallow Permian (regolith), as shown in Figure 4.2 of Appendix 2. Bore X14MB-1S, located to the north of Saddlers Creek, recorded the most drawdown. In comparison, deeper paired bore X14MB-2D screened within the Glen Munro Seam, recorded an increase in water levels (i.e., no drawdown). Figure 4.3 of Appendix 2 shows a general decline in groundwater levels within the Permian coal measures to the southwest of open cut operations, showing a response to the progression of mining to the southwest. However, in-pit water storage (Belmont, McDonalds and Saddlers pits) potentially buffers the extent of drawdown in localised areas.

To monitor drawdown within the Hunter River alluvium, VWPs were installed near the cut-off wall to monitor the Permian coal measures underlying the Hunter River alluvium. The VWP sensors monitor:

- VWP1 - Edinglassie Seam (footwall) at 204.5 m depth (-69.0 mAHD) (decommissioned in 2020)
- VWP2 - F4 fault at 216.5 m depth (-81.1 mAHD)
- VWP3 - Sensor 1 - Edinglassie Seam (hanging wall) at 227.0m depth (-91.6 mAHD)
- VWP3 - Sensor 2 - Ramrod Creek Seam at 241 m depth (-105.6 mAHD).

Exceedances relating to the VWPs are included in the Groundwater Level section below and further expanded upon in Appendix 2 Ground Water Monitoring Results and Groundwater Level Drawdown Analysis .

Groundwater Level

Groundwater level data collected over the reporting period have been compared to the trigger values outlined in the WMP. Over the monitoring period bores BCGW18, GW44 and VWPs VWP04 (Vaux, Bayswater, Edderton, Edinglassie and Ramrod Creek seams), VWP06 (Edinglassie Seam) and VWP07 (Piercefield Seam) recorded groundwater level exceedances between July 2022 and March 2023, when compared to trigger levels detailed in the 2021 WMP. There were no water level trigger exceedances recorded in June 2023, when compared to trigger levels detailed in the 2023 WMP. VWPs VWP07 (Ramrod Creek Seam) and X1 (Interburden and Mt Arthur Seam) also recorded water levels below the new trigger levels detailed in the 2023 WMP but have only been below the trigger level for one monitoring round and therefore do not constitute an exceedance. A summary of the exceedances is presented in Table 34.

Table 34: Groundwater Level Trigger Exceedances

Bore ID	Exceedance	Screened Lithology and Location	Comment	Action
BCGW18	Nine water level readings below trigger of 147.3 mAHD between March 2021 and March 2023	Arrowfield Seam On site – west of MAC	The purpose of bore BCGW18 is monitoring of the Arrowfield Seam, close to an old channel of Quarry Creek, and to monitor the impact of mining activities adjacent to mining areas to the west of MAC. The bore is located within 1 km of the open cut pit and close to an old channel of Quarry Creek and west of MAC open cut (Huon Pit).	Water level readings exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The bore was removed from the revised WMP approved by DPE at the end of March 2023.

Bore ID	Exceedance	Screened Lithology and Location	Comment	Action
			Groundwater levels in bore BCGW18 have gradually declined since October 2012 and has been recorded as dry and below the trigger level of 147.3 mAHD, since March 2021. Comparison between modelled and observed water levels (refer Figure 4.4) indicates that depressurisation of the coal seam was predicted at BCGW18.	
GW44	Ten water level readings below trigger level of 99.9 mAHD between December 2020 and March 2023	Woodlands Hill Seam On site – west of Saddlers Pit South	The purpose of bore GW44 is monitoring of groundwater response in the Woodlands Hill Seam to mining. The bore is located 200 m west of Saddlers Pit. The 2020 network review (Umwelt, 2021) recommended that GW44 be used for water level monitoring only as sampling is difficult due to the depth of the bore (133 m). Groundwater levels in GW44 have gradually declined since July 2018, declining below the water level trigger of 99.9 mAHD from December 2020 onwards. Comparison between modelled and observed water levels (refer Appendix 2 Figure 4.5) indicates that depressurisation of the coal seam was predicted at GW44. However, the model shows a delay in the timing compared to the observed data. This may relate to timing within the model drain package.	Water level readings exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates depressurisation of the coal seam was predicted in this area; however, there is a difference in the timing that may relate to how the model drain package represents actual mine progression at site. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.
VWP04	Pressure levels below trigger levels of: 42.2 mAHD (Vaux) 37.3 mAHD (Bayswater) 22.0 mAHD (Edderton) -7.5 mAHD (Edinglassie) -12.6 mAHD (Ramrod)	Vaux Seam Bayswater Seam Edderton Seam Edinglassie Seam Ramrod Creek Seam On site - immediately west of MAC open pit (Windmill Pit)	Levels in the Vaux, Bayswater, Edderton, Edinglassie, and Ramrod Creek seams have exceeded the trigger levels since October 2020 (refer Appendix 2 Figure 4.6). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). The VWP is located approximately 90 m from active mining. The model predicted greater drawdown than observed (refer Appendix 2 Figure 4.7).	Water level readings exceeded the trigger threshold and DPE were notified in December 2022. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The VWP was removed from the revised WMP which was approved by DPE at the end of March 2023.

Bore ID	Exceedance	Screened Lithology and Location	Comment	Action
	in all coal seams monitored since October 2020			
VWP06	Pressure levels below trigger level of: 58.1 mAHD in the Edinglassie Seam between June 2022 and March 2023	Edinglassie Seam On site - west of MAC open pit (Windmill Pit)	Levels in the Edinglassie Seam have exceeded the trigger level since June 2022 (refer Appendix 2 Figure 4.8). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). SLR (2020a) predicted continued drawdown in this area with simulated water levels in all seams (refer Appendix 2 Figure 4.9). The model predicted slightly higher starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Water level readings have exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.
VWP07	Pressure levels below trigger level of 94.5 mAHD between October 2021 and March 2023	Piercefield Seam On site - west of MAC open pit (Windmill Pit)	Levels in the Piercefield Seam have exceeded the trigger level since October 2021 (refer Appendix 2 Figure 4.10). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). SLR (2020a) predicted continued drawdown in this area with simulated water levels in all seams (refer Appendix 2 Figure 4.11). The model predicted slightly lower starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Water level readings have exceeded the trigger threshold and DPE were notified in February 2023. Water level readings exceeded the trigger threshold again in March 2023; however, DPE were not notified previously as the data was not downloaded in Q3 due to access issues. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.

Groundwater Quality

Bores X10MB and X14MB-2D recorded pH readings in June 2023 above the upper pH trigger level specified in the revised WMP (BHP, 2023). However, they are not consecutive readings and are therefore not considered an exceedance. During the reporting period, bores BCGW22P (IW4026) and GW45 recorded three consecutive readings above the upper pH trigger level and bore GW43 recorded three consecutive readings above the Stage 1 EC trigger level, constituting reportable exceedances.

An analysis of the trigger exceedances for the three bores is summarised in Table 35.

Trigger exceedances have been reviewed by comparing groundwater levels and climate indicated by the cumulative rainfall departure plot. Graphs of pH and EC for all monitoring bores are presented in Appendix 2.

Table 35: Groundwater Quality Trigger Exceedances

Bore ID	Exceedance	Screened Lithology and Location	Comment	Action
BCGW22P (IW4026)	Four pH readings above the trigger level of 9.9 between June 2022 and March 2023	Glen Munro Seam/Interburden On site – southwest of McDonalds Pit and north of Saddlers Creek	pH has an increasing trend, ranging from 11.84 to 12.08 between June 2022 and June 2023 (refer Appendix 2 Figure 5.1). Following the recommendations in the 2021 Annual Review, an investigation was undertaken during the 2022 reporting period which determined that the slow recovery of groundwater and unique water quality results indicate the bore is not screened within the coal seam but within a low permeability interburden unit. The investigation recommended that BCGW22P (IW4026) be maintained for monitoring groundwater levels but removed from the WMP as a compliance bore.	Already removed as a compliance monitoring bore in the revised WMP, as previously recommended, but water levels should continue to be monitored for future closure planning. The revised WMP was approved by DPE at the end of March 2023.
GW43	Three EC readings above the Stage 1 trigger level of 4,400 µS/cm between June and December 2022	Woodlands Hill Seam On site – northwest of Belmont Pit	The purpose of bore GW43 is to assess vertical hydraulic gradient of Permian coal measures (Woodlands Hill Seam), and the impact of mining activities adjacent to mining areas to the west of MAC. The EC in bore GW43 ranged from 3,900 µS/cm in December 2016 peaking at 5,210 µS/cm in September 2021 (refer Appendix 2 Figure 5.2). Levels have remained stable between December 2021 and December 2022 fluctuating between 4,120 µS/cm and 4,460 µS/cm. EC levels declined to 4,240 µS/cm by June 2023. The initial review of the trigger exceedance in bore GW43 indicated that EC exceeded the first stage trigger level on three consecutive occasions; however, they have remained stable since June 2022 and remained within the historic range. It is recommended the EC levels continue to be monitored and reviewed for any changes outside the historical range.	The EC level in Q2 was a consecutive trigger exceedance and DPE were notified in February 2023. The trigger level has been updated in the revised WMP which was approved by DPE at the end of March 2023. EC levels do not exceed the updated trigger level.

Bore ID	Exceedance	Screened Lithology and Location	Comment	Action
GW45	Five pH readings above the trigger level of 7.1 between March 2022 and March 2023	Saddlers Creek alluvium On site – south of Saddlers Creek and Saddlers Pit	The purpose of bore GW45 is monitoring of Saddlers Creek alluvium in the Saddlers Creek area. A paired bore with GW2, GW3 and GW46 to assess vertical hydraulic gradient between Permian coal measures (Woodlands Hill seam) and alluvium, and the impact of mining activities adjacent to mining areas in the Saddlers Creek area. pH has gradually declined in GW45 since July 2017 from 7.6 to 6.3 in September 2019, this corresponded with an increase in EC and sulphate (refer Appendix 2 Figure 5.3). Since September 2019 levels fluctuated, with a general increase to 7.54 in December 2022, followed by a decline to 7.34 by June 2023. The fluctuating trend of increasing pH towards neutral conditions appears to correspond to rainfall.	An initial investigation into the water quality trends at GW45 has been completed and submitted to DPE. A further investigation is ongoing. The trigger level has also been updated in the revised WMP which was approved by DPE at the end of March 2023. pH levels do not exceed the updated trigger level.

7.4.3 Proposed Improvements

- Commence capital project to review the condition and instrumentation of groundwater bores and to restore and remediate bores where required.
- Install further secure fencing around groundwater bores to prevent damage from livestock.

8 Rehabilitation

8.1 Buildings and Infrastructure

During the reporting period 2 ROM tanks (approximately 20,000L) and associated piping / pump infrastructure were decommissioned.

8.2 Topsoil

Topsoil management at Mt Arthur Coal focuses on maintaining the quality of the topsoil resource as a rehabilitation growth medium. Activities undertaken during the reporting period included:

- Prioritising direct placement of topsoil;
- Testing topsoil to determine appropriate depths for stripping and recovery as well as ameliorant requirements;
- Felling and mulching trees in situ on disturbance areas to increase organic content within the topsoil that was used directly on rehabilitation areas; and
- Reusing felled trees from disturbance areas on new rehabilitation areas to provide habitat.
- Additional measures generally undertaken when stockpiling topsoil include:
    - Locating stockpiles so as to reduce the requirement for re-handling;
    - Addition of ameliorants such as fertiliser, compost and gypsum;
    - Establishing cover crops;
    - Weed treatment by slashing and scalping.

Topsoil was placed and spread to an approximate depth of approximately 200 millimetres on rehabilitation areas where required. The newly spread topsoil surface was contour cultivated prior to sowing to provide a suitable environment that encourages water infiltration in the soil.

Targeted maintenance on stockpiles included:

- Weed treatment (slashing and spraying of broadleaf weed treatment);
- Application of fertiliser - Mono-Ammonium Phosphate (MAP); and
- Spreading of pasture seed mix as per the Rehabilitation Management Plan.

Specific stockpile management activities are included in Table 36.

Table 36 Topsoil stockpiles maintained in the reporting period.

Stockpile	Area (ha)	Weed treatment	Gypsum (t)	Seeding	MAP (kg)	Compost (m^3)
TSS099	6	✓	6	✓	300	60
TSS082	2	✓	3	✓	100	20
TSS 104	11	✓	11		550	110
TSS 070	9	✓	9		450	-
TSS 075	10	✓	8		400	80

Stockpile	Area (ha)	Weed treatment	Gypsum (t)	Seeding	MAP (kg)	Compost (m^3)
TSS 074	11	✓	11		550	110
TSS059 and TSS 011	5	✓	5		250	50

8.3 Landform Design

Mt Arthur Coal aims to create rehabilitation that is safe, stable and non-polluting, that is self-sustaining and comparable to the surrounding natural landscape. Landform and rehabilitation established since 2014 utilises geomorphic design and incorporates micro-relief and drainage lines for landforms designed and constructed post the current modification project approval. The geomorphic design uses the characteristics of stable natural alluvial landforms in the local environment as an analogue on which to base the design of overburden landforms.

The final landform design can be seen in Figure 7 and Figure 8. Figure 7 and Figure 8 show the shaped waste rock with topsoil being placed. Although this geomorphic design has been implemented on other sites within NSW and also worldwide there are many defining characteristics that restrict its use such as space, waste characterisation, rainfall, availability of suitable rock, availability of mulch, final landuse, landform height and steepness of the landform. Mt Arthur Coal has larger higher landforms than other sites in the Hunter Valley and is also space constrained for emplacement area. The resultant design aligns with industry best practice but will be monitored over the coming years to ensure further natural landform design incorporates learnings and improvement from the current work.

Figure 7: Topsoil spreading at OPD emplacement

Figure 8 Bulk shaping and topsoil spreading at the Saddlers North emplacement

Rehabilitation of land is carried out in accordance with:

- MAC-ENC-MTP-052 Mt Arthur Coal Forward Program;
- MAC-ENC-MTP-055 Mt Arthur Coal Rehabilitation Management Plan
- MAC-STE-STD-214 Mine Rehabilitation Standard
- MAC-ENC-MTP-047 Rehabilitation Strategy;
- MAC-ENC-MTP-050 Biodiversity Management Plan; and
- MAC-ENC-PRO-080 Rehabilitation and Ecological Monitoring.

Rehabilitation is designed to achieve a stable final landform compatible with the surrounding environment and to meet the landform commitments presented in the Rehabilitation Management Plan (RMP).

During the reporting period Mt Arthur Coal completed (achieved Phase 4 – Ecosystem and Landuse Establishment) 68.2 hectares of rehabilitation across four areas (VD4, Drayton Void, Out of Pit Dump [OPD] and Saddlers North). This exceeded the FWP target of 67 hectares to Phase 4 – Ecosystem and Landuse Establishment, as shown in Table 38. Table 39 provide the Mt Arthur Coal rehabilitation summary for the operation. These areas were all seeded with the pasture species mix from the RMP, see Table 37.

Table 37 Mt Arthur Coal pasture seed mix

Common name	Species name	Seed mix kg/ha
Couch	*Cynodon dactylon*	10
Lucerne	*Medicago Sativa*	3

Common name	**Species name**	**Seed mix kg/ha**
Green Panic	*Panicum Coloratum*	3
Seaton Park Sub-clover	*Trifolium Subterranean*	3
Haifa White Clover	*Trifolium Repens*	3
Kikuyu	*Pennisetum Clandestinum*	3
Wimmera Rye	*Lolium Rigidum*	7
Perennial Rye	*Lolium Perenne*	7
Phalaris	*Phalaris Aquatica*	5
Shirohie Millet (summer)	*Echinochloa Esculenta*	10
Oats (winter)	*Avena Sativa*	10

Table 38: Mt Arthur Coal rehabilitation claimed for FY22

Rehabilitation phase	**FY23 FWP rehabilitation commitments (hectares)**	**FY23 areas in active rehabilitation phases (hectares)**
Phase 2 – Landform Establishment	0	0.07
Phase 3 – Growing Media Development	0	0.8
Phase 4 – Ecosystem and Landuse Establishment	67	68.2
Total	67	69.07

Note: All areas calculated using GDA2020 Zone 56 coordinate system

Table 39: Mt Arthur Coal rehabilitation summary

Mine area type	**Previous reporting period (FY22 actual)**	**This reporting period (FY23 actual)**	**Next reporting period (FY24 forecast)**
A. Total mine footprint[1]	5,564.05	5,762.84	5,908.30
B. Total active disturbance[2]	4,469.61	4,650.94	4,732.07
C. Land being prepared for rehabilitation[3]	3.66	0.87	0.80
D. Land under active rehabilitation[4]	1,094.45	1,111.90	1,176.24
E. Completed rehabilitation[5] (as formally certified by NSW Government)	0	0	0

Note: All areas calculated using GDA1994 Zone 56 coordinate system

1 Total mine footprint includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities.

2 Total active disturbance includes all areas ultimately requiring rehabilitation.

3 Land being prepared for rehabilitation includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growing media development.
4 Land under active rehabilitation includes areas under rehabilitation and being managed to achieve relinquishment includes the sum of mine disturbed land that is under the following rehabilitation phases - .
5 Completed rehabilitation requires formal signoff by the NSW Resources Regulator that the area has successfully met the rehabilitation land use objectives and completion criteria.

8.4 Other Activities

8.4.1 Maintenance and Improvement

Weed control for rehabilitation maintenance and improvement occurred across:

- VDs 1, 4 and 5;
- CD1;
- Drayton Void;
- Saddlers South; and
- McDonald's South.

Work completed in VD4 and VD5 continued on from the rework completed in the FY21 reporting period. See Section 6.5 and Appendix 6 Baiting & Weed Management Reports for details of weed treatment. Locations of rehab areas are presented in Figure 9.

Improvement works focussed on a targeted revegetation program in the McDonald's void area has been completed. The scope included:

- Stem thinning of denser existing woodland;
- Intense spot weed treatment targeting African olive, African boxthorn;
- Slashing and ripping of planting beds;
- Tube stock diversification (see Table 40) of approximately 17ha;
- Diversification by seeding ground cover amongst the tubestock of 1approximately 7ha (see Table 41, species selected from the Box Gum Woodland species list in the RMP); and
- Diversification by seeding Box Gum Woodland species list in the RMP in existing canopy cover of approximately 17ha.

Table 40 Diversity Tube stock mix used in McDonalds South

Species	Number of individuals
Brachychiton populneus	1000
Eucalyptus albens	197
Eucalyptus blakelyii	1381
Eucalyptus melliodora	360
Bursaria spinosa	16
Cassinia aculeata	0
Boerhavia	0
Lomandra longifolia	500
Notelaea microcarpa	500
Acacia paradoxa	Mix of each totalling 1500
Acacia ulicifolia	
Daviesia genistifolia	
Daviesia mimisoides	
Dianella caerula	

Dianella revoluta	
Dodonaea triangularis	
Dodonaea viscosa	
Eremophila debilis	
Hardenbergia violacea	
Indigofera australis	
Jacksonia scoparia	
Pultenaea spinosa	
Swainsonia galegifolia	
Total	**5454**

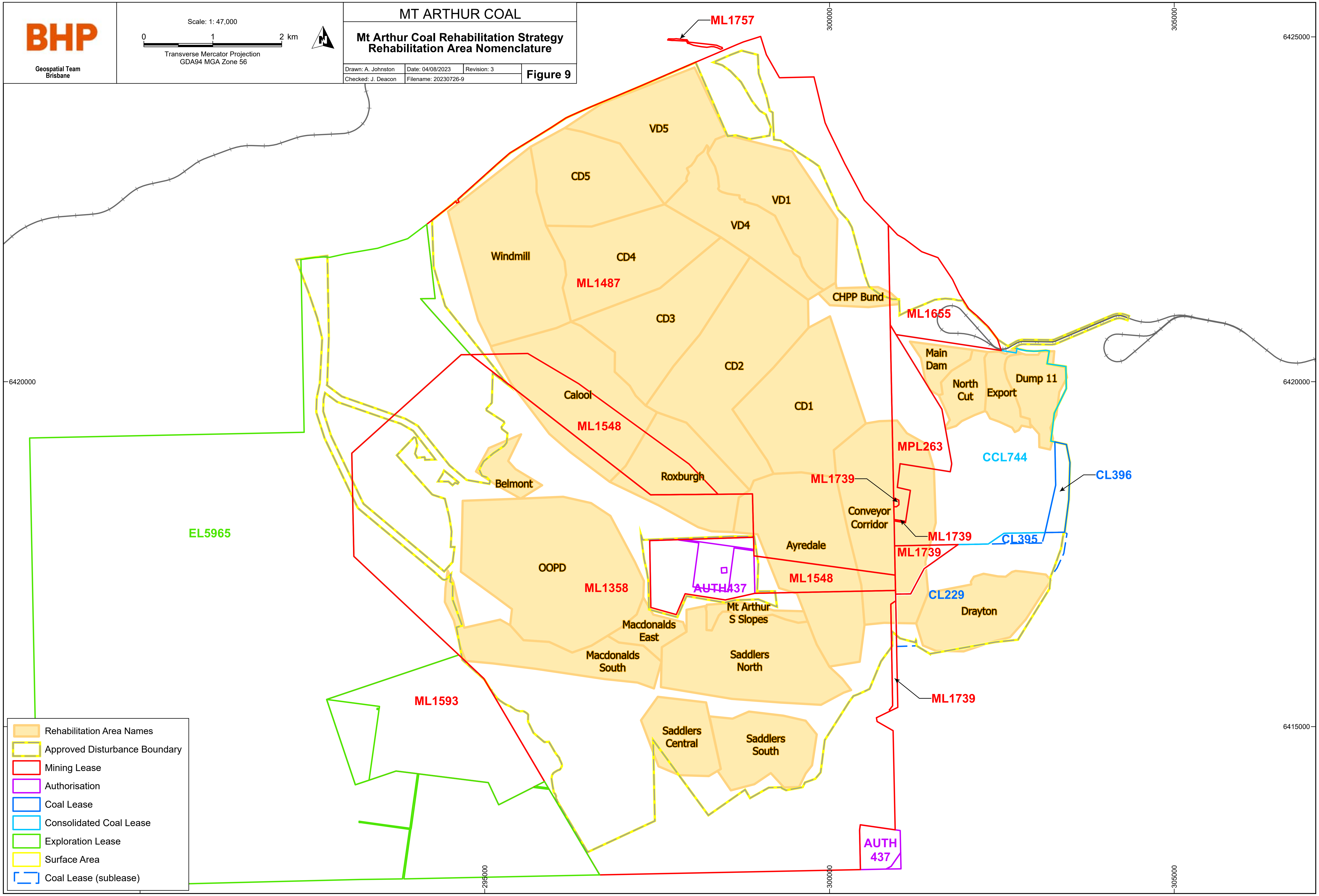
Table 41 Diversity ground cover seed mix used in MacDonalds South

Species	kg/Ha	Species Count
Forbs and Subshrubs		
Calotis cuneifolia	0.142	1
Calotis lappulacea	0.142	1
Dichondra repens	0.133	1
Einadia spp. Mix	0.142	1
Enchylaena tomentosa	0.133	1
Eremophila debilis	0.133	1
Hardenbergia violacea*	0.142	1
Maireana microphylla	0.133	1
Solanum cinereum*	0.133	1
Vitadinia spp.	0.133	1
Native Grasses		
Austrostipa scabra	2.000	1
Bothriochloa macra	2.000	1
Chloris truncata	2.000	1
Dichanthium sericeum	2.000	1
Microleana stipoides	2.000	1
Total Species	**11.500**	**16**

Table 42 Box Gum Woodland Mix used in MacDonalds South diversification

Species	kg/Ha	Species Count
Dominant tall tree species		
Eucalyptus albens	0.100	1
Eucalyptus blakelyi	0.050	1
Eucalyptus crebra	0.150	1
Eucalyptus melliodora	0.100	1
Eucalyptus moluccana	0.100	1
Sub-dominant small trees		
Brachychiton populneus	0.100	1
*Geijera parviflora/salicifolia**	0.100	1
Notelaea microcarpa	0.300	1
Shrubs - Acacia		
*Acacia decora**	0.250	1

Species	kg/Ha	Species Count
*Acacia falcata**	0.250	1
*Acacia implexa**	0.200	1
*Acacia paradoxa**	0.100	1
*Acacia parvipinnula**	0.200	1
Shrubs - Non-Acacia		
Bursaria spinosa	0.150	1
Cassinia arcuata	0.150	1
*Dodonaea viscosa**	0.100	1
*Indigofera australis**	0.150	1
Myoporum montanum	0.100	1
Sclerolaena birchii	0.1	1
Scleroleana muricata	0.1	1
*Senna artemisioides**	0.1	1
Forbs and Subshrubs		
Atriplex semibaccata	0.15	1
Calotis lappulacea	0.1	1
Chrysocephalum apiculatum	0.1	1
Einadia spp. Mix	0.2	1
Enchylaena tomentosa	0.2	1
Eremophila debilis	0.1	1
Maireana microphylla	0.1	1
*Solanum cinereum**	0.15	1
*Swainsona galegifolia**	0.1	1
Vittadinia spp.	0.1	1
Native Grasses		
Aristida spp.	1.5	1
Austrostipa scabra	1.5	1
Bothriochloa decipiens	0.9	1
Bothriochloa macra	0.9	1
Chloris truncata	1.5	1
Chloris ventricosa	0.9	1
Cymbopogon refractus	0.5	1
Microleana stipoides	0.9	1
Paspalidium distans	0.5	1
Sporobolus creber	0.9	1
Themeda australis	2	1
TOTAL ALL CATEGORIES	**16.25**	**42**


BHP
Geospatial Team
Brisbane
Scale: 1: 47,000
0
1
2 km
Transverse Mercator Projection
GDA94 MGA Zone 56
MT ARTHUR COAL
Mt Arthur Coal Rehabilitation Strategy
Rehabilitation Area Nomenclature
Drawn: A. Johnston
Date: 04/08/2023
Revision: 3
Checked: J. Deacon
Filename: 20230726-9
Figure 9
ML1757
VD5
CD5
VD1
VD4
Windmill
CD4
ML1487
CHPP Bund
ML1655
CD3
CD2
Main Dam
North Cut
Export
Dump 11
Calool
ML1548
CD1
MPL263
CCL744
CL396
Belmont
Roxburgh
ML1739
Conveyor Corridor
EL5965
OOPD
ML1358
Ayredale
ML1739
CL395
ML1739
ML1548
AUTH437
CL229
Drayton
Mt Arthur S Slopes
Macdonalds East
Macdonalds South
Saddlers North
ML1593
ML1739
Saddlers Central
Saddlers South
AUTH 437
Rehabilitation Area Names
Approved Disturbance Boundary
Mining Lease
Authorisation
Coal Lease
Consolidated Coal Lease
Exploration Lease
Surface Area
Coal Lease (sublease)
300000
305000
295000
6425000
6420000
6415000

Also during the reporting period two *Cymbidium canaliculatum* were relocated from clearing works to rehabilitation areas in VD1.

Figure 10 Relocated Tiger Orchid (*Cymbidium canaliculatum*)

8.4.1 Rehabilitation Improvements

A major step change in the execution and maintenance of rehabilitation at Mt Arthur this reporting period was the awarding and execution of an overarching rehabilitation contract. This covered all activities from bulk shaping to ongoing weed treatment and maintenance activities. The main goals of the contract were to:

- Allow for consistent effort by having a dedicated work force;
- Have consistent ownership across all stages of rehabilitation; and
- Integrate all quality assurance and quality control requirements.

Mt Arthur Coal refined the use of remote sensing to assess erosion. Results focused on use of lidar to identify erosion gullies of certain depth and length and classifying them on as a risk to rehabilitation. See Appendix 5 Rehabilitation Plan & and Monitoring Results for the report.

The process of updating rehabilitation objectives and completion criteria continued in the reporting period with:

- Updating the Mt Arthur Rehabilitation Strategy. This update included:

  - Review of the historic Mt Arthur Environmental Assessments and development of a gap analysis between commitments, obligations and current Rehabilitation Strategy;
  - Assessment of pre-mining ecological and agronomy data;
  - Ecological communities listed in the project approval (Schedule 3 Condition 38) and Environment Protection and Biodiversity Conservation (EPBC) approvals were assessed to convert to best fit Plant Community Types (PCT). In identifying appropriate or 'best-fit' PCTs for the vegetation communities included in the project approvals.
- Rehabilitation Objectives (ROBJs) were submitted to NSW Resources Regulator August 2022. The initial submission of the ROBJs were rejected with updated ROBJs submitted 26 June 2023.

Mt Arthur improved the quality control and assurance of rehabilitation with the updating of:

- MAC-TCS-STD-002 Landform Design document to capture the workflow of landform design updates; and
- Review and updating of the Inspection Test Plans in the MAC-STE-STD-214 Mine Rehabilitation Standard.

8.4.2 Trials

Growth Media Alternatives

A trial commenced on VD4 in FY22 reporting period to develop standard growth media alternatives to topsoil. The trial has the aims to:

- Reduce risk of topsoil deficit;
- Eliminate the weed seed bank risk in topsoil out competing the native species; and
- Closing the erosion window.

The trial was broken into three areas with the following treatments:

- Area 1:
  - Following shaping and gypsum application create a friable seed bed and incorporate gypsum; and
  - Seed directly to shaped waste rock
- Area 2:
  - Following shaping and gypsum application: Padfoot roller or similar to create a friable seed bed and incorporate gypsum;
  - Spread hay to depth of ~3cm; and
  - Seed directly onto spread hay.
- Area 3:
  - Following shaping and gypsum application: Padfoot roller or similar to create a friable seed bed and incorporate gypsum;
  - Application of 50m3/ha of rehab grade compost; and
  - Spread seed directly onto amended waste rock.
- Control area:
  - Application of topsoil;
  - Application of 5t/ha of gypsum;
  - Application of 30m3/ha of rehab grade compost; and
  - Direct seeding into harrowed topsoil.

Summary of the results of the trials

- Area 1:

- Poor establishment with almost no germination of native or weed species, with the area regaining most of it compaction and crusting, preventing seed from being retained on the surface or being able to germinate;
- No monitoring results were obtained for this area

- Area 2:
  - Hay applied was too dense for seed to be stimulated into germination through contact with soil;
  - Hay contained some still active seed head and germinated hay species; and
  - Windblown weed species also present.
- Area 3:
  - Germination of a range of strata species;
  - Some wind blown weed species present;
  - Some crusting preventing some seed to germinate
- Control Area:
  - Both windblown and weed seed bank within the topsoil caused high coverage and types of exotic species;
  - A higher number of native species were found in the control area, however the coverage was much lower and exotic species more than doubled the other areas.

Quantitative results are presented in Table 43.

Table 43 Alternative Growth Media Trials

Area and Monitoring Site	Average % Native Species Cover	Average % Exotic Species Cover	Average % Bare Ground	No. Native Species	No. Exotic Species
Control - R10	7	47	43	15	25
Area 2 - R15	3.4	54	25.6	2	10
Area 3 - R14	19	17	62	13	11

Note – green highlights indicate the better results across the trials.

Weather Forecasting and Inclusion in Rehabilitation Planning

Mt Arthur planned the used of weather modelling in rehabilitation planning, however, this trial has been abandoned due to the execution of the rehabilitation contract and difficulties in this sort of work into contractor KPIs.

Temporary Stabilisation

Mt Arthur is investigating the various methodologies of spreading hay mulch to close the erosion window between seed spreading and cover crop germinating. The methodologies tested to date are:

- Fresh hay broken up with excavator pincers and loaded directly to spreader.
  - Failed to adequately spread to gain coverage and resulted in large clumps of hay.
- Rotting hay broken up with excavator pincers then spreader (see Growth Media Alternatives above)
  - Hay was left to sit for 6 to 12 months with the hay partially decomposing; and
  - Good coverage was achieved, however was too dense to allow for seed germination.

8.3 Rehabilitation Activities for Next Reporting Period

Next reporting period will see an update to the rehabilitation TARP in the RMP and associated monitoring. The updates will include:

- Use of remote sensing to assess vegetation health and ecological development and integrate this with the erosion risk monitoring;
- Further refinement of the ecological monitoring and tracking of TARP triggers from the updated ecological communities completion criteria;
- Integration GIS monitoring data of TARP triggers; and
- Integration of TARP triggers into the rehabilitation contract.

The trials will continue in new areas in FY24 with:

- Growth Media Alternatives
  - Follow up sampling of Area 3 to assess the amelioration success;
  - Trials into varying application of compost;
  - Trials for reworking of other materials to be investigated (e.g. sub soil materials)
- Temporary Stabilisation
  - Assess application rate of hay to create a thinner layer to allow for germination;
  - Assessment of other spreading equipment including grinding hay before application

Following the approval of the submitted ROBJs and updated Rehabilitation Strategy Mt Arthur will review and update the rehabilitation completion criteria and performance indicators.

Following the announcement of cessation of mining at Mt Arthur in 2030, Mt Arthur will commence detailed studies into the closure of the mine. These studies are expected to improve rehabilitation practices at Mt Arthur.

Rehabilitation activities for the reporting period include the continuation of natural landform design rehabilitation techniques and the inclusion of habitat in new areas as they become available. FY23 has an annual rehabilitation area target of 141 hectares.

New rehabilitation of land will be carried out in accordance with:

- Mt Arthur Coal's Forward Program;
- Mt Arthur Coal's Rehabilitation Management Plan;
- MAC-ENC-MTP-047 Rehabilitation Strategy
- MAC-ENC-MTP-050 Biodiversity Management Plan
- MAC-TCS-STD-002 Landform Design; and
- MAC-STE-STD-214 Mine Rehabilitation Standard.

9 Community

9.1 Community Engagement

Mt Arthur Coal continues to actively engage and build relationships with key stakeholders and the local community through its program of community engagement and consultation. Mt Arthur Coal's community engagement and consultation process was ongoing throughout the reporting period with the following consultation measures undertaken:

- Quarterly Community Consultative Committee (CCC) meetings
- MAC representatives attendance at Muswellbrook Chamber of Commerce and Industry, Singleton Business Chamber and Hunter Business Chamber events
- Participation in the Upper Hunter Mining Dialogue and several of its working groups
- Telephone and face-to-face engagement with neighbouring landholders as well as written correspondence
- Site tours from school groups, universities and Government representatives
- 24-hour BHP Mt Arthur Coal Community Response Line: 1800 882 044
- Biennial Community Perception Survey, conducted by independent research firm IPSOS, to provide the local community and key stakeholders with a way to provide feedback to Mt Arthur Coal on its business activities and key issues of concern for the community.
- Comprehensive engagement with local stakeholders regarding the decision and announcement in June 2022 by BHP to retain Mt Arthur Coal in its portfolio, seek the relevant approvals to continue mining for an additional four years beyond 2026 when the current consent expires, as part of a managed process to cease mining in June 2030 and transition to closure and rehabilitation.

Mt Arthur Coal invites feedback about its activities through a free-call 24-hour Community Response Line (1800 882 044), which is advertised in local newspapers and on the BHP website at: https://www.bhp.com/sustainability/environment/regulatory-information/

9.1.1 Community Response Line

During the reporting period, Mt Arthur Coal received 49 complaints from community members and near neighbours. A comparison of complaints received during the reporting period against previous financial years is shown in

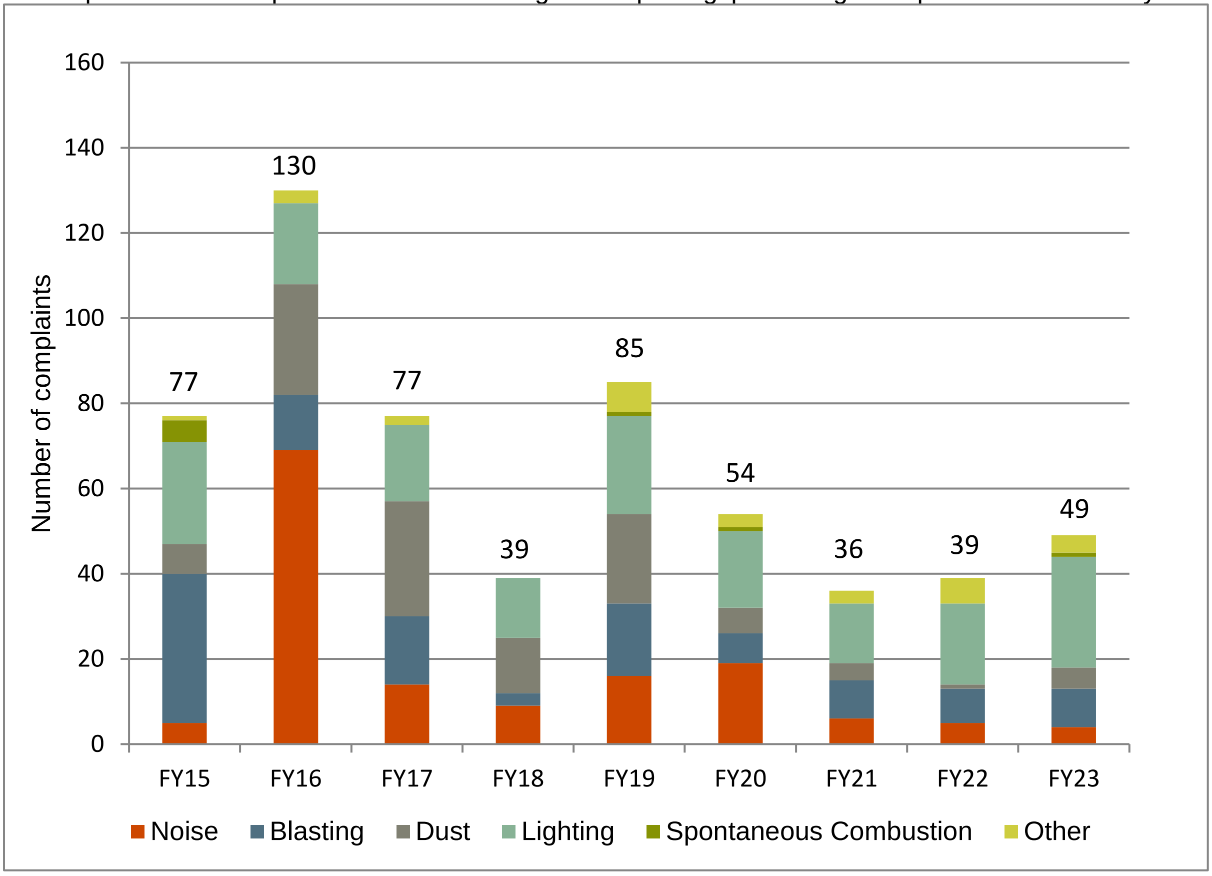


Figure **11** and a complete register of complaints is presented in Appendix 3 Community Complaints.

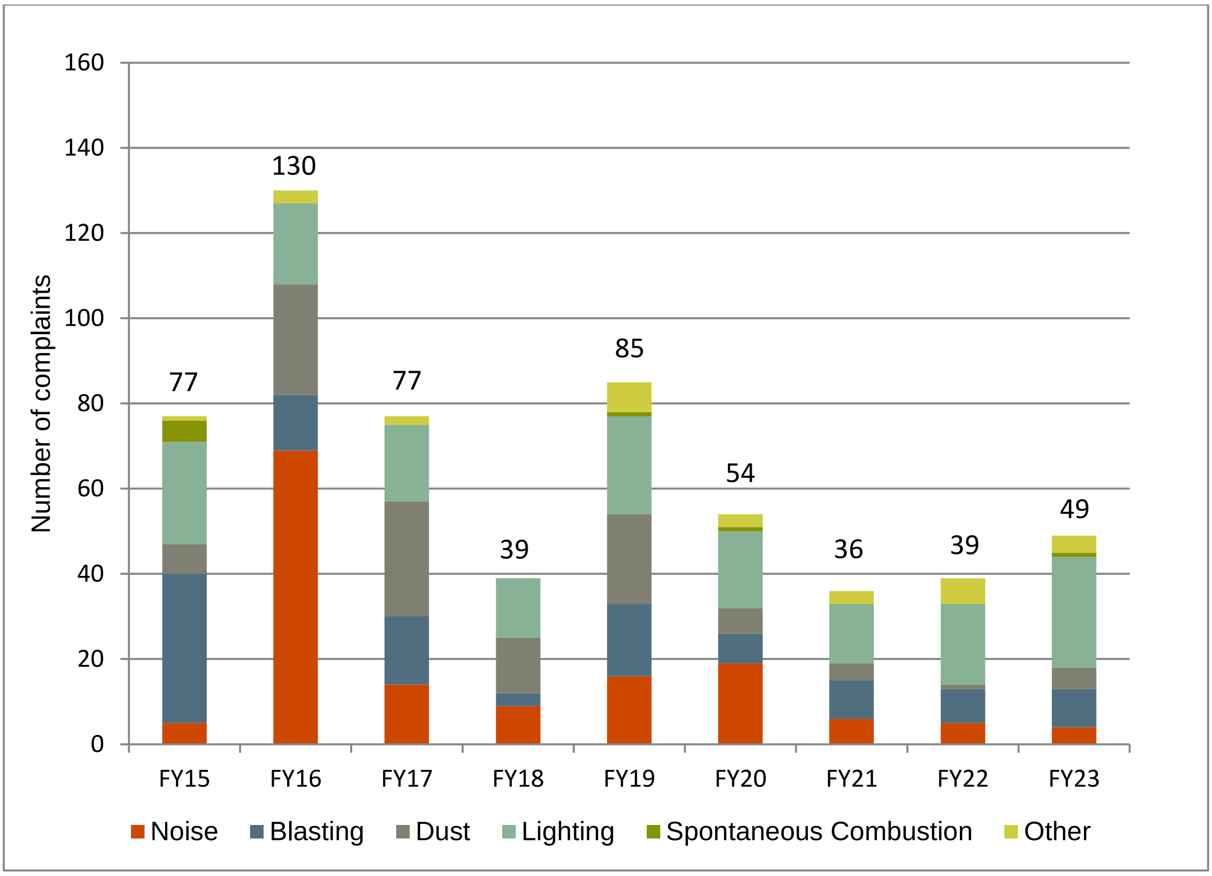


Figure 11: Comparison of complaints received during current and previous financial years

9.1.2 Q1 (July to September 2022)

Mt Arthur Coal received eleven (11) complaints during this period. Of the 11 complaints, five (5) were related to lighting; four (4) to blasting activity; one (1) to noise and one (1) in the “other” category related to historical operational impacts. Of the eleven (11) complaints received for the three-month reporting period, five (5) came from residents at Roxburgh Rd, four (4) from Denman Rd, one (1) from Racecourse Rd/Sheppard Avenue and one from a caller who declined to give their location.

9.1.3 Q2 (October to December 2022)

Mt Arthur Coal received nine (9) complaints during this period. Of the ten complaints, three (3) were related to lighting; three (3) to blasting activity; two (2) to dust and one (1) to spontaneous combustion. Of the 10 complaints received for the three-month reporting period, one was from Jerrys Plains, five were from Roxburgh Rd and four were from Denman Rd during this period.

9.1.4 Q3 (January to March 2023)

Mt Arthur Coal received sixteen (16) complaints during this period, up from nine (9) in the previous period. Of the 15 complaints: Eight (8) were related to lighting; two (2) to blasting activity; two (2) to operational noise; one (1) to dust; one (1) to other; one (1) to spontaneous combustion; and one (1) to operational noise. Of the 15 complaints received for the three-month reporting period, Ten (10) came from residents at Roxburgh Road, two (2) from Denman Rd and one (1) from Racecourse Road and two (2) were unknown locations.

9.1.5 Q4 (April to June 2023)

Mt Arthur Coal received thirteen (13) complaints during this period. Nine (9) were in Roxburgh Rd, two (2) for Denman Rd, one (1) for Racecourse Rd and one (1) for other which was a complaint about MAC South lighting. Of the 13 complaints, ten (10) were for lighting, two (2) for blast vibration and one (1) for dust.

9.1.6 Website

Mt Arthur Coal provides information about the operation through the BHP website at https://www.bhp.com/sustainability/environment/regulatory-information/, including project approval documents, blast schedules, coal transport information, Community Consultative Committee (CCC) meeting minutes, community complaint records, environmental monitoring information, independent environmental audits, environmental management plans, EPBC compliance reports and Annual Reviews. Note that the Annual Coal Transport Report is now provided as part of this Annual Review in Appendix 4.

9.1.7 Community Consultative Committee

During the reporting period, Mt Arthur Coal coordinated four CCC meetings in accordance with the Community Consultative Committee Guidelines (DPE, 2019) on:

- 10 August 2022
- 9 November 2022
- 8 February 2023
- 17 May 2023

Mt Arthur Coal also participated in two Joint CCC meetings and one extra-ordinary CCC meeting with Maxwell Infrastructure Malabar Coal held on:

- 7 December 2022
- 15 March 2023 (extraordinary meeting)
- 5 June 2023

9.2 Community Investment

During the reporting period Mt Arthur Coal voluntary contributed more than $625,000 to the local community, including $150,000 in one-off grants through the Benefiting My Community program.

Central to Mt Arthur Coal's commitment to the local community is its Voluntary Planning Agreement (VPA) with Muswellbrook Shire Council, of which $690,027 was provided in FY23 toward the Mt Arthur Coal Community Fund. Established under the *Environmental Planning and Assessment Act 1979*, the VPA is an annual commitment that contributes to public amenities and services that may be impacted by the growth of mining operations.

9.2.1 Local Buying Program

Mt Arthur Coal continues to engage and support eligible small, local and indigenous businesses by procuring goods and services through the Local Buying Program – a program delivered in partnership between BHP and C-Res, a cost-neutral entity. A record $23,616,298 was spent in NSW in FY23, primarily in the shires of Muswellbrook, Singleton and Upper Hunter.

9.2.2 Local Buying Foundation

The Local Buying Foundation is an important element of the Local Buying Program; each time BHP procures goods and services through the Program additional funds are provided to the Local Buying Foundation. The Foundation directs these funds to programs, initiatives and events that focus on building stronger and more resilient local business communities.

Since the Foundation's inception in NSW in 2017, a total of 41 projects have been supported at a value of $813,000 within the Singleton, Muswellbrook and Upper Hunter Shires.

10 Independent Audit

An Independent Environmental Audit (IEA was undertaken at Mt Arthur Coal in during September and October 2020. The IEA covered the Mt Arthur Coal Complex. The IEA period was 1 July 2017 to 30 June 2020. The IEA was the three - year period based on the date of the previous IEA. The Department of Planning Industry and Environment (DPIE) endorsed the following IEA team in the letter dated 12 June 2020:

- Chris Jones – (Integrated Environmental Management Australia - IEMA) - Lead Auditor and Surface Water Specialist;
- Nathan Archer – (SLR Consulting Australia Pty Ltd - SLR) Assistant Auditor and Noise/Blasting Specialist;
- Ali Naghizadeh (SLR) – Air Quality Specialist;
- Clayton Richards (Mine Soils) – Rehabilitation Specialist; and
- Katarina David (Independent Consultant) – Groundwater

The IEA covered the requirements of Schedule 5 Condition 9 of the Project Approval (PA 09-0062).

The IEA included a series of specialists including surface water, groundwater, noise/blast, air and rehabilitation.

The IEA generally identified a high level of compliance with no high or medium risks identified during the IEA.

As summarised in Table 44 the following non – compliances were observed:

- There were eight low-risk non – compliances and four administrative non – compliances for the Project Approval;
- There were three low-risk non – compliances and four administrative non – compliances for the Environment Protection Licence;
- There were four low-risk non – compliances and one administrative non – compliances for the Mitigation Measures and Management from Mt Arthur Coal Open Cut Modification - Environmental Assessment 2013;

Table 44: Summary of IEA Non-Compliances and Recommendations

Regulatory Document	Non- Compliances		Recommendations	
	Low Risk	Administrative	Non-compliance	Improvement
Project Approval	8	4	9	15
Environment Protection Licence	3	4	2	4
Key Environmental Assessment Commitments 2013 EA	4	1	2	-
CCL 396	-	-	-	1
TOTAL	**15**	**9**	**13**	**20**

Of the 26 actions agreed with DPE, all of them have now been completed.

The next IEA will be undertaken in FY24. Table 45 and Table 46 detail the findings of the IEA and Mt Arthur Coal response and agreed action.

Table 45: 2020 Independent Environmental Audit Non-compliance Recommendations and Actions

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
Project Approval (PA09-0062)					
S3 C20	**Impact Assessment Criteria** The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not cause exceedances of the criteria listed in Tables 6, 7 and 8 at any residence on privately-owned land (except for air quality affected land listed in Table 1).	Admin Non - Compliance	NC REC 1: Ensure that all non - compliances are recorded in the Annual Review under the Incident Reporting Section.	**<u>Comments</u>** NC REC 1: The evidence referenced in the audit report identified specifically that the Non-compliance related to; 1. *"The Annual Reviews recorded times where the data capture for the TEOM's was not 100%. Although the capture rate was high this still is a non - compliance, as this affects the annual average and some short term results for PM_{10}. DC09 had a data capture of 85% during the FY 2019 period. This triggers a <u>non - compliance</u> in relation to data collection."* Mt Arthur Coal will access and report data capture compliance in the Annual Review consistent with the accepted approach for EPA Annual Return reporting, which includes consideration for scheduled maintenance and calibrations which are in place to ensure compliant operation of the monitoring equipment. 2. *"1 July 2017 - 30 June 2018 - Table 15 (pg 34) from the FY 2018 Annual Review had the MT ARTHUR COAL contribution for the TEOM - DC09 (27 September 2017) as 51µg/m^3), which is above the short term criteria for PM_{10}. This was not recorded as a non - compliance in the FY 2018 Annual Review in the Incident Section, however information was provided outlining that DPIE were notified at the time of the exceedance."*	

Table 6: Long term impact assessment criteria for particulate matter

Pollutant	**Averaging period**	**[d] Criterion**
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 7: Short term impact assessment criterion for particulate matter

Pollutant	**Averaging period**	**[d] Criterion**
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3

Table 8: Long term impact assessment criteria for deposited dust

Pollutant	**Averaging period**	**Maximum increase in deposited dust level**	**Maximum total deposited dust level**
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
				Mt Arthur Coal acknowledges this omission from the non-compliance summary table (Table 3) contained within the Annual Review FY18. The exceedance was reported in Table 15 of the Annual Review FY18. **ACTION** NC REC 1: Update the annual review process document to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** 31 March 2021	**ACTION** NC REC 1: **Complete** Annual review procedure updated to include this requirement. Included in Section **Error! Reference source not found.** of this report.
S3 C33	**Groundwater Monitoring Program** The Groundwater Monitoring Program must include: (a) detailed baseline data of groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the project; (b) groundwater impact assessment criteria; (c) a program to monitor:	Non - Compliant (Low Risk)	NC REC 2: MT ARTHUR COAL needs to have the Site water management plan and the GMP approved by DPIE and undertake any further monitoring considering these approved documents.	**Comments** NC REC 2: MT ARTHUR COAL submitted a new Water Management Plan to DPIE for approval in April 2020, which includes a revised groundwater monitoring program. As at December 2020 Mt Arthur Coal has responded to all Requests for Information relating to the assessment of the Water Management Plan and is awaiting approval of the plan by DPIE. Once approved Mt Arthur Coal will ensure that all further groundwater monitoring is conducted in accordance with the new Water Management Plan. **ACTION** NC REC 2:	**ACTION** NC REC 2: **Complete**

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
	• groundwater inflows to the mining operations; • impacts on regional aquifers; • impacts on the groundwater supply of potentially affected landowners; • impacts on the Hunter River and Saddlers Creek alluvial aquifers; and • impacts on any groundwater dependent ecosystems and riparian vegetation; (d) procedures for the verification of the groundwater model; and (e) reporting procedures for the results of the monitoring program and model verification.		NC REC 3: There are a number of monitoring protocols and procedures which have not been followed in spite of those being recommended: these monitoring protocols recommended in Section 4 of the 2018/2019 Groundwater Annual Review need to be made mandatory to ensure that the results are reliable and reflective of site conditions. It is recommended that quality control for groundwater data is improved. NC REC 4: A number of exceedances that are reported for Hunter River and Saddlers Creek alluvium need to be investigated and the mitigation measure/resolution provided in the next monitoring report.	A new scope of works will be issued to the groundwater monitoring contractor to commence monitoring in accordance with the revised groundwater monitoring program approved in the Water Management Plan. **Forecast Completion:** Within 3 months of approval of the Water Management Plan. **ACTION** NC REC 3: Assess and develop an action plan of all monitoring protocols recommended in the 2018/2019 Groundwater Annual Review and the more recent 2019/2020 reports. **Forecast Completion:** 31 March 2021 **ACTION** NC REC 4: An investigation has been triggered in relation to exceedances that were reported for Hunter River and Saddlers Creek alluvium. The results of the Investigation will be reported to DPIE and included in the next Annual Ground Water Review. **Forecast Completion:** 31 March 2021 **Comments** NC REC 5:	Approval of the WMP by DPE was granted in February 2021. New Scope of works issued, monitoring undertaken in accordance with the WMP. **ACTION** NC REC 3: **Complete** Monitoring protocol have been reviewed by the independent groundwater consultants for this Annual Review period and found to be substantially compliant. **ACTION** NC REC 4: **Complete** Reported in 2019-2020 Annual Review **Comments** NC REC 5:

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
			NC REC 5: GMP 2015 states that as no measurement of inflow volumes can be taken, therefore the modelled values are considered most appropriate method of estimates, unless the trigger values are exceeded. Given that trigger values were exceeded in 2018, 2019 and 2020 the impacts also need to be re-assessed.	The groundwater model was under revision in 2020 but had not been completed at the time of the Audit. The model revision was completed in November 2020. All inflow predictions have been assessed as complaint against EA predictions and the Project Approval. New Trigger levels resulting from this review have been included within the revised Water Management Plan currently with DPIE for approval. **No further action is proposed.**	No further action is proposed.
S3 C34	**Surface and Ground Water Response Plan** The Surface and Ground Water Response Plan must describe the measures and/or procedures that would be implemented to: (a) investigate, notify and mitigate any exceedances of the surface water, stream health and groundwater impact assessment criteria; (b) compensate landowners of privately-owned land whose water supply is adversely affected by the project, including provision of an alternative supply of water to the affected landowner that is equivalent to the loss attributed to the project;	Non - Compliant (Low Risk)	Groundwater: NC REC 6: Annual reporting needs to make a record of no complaints from the private bore owners.	**Comments** NC REC 6: Future annual reports will make a record of no complaints from the private bore owners following a similar format to the most recent 2019/2020 Annual Review that was assessed with this condition. **ACTION** NC REC 6: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed – 21/01/2021	**ACTION** NC REC 6: **Complete** Annual review procedure updated to include this requirement. Included in Section **Error! Reference source not found.** of this report.

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
	(c) minimise, prevent or offset potential groundwater leakage from the Hunter River and Saddlers Creek alluvial aquifers; and (d) mitigate and/or offset any adverse impacts on groundwater dependent ecosystems or riparian vegetation.				
S3 C45	**Aboriginal Cultural Heritage Management Plan** The Proponent shall prepare and implement an Aboriginal Heritage Management Plan for the project to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with OEH, the Aboriginal community, Council and relevant landowners; (b) include the following for the management of Aboriginal heritage on-site: • a plan of management for the Thomas Mitchell Drive Offsite Offset Area (identified in Condition 36); and • a program/procedures for:	Admin Non - Compliance	NC REC 7: Access protocols need to be determined through consultation with Aboriginal Stakeholders. Additional details on the outcome of this consultation will be provided in Section 5.5 of the ACHMP regarding access into the Thomas Mitchell Drive heritage offset area. NC REC 8: Further information is required including location and a procedure for moving and managing items within the Keeping Place. Details should be added about who is allowed to access the Keeping Place.	**Comments** NC REC 7 & NC REC 8: The Aboriginal Cultural Heritage Management Plan was being revised in 2019/2020. However due to Covid-19 restrictions through 2020 consultation with the Aboriginal Community has not been possible. DPIE have been consulted in relation to the delay in finalising the Management Plan due to consultation restrictions. **ACTION** NC REC 7 & NC REC 8: Submit the Aboriginal Cultural Heritage Management Plan incorporating the requirement of NC REC7 and NC REC 8. **Forecast Completion:** 31 August 2021	**ACTION** NC REC 7 & NC REC 8: **Complete** Aboriginal Heritage Management Plan was approved by DPE in February 2022

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
	o salvage, excavation and/or management of Aboriginal sites and potential archaeological deposits within the project disturbance area; o protection and monitoring of Aboriginal sites outside the project disturbance area, including the scarred trees and axe grinding grooves identified on the site; o managing the discovery of any new Aboriginal objects or skeletal remains during the project; o maintaining and managing access to archaeological sites by the Aboriginal community; o ongoing consultation and involvement of the Aboriginal communities in the conservation and management of Aboriginal cultural heritage on the site; and o management of the “Fairford 1” site in situ, including reasonable and feasible measures to mitigate impacts on this site, until an agreement can be reached with relevant Aboriginal stakeholders and OEH, for its salvage and relocation.				

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response/ Agreed Action	Status
S5 C4	**Revision of Strategies, Plans and Programs** Within 3 months of: (a) the submission of an annual review under condition 3 above; (b) the submission of an incident report under condition 7 below; (c) the submission of an audit under condition 9 below; or (d) any modification to the conditions of this approval, the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within four weeks of the review the revised document must be submitted to the Secretary for approval.	Admin Non - Compliance	NC REC 9: In terms of the timings of updating management plans, this should be completed in accordance with Schedule 5 Condition 4 of the Development Consent.	**ACTION** NC REC 9: All management plans will be reviewed within 3 months of the submission of the IEA Report. Where this review identifies revisions are required, the revision will be undertaken within four weeks of the review. The revised document will then be submitted to the Secretary for approval. **Forecast Completion:** Review Completed: 22 April 2021 Revisions completed (where triggered): 20 May 2021	**ACTION** NC REC 9: **Complete** Reviews of management plans completed during the reporting period. A review of the Blast management plan was triggered as part of these revisions. A revised Blast Management Plan was approved by DPE in February 2022.

<table>
<tr><th>Schedule and Condition Number</th><th>Condition</th><th>Compliance Status</th><th>Recommendations</th><th>Mt Arthur Coal Response</th><th>Status</th></tr>
<tr><td colspan="5">Environment Protection Licence (EPL) 11457</td><td></td></tr>
<tr><td>M2.2</td><td>Air Monitoring Requirements
POINT 11,12,13,14<table><tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr><tr><td>PM10</td><td>micrograms per cubic metre</td><td>Continuous</td><td>AM-22</td></tr></table></td><td>Admin Non - Compliance</td><td>NC REC 10: Continue to investigate methods of improving the reliability of continuous and real time monitoring systems to increase data capture.</td><td><u>Comments</u> NC REC 10:

In December 2020 Mt Arthur Coal has implemented a series of alerts to provide early warning when sites go offline. Reports are also distributed daily that provide information on the data capture for the reporting period. This allows for immediate diagnosis of equipment errors and system faults. Mt Arthur Coal believes that this new system satisfies NC REC 10. No further action is proposed.</td><td><u>Comments</u> NC REC 10:

No further action is proposed.</td></tr>
<tr><td>M2.3</td><td>POINT 15<table><tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr><tr><td>Faecal Coliforms</td><td>colony forming units per 100 millilitres</td><td>Quarterly</td><td>Grab sample</td></tr></table></td><td>Admin Non - compliance</td><td>NC REC 11: Ensure all sampling undertaken to required frequencies for LDP 15.</td><td><u>ACTION</u> NC REC 11:

Develop a compliance action management system (SAP) work management strategy for sampling to ensure sampling is planned and executed in accordance with requirements.

<u>Forecast Completion:</u> 28 February 2021</td><td><u>ACTION</u> NC REC 11:

<u>Complete</u>

SAP protocol implemented in June 2021.</td></tr>
</table>

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response	Status
Key Environmental Commitments 2013 Environmental Assessment					
Groundwater	Groundwater monitoring at the Mt Arthur Coal Mine would continue to be undertaken in accordance with the Ground Water Monitoring Program (BHP Billiton, 2012e). The Ground Water Monitoring Program would be reviewed and, if necessary, revised to incorporate the Modification.	Non - Compliant (Low Risk	NC REC 12: Surface Water and Groundwater Response Plan needs to be updated if the proposed and submitted SWMP is approved by DPIE.	**Comments** NC REC 12: Mt Arthur Coal has submitted a new Water Management Plan to DPIE for approval in April 2020. The New Water Management Plan includes a revised Groundwater Response Plan. As at December 2020 Mt Arthur Coal had responded to all Requests for Information relating to the assessment of the Water Management Plan and is awaiting approval of the plan by DPIE. **No further action is proposed**.	**Comments** NC REC 12: No further action is proposed. WMP Approved in February 2021
Surface and Groundwater Response	The Surface and Groundwater Response Plan (BHP Billiton, 2012f) would be reviewed and, if necessary, revised to incorporate the Modification. Notwithstanding the negligible effects due to the	Non - Compliant (Low Risk	As per Schedule 3 Condition 34 recommendation. Annual reporting needs to make a record of no complaints from the private bore owners.	***Note: this item links directly to NC REC 6 with the comment and action replicated below.*** **Comments** NC REC 6: Future annual reports will make a record of no complaints from the private bore owners following a similar format to the most recent 2019/2020 Annual Review that was assessed with this condition **ACTION** NC REC 6: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed - 21/01/21	**ACTION** NC REC 6: ***Note: this item links directly to NC REC 6 completion status outlined above in NC REC 6.***

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response	Status
	Modification predicted at surrounding private bores (Appendix B), consistent with the Project Approval for the Mt Arthur Coal Mine – Open Cut Consolidation Project Statement of Commitments: In the event of interruption to water supply resulting from the Project, an alternative water supply will be provided, until such interruption ceases. The process for identifying and compensating the interruption to water supply resulting from Mt Arthur Coal operations would be in accordance with the "protocol for adverse affects to nearby users" outlined in the Surface and Groundwater Response Plan (BHP Billiton, 2012f).				

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response	Status
Groundwater	In addition, notwithstanding the minor impacts to alluvium associated with the Modification, consistent with the Project Approval for the Mt Arthur Coal Mine – Open Cut Consolidation Project Statement of Commitments: Mt Arthur Coal will continue to monitor hydro-geomorphological conditions and scrutinise for evidence of any groundwater ingress or endwall instability indicators as it progresses the previously approved mining towards the Hunter River Alluvials. Mining (other than that already approved in the MAN [Mt Arthur North] EIS) will not extend beyond a nominal 150 m buffer zone from the Hunter River Alluvials until agreement is reached with DWE	Non - Compliant (Low Risk	NC REC 13: It is recommended that the groundwater model be verified such that the predicted drawdown reflects the observed drawdown and that hydro-geomorphological conditions can be assessed accurately.	**Comments** NC REC 13: The Groundwater Model was revised and verified in 2020. This will be reported on in the next Annual Review. **ACTION** NC REC 13: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed - 21/01/21	**ACTION** NC REC 13: **Complete** Annual review procedure updated to include this requirement.

Schedule and Condition Number	Condition	Compliance Status	Recommendations	Mt Arthur Coal Response	Status
	regarding the installation of a lower permeability barrier along the point of connections of mining and the alluvium or other appropriate safeguards.				

Table 46: 2020 Independent Environmental Audit Improvement Recommendations and Actions

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Demolition/Annual Review	S2 C10 of PA	IMP REC 1	Details of demolition should be included in the Annual Review going forward.	**Comments** IMP REC 1: There is a section in the current Mt Arthur Coal template for the inclusion of Demolition works, however not all demolition works were identified at the time of completing the report., Mt Arthur Coal will ensure that all demolition works are detailed in the Annual Review. **ACTION** IMP REC 1: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed - 21/01/21	**ACTION** IMP REC 1: **Complete** Annual review procedure updated to include this requirement. Included in Section 8.18.1 of this report.
Noise Monitoring Locations	S3 C2	IMP REC 2	When a review of the Noise Management Plan is triggered, the monitoring locations table should be updated to provide a reference between the Project Approval and EPL monitoring identification locations.	**ACTION** IMP REC 2: Mt Arthur Coal will include this improvement recommendation in the management plan review process triggered by this IEA **Forecast Completion:** 22 April 2021	**ACTION** IMP REC 2: **Complete** Review register updated with this improvement recommendation.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Traffic Noise Criteria	S3 C6	IMP REC 3	Include reference to the traffic noise criteria and compliance with them in the Annual Reviews. The Annual Review should include information about when the most recent traffic noise assessment was undertaken and when the next one is due.	**Comments** IMP REC 3: Mt Arthur Coal will include reference to traffic noise assessments in Annual Reviews. **ACTION** IMP REC 3: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed - 21/01/21	**ACTION** IMP REC 3: **Complete** Annual review procedure updated to include this requirement. Included in Section **Error! Reference source not found.** of this report.
Blasting Hours	S3 C11	IMP REC 4	Include day of week in blast database addition to date to confirm blasting does not occur on Sundays or public holidays.	**ACTION** IMP REC 4: Update the blasting spreadsheet to include the day of the week. **Forecast Completion:** 31 March 2021	**ACTION** IMP REC 4: **Complete** Spreadsheet has been updated.

Air Quality – Impact Assessment Criteria	S3 C20	IMP REC 5	Reporting of exceedances' of criteria, with evidence to be provided by Mt Arthur Coal to support compliance with the 'all reasonable and feasible avoidance and mitigation measures' component of this air quality management condition.	**<u>Comments</u>** IMP REC 5: Mt Arthur Coal reports exceedances to the DPIE in accordance with the approved Air Quality Management Plan. An email notification is provided to the DPIE as soon as practicable after becoming aware of an exceedance of the PM10 24-hour average criterion Assessment Criteria. An investigation is then conducted to validate the monitoring result. The investigation includes calculating the contribution from Mt Arthur Coal mining activities and the reporting evidence of the reasonable and feasible mitigation measures which were implemented in line with the approved Air Quality Management Plan. Mt Arthur Coal currently reports the total number of the cumulative PM10 24-hour average criterion Assessment Criteria in the Annual Review and will provide additional detail to support compliance with the requirement to employ 'all reasonable and feasible avoidance and mitigation measures' where the mine contribution is found to have caused the exceedance of the criteria. The information provided in the previous Annual Review documents has been accepted by the DPIE. **<u>ACTION</u>** IMP REC 5: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **<u>Forecast Completion:</u>** Completed - 21/01/21	**<u>ACTION</u>** IMP REC 5: **<u>Complete</u>** Annual review procedure updated to include this requirement. Included in Section **Error! Reference source not found.** of this report.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Air Quality Management Plan	S3 C24	IMP REC 6	We recommend that an independent air quality specialist is engaged to complete a quality check and review of the real time air quality management system. This includes a review of the dust contributions from the site.	**ACTION** IMP REC 6: Engage an air quality specialist to complete a quality check and review of the real time air quality management system. **Forecast Completion:** 31 March 2022	**ACTION** IMP REC 6: **Complete** Quality check and review of the real time air quality management system undertaken by Air Quality Specialist in January 2022.
Rehabilitation Management Plan	S3 C44	IMP REC 7	Undertake a complete site soil balance. This is urgent and critical to long term rehabilitation planning and future costings.	**Comments** IMP REC 7: An estimated topsoil balance will be prepared as part of a Topsoil Management Plan. Previous work has been completed to undertake trials in the use of alternative growth media to ensure adequate topsoil materials available for planned rehabilitation activities. This includes trials using Mixed Waste Organic Output (MWOO), prior to the EPA revoking the general and specific Resource Recovery Orders and Resource Recovery Exemptions. **ACTION** IMP REC 7 Revise the Rehabilitation Management Plan (part of the Mining Operations Plan) to include a draft version of the Topsoil Management Plan. **Forecast completion:** June 2021	**ACTION** IMP REC 7 **Complete** Updated Rehabilitation Management Plan with Topsoil Management Plan approved by the Resources Regulator in October 2021.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Rehabilitation Management Plan	S3 C44	IMP REC 8	Soil stockpiles should be either nominated as long-term or short-term stockpiles. Long-term stockpiles should be shaped and seeded. Stockpiles were observed to not be shaped or seeded with cover crop or pastures. Soil stockpiles should be sign posted and the locations updated on a GIS based program (created by the soil balance in Point 1). No stockpile signage was observed.	**Comments** IMP REC 8: Mt Arthur Coal has a topsoil management process detailed in MAC-ENC-PRO-012 Land Management Procedure. MAC also has a GIS database of topsoil stockpile locations supplied to the Auditor as part of the August 2020 information request. **ACTION** IMP REC 8: Revise the Rehabilitation Management Plan (part of the Mining Operations Plan) to include a tracking process that matches the operational requirements and internal planning process within the Topsoil Management Plan. **Forecast completion:** June 2021	**ACTION** IMP REC 8: **Complete** Updated Rehabilitation Management Plan with Topsoil Management Plan approved by the Resources Regulator in October 2021.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Rehabilitation Management Plan	S3 C44	IMP REC 9	Soil stockpiles should be managed for weeds to avoid an increase to the weed seed bank. Stockpile was infested with weeds creating a weed seed bank for future management.	**Comments** IMP REC 9: MAC has a topsoil management process detailed in MAC-ENC-PRO-012 Land Management Procedure. Mt Arthur Coal notes that weeds present in stockpiles are annual species from a seed bank present in topsoil prior to stripping. High rainfall and warm weather broke seed dormancy of the pre-existing seed bank. This is a regional issue. Weeds treatment at Mt Arthur Coal occurs as scheduling of contractors allows. **ACTION** IMP REC 9: Revise the Rehabilitation Management Plan (part of the Mining Operations Plan) to include a more detailed topsoil management process. **Forecast completion:** June 2021	**ACTION** IMP REC 9: **Complete** Updated Rehabilitation Management Plan with Topsoil Management Plan approved by the Resources Regulator in October 2021.
Visual Amenity and Lighting	S3 C52	IMP REC 10	Recommend a Lighting Audit to assess against Australian Standards AS 4282 - 1997. This will cover fixed exterior lighting and interior lighting that could impact the outdoor environment.	**ACTION** IMP REC 10: MAC will undertake a lighting audit of high risk fixed lighting. **Forecast Completion:** 31 January 2022	**ACTION** IMP REC 10: **Complete** Lighting audit commenced in January 2022 and report finalised April 2022.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Waste	S3 C53	IMP REC 11	Ensure all contractor areas are inspected as part of general inspections as these are areas of higher risk of poorer environmental management. Ensure future oil storage and servicing areas are within bunded areas. This recommendation currently relates to the EMECO and Pit Master Areas only.	**Comments** IMP REC 11: The contractor areas referred to in the audit were scheduled for decommissioning at the time of the audit. **ACTION** IMP REC 11: The EMECO and Pit Master Areas will be decommissioned. **Forecast Completion:** 31 December 2021	**ACTION** IMP REC 11: **Complete** Emeco was demobilised from site as previously reported however the area is still in use as a result of change in available work areas at MAC. In light of this change, MAC will continue to complete scheduled audits of the area to ensure sufficient controls are in place for servicing activities. This is in line with the intent of IMP REC 13 below. No further action is proposed.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Waste	S3 C53	IMP REC 12	Consider completing a review of segregation requirements and labelling of bins across site to identify improvement opportunities.	**<u>Comments</u>** IMP REC 12: Mt Arthur Coal has a robust waste management system in place all bins referred to in this recommendation are colour coded to the Australian Standard for mobile bin colours AS 4123.7–2006 and are positioned in designated locations. It is also noted that due to the harsh workshop environments the longevity of labels is limited, which is why the bin colour coding is the preferred identification mechanism in these situations. This system is proving effective an inspection of the bin content during the audit showed that they were being used correctly. **No further action is proposed.**	**<u>Comments</u>** IMP REC 12: No further action is proposed.
Waste	S3 C53	IMP REC 13	Ensure inspections are completed at a higher interval at the Thiess Workshop as the area does not have a setup to trap potentially contaminated water/liquids prior to it leaving the Thiess workshop area. Additional controls could be put in place during servicing within this workshop to prevent leakage of hydrocarbons.	**<u>Comments</u>** IMP REC 13: The Layered audit process is part of the Mt Arthur Coal Field Leadership program and provides a structured audit process for identifying risks and controls, as well implementing any identified corrective actions. **<u>ACTION</u>** IMP REC 13: Undertake a layered audit of the hydrocarbon management and drainage in the Thiess workshop area. **<u>Forecast Completion:</u>** 30 May 2021	**<u>ACTION</u>** IMP REC 13: **<u>Complete</u>** Layered Audit completed in May 2021

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Management Plans	S5 C2	IMP REC 14	Cross referencing tables containing the relevant conditions should be added to Management Plans which have not received a recent update. This would include all relevant conditions of the Development Consent and EPL and commitments from the 2013 Environmental Assessment.	**ACTION** IMP REC 14: The Project Approval Controlled Document Review Checklist MAC-HSE-FRM-001 will be updated to include a requirement to access Cross Referencing tables that include all relevant conditions of the Development Consent and EPL. **Forecast Completion:** 31 March 2021	**ACTION** IMP REC 14: **Complete** Project Approval Controlled Document Review Checklist and associated process has been revised in June 2021 and updated to include a requirement to assess Cross Referencing tables that include all relevant conditions of the Development Consent and EPL.
Incident Reporting	S5 C7	IMP REC 15	Consider improving the information provided in incident reports, this may include the addition of photographs where appropriate, consistent headings and layouts for reports. This will ensure consistency across incident reporting.	**Comments** IMP REC 15: MAC has not had any comments from the EPA or DPIE that incident reporting is not to an acceptable standard. Mt Arthur Coal will however consider this recommendation when writing future reports and will continue to work with the appropriate regulators on further improvements. **No further action proposed.**	**Comments** IMP REC 15: No further action is proposed.
Discharge Monitoring Points	P1.3 of EPL	IMP REC 16	Review and update Surface Water Management Plan and Monitoring Program to reflect the EPL variation.	**Comments** IMP REC 16: The Project Approval Controlled Document Review Checklist MAC-HSE-FRM-001 includes a requirement to review any changes to the EPL since the last management plan review. **No further action is proposed**.	**Comments** IMP REC 16: No further action is proposed.

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Blast Monitoring Locations	P1.4 of EPL	IMP REC 17	Clearly identify the EPL monitoring locations and ID within the BMP and Annual Reviews (ie BP04 [EPL ID 7])	**ACTION** IMP REC 17: Mt Arthur Coal will include this improvement recommendation in the management plan review process triggered by this IEA. **Forecast Completion:** 22 April 2021	**ACTION** IMP REC 17: **Complete** Blast Management Plan revised and approved by DPE in February 2022
Pollution of Waters	L1.1 of EPL	IMP REC 18	Implement the PRP for water pipelines in consultation with the EPA.	**Comments** IMP REC 18: Mt Arthur Coal is currently in consultation with EPA regarding the incident and implement the actions that result in accordance with the EPA's requirements. As this process is being controlled by the EPA regulatory instruments. **No further action is proposed**.	**Comments** IMP REC 18: No further action is proposed
Blasting	L6.1 of EPL	IMP REC 19	Include day of week in blast database addition to date to confirm blasting does not occur on Sundays or public holidays.	**ACTION** IMP REC 19: Update the blast database to include the day of the week. **Forecast Completion:** 28 February 2021	**ACTION** IMP REC 19: **Complete** Spreadsheet has been updated

Aspect	Condition Reference	Improvement REC Number	Recommendation	Mt Arthur Coal Response	Status
Annual Review	CCL 396 Condition 2	IMP REC 20	Include a cross referencing table in the Annual Review outlining the conditions relevant to the Development Consent and Mining Lease.	**ACTION** IMP REC 20: The annual review process document has been updated to include a task to ensure that all independent environmental audit actions relating to annual review content are reviewed and included in the Annual Review. **Forecast Completion:** Completed - 21/01/21	**ACTION** IMP REC 20: **Complete** Project Approval Controlled Document Review Checklist and associated process has been revised in June 2021 and updated to include a requirement to assess Cross Referencing tables that include all relevant Development Consent and Mining Lease conditions.

11 Incidents and Non-compliances

<100% data capture at EPL HRSTS Discharge Point 6 – 12 July 2022

While undertaking discharge on the 12th of July 2022 under river register 2022-195(1) the HRSTS discharge valve was open and providing a consistent flow rate through the discharge point. At 6:45pm while the discharge was still occurring, the communication device providing discharge rates started sending through an error message. The error caused incorrect salt load calculations and the discharge volumes being provided to WaterNSW.

As soon as it was identified the discharge valve was closed. Further monitoring of the valve was undertaken for several hours following the issue being identified. A technician was sent out to investigate the issue with no systemic or obvious issues identified.

The EPA were notified of the issue on the 13th of July. A new flow meter was installed to help eliminate the possibility that the cause was related to equipment issues, it was ruled out as a potential issue. This incident was reported to the EPA in the 2022 Annual Return as a non-compliance to the water monitoring requirements in Condition M2.3 of the EPL with no further action requested by the EPA.

Overpressure exceedance – 26 July 2022

An elevated overpressure result was recorded at the Sheppard Avenue monitoring site (BP07 / EPA Monitoring Point 8) as exceeding the criteria following a blast on 26 July 2022 at 13:24. The exceedance was subsequently reported to both the EPA and DPE.

A third-party subject matter expert was engaged to investigate the overpressure exceedance. The results concluded that the exceedances were found to be recorded outside of the airblast arrival time and due to wind gust interference. Based on scaling analysis, it was determined that the airblast overpressure results for both the North Yammanie and Sheppard Ave blast monitors were below the airblast overpressure criteria.

The DPE determined that there was no breach of the Approval. This incident was also reported in the 2022 Annual Return as a non-compliance to Condition L6.3 of the EPL.

<100% data capture at EPL HRSTS Discharge Point 6 – 5 September 2022

While undertaking a discharge under the HRSTS on the 5th of September 2022, the Discharge Point communications device failed which resulted in the live data feed of continuous flow and water quality data required under EPL11457 to be lost. This issue was not identified until a few hours after the issue had self-rectified.

The data from this period was not able to be recovered resulting in a loss of 50 minutes' worth of 5-minute readings.

Since this time improvements have been made to the Discharge Point with a new alert system in place notifying site personnel when there are any communication errors or dropouts at any time.

This incident will be reported in the 2023 EPL annual return as a non-compliance to the water monitoring requirements in Condition M2.3.

Missed Complaint Response – 7 November 2022

A dust complaint was received by Mt Arthur Coal on the 7th of November 2022. Mt Arthur Coal is required to call all complainants back within 48 hours of receiving the complaint. On this occasion Mt Arthur Coal was unable to call the complainant back within the required timeframe due to staff shortages and leave periods.

On the 10th of November 2022 Mt Arthur Coal received a request for information from DPE regarding this complaint. Mt Arthur Coal provided a response to DPE outlining the actions that were taken in the days preceding the complaint and provided details on the actions that were taken to respond to dust concerns.

The DPE determined that there was no breach of the Project Approval or the Environmental Management System (EMS requirements) as such, this has not been captured in Section 1 Table 3 as a non-compliance.

Noise exceedance not reported to EPA

On 19th October 2021 a noise exceedance occurred which was detected as part of the routine compliance monitoring, which was reported and investigated by DPE and included as a non-compliance in the FY22 Annual Review. Following the exceedance, a report was provided to DPE and investigations undertaken accordingly, however the EPA was not notified of the exceedance as required under Condition R4.2 of EPL 11457 as the conditions between the EPL and PA were misaligned.

As previously reported in the FY22 Annual Review, upon analysis of the meteorological data it was determined that the criteria was not applicable at the time of the measurement as per Appendix 10 of the Project Approval. It was also later identified that there was a small inconsistency between the meteorological conditions listed in the EPL and the conditions in Appendix 10 of the Project Approval.

An EPL variation was later completed to align the meteorological conditions between the EPL and the Project Approval to ensure reporting is consistent moving forward.

This incident was reported in the 2022 Annual Return as a non-compliance to Condition R4.2 with no further action requested.

<100% data capture at EPL Air Quality Monitoring Points

During the reporting period Mt Arthur Coal recorded <100% data capture at the four EPL air quality monitoring points, data capture rates as below.

- EPL Monitoring Point 11: 97.5%
- EPL Monitoring Point 12: 97.8%
- EPL Monitoring Point 13: 86%
- EPL Monitoring Point 14: 95.9%

The reason for the missed data capture was due to routine servicing / calibrations as well as a few minor technical issues and equipment malfunctions, and intermittent power outages. To prevent recurrence of non-compliance and increase valid data capture, Mt Arthur Coal conducts daily system checks on the PM10 air quality monitoring units. Regular maintenance and calibration are also carried out in accordance with the manufacturer's specifications. During FY23 seven new TEOMs were installed and a total of 11 new UPS battery units were also installed to improve data capture during periods of power interruption.

In addition to this, an EPL variation was undertaken to reduce data capture requirements to a total of 95% for the reporting period. This aligns with the EPA guidance and allows for routine maintenance and calibrations to be undertaken in line with manufacturers specifications and Australian Standards.

This incident was reported in the 2022 Annual Return as a non-compliance to Condition M2.2 with no further action requested.

Missing quarterly STP records

Mt Arthur Coal is required to undertake inspections of the site Sewage Treatment Plan (STP) on a quarterly basis and keep written records, in accordance with Condition O2.6 of EPL 11457. During the reporting period as the 2022 Annual Return was being prepared it was found that the evidence documented in various written records had been misplaced.

All of the required maintenance tasks were undertaken throughout the year which was evident through sign off of the internal task tracking system (SAP) however the written records were unable to be located.

To prevent this from occurring again, all of the work orders from SAP that are associated with the STP were marked as critical work orders which ensures that each task is now treated with the highest level of importance, requiring all records to be scanned and saved following completion of each task.

In addition to this, an EPL variation was undertaken to allow for either a written record or an electronic confirmation to be provided as evidence for each quarterly inspection. This incident was reported to the EPA in the 2022 Annual Return as a non-compliance Condition O2.6 of the EPL with no further action requested.

Groundwater Trigger Exceedances

During the reporting period there were Groundwater Quality and Level trigger events. All trigger events reported to DPE and are detailed in Section 7.4 and 0. Assessment by expert groundwater consultants determined that the trigger events were not caused by mining activities at Mt Arthur Coal and as such, they have not been captured in Section 1 Table 3 as non-compliances.

Mt Arthur will continue to review trigger levels to ensure they are appropriate and where required revise the Site Water Management Plan.

Air Quality Exceedances

During the reporting period there were 11 cumulative 24-hour PM10 exceedance events (Cumulative 24-hour PM10 >50$\mu g/m^3$). The events were all reported DPE and are detailed in Section 0. Investigations, in accordance with the Mt Arthur Coal Air Quality Management plan, determined that the exceedances were not caused by mining activities at Mt Arthur Coal. In accordance with the site Air Quality Management Plan and the Project Approval, Mt Arthur Coal employed all reasonable and feasible avoidance and mitigation measures and as such, they have not been captured in Section 1 Table 3 as non-compliances.

12 Activities during Next Reporting Period

Mt Arthur Coal has established the following targets for the next reporting period:

- Mt Arthur Coal upgraded the site real time monitoring platform and technology to incorporate further user improvements and introduced new noise monitoring capabilities such as live audio streaming and data capture in the last reporting period and in the next reporting period, further improvements will be made to incorporate data from the fleet management system as well as reviewing potential for real time forecasting and modelling. Mt Arthur Coal also intends to introduce a local and regional background calculation method to improve the assessment for the mine's incremental contribution.

- Mt Arthur Coal will continue to assess and upgrade real time monitoring sites to improve reliability and data capture rates across all real time monitoring including replacements of communication devices at monitoring sites including dust, noise, and blast.

- Mt Arthur Coal will continue to investigate and, where feasible, implement projects to reduce fossil fuel energy consumption and greenhouse gas emissions in accordance with BHP's sustainability commitments, including the company's greenhouse gas emission targets.

- Mt Arthur Coal will finalise the installation of a new hydrocarbon remediation and management area.

- Improvements to the mine water pipeline network will be completed in FY24 to reduce the risk of pollution of waters from mine water pipeline breaks in accordance with the PRP schedule.

- Mt Arthur Coal will commence a project to replace and repair current boreholes and telemetry at boreholes as required.

- Mt Arthur Coal will engage an air quality specialist to complete a quality check and review of the newly implemented real time monitoring system.

- Mt Arthur Coal will look to relocate a blast monitor to a more representative location following an acquisition.

- Mt Arthur Coal will update the Blast Management Plan and Environmental Protection Licence in accordance with the relocated blast monitoring site.

- Mt Arthur Coal will undertake the next three yearly Independent Environmental Audit.

- Mt Arthur Coal will install additional water meters to the site water network, these will improve the understanding of water movement on site and consumption. The data will improve water model accuracy and allow for improved planning strategies and efficiencies in the water management system.

These targets will be closely monitored and an update on the status of each will be reported in the next Annual Review.

Table 47 outlines a progress summary of Mt Arthur Coal's performance against targets set for the FY22 period.

Table 47: Mt Arthur Coal's performance against targets for FY22

Target	Status	Performance
In the last reporting period Mt Arthur Coal has installed three new systems for unattended noise monitoring with the intention to install two new systems in the coming months with improved capability and technology.	Completed	Systems installed.

Target	Status	Performance
Update of the Noise Management Plan.	Completed	Noise Management Plan updated and approved by DPE on 28/04/2023.
Mt Arthur Coal will continue to assess and upgrade real time monitoring sites to improve reliability and data capture rates across all real time monitoring including replacements of TEOMs and UPS units.	Completed	TEOMs scheduled for upgrades have been replaced and UPS units were upgraded to include additional capability, triggering an alert when the monitoring site loses power.
Mt Arthur Coal will roll out the use of a newly developed real time monitoring system in FY23.	Completed	New real time monitoring system rolled out in November 2022.
Mt Arthur Coal will continue to use remote sensing in the assessment of landform stability as part of the review of the REMP and complete the review of the aerial weed assessment.	Ongoing	This work is currently underway and will be ongoing through the next reporting period.
Mt Arthur Coal will continue to investigate and, where feasible, implement projects to reduce fossil fuel energy consumption and greenhouse gas emissions in accordance with BHP's sustainability commitments, including the company's greenhouse gas emission targets.	Ongoing	Continued to review potential for projects to reduce fossil fuel consumption. Work in this space is still ongoing.
Mt Arthur Coal will finalise the installation of a new hydrocarbon management area.	Ongoing	The new hydrocarbon management area project is yet to be completed due to relocation of the new area required. The project is still ongoing and expected to be complete in FY24.
Improvements to the mine water pipeline network will continue to be undertaken throughout the FY23 reporting period to reduce the risk of pollution of waters from mine water pipeline breaks in accordance with the PRP schedule.	Completed	The PRP upgrades were completed to schedule in FY23.
Mt Arthur Coal will undertake a review of the Water Management Plan to revise groundwater and surface water triggers in accordance with groundwater investigation findings.	Complete	The triggers in the Water Management Plan were revised with the new WMP approved by DPE on 29/03/2023. The new triggers were utilised for the first round of monitoring in June 2023.
Mt Arthur Coal will commence a project to replace and repair current boreholes and telemetry at boreholes as required.	Ongoing	The project to replace and repair current boreholes is still ongoing. This project is expected to go into execution during FY24.
Mt Arthur Coal will engage an air quality specialist to complete a quality check and review of the newly implemented real time monitoring system.	Complete	Quality and logic review completed during the development of the new real time data platform.

Appendix 1 - Surface Water Quality Monitoring Results

Surface Water Quality Results

Site	Month	Date sampled	Flow (description)	Field pH	Field EC (uS/cm)	TSS (mg/L)
SW02	Jul-22	12/07/2022	Too wet to access			
	Aug-22	16/08/2022	Too wet to access			
	Sep-22	13/09/2022	Dry			
	Oct-22	11/10/2022	Dry			
	Nov-22	15/11/2022	Dry			
	Dec-22	13/12/2022	Dry			
	Jan-23	17/01/2023	Dry			
	Feb-23	14/02/2023	Dry			
	Mar-23	14/03/2023	Dry			
	Apr-23	12/04/2023	Dry			
	May-23	15/05/2023	Dry			
	Jun-23	14/06/2023	Dry			
	Impact Assessment Criteria Trigger Values prior to new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**12365**	**219**
			Stage 2 Trigger		**13900**	**277**
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**12365**	**219**
			Stage 2 Trigger		**13900**	**277**
SW03	Jul-22	12/07/2022	Too wet to access			
	Aug-22	16/08/2022	Too wet to access			
	Sep-22	13/09/2022	Still	7.88	7220	<5
	Oct-22	11/10/2022	Too wet to access			
	Nov-22	15/11/2022	Slow	7.80	1591	7
	Dec-22	13/12/2022	Slow	7.64	7230	10
	Jan-23	17/01/2023	Trickle	7.64	8260	5
	Feb-23	14/02/2023	Still	7.55	8660	<5
	Mar-23	14/03/2023	Still	7.82	8670	<5
	Apr-23	12/04/2023	Still	7.64	8390	6
	May-23	15/05/2023	Still	8.02	8490	20
	Jun-23	14/06/2023	Still	7.58	9020	6
	Impact Assessment Criteria Trigger Values prior to new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**10133**	**37**
			Stage 2 Trigger		**11402**	**46**
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**10133**	**37**
			Stage 2 Trigger		**11402**	**46**

Site	Month	Date sampled	Flow (description)	Field pH	Field EC (uS/cm)	TSS (mg/L)
SW04	Jul-22	12/07/2022	Trickle	7.97	5040	10
	Aug-22	16/08/2022	Trickle	7.93	3730	8
	Sep-22	13/09/2022	Trickle	7.92	7470	<5
	Oct-22	11/10/2022	Trickle	7.91	3610	14
	Nov-22	15/11/2022	Steady	7.51	258	127*
	Dec-22	13/12/2022	Trickle	7.94	7820	8
	Jan-23	17/01/2023	Trickle	7.98	8590	<5
	Feb-23	14/02/2023	Trickle	7.82	8660	17
	Mar-23	14/03/2023	Trickle	7.89	8550	12
	Apr-23	12/04/2023	Trickle	7.97	8560	5
	May-23	16/05/2023	Trickle	7.98	7900	7
	Jun-23	14/06/2023	Trickle	8.15	7550	<5
	Impact Assessment Criteria Trigger Values prior to new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**13959**	**82**
			Stage 2 Trigger		**15509**	**104**
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**13959**	**82**
			Stage 2 Trigger		**15509**	**104**
SW12	Jul-22	12/07/2022	Steady	7.88	3230	7
	Aug-22	16/08/2022	Steady	8.07	2200	<5
	Sep-22	13/09/2022	Slow	7.94	4100	7
	Oct-22	11/10/2022	Slow	7.96	2476	<5
	Nov-22	15/11/2022	Steady	7.60	1086	22
	Dec-22	13/12/2022	Slow	7.70	5660	<5
	Jan-23	17/01/2023	Still	7.71	5510	14
	Feb-23	14/02/2023	Still	7.57	6050	10
	Mar-23	13/03/2023	Still	7.85	4580	23
	Apr-23	11/04/2023	Trickle	8.27	7120	15
	May-23	16/05/2023	Still	8.02	5660	29
	Jun-23	13/06/2023	Still	8.46	5780	45
	Impact Assessment Criteria Trigger Values prior to new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**6659**	**555**
			Stage 2 Trigger		**7153**	**708**
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**6659**	**555**
			Stage 2 Trigger		**7153**	**708**
SW15	Jul-22	12/07/2022	Dam	8.08	442	<5
	Aug-22	16/08/2022	Dam	7.77	581	<5
	Sep-22	13/09/2022	Dam	8.21	1205	70
	Oct-22	11/10/2022	Slow	7.81	532	10
	Nov-22	15/11/2022	Dam	7.93	799	11
	Dec-22	13/12/2022	Too low to sample			
	Jan-23	17/01/2023	Dam	7.48	2347	10
	Feb-23	14/02/2023	Too low to sample			
	Mar-23	13/03/2023	Dry			
	Apr-23	11/04/2023	Dry			
	May-23	16/05/2023	Dry			
	Jun-23	13/06/2023	Too low to sample			
			Stage 1 Trigger	**6.5< >9.0**	**7128**	**103**

	Impact Assessment Criteria Trigger Values prior to new WMP approval on 29 March 2023		**Stage 2 Trigger**		**8262**	**130**
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**6.5< >9.0**	**7128**	**103**
			Stage 2 Trigger		**8262**	**130**
SW34	Apr-23	12/04/2023	Slow	7.97	1141	22
	May-23	16/05/2023	Steady	8.03	1212	16
	Jun-23	14/06/2023	Moderate	8.27	512	16
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**N/A**	**N/A**	**N/A**	**N/A**
SW35	Apr-23	12/04/2023	Steady	8.27	1143	24
	May-23	16/05/2023	Steady	8.18	1250	17
	Jun-23	13/06/2023	Moderate	8.33	497	19
	Impact Assessment Criteria Trigger Values after new WMP approval on 29 March 2023		**Stage 1 Trigger**	**7.8< >8.5**	**893**	**54**

*TSS exceeded the trigger level in November 2022 at SW04 however the version of the Surface and Groundwater Response Plan (2021 WMP) that was in place at the time did not include requirement to report any TSS exceedances. This has been updated in the new WMP with TSS triggers included in the Response Plan (2023 WMP)

Appendix 2 Ground Water Monitoring Results and Groundwater Level Drawdown Analysis

Environmental & Social Consultants

MT ARTHUR COAL

Groundwater Annual Review – 2022/2023

FINAL

August 2023

MT ARTHUR COAL

Groundwater Annual Review – 2022/2023

FINAL

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

BHP

Project Director: Claire Stephenson
Project Manager: Kirsty Cooksey
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Technical Manager: Claire Stephenson

Report No. 21576/R22
Date: August 2023

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Document Status

Rev No.	Prepared By		Approved for Issue	
	Name	Date	Name	Date
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Final V3	K Cooksey	30/08/2023	K Cooksey	30/08/2023

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1.0 Introduction

1.1 Overview

The Mt Arthur Coal (MAC) mine is located approximately 5 km southwest of Muswellbrook within the Muswellbrook Shire Local Government Area (LGA) in the Upper Hunter Valley of NSW. MAC sits within 15 mining leases and consists of open cut pits, tailings storage facilities, a coal handling preparation plant, a rail loop and associated rail loading facilities, in addition to an approved underground operation. Over 2022 and 2023 open cut mining continued at MAC, progressing down-dip to the southwest. Mining occurred in the Windmill, Calool, Roxburgh, Ayredale and Saddlers pits (BHP, 2022).

The Water Management Plan (WMP) covers approval commitments in Project Approval 09_0062 MOD1 and conditions of Environment Protection Licence 11457. This includes requirements for the monitoring of groundwater, assessment of potential impacts and reporting. The WMP (MAC-ENC-MTP-034) dated 6 October 2021, was updated and approved by the Department of Planning and Environment (DPE) on 29 March 2023.

Umwelt has been engaged to undertake a review of the groundwater monitoring data collected from 1 July 2022 to 30 June 2023 (reporting period). This report has been prepared to address conditions of approval relating to groundwater, and as a requirement of MAC's 2022/2023 Annual Review (AR).

1.2 Groundwater Management Plan

The WMP includes a Groundwater Monitoring Program, in accordance with Schedule 3 Condition 29 and 33 of Development Consent 09_0062. The Groundwater Monitoring Program outlined in Section 9.3 of the WMP details the monitoring methodology, monitoring locations, frequency impact assessment criteria (water levels and quality), mine inflows/licensing, impacts to private bores and groundwater dependent ecosystems (GDEs), cut-off wall and flood levee monitoring and monitoring records.

The WMP was updated in 2022 and approved by DPE on 29 March 2023. Updates to the WMP were made based on additional work conducted on site. This included fieldwork by Carbon Based Environmental Ltd (CBE) between August and October 2022 to check the condition and construction of the bore network, and a subsequent desktop network review conducted by Umwelt. The findings from the network review were used to inform the current compliance monitoring network details in the WMP, discussed in **Section 3.1**.

In 2020 an updated numerical groundwater model was developed by SLR (2020a), which was calibrated with observation data to June 2020. The predictions for approved operations from the updated numerical model were used to inform the proposed water level triggers. The groundwater monitoring locations, schedule and triggers from the WMP are presented in **Appendix A** and discussion on the network included in **Section 3.1**. Between July 2022 and March 2023, during the reporting period, groundwater monitoring and reporting was conducted at MAC in accordance with the WMP that was in place at this time (MAC-ENC-MTP-034). Following approval of the updated WMP, groundwater monitoring and reporting was conducted at MAC in accordance with the new requirements in the WMP (MAC-ENC-MTP-034 during the reporting period.

The monitoring results and discussion within this report have been split into two periods:

- July 2022 to March 2023 to reflect the monitoring programme and trigger levels in the WMP (MAC-ENC-MTP-034) (BHP, 2021).
- April to June 2023 to reflect the monitoring programme and trigger levels in the WMP (MAC-ENC-MTP-034) (BHP, 2023).

The threshold criteria as outlined in Section 10 Response Plan of the WMP is included in **Table 1.1**.

Table 1.1 Surface Water and Groundwater Exceedance Protocol (BHP, 2023)

Impact Assessment Criteria	Exceedance Criterion	Exceedance Response
pH surface water or groundwater quality	Measured values that are outside the trigger level shall trigger the exceedance response.	Step 1: Quality assurance check of the sampling procedure and analytical data acquired, reported and entered. Step 2: For a single exceedance of the trigger value, no further action is required other than to record the exceedance. If the trigger value of the same parameter is exceeded at the same location for **three consecutive monitoring periods**, then the actions required for exceedance of the trigger values should be carried out. Step 3: Consult with the DPE to determine if a written report on the exceedance will be required and implement identified corrective/preventative actions.
pH surface water or groundwater quality	pH values recorded outside the trigger level range for three consecutive monitoring periods shall trigger the groundwater quality exceedance response.	Step 1: Notify the DPE of an 'interim exceedance' as soon as practicable after becoming aware of the exceedance and relevant information required for the notification is confirmed (including preliminary quality assurance of information). Step 2: If quality assurance check of the sampling procedure and analytical data acquired, reported and entered, and the trigger level is still exceeded, then an investigation of the exceedance should be carried out and reasons for the exceedance identified. Step 3: Consult with the DPE to determine if a written report on the exceedance will be required and implement identified corrective/preventative actions.
Electrical Conductivity (EC) **Stage 1 surface water or groundwater quality**	Measured values that are above the Stage 1 trigger level shall trigger the exceedance response.	Step 1: Quality assurance check of the sampling procedure and analytical data acquired, reported and entered. Step 2: For a single exceedance of a 1st stage trigger value, no further action is required other than to record the exceedance. If the 1st stage trigger value of the same parameter is exceeded at the same location for **three consecutive monitoring periods**, then the actions required for exceedance of the 2nd stage trigger values should be carried out.
Electrical Conductivity (EC) **Stage 2 surface water or groundwater quality**	Measured values above Stage 1 trigger levels for three consecutive monitoring periods shall trigger the exceedance response.	Step 1: Notify the DPE of an 'interim exceedance' as soon as practicable after becoming aware of the exceedance and relevant information required for the notification is confirmed (including preliminary quality assurance of information).

Impact Assessment Criteria	Exceedance Criterion	Exceedance Response
	Measured values above Stage 2 trigger levels for two consecutive monitoring periods shall trigger the exceedance response.	Step 2: If quality assurance check of the sampling procedure and analytical data acquired, reported and entered, and the trigger level is still exceeded, then an investigation of the exceedance should be carried out and reasons for the exceedance identified. Step 3: Consult with the DPE to determine if a written report on the exceedance will be required and implement identified corrective/preventative actions.
Total Suspended Solids **Stage 1 surface water**	Measured values that are above the Stage 1 trigger level shall trigger the exceedance response.	Step 1: Quality assurance check of the sampling procedure and analytical data acquired, reported and entered. Step 2: For a single exceedance of a 1st stage trigger value, no further action is required other than to record the exceedance. If the 1st stage trigger value of the same parameter is exceeded at the same location for **three consecutive monitoring periods**, then the actions required for exceedance of the 2nd stage trigger values should be carried out.
Total Suspended Solids **Stage 2 surface water**	Measured values above Stage 1 trigger levels for three consecutive monitoring periods shall trigger the exceedance response. Measured values above Stage 2 trigger levels for two consecutive monitoring periods shall trigger the exceedance response.	Step 1: Notify the DPE of an 'interim exceedance' as soon as practicable after becoming aware of the exceedance and relevant information required for the notification is confirmed (including preliminary quality assurance of information). Step 2: If quality assurance check of the sampling procedure and analytical data acquired, reported and entered, and the trigger level is still exceeded, then an investigation of the exceedance should be carried out and reasons for the exceedance identified. Step 3: Consult with the DPE to determine if a written report on the exceedance will be required and implement identified corrective/preventative actions.
Groundwater Level	Any monitoring bore groundwater level or vibrating wire piezometer groundwater head pressure recorded below the trigger level for three consecutive monitoring periods shall trigger the groundwater level exceedance response.	Step 1: Notify the DPE of an 'interim exceedance' as soon as practicable after becoming aware of the exceedance and relevant information required for the notification is confirmed (including preliminary quality assurance information). Step 2: If quality assurance check of the sampling procedure and analytical data acquired, reported and entered, and the trigger level is still exceeded, then an investigation of the exceedance should be carried out and reasons for the exceedance identified. Step 3: Consult with the DPE to determine if a written report on the exceedance will be required and implement identified corrective/preventative actions.

2.0 Hydrogeological Setting

2.1 Climate

The climate within the MAC area is sub-tropical, with temperatures, rainfall and evaporation highest over the summer months of December to February. Climate data was obtained from the Scientific Information for Land Owners (SILO) database of historical climate records for Australia hosted by the Department of Environment and Science (DES). This service interpolates raw rainfall and evaporation records obtained from the Bureau of Meteorology (BOM), with data gaps addressed through data processing in order to provide a spatially and temporally complete climate dataset.

Climate data was obtained for a SILO grid point (Latitude -32.35, Longitude 150.85) at MAC between 01/01/1900 to 30/06/2023. A summary of rainfall data for SILO is presented in **Table 2.1**. The historical average rainfall data indicates slightly higher rainfall over the summer months, from December to February. Based on the SILO dataset, the historical average annual rainfall is 610.8 mm.

Table 2.1 Monthly Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Historical Average	72.4	65.3	57.0	42.4	36.4	45.8	43.6	37.2	42.0	49.4	57.5	61.8	**610.8**
2022	-	-	-	-	-	-	160.6	94.3	76.2	132.7	96.8	24.9	**803.9**
2023	53.7	51.8	54.6	41.6	0.9	15.8	-	-	-	-	-	-	

Note: Based on SILO dataset date range January 1900 to June 2023.

The SILO database provides the most complete long-term dataset and is therefore the most useful for assessing long term rainfall trends in the vicinity of MAC. Monthly records from the SILO dataset were used to calculate the Cumulative Rainfall Departure (CRD). The CRD shows graphically trends in recorded rainfall compared to long-term averages and provides a historical record of relatively wet and dry periods. A rising trend in slope in the CRD graph indicates periods of above average rainfall, whilst a declining slope indicates periods when rainfall is below average. A level slope indicates average rainfall conditions.

Figure 2.1 shows the CRD and total monthly rainfall. The graph indicates the area has generally experienced a period of relatively average rainfall from 2000 to 2007. Above average rainfall was experienced from 2007 to 2017. From 2017 to 2020 the area experienced below average rainfall and between the start of 2020 and the end of 2022 area experienced above average rainfall. In 2023, rainfall to date is below average.

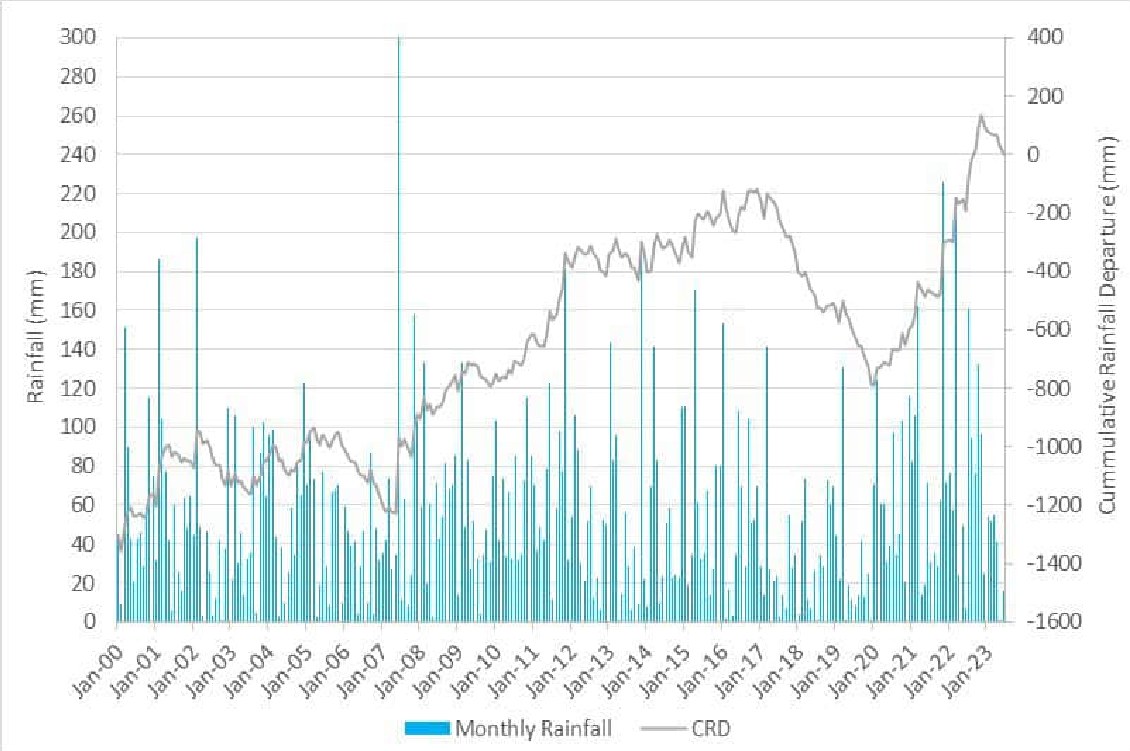


Figure 2.1 SILO Monthly Rainfall and CRD

2.2 Terrain and Drainage

The surface topography at MAC varies between approximately 127 metres (m) Australian Height Datum (AHD) to the northwest of the site along Whites Creek and rises up to a maximum of approximately 465 mAHD on the top of Mt Arthur to the south of the site. Within MAC, the surface areas are drained by Saddlers Creek and its tributaries to the southeast, as well as Quarry Creek, Whites Creek and Ramrod Creek that all flow towards the Hunter River.

Saddlers Creek is an ephemeral creek that is around 5 to 10 m wide and consists of sand, silt and scattered woody debris (EcoLogical, 2019). Historical mining at Drayton truncated the upper reaches of Saddlers Creek, which previously had a catchment of approximately 78 km^2. The creek bed is dry much of the year, with shallow (20 cm) isolated pools of water (Hydrosimulations, 2019). Historically, high flow events occurred in response to rainfall events, with available data indicating the majority of stream flow occurred in the summer months, from January to March, with negligible flows from July to December.

Within the region, the Hunter River is around 20 m to 50 m wide and flows in a south to south-easterly direction. Flows within the Hunter River are monitored at gauging stations under the Hunter Integrated Telemetry System (HITS) operated by WaterNSW. Based on flow data recorded between 1913 and 2023, the Hunter River has perennial flows, ranging between 0 ML/day and 175,000 ML/day, with an average flow of 807 ML/day. Over the reporting period flows recorded at HITS gauging station 210002 ranged between 68 ML/day and 28,162 ML/day, with an average flow of 1,924 ML/day. High flow/flood events, with flows over 10,000 ML/day, were recorded along the Hunter River in July, August, October and November 2022. Only one moderate flow event was recorded in 2023, as shown in **Figure 2.2**.

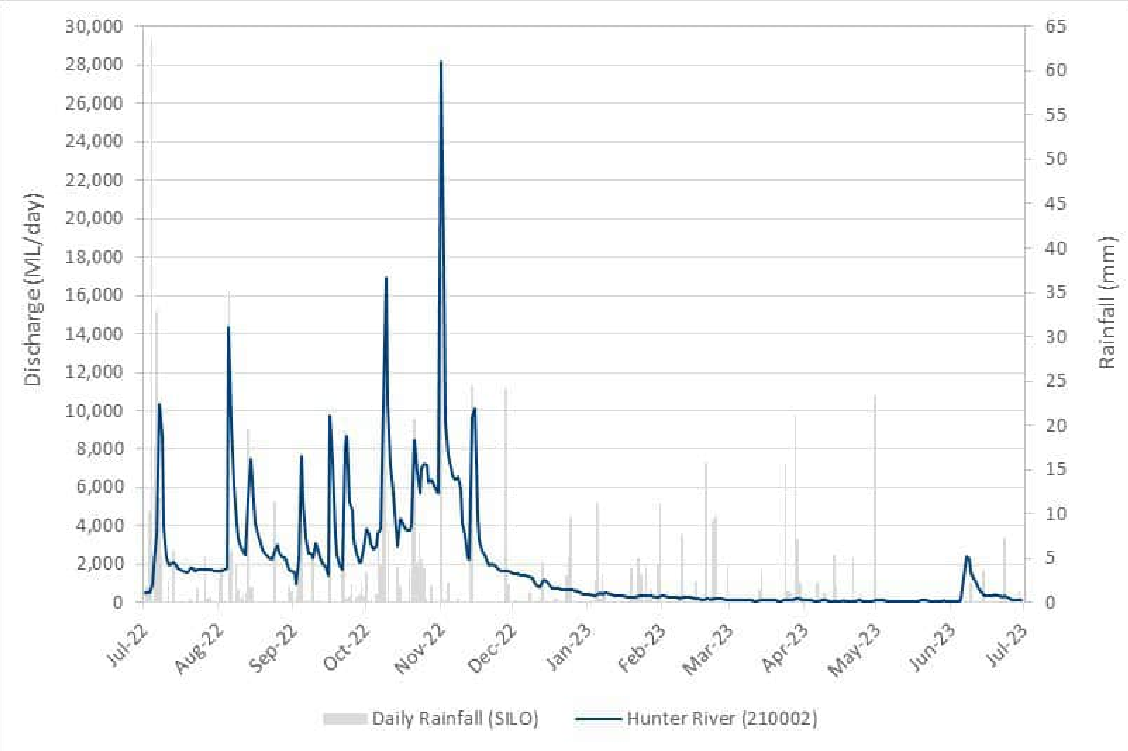


Figure 2.2 Hunter River Flow and Daily Rainfall Over Monitoring Period

2.3 Hydrogeology

2.3.1 Hunter River Alluvium

The Hunter River alluvium generally comprises surficial clays underlain by sands and gravels. The alluvium can be variably saturated spatially and temporally, with unconfined groundwater conditions and fresh to brackish water quality. The alluvium is recharged from rainfall and streamflow. The water levels in the alluvium are generally 5 to 10 m below surface and approximately 2 m below the base of the Hunter River, indicating variable losing conditions depending on peak flood events. There is also potential for upward seepage from the underlying Permian coal measures where gradients enable this.

Groundwater flow in the alluvium generally follows the Hunter River flow direction and topography.

2.3.2 Saddlers Creek Alluvium

The Saddlers Creek alluvium is unconfined and recharged from occasional streamflow and rainfall, with potential recharge from water storage in localised areas. The alluvium also potentially receives upward seepage from the underlying coal measures, with coal seams occurring at subcrop beneath the alluvium.

The water levels in the alluvium have been recorded around 3 m to 10 m below surface, indicating losing conditions. However, gaining conditions can occur downstream near the confluence with the Hunter River. The water quality in the alluvium along Saddlers Creek has been characterised as moderately saline (SLR, 2020b).

2.3.3 Permian Coal Measures

The Permian coal measures include the hydraulically 'tight' interburden sequences of siltstone and sandstone, and the coal seams that exhibit secondary porosity associated with the fractures and cleats in the coal. The coal measures occur at subcrop in the north and east of MAC where groundwater conditions are semi-confined, becoming confined with depth. The coal measures are recharged by rainfall and downward seepage from overlying alluvium, regolith and spoil. Groundwater flow in the coal measures is locally influenced by mining at MAC, Drayton and Bengalla, but is generally towards the south. The water quality is moderately saline (SLR, 2020b).

3.0 Groundwater Monitoring Program

3.1 Groundwater Monitoring Network

The groundwater monitoring network at MAC is comprised of a series of monitoring bores and vibrating wire piezometers (VWPs).

The groundwater monitoring network outlined within the 2021 WMP and shown in **Figure 3.1**, applies to the period July 2022 to March 2023, and includes:

- 22 monitoring bores, including:
  - four bores along Saddlers Creek alluvium, one of which intersects both alluvium and regolith
  - five bores within Hunter River alluvium
  - one bore in the regolith near Saddlers Creek
  - twelve monitoring bores predominantly targeting coal seams down to the Ramrod Creek Seam.
- Six VWPs with sensors in the interburden and coal seams, including:
  - two sites around the mapped F4 fault with a sensor in the fault zone at 216.5 mbgl (VWP2_P1), a sensor in the Edinglassie Seam at 227 mbgl (VWP3_P1) and a sensor in the Ramrod Creek Seam at 241 mbgl (VWP3_P2)
  - four sites (VWP04 to VWP07) southwest of MAC open cut with sensors in the different coal seams.

The groundwater monitoring network outlined within the 2023 WMP, shown in **Figure 3.2** and detailed in **Appendix A**, applies to the period April 2023 to June 2023, and includes:

- 22 monitoring bores, including:
  - two bores along Saddlers Creek alluvium
  - six bores within Hunter River alluvium
  - three bores in the Saddlers Creek shallow Permian (regolith)
  - eleven monitoring bores predominantly targeting coal seams down to the Ramrod Creek Seam.
- Six VWPs with sensors in the interburden and coal seams, including:
  - two sites around the mapped F4 fault with a sensor in the fault zone at 216.5 mbgl (VWP2_P1), and a sensor in the Edinglassie Seam at 227 mbgl (VWP3_P1)
  - four sites (VWP05, VWP06, VWP07 and X1) southwest of MAC open cut with sensors in the different coal seams.

Monitoring of groundwater levels and groundwater quality is undertaken at the bores detailed in the WMP, and defined below:

- Groundwater Level (22 bores):
  - Manual groundwater elevation/depth to groundwater every three months.
  - Timeseries groundwater level data is recorded with data loggers installed in selected alluvial bores, as indicated in **Appendix A**.
  - VWP data logger download, and verification and validation of instrument drift and correction.
- Groundwater Quality Analysis (20 bores – reduced to 19 bores from April 2023):
  - Standard – quarterly: Field readings of water temperature, pH and EC, as well as laboratory analysis of pH, EC, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), dissolved iron, sulphate, chloride, calcium, magnesium, potassium, sodium, carbonate and bicarbonate.
  - Comprehensive – annually: the standard analyses with the addition of total phosphorus, aluminium, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, mercury, molybdenum, selenium and zinc. All metals and metalloids required as dissolved analytes.

Groundwater quality sampling is undertaken quarterly by external contractor CBE in accordance with *AS 5667.1-1998*, *Guidance on the Sampling of Groundwater's*. Field sheets, detailing the sample location, date, time, field EC, field pH and water level below top of casing are completed by CBE during each monitoring round. The field sheets and database compiled by CBE have been reviewed by Umwelt for this report.

3.2 Data Recovery

The WMP specifies the monitoring frequency and trigger levels for groundwater level and groundwater quality for the monitoring network. This includes water quality monitoring at 20 bores and water level monitoring at 28 sites, which includes 22 bores and six VWPs.

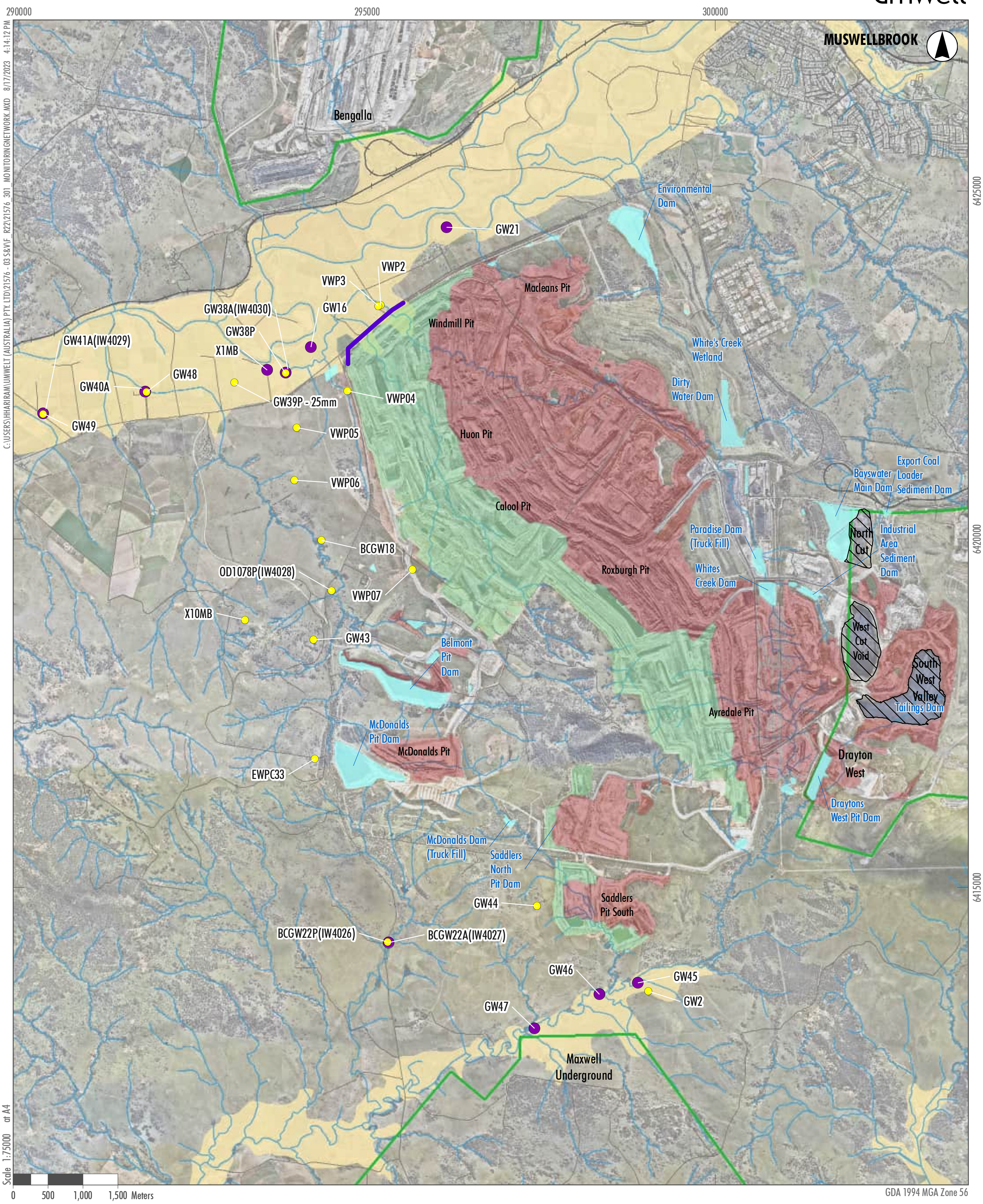
Groundwater levels in all of the 22 monitoring bores specified in the WMP were monitored over the reporting period. VWP sites VWP2, VWP3, VWP05, VWP06 and VWP07 were operational over the reporting period. VWP04 has been mined through.

The individual sensors within each VWP site sit vertically above each other at different elevations within a sealed hole. When individual sensors fail it is not possible to replace them. The VWP site still provides valuable information from the other functioning sensors, therefore there has been no recommendations historically to replace individual sensors that have failed. Six sensors in the deeper seams failed prior to the reporting period at VWP3 PL2 (Ramrod Creek), VWP05 (Edinglassie), VWP05 (Ramrod Creek), VWP06 (Vaux), VWP06 (Ramrod Creek) and VWP07 (Ramrod Creek) and are no longer used. Data is still being collected by the shallower sensors at each of these VWP sites. It was recommended in the 2022 Annual Review (Umwelt, 2022a), that the VWPs are maintained in the WMP, but the individual sensors that have failed be removed from ongoing monitoring and reporting requirements. The WMP has been approved and these sensors have now been removed from the compliance monitoring network.

Of the 20 bores included for water quality monitoring schedule, 19 were sampled. A water quality sample was unable to be collected from bore BCGW18 as it was dry over the reporting period. Sites with a data capture rate less than 100 per cent are outlined in **Table 3.1**.

Table 3.1 Groundwater Monitoring Data Recovery

Bore/VWP ID	Type	Data Recovery	Comment
VWP04	WL	0%	No longer exists, mined through.



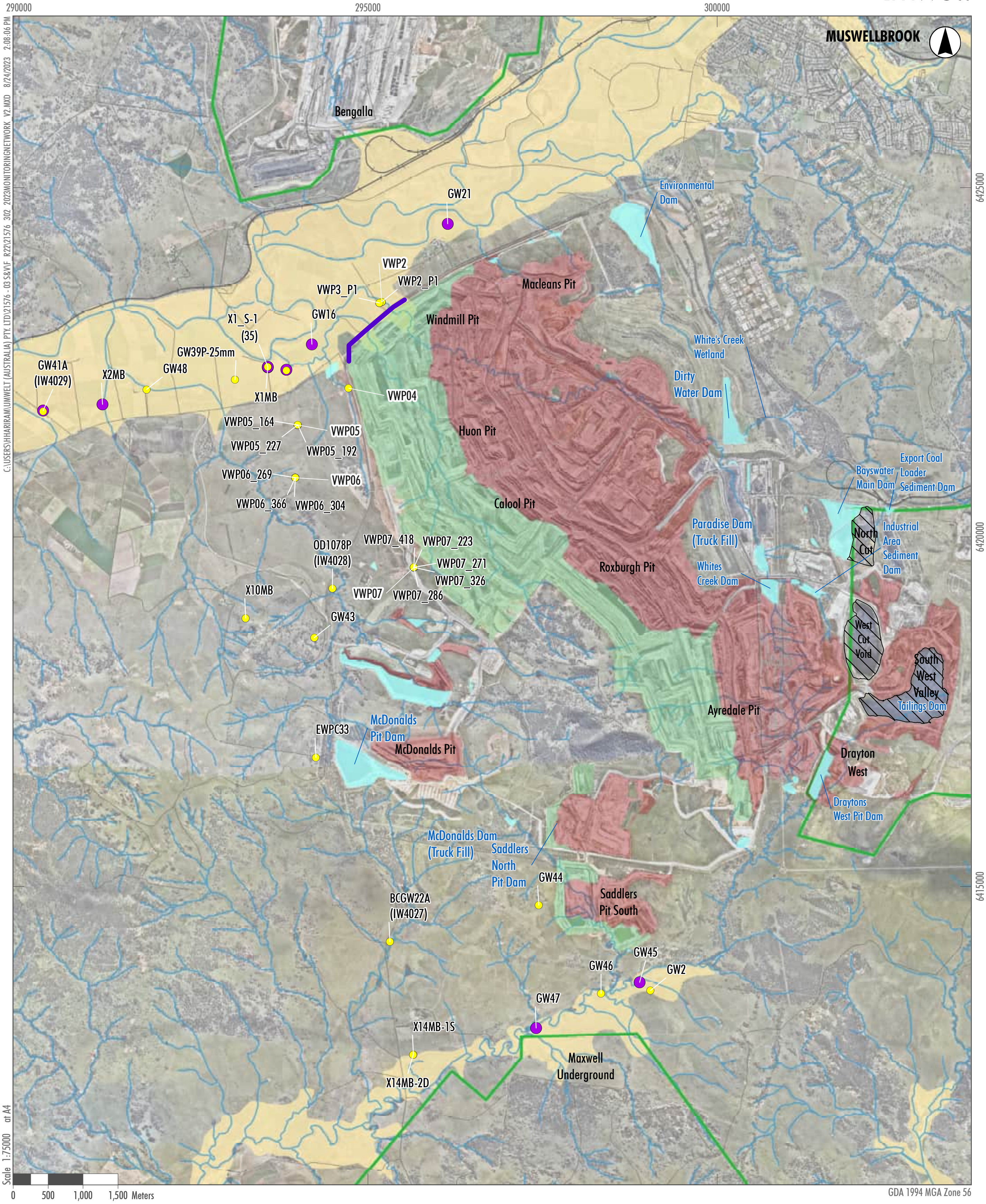
Legend

- Surrounding Mines
- Active Mining Area
- Overburden Emplacement Area
- Tailings Storage Facility
- Water Management Dam
- Cut-off Wall
- Alluvium Extent
- Alluvium Monitoring Bore
- Permian Coal Measure Monitoring Bore
- Railway
- Roads
- Watercourse

FIGURE 3.1

Groundwater Compliance Monitoring Network (July 2022 to March 2023)

Image Source: Nearmap (May 2022) Data source: Qspatial (2021) umwelt



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Scale 1:75000 at A4

Legend

Compliance Monitoring Network 2023

- Alluvium Monitoring Bore
- Permian Coal Measure Monitoring Bore
- Surrounding Mines
- Active Mining Area
- Overburden Emplacement Area
- Tailings Storage Facility
- Water Management Dam
- Cut-off Wall
- Alluvium Extent
- Railway
- Roads
- Watercourse

FIGURE 3.2

2023 Groundwater Monitoring Network (April 2023 to June 2023)

Image Source: Nearmap (May 2022) Data source: Qspatial (2021)

4.0 Groundwater Levels

Groundwater levels for the WMP compliance bore network, as shown in **Figure 3.1** are summarised in **Table 4.1** for July 2022 to March 2023. Groundwater levels for the WMP compliance bore network, as shown in **Figure 3.2** are summarised in **Table 4.2** for April to June 2023. Details of the compliance bore network presented in **Appendix B** summarises:

- Bore details including surveyed location, elevation, depth and target formation.
- Groundwater levels measured in each bore (initial measurement, July 2022 and June 2023).
- Change in groundwater levels since records commenced and for the period July 2022 to June 2023.
- Groundwater levels predicted by the numerical model for July 2022 to June 2023.
- Difference in groundwater levels predicted by the numerical model and measured in the monitoring network.

Groundwater level graphs showing manual dip and continuous logger data are presented in **Appendix C**. A review of the dataloggers noted issues for five bores. It is recommended that the condition of the datalogger and connection to Ontoto be reviewed and, if required, replaced to assist in correlating groundwater trends with rainfall and streamflow trends. The datalogger issues are summarised below:

- X1MB is listed as terminated since January 2023. The data also requires conversion to a water level (mbgl) in Ontoto.
- X2MB is listed as data fault since March 2022 and X14MB-2D is listed as inactive since April 2022 in Ontoto.
- GW39P-25mm does not record fluctuating water levels recorded by manual dip data. Recommend replacing the data logger.
- Logger drift in bores GW38P, GW43, GW48 and GW49. Recommend replacing data loggers.

Table 4.1 Groundwater Level Monitoring Results – July 2022 to March 2023 (2021 WMP)

Bore ID	Depth to Water (mAHD)			
	Trigger Level	Q1	Q2	Q3
Hunter River Alluvium				
GW16	*120.9*	123.48	123.83	124.97
GW21	*125.0*	127.92	128.25	126.04
GW38A (IW4030)	*120.7*	123.36	123.60	123.01
GW40A	*117.8*	121.14	121.38	120.96
GW41A (IW4029)	*117.9*	119.95	120.16	119.82
X1MB	*119.7*	122.49	122.52	121.98
Saddlers Creek Alluvium				
BCGW22A (IW4027)	*137.6*	141.14	141.24	140.57
GW45	*138.9*	144.54	145.09	143.46
GW46	*129.0*	137.44	137.28	137.08
GW47	*127.3*	130.82	131.08	130.64

Bore ID	Depth to Water (mAHD)			
	Trigger Level	Q1	Q2	Q3
Permian Coal Measures				
BCGW18	*147.3*	DRY		
BCGW22P (IW4026)	*133.7*	140.73	140.91	138.95
EWPC33	*194.3*	201.46	202.54	201.49
GW2	*133.2*	145.17	146.15	146.18
GW38P	*120.9*	122.72	122.68	121.85
GW39P-25mm	*116.0*	120.97	121.07	120.92
GW43	*165.4*	170.47	171.23	170.90
GW44	*99.9*	**98.74**	**99.59**	**99.74**
GW48	*117.7*	120.81	121.17	119.82
GW49	*117.6*	119.63	119.98	119.72
OD1078 (IW4028)	*134.6*	135.00	135.58	135.95
X10MB	*174.9*	185.49	188.88	189.50
Permian Coal Measures – VWPs				
VWP2_P1	*-0.6*	2.23	2.51	1.92
VWP3_P1	*-0.6*	4.47	4.19	3.70
VWP3_P2*	*-27.9*	-	-	-
VWP04_130^	*42.2*	22.92	-	-
VWP04_161^	*37.3*	28.19	-	-
VWP04_201^	*22.0*	13.05	-	-
VWP04_262^	*-7.5*	-14.13	-	-
VWP04_285^	*-12.6*	-22.43	-	-
VWP05_164	*32.4*	41.13	40.05	39.18
VWP05_192	*32.4*	38.83	37.93	37.06
VWP05_227	*-6.2*	36.25	35.17	33.87
VWP05_288%	*28.2*	-	-	-
VWP05_311~	*6.6*	-	-	-
VWP06_237#	*43.1*	-	-	-
VWP06_269	*43.1*	70.89	69.81	66.85
VWP06_304	*4.1*	57.72	57.00	54.58
VWP06_366	*58.1*	**55.80**	**54.80**	**53.03**
VWP06_388+	*53.7*	-	-	-
VWP07_223	*94.5*	**92.8**	**91.70**	**89.00**
VWP07_271	*77.5*	92.2	91.00	88.20
VWP07_286	*40.4*	82.2	81.90	80.90
VWP07_326	*-16.7*	79.7	78.70	77.10
VWP07_418**	*95.7*	-	121.07	**84.88**

Note:

** Exceedance based on 2021 Impact Assessment Criteria (less than 3 readings).*

** Exceedance based on 2021 Impact Assessment Criteria (3 consecutive readings).*

** EC exceedance based on 2021 Impact Assessment Criteria – Second Stage (1 reading).*

** SensorVWP3_P2 failed in June 2020*

^ VWP04 mined out in December 2020

% Sensor VWP05_288 failed in May 2018

~ Sensor VWP05_311 failed in September 2017

 # Sensor VWP06_237 failed in May 2021

+ Sensor VWP06_388 failed in August 2016

*** Sensor VWP07_418 not functional between 2018 and October 2022*

Table 4.2 Groundwater Level Monitoring Results – April 2023 to June 2023 (2023 WMP)

Bore ID	Depth to Water (mAHD)	
	Trigger Level	Q4
Hunter River Alluvium		
GW16	*119.0*	123.48
GW21	*118.3*	127.92
GW38A (IW4030)	*119.7*	123.36
GW41A (IW4029)	*116.7*	119.95
X1MB	*118.7*	122.49
X2MB	*117.9*	120.95
Saddlers Creek Alluvium		
GW45	*137.7*	144.54
GW47	*126.9*	130.82
Saddlers Creek shallow Permian		
BCGW22A (IW4027)	*136.6*	141.14
GW46	*132.5*	137.44
X14MB-1S	*114.5*	119.36
Permian Coal Measures		
EWPC33	*190.4*	201.46
GW2	*140.0*	145.17
GW38P	*117.3*	122.72
GW39P-25mm	*117.2*	120.97
GW43	*166.8*	170.47
GW44	*65.6*	98.74
GW48	*115.9*	120.81
GW49	*115.8*	119.63
OD1078 (IW4028)	*132.9*	135.00
X10MB	*179.6*	185.49
X14MB-2D	*116.1*	123.74
Permian Coal Measures - VWPs		
VWP2_P1	*-64.4*	1.00
VWP3_P1	*-46.5*	-3.70
VWP05_164	*-46.2*	38.77
VWP05_192	*-29.1*	36.48
VWP05_227	*-74.1*	33.05
VWP06_269	*-15.3*	64.78
VWP06_304	*-59.8*	52.31
VWP06_366	*-4.5*	51.58
VWP07_223	*64.7*	86.3
VWP07_271	*57.3*	85.0
VWP07_286	*-17.1*	80.6
VWP07_326	*-91.3*	75.0
VWP07_418	*142.3*	**82.19**
X1_S-1 (35)	*97.6*	101.34

Bore ID	Depth to Water (mAHD)	
	Trigger Level	Q4
X1_S-2 (59)	*91.0*	**90.54**
X1_S-3 (128.5)	*24.6*	50.54
X1_S-4 (164)	*16.1*	42.84
X1_S-5 (215)	*-31.7*	57.64
X1_S-6 (255)	*-55.6*	-14.46
X1_S-7 (276.5)	*-64.6*	-21.96

Note:

** Exceedance based on 2023 Impact Assessment Criteria (less than 3 readings).*

** Exceedance based on 2023 Impact Assessment Criteria (3 consecutive readings).*

** EC exceedance based on 2023 Impact Assessment Criteria - Second Stage (1 reading).*

4.1 Drawdown

The calculated total drawdown is based on the difference between the first recorded groundwater level compared to levels recorded in June 2023 measured at each bore, as shown in the table in **Appendix B**. A negative value represents a decline in water levels, while a positive value represents a rise in water levels over the reporting period. **Figure 4.1** shows the change in groundwater levels in the alluvium and **Figure 4.3** shows the change in groundwater levels the Permian coal measures.

There has generally been a negligible change in water levels within the Hunter River alluvium, as shown in **Figure 4.1**. However, the change in total drawdown did vary spatially, with bores GW16 and GW21 recording a minor decline in levels, while bores further to the west (GW38A (IW4030), GW41A (IW4029), X1MB and X2MB) recorded a slight increase in water levels. However, it should be noted that the total drawdown recorded in bores GW16 and GW21 covers a much larger time frame (24 years) compared to bores GW38A (IW4030) and GW41A (IW4029) (seven years) and X1MB and X2MB (three years). The amount of drawdown recorded is in line with climatic variations.

Groundwater levels in the alluvial bores along Saddlers Creek have fluctuated over time, potentially in response to rainfall trends, with an overall increasing trend in groundwater levels since the end of 2020. However, since monitoring began in 2016 there has been an overall minor decline in water levels (drawdown) within the Saddlers Creek alluvium (**Figure 4.1**) but less than predicted by the 2020 groundwater model. Total drawdown varied spatially, with bore GW45, located in the upper reaches of Saddlers Creek, recording the most drawdown in the Saddlers Creek alluvium. The model predicted drawdown for of 2.41 m between 2016 and 2023 for GW45; however, the total measured drawdown over the same period was 0.99 m. Therefore, the model predicted more drawdown than has occurred. The total drawdown between July 2022 and June 2023 was 0.15 m, with levels fluctuating slightly in response to climatic conditions.

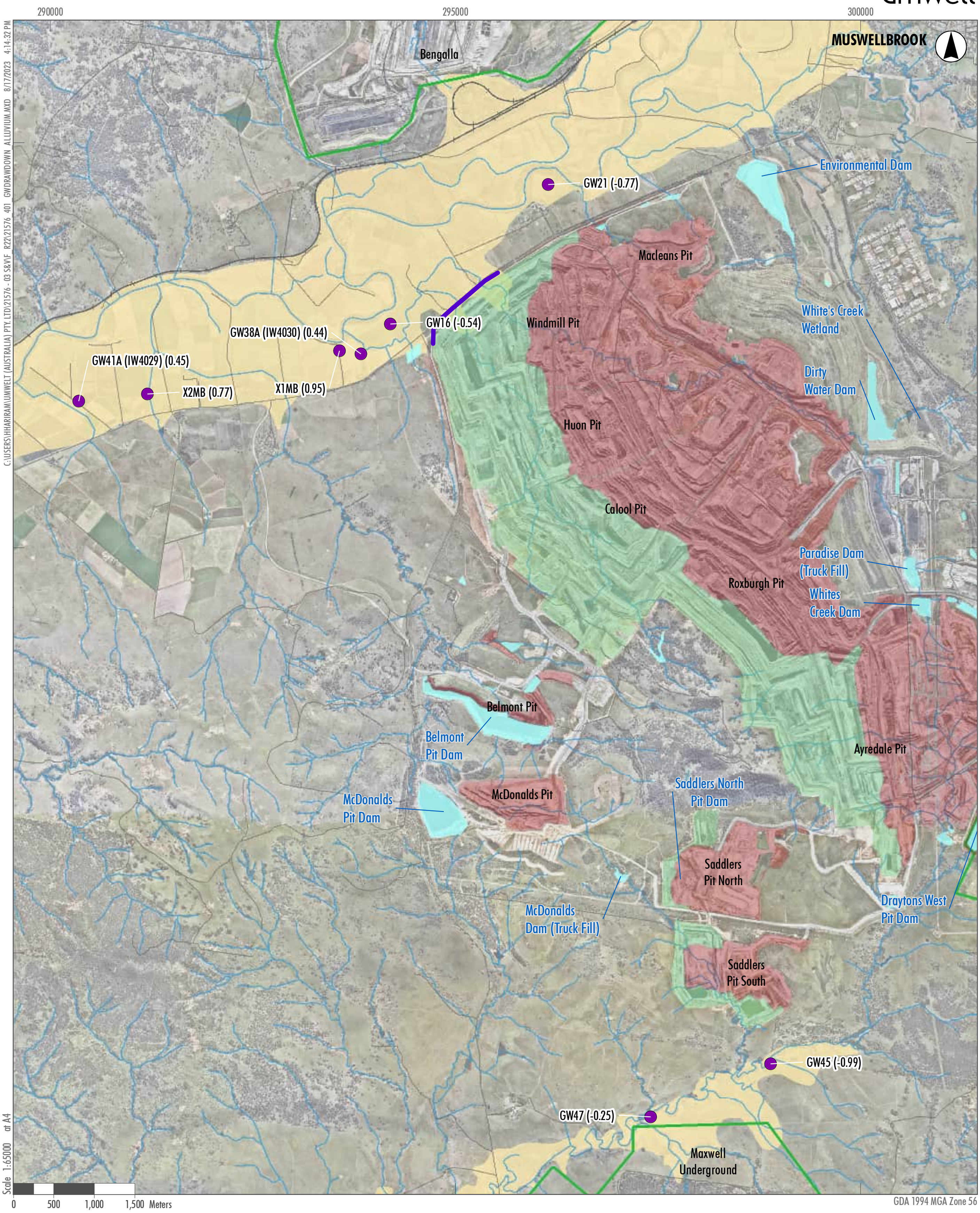
There has been a decline in groundwater levels within the Saddlers Creek shallow Permian (regolith), as shown in **Figure 4.2**. Bore X14MB-1S, located to the north of Saddlers Creek, recorded the most drawdown. In comparison, deeper paired bore X14MB-2D screened within the Glen Munro Seam, recorded an increase in water levels (i.e., no drawdown).

Figure 4.3 shows a general decline in groundwater levels within the Permian coal measures to the southwest of open cut operations, showing a response to the progression of mining to the southwest.

However, in-pit water storage (Belmont, MacDonald and Saddlers pits) potentially buffers the extent of drawdown in localised areas.

4.2 Trigger Exceedances

Groundwater level data collected over the reporting period have been compared to the trigger values outlined in the WMP. Over the monitoring period bores BCGW18, GW44 and VWPs VWP04 (Vaux, Bayswater, Edderton, Edinglassie and Ramrod Creek seams), VWP06 (Edinglassie Seam) and VWP07 (Piercefield Seam) recorded groundwater level exceedances between July 2022 and March 2023, when compared to trigger levels detailed in the 2021 WMP. There were no water level trigger exceedances recorded in June 2023, when compared to trigger levels detailed in the 2023 WMP. VWPs VWP07 (Ramrod Creek Seam) and X1 (Interburden and Mt Arthur Seam) also recorded water levels below the new trigger levels detailed in the 2023 WMP but have only been below the trigger level for one monitoring round and therefore do not constitute an exceedance. A summary of the exceedances is presented in **Table 4.3**.



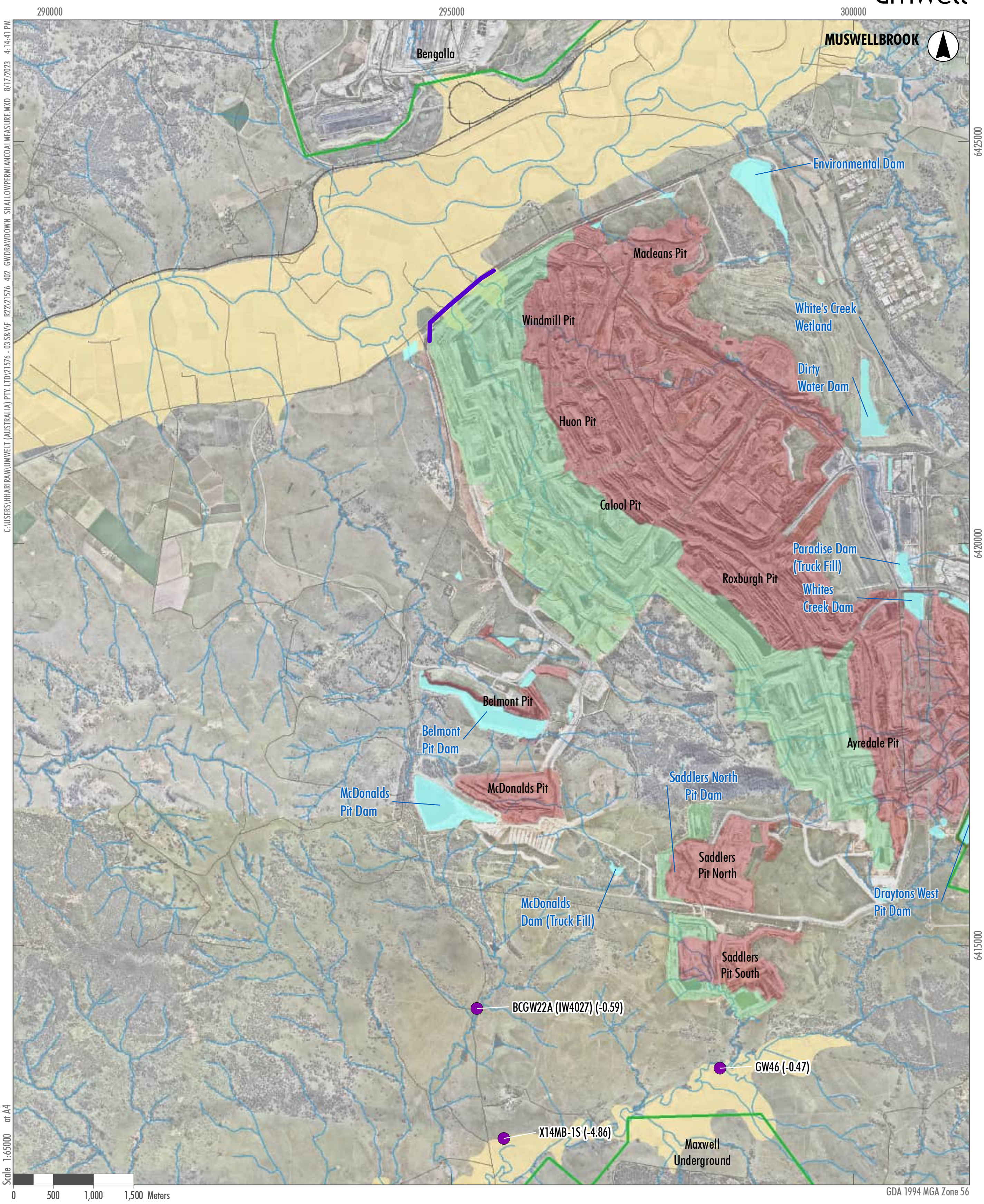
Legend

Surrounding Mines
Active Mining Area
Overburden Emplacement Area
Water Management Dam
Alluvium Monitoring Locations
Cut-off Wall
Alluvium Extent
Railway
Roads
Watercourse

FIGURE 4.1

Total Groundwater Drawdown to June 2023
Alluvium

Image Source: Nearmap (May 2022) Data source: NSW DFSI (2021)

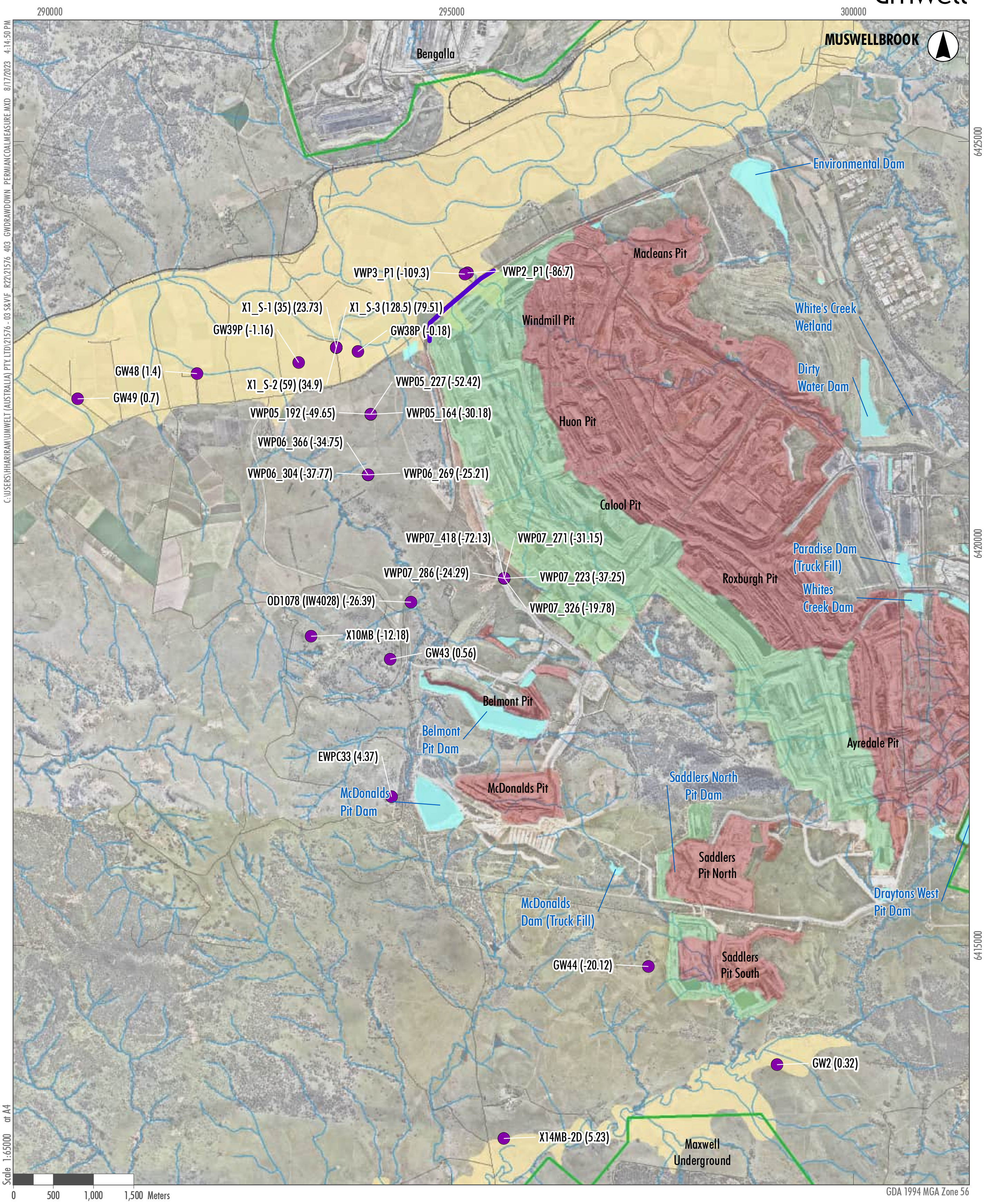


Legend

- Surrounding Mines
- Active Mining Area
- Overburden Emplacement Area
- Water Management Dam
- Shallow Permian Coal Monitoring Locations
- Cut-off Wall
- Alluvium Extent
- Railway
- Roads
- Watercourse

FIGURE 4.2

Total Groundwater Drawdown to June 2023 - Shallow Permian Coal Measures (Regolith)



Legend

- Surrounding Mines
- Active Mining Area
- Overburden Emplacement Area
- Water Management Dam
- Permian Coal Monitoring Locations
- Cut-off Wall
- Alluvium Extent
- Railway
- Roads
- Watercourse

FIGURE 4.3

Total Groundwater Drawdown to June 2023 Permian Coal Measures

Image Source: Nearmap (May 2022) Data source: NSW DFSI (2021)

Table 4.3 Groundwater Level Trigger Exceedances

Bore ID	Exceedance	Screened Lithology	Location	Comment	Action
BCGW18	Nine water level readings below trigger of 147.3 mAHD between March 2021 and March 2023	Arrowfield Seam	On site – west of MAC	The purpose of bore BCGW18 is monitoring of the Arrowfield Seam, close to an old channel of Quarry Creek, and to monitor the impact of mining activities adjacent to mining areas to the west of MAC. The bore is located within 1 km of the open cut pit and close to an old channel of Quarry Creek and west of MAC open cut (Huon Pit). Groundwater levels in bore BCGW18 have gradually declined since October 2012 and has been recorded as dry and below the trigger level of 147.3 mAHD, since March 2021. Comparison between modelled and observed water levels (refer **Figure 4.4**) indicates that depressurisation of the coal seam was predicted at BCGW18.	Water level readings exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The bore was removed from the revised WMP approved by DPE at the end of March 2023.
GW44	Ten water level readings below trigger of 99.9 mAHD between December 2020 and March 2023	Woodlands Hill Seam	On site – west of Saddlers Pit South	The purpose of bore GW44 is monitoring of groundwater response in the Woodlands Hill Seam to mining. The bore is located 200 m west of Saddlers Pit. The 2020 network review (Umwelt, 2021) recommended that GW44 be used for water level monitoring only as sampling is difficult due to the depth of the bore (133 m). Groundwater levels in GW44 have gradually declined since July 2018, declining below the water level trigger of 99.9 mAHD from December 2020 onwards. Comparison between modelled and observed water levels (refer **Figure 4.5**) indicates that depressurisation of the coal seam was predicted at GW44. However, the model shows a delay in the timing compared to the observed data. This may relate to timing within the model drain package.	Water level readings exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates depressurisation of the coal seam was predicted in this area; however, there is a difference in the timing that may relate to how the model drain package represents actual mine progression at site. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.

Bore ID	Exceedance	Screened Lithology	Location	Comment	Action
VWP04	Pressure levels below trigger levels of: 42.2 mAHD (Vaux) 37.3 mAHD (Bayswater) 22.0 mAHD (Edderton) -7.5 mAHD (Edinglassie) -12.6 mAHD (Ramrod) In all coal seams monitored since October 2020	Vaux Seam Bayswater Seam Edderton Seam Edinglassie Seam Ramrod Creek Seam	On site – immediately west of MAC open pit (Windmill Pit)	Levels in the Vaux, Bayswater, Edderton, Edinglassie, and Ramrod Creek seams have exceeded the trigger levels since October 2020 (refer **Figure** 4.6). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). The VWP is located approximately 90 m from active mining. The model predicted greater drawdown than observed (refer **Figure 4.7**).	Water level readings exceeded the trigger threshold and DPE were notified in December 2022. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The VWP was removed from the revised WMP which was approved by DPE at the end of March 2023.
VWP06	Pressure levels below trigger level of: 58.1 mAHD in the Edinglassie Seam between June 2022 and March 2023	Edinglassie Seam	On site – immediately west of MAC open pit (Windmill Pit)	Levels in the Edinglassie Seam have exceeded the trigger level since June 2022 (refer **Figure 4.8**). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). SLR (2020a) predicted continued drawdown in this area with simulated water levels in all seams (refer **Figure 4.9**). The model predicted slightly higher starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Water level readings have exceeded the trigger threshold and DPE were notified in April 2023. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.
VWP07	Pressure levels below trigger level of: 94.5 mAHD (Piercefield) In the Piercefield Seam between October 2021 and March 2023	Piercefield Seam	On site – immediately west of MAC open pit (Windmill Pit)	Levels in the Piercefield Seam have exceeded the trigger level since October 2021 (refer **Figure 4.10**). The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations by SLR (2020a). SLR (2020a) predicted continued drawdown in this area with simulated water levels in all seams (refer **Figure 4.11**). The model predicted slightly lower starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Water level readings have exceeded the trigger threshold and DPE were notified in February 2023. Water level readings exceeded the trigger threshold again in March 2023; however, DPE were not notified previously as the data was not downloaded in Q3 due to access issues. Initial review indicates no adverse impacts beyond those predicted for the approved operations. The water level trigger has been updated in the revised WMP which was approved by DPE at the end of March 2023. Groundwater levels do not exceed the updated trigger level.

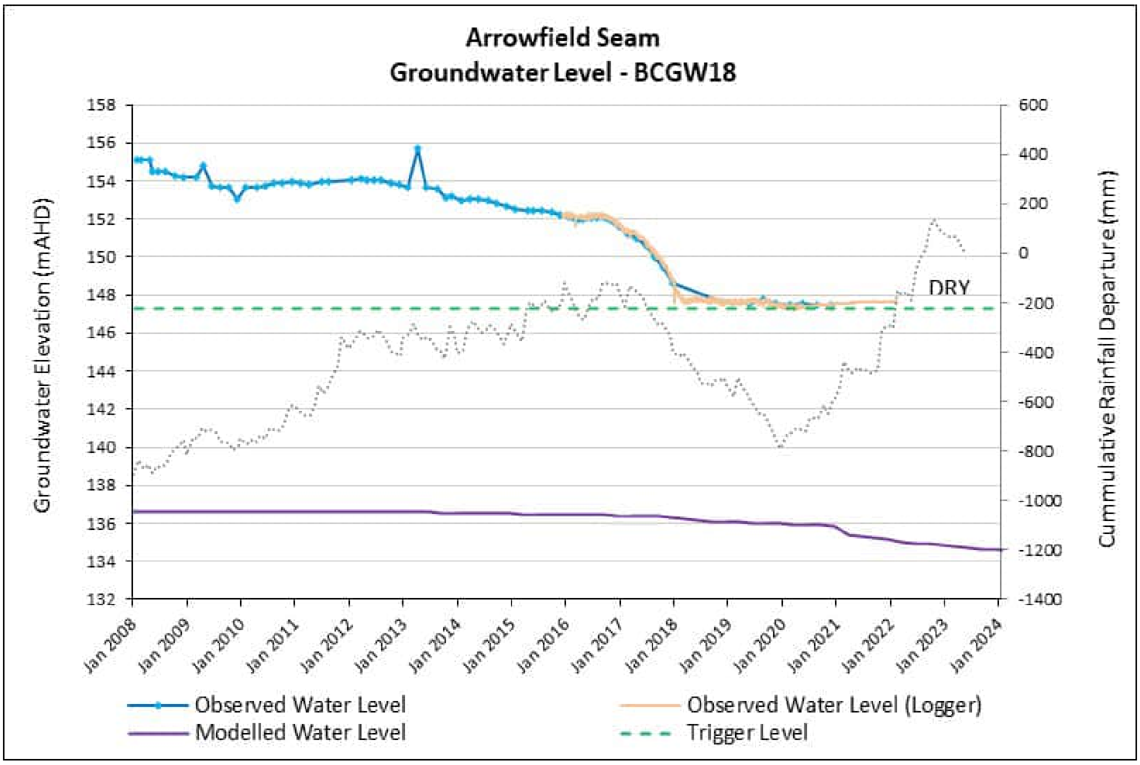


Figure 4.4 BCGW18 – Modelled and Observed Water Levels

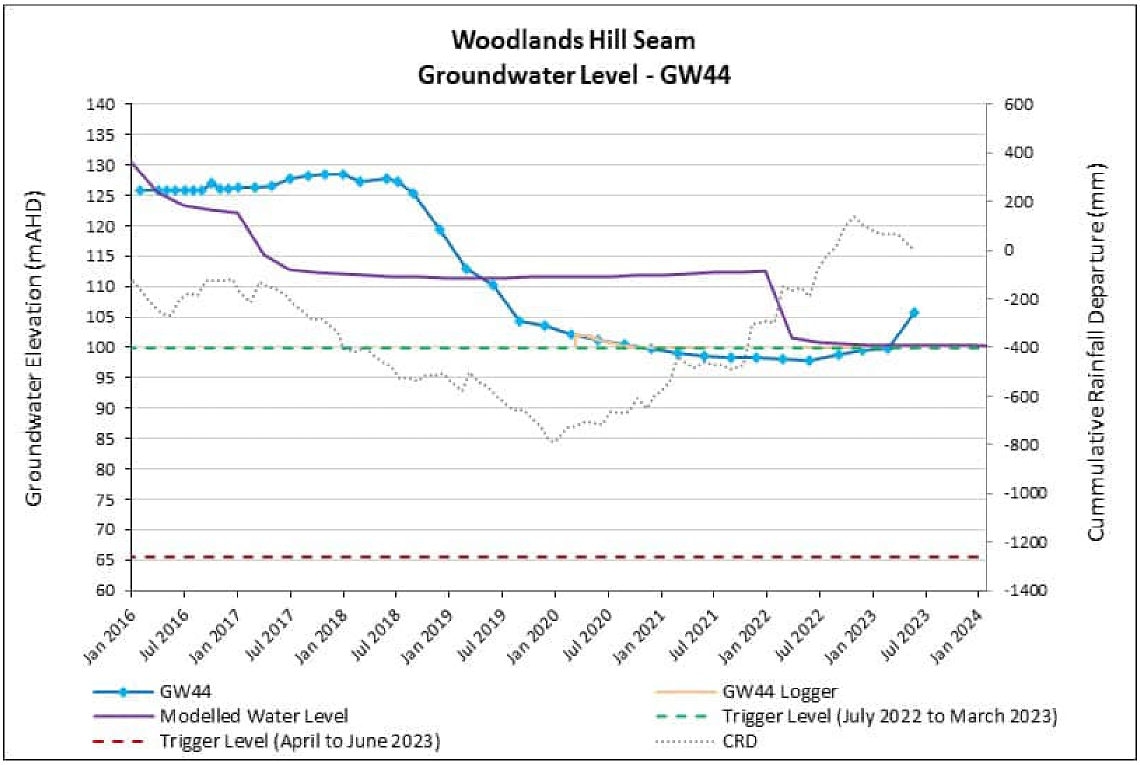


Figure 4.5 GW44 – Modelled and Observed Water Levels

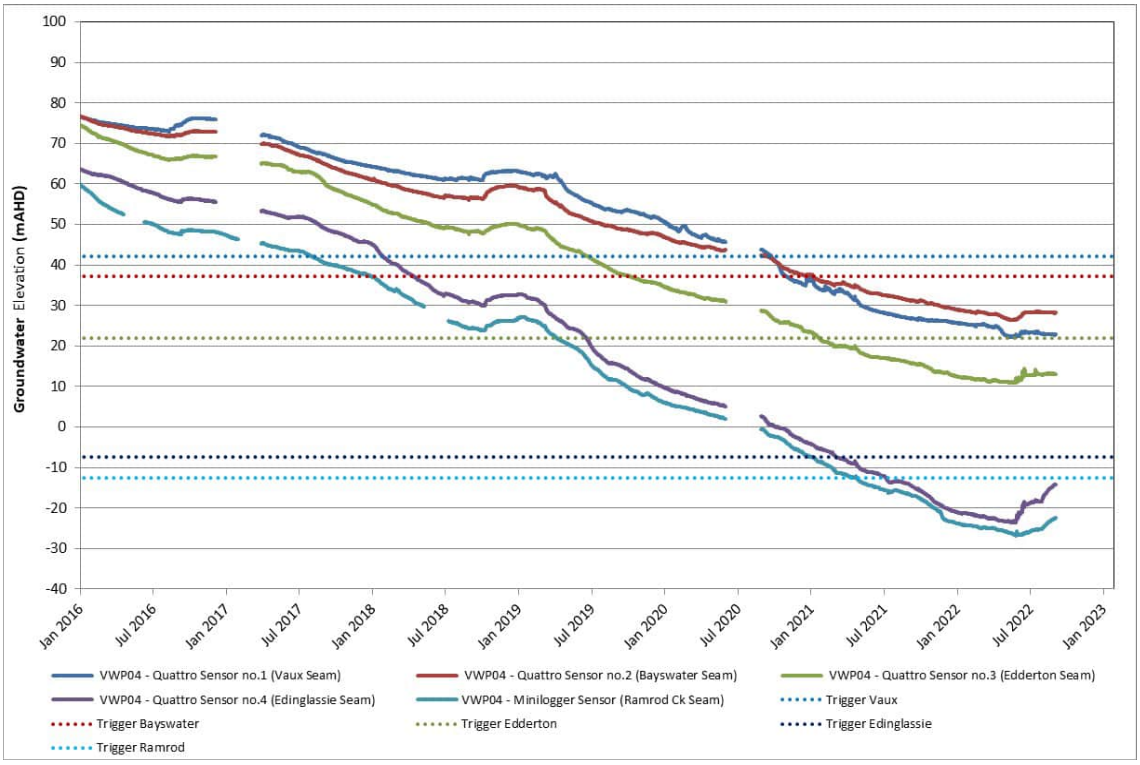


Figure 4.6 VWP04 – Trigger Levels

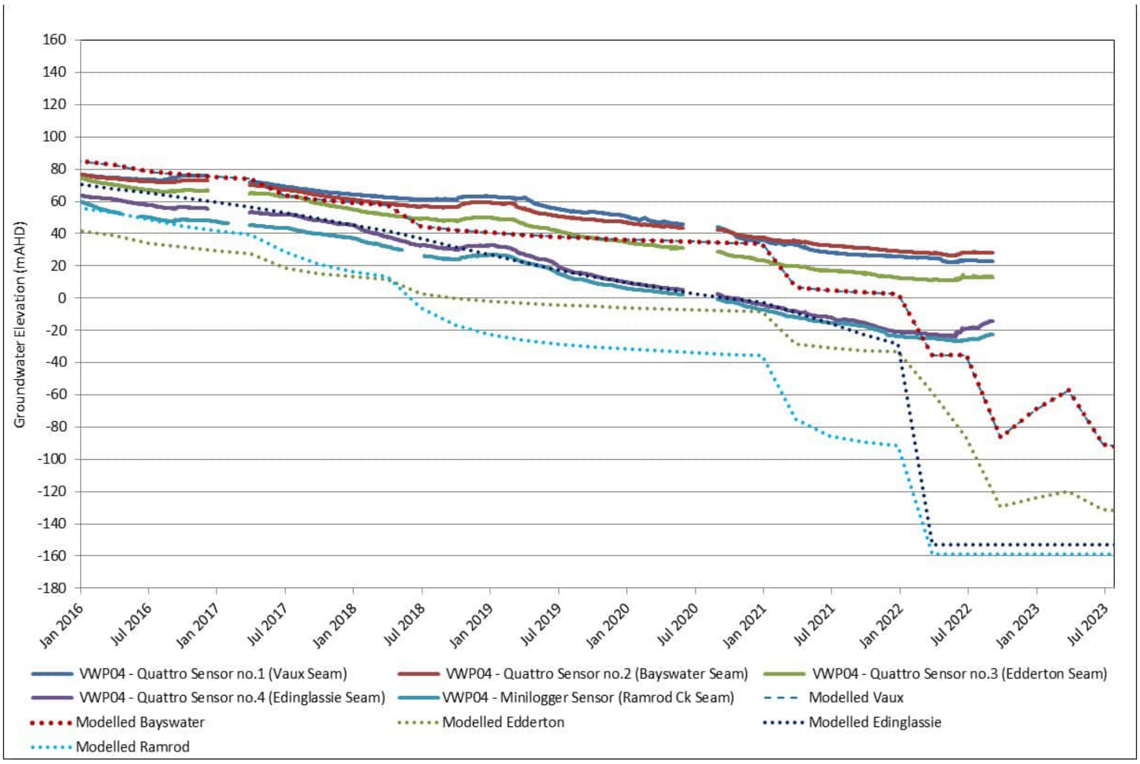


Figure 4.7 VWP04 – Modelled and Observed Water Levels

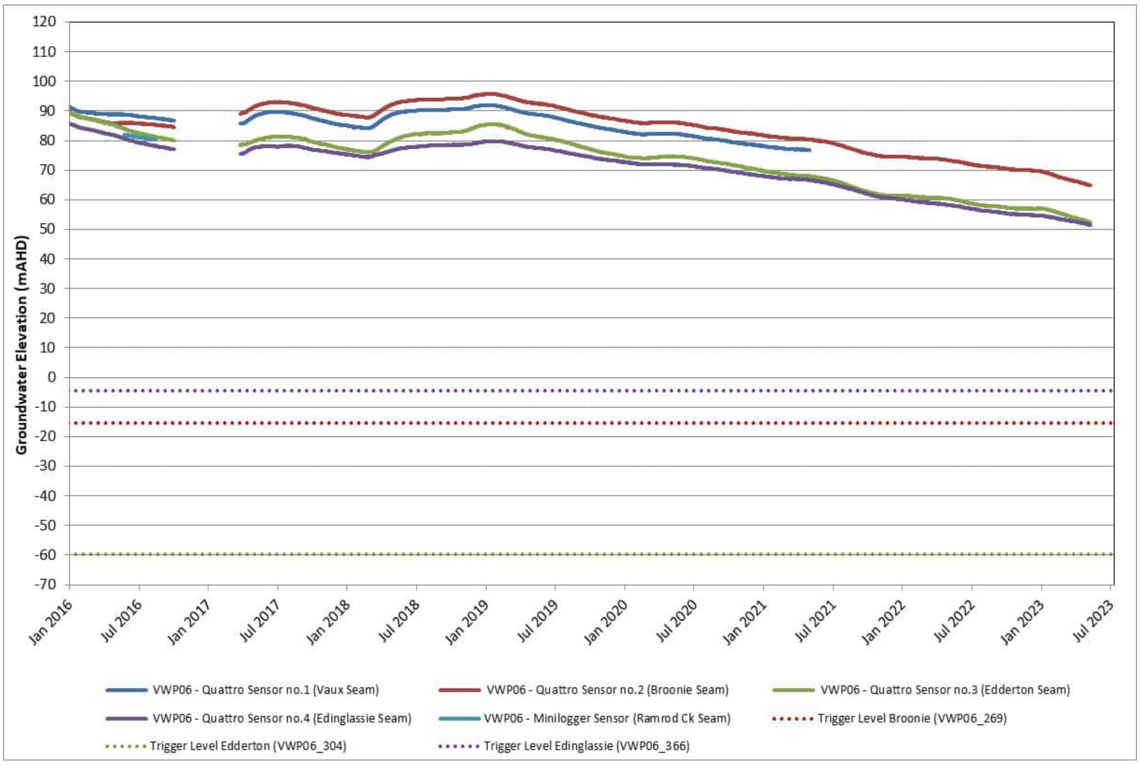


Figure 4.8 VWP06 – Trigger Levels (2023 WMP)

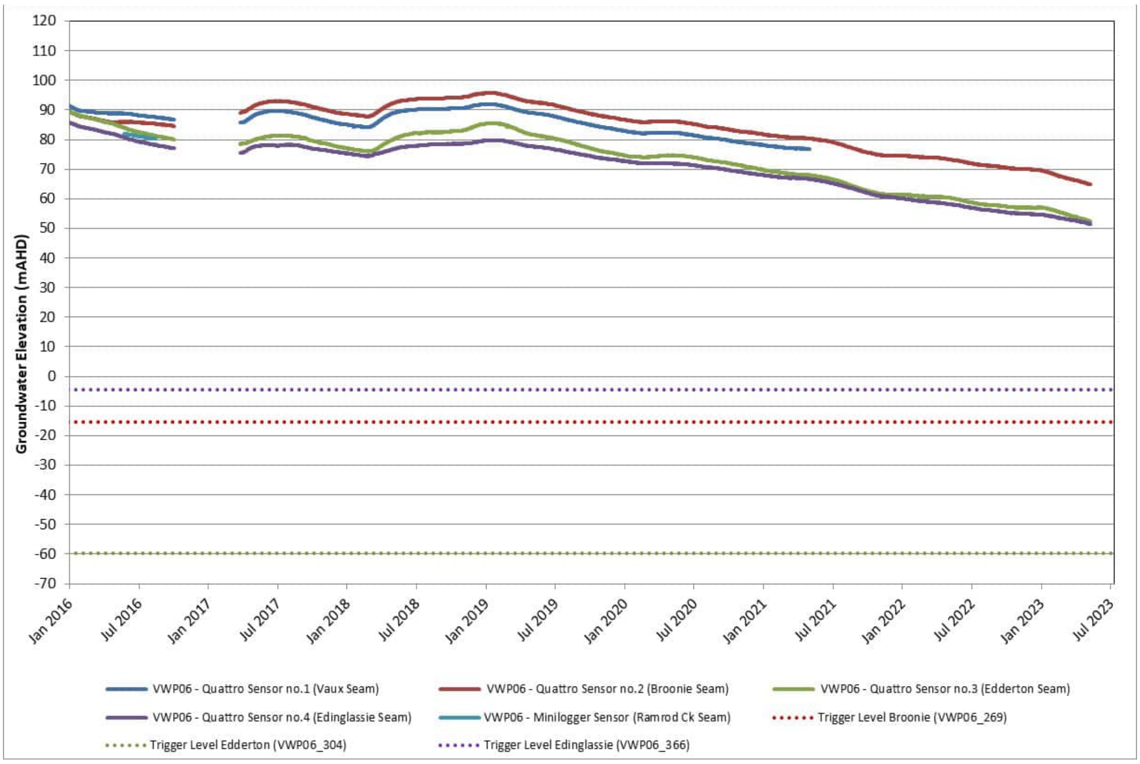


Figure 4.9 VWP06 – Modelled and Observed Water Levels

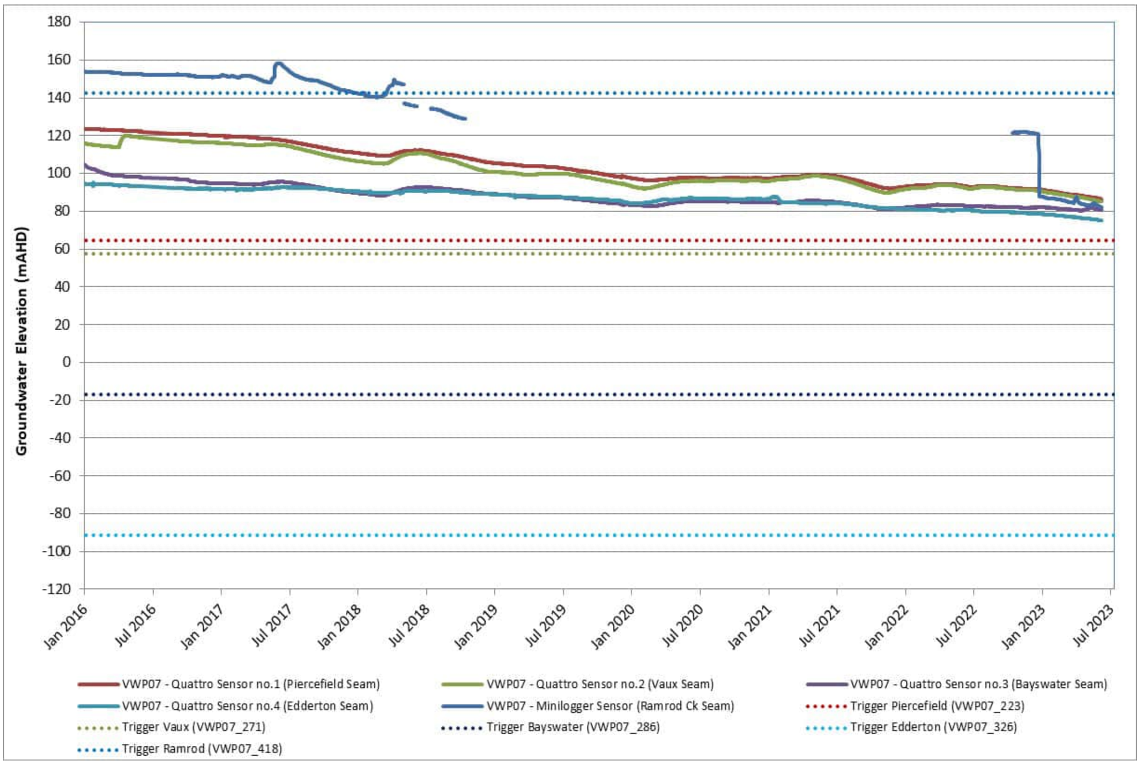


Figure 4.10 VWP07 – Trigger Levels (2023 WMP)

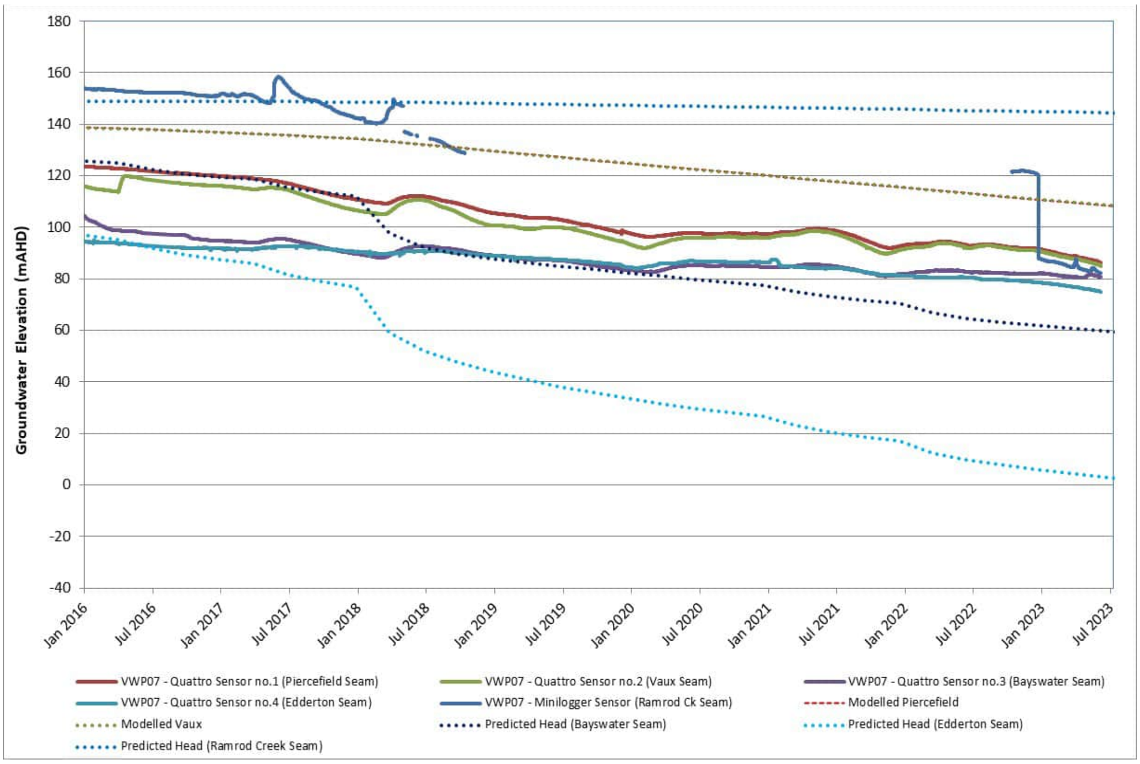


Figure 4.11 VWP07 – Modelled and Observed Water Levels

5.0 Groundwater Quality

Groundwater quality monitoring is conducted to identify any impacts from mining of coal measures to alluvial aquifers. Under the WMP, standard groundwater quality monitoring is required quarterly, and a comprehensive water quality analysis is required annually for 20 of the monitoring bores within the network, as outlined in **Appendix A**. A summary of groundwater quality (field pH and field EC) for the reporting period is presented in **Table 5.1** for July 2022 to March 2023 and **Table 5.2** for April to June 2023. A detailed summary of groundwater quality results for the review period are summarised in **Appendix D** with water quality graphs presented in **Appendix E**.

5.1 Laboratory Water Quality Results

Groundwater quality samples are submitted quarterly to ALS for laboratory analysis of TDS, TSS, iron, sulphate, chloride, calcium, magnesium, potassium, sodium, carbonate and bicarbonate and annually for total phosphorus, aluminium, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, mercury, molybdenum, selenium and zinc. Review of the data indicates that over the reporting period most bores have recorded relatively consistent concentrations of TDS, TSS, iron and major ions (sulphate, chloride, calcium, magnesium, potassium, sodium, carbonate and bicarbonate). A summary of the quarterly water quality data is shown in **Appendix D**.

5.2 Trigger Exceedances

Water quality data collected over the reporting period have been compared to the trigger values outlined in the WMP. As specified in the WMP, bores that recorded pH or EC levels outside of the trigger level range over the reporting period are highlighted in **Table 5.1** for July 2022 to March 2023 and **Table 5.2** for April to June 2023.

Bores X10MB and X14MB-2D recorded pH readings in June 2023 above the upper pH trigger level specified in the revised WMP (BHP, 2023), as shown in **Table 5.2**. However, they are not consecutive readings and are therefore not considered an exceedance. During the reporting period, bores BCGW22P (IW4026) and GW45 recorded three consecutive readings above the upper pH trigger level and bore GW43 recorded three consecutive readings above the Stage 1 EC trigger level, constituting reportable exceedances.
An analysis of the trigger exceedances for the three bores is summarised in **Table 5.3**.

Trigger exceedances have been reviewed by comparing groundwater levels and climate indicated by the cumulative rainfall departure plot (refer **Figure 2.1**). Graphs of pH and EC for all monitoring bores are presented in **Appendix E**.

Table 5.1 Groundwater Quality Monitoring Results – July 2022 to March 2023 (2021 WMP)

Bore ID	Field pH					Field EC (µS/cm)				
	Lower Trigger (5th Percentile)	Upper Trigger (95th Percentile)	Q1	Q2	Q3	Stage 1 Trigger (95th Percentile)	Stage 2 Trigger (Maximum Value)	Q1	Q2	Q3
Hunter River Alluvium										
GW16	*7.0*	*7.7*	7.30	7.24	7.29	*4210*	*4690*	3340	3280	2800
GW21	*6.8*	*7.8*	7.05	6.95	7.02	*1197*	*2000*	1122	**1242**	1044
GW38A (IW4030)	*6.5*	*7.7*	7.46	7.42	7.36	*4900*	*5560*	1762	1938	2306
GW40A	*6.9*	*8.0*	7.43	7.32	7.37	*5290*	*5650*	4150	4860	4170
GW41A (IW4029)	*6.6*	*7.7*	7.37	7.38	7.28	*9090*	*10600*	4120	4660	3840
X1MB	*No Trigger*		7.30	7.36	7.72	*No Trigger*		4080	3930	3610
Saddlers Creek Alluvium										
BCGW22A (IW4027)	*6.6*	*7.1*	6.90	6.89	6.70	*11810*	*14500*	10900	11800	11200
GW45	*6.6*	*7.1*	**7.35**	**7.54**	**7.38**	*11810*	*14500*	1280	668	1265
GW46	*6.3*	*8.0*	7.01	7.08	7.01	*8050*	*11380*	6030	5710	6160
GW47	*6.5*	*7.6*	7.06	7.17	7.02	*7320*	*8220*	4840	4030	4900
Permian Coal Measures										
BCGW18	*7.0*	*9.1*	*DRY*			*8030*	*8510*	*DRY*		
BCGW22P (IW4026)	*7.1*	*9.9*	**11.89**	**11.94**	**11.88**	*14100*	*16270*	14000	**14600**	14000
EWPC33	*6.5*	*7.5*	7.15	7.12	6.94	*4592*	*16270*	2294	2641	2640
GW2	*6.5*	*8.0*	7.66	7.72	7.69	*4266*	*6280*	4250	3710	4160
GW38P	*7.2*	*8.1*	7.63	7.60	7.58	*3224*	*3830*	1290	2493	2410
GW39P-25mm	*No Trigger*		*Not Required*			*No Trigger*		*Not Required*		
GW43	*6.7*	*7.4*	7.07	7.01	6.92	*4400*	*4470*	**4440**	**4420**	3980
GW44	*No Trigger*		*Not Required*			*No Trigger*		*Not Required*		
GW48	*6.8*	*8.2*	7.62	7.55	7.38	*4090*	*4750*	3680	3660	3220
GW49	*6.1*	*7.5*	6.96	6.90	6.88	*6170*	*7530*	5970	6020	5620
OD1078 (IW4028)	*No Trigger*		*Not Required*			*No Trigger*		*Not Required*		
X10MB	*No Trigger*		9.34	8.78	8.93	*No Trigger*		3740	4170	3520

Note:

** Exceedance based on 2021 Impact Assessment Criteria (less than 3 readings).*

** Exceedance based on 2021 Impact Assessment Criteria (3 consecutive readings).*

** EC exceedance based on 2021 Impact Assessment Criteria - Stage 2 (1 reading).*

Table 5.2 Groundwater Quality Monitoring Results – April to June 2023 (2023 WMP)

Bore ID	Field pH			Field EC (µS/cm)		
	Lower Trigger (5th Percentile)	Upper Trigger (95th Percentile)	Q4	Stage 1 EC Trigger (95th Percentile)	Stage 2 EC Trigger (Maximum Value)	Q4
Hunter River Alluvium						
GW16	*6.9*	*7.7*	7.30	*5228*	*9090*	3340
GW21	*6.9*	*7.7*	7.05	*5228*	*9090*	1122
GW38A (IW4030)	*6.9*	*7.7*	7.46	*5228*	*9090*	1762
GW41A (IW4029)	*6.9*	*7.7*	7.37	*5228*	*9090*	4120
X1MB	*6.9*	*7.7*	7.30	*5228*	*9090*	4080
X2MB	*6.9*	*7.7*	7.21	*5228*	*9090*	4170
Saddlers Creek Alluvium						
GW45	*6.6*	*7.6*	7.35	*8783*	*11380*	1280
GW47	*6.6*	*7.6*	7.06	*8783*	*11380*	4840
Saddlers Creek shallow Permian						
BCGW22A (IW4027)	*6.7*	*7.1*	6.90	*14800*	*21480*	10900
GW46	*6.7*	*7.1*	7.01	*14800*	*21480*	6030
X14MB-1S	*6.7*	*7.1*	6.92	*14800*	*21480*	10450
Permian Coal Measures						
EWPC33	*6.8*	*7.5*	7.15	*2973*	*3040*	2294
GW2	*7.0*	*8.5*	7.66	*4802*	*5810*	4250
GW38P	*7.2*	*8.1*	7.63	*6170*	*9170*	1290
GW39P-25mm	*No Trigger*		*Not Required*	*No Trigger*		*Not Required*
GW43	*7.0*	*8.5*	7.07	*4802*	*5810*	4440
GW44	*No Trigger*		*Not Required*	*No Trigger*		*Not Required*
GW48	*6.8*	*7.7*	7.62	*7891*	*8300*	3680
GW49	*6.7*	*8.9*	6.96	*7831*	*8210*	5970
OD1078 (IW4028)	*No Trigger*		*Not Required*	*No Trigger*		*Not Required*
X10MB	*6.7*	*8.3*	**9.34**	*11200*	*14710*	3740
X14MB-2D	*6.7*	*8.3*	**9.53**	*11200*	*14710*	5610

Note:

** Exceedance based on 2023 Impact Assessment Criteria (less than 3 readings).*

** Exceedance based on 2023 Impact Assessment Criteria (3 consecutive readings).*

** EC exceedance based on 2023 Impact Assessment Criteria - Stage 2 (1 reading).*

Table 5.3 Groundwater Quality Trigger Exceedances

Bore ID	Exceedance	Screened Lithology	Location	Comment	Action
BCGW22P (IW4026)	Four pH readings above the trigger level of 9.9 between June 2022 and March 2023	Glen Munro Seam/Interburden	On site – southwest of McDonalds Pit and north of Saddlers Creek	pH has an increasing trend, ranging from 11.84 to 12.08 between June 2022 and June 2023 (refer **Figure 5.1**). Following the recommendations in the 2021 Annual Review, an investigation was undertaken during the 2022 reporting period which determined that the slow recovery of groundwater and unique water quality results indicate the bore is not screened within the coal seam but within a low permeability interburden unit. The investigation recommended that BCGW22P (IW4026) be maintained for monitoring groundwater levels but removed from the WMP as a compliance bore.	Already removed as a compliance monitoring bore in the revised WMP, as previously recommended, but water levels should continue to be monitored for future closure planning. The revised WMP was approved by DPE at the end of March 2023.
GW43	Three EC readings above the Stage 1 trigger level of 4,400 µS/cm between June and December 2022	Woodlands Hill Seam	On site – northwest of Belmont Pit	The purpose of bore GW43 is to assess vertical hydraulic gradient of Permian coal measures (Woodlands Hill Seam), and the impact of mining activities adjacent to mining areas to the west of MAC. The EC in bore GW43 ranged from 3,900 µS/cm in December 2016 peaking at 5,210 µS/cm in September 2021 (refer **Figure 5.2**). Levels have remained stable between December 2021 and December 2022 fluctuating between 4,120 µS/cm and 4,460 µS/cm. EC levels declined to 4,240 µS/cm by June 2023. The initial review of the trigger exceedance in bore GW43 indicated that EC exceeded the first stage trigger level on three consecutive occasions; however, they have remained stable since June 2022 and remained within the historic range. It is recommended the EC levels continue to be monitored and reviewed for any changes outside the historical range.	The EC level in Q2 was a consecutive trigger exceedance and DPE were notified in February 2023. The trigger level has been updated in the revised WMP which was approved by DPE at the end of March 2023. EC levels do not exceed the updated trigger level.

Bore ID	Exceedance	Screened Lithology	Location	Comment	Action
GW45	Five pH readings above the trigger level of 7.1 between March 2022 and March 2023	Saddlers Creek alluvium	On site – south of Saddlers Creek and Saddlers Pit	The purpose of bore GW45 is monitoring of Saddlers Creek alluvium in the Saddlers Creek area. A paired bore with GW2, GW3 and GW46 to assess vertical hydraulic gradient between Permian coal measures (Woodlands Hill seam) and alluvium, and the impact of mining activities adjacent to mining areas in the Saddlers Creek area. pH has gradually declined in GW45 since July 2017 from 7.6 to 6.3 in September 2019, this corresponded with an increase in EC and sulphate (refer **Figure 5.3**). Since September 2019 levels fluctuated, with a general increase to 7.54 in December 2022, followed by a decline to 7.34 by June 2023. The fluctuating trend of increasing pH towards neutral conditions appears to correspond to rainfall.	An initial investigation into the water quality trends at GW45 has been completed and submitted to DPE. A further investigation is ongoing. The trigger level has also been updated in the revised WMP which was approved by DPE at the end of March 2023. pH levels do not exceed the updated trigger level.

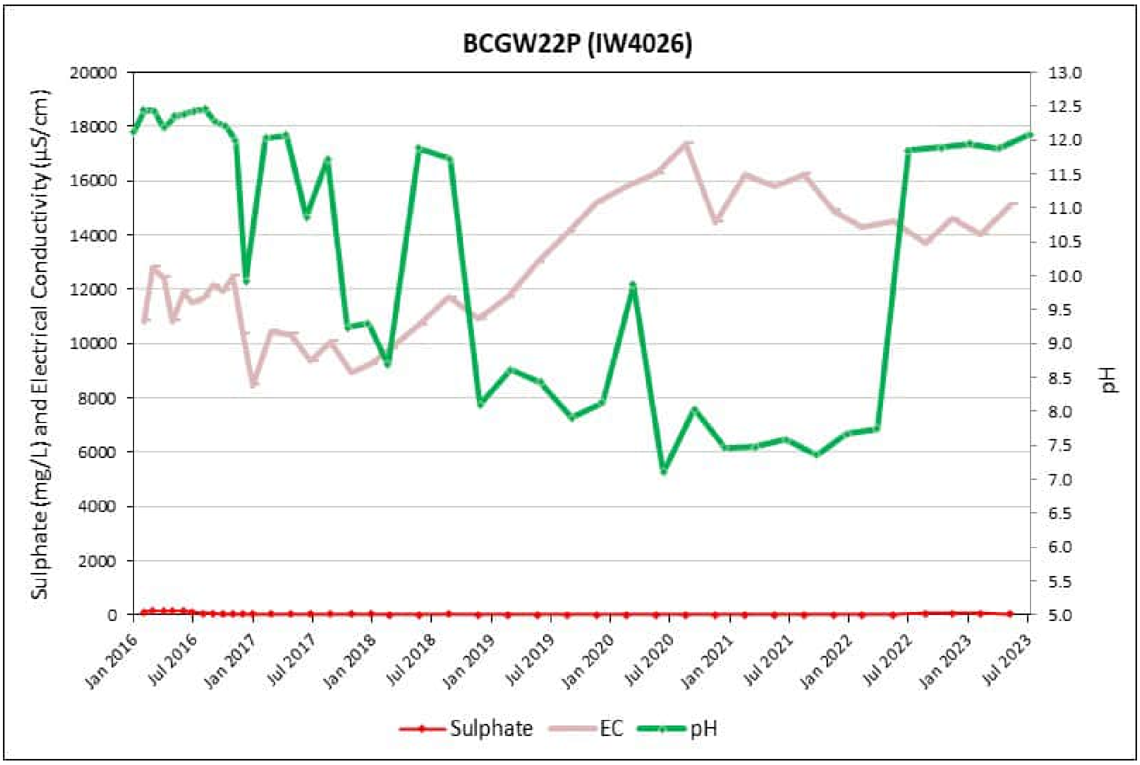


Figure 5.1 **BCGW22P (IW4026) – pH**

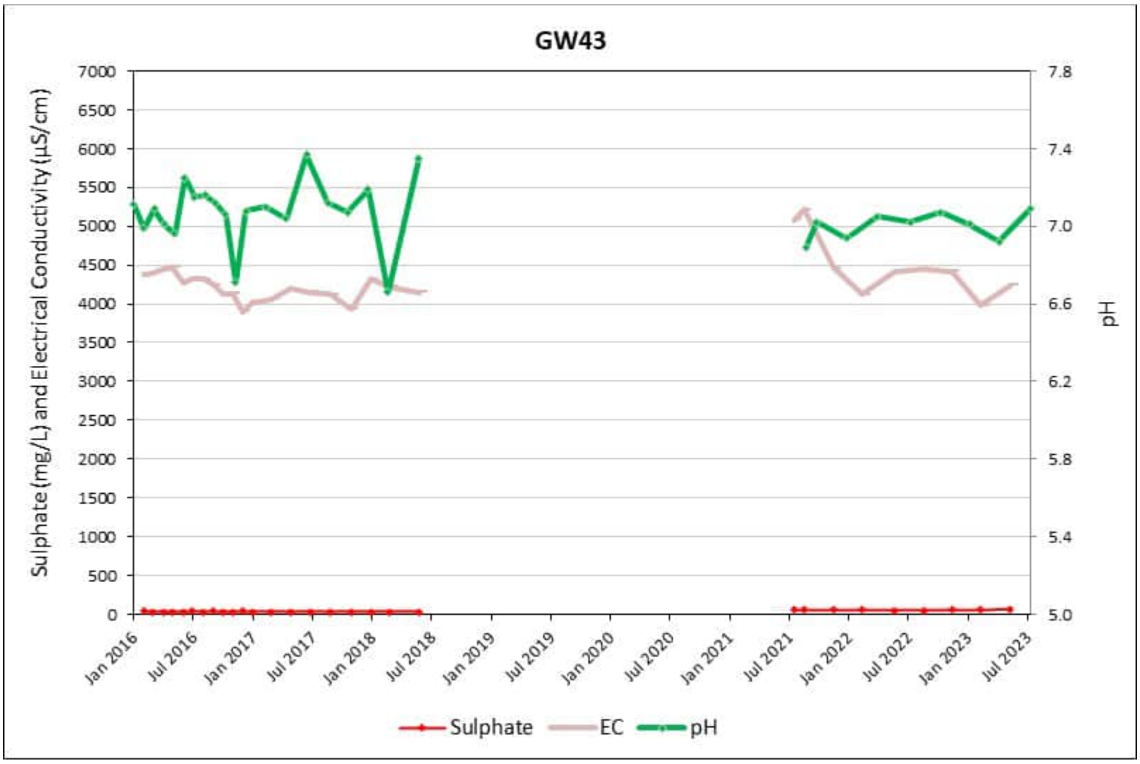


Figure 5.2 **GW43 – EC**

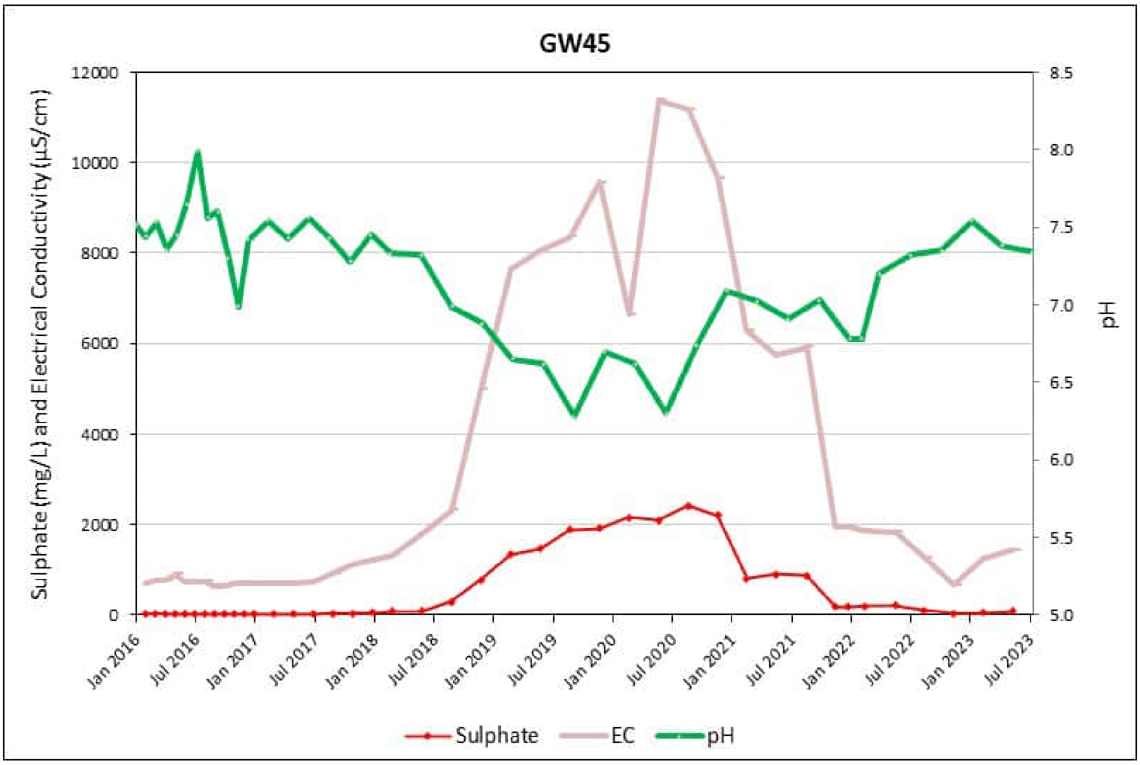


Figure 5.3 GW45 – pH

6.0 Trigger Investigations

As specified in the WMP, MAC are required to report on the effectiveness of the WMP in the MAC Annual Groundwater Review, which includes a summary of management/mitigation measures undertaken in the event of a confirmed exceedance of the impact assessment criteria and the effectiveness of the management/mitigation measures. The 2022 Annual Groundwater Review undertaken by Umwelt (2022) reviewed exceedances for groundwater quality and made a number of recommendations for investigations to be undertaken over 2022/2023. In addition, a number of exceedances have been identified during routine monitoring, which have already been reported to DPE over the reporting period. Details of the trigger investigations undertaken, and exceedances reported to DPE during the reporting period are summarised in **Table 6.1**.

Table 6.1 Summary of Investigations Undertaken Over Reporting Period

Bore ID	Background	Investigations Completed	Action Being Undertaken
GW43	The purpose of bore GW43 is to assess vertical hydraulic gradient of Permian coal measures (Woodlands Hill Seam), and the impact of mining activities adjacent to mining areas to the west of MAC. The initial review of the trigger exceedance in bore GW43 indicated that EC exceeded the first stage trigger level on three consecutive occasions over the reporting period.	The initial review of the trigger exceedance indicates that EC has exceeded the first stage trigger; however, has remained stable since June 2022 and remained within the historic range. Trigger levels have been reviewed and updated in the WMP was approved by DPE at the end of March 2023. It is recommended the EC levels continue to be monitored and reviewed for any changes outside the historical range.	No further action required.
GW45	The bore is screened within the Saddlers Creek alluvium. The bore did not record a trigger exceedance, but it was noted in the 2021 network review that EC and sulphate concentrations historically increased in the bore, and saturated groundwater conditions are observed despite modelling predicting unsaturated conditions. This may indicate a separate source of recharge to the alluvium in this upgradient area. Further investigation and review against recently installed nearby bores and surface water quality data was recommended.	In 2022 a detailed review of the changes in water quality in GW45 identified that a further investigation be undertaken to determine the source of the water.	Further investigation into water quality changes in the bore currently in progress.
VWP06	Water levels in the Edinglassie Seam have exceeded the trigger level since June 2022. The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations. The model predicted continued drawdown in this area with simulated water levels in all seams. The model predicted slightly higher starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Initial review indicated no adverse impacts beyond those predicted for the approved operations. Trigger levels have been reviewed in consideration of the groundwater model limitations, and the updated WMP was approved by DPE at the end of March 2023.	No further action required.

Bore ID	Background	Investigations Completed	Action Being Undertaken
VWP07	Water levels in the Piercefield Seam recorded at VWP07 have exceeded the trigger level since October 2021. The continuing declining groundwater level trend represents mining induced depressurisation as predicted for the approved operations. The model predicted continued drawdown in this area with simulated water levels in all seams. The model predicted slightly lower starting heads in this location but does capture the trend of declining groundwater head over time consistent with the observed data.	Initial review indicated no adverse impacts beyond those predicted for the approved operations. Trigger levels have been reviewed in consideration of the groundwater model limitations, and the updated WMP was approved by DPE at the end of March 2023.	No further action required.

7.0 Quality Assurance Review

An assessment of the quality assurance measures implemented by Carbon Based Environmental Pty Ltd (CBE) for the quarterly groundwater sampling is required as part of the WMP to identify potential errors with either the sampling methodology or laboratory techniques. This review includes:

- Comparison of duplicate samples and calculation of Relative Percentage Difference (RPD) for the laboratory analysis results for each sampling round.
- Review of the CBE groundwater sampling field sheets for assessment of field parameter stabilisation and purging volume for collection for a representative water sample. Review of equipment calibration records by CBE was not undertaken.
- Review of sample holding times prior to being dispatched to the Australian Laboratory Services Pty Ltd (ALS).

The quality assurance review results are summarised in **Table 7.1** and detailed in **Appendix D**. The results of the quality assurance review, with recommendations, are summarised below:

- CBE provided sample stabilisation data for all sampling events with the acceptable deviations for temperature set at (±0.2°C), pH (±0.1 pH units) and EC (±5 %). On average, three bore volumes were purged for each bore before sampling. Where less than three volumes were purged, the field sheets note that it was due to dry bores, slow recharge or when hand bailing was implemented. Bore BCGW18 was unable to be sampled at all as there was insufficient water. Where hand bailing is required in smaller diameter bores, it is recommended a small diameter pump is used.
- Six of the 35 sample batches received by ALS were above the recommended temperature of 4°C. It is recommended that all samples should be chilled sufficiently to reach the lab below 4°C. In each monitoring round the bores were monitored in a consistent manner and the samples are considered representative of the aquifer at each monitoring location.
- All samples were within the specified holding times for the parameters analysed. The exception to this is laboratory pH where holdings time breaches ranged from one to seven days. The holding time for TDS and TSS were also overdue in the December sampling round by one day. All of the samples were also analysed for field pH, which is considered a more reliable source of data and has been used for the trigger level review in this report.
- Duplicate samples were collected and field parameters for pH, EC, and temperature were recorded for each duplicate sample. RPDs greater than 20 % were identified for Total Suspended Solids in December 2022. The results indicate variation in the laboratory analysis between the primary and duplicate samples. This is potentially influenced by sampling methodology and timing between the samples, which can influence results for TSS and total metals. The RPDs do not correlate to any reported trigger exceedances for the reporting period.

Table 7.1 Summary of Groundwater Quality Assurance Review

Monitoring Round	Field Data	Field Parameter Stabilisation	Frequency of Analyses	Analysis Parameters	Holding Time (days)	Duplicate Sample	Relative Percentage Difference (RPD)	Comments
Sep-22	WL, T (°C), pH, EC	All samples within stabilisation parameters.	Quarterly	All samples: pH, EC, TSS, TDS, Cl, Ca, Mg, K, Na, SO4, Alkalinity, Dissolved Fe.	Lab Quality Control Report indicates samples were within the specified holding times for the parameters analysed with the exception of pH where holdings time breaches ranged from one to three days.	GW21	No RPDs greater than 20%	All compliance bores purged 3 x bore volumes prior to sampling except: GW39P-25mm (hand bailed), GW41A (IW4029) (hand bailed), BCGW18 (dry), BCGW22P (IW4026) (pumped dry), X10MB (issued with bore), X14MB-2D (no reason given). It is noted that two of the eleven sample submissions reached the lab above specified temperature of 4 °C. Field calibration sheets not provided.
Dec-22	WL, T (°C), pH, EC	All samples within stabilisation parameters.	Quarterly	All samples: pH, EC, TSS, TDS, Cl, Ca, Mg, K, Na, SO4, Alkalinity, Dissolved Fe.	Lab Quality Control Report indicates samples were within the specified holding times for the parameters analysed with the exception of pH, TDS and TSS where holdings time breaches ranged from one to five days.	GW48	Total Suspended Solids 200%	All compliance bores purged 3 x bore volumes prior to sampling except: GW39P-25mm (hand bailed), BCGW18 (dry), BCGW22P (IW4026) (pumped dry), X10MB (too deep to pump), X14MB-1S (no reason given), X14MB-2D (no reason given). It is noted that two out of eight sample submissions reached the lab above specified temperature of 4 °C. Field calibration sheets not provided.
Mar-23	WL, T (°C), pH, EC	All samples within stabilisation parameters.	Quarterly	All samples: pH, EC, TSS, TDS, Cl, Ca, Mg, K, Na, SO4, Alkalinity, Dissolved Fe.	Lab Quality Control Report indicates samples were within the specified holding times for the parameters analysed with the exception of pH where holdings time breaches ranged from one to five days.	EPWC33	No RPDs greater than 20%	All compliance bores purged 3 x bore volumes prior to sampling except: GW39P-25mm (hand bailed), BCGW18 (dry), BCGW22P (IW4026) (pumped dry), EWPC33 (pump failed), X10MB (issue with bore), X14MB-1S (no reason given), X14MB-2D (no reason given). It is noted that two out of seven sample submissions reached the lab above specified temperature of 4 °C. Field calibration sheets not provided.

Monitoring Round	Field Data	Field Parameter Stabilisation	Frequency of Analyses	Analysis Parameters	Holding Time (days)	Duplicate Sample	Relative Percentage Difference (RPD)	Comments
Jun-23	WL, T (°C), pH, EC	All samples within stabilisation parameters.	Quarterly/ Annually	All samples: pH, EC, TSS, TDS, Cl, Ca, Mg, K, Na, SO4, Alkalinity, Dissolved Al, Sb, As, Ba, Ca, Cr, Cu, Ni, Pb, Zn, Mo, Se, B, Fe, Hg, Total P.	Lab Quality Control Report indicates samples were within the specified holding times for the parameters analysed with the exception of pH where holdings time breaches ranged from one to seven days.	GW46	No RPDs greater than 20%	All compliance bores purged 3 x bore volumes prior to sampling except: GW39-25mm (hand bailed), BCGW18 (dry), BCGW22P (IW4026) (pumped dry), X10MB (hand bailed), X14MB-2D (pumped dry). All of the nine sample submissions reached the lab below specified temperature of 4 °C. Field calibration sheets not provided.

8.0 Cut-off Wall Performance

The alluvial cut-off wall is a bentonite barrier wall constructed between the Hunter River and the Windmill Open Cut pit, close to the F4 fault. The cut-off wall was extended to the west in November 2020 ahead of the progression of active mining towards the west. The purpose of the cut-off wall is to minimise drawdown within the Hunter River alluvium.

To monitor drawdown within the Hunter River alluvium, VWPs were installed near the cut-off wall to monitor the Permian coal measures underlying the Hunter River alluvium. The location of the VWPs is shown in **Figure 3.1**. The VWP sensors monitor:

- VWP2 – F4 fault at 216.5 m depth (-81.1 mAHD).
- VWP3 – Sensor 1 – Edinglassie Seam (hanging wall) at 227.0 m depth (-91.6 mAHD).

Continuous data has been captured by the VWPs since December 2013. However, the footwall of the Edinglassie Seam is no longer monitored as VWP1 has been decommissioned due to sensor failure in 2020. VWP3 Sensor 2 (Ramrod Creek) also failed in June 2020. **Figure 8.1** shows groundwater levels have declined 87 m in the F4 fault, 113 m in the Edinglassie Seam and 103 m in the Ramrod Creek Seam, since installation.

The Hunter River alluvium and shallow weathered sandstone (regolith) were previously monitored by bore GW42 which is located adjacent to the VWPs. However, monitoring of GW42 ceased in June 2021 due to the intermittent nature of groundwater within the bore, but monitoring restarted again in September 2022, and it is recommended monitoring continues until a replacement bore is installed. Although not as proximal to the cut-off wall as GW42, bore GW16 also monitors the Hunter River alluvium, located approximately 400 m to the northwest of the cut-off wall. Bore GW16 has been used to compare trends in the coal seams and alluvium, as a substitute for GW42 in the interim until a replacement bore for GW42 is installed. In November 2020, six additional monitoring bores were installed (VB1, VB2, VB3, VB4, VB5 and VB6) in fill/regolith forming the cut-off wall extension to monitor the effectiveness of the barrier wall extension.

Groundwater levels at GW16 have fluctuated over time but have remained relatively stable, with a slight increase of 0.09 m between February 2008 and September 2021, followed by a sharp increase of 2.57 m by March 2023, then a decline of 2.51 m by June 2023, as shown in **Figure 8.2**. The fluctuations in groundwater levels appear to be a response to increased rainfall and flows within the Hunter River. Depressurisation observed in the Permian coal measures has not impacted the Hunter River alluvium groundwater levels observed in bore GW16.

Groundwater level data is available in the area at bores close to the Hunter River (GW21, GW38A and X1MB) and close to the cut-off wall (GW16). All of the bores recorded a similar stable to slightly rising trend over the monitoring period, as shown in **Figure 8.2**. Groundwater levels in the Hunter River alluvium bores fluctuate in response to rainfall and streamflow trends.

Groundwater levels have also been monitored in the VB series of bores since September 2021. Groundwater levels remained relatively stable, responding to climatic events, similar to surrounding alluvium monitoring bores. Levels ranged between 121.70 mAHD (VB2 December 2021) and 124.47 (VB5 December 2022). Groundwater levels were recorded at a slightly higher elevation compared to nearby bores GW16 and GW38A which monitor the Hunter River alluvium. Bore VB6 has been dry since installation and is the closest bore to active mining. It is also noted that bore VB3 had two large fluctuations of over 9 m and are likely a field reading error.

The relatively stable groundwater level trends shown in the alluvial bores indicate that the depressurisation observed in the Permian coal measures does not appear to have impacted the Hunter River alluvium groundwater levels. Monitoring of the Hunter River alluvium shows no adverse impact from mining activities on alluvial groundwater conditions and beneficial use of groundwater.

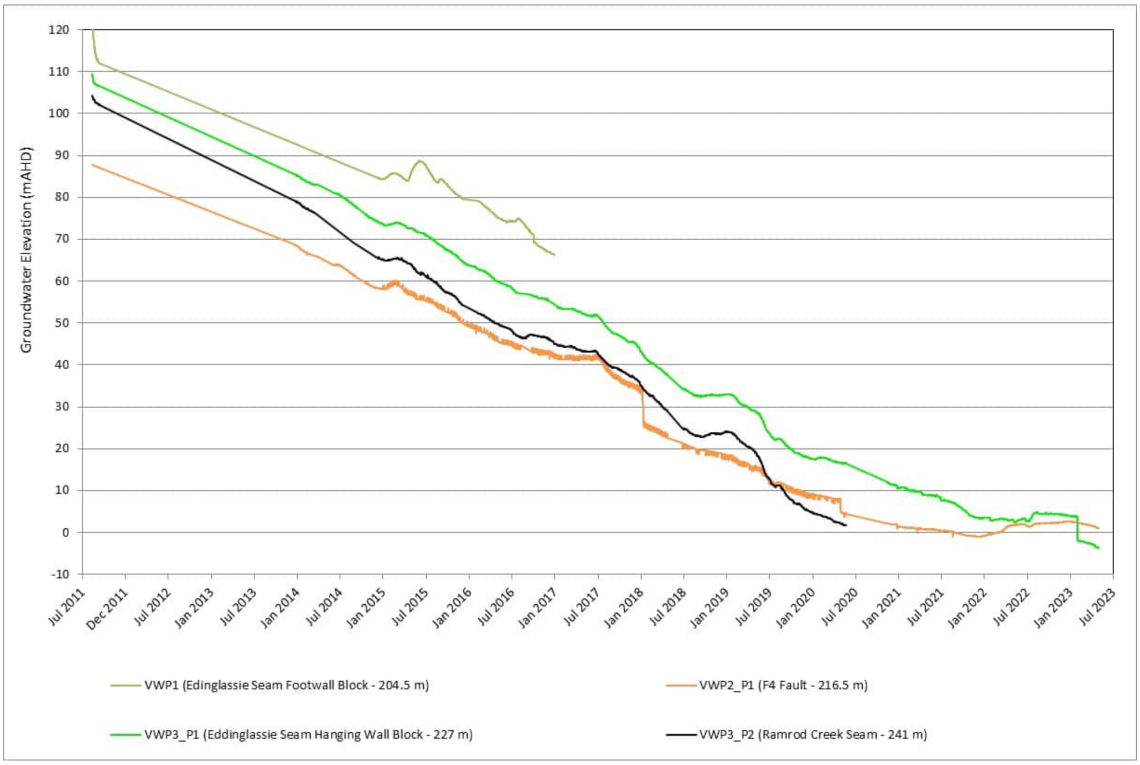


Figure 8.1 Groundwater Levels in Permian Coal Measures Adjacent to the Cut-off Wall

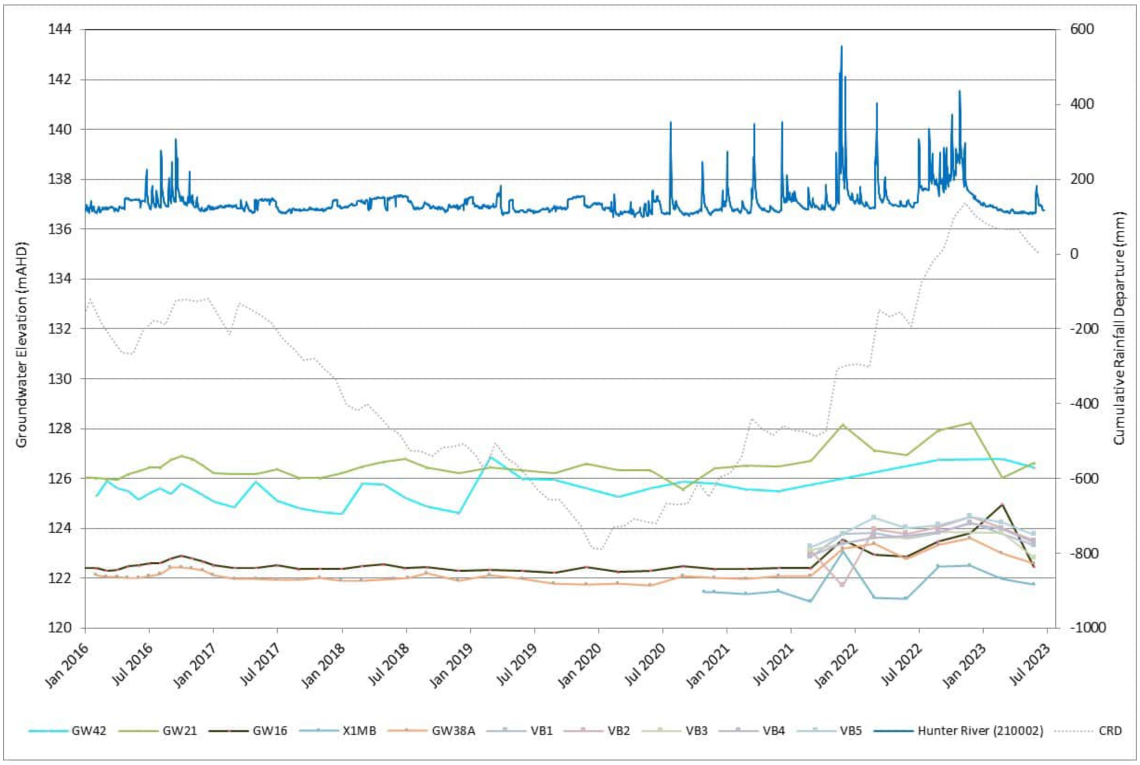


Figure 8.2 **Groundwater Levels in the Hunter River Alluvium Adjacent to the Cut-off Wall**

9.0 Numerical Model Predictions Review

The WMP requires a review of groundwater level predictions, which are calculated using a groundwater model to support current mining. To validate the model, the predictions are compared on an annual basis to the measured groundwater level data obtained from the monitoring program.

As summarised in SLR (2020b), the groundwater assessment was conducted by AGE (2013) concluded that approved operations at MAC would drawdown groundwater levels within 2 km of active mining operations. AGE (2013) also found that drawdown associated with operations at Bengalla Mine, to the north of MAC, would not interact with drawdown at MAC. There were no reported potential impacts on GDEs as a result of MAC (AGE, 2013). Less than 1 m drawdown was predicted at all privately owned bores intersecting alluvium and used for stock water supply and irrigation, due to mining at MAC, as shown in **Figure 9.1**. Drawdown of more than 2 m was predicted at some privately owned bores intersecting the Permian coal measures used for stock water supply as shown in **Figure 9.2**.

A review of the groundwater model was conducted by AGE (2020) and found that improvements could be made. BHP engaged SLR (2020a) to develop a numerical groundwater model for MAC that included calibration of measured groundwater levels to June 2020. The model was developed in MODFLOW-USG with steady state and transient calibration with a good fit to historical water level and mine inflow data. The updated model predicted:

- Negligible groundwater drawdown in the Saddlers Creek alluvium consistent with previous predictions. However, it is noted that the model generally predicts unsaturated conditions in the regolith and alluvium in the upper reach of Saddlers Creek.
- Localised drawdown of up to 5 m within the alluvium along Hunter River. The extent of predicted water table drawdown is consistent compared to the previous predictions for approved operations by AGE (2013).
- No impacts predicted on landholder bores intersecting alluvium.
- Predicted reduction in groundwater levels at three BHP owned bores that intersect the Permian coal measures.
- Negligible reductions in surface water flows/balance resulting from changes in groundwater baseflows to surface stream systems in Saddlers Creek.
- Up to 13.2 ML/year leakage (indirect take) from the Hunter River as a result of depressurisation due to mining, which is lower than previously predicted.
- Reduction in upward leakage from the Permian coal measures to the overlying alluvium of the Hunter River by a maximum of 82 ML/year (0.22 ML/day) which is lower than previously predicted by AGE (2013) which predicted between 0.63 ML/day to 0.72 ML/day leakage from Hunter River.
- Total groundwater inflows to the MAC open cut of approximately 657.5 ML/year on average (between 2020 to 2027) and ranging up to a peak in the order of 1,114 ML/year in 2026. The predicted inflow is largely consistent with the previously predicted average inflows by AGE (2013), which ranged between 711 ML/year to 912 ML/year from 2020 to 2026.

The updated model predictions by SLR (2020a) are consistent or slightly lower than previously predicted impacts on groundwater by AGE (2013). Further details on the up-to-date groundwater model are included in the model report by SLR (2020a).

Measured groundwater level elevations for June 2023 were compared to groundwater levels predicted in the current SLR (2020a) site model from July 2022 to June 2023. The difference between the model prediction and measured levels (residuals) are shown in **Figure 9.3**. Positive values indicate the model predicted higher groundwater levels (i.e., less drawdown) than is observed (measured). Negative values indicate the model predicted lower groundwater levels (i.e., more drawdown) than was observed (measured).

The groundwater model predictions in the Hunter River alluvium compare well to the measured levels as shown in **Figure 9.3**. Overall, the residual in the Hunter River alluvium is less than 5 m as shown in bores GW16, GW21, GW38A (IW4030), GW41A (IW4029), X1MB and X2MB.

The model also showed a fairly good fit (i.e., less than 5 m difference) between measured and modelled groundwater levels for bore GW16 that intersects alluvium and regolith on the north side of the alluvium barrier wall that separates MAC from the Hunter River alluvium. At the same location (i.e., VWP2 and VWP3) modelled groundwater levels in underlying coal seams show a fairly good fit with measured depressurisation. This indicates the model can replicate the vertical gradient and interaction between the depressurisation from mining and the Hunter River alluvium in the area of the barrier wall.

The model also shows a fairly good fit for the bores within the Saddlers Creek alluvium and Saddlers Creek shallow Permian (regolith) to the southwest of active mining. The modelled heads for bores GW45, GW47 and X14MB-1S are within 5 m of measured levels.

However, the modelled head for GW46, screened within the Saddlers Creek shallow Permian (regolith) was greater than 5 m of measured levels (-7.13 m residual) indicating the area was more saturated than predicted. It is noted that the model generally predicts unsaturated conditions in the regolith and alluvium in the upper reach of Saddlers Creek. This is likely influenced by the assumption of average streamflow and rainfall and could be improved in future iterations of the model.

With the exception of VWP X1, the response to mining is well represented in the Permian coal measure monitoring bores located along the Hunter River and show a fairly good fit with modelled heads within 5 m of measured levels. The modelled heads in VWP X1 are greater than 5 m of the measured levels. The model under predicted drawdown in all layers in X1 (Interburden, Mt Arthur, Vaux, Bayswater/Wynn, Interburden above Bengalla, Edinglassie and Ramrod Creek seams) indicating the area was less saturated than predicted.

To the west of active mining, the model did not fully capture groundwater levels at GW43 (Woodlands Hill Seam) and X10MB (Glen Munro Seam), near Belmont Pit and to the southwest of mining at GW2 (Woodlands Hill Seam), near Saddlers Pit, where the model predicted levels more than 5 m below measured levels. This likely relates to influence of modelled in-pit water storage in the area, which may not accurately replicate actual dam water storage levels.

The model under predicted drawdown west of the open cut (Huon Pit and Calool Pit) in some layers at VWP05 (Vaux and Bayswater seams), VWP06 (Edinglassie Seam) and VWP07 (Piercefield, Vaux and Ramrod Creek seams) and over predicted drawdown in VWP06 (Edderton Seam) and VWP07 (Bayswater and Edderton seams). However, this response is variable and likely reflects the simplified vertical discretisation in the model layers compared to the VWP sensor intervals.

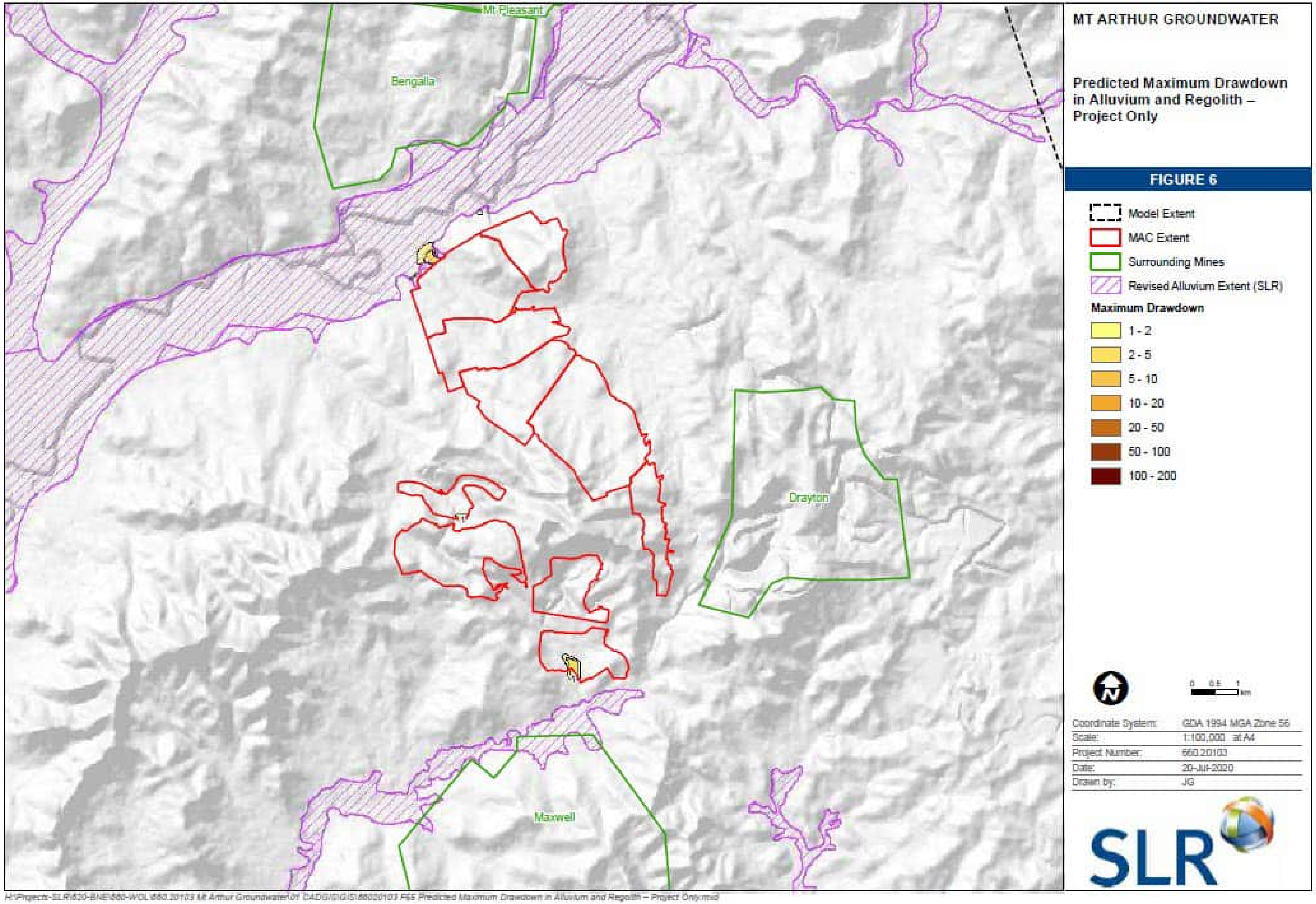


Figure 9.1 **Predicted Maximum Drawdown in Unconsolidated (Layer 1 and 2) – Approved Operations (Source: SLR, 2020a)**

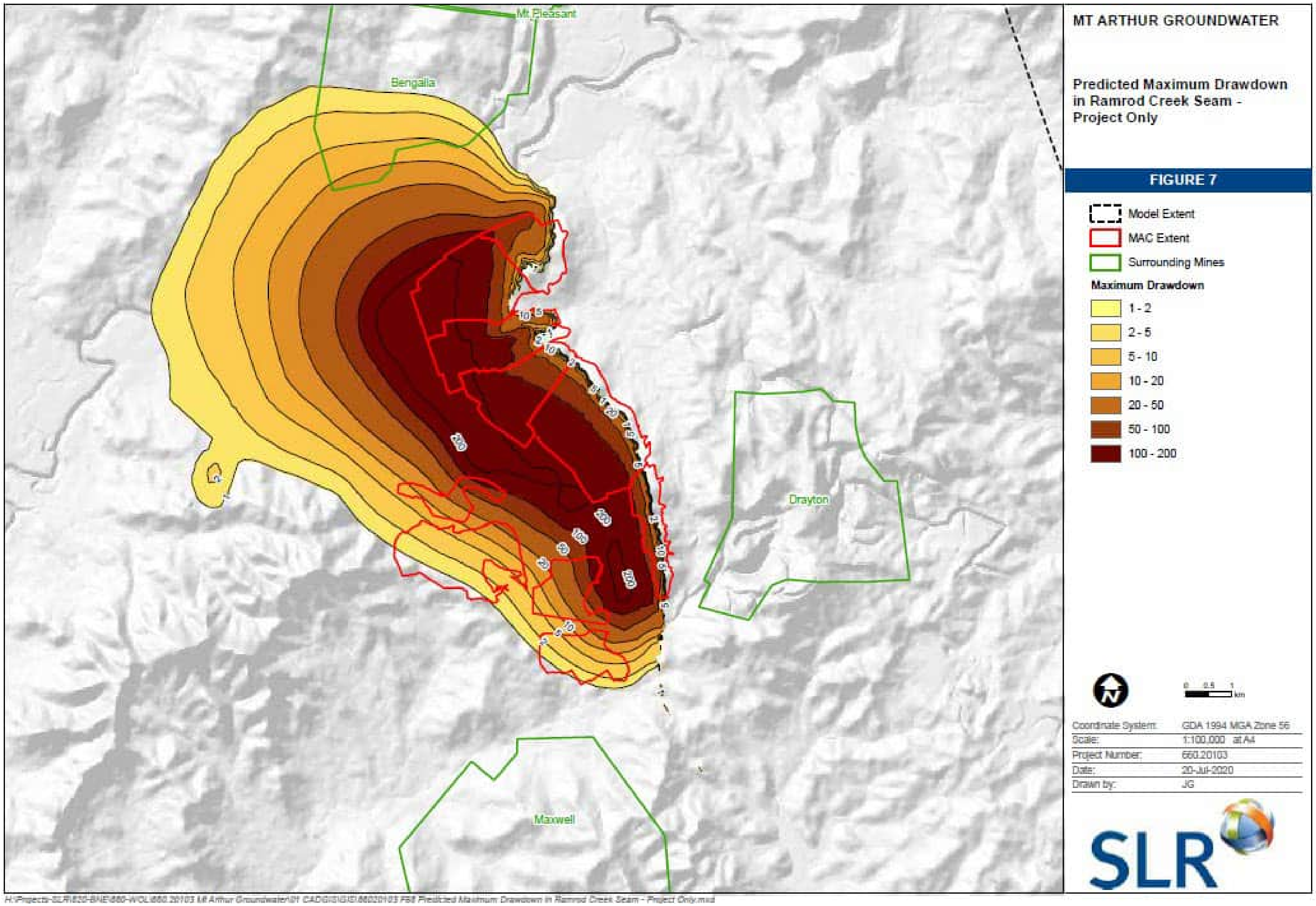
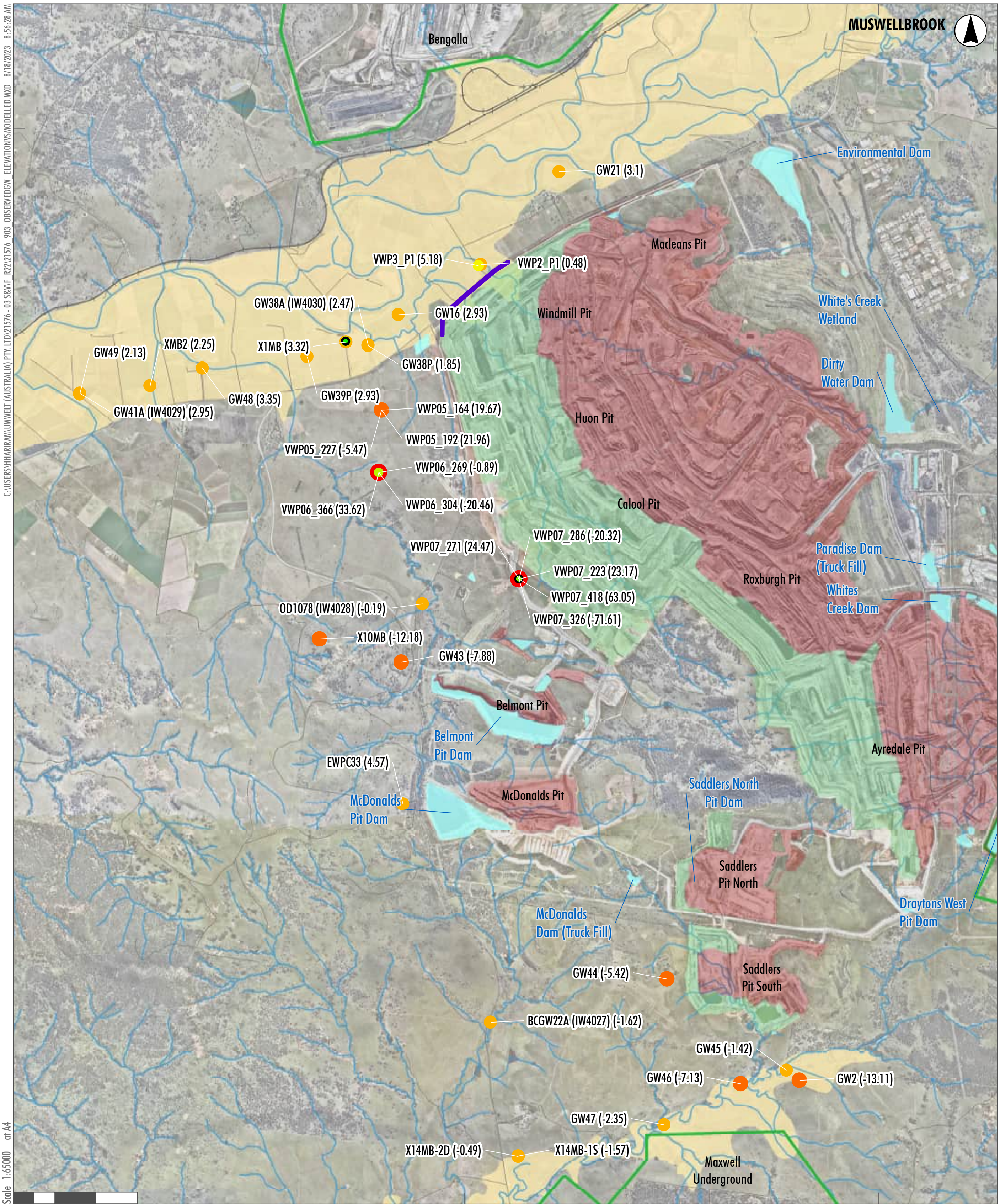


Figure 9.2 **Predicated Maximum Drawdown in Ramrod Creek Seam (Layer 26) – Approved Operations (Source: SLR, 2020a)**



Scale 1:65000 at A4

0 500 1,000 1,500 Meters

GDA 1994 MGA Zone 56

C:\USERS\HHARIRAM\UMWELT (AUSTRALIA) PTY. LTD\21576 - 03 S&W\F R22\21576 903 OBSERVEDGW ELEVATIONSVSMODELLED.MXD 8/18/2023 8:56:28 AM

Legend

- Surrounding Mines
- Active Mining Area
- Overburden Emplacement Area
- Water Management Dam

Modelled vs Measured Heads (Residuals) (m)

- -75 to -20
- -20 to -5
- -5 to 5
- 5 to 20
- 20 to 50
- 50 to 100
- 100 to 160

- Cut-off Wall
- Alluvium Extent
- Railway
- Roads
- Watercourse

FIGURE 9.3

Modelled versus Measured Heads June 2023

Image Source: Nearmap (May 2022) Data source: NSW DFSI (2021)

10.0 Recommendations

The following improvements to the groundwater monitoring program are recommended:

- GW42 – as per the Umwelt 2021 network review, the bore should be replaced with a new bore, but continue to be monitored until the replacement bore is installed.
- X1MB – update Ontoto settings to convert data to metres below ground level (mbgl).
- X1MB, X2MB, X14MB-2D – are listed as either data fault, inactive or terminated in Ontoto. It is recommended that the condition of the datalogger and connection to Ontoto be reviewed and, if required, replaced to assist in correlating groundwater trends with rainfall and streamflow trends.
- GW39P-25mm – data logger not recording fluctuating water levels, recommend replacing logger.
- GW38P, GW43, GW48 and GW49 - show instrument drift in the installed datalogger. It is recommended that the datalogger be replaced to assist in correlating groundwater trends with rainfall and streamflow trends.

The following improvements to the field monitoring and sampling programme by CBE are recommended:

- Chilled groundwater lab samples – six of the 35 sample batches received by ALS were above the recommended temperature of 4°C. It is recommended that all samples should be chilled sufficiently to reach the lab below 4°C.
- Recommend using a small diameter pump in bores where hand bailing is required due to the diameter of the bore.
- Supply all field calibration sheets and lab QA/QC sheets for quality review.
- Set logger frequency to 6 am/12 pm/6 pm/12 am, on the hour, in all water level loggers to ensure consistency of logger data.

11.0 References

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APPENDIX A

Groundwater Monitoring Network and Trigger Levels (2023)

2023 WMP Compliance Monitoring Network

Bore ID	Easting (m)	Northing (m)	Type	TOC Elevation (mAHD)	Surface Elevation (mAHD)	Bore/ Sensor Depth (mbgl)	Screen/Sensor (mAHD)	Stratigraphy	Logger/ Sensor Installed	Purpose of Bore	SWL Frequency	WQ Frequency	Water Level Trigger Derivation Method*	Water Level Trigger (mAHD)	Water Level Trigger (mbTOC)	pH Trigger Range	EC Trigger Stage 1 (µS/cm)	EC Trigger Stage 2 (µS/cm)
BCGW22A (IW4027)	295314	6414210	MB	143.8	143.45	14.65	129.3–135.3	Saddlers Creek Shallow Permian (regolith)	Y	Monitoring of regolith in unnamed tributary of Saddlers Creek, between McDonalds Pit/Void and Saddlers Creek. To assess any impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	2	136.6	7.20	6.8-7.1	14800	21480
EWPC33	294253	6416847	MB	230.32	229.32	56.38	175.6–178.6	Blakefield Seam	Y	Monitoring of Blakefield Seam to the west of McDonalds Pit/Void (mined to Blakefield seam) and monitor the impact of mining activities adjacent to mining areas in the area west of MAC.	D/Q	Q/A	2	190.4	39.92	6.8-7.5	2973	3040
GW2	299045	6413511	MB	153.84	153.47	112.63	40.8–43.8	Woodlands Hill Seam	Y	Monitoring of Woodlands Hill Seam in the Saddlers Creek area. A paired bore with GW45 and GW46 to assess vertical hydraulic gradient between Permian Coal measures (Woodlands Hill seam) and alluvium, and the impact of mining activities adjacent to mining areas in the Saddlers Creek area.	D/Q	Q/A	2	140.0	13.84	7.0-8.5	4802	5810
GW16	294197	6422759	MB	131.71	131.57	12.76	120.5–126.5	Hunter River Alluvium	Y	Monitoring of Hunter River alluvium between the Hunter River and northwest end of MAC to identify any leakage from the Hunter River alluvium due to adjacent mining activities at MAC.	D/Q	Q/A	2	119.0	12.71	6.9-7.7	5228	9090
GW21	296141	6424483	MB	136.96	136.96	16.00	122.4–128.4	Hunter River Alluvium	Y	Monitoring of Hunter River alluvium between the Hunter River and north end of MAC to identify any leakage from the Hunter River alluvium due to adjacent mining activities at MAC.	D/Q	Q/A	2	118.3	18.66	6.9-7.7	5228	9090
GW38A (IW4030)	293831	6422393	MB	131.71	131.1	10.76	108.7–131.7	Hunter River Alluvium	Y	Monitoring of Hunter River alluvium close to the Hunter River and northwest end of main pit. A paired bore with GW38P to assess vertical hydraulic gradient between Permian Coal measures (Warkworth Seam) and alluvium, as well as any impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	2	119.7	12.01	6.9-7.7	5228	9090
GW38P	293832	6422384	MB	131.16	131.16	22.52	98.6–131.6	Warkworth Seam	Y	Monitoring of Warkworth Seam close to the Hunter River and northwest end of main pit. A paired bore with GW38A (IW4030) to assess vertical hydraulic gradient between Permian coal measures (Warkworth Seam) and alluvium, and the impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	1	117.3	13.86	7.2-8.1	6170	9170
GW39P-25mm	293094	6422251	MB	130.72	130.3	41.74	88.1–91.1	Warkworth Seam	Y	Monitoring of Hunter River alluvium close to the Hunter River and northwest end of the main pit. To assess any impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	-	1	117.2	13.52	-	-	-
GW41A (IW4029)	290348	6421810	MB	126.48	125.91	7.44	112.5–126.5	Hunter River alluvium	Y	Monitoring of Hunter River alluvium. A paired bore with GW49 to assess vertical hydraulic gradient between Permian coal measures (Arrowfield Seam) and alluvium, as well as any impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	1	116.9	9.58	6.9-7.7	5528	9090
GW43	294233	6418560	MB	197.33	196.83	68.50	133.8–139.8	Woodlands Hill Seam	Y	Monitoring of Woodlands Hill Seam, northwest of Belmont Pit/Void (mined to Glen Munro Seam). To assess any impact of mining activities adjacent to mining areas to the west of MAC.	D/Q	Q/A	1	166.8	30.53	7.0-8.5	4802	5810

Bore ID	Easting (m)	Northing (m)	Type	TOC Elevation (mAHD)	Surface Elevation (mAHD)	Bore/ Sensor Depth (mbgl)	Screen/Sensor (mAHD)	Stratigraphy	Logger/ Sensor Installed	Purpose of Bore	SWL Frequency	WQ Frequency	Water Level Trigger Derivation Method*	Water Level Trigger (mAHD)	Water Level Trigger (mbTOC)	pH Trigger Range	EC Trigger Stage 1 (µS/cm)	EC Trigger Stage 2 (µS/cm)
GW44	297445	6414733	MB	211.03	210.5	132.47	80.5–86.5	Woodlands Hill Seam	Y	Monitoring of Woodlands Hill Seam to the west of Saddlers Central Pit and to monitor the impact of mining activities adjacent to mining areas in the Saddlers Creek area.	D/Q	-	1	65.6	145.43	-	-	-
GW45	298890	6413630	MB	152.41	151.89	14.49	138.9–141.9	Saddlers Creek alluvium	Y	Monitoring of Saddlers Creek alluvium in the Saddlers Creek area. A paired bore with GW2 and GW46 to assess vertical hydraulic gradient between Permian coal measures (Woodlands Hill Seam) and alluvium, and the impact of mining activities adjacent to mining areas in the Saddlers Creek area.	D/Q	Q/A	2	137.7	14.71	6.6-7.6	8783	11380
GW46	298337	6413469	MB	144.14	143.63	20.49	126.1–129.1	Saddlers Creek Shallow Permian (regolith)	Y	Monitoring of Saddlers Creek alluvium in the Saddlers Creek area. A paired bore with GW2 and GW45 to assess vertical hydraulic gradient between Permian coal measures (Woodlands Hill Seam) and alluvium, as well as any impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	2	132.5	11.64	6.7-7.1	14800	21480
GW47	297409	6412974	MB	137.00	136.51	17.51	120.5–123.5	Saddlers Creek alluvium	Y	Monitoring Saddlers Creek alluvium to the south of Saddlers Creek and monitor the impact of mining activities adjacent to mining areas in the Saddlers Creek area.	D/Q	Q/A	2	126.9	10.10	6.6-7.6	8783	11380
GW48	291830	6422111	MB	129.62	129.07	35.6	95.0–98.0	Bowfield Seam	Y	Monitoring of Bowfield Seam and any impact from mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	1	115.9	13.72	6.8-7.7	7891	8300
GW49	290346	6421798	MB	126.62	126.02	35.47	92.1–95.1	Arrowfield Seam	Y	Monitoring of Arrowfield Seam. A paired bore with GW41A (IW4029) to assess vertical hydraulic gradient between Permian coal measures (Arrowfield Seam) and alluvium, and the impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	1	115.8	10.82	6.7-8.9	7831	8210
OD1078 (IW4028)	294491	6419265	MB	171.26	171.26	64.82	107.3–110.3	Arrowfield Seam	Y	Monitoring of Arrowfield Seam close to an old channel of Quarry Creek, to the northwest of Belmont Pit/Void (mined to Glen Munro Seam).	D/Q	-	2	132.9	38.36	-	-	-
X1MB	293566	6422429	MB	131.47	131.47	13.30	65.0–118.2	Hunter River Alluvium	Y	Monitoring of Hunter River alluvium between the Hunter River and north end of MAC to identify any leakage from the Hunter River alluvium due to adjacent mining activities at MAC.	D/Q	Q/A	2	118.7	12.77	6.9-7.7	5228	9090
X2MB	291196	6421899	MB	127.36	126.84	15.00	113.92–119.92	Hunter River Alluvium	Y	Monitoring of Hunter River alluvium between the Hunter River and north end of MAC to identify any leakage from the Hunter River alluvium due to adjacent mining activities at MAC.	D/Q	Q/A	2	117.9	9.46	6.9-7.7	5228	9090
X10MB	293247	6418841	MB	248.19	248.19	80.60	166.93–169.93	Glen Munro Seam	Y	Monitoring of Glen Munro Seam.	D/Q	Q/A	1	179.6	68.59	6.7-8.3	11200	14710
X14MB-1S	295649	6412596	MB	127.58	127.58	20.00	108.08–111.08	Saddlers Creek shallow Permian (regolith)	Y	Monitoring of regolith in unnamed tributary of Saddlers Creek, between McDonalds Pit/Void and Saddlers Creek. To assess any impact of mining activities adjacent to mining areas to the north of MAC. A paired bore with X14MB-2D to assess the hydraulic gradient between the regolith and Permian coal measures (Glen Munro Seam).	D/Q	Q/A	2	114.5	13.08	6.7-7.1	14800	21480

Bore ID	Easting (m)	Northing (m)	Type	TOC Elevation (mAHD)	Surface Elevation (mAHD)	Bore/ Sensor Depth (mbgl)	Screen/Sensor (mAHD)	Stratigraphy	Logger/ Sensor Installed	Purpose of Bore	SWL Frequency	WQ Frequency	Water Level Trigger Derivation Method*	Water Level Trigger (mAHD)	Water Level Trigger (mbTOC)	pH Trigger Range	EC Trigger Stage 1 (µS/cm)	EC Trigger Stage 2 (µS/cm)
X14MB-2D	295648	6412592	MB	128.06	127.48	75.5	52.28–55.28	Glen Munro Seam	Y	Monitoring of Glen Munro Seam near an unnamed tributary of Saddlers Creek, between McDonalds Pit/Void and Saddlers Creek. To assess any impact of mining activities adjacent to mining areas to the north of MAC. A paired bore with X14MB-1S to assess the hydraulic gradient between the regolith and Permian coal measures (Glen Munro Seam).	D/Q	Q/A	2	116.1	11.96	6.7-8.3	11200	14710
VWP2_P1	295195	6423364	VWP	135.41	135.41	216.5	-81.09	F4 Fault	Y	Targeting F4 Fault zone to monitor any variations in water levels within the fault and coals seams either side of, and displaced by, fault movement. Also, to monitor the effectiveness of cut off wall located between the Hunter River and the northern end of MAC. A paired bore with GW42 and VWP3 to assess vertical hydraulic gradient between Permian Coal measures and alluvium, and the impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	Q/A	1	-64.4	-	-	-	-
VWP3_P1	295166	6423349	VWP	135.38	135.38	227.0	-91.62	Edinglassie Seam	Y	Targeting Edinglassie Seam, above F4 fault on footwall, to monitor any variations in water levels within the fault and coals seams either side of, and displaced by, fault movement. Also, to monitor the effectiveness of cut off wall located between the Hunter River and the northern end of MAC. A paired bore with GW42 and VWP2 to assess vertical hydraulic gradient between Permian Coal measures and alluvium, and the impact of mining activities adjacent to mining areas to the north of MAC.	D/Q	-	1	-46.5	-	-	-	-
VWP05_164	293993	6421605	VWP	161.40	161.40	164.0	-2.60	Vaux Seam	Y	Monitoring any depressurisation in Vaux Seam due to mining activities at MAC.	D/Q	-	1	-46.2	-	-	-	-
VWP05_192						192.0	-30.60	Bayswater Seam	Y	Monitoring any depressurisation in Bayswater Seam due to mining activities at MAC.	D/Q	-	1	-29.1	-	-	-	-
VWP05_227						227.0	-65.60	Edderton Seam	Y	Monitoring any depressurisation in Edderton Seam due to mining activities at MAC.	D/Q	-	1	-74.1	-	-	-	-
VWP06_269	293960	6420850	VWP	179.64	179.64	269.0	-89.36	Broonie Seam	Y	Monitoring any depressurisation in Broonie Seam due to mining activities at MAC.	D/Q	-	1	-15.3	-	-	-	-
VWP06_304						304.0	-124.36	Edderton Seam	Y	Monitoring any depressurisation in Edderton Seam due to mining activities at MAC.	D/Q	-	1	-59.8	-	-	-	-
VWP06_366						366.0	-186.36	Edinglassie Seam	Y	Monitoring any depressurisation in Edinglassie Seam due to mining activities at MAC.	D/Q	-	1	-4.5	-	-	-	-
VWP07_223	295656	6419565	VWP	215.95	215.95	223.0	-7.05	Piercefield Seam	Y	Monitoring of Piercefield Seam to assess vertical hydraulic gradient between Permian Coal measures (Vaux, Bayswater, Edderton and Ramrod Creek seams), and the impact of mining activities adjacent to mining areas to the northwest of MAC.	D/Q	-	1	64.7	-	-	-	-
VWP07_271						271.0	-55.05	Vaux Seam	Y	Monitoring of Vaux Seam to assess vertical hydraulic gradient between Permian Coal measures (Piercefield, Bayswater, Edderton and Ramrod Creek seams), and the impact of mining activities adjacent to mining areas to the northwest of MAC.	D/Q	-	1	57.3	-	-	-	-

Bore ID	Easting (m)	Northing (m)	Type	TOC Elevation (mAHD)	Surface Elevation (mAHD)	Bore/ Sensor Depth (mbgl)	Screen/Sensor (mAHD)	Stratigraphy	Logger/ Sensor Installed	Purpose of Bore	SWL Frequency	WQ Frequency	Water Level Trigger Derivation Method*	Water Level Trigger (mAHD)	Water Level Trigger (mbTOC)	pH Trigger Range	EC Trigger Stage 1 (µS/cm)	EC Trigger Stage 2 (µS/cm)
VWP07_286						286.0	-70.5	Bayswater Seam	Y	Monitoring of Bayswater Seam to assess vertical hydraulic gradient between Permian Coal measures (Piercefield, Vaux, Edderton and Ramrod Creek seams), and the impact of mining activities adjacent to mining areas to the northwest of MAC.	D/Q	-	1	-17.1	-	-	-	-
VWP07_326						326.0	-110.1	Edderton Seam	Y	Monitoring of Edderton Seam to assess vertical hydraulic gradient between Permian Coal measures (Piercefield, Vaux, Bayswater and Ramrod Creek seams), and the impact of mining activities adjacent to mining areas to the northwest of MAC.	D/Q	-	1	-91.3	-	-	-	-
VWP07_418						418.0	-202.1	Ramrod Creek Seam	Y	Monitoring of Ramrod Creek Seam to assess vertical hydraulic gradient between Permian Coal measures (Piercefield, Vaux, Bayswater and Edderton seams), and the impact of mining activities adjacent to mining areas to the northwest of MAC.	D/Q	-	1	142.3	-	-	-	-
X1_S-1 (35)	293564	6422437	VWP	131.44	131.44	35.0	96.44	Alluvium	Y	Monitoring any depressurisation in alluvium near the Hunter River due to mining activities at MAC.	D/Q	-	1	97.6	-	-	-	-
X1_S-2 (59)						59.0	72.44	Mt Arthur Seam	Y	Monitoring any depressurisation in the Mt Arthur Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	91.0	-	-	-	-
X1_S-3 (128.5)						128.5	2.94	Vaux Seam	Y	Monitoring any depressurisation in the Vaux Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	24.6	-	-	-	-
X1_S-4 (164)						164.0	-32.56	Bayswater/Wynn Seam	Y	Monitoring any depressurisation in the Bayswater/Wynn Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	16.1	-	-	-	-
X1_S-5 (215)						215.0	-83.56	Interburden above Bengalla Seam	Y	Monitoring any depressurisation in the Interburden above Bengalla Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	-31.7	-	-	-	-
X1_S-6 (255)						255.0	-123.56	Edinglassie Seam	Y	Monitoring any depressurisation in the Edinglassie Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	-55.6	-	-	-	-
X1_S-7 (276.5)						276.5	-145.06	Ramrod Creek Seam	Y	Monitoring any depressurisation in the Ramrod Creek Seam near the Hunter River due to mining activities at MAC.	D/Q	-	1	-64.6	-	-	-	-

Note: Coordinates – GDA94z56 *TOC – Top of Casing.*

APPENDIX B

Groundwater Level Monitoring Data

Bore ID	Easting (m)	Northing (m)	TOC Elevation (mAHD)	Bore/Sensor Depth (mbTOC)	Target Formation	Type	Trigger Levels (mAHD)	MAC Consolidation Project June 2023 Modelled Head (mAHD)	Measured Groundwater Levels							Drawdown		
									First Record			June 2022		June 2023		Head Difference (m)	Measured Drawdown (m)	Expected Drawdown (m)
									WL Date	Depth to Water (mBTOC)	WL Elevation (mAHD)	Depth to Water (mBTOC)	WL Elevation (mAHD)	Depth to Water (mBTOC)	WL Elevation (mAHD)	Modelled vs Measured June 2023[1] (Residual)	First Record vs Measured June 2023[2]	First Record vs Modelled June 2023[2]
BCGW22A (IW4027)	295313.5	6414209.7	143.80	14.65	Saddlers Creek shallow Permian	MB	136.60	138.79	Feb-16	3.02	141.00	3.40	140.40	3.39	140.41	-1.62	-0.59	-2.21
EWPC33	294252.7	6416847.0	230.32	56.38	Blakefield Seam	MB	190.40	204.94	Jan-08	34.30	196.00	26.60	203.72	29.95	200.37	4.57	4.37	8.94
GW16	294197.2	6422759.2	131.71	12.76	Hunter River Alluvium	MB	119.00	125.39	Feb-99	9.20	123.00	8.83	122.88	9.25	122.46	2.93	-0.54	2.39
GW2	299044.8	6413510.6	153.84	112.63	Woodlands Hill Seam	MB	140.00	133.61	Jun-01	7.50	146.40	9.44	144.40	7.12	146.72	-13.11	0.32	-12.79
GW21	296141.3	6424482.9	135.96	16.00	Hunter River Alluvium	MB	118.30	129.73	Feb-99	8.60	127.40	9.01	126.95	9.33	126.63	3.10	-0.77	2.33
GW38A (IW4030)	293831.3	6422393.0	131.71	10.76	Hunter River alluvium	MB	119.70	125.06	Feb-16	9.60	122.15	8.93	122.78	9.12	122.59	2.47	0.44	2.91
GW38P	293831.6	6422384.0	131.64	22.52	Warkworth Seam	MB	117.30	123.67	Jan-08	9.50	122.00	9.71	121.93	9.82	121.82	1.85	-0.18	1.67
GW39P-25mm	293094.4	6422250.9	130.72	41.74	Warkworth Seam	MB	117.20	123.67	Jan-08	8.50	121.90	10.05	120.67	9.98	120.74	2.93	-1.16	1.77
GW41A (IW4029)	290347.7	6421809.9	126.48	7.44	Hunter River alluvium	MB	116.70	122.60	Feb-16	7.36	119.20	6.90	119.58	6.83	119.65	2.95	0.45	3.40
GW43	294232.9	6418560.1	197.33	68.50	Woodlands Hill Seam	MB	166.80	162.52	Feb-16	27.49	169.84	27.79	169.54	26.93	170.40	-7.88	0.56	-7.32
GW44	297444.5	6414732.5	211.03	132.47	Woodlands Hill Seam	MB	65.60	100.35	Feb-16	85.14	125.89	113.10	97.93	105.26	105.77	-5.42	-20.12	-25.54
GW45	298889.8	6413629.5	152.41	14.49	Saddlers Creek alluvium	MB	137.70	141.62	Feb-16	8.43	144.03	9.22	143.19	9.37	143.04	-1.42	-0.99	-2.41
GW46	298336.7	6413469.3	144.14	20.49	Saddlers Creek shallow Permian	MB	132.50	129.65	Feb-16	6.91	137.25	7.02	137.12	7.36	136.78	-7.13	-0.47	-7.60
GW47	297408.8	6412974.0	137.00	17.51	Saddlers Creek alluvium	MB	126.90	128.06	Feb-16	6.41	130.66	6.59	130.41	6.59	130.41	-2.35	-0.25	-2.60
GW48	291829.6	6422110.6	129.62	35.60	Bowfield Seam	MB	115.90	123.68	Feb-16	10.77	118.93	9.21	120.41	9.29	120.33	3.35	1.40	4.75
GW49	290345.7	6421797.5	126.55	35.47	Arrowfield Seam	MB	115.80	121.60	Feb-16	7.78	118.77	7.15	119.40	7.08	119.47	2.13	0.70	2.83
OD1078 (IW4028)	294490.6	6419265.1	171.26	64.82	Arrowfield Seam	MB	132.90	137.52	Jan-08	7.30	164.10	36.27	134.99	33.55	137.71	-0.19	-26.39	-26.58
VWP05_164	293993.3	6421605.1	161.40	164.00	Vaux Seam	VWP	-46.20	58.44	Dec-15	89.55	68.95	-	42.07	-	38.77	19.67	-30.18	-10.51
VWP05_192				192.00	Bayswater Seam	VWP	-29.10	58.44		116.78	86.13	-	39.62	-	36.48	21.96	-49.65	-27.69
VWP05_227				227.00	Edderton Seam	VWP	-74.10	27.58		151.13	85.47	-	36.62	-	33.05	-5.47	-52.42	-57.89
VWP06_269				269.00	Broonie Seam	VWP	-15.30	63.89		179.49	89.99	-	73.08	-	64.78	-0.89	-25.21	-26.10
VWP06_304				304.00	Edderton Seam	VWP	-59.80	31.85		214.63	90.08	-	60.03	-	52.31	-20.46	-37.77	-58.23
VWP06_366				366.00	Edinglassie Seam	VWP	-4.50	85.20		272.85	86.33	-	58.01	-	51.58	33.62	-34.75	-1.13
VWP07_223	295656.1	6419564.9	215.95	223.00	Piercefield Seam	VWP	64.70	109.47	Dec-15	130.65	123.55	-	93.80	-	86.30	23.17	-37.25	-14.08
VWP07_271				271.00	Vaux Seam	VWP	57.30	109.47		171.33	116.15	-	93.10	-	85.00	24.47	-31.15	-6.68
VWP07_286				286.00	Bayswater Seam	VWP	-17.10	60.28		175.42	104.89	-	83.20	-	80.60	-20.32	-24.29	-44.61
VWP07_326				326.00	Edderton Seam	VWP	-91.30	3.39		204.93	94.78	-	80.50	-	75.00	-71.61	-19.78	-91.39
VWP07_418				418.00	Ramrod Creek Seam	VWP	142.30	145.24		264.50	154.32	-	Faulty Sensor	-	82.19	63.05	-72.13	-9.08
VWP2_P1	295194.7	6423364.0	135.41	216.50	F4 Fault	VWP	-64.40	1.48	Aug-11	47.70	87.70	-	1.89	-	1.00	0.48	-86.70	-86.22

Bore ID	Easting (m)	Northing (m)	TOC Elevation (mAHD)	Bore/Sensor Depth (mbTOC)	Target Formation	Type	Trigger Levels (mAHD)	MAC Consolidation Project June 2023 Modelled Head (mAHD)	Measured Groundwater Levels							Drawdown		
									First Record			June 2022		June 2023		Head Difference (m)	Measured Drawdown (m)	Expected Drawdown (m)
									WL Date	Depth to Water (mBTOC)	WL Elevation (mAHD)	Depth to Water (mBTOC)	WL Elevation (mAHD)	Depth to Water (mBTOC)	WL Elevation (mAHD)	Modelled vs Measured June 2023[1] (Residual)	First Record vs Measured June 2023[2]	First Record vs Modelled June 2023[2]
VWP3_P1	295165.8	6423349.3	135.38	227.00	Edinglassie Seam	VWP	-46.50	1.48	Sep-11	29.80	105.60	-	2.52	-	-3.70	5.18	-109.30	-104.12
X1MB	293566.0	6422429.0	131.47	13.30	Hunter River Alluvium	MB	118.70	125.07	Nov-20	10.67	120.80	10.29	121.18	10.38	121.75	3.32	0.95	4.27
X1_S-1 (35)	293564.0	6422437.0	131.44	35.00	Alluvium	VWP	97.60	125.07	May-20	-	100.64	-	103.24	-	101.34	23.73	0.70	24.43
X1_S-2 (59)			131.44	59.00	Mt Arthur Seam	VWP	91.00	125.44		-	95.84	-	91.24	-	90.54	34.90	-5.30	29.60
X1_S-3 (128.5)			131.44	128.50	Vaux Seam	VWP	24.60	130.05		-	72.94	-	50.14	-	50.54	79.51	-22.40	57.11
X1_S-4 (164)			131.44	164.00	Bayswater/Wynn Seam	VWP	16.10	130.05		-	64.44	-	46.34	-	42.84	87.21	-21.60	65.61
X1_S-5 (215)			131.44	215.00	Interburden above Bengalla Seam	VWP	-31.70	134.93		-	67.54	-	62.54	-	57.64	77.29	-9.90	67.39
X1_S-6 (255)			131.44	255.00	Edinglassie Seam	VWP	-55.60	135.50		-	26.74	-	-13.76	-	-14.46	149.96	-41.20	108.76
X1_S-7 (276.5)			131.44	276.50	Ramrod Creek Seam	VWP	-64.40	136.01		-	17.04	-	-20.26	-	-21.96	157.97	-39.00	118.97
X2MB	291196.0	6421899.0	127.36	15.00	Hunter River Alluvium	MB	117.90	122.89	Nov-20	7.49	119.87	6.73	120.63	6.72	120.64	2.25	0.77	3.02
X10MB	293247.0	6418841.0	248.19	80.60	Glen Munro Seam	MB	179.60	176.74	Nov-20	65.60	182.59	64.40	183.79	59.27	188.92	-12.18	6.33	-5.85
X14MB-1S	295649.0	6412596.0	127.58	20.00	Saddlers Creek shallow Permian	MB	114.50	117.85	Nov-20	3.30	124.28	8.66	118.92	8.16	119.42	-1.57	-4.86	-6.43
X14MB-2D	295648.0	6412592.0	128.06	75.50	Glen Munro Seam	MB	116.10	122.85	Nov-20	9.95	118.11	4.02	124.04	4.72	123.34	-0.49	5.23	4.74

Note: *TOC Elevation – Top of Casing elevation.*

mAHD metres above Australian Height Datum.

WL – water level.

mBTOC – metres below top of casing.

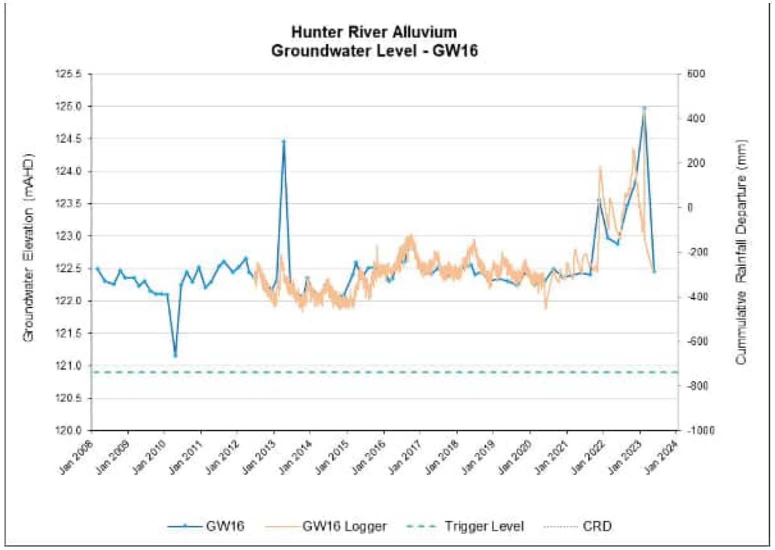
[1] Negative values indicate the measured piezometric level is higher than modelled – this means the model is over-predicting effects at this site for FY23.

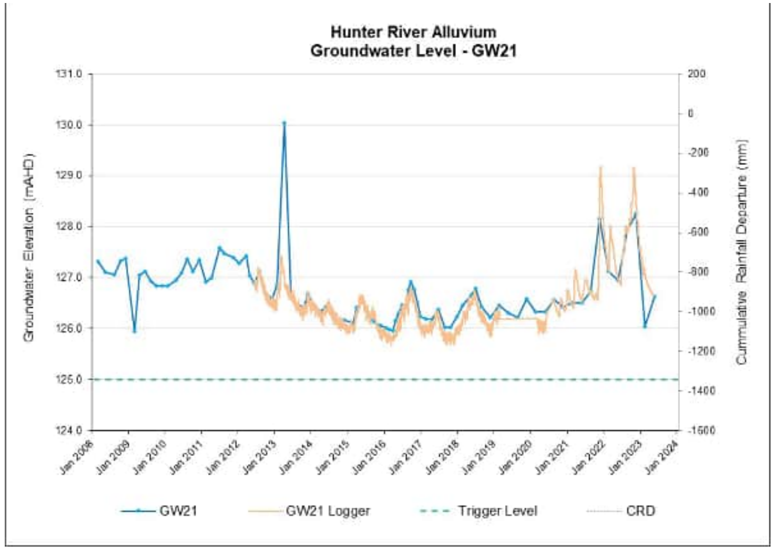
[2] Negative values indicate drawdown.

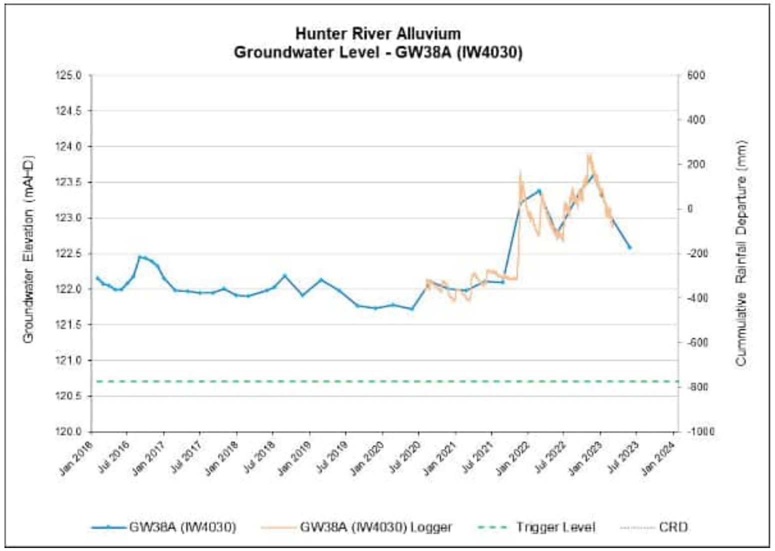
APPENDIX C

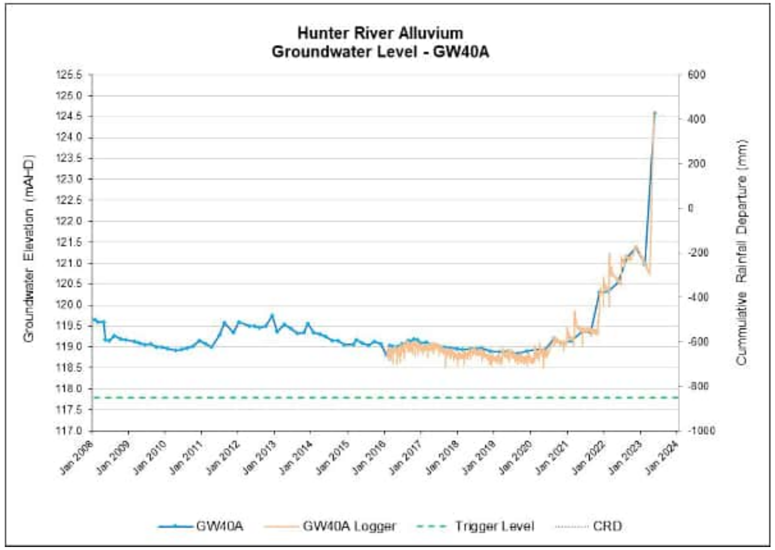
Groundwater Level Graphs

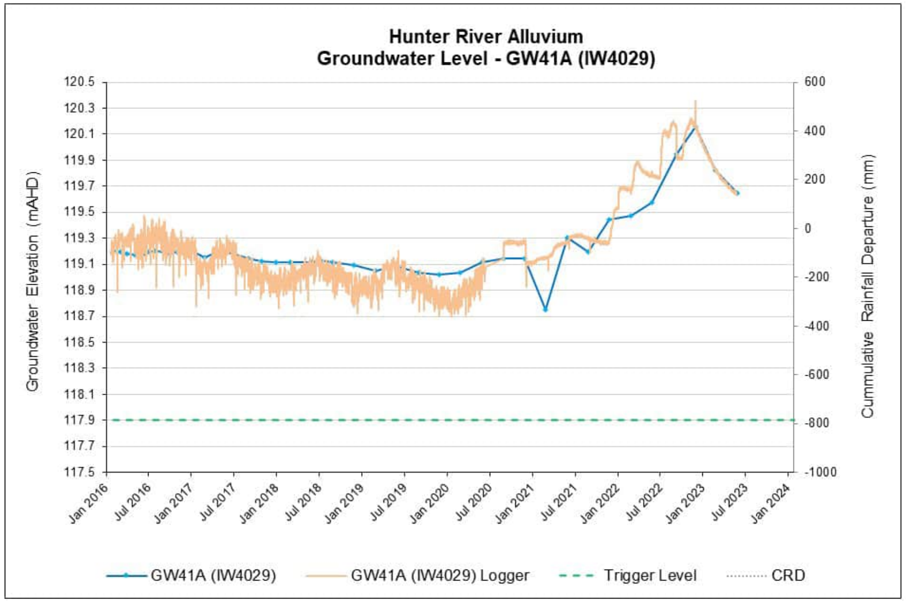
Groundwater Levels – WMP V2.1 Trigger Levels (July 2022 to March 2023)

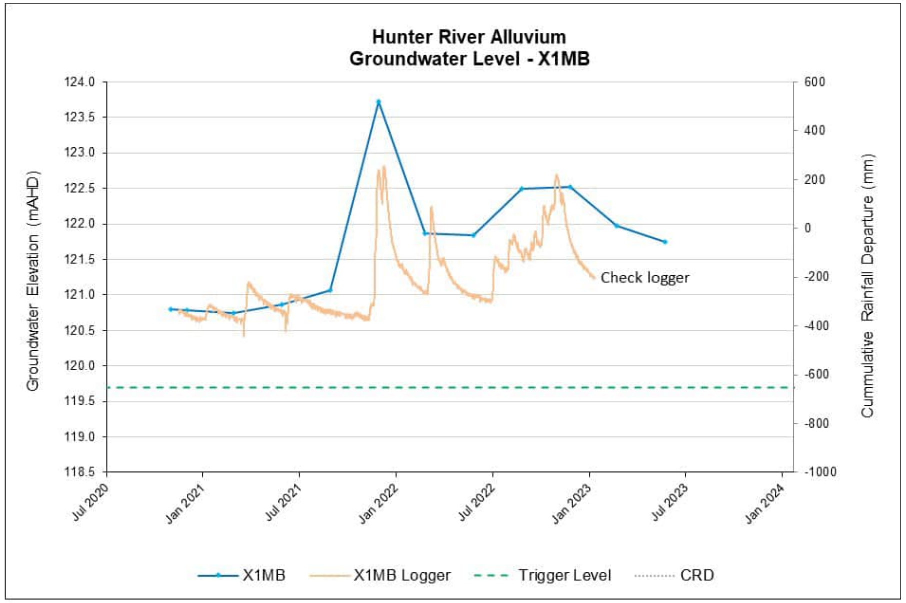


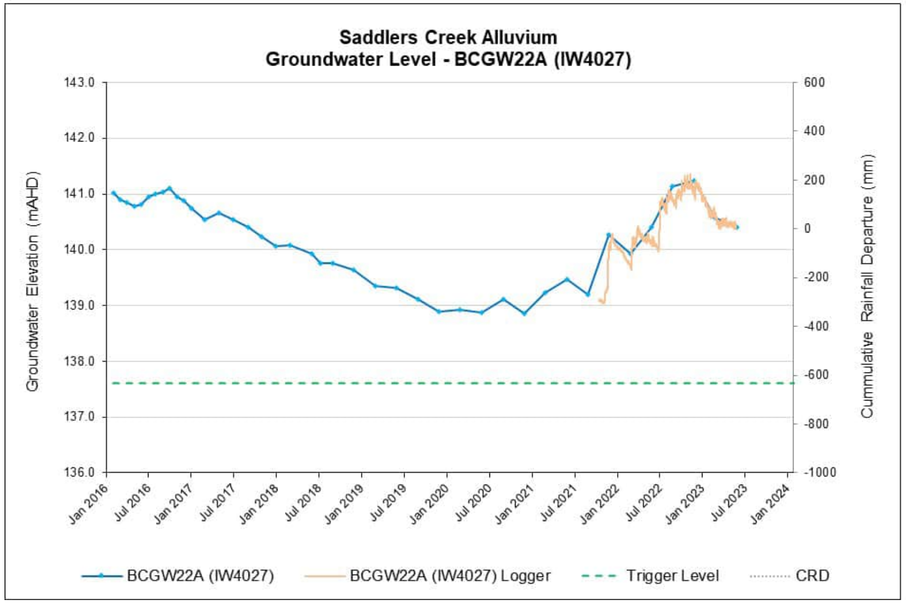


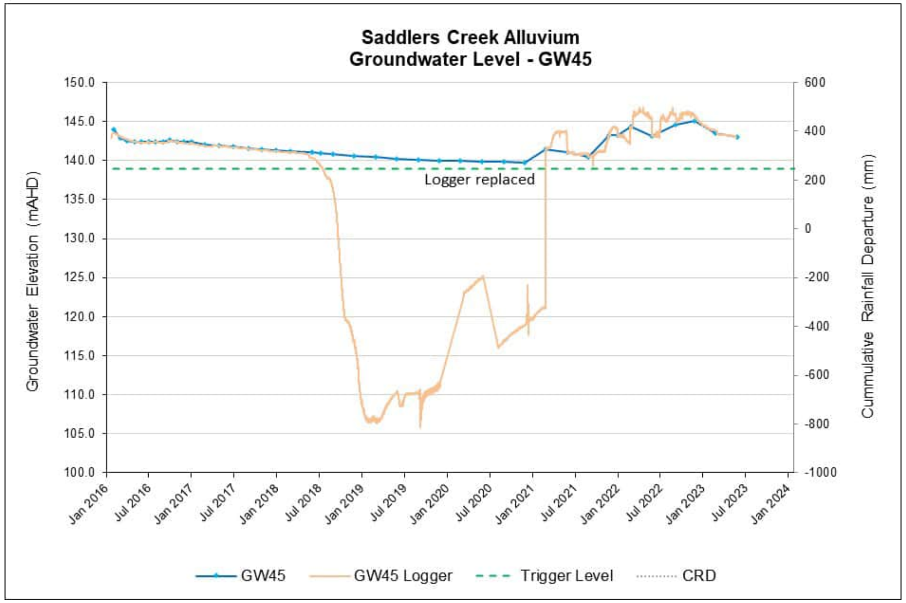


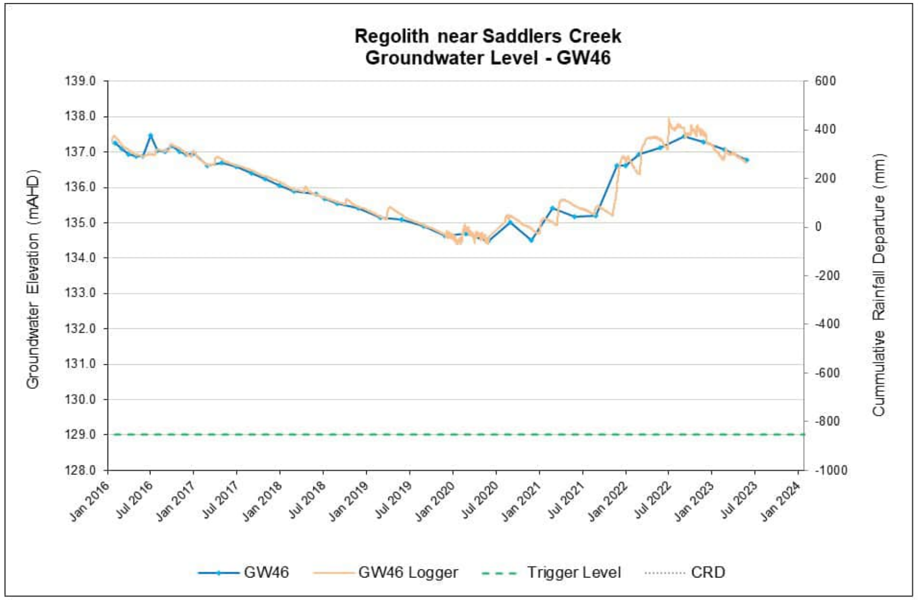



Hunter River Alluvium
Groundwater Level - GW41A (IW4029)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW41A (IW4029)
GW41A (IW4029) Logger
Trigger Level
CRD

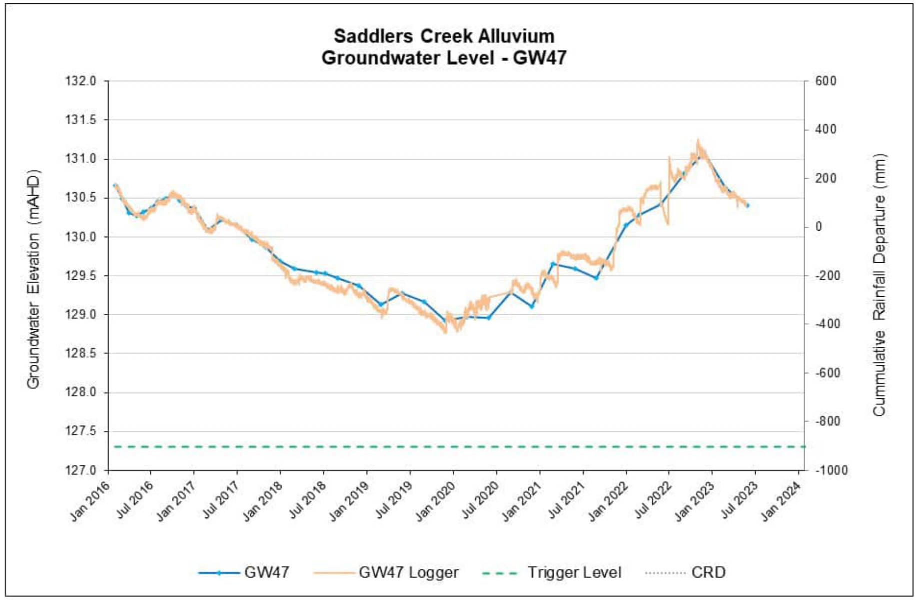

Hunter River Alluvium
Groundwater Level - X1MB
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Check logger
X1MB
X1MB Logger
Trigger Level
CRD


Saddlers Creek Alluvium
Groundwater Level - BCGW22A (IW4027)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
BCGW22A (IW4027)
BCGW22A (IW4027) Logger
Trigger Level
CRD

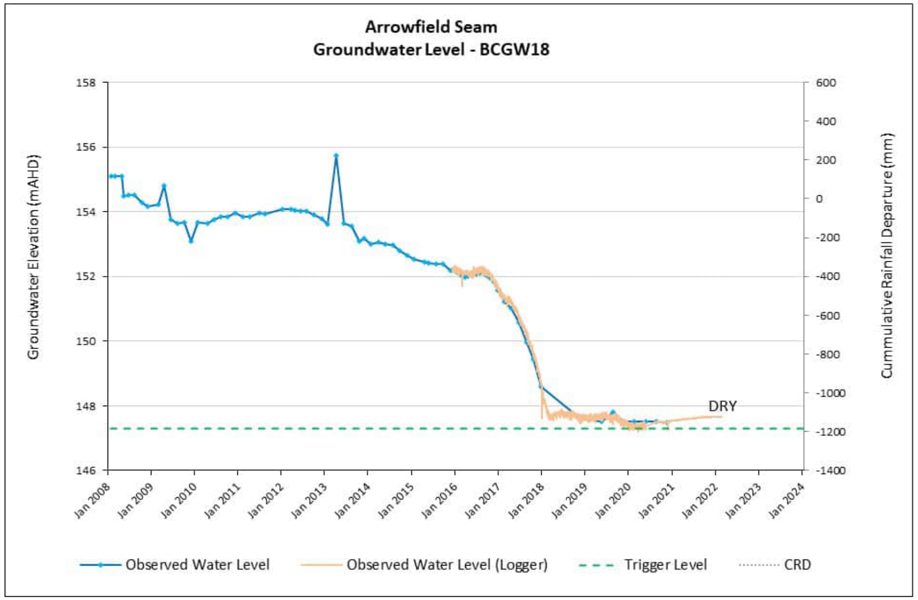

Saddlers Creek Alluvium
Groundwater Level - GW45
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger replaced
GW45
GW45 Logger
Trigger Level
CRD



Regolith near Saddlers Creek
Groundwater Level - GW46
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW46
GW46 Logger
Trigger Level
CRD

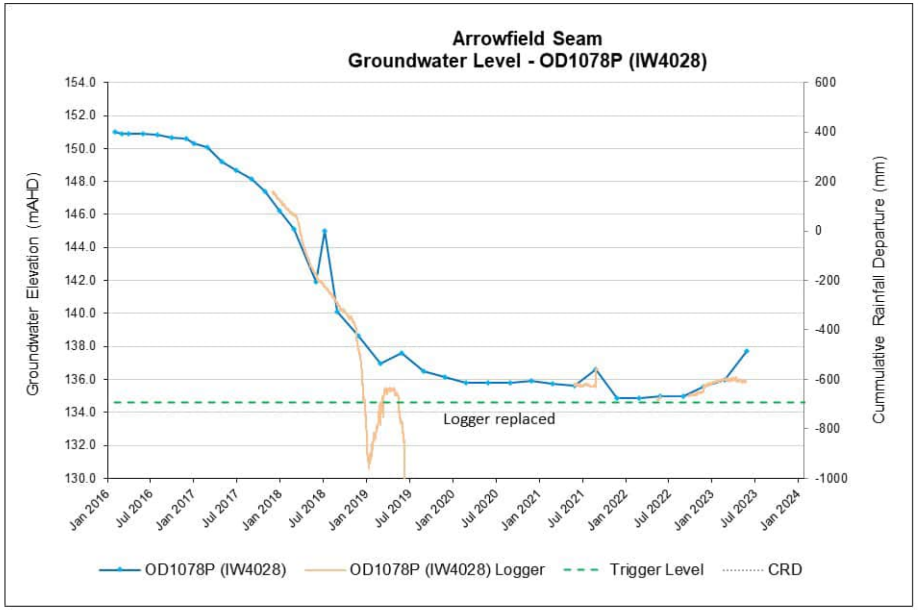


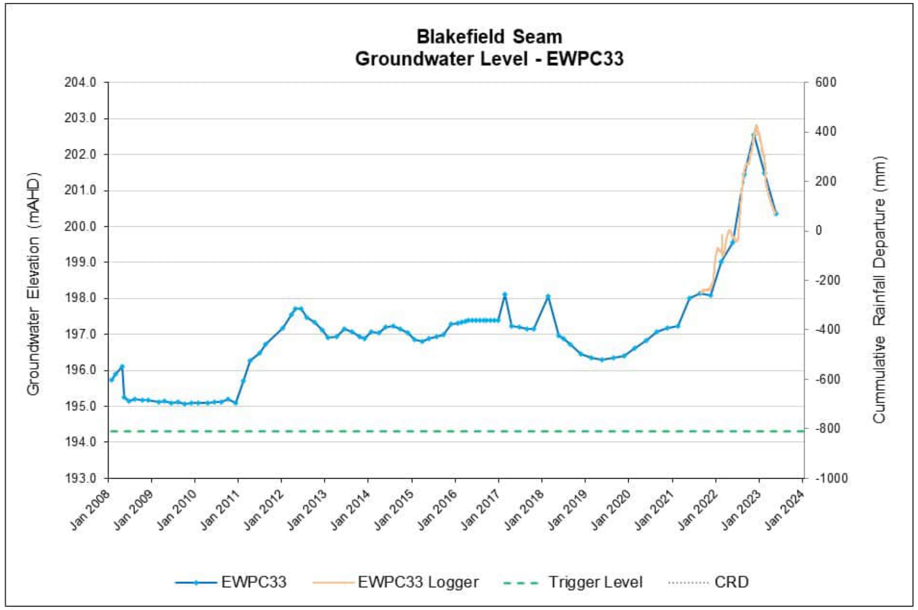
Saddlers Creek Alluvium
Groundwater Level - GW47
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW47
GW47 Logger
Trigger Level
CRD

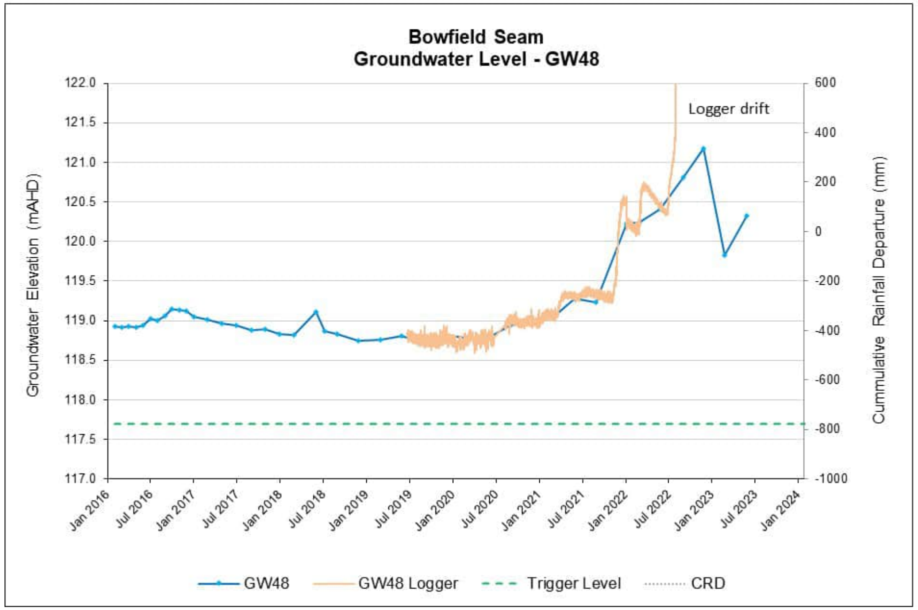


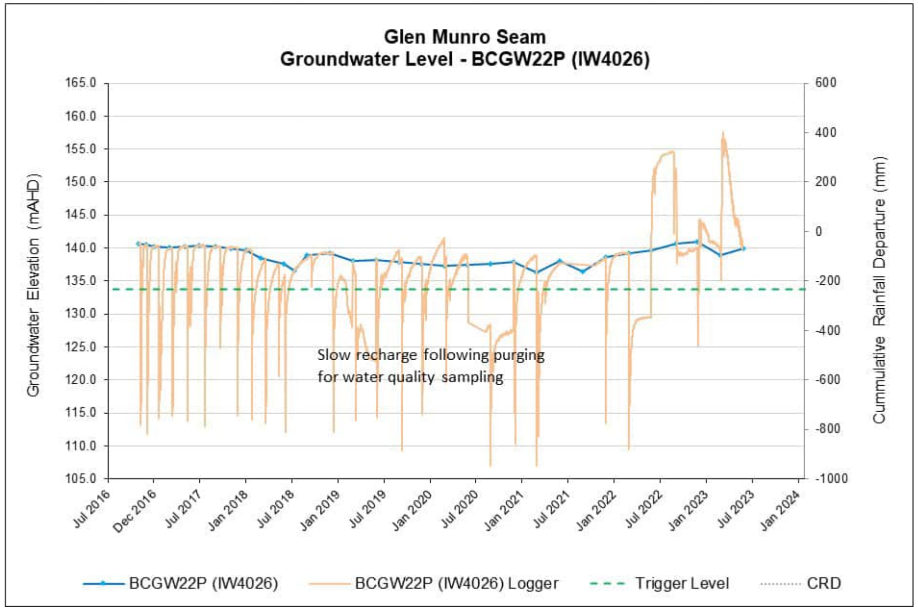
Arrowfield Seam
Groundwater Level - BCGW18
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
DRY
Observed Water Level
Observed Water Level (Logger)
Trigger Level
CRD

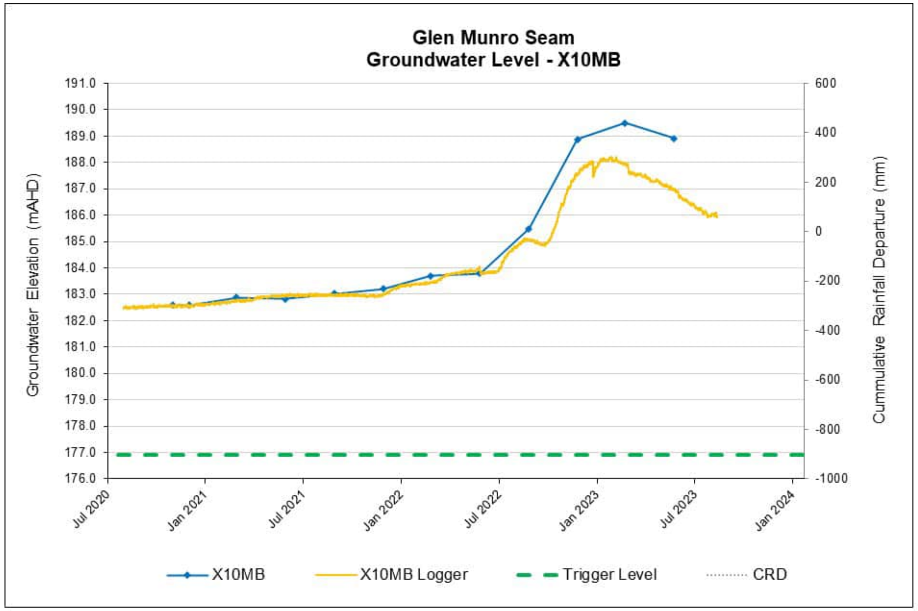
Arrowfield Seam
Groundwater Level - GW49
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
GW49
GW49 Logger
Trigger Level
CRD


Arrowfield Seam
Groundwater Level - OD1078P (IW4028)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger replaced
OD1078P (IW4028)
OD1078P (IW4028) Logger
Trigger Level
CRD

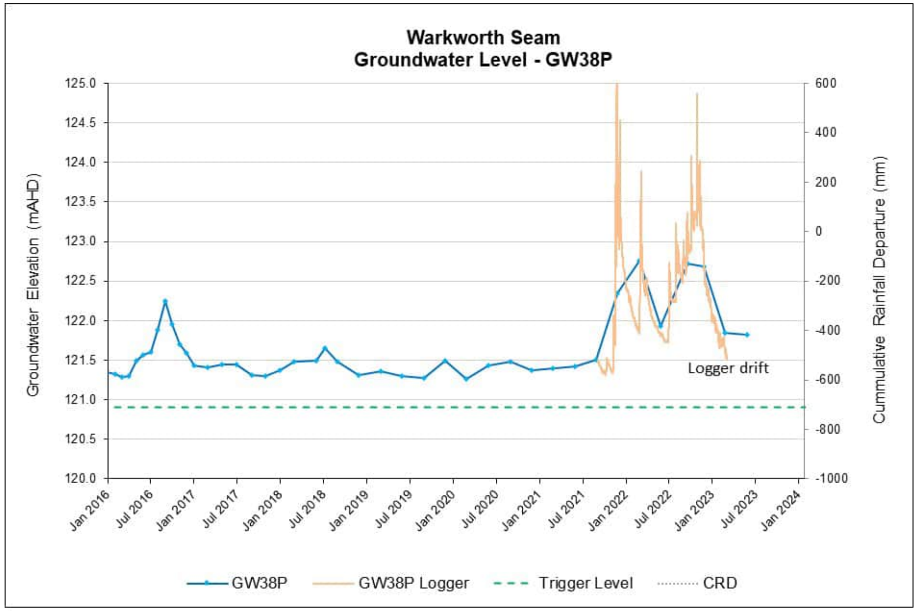

Blakefield Seam
Groundwater Level - EWPC33
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
EWPC33
EWPC33 Logger
Trigger Level
CRD


Bowfield Seam
Groundwater Level - GW48
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
GW48
GW48 Logger
Trigger Level
CRD

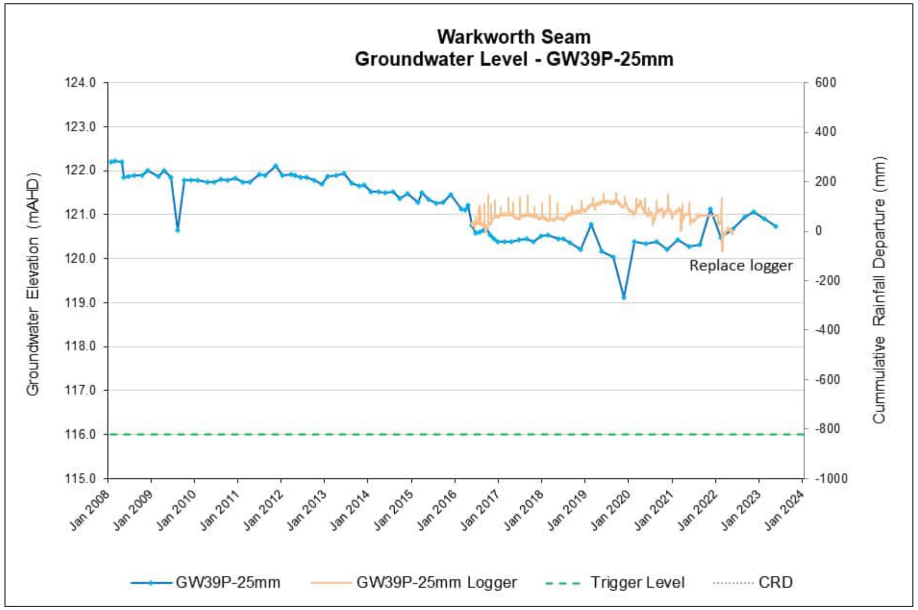

Glen Munro Seam
Groundwater Level - BCGW22P (IW4026)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Slow recharge following purging
for water quality sampling
BCGW22P (IW4026)
BCGW22P (IW4026) Logger
Trigger Level
CRD



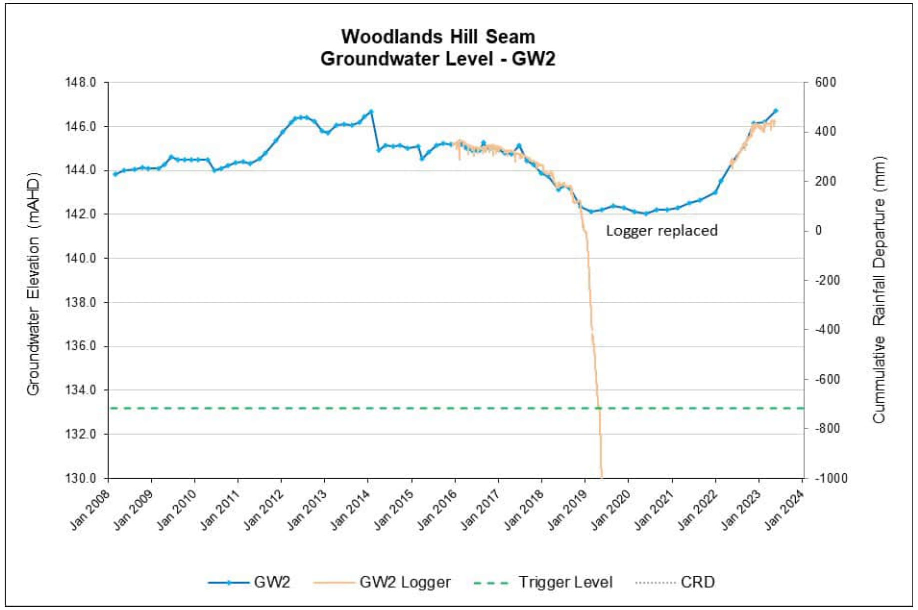
Glen Munro Seam
Groundwater Level - X10MB
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
X10MB
X10MB Logger
Trigger Level
CRD



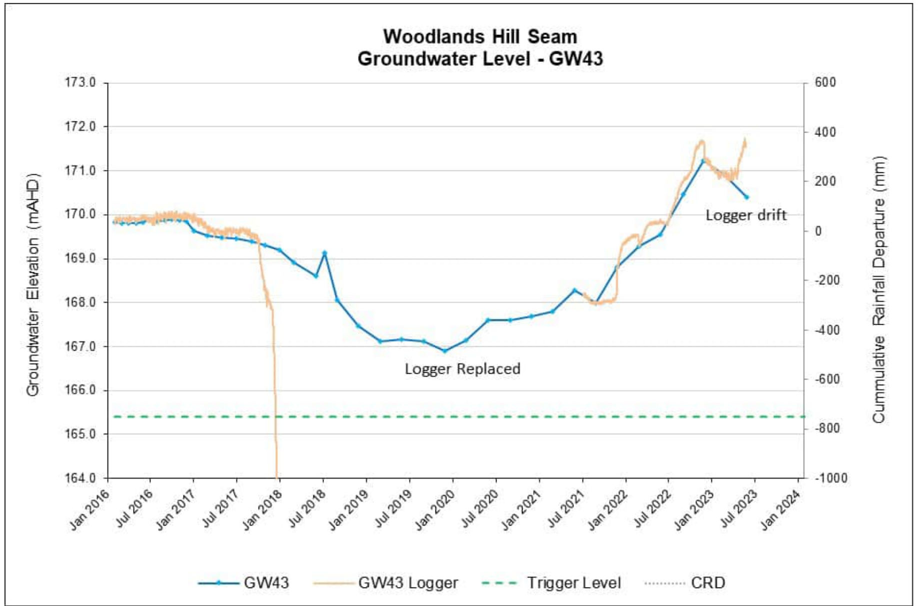
Warkworth Seam
Groundwater Level - GW38P
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
GW38P
GW38P Logger
Trigger Level
CRD

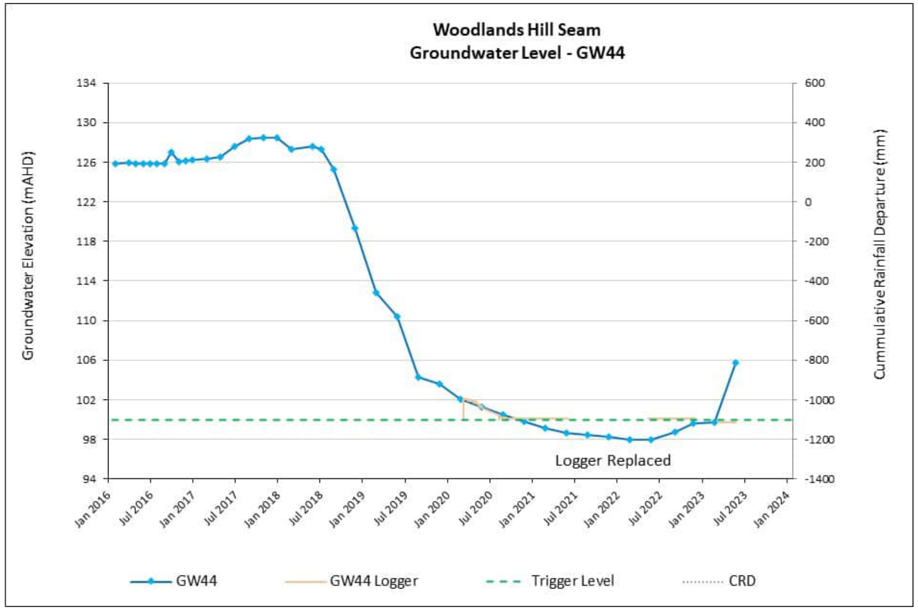


Warkworth Seam
Groundwater Level - GW39P-25mm
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Replace logger
GW39P-25mm
GW39P-25mm Logger
Trigger Level
CRD

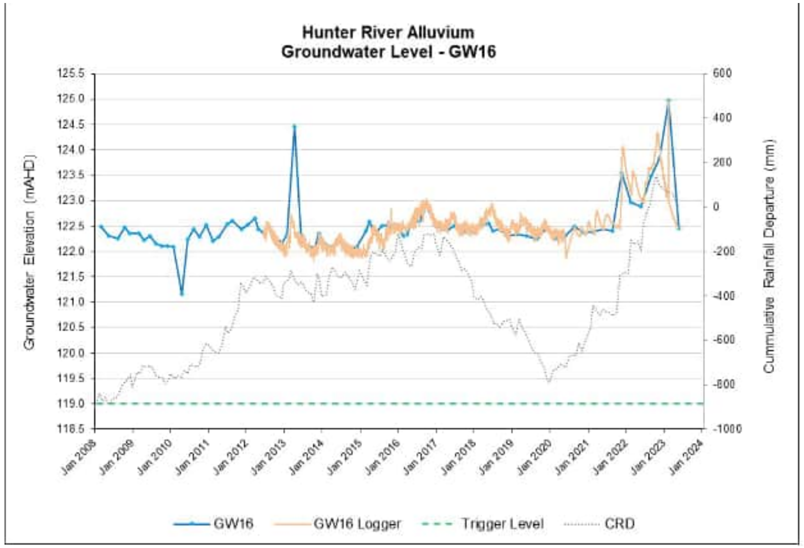


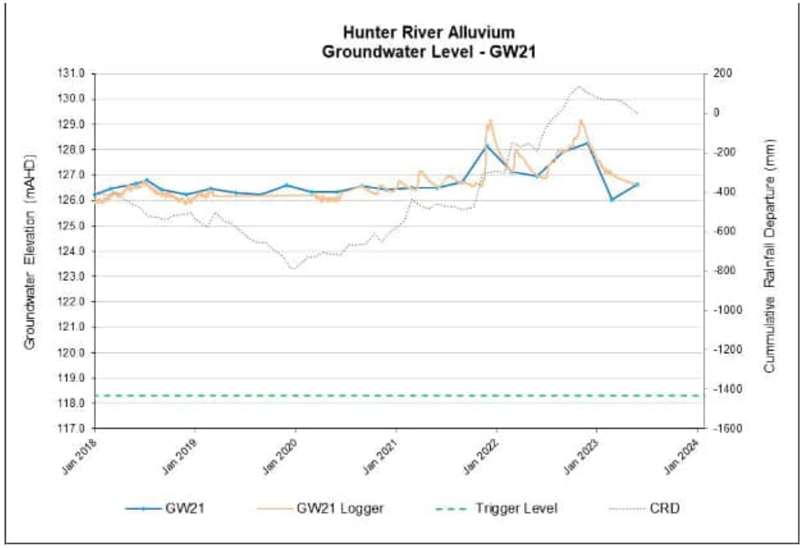
Woodlands Hill Seam
Groundwater Level - GW2
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger replaced
GW2
GW2 Logger
Trigger Level
CRD

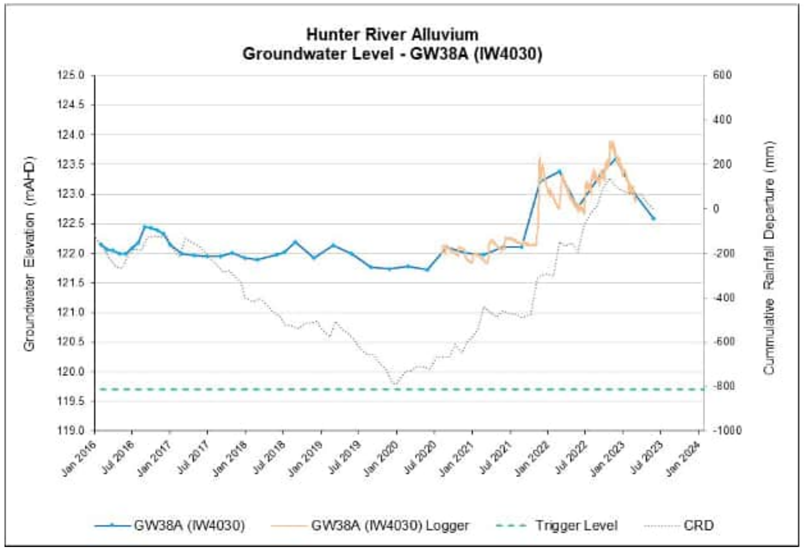

Woodlands Hill Seam
Groundwater Level - GW43
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
Logger Replaced
GW43
GW43 Logger
Trigger Level
CRD

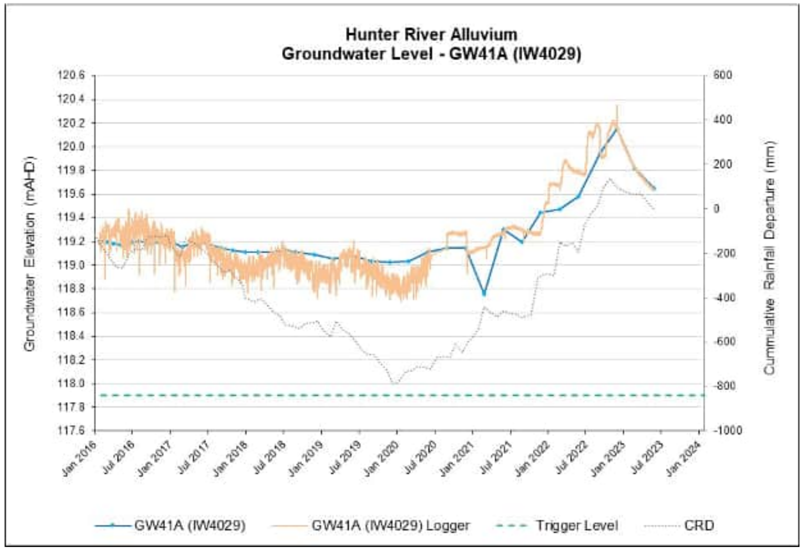

Woodlands Hill Seam
Groundwater Level - GW44
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger Replaced
GW44
GW44 Logger
Trigger Level
CRD

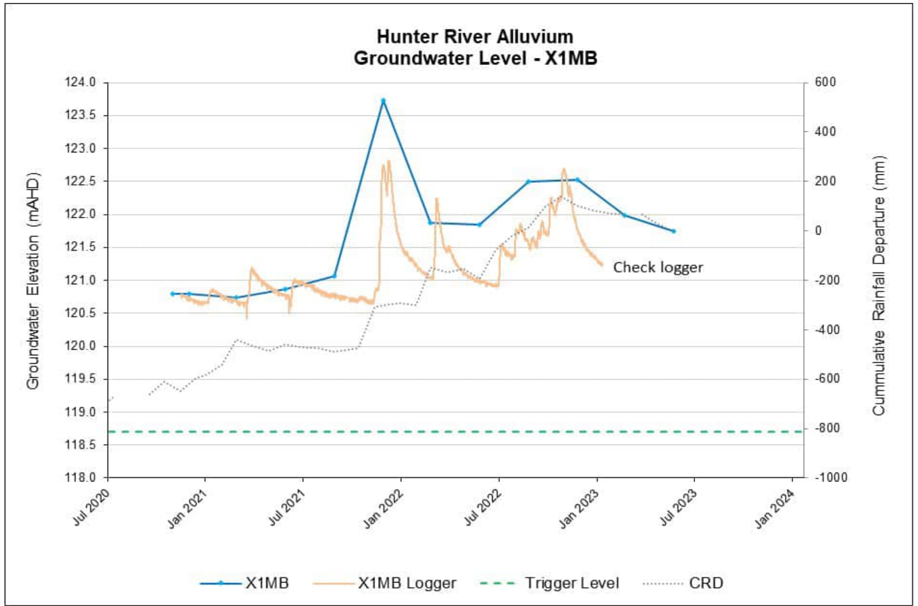
Groundwater Levels – WMP V3 (April to June 2023)

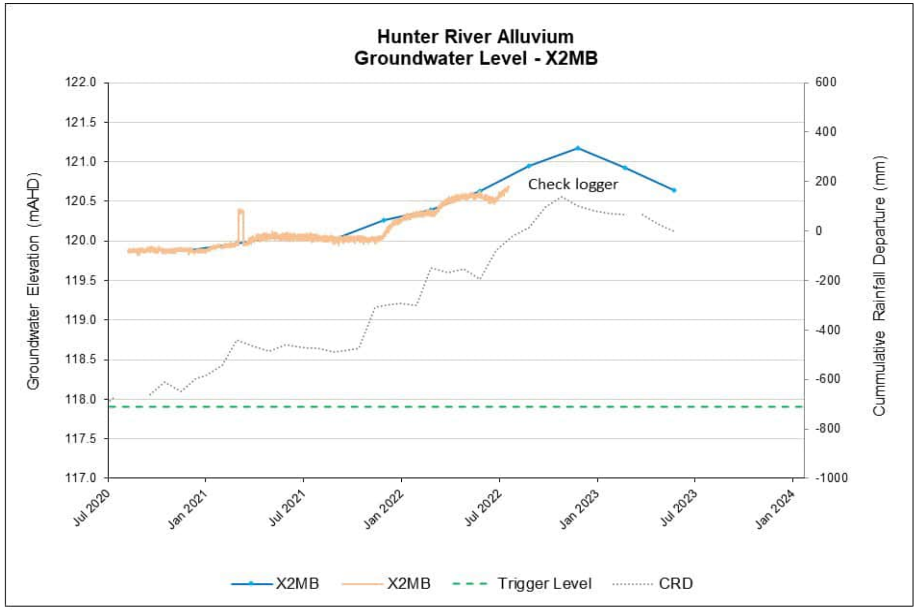


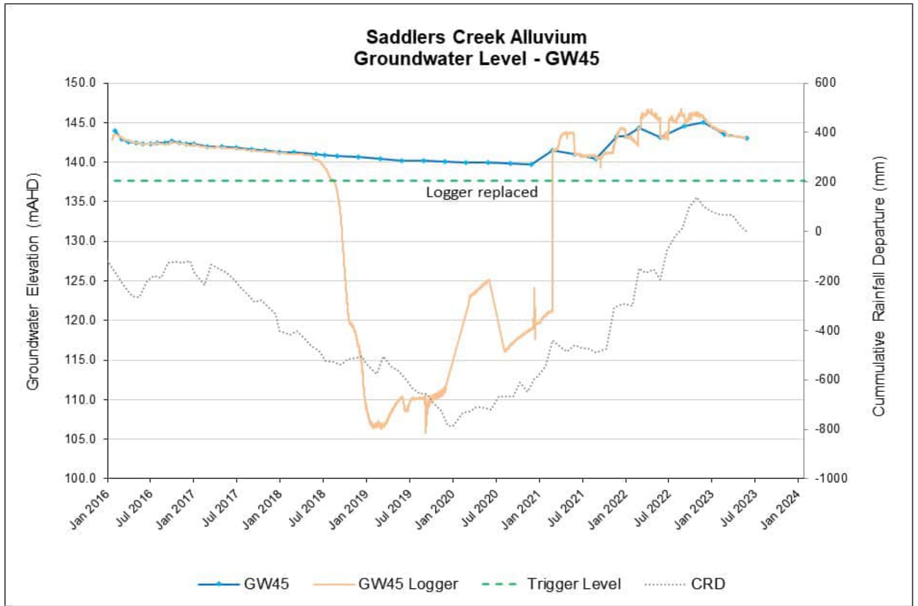


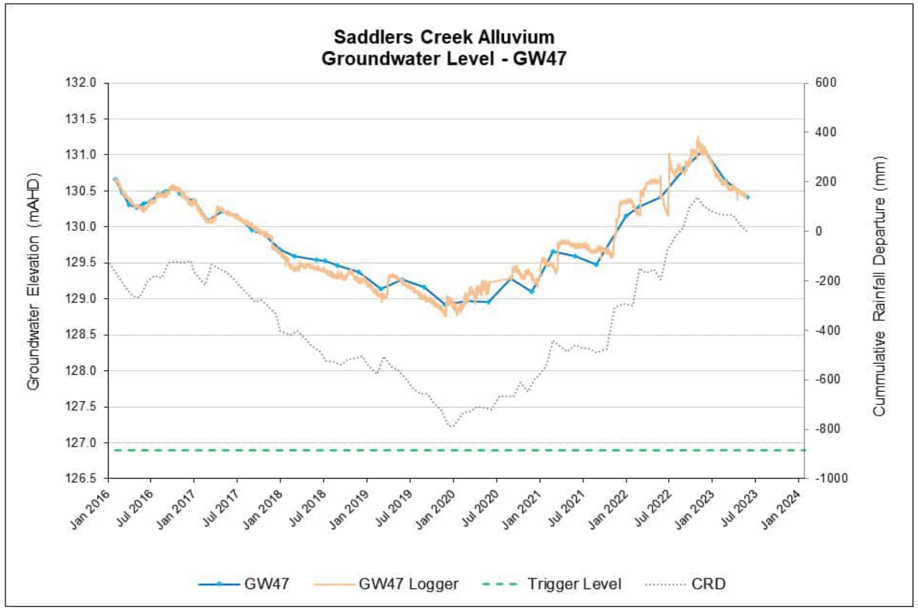


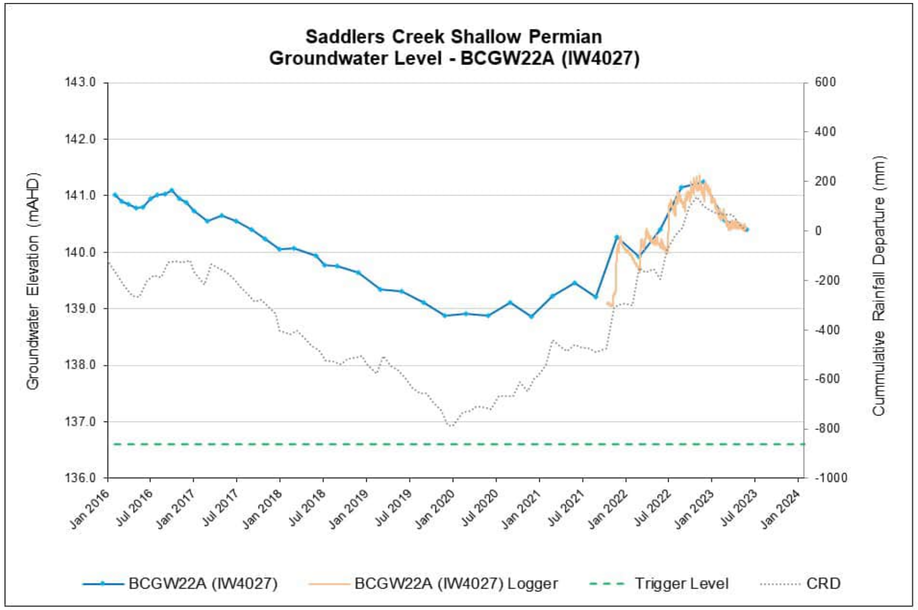


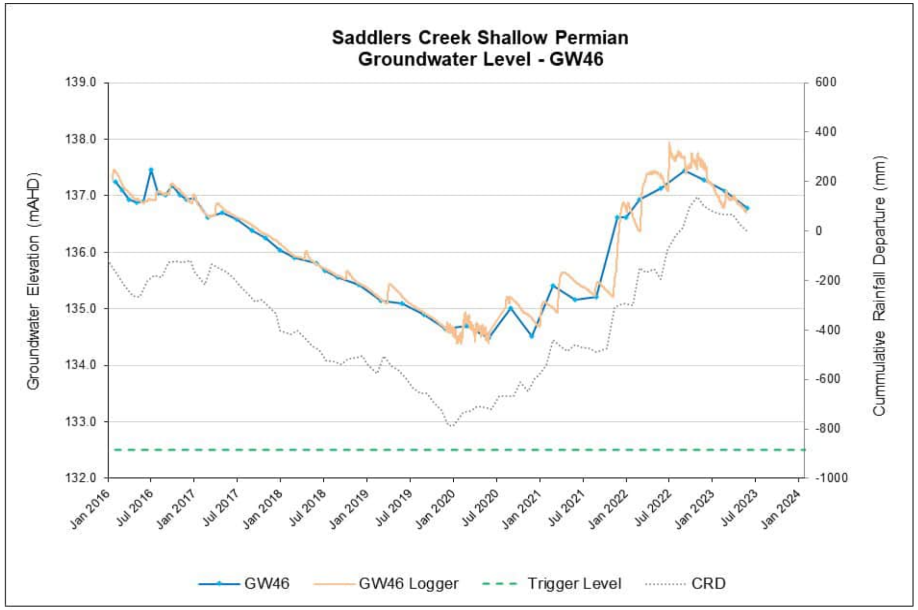

Hunter River Alluvium
Groundwater Level - X1MB
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Check logger
X1MB
X1MB Logger
Trigger Level
CRD

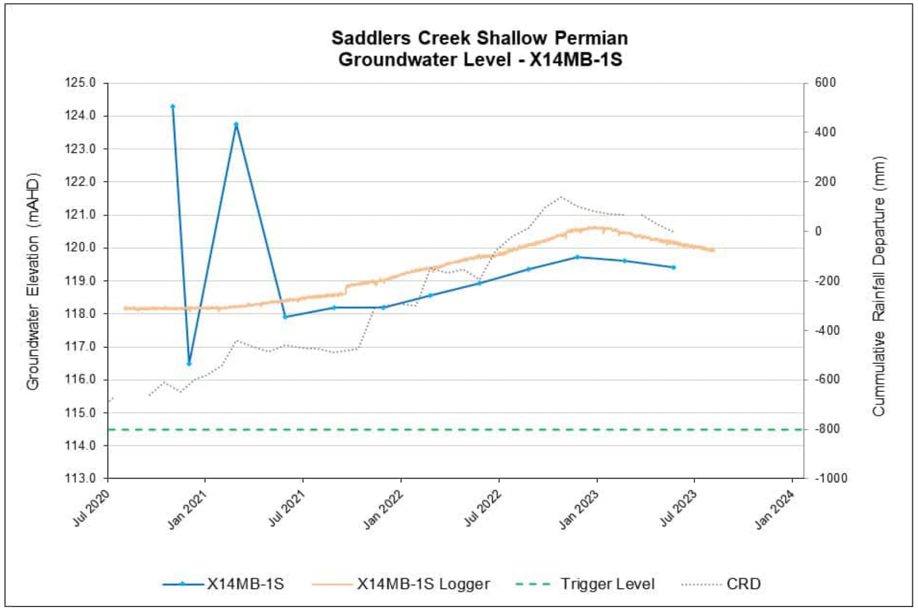

Hunter River Alluvium
Groundwater Level - X2MB
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Check logger
X2MB
X2MB
Trigger Level
CRD

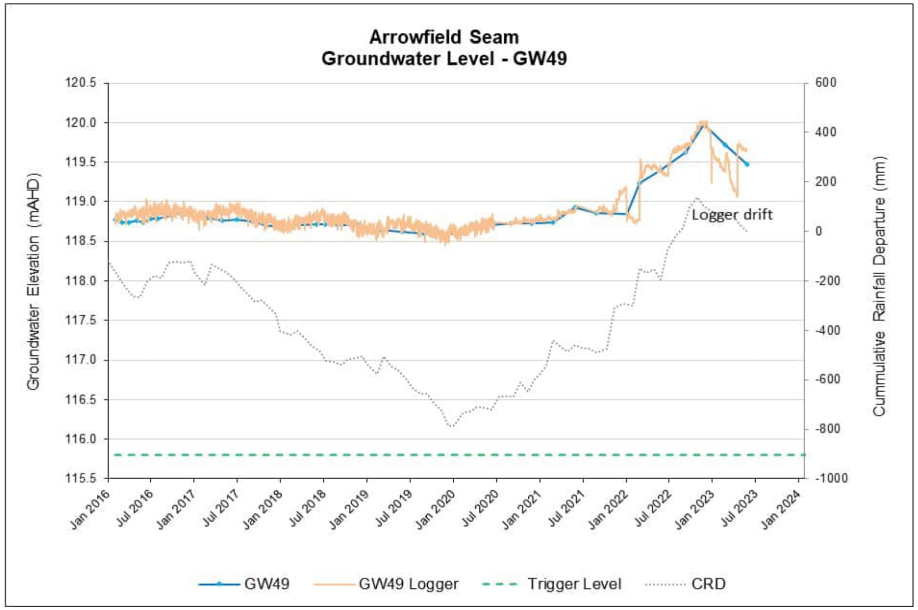

Saddlers Creek Alluvium
Groundwater Level - GW45
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger replaced
GW45
GW45 Logger
Trigger Level
CRD

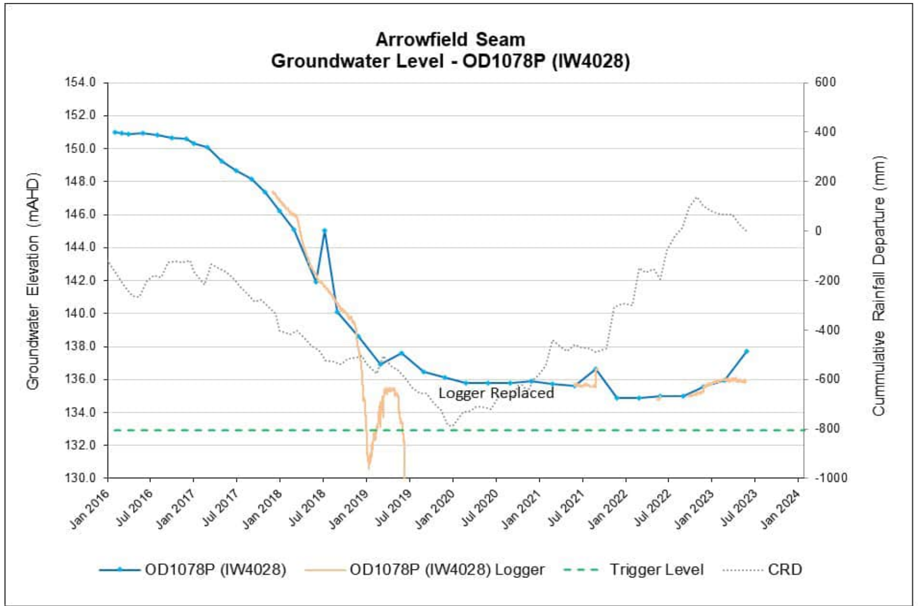

Saddlers Creek Alluvium
Groundwater Level - GW47
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW47
GW47 Logger
Trigger Level
CRD

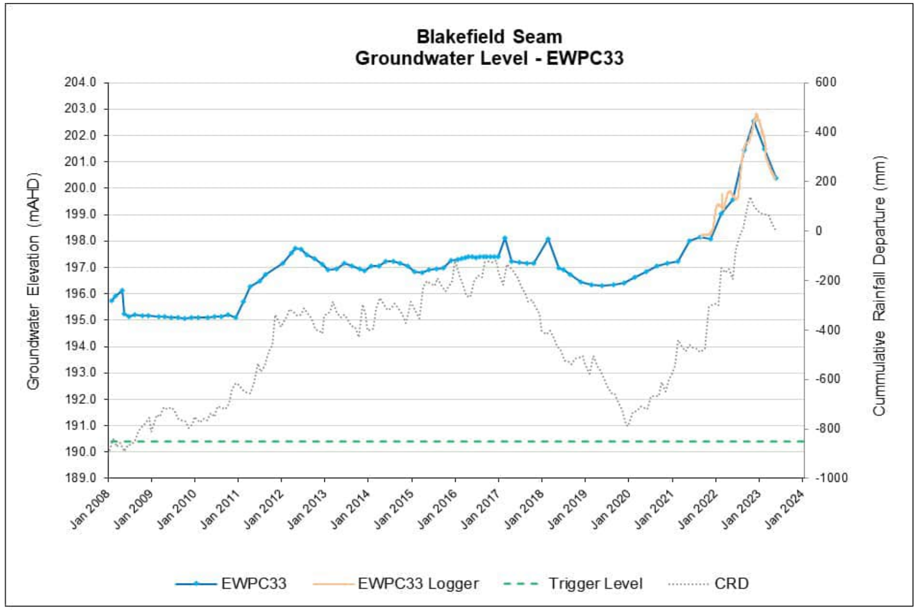

Saddlers Creek Shallow Permian
Groundwater Level - BCGW22A (IW4027)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
BCGW22A (IW4027)
BCGW22A (IW4027) Logger
Trigger Level
CRD

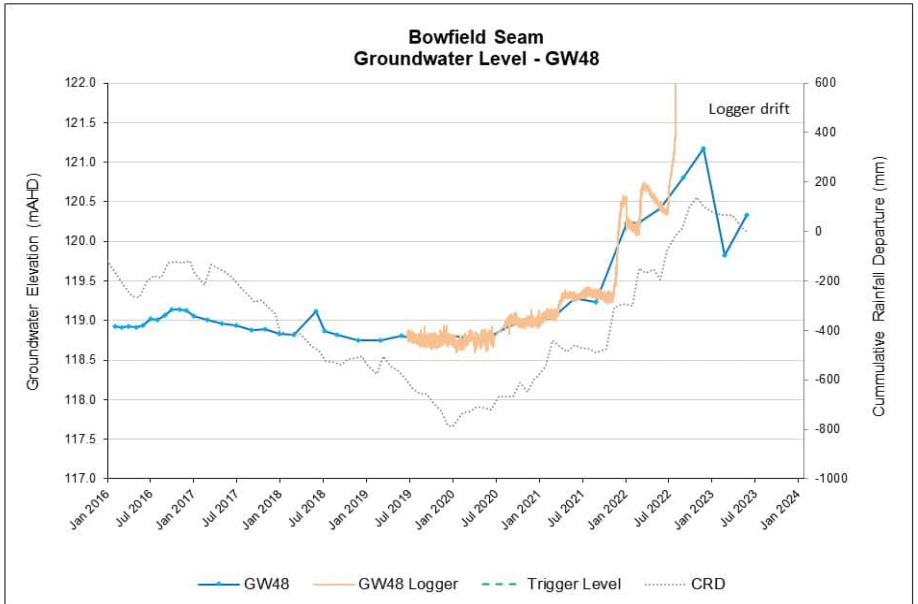

Saddlers Creek Shallow Permian
Groundwater Level - GW46
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW46
GW46 Logger
Trigger Level
CRD

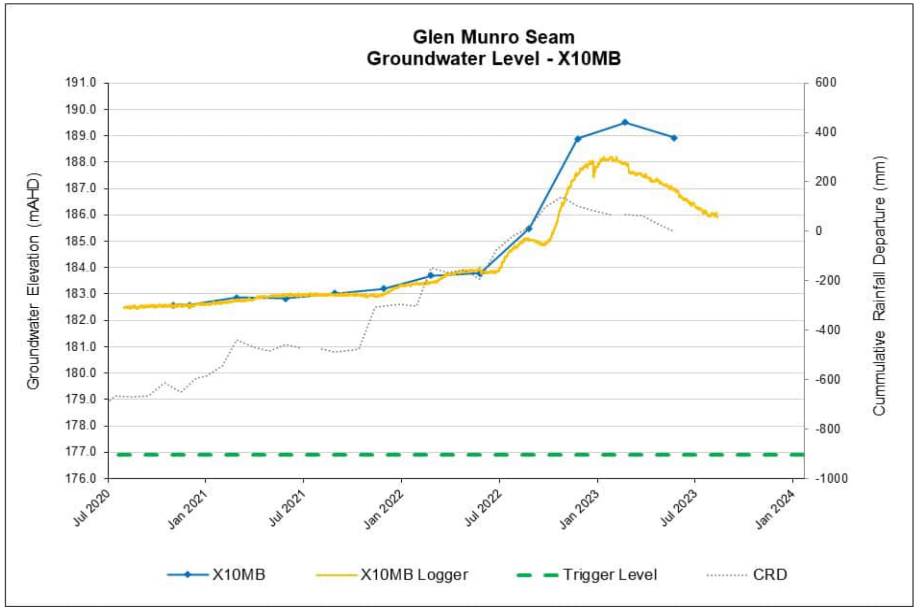

Saddlers Creek Shallow Permian
Groundwater Level - X14MB-1S
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
X14MB-1S
X14MB-1S Logger
Trigger Level
CRD

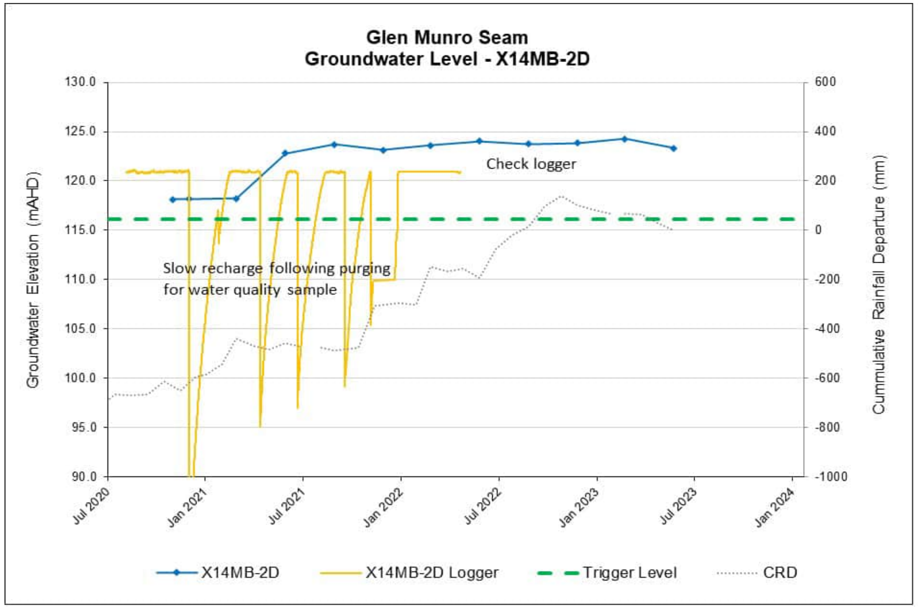

Arrowfield Seam
Groundwater Level - GW49
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
GW49
GW49 Logger
Trigger Level
CRD

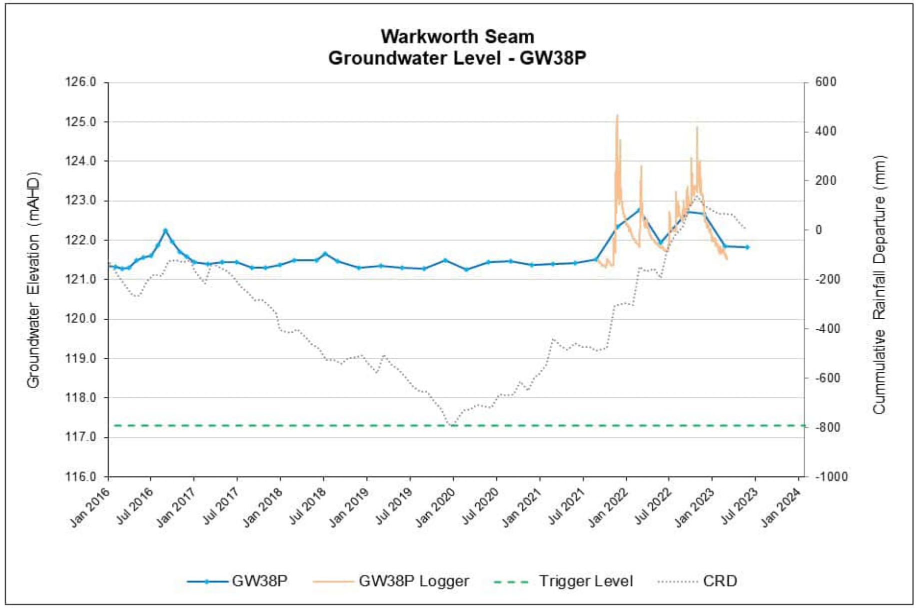

Arrowfield Seam
Groundwater Level - OD1078P (IW4028)
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger Replaced
OD1078P (IW4028)
OD1078P (IW4028) Logger
Trigger Level
CRD

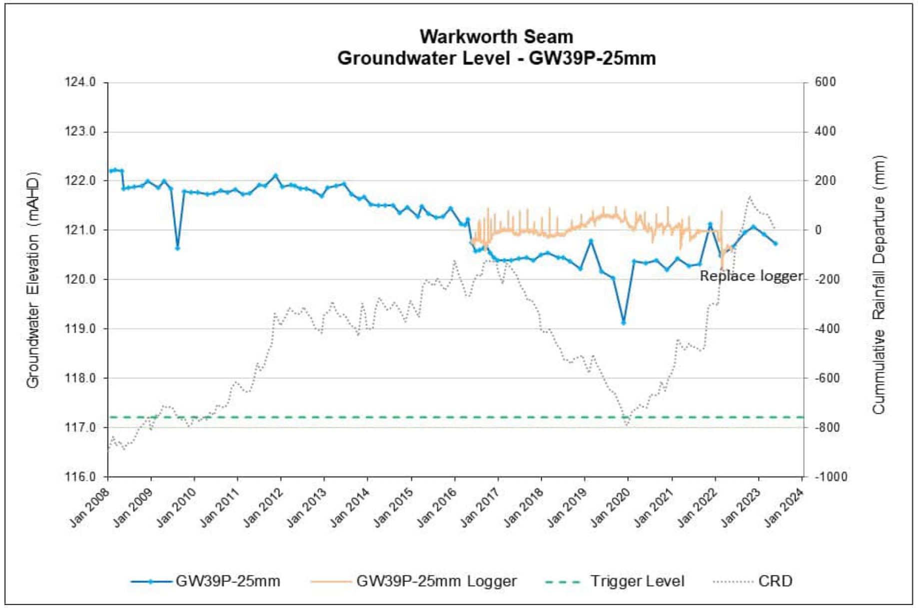

Blakefield Seam
Groundwater Level - EWPC33
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
EWPC33
EWPC33 Logger
Trigger Level
CRD

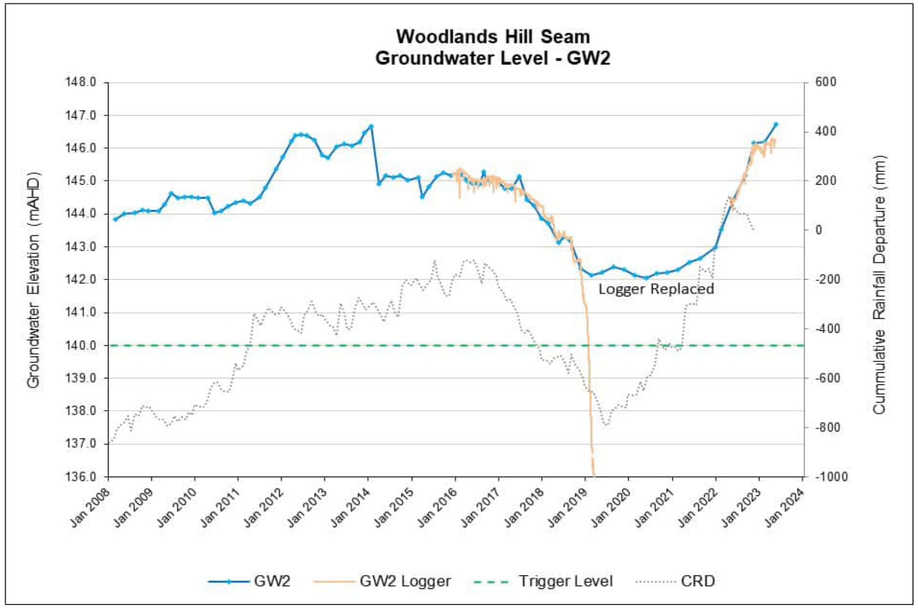

Bowfield Seam
Groundwater Level - GW48
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
GW48
GW48 Logger
Trigger Level
CRD

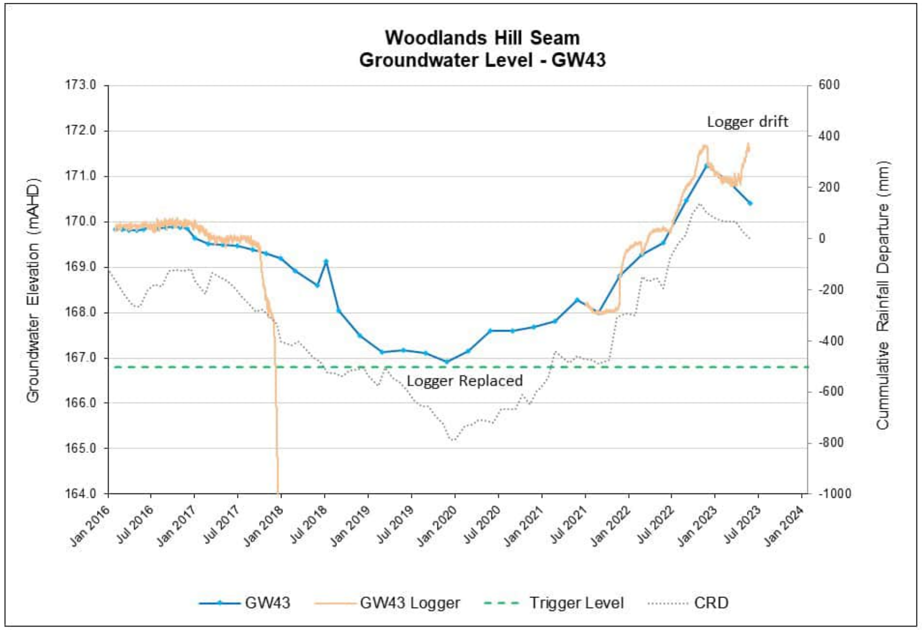

Glen Munro Seam
Groundwater Level - X10MB
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
X10MB
X10MB Logger
Trigger Level
CRD

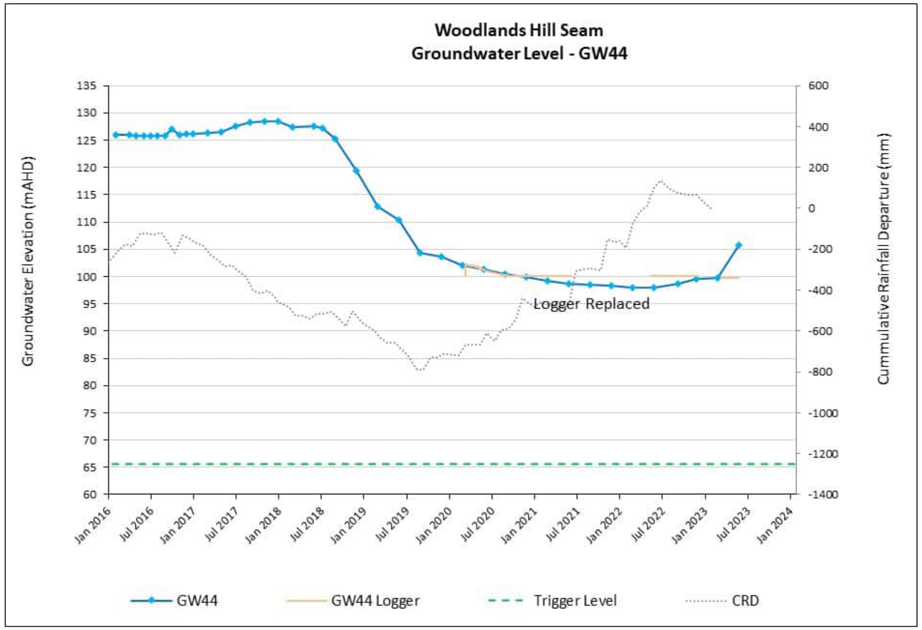

Glen Munro Seam
Groundwater Level - X14MB-2D
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Check logger
Slow recharge following purging
for water quality sample
X14MB-2D
X14MB-2D Logger
Trigger Level
CRD

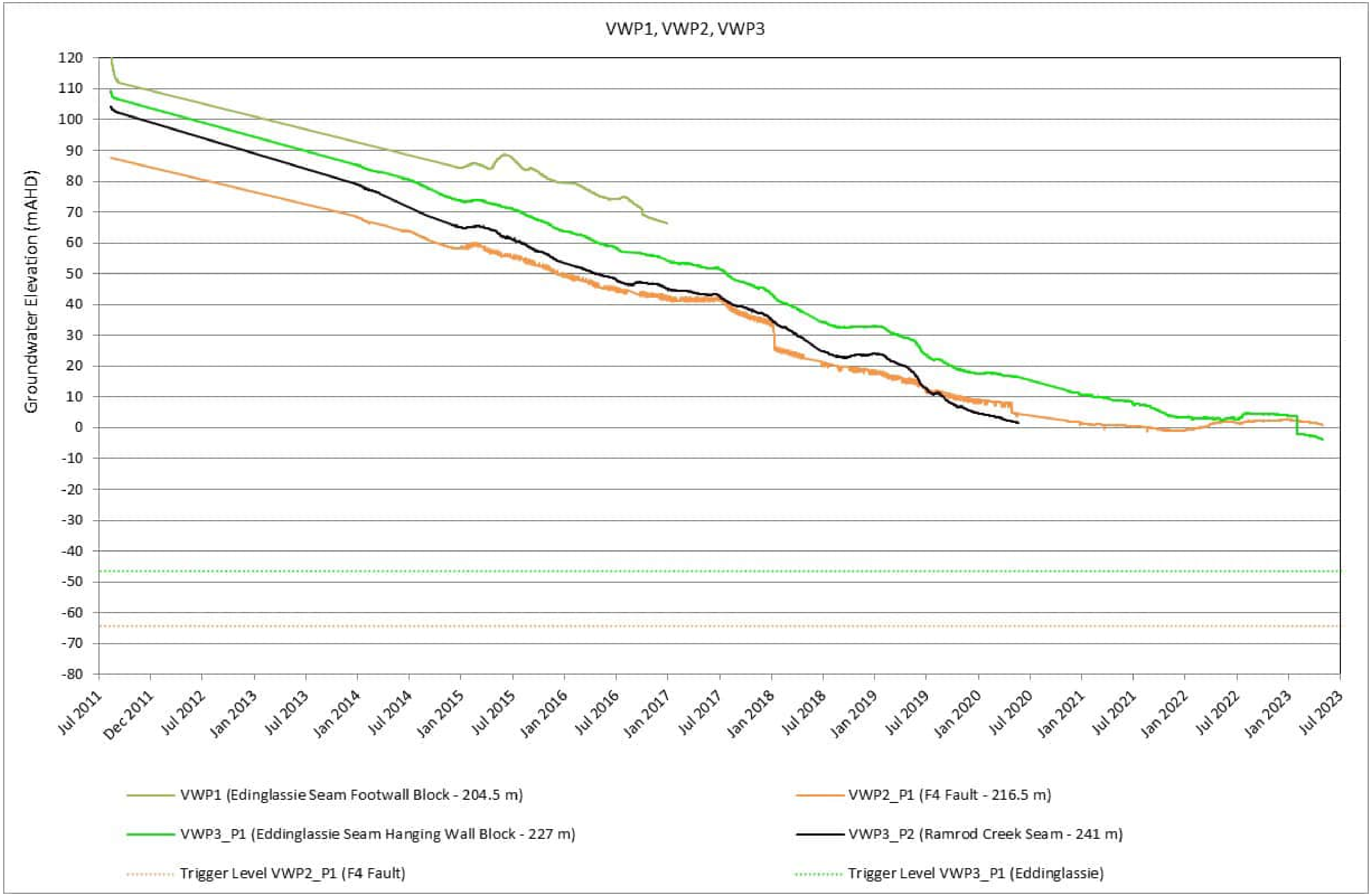

Warkworth Seam
Groundwater Level - GW38P
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
GW38P
GW38P Logger
Trigger Level
CRD


Warkworth Seam
Groundwater Level - GW39P-25mm
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Replace logger
GW39P-25mm
GW39P-25mm Logger
Trigger Level
CRD

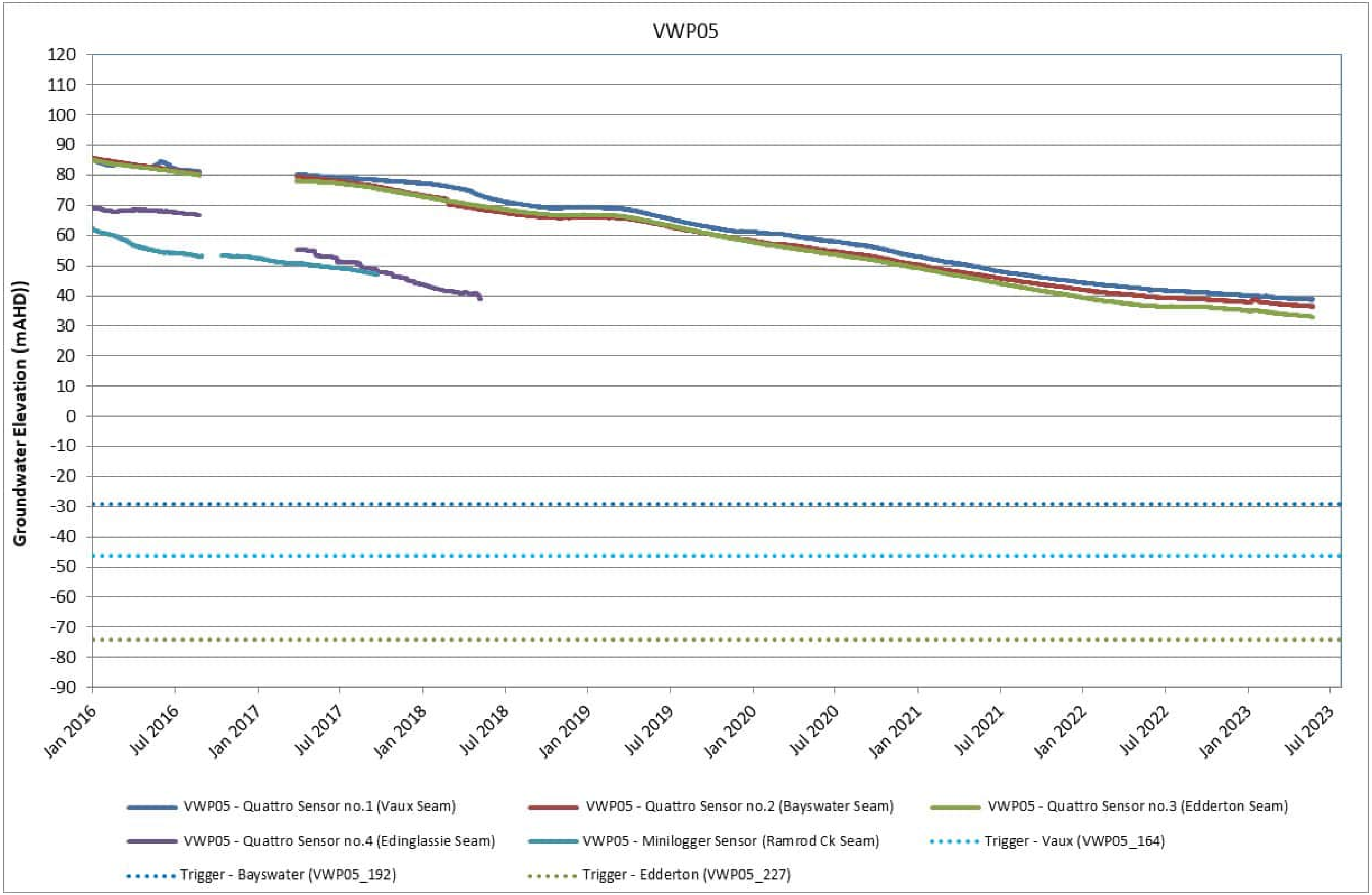

Woodlands Hill Seam
Groundwater Level - GW2
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger Replaced
GW2
GW2 Logger
Trigger Level
CRD

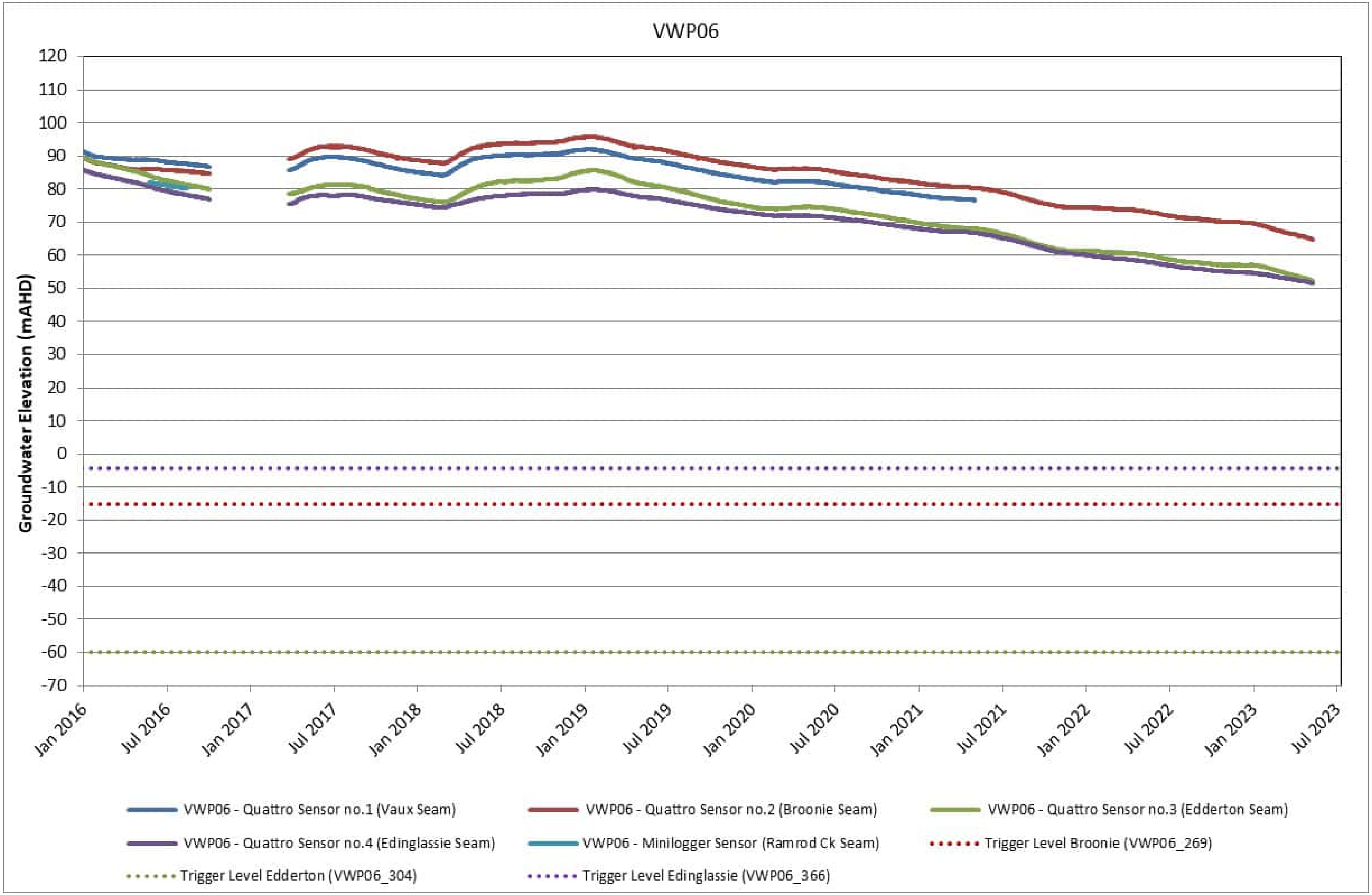

Woodlands Hill Seam
Groundwater Level - GW43
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger drift
Logger Replaced
GW43
GW43 Logger
Trigger Level
CRD

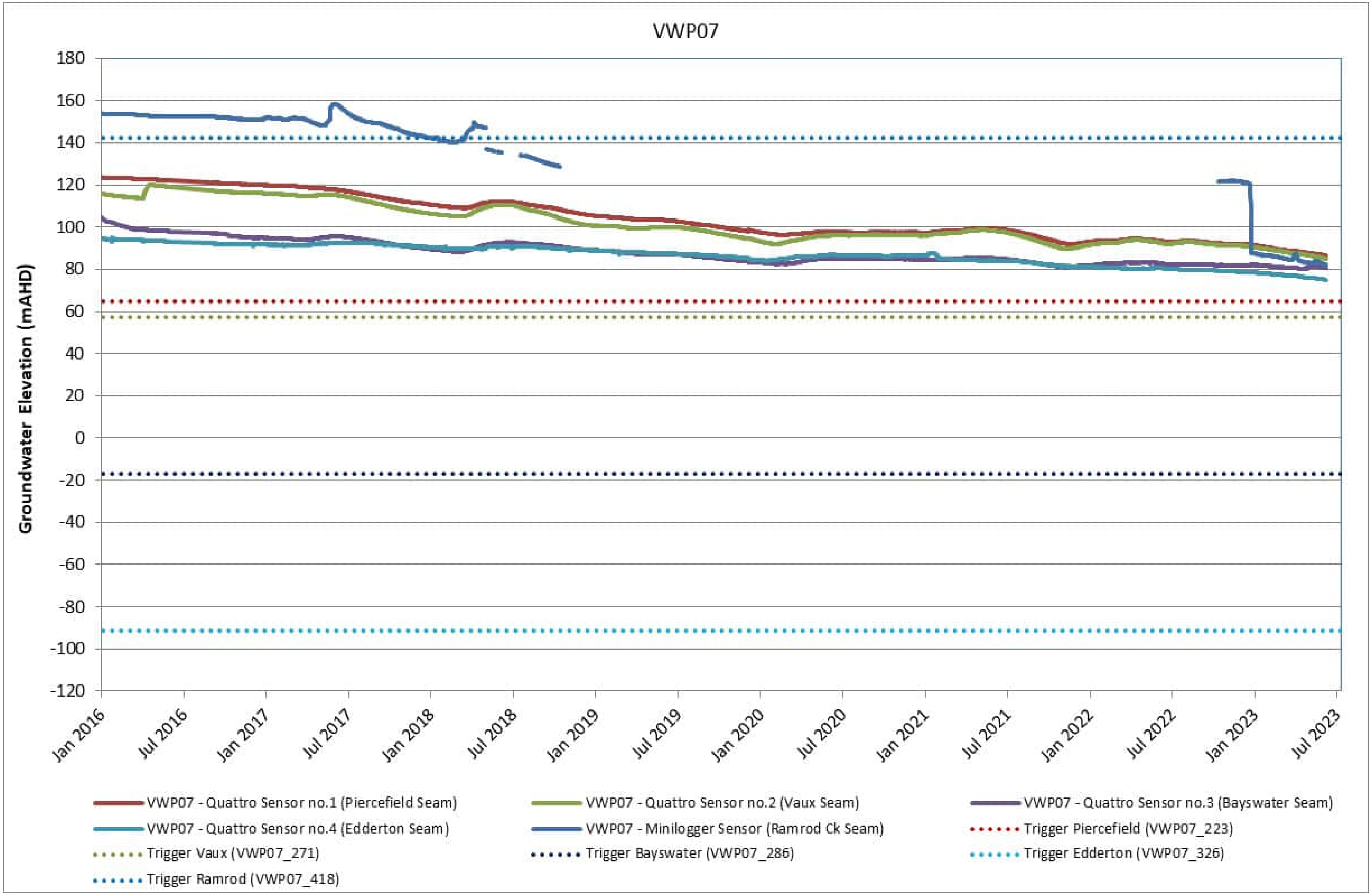

Woodlands Hill Seam
Groundwater Level - GW44
Groundwater Elevation (mAHD)
Cummulative Rainfall Departure (mm)
Logger Replaced
GW44
GW44 Logger
Trigger Level
CRD

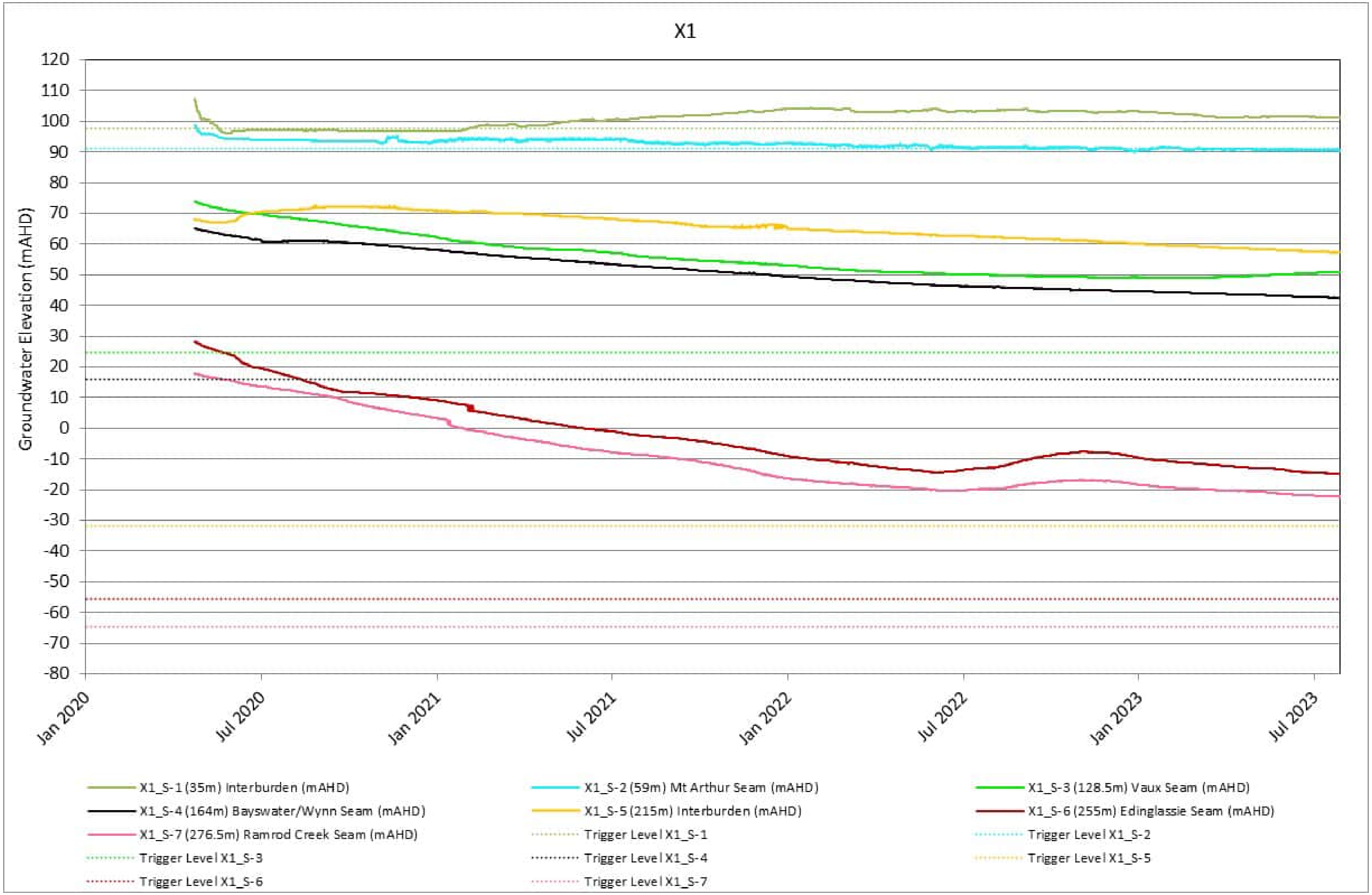


VWP1, VWP2, VWP3
Groundwater Elevation (mAHD)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Jul 2011
Dec 2011
Jul 2012
Jan 2013
Jul 2013
Jan 2014
Jul 2014
Jan 2015
Jul 2015
Jan 2016
Jul 2016
Jan 2017
Jul 2017
Jan 2018
Jul 2018
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
VWP1 (Edinglassie Seam Footwall Block - 204.5 m)
VWP2_P1 (F4 Fault - 216.5 m)
VWP3_P1 (Eddinglassie Seam Hanging Wall Block - 227 m)
VWP3_P2 (Ramrod Creek Seam - 241 m)
Trigger Level VWP2_P1 (F4 Fault)
Trigger Level VWP3_P1 (Eddinglassie)


VWP05
Groundwater Elevation (mAHD)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Jan 2016
Jul 2016
Jan 2017
Jul 2017
Jan 2018
Jul 2018
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
VWP05 - Quattro Sensor no.1 (Vaux Seam)
VWP05 - Quattro Sensor no.2 (Bayswater Seam)
VWP05 - Quattro Sensor no.3 (Edderton Seam)
VWP05 - Quattro Sensor no.4 (Edinglassie Seam)
VWP05 - Minilogger Sensor (Ramrod Ck Seam)
Trigger - Vaux (VWP05_164)
Trigger - Bayswater (VWP05_192)
Trigger - Edderton (VWP05_227)


VWP06
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Groundwater Elevation (mAHD)
Jan 2016
Jul 2016
Jan 2017
Jul 2017
Jan 2018
Jul 2018
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
VWP06 - Quattro Sensor no.1 (Vaux Seam)
VWP06 - Quattro Sensor no.2 (Broonie Seam)
VWP06 - Quattro Sensor no.3 (Edderton Seam)
VWP06 - Quattro Sensor no.4 (Edinglassie Seam)
VWP06 - Minilogger Sensor (Ramrod Ck Seam)
Trigger Level Broonie (VWP06_269)
Trigger Level Edderton (VWP06_304)
Trigger Level Edinglassie (VWP06_366)


VWP07
Groundwater Elevation (mAHD)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
Jan 2016
Jul 2016
Jan 2017
Jul 2017
Jan 2018
Jul 2018
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
VWP07 - Quattro Sensor no.1 (Piercefield Seam)
VWP07 - Quattro Sensor no.2 (Vaux Seam)
VWP07 - Quattro Sensor no.3 (Bayswater Seam)
VWP07 - Quattro Sensor no.4 (Edderton Seam)
VWP07 - Minilogger Sensor (Ramrod Ck Seam)
Trigger Piercefield (VWP07_223)
Trigger Vaux (VWP07_271)
Trigger Bayswater (VWP07_286)
Trigger Edderton (VWP07_326)
Trigger Ramrod (VWP07_418)


X1
Groundwater Elevation (mAHD)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
X1_S-1 (35m) Interburden (mAHD)
X1_S-2 (59m) Mt Arthur Seam (mAHD)
X1_S-3 (128.5m) Vaux Seam (mAHD)
X1_S-4 (164m) Bayswater/Wynn Seam (mAHD)
X1_S-5 (215m) Interburden (mAHD)
X1_S-6 (255m) Edinglassie Seam (mAHD)
X1_S-7 (276.5m) Ramrod Creek Seam (mAHD)
Trigger Level X1_S-1
Trigger Level X1_S-2
Trigger Level X1_S-3
Trigger Level X1_S-4
Trigger Level X1_S-5
Trigger Level X1_S-6
Trigger Level X1_S-7

APPENDIX D

Groundwater Quality Data

Water Quality Data

BCGW18	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH					5.5	9.3	8.1
Field EC (µS/cm)					3100	8210	5799
TDS (mg/L)					1980	4900	3124
TSS (mg/L)					6	116	26
Dissolved Fe (mg/L)					0.1	32.8	2.7
Sulphate (mg/L)					2.0	39.0	10.8
Chloride (mg/L)		Dry			739.0	2600.0	1806.1
Calcium (mg/L)					1.0	43.0	22.9
Magnesium (mg/L)					25.0	253.0	192.9
Potassium (mg/L)					21.0	38.0	24.8
Sodium (mg/L)					738.0	1420.0	1204.7
Carbonate (mg/L)					76.0	76.0	76.0
Bicarbonate (mg/L)					298.0	1160.0	889.4

BCGW22 (IW4026)	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	11.9	11.9	11.9	12.1	7.1	12.5	10.3
Field EC (µS/cm)	14000	14600	14000	15100	8470	17350	12662
TDS (mg/L)	8410	8970	8930	8880	3100	10100	6712
TSS (mg/L)	28	28	<5	22	7	9160	310
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	73.0	60.0	69.0	42.0	2.0	172.0	48.2
Chloride (mg/L)	4460.0	4020.0	4160.0	4340.0	1640.0	5160.0	3583.8
Calcium (mg/L)	613.0	519.0	550.0	604.0	4.0	613.0	211.6
Magnesium (mg/L)	<1	2.0	<1	<1	<1	38.0	18.2
Potassium (mg/L)	27.0	21.0	21.0	23.0	21.0	290.0	109.5
Sodium (mg/L)	2100.0	2170.0	2240.0	2380.0	1420.0	2930.0	2090.0
Carbonate (mg/L)	34.0	64.0	27.0	63.0	4.0	244.0	69.3
Bicarbonate (mg/L)	<1	<1	<1	<1	<1	436.0	182.4

BCGW22A (IW4027)	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	6.9	6.9	6.7	6.9	6.6	7.1	6.9
Field EC (µS/cm)	10900	11800	11200	10500	9200	15690	11533
TDS (mg/L)	6710	7530	7920	7370	4580	8930	7145
TSS (mg/L)	<5	6	6	<5	<5	410	54
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.1
Sulphate (mg/L)	300.0	304.0	295.0	354.0	188.0	354.0	255.3
Chloride (mg/L)	3300.0	3690.0	3840.0	3600.0	2720.0	4140.0	3519.5
Calcium (mg/L)	205.0	245.0	265.0	240.0	175.0	276.0	231.4
Magnesium (mg/L)	323.0	334.0	356.0	335.0	274.0	399.0	334.1
Potassium (mg/L)	5.0	6.0	7.0	7.0	4.0	9.0	6.0
Sodium (mg/L)	1650.0	1770.0	1910.0	1820.0	1360.0	1920.0	1747.8
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	831.0	863.0	922.0	933.0	536.0	1030.0	860.0

EWPC33	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.2	7.1	6.9	7.1	6.5	8.0	7.1
Field EC (µS/cm)	2294	2641	2640	2777	290	6280	2285
TDS (mg/L)	1330	1530	1530	1440	149	2060	1270
TSS (mg/L)	<5	<5	<5	<5	5	1570	52
Dissolved Fe (mg/L)	0.1	<0.05	0.1	0.1	0.1	1.5	0.3
Sulphate (mg/L)	25.0	31.0	24.0	24.0	12.0	39.0	23.6
Chloride (mg/L)	205.0	316.0	281.0	243.0	161.0	316.0	207.0
Calcium (mg/L)	22.0	24.0	21.0	20.0	13.0	24.0	18.1
Magnesium (mg/L)	88.0	99.0	88.0	96.0	63.0	100.0	83.4
Potassium (mg/L)	15.0	18.0	14.0	17.0	12.0	18.0	14.3
Sodium (mg/L)	412.0	430.0	402.0	476.0	379.0	538.0	460.0
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	1100.0	821.0	1150.0	1170.0	821.0	1290.0	1160.8

GW16	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.3	7.2	7.3	7.3	6.4	8.0	7.3
Field EC (µS/cm)	3340	3280	2800	2750	2139	4690	3339
TDS (mg/L)	1990	2120	1860	1610	1350	2860	2001
TSS (mg/L)	<5	18	<5	<5	<5	492	59
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	0.0	0.3	0.1
Sulphate (mg/L)	252.0	250.0	258.0	246.0	191.0	313.0	247.7
Chloride (mg/L)	659.0	700.0	655.0	581.0	458.0	869.0	661.5
Calcium (mg/L)	135.0	121.0	129.0	100.0	76.0	160.0	117.0
Magnesium (mg/L)	110.0	104.0	100.0	87.0	62.0	130.0	103.2
Potassium (mg/L)	2.0	2.0	2.0	2.0	1.0	2.0	1.8
Sodium (mg/L)	422.0	402.0	422.0	374.0	305.0	469.0	399.4
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	481.0	486.0	447.0	428.0	404.0	598.0	481.2

GW2	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.7	7.7	7.7	7.7	6.5	8.5	7.7
Field EC (µS/cm)	4250	3710	4160	4040	3030	5030	3859
TDS (mg/L)	2490	2460	2440	2410	1670	2610	2211
TSS (mg/L)	8	<5	<5	6	<5	432	24
Dissolved Fe (mg/L)	<0.05	0.1	0.1	0.1	<0.05	0.2	0.1
Sulphate (mg/L)	112.0	113.0	118.0	114.0	85.0	152.0	117.1
Chloride (mg/L)	747.0	728.0	704.0	728.0	442.0	846.0	631.8
Calcium (mg/L)	15.0	14.0	14.0	13.0	6.0	20.0	14.1
Magnesium (mg/L)	14.0	14.0	15.0	15.0	9.0	17.0	12.3
Potassium (mg/L)	3.0	4.0	4.0	4.0	2.0	5.0	3.6
Sodium (mg/L)	983.0	922.0	948.0	939.0	736.0	1070.0	902.1
Carbonate (mg/L)	<1	40.0	<1	<1	<1	99.0	47.0
Bicarbonate (mg/L)	1160.0	852.0	1150.0	1120.0	852.0	1240.0	1105.5

GW21	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.1	7.0	7.0	7.2	6.4	8.0	7.2
Field EC (µS/cm)	1122	1242	1044	1125	636	2000	944
TDS (mg/L)	684	722	687	644	370	992	536
TSS (mg/L)	<5	<5	<5	54	<5	280	58
Dissolved Fe (mg/L)	0.1	<0.05	0.1	<0.05	<0.05	10.7	0.6
Sulphate (mg/L)	84.0	101.0	98.0	101.0	4.0	102.0	34.4
Chloride (mg/L)	92.0	87.0	91.0	106.0	39.0	147.0	68.3
Calcium (mg/L)	90.0	114.0	104.0	100.0	50.0	133.0	71.4
Magnesium (mg/L)	58.0	65.0	64.0	62.0	29.0	81.0	44.0
Potassium (mg/L)	<1	<1	1.0	2.0	<1	3.0	1.8
Sodium (mg/L)	58.0	59.0	76.0	64.0	51.0	81.0	62.4
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	402.0	379.0	380.0	388.0	288.0	442.0	358.8

GW38A (IW4030)	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.5	7.4	7.4	7.4	6.5	8.3	7.3
Field EC (µS/cm)	1762	1938	2306	2600	1762	5560	3829
TDS (mg/L)	958	989	1370	1500	958	3200	2138
TSS (mg/L)	96	40	106	273	6	273	68
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	116.0	108.0	159.0	208.0	108.0	247.0	177.2
Chloride (mg/L)	262.0	288.0	424.0	506.0	262.0	1130.0	782.8
Calcium (mg/L)	30.0	37.0	48.0	55.0	30.0	144.0	98.2
Magnesium (mg/L)	35.0	41.0	55.0	64.0	35.0	157.0	108.7
Potassium (mg/L)	1.0	2.0	2.0	2.0	1.0	3.0	2.6
Sodium (mg/L)	296.0	317.0	409.0	429.0	291.0	800.0	562.2
Carbonate (mg/L)	<1	<1	<1	<1	<1	12.0	12.0
Bicarbonate (mg/L)	432.0	411.0	521.0	577.0	390.0	845.0	664.4

GW38P	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.6	7.6	7.6	7.6	7.1	8.6	7.7
Field EC (µS/cm)	1290	2493	2410	2349	1290	3830	2326
TDS (mg/L)	1290	1310	1380	1290	1000	3650	1290
TSS (mg/L)	6	<5	<5	34	<5	87	15
Dissolved Fe (mg/L)	0.1	0.1	0.1	0.1	0.1	0.5	0.1
Sulphate (mg/L)	48.0	42.0	41.0	55.0	35.0	69.0	43.0
Chloride (mg/L)	493.0	523.0	494.0	516.0	397.0	597.0	477.4
Calcium (mg/L)	12.0	13.0	12.0	10.0	8.0	14.0	11.5
Magnesium (mg/L)	16.0	17.0	17.0	15.0	12.0	17.0	15.4
Potassium (mg/L)	6.0	7.0	7.0	7.0	5.0	8.0	6.2
Sodium (mg/L)	476.0	497.0	530.0	491.0	414.0	599.0	481.4
Carbonate (mg/L)	<1	<1	<1	<1	<1	59.0	20.3
Bicarbonate (mg/L)	522.0	442.0	523.0	511.0	442.0	607.0	513.6

GW39P	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.6	7.5	7.5	7.5	6.7	8.5	7.6
Field EC (µS/cm)	5080	5130	4810	6060	500	9170	5212
TDS (mg/L)	3040	3040	3050	3070	230	4140	3012
TSS (mg/L)	394	132	56	233	12	5100	177
Dissolved Fe (mg/L)	0.1	0.4	0.1	0.6	0.1	3.2	0.7
Sulphate (mg/L)	<1	<1	<1	<1	<1	55.0	19.7
Chloride (mg/L)	851.0	899.0	846.0	886.0	725.0	1080.0	833.0
Calcium (mg/L)	16.0	16.0	18.0	16.0	14.0	21.0	16.6
Magnesium (mg/L)	16.0	17.0	17.0	17.0	14.0	20.0	16.6
Potassium (mg/L)	9.0	10.0	10.0	11.0	9.0	12.0	10.0
Sodium (mg/L)	1210.0	1170.0	1230.0	1190.0	1060.0	1390.0	1202.0
Carbonate (mg/L)	<1	<1	<1	<1	<1	405.0	169.5
Bicarbonate (mg/L)	1100.0	1580.0	1570.0	1610.0	1100.0	1850.0	1583.8

GW40A	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.4	7.3	7.4	7.5	6.5	8.9	7.4
Field EC (µS/cm)	4150	4860	4170	4230	3250	5680	4395
TDS (mg/L)	2460	3000	2500	2520	2080	3410	2643
TSS (mg/L)	26	13	<5	16	8	1580	237
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	0.7	0.1
Sulphate (mg/L)	295.0	204.0	150.0	159.0	150.0	387.0	287.1
Chloride (mg/L)	861.0	1090.0	1000.0	1080.0	746.0	1260.0	953.7
Calcium (mg/L)	108.0	103.0	78.0	77.0	77.0	157.0	117.7
Magnesium (mg/L)	187.0	177.0	138.0	130.0	60.0	242.0	195.4
Potassium (mg/L)	7.0	5.0	3.0	4.0	3.0	9.0	7.0
Sodium (mg/L)	466.0	649.0	740.0	750.0	466.0	750.0	525.9
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	660.0	748.0	780.0	746.0	30.0	780.0	625.8

GW41A (IW4029)	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.4	7.4	7.3	7.6	6.6	8.0	7.4
Field EC (µS/cm)	4120	4660	3840	3830	815	10600	4628
TDS (mg/L)	2320	3200	2520	2420	505	6030	2600
TSS (mg/L)	36	49	14	72	14	3340	627
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.1
Sulphate (mg/L)	113.0	130.0	128.0	141.0	26.0	368.0	157.0
Chloride (mg/L)	948.0	1110.0	1010.0	1040.0	69.0	2330.0	1026.9
Calcium (mg/L)	142.0	128.0	117.0	109.0	19.0	260.0	121.9
Magnesium (mg/L)	142.0	156.0	139.0	132.0	16.0	339.0	146.0
Potassium (mg/L)	7.0	7.0	6.0	7.0	4.0	12.0	7.5
Sodium (mg/L)	505.0	574.0	538.0	567.0	134.0	1210.0	598.6
Carbonate (mg/L)	<1	<1	<1	<1	<1	7.0	7.0
Bicarbonate (mg/L)	534.0	550.0	587.0	591.0	251.0	1660.0	622.4

GW43							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.1	7.0	6.9	7.1	6.7	7.4	7.1
Field EC (µS/cm)	4440	4420	3980	4240	3900	5210	4294
TDS (mg/L)	2500	2560	2480	2450	2120	3010	2428
TSS (mg/L)	<5	<5	<5	<5	<5	14	10
Dissolved Fe (mg/L)	0.2	0.1	0.2	0.2	0.1	0.3	0.2
Sulphate (mg/L)	47.0	52.0	52.0	67.0	27.0	67.0	37.9
Chloride (mg/L)	684.0	581.0	759.0	736.0	581.0	829.0	694.3
Calcium (mg/L)	10.0	10.0	9.0	10.0	6.0	10.0	8.7
Magnesium (mg/L)	166.0	166.0	174.0	168.0	130.0	175.0	159.4
Potassium (mg/L)	27.0	24.0	26.0	25.0	21.0	27.0	24.6
Sodium (mg/L)	725.0	734.0	756.0	721.0	658.0	834.0	749.5
Carbonate (mg/L)	<1	<1	<1	<1	<1	244.0	244.0
Bicarbonate (mg/L)	1380.0	1390.0	1410.0	1340.0	1070.0	1540.0	1392.1

GW45							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.4	7.5	7.4	7.3	6.3	8.0	7.2
Field EC (µS/cm)	1280	668	1265	1430	638	11380	3105
TDS (mg/L)	718	412	730	829	302	7580	2018
TSS (mg/L)	<5	<5	<5	8	<5	1680	90
Dissolved Fe (mg/L)	<0.05	<0.05	0.1	0.1	<0.05	2.2	0.5
Sulphate (mg/L)	104.0	42.0	63.0	81.0	16.0	2410.0	510.2
Chloride (mg/L)	164.0	63.0	191.0	245.0	22.0	2240.0	539.0
Calcium (mg/L)	62.0	36.0	65.0	70.0	30.0	550.0	171.6
Magnesium (mg/L)	67.0	36.0	61.0	69.0	30.0	520.0	162.0
Potassium (mg/L)	1.0	<1	1.0	1.0	<1	9.0	3.3
Sodium (mg/L)	109.0	68.0	107.0	132.0	68.0	917.0	242.2
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	341.0	253.0	324.0	375.0	253.0	556.0	366.5

GW46							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.0	7.1	7.0	7.0	6.5	7.6	7.0
Field EC (µS/cm)	6030	5710	6160	6140	4840	8220	6412
TDS (mg/L)	4030	4300	4390	4360	3290	4590	4026
TSS (mg/L)	6	12	6	<5	5	76	13
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.1
Sulphate (mg/L)	1040.0	1060.0	925.0	935.0	213.0	1380.0	660.7
Chloride (mg/L)	1240.0	1180.0	1220.0	1260.0	899.0	1570.0	1341.4
Calcium (mg/L)	184.0	216.0	217.0	210.0	167.0	228.0	195.1
Magnesium (mg/L)	250.0	267.0	266.0	272.0	208.0	295.0	256.1
Potassium (mg/L)	5.0	6.0	6.0	6.0	5.0	10.0	5.7
Sodium (mg/L)	805.0	853.0	878.0	862.0	699.0	957.0	818.6
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	619.0	667.0	655.0	646.0	545.0	766.0	663.2

GW47							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.1	7.2	7.0	7.0	6.8	7.5	7.1
Field EC (µS/cm)	4840	4030	4900	4970	3540	6100	4944
TDS (mg/L)	2740	2650	2700	2790	2130	3840	2868
TSS (mg/L)	6	45	<5	7	6	1080	139
Dissolved Fe (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.1
Sulphate (mg/L)	181.0	166.0	180.0	187.0	101.0	246.0	177.7
Chloride (mg/L)	1170.0	1020.0	1100.0	1250.0	733.0	1340.0	1047.3
Calcium (mg/L)	96.0	94.0	100.0	104.0	68.0	118.0	92.4
Magnesium (mg/L)	283.0	253.0	269.0	293.0	188.0	363.0	274.0
Potassium (mg/L)	7.0	8.0	8.0	8.0	5.0	8.0	6.9
Sodium (mg/L)	556.0	527.0	547.0	571.0	462.0	622.0	541.9
Carbonate (mg/L)	<1	<1	<1	<1	<1	7.0	7.0
Bicarbonate (mg/L)	856.0	787.0	893.0	859.0	769.0	991.0	878.0

GW48							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.6	7.6	7.4	7.6	6.8	8.2	7.6
Field EC (µS/cm)	3680	3660	3220	3440	3090	4750	3730
TDS (mg/L)	2290	2340	2340	2260	1920	2520	2232
TSS (mg/L)	<5	6	<5	<5	<5	30	11
Dissolved Fe (mg/L)	0.3	0.3	0.3	0.3	0.2	0.6	0.4
Sulphate (mg/L)	<1	<10	<1	<1	<1	152.0	77.0
Chloride (mg/L)	236.0	248.0	241.0	248.0	214.0	284.0	240.3
Calcium (mg/L)	13.0	13.0	15.0	14.0	10.0	15.0	13.5
Magnesium (mg/L)	15.0	15.0	15.0	15.0	11.0	17.0	14.2
Potassium (mg/L)	9.0	9.0	9.0	9.0	6.0	11.0	8.2
Sodium (mg/L)	894.0	884.0	947.0	926.0	756.0	1030.0	925.9
Carbonate (mg/L)	<1	<1	<1	<1	<1	422.0	139.4
Bicarbonate (mg/L)	1790.0	1830.0	1780.0	1820.0	1380.0	2120.0	1787.8

GW49							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.0	6.9	6.9	7.1	6.1	7.5	6.9
Field EC (µS/cm)	5970	6020	5620	5700	5020	7530	5909
TDS (mg/L)	3670	3810	3680	3700	2850	3810	3476
TSS (mg/L)	6	5	7	11	5	54	15
Dissolved Fe (mg/L)	0.4	0.4	0.3	0.4	0.1	0.6	0.4
Sulphate (mg/L)	<1	<10	<1	<1	<1	1.0	1.0
Chloride (mg/L)	809.0	838.0	864.0	896.0	725.0	997.0	827.0
Calcium (mg/L)	52.0	54.0	54.0	52.0	41.0	68.0	48.8
Magnesium (mg/L)	47.0	51.0	52.0	48.0	37.0	61.0	46.7
Potassium (mg/L)	36.0	35.0	34.0	33.0	25.0	42.0	32.0
Sodium (mg/L)	1350.0	1420.0	1420.0	1350.0	1100.0	1460.0	1320.7
Carbonate (mg/L)	<1	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	2120.0	2270.0	2320.0	2270.0	1530.0	2460.0	2091.2

X1							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.3	7.4	7.7	7.4	7.1	7.7	7.4
Field EC (µS/cm)	4080.0	3930	3610	3860	3600	5390	4375
TDS (mg/L)	0.0	2250	2170	2200	2170	2700	2383
TSS (mg/L)	0.0	210	257	511	210	1800	686
Dissolved Fe (mg/L)	0.0	<0.05	<0.05	<0.05	0.2	0.2	0.2
Sulphate (mg/L)	0.0	185.0	212.0	209.0	160.0	212.0	193.4
Chloride (mg/L)	0.0	763.0	806.0	832.0	763.0	975.0	855.0
Calcium (mg/L)	0.0	125.0	140.0	113.0	113.0	144.0	130.7
Magnesium (mg/L)	0.0	107.0	118.0	111.0	107.0	134.0	120.7
Potassium (mg/L)	0.0	4.0	4.0	4.0	3.0	8.0	5.0
Sodium (mg/L)	0.0	550.0	605.0	566.0	544.0	605.0	570.6
Carbonate (mg/L)	0.0	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	0.0	678.0	695.0	683.0	641.0	790.0	693.6

X2							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	7.2	7.1	7.1	7.4	7.0	7.4	7.2
Field EC (µS/cm)	4170.0	4760	4750	4790	3280	7420	4779
TDS (mg/L)	0.0	2690	2940	2920	1840	3620	2634
TSS (mg/L)	0.0	<5	<5	<5	12	49	26
Dissolved Fe (mg/L)	0.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	0.0	167.0	166.0	183.0	119.0	240.0	158.6
Chloride (mg/L)	0.0	1110.0	1100.0	1130.0	680.0	1620.0	1043.4
Calcium (mg/L)	0.0	97.0	105.0	98.0	55.0	129.0	85.9
Magnesium (mg/L)	0.0	212.0	223.0	197.0	115.0	278.0	175.2
Potassium (mg/L)	0.0	7.0	7.0	8.0	4.0	8.0	6.5
Sodium (mg/L)	0.0	593.0	697.0	698.0	454.0	795.0	623.8
Carbonate (mg/L)	0.0	<1	<1	<1	0.0	0.0	#DIV/0!
Bicarbonate (mg/L)	0.0	627.0	646.0	640.0	606.0	798.0	665.4

X10							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	9.3	8.8	8.9	8.8	7.3	10.0	8.8
Field EC (µS/cm)	3740.0	4170	3520	3740	3520	6570	4902
TDS (mg/L)	0.0	2400	2460	2340	2340	3300	2756
TSS (mg/L)	0.0	41	67	27.0	13	308	76
Dissolved Fe (mg/L)	0.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	0.0	43.0	44.0	43.0	7.0	95.4	44.7
Chloride (mg/L)	0.0	635.0	630.0	675.0	594.0	776.0	697.9
Calcium (mg/L)	0.0	45.0	37.0	48.0	4.0	48.0	26.8
Magnesium (mg/L)	0.0	128.0	110.0	138.0	18.0	138.0	90.9
Potassium (mg/L)	0.0	128.0	142.0	93.0	93.0	471.0	241.5
Sodium (mg/L)	0.0	651.0	632.0	641.0	632.0	882.0	725.7
Carbonate (mg/L)	0.0	115.0	178.0	<1	115.0	1250.0	631.9
Bicarbonate (mg/L)	0.0	1310.0	1250.0	1350.0	590.0	1510.0	1182.3

X14-1S							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	6.9	6.9	6.9	7.0	6.9	12.6	8.3
Field EC (µS/cm)	10450	10900	10700	11000.0	10450	21480	12582
TDS (mg/L)	0	6270	6500	5950.0	4350	7390	6150
TSS (mg/L)	0	60	302	38.0	18	302	111
Dissolved Fe (mg/L)	0.0	0.6	0.6	0.6	0.3	2.8	1.3
Sulphate (mg/L)	0.0	17.0	19.0	15.0	15.0	155.0	65.8
Chloride (mg/L)	0.0	3440.0	3150.0	3200.0	849.0	3810.0	2943.0
Calcium (mg/L)	0.0	152.0	152.0	122.0	2.0	197.0	114.6
Magnesium (mg/L)	0.0	262.0	263.0	254.0	5.0	356.0	243.7
Potassium (mg/L)	0.0	18.0	19.0	15.0	15.0	509.0	111.1
Sodium (mg/L)	0.0	1840.0	1910.0	1760.0	1430.0	2060.0	1770.0
Carbonate (mg/L)	0.0	<1	<1	<1	<1	<1	<1
Bicarbonate (mg/L)	0.0	1130.0	1230.0	1080.0	816.0	1230.0	1071.8

X14-2D							
	2022 / 2023				All Data		
Parameter	Q1	Q2	Q3	Q4	Minimum	Maximum	Average
Field pH	9.5	9.6	9.5	9.6	6.8	11.6	9.2
Field EC (µS/cm)	5610	5940	5820	5970	5610	16250	8571
TDS (mg/L)	0	3460	3330	3270	3270	8290	4737
TSS (mg/L)	0.0	60.0	66.0	40.0	17	136	53
Dissolved Fe (mg/L)	0.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	0.0	24.0	3.0	4.0	3.0	138.0	50.8
Chloride (mg/L)	0.0	1130.0	1080.0	1070.0	990.0	3630.0	1586.0
Calcium (mg/L)	0.0	3.0	4.0	3.0	2.0	239.0	57.5
Magnesium (mg/L)	0.0	2.0	4.0	3.0	1.0	392.0	112.7
Potassium (mg/L)	0.0	41.0	38.0	31.0	29.0	168.0	64.5
Sodium (mg/L)	0.0	1350.0	1350.0	1290.0	1240.0	1960.0	1508.2
Carbonate (mg/L)	0.0	579.0	553.0	512.0	512.0	1680.0	901.3
Bicarbonate (mg/L)	0.0	898.0	989.0	872.0	267.0	1240.0	880.8

Note: The minimum, maximum and average values are based on all data since monitoring began

Groundwater Quality Assurance Review

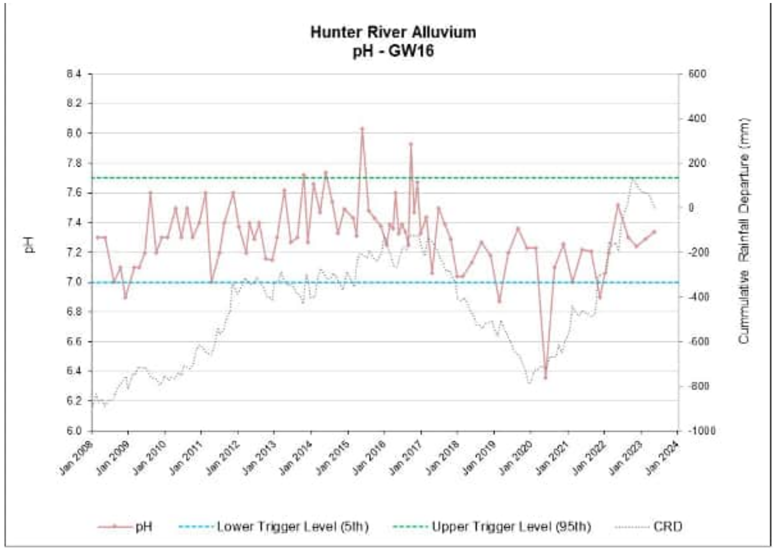
Sample Date:			5/09/2022		Relative Percentage Difference	16/12/2022		Relative Percentage Difference	10/03/2023		Relative Percentage Difference	31/05/2023		Relative Percentage Difference
ALS Batch Number:			ES2231785			ES2244163			ES22308184			ES2318387		
Client sample ID (1st):			GW21	DUPLICATE		GW48	DUPLICATE		EPWC33	DUPLICATE		GW46	DUPLICATE	
Analyte grouping/Analyte	Unit	LOR												
Physical parameters														
pH Value	pH Unit	0.01	7.08	7.09	-0.1%	7.70	7.65	-0.7%	7.10	7.11	0.1%	7.08	7.08	0.0%
Electrical Conductivity @ 25°C	µS/cm	1	1110	1110	0.0%	3630	3640	0.3%	2640	2630	-0.4%	6120	6180	1.0%
Total Dissolved Solids @ 180°C	mg/L	10	684	675	1.3%	2340	2720	15.0%	1530	1580	3.2%	4360	4340	-0.5%
Total Suspended Solids (TSS)	mg/L	5	<5	<5	0.0%	6	<5	-200.0%	<5	<5	0.0%	<5	<5	0.0%
Major ions														
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	0.0%	<1	<1	0.0%	<1	<1	0.0%	<1	<1	0.0%
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	0.0%	<1	<1	0.0%	<1	<1	0.0%	<1	<1	0.0%
Bicarbonate Alkalinity as CaCO3	mg/L	1	402	404	-0.5%	1830	1820	-0.5%	1150	1070	-7.2%	646	647	-0.2%
Total Alkalinity as CaCO3	mg/L	1	402	404	-0.5%	1830	1820	-0.5%	1150	1070	-7.2%	646	647	-0.2%
Sulfate as SO4 - Turbidimetric	mg/L	1	84	86	-2.4%	<10	<10	0.0%	24	25	4.1%	935	965	-3.2%
Chloride by Discrete Analyser	mg/L	1	92	90	2.2%	248	254	2.4%	281	276	-1.8%	1260	1280	-1.6%
Calcium	mg/L	1	90	90	0.0%	13	13	0.0%	21	20	-4.9%	210	215	-2.4%
Magnesium	mg/L	1	58	58	0.0%	15	15	0.0%	88	88	0.0%	272	271	0.4%
Sodium	mg/L	1	58	59	-1.7%	884	885	0.1%	402	412	2.5%	862	865	-0.3%
Potassium	mg/L	1	<1	<1	0.0%	9	9	0.0%	14	14	0.0%	6	6	0.0%

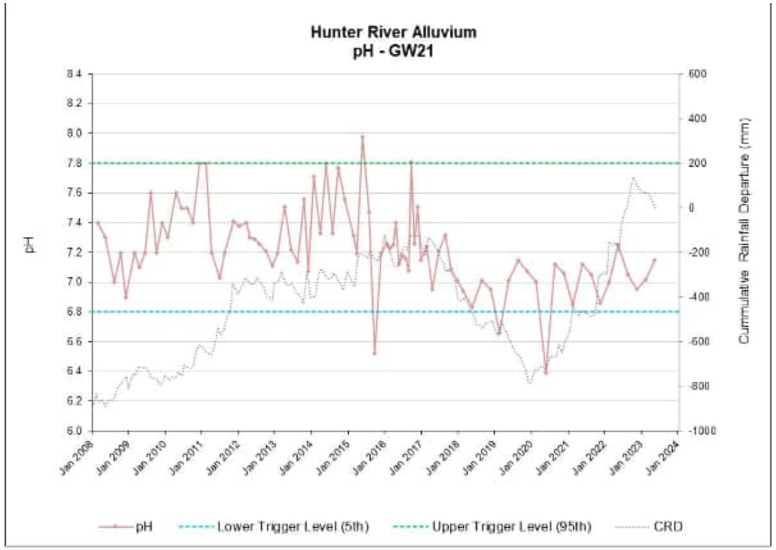
Sample Date:			5/09/2022		Relative Percentage Difference	16/12/2022		Relative Percentage Difference	10/03/2023		Relative Percentage Difference	31/05/2023		Relative Percentage Difference
ALS Batch Number:			ES2231785			ES2244163			ES22308184			ES2318387		
Client sample ID (1st):			GW21	DUPLICATE		GW48	DUPLICATE		EPWC33	DUPLICATE		GW46	DUPLICATE	
Total Phosphorus as P	mg/L	0.01	-	-	-	-	-	-	-	-	-	0.02	0.02	0.0%
Total Anions	meq/L	0.01	12.4	12.4	0.0%	43.6	43.5	-0.2%	31.4	29.7	-5.6%	67.9	69.1	-1.8%
Total Cations	meq/L	0.01	11.8	11.8	0.0%	40.6	40.6	0.0%	26.1	26.5	1.5%	70.5	70.8	-0.4%
Dissolved Metals														
Aluminium	mg/L	0.01	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.0%
Antimony	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Arsenic	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Barium	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.064	0.064	0.0%
Boron	mg/L	0.05	-	-	-	-	-	-	-	-	-	0.130	0.140	-7.4%
Cadmium	mg/L	0.0001	-	-	-	-	-	-	-	-	-	<0.0001	<0.0001	0.0%
Chromium	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Copper	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.001	0.001	0.0%
Iron	mg/L	0.05	0.07	0.07	0.0%	0.27	0.26	-3.8%	0.06	0.06	0.0%	<0.05	<0.05	0.0%
Lead	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Mercury	mg/L	0.0001	-	-	-	-	-	-	-	-	-	<0.0001	<0.0001	0.0%
Molybdenum	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Nickel	mg/L	0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.0%
Selenium	mg/L	0.01	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.0%
Zinc	mg/L	0.005	-	-	-	-	-	-	-	-	-	0.006	0.006	0.0%

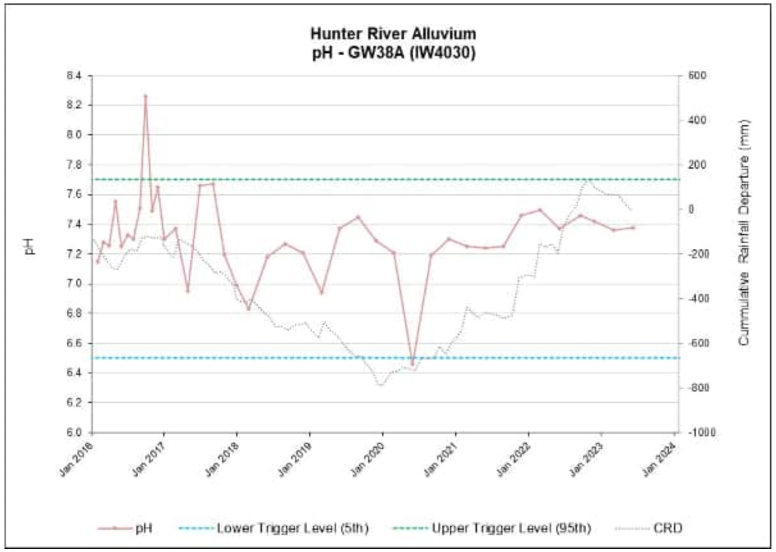
APPENDIX E

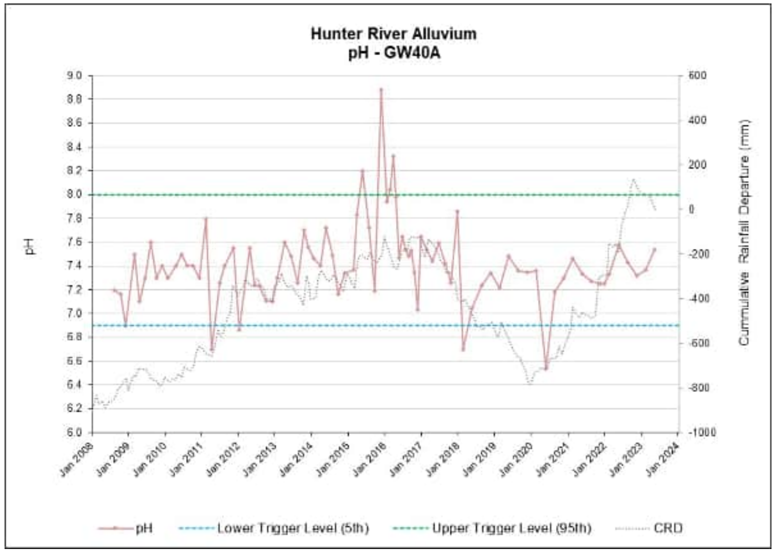
Groundwater Quality Graphs

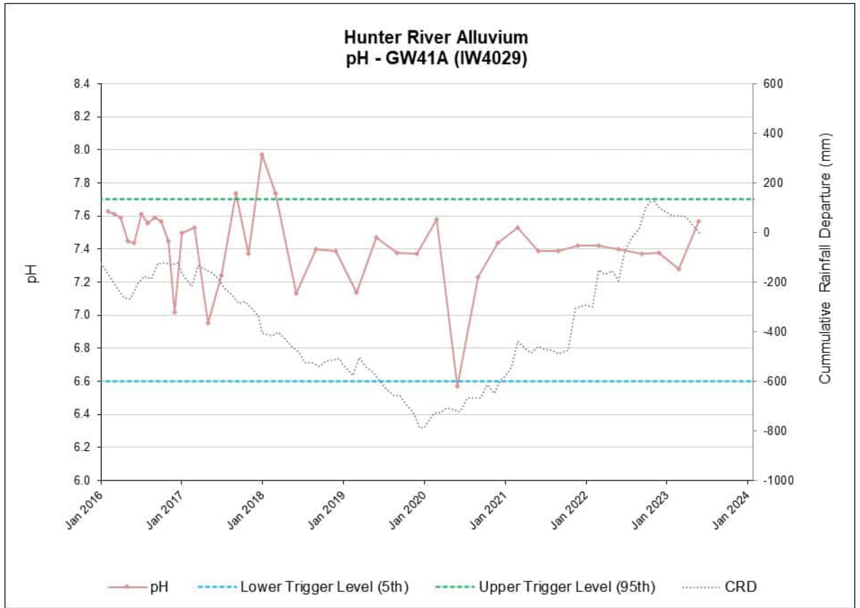
pH Graphs – WMP V2.1 Trigger Levels (Applies to data from July 2022 to March 2023)



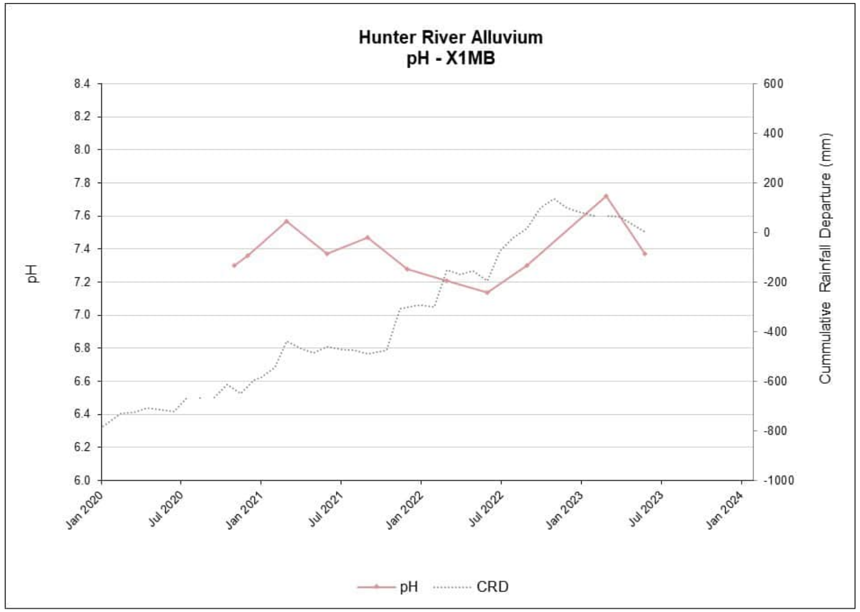




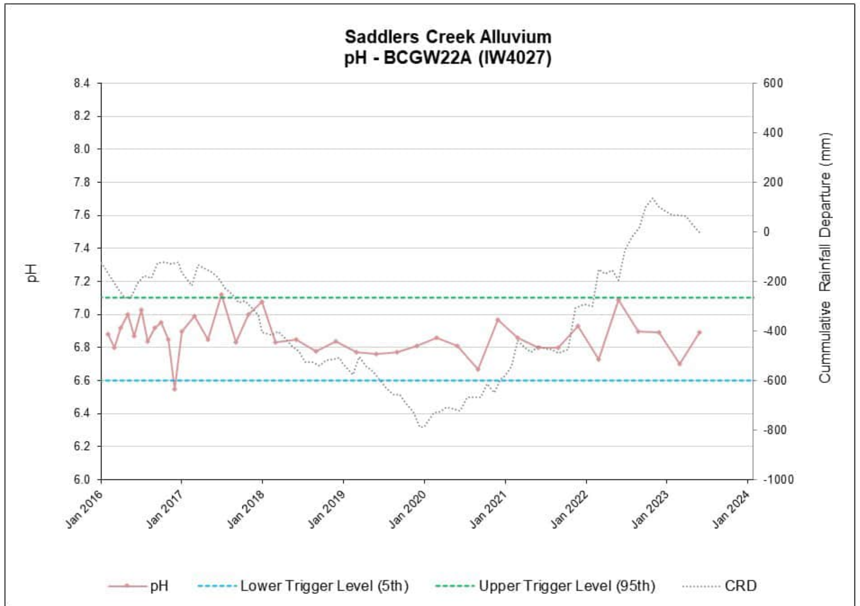




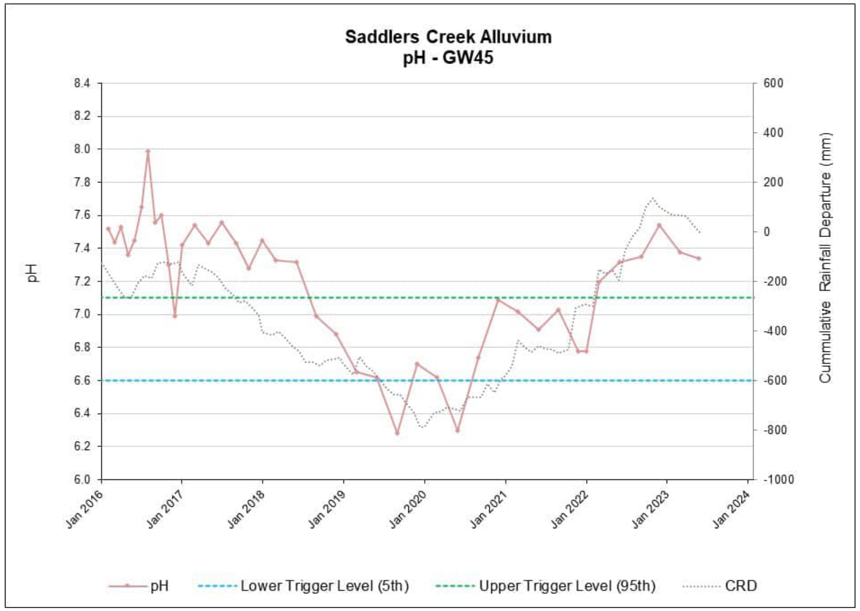
Hunter River Alluvium
pH - GW41A (IW4029)
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD



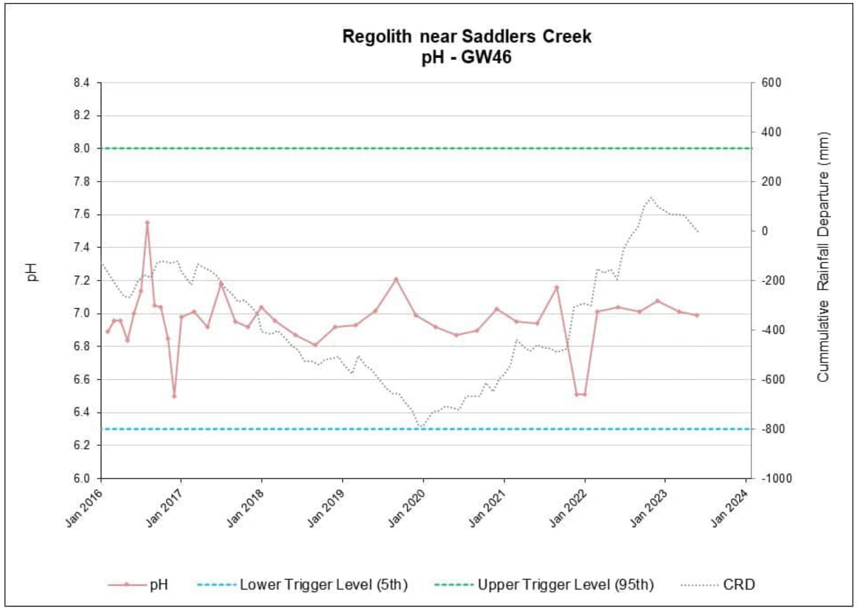
Hunter River Alluvium
pH - X1MB
pH
Cummulative Rainfall Departure (mm)
pH
CRD



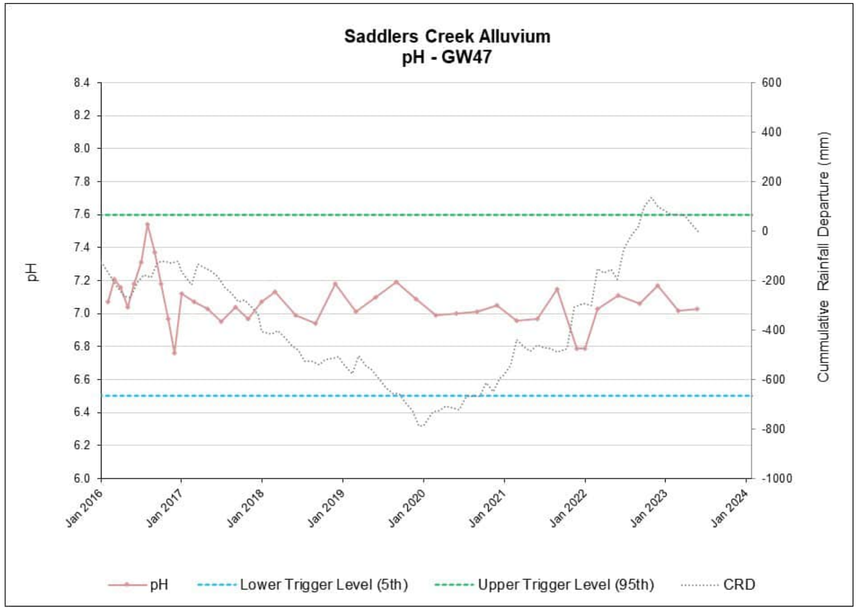
Saddlers Creek Alluvium
pH - BCGW22A (IW4027)
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD



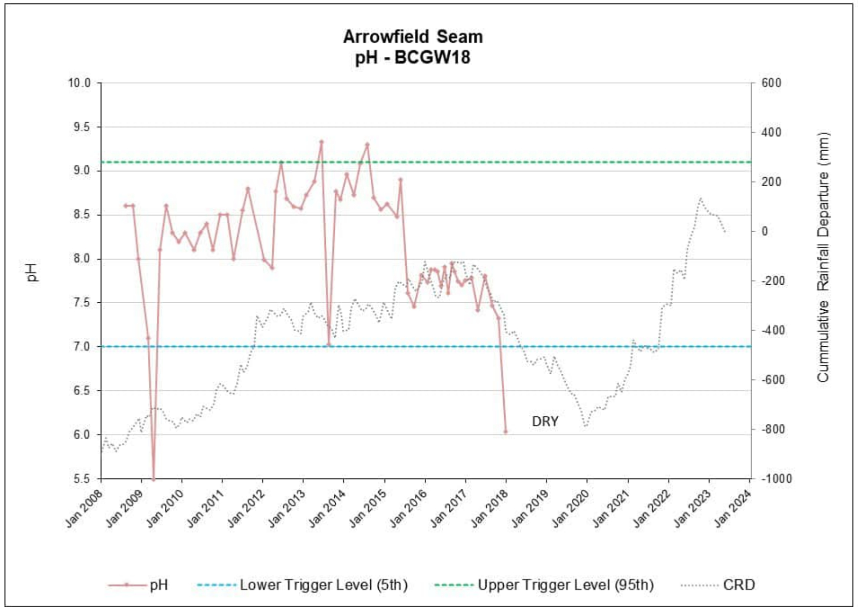
Saddlers Creek Alluvium
pH - GW45
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD



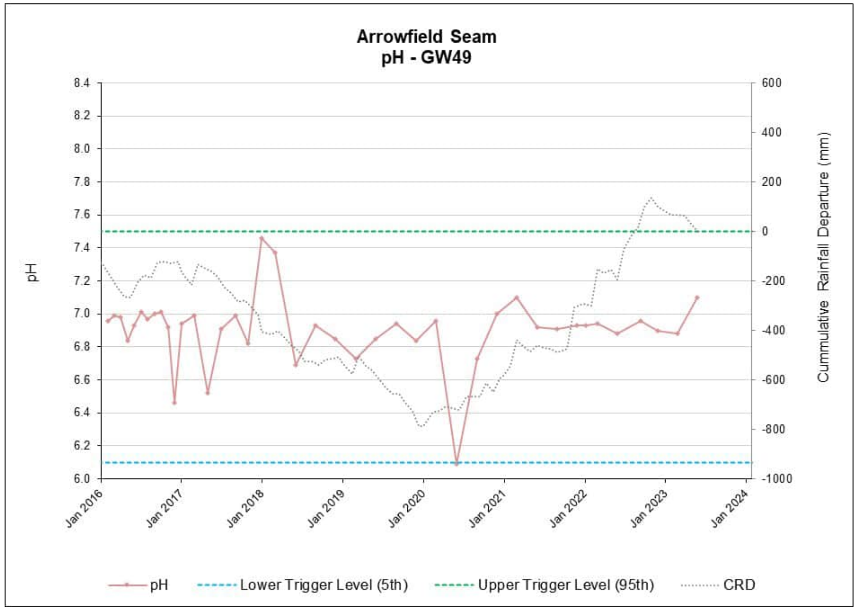
Regolith near Saddlers Creek
pH - GW46
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD



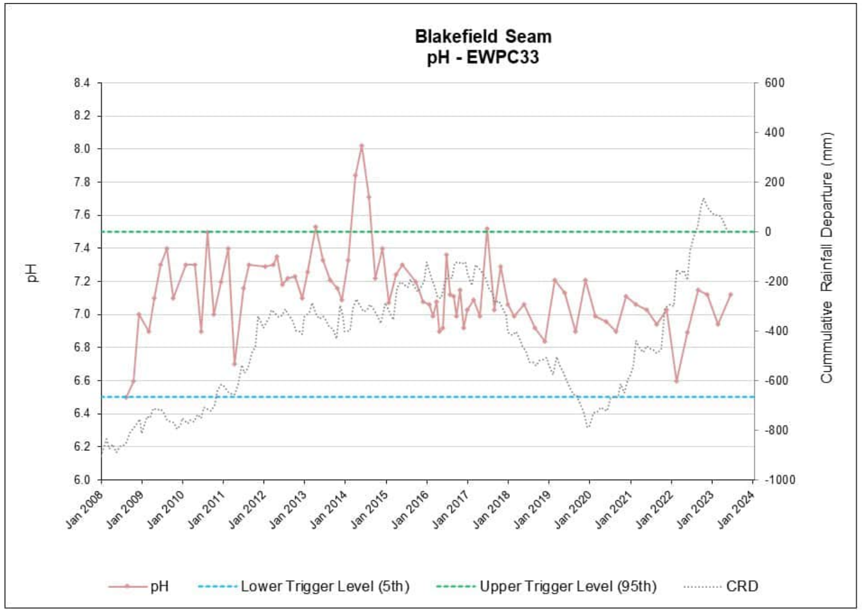
Saddlers Creek Alluvium
pH - GW47
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

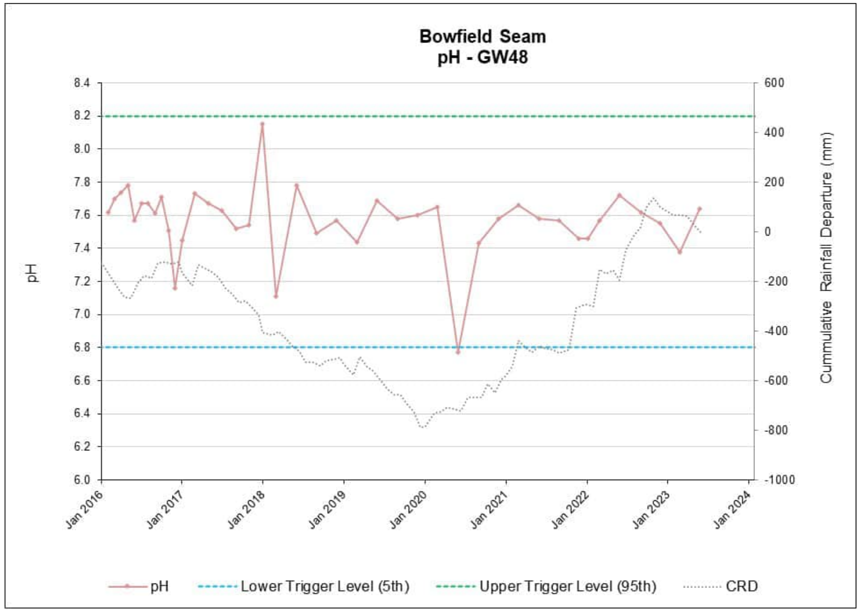


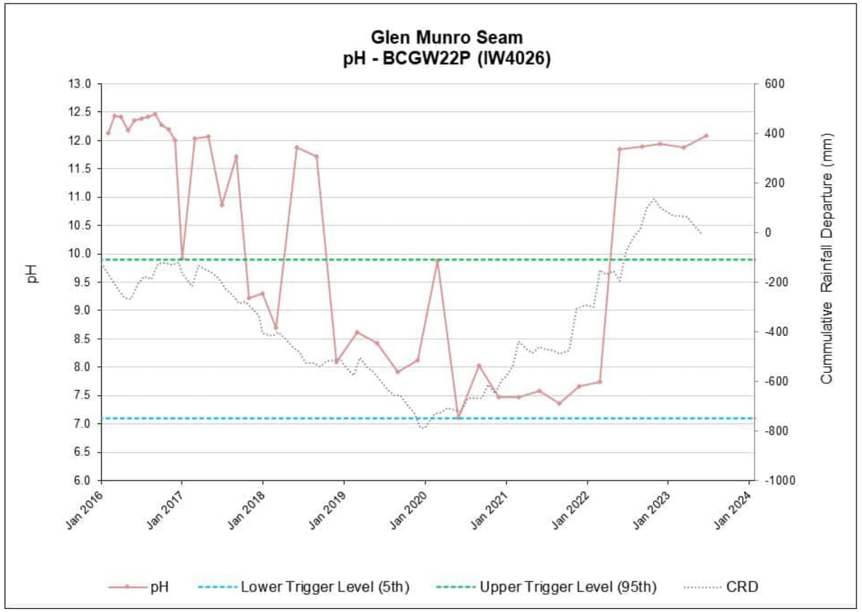
Arrowfield Seam
pH - BCGW18
pH
Cummulative Rainfall Departure (mm)
DRY
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

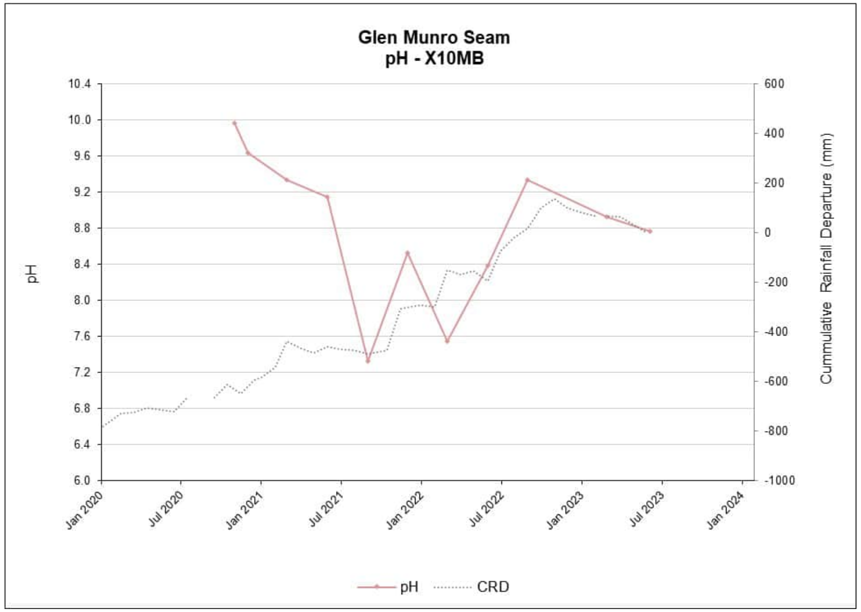


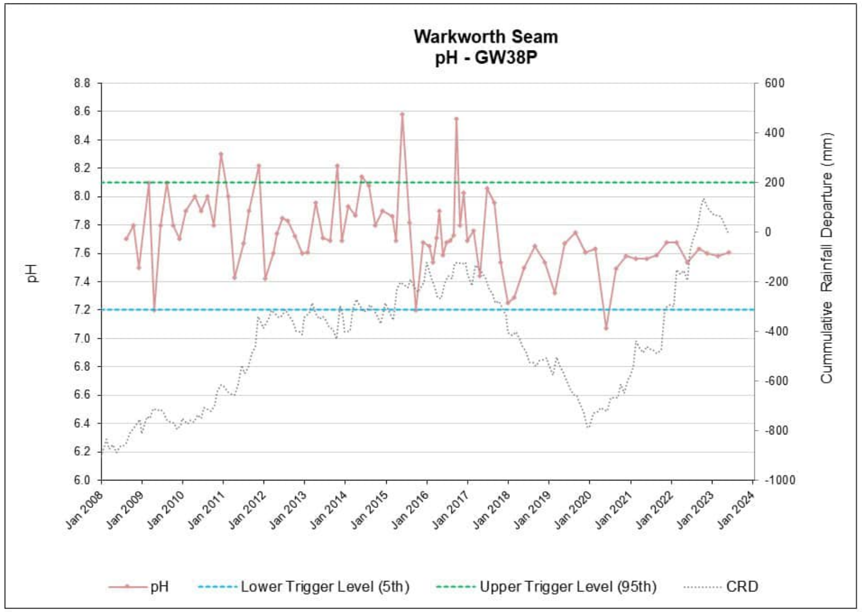
Arrowfield Seam
pH - GW49
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

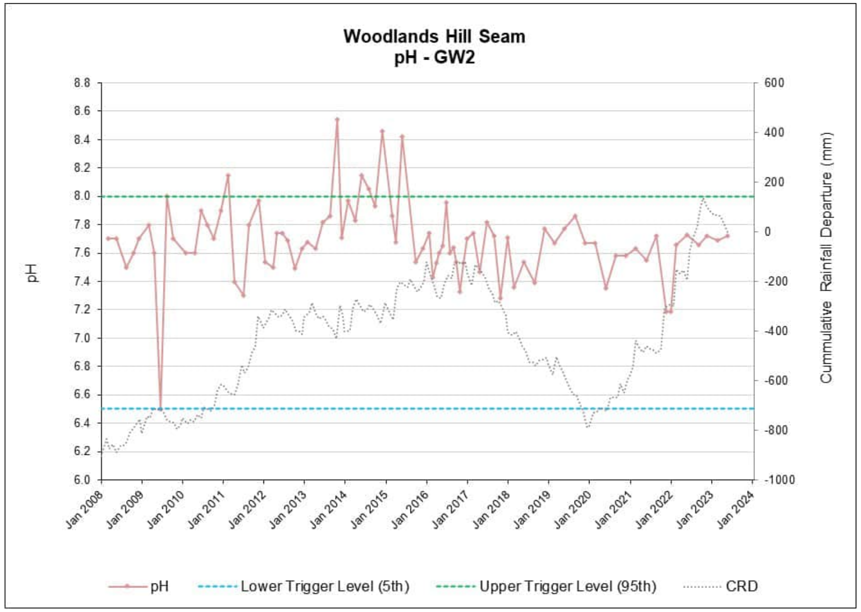

Blakefield Seam
pH - EWPC33
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

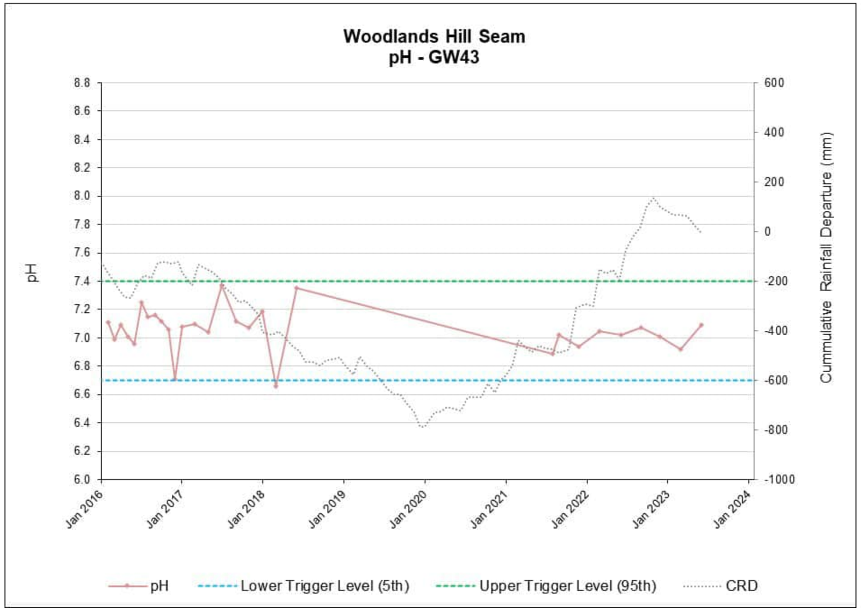

Bowfield Seam
pH - GW48
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD


Glen Munro Seam
pH - BCGW22P (IW4026)
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

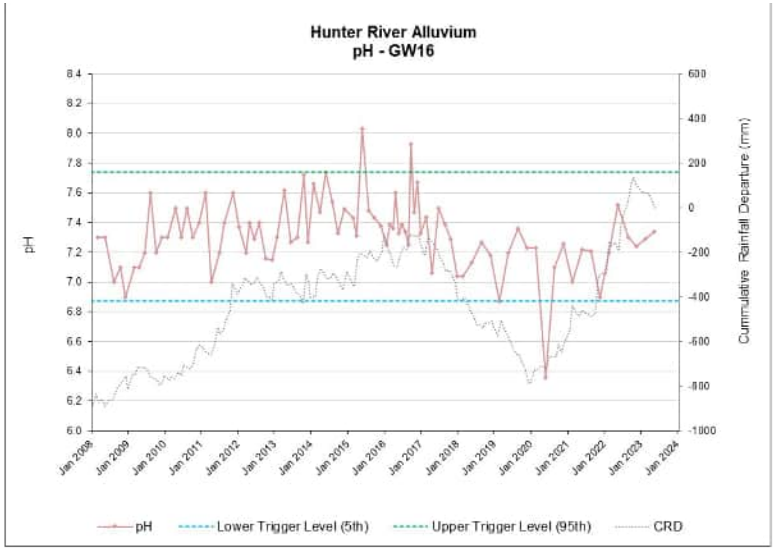

Glen Munro Seam
pH - X10MB
pH
Cummulative Rainfall Departure (mm)
pH
CRD

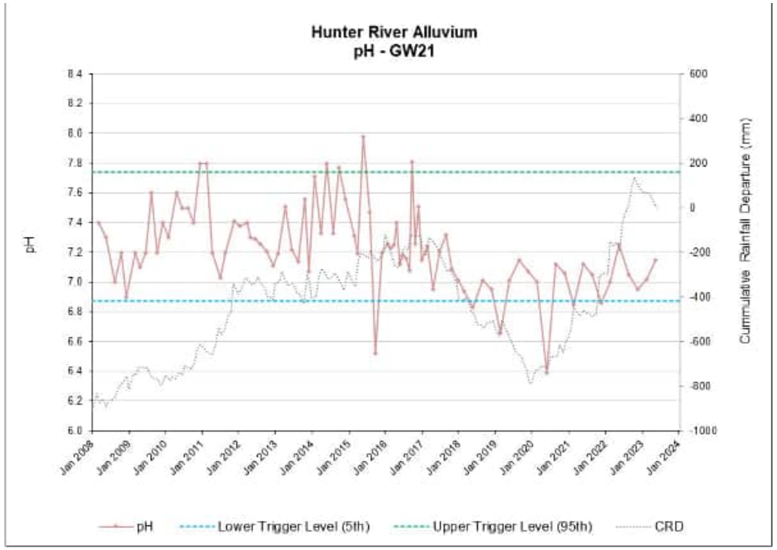

Warkworth Seam
pH - GW38P
pH
Cummulative Rainfall Departure (mm)
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
600
400
200
0
-200
-400
-600
-800
-1000
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023
Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

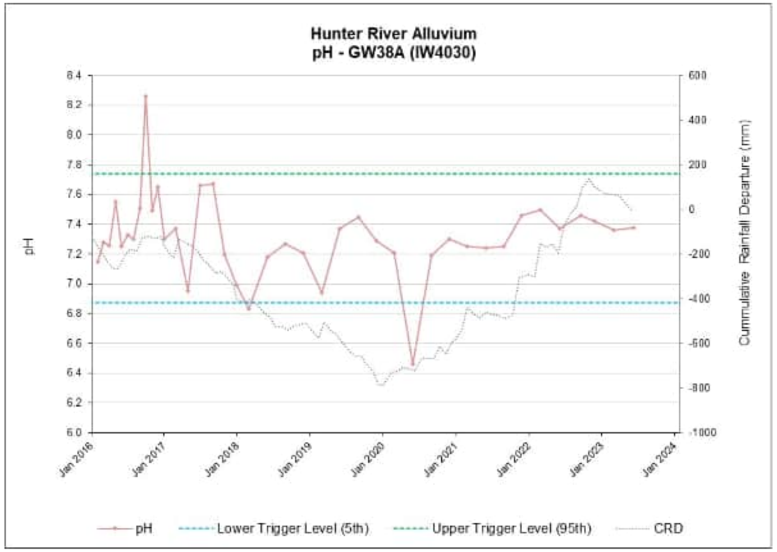

Woodlands Hill Seam
pH - GW2
pH
Cummulative Rainfall Departure (mm)
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
600
400
200
0
-200
-400
-600
-800
-1000
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023
Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

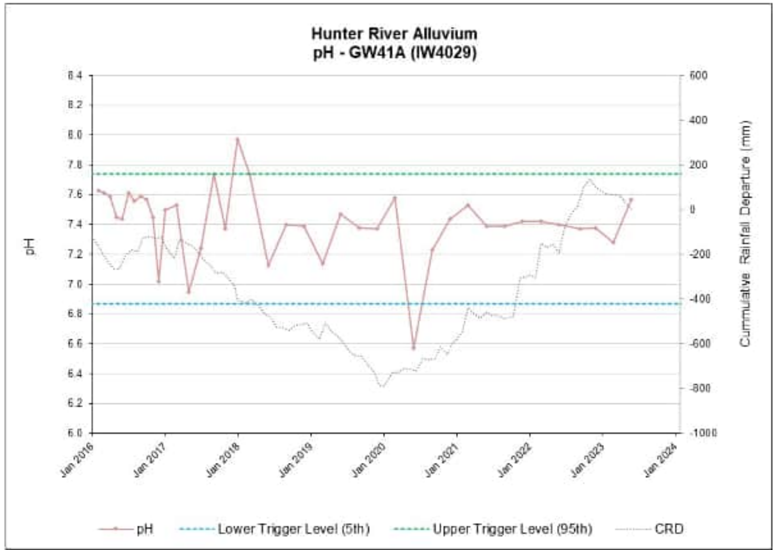

Woodlands Hill Seam
pH - GW43
pH
Cummulative Rainfall Departure (mm)
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
600
400
200
0
-200
-400
-600
-800
-1000
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023
Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

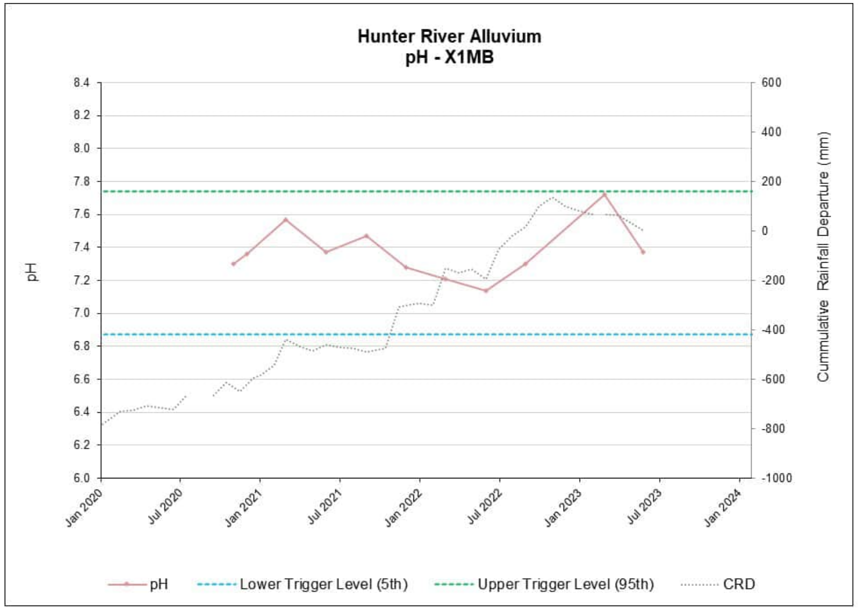
pH Graphs – WMP V3 Trigger Levels (Applies to data from April to June 2023)

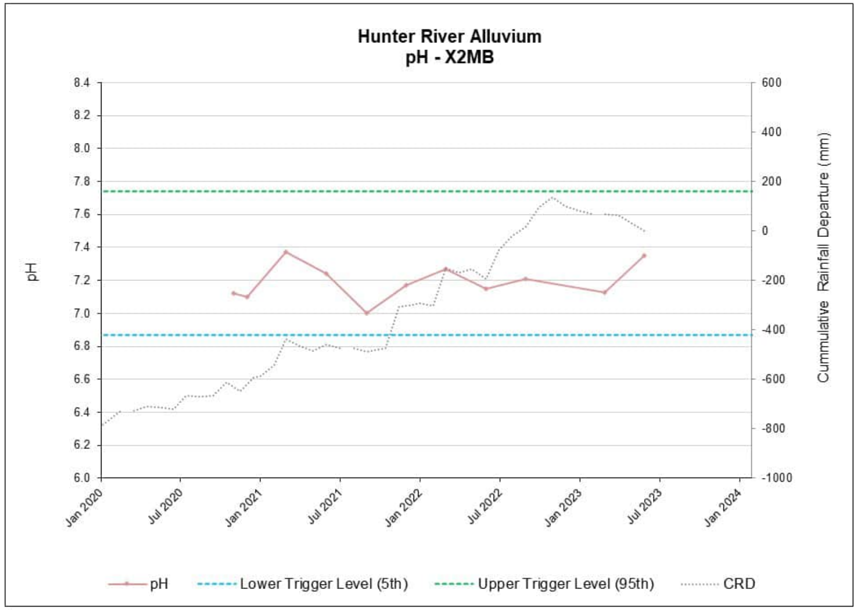


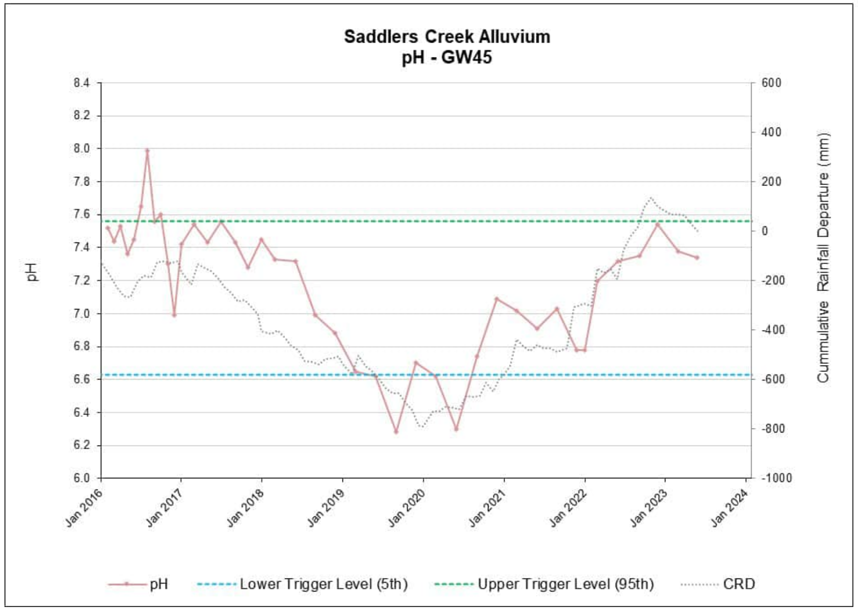


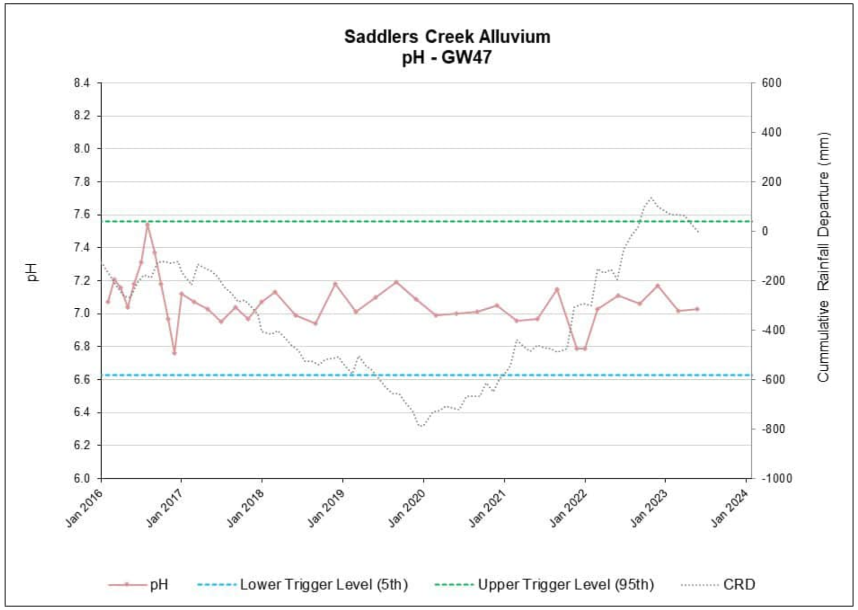


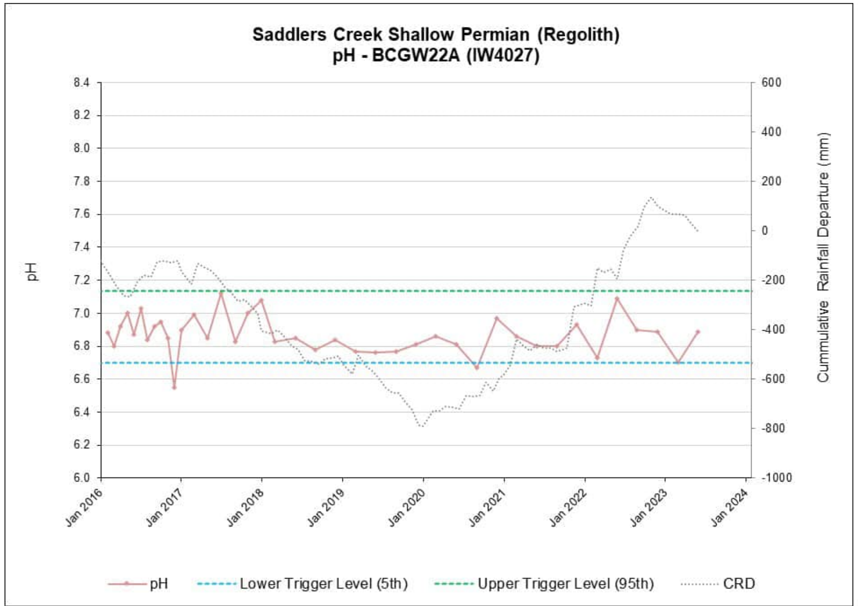


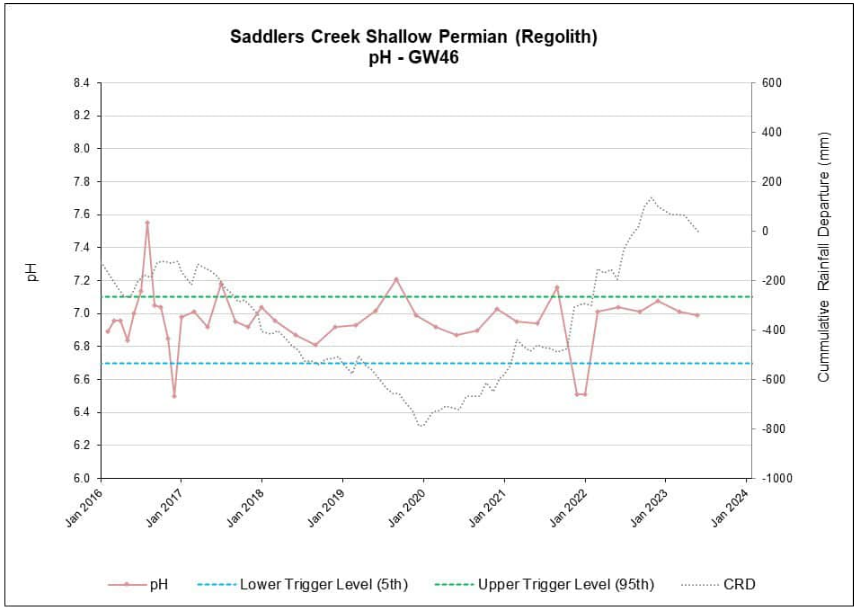

Hunter River Alluvium
pH - X1MB
pH
Cummulative Rainfall Departure (mm)
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0
600 400 200 0 -200 -400 -600 -800 -1000
Jan 2020 Jul 2020 Jan 2021 Jul 2021 Jan 2022 Jul 2022 Jan 2023 Jul 2023 Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

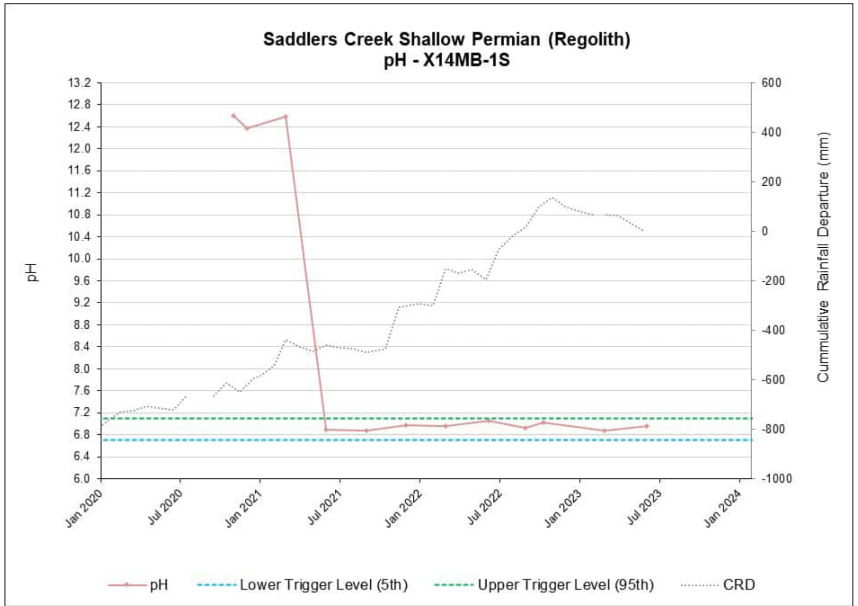

Hunter River Alluvium
pH - X2MB
pH
Cummulative Rainfall Departure (mm)
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0
600 400 200 0 -200 -400 -600 -800 -1000
Jan 2020 Jul 2020 Jan 2021 Jul 2021 Jan 2022 Jul 2022 Jan 2023 Jul 2023 Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

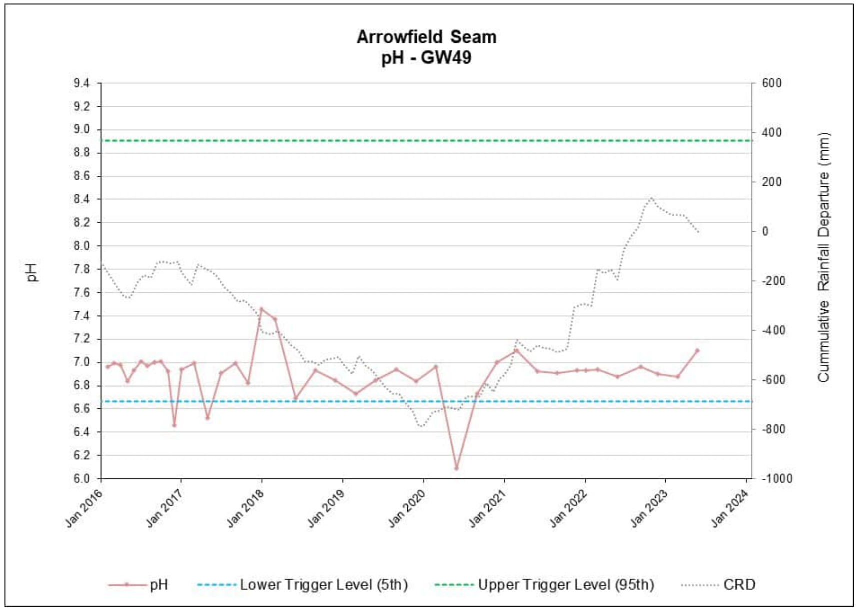

Saddlers Creek Alluvium
pH - GW45
pH
Cummulative Rainfall Departure (mm)
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0
600 400 200 0 -200 -400 -600 -800 -1000
Jan 2016 Jan 2017 Jan 2018 Jan 2019 Jan 2020 Jan 2021 Jan 2022 Jan 2023 Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

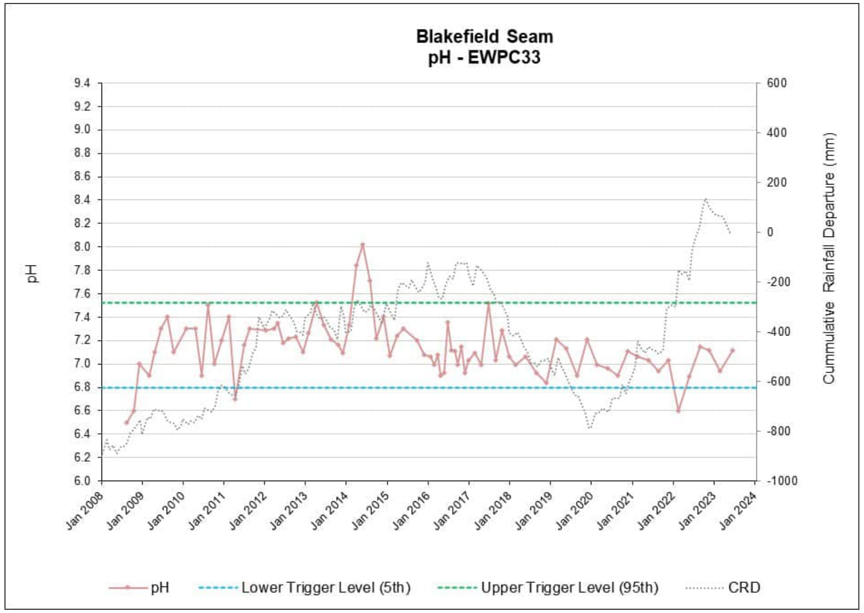

Saddlers Creek Alluvium
pH - GW47
pH
Cummulative Rainfall Departure (mm)
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0
600 400 200 0 -200 -400 -600 -800 -1000
Jan 2016 Jan 2017 Jan 2018 Jan 2019 Jan 2020 Jan 2021 Jan 2022 Jan 2023 Jan 2024
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

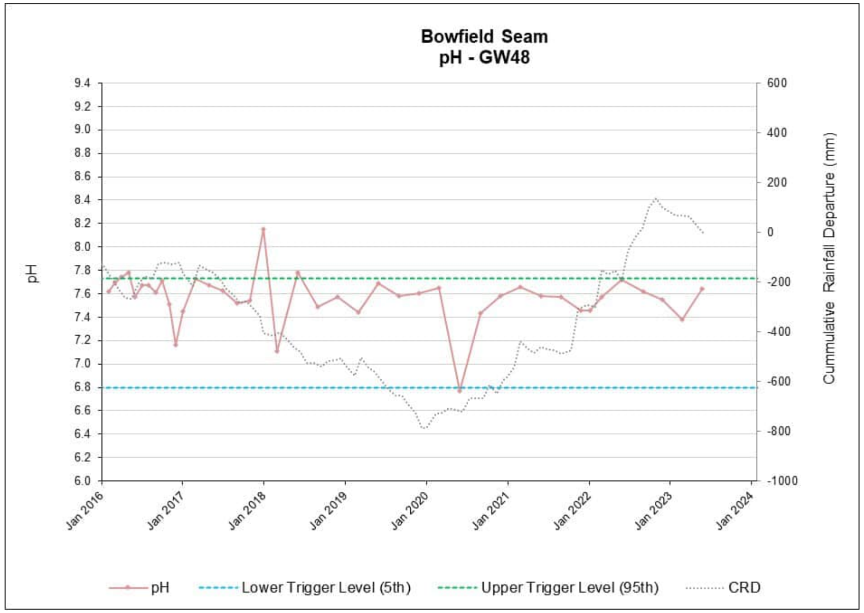

Saddlers Creek Shallow Permian (Regolith)
pH - BCGW22A (IW4027)
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

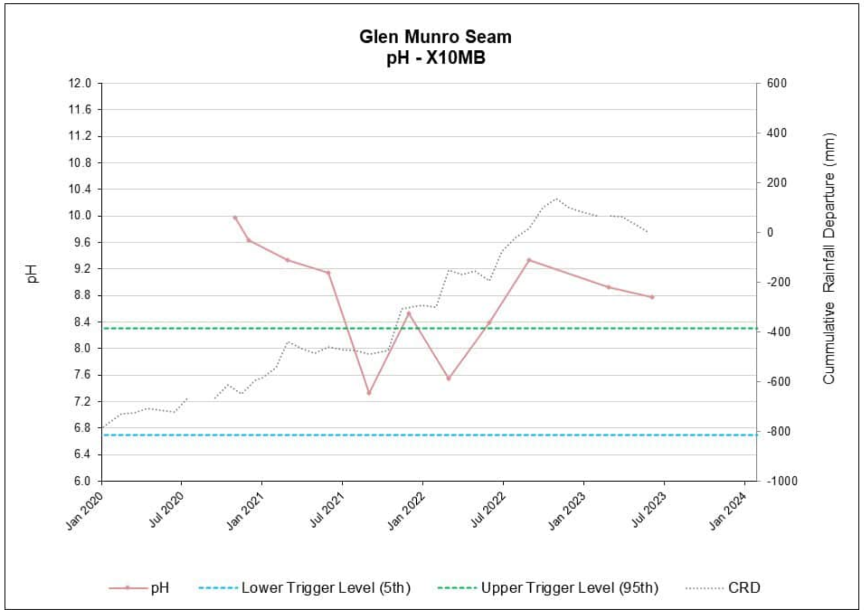

Saddlers Creek Shallow Permian (Regolith)
pH - GW46
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

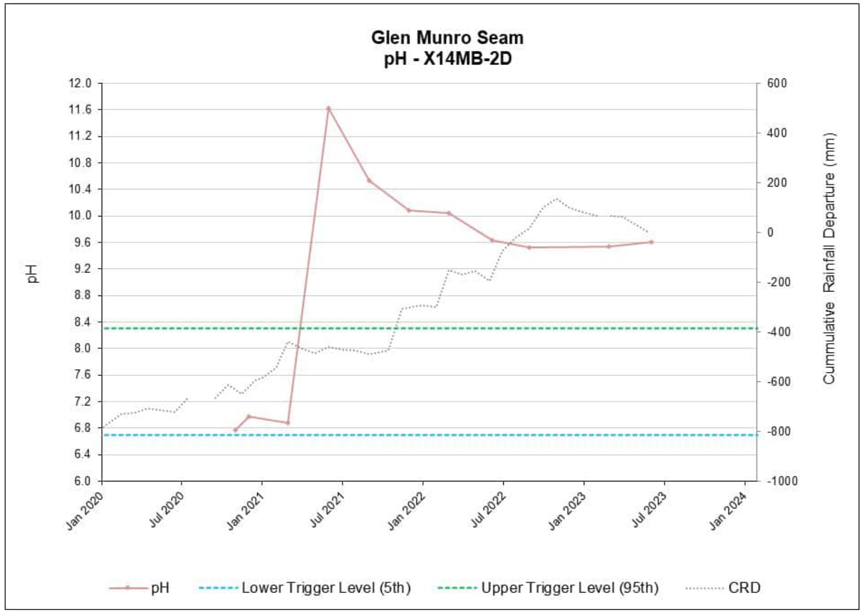

Saddlers Creek Shallow Permian (Regolith)
pH - X14MB-1S
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

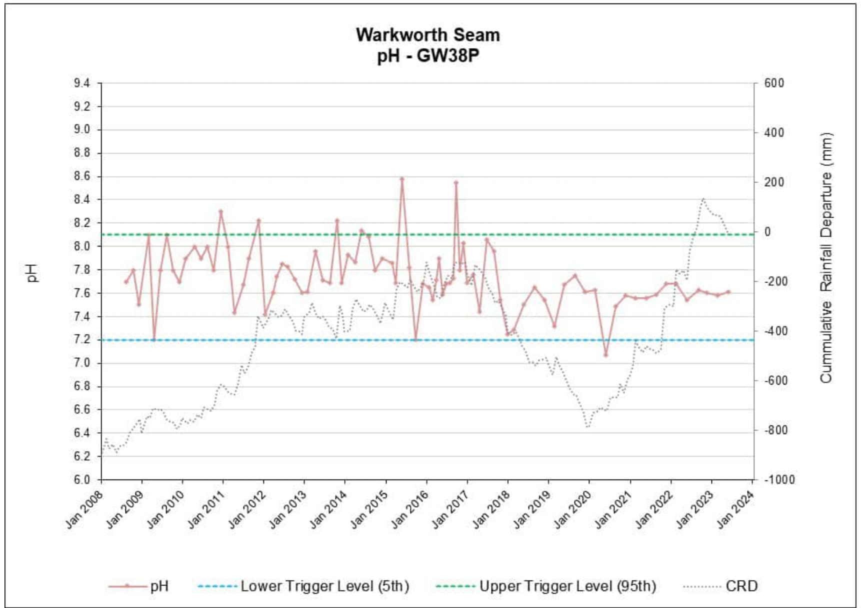

Arrowfield Seam
pH - GW49
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

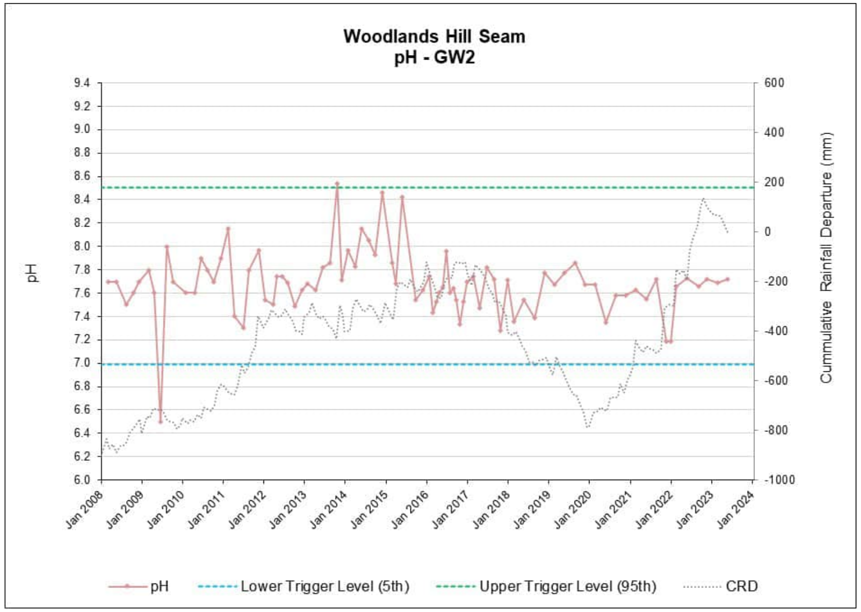

Blakefield Seam
pH - EWPC33
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

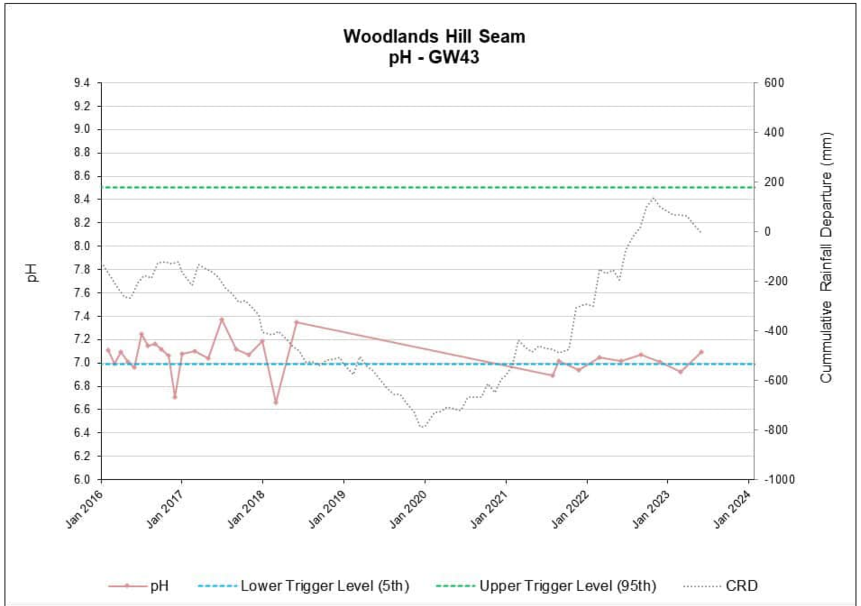

Bowfield Seam
pH - GW48
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD


Glen Munro Seam
pH - X10MB
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

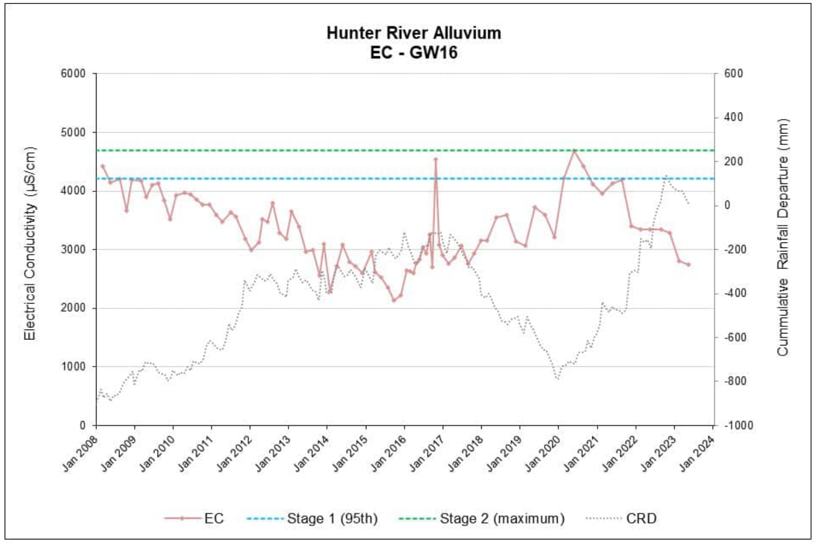

Glen Munro Seam
pH - X14MB-2D
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

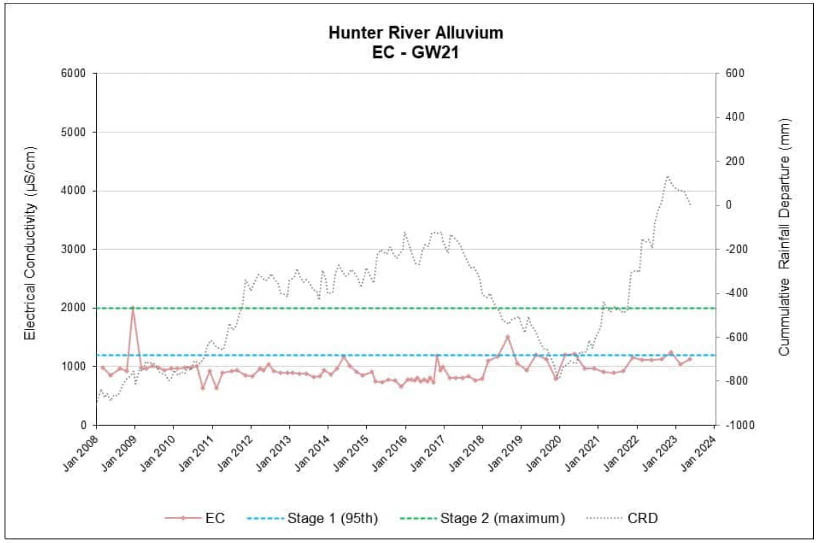

Warkworth Seam
pH - GW38P
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

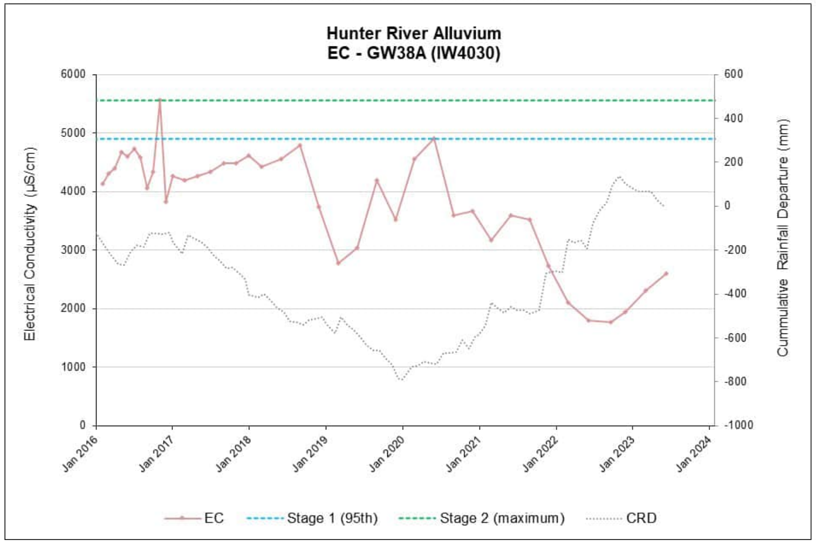

Woodlands Hill Seam
pH - GW2
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

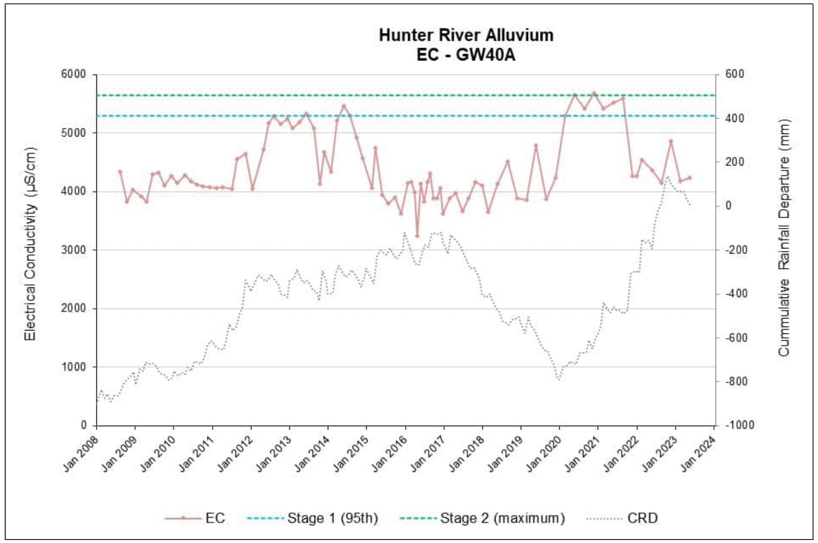

Woodlands Hill Seam
pH - GW43
pH
Cummulative Rainfall Departure (mm)
pH
Lower Trigger Level (5th)
Upper Trigger Level (95th)
CRD

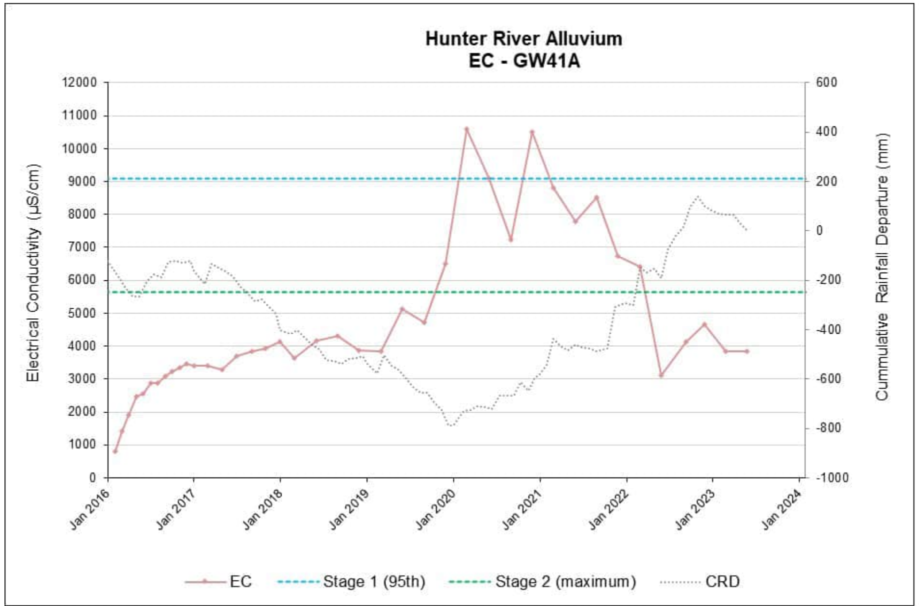
EC Graphs – WMP V2.1 Trigger Levels (Applies to July 2022 to March 2023 data)

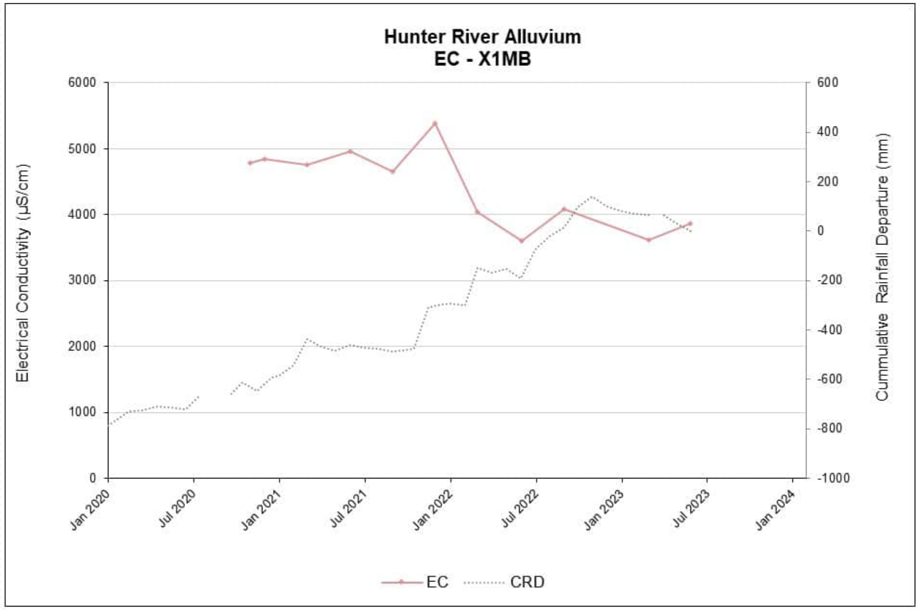


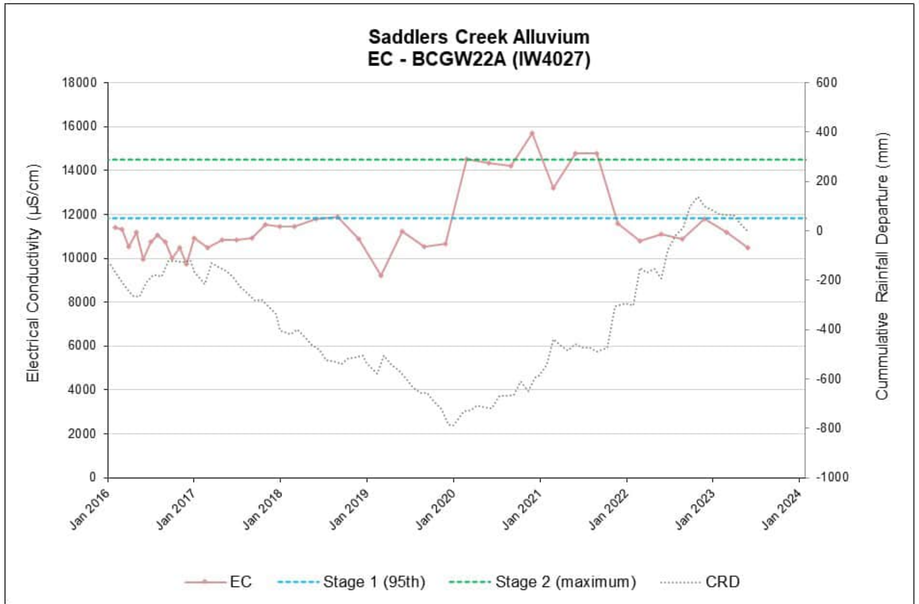


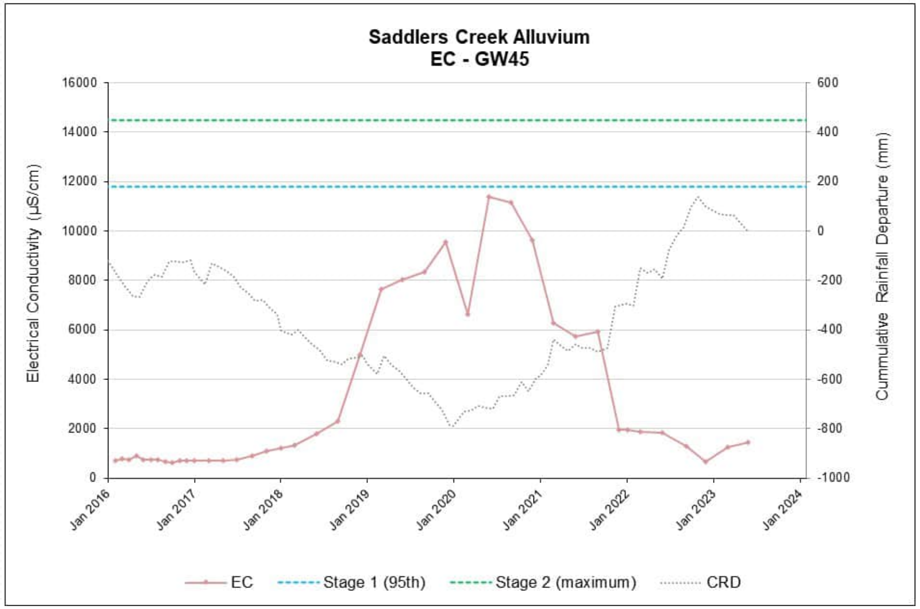


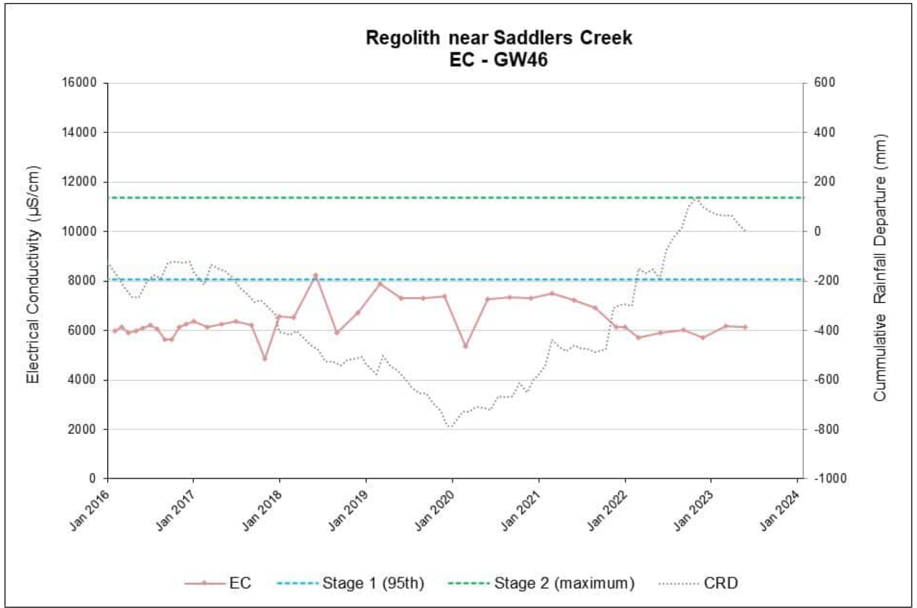



Hunter River Alluvium
EC - GW41A
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

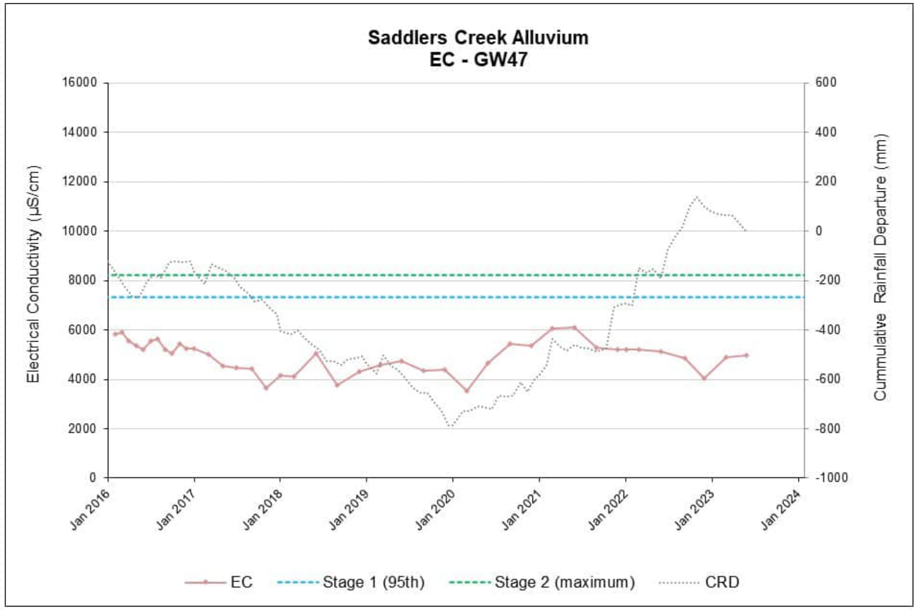

Hunter River Alluvium
EC - X1MB
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
CRD


Saddlers Creek Alluvium
EC - BCGW22A (IW4027)
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

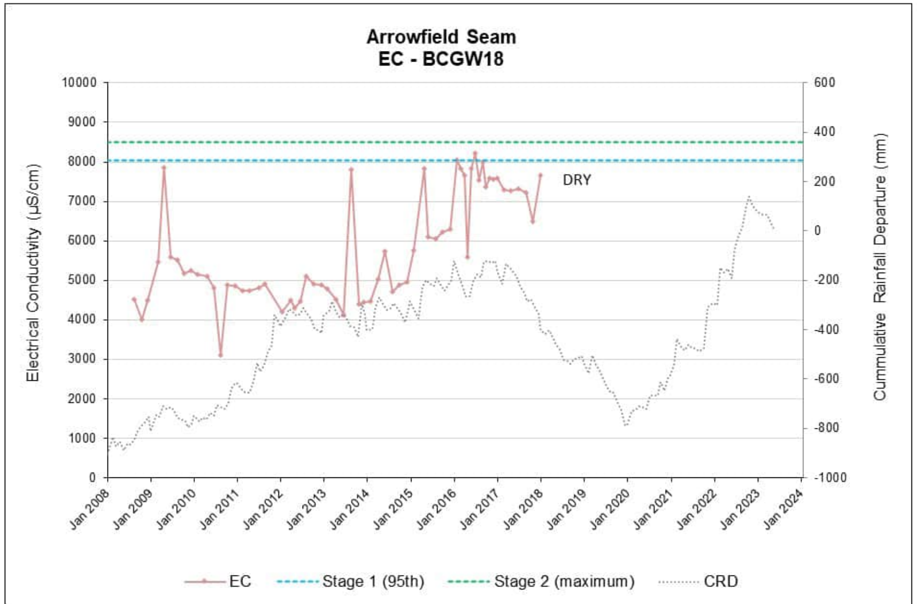

Saddlers Creek Alluvium
EC - GW45
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD



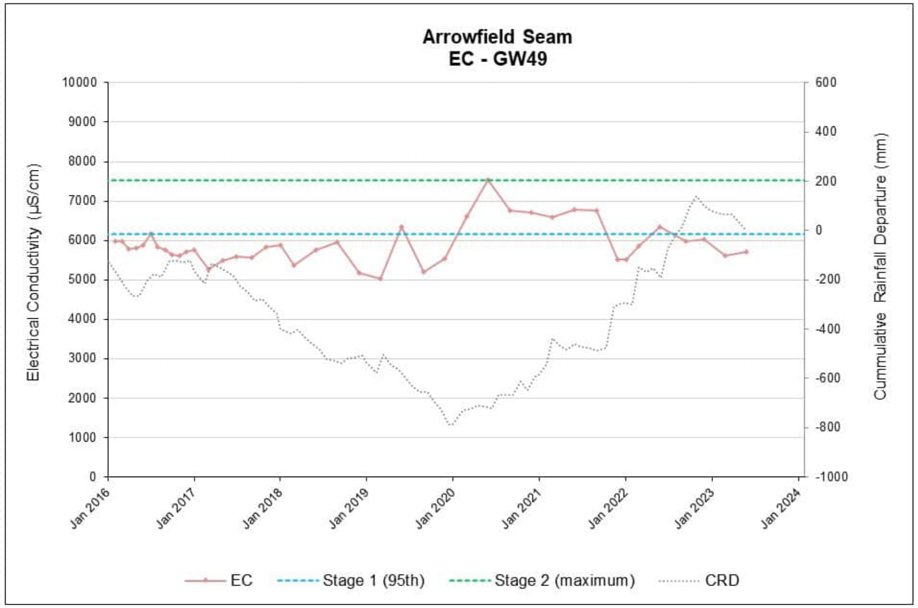
Regolith near Saddlers Creek
EC - GW46
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD



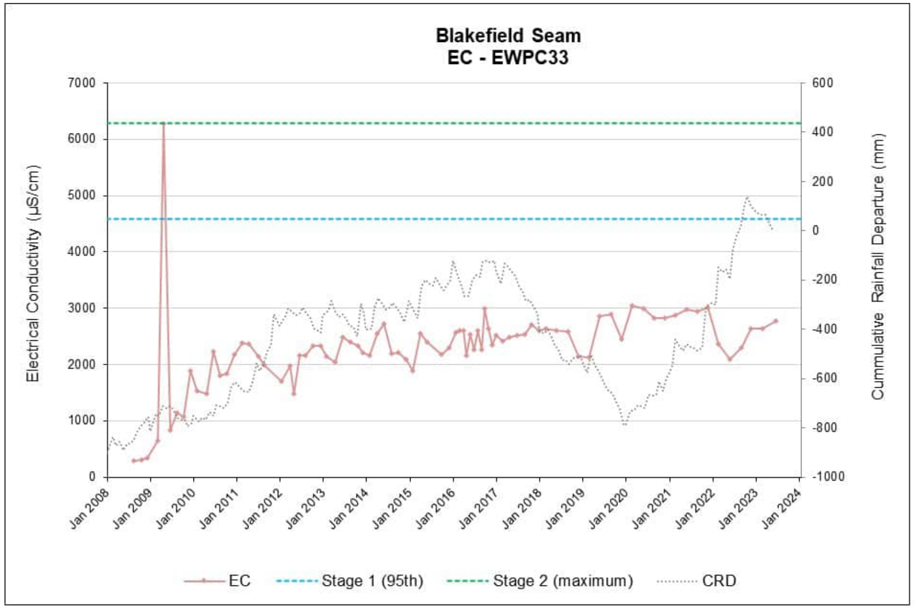
Saddlers Creek Alluvium
EC - GW47
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

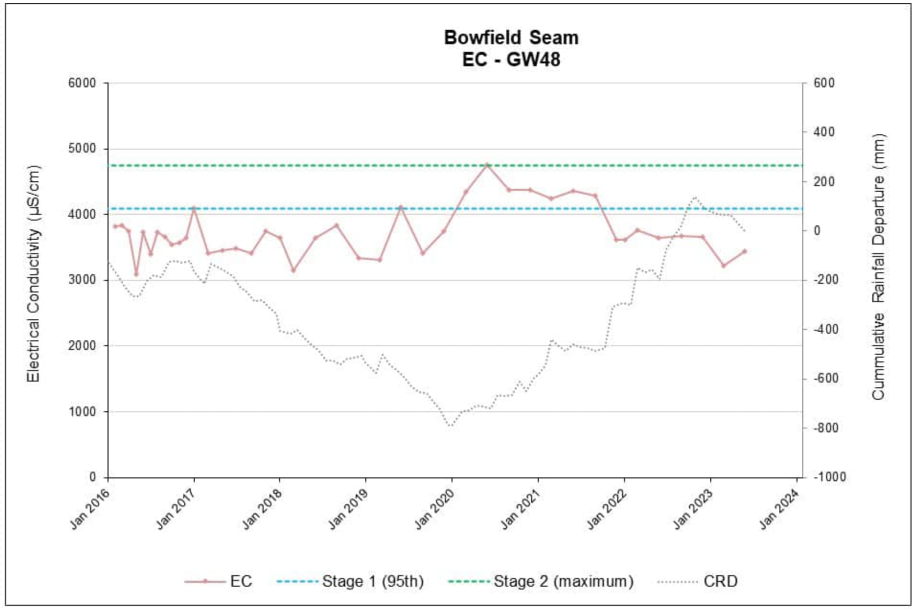


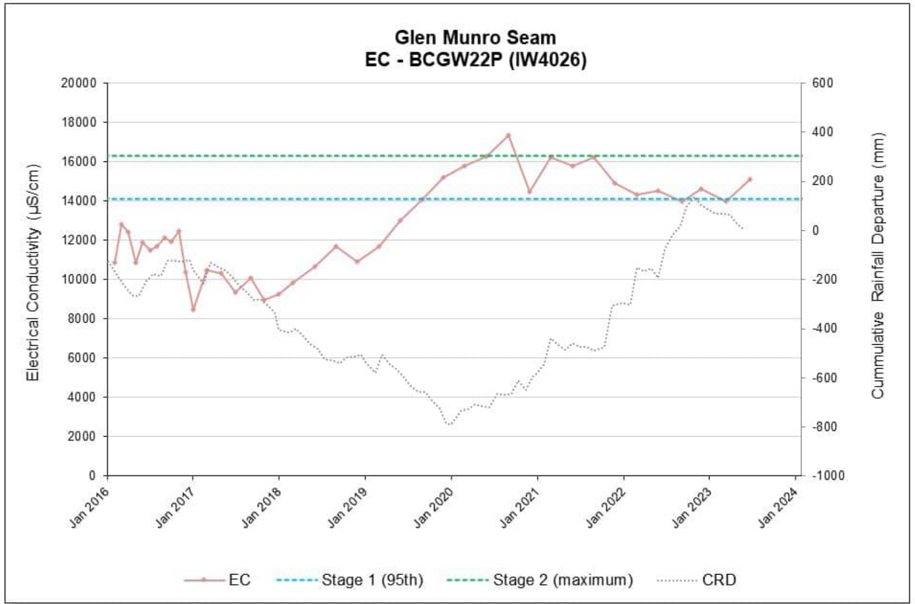
Arrowfield Seam
EC - BCGW18
DRY
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

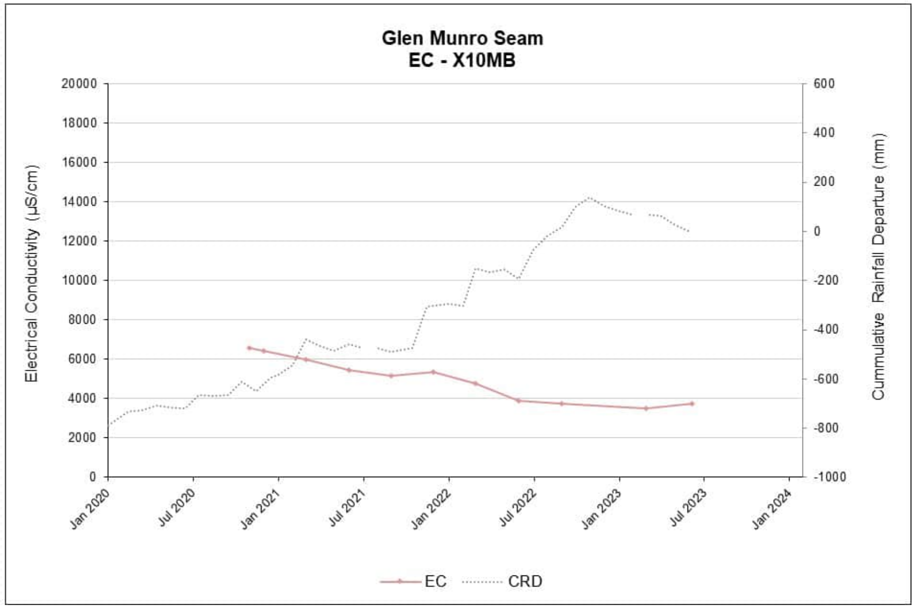


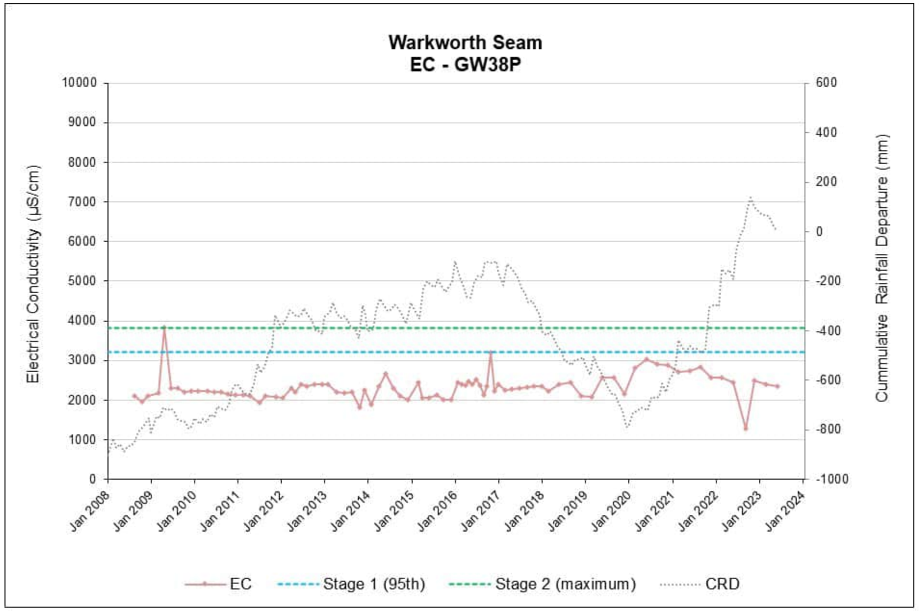
Arrowfield Seam
EC - GW49
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

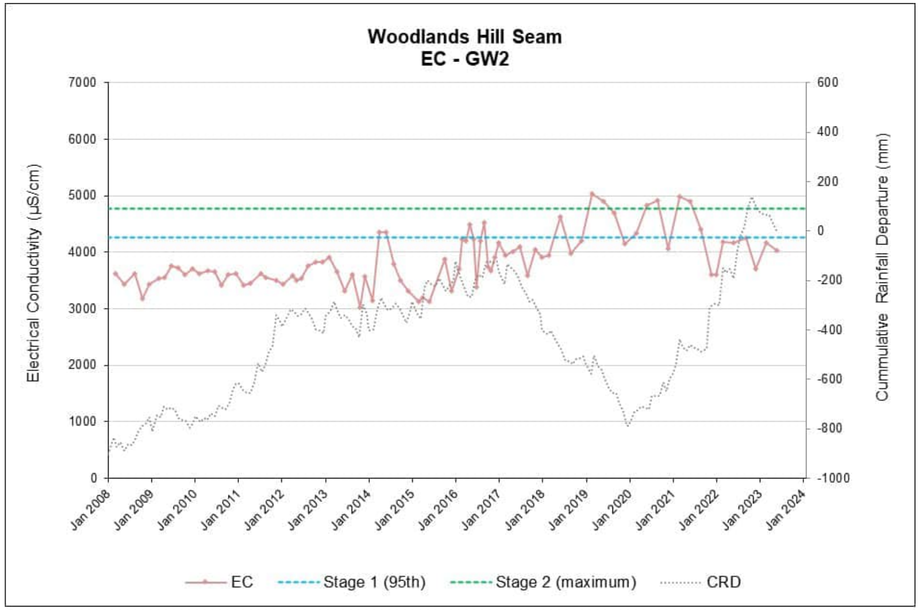

Blakefield Seam
EC - EWPC33
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

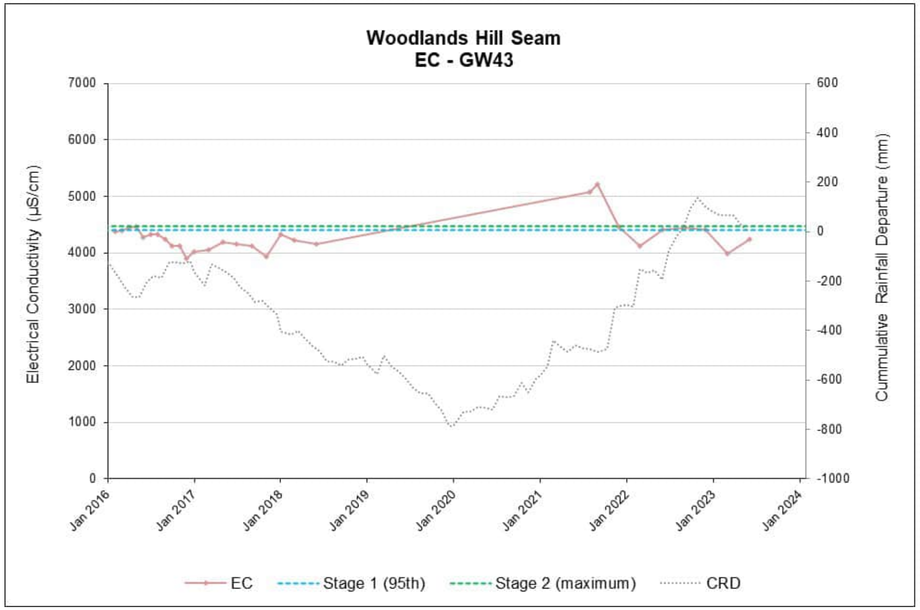

Bowfield Seam
EC - GW48
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Glen Munro Seam
EC - BCGW22P (IW4026)
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

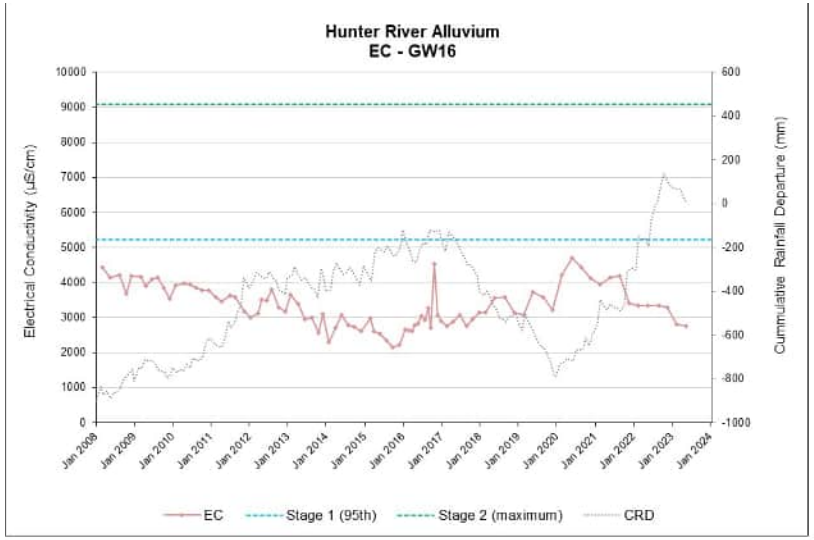

Glen Munro Seam
EC - X10MB
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
CRD

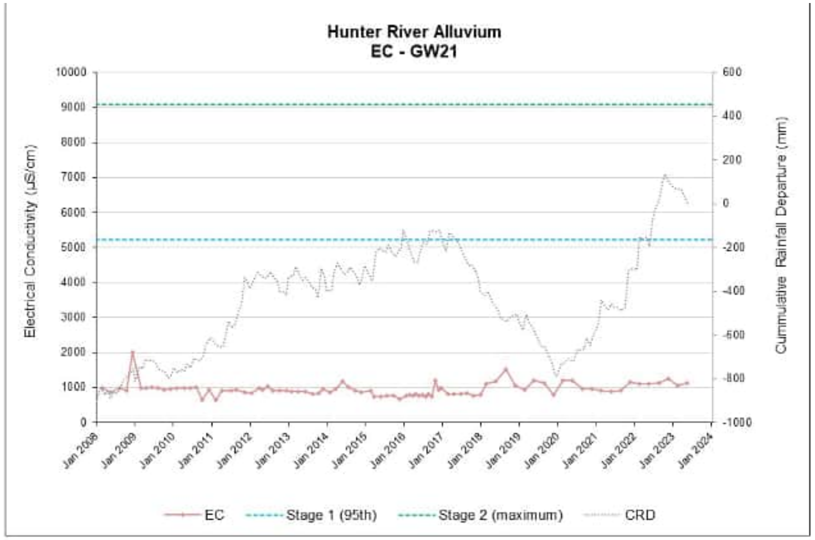

Warkworth Seam
EC - GW38P
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

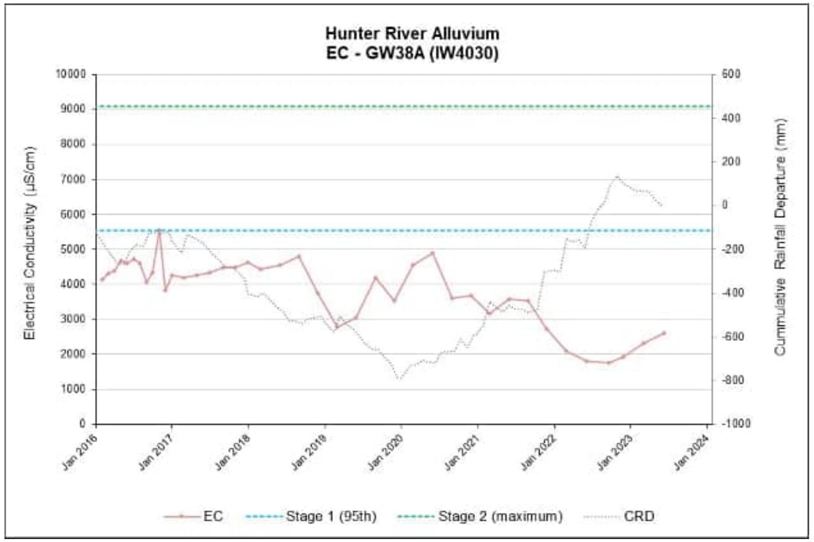

Woodlands Hill Seam
EC - GW2
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

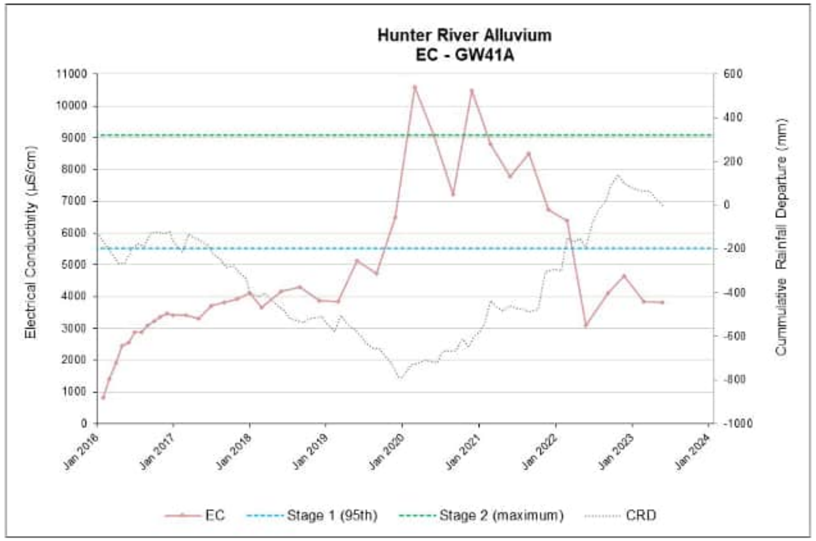

Woodlands Hill Seam
EC - GW43
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

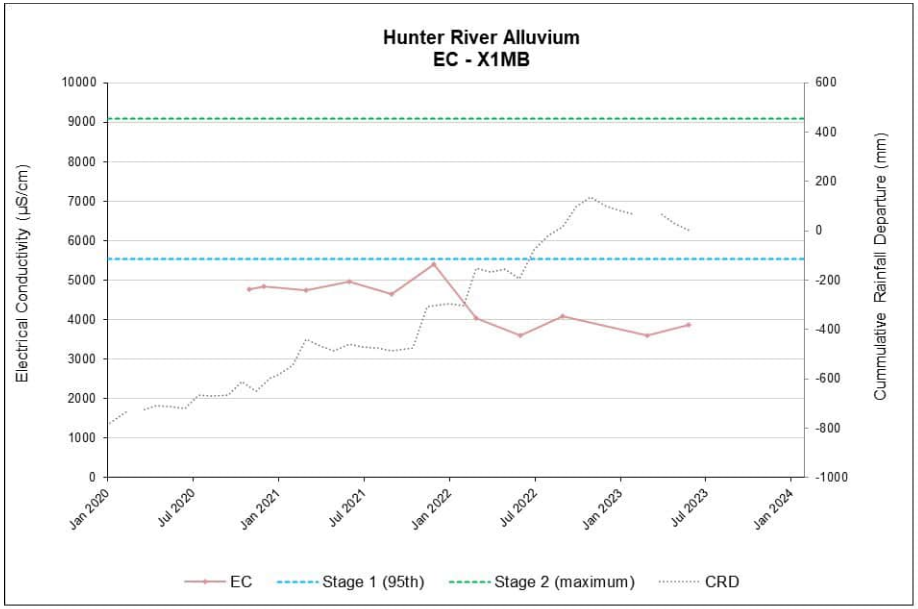
EC Graphs – WMP V3 Trigger Levels (Applies to April to June 2023 data)



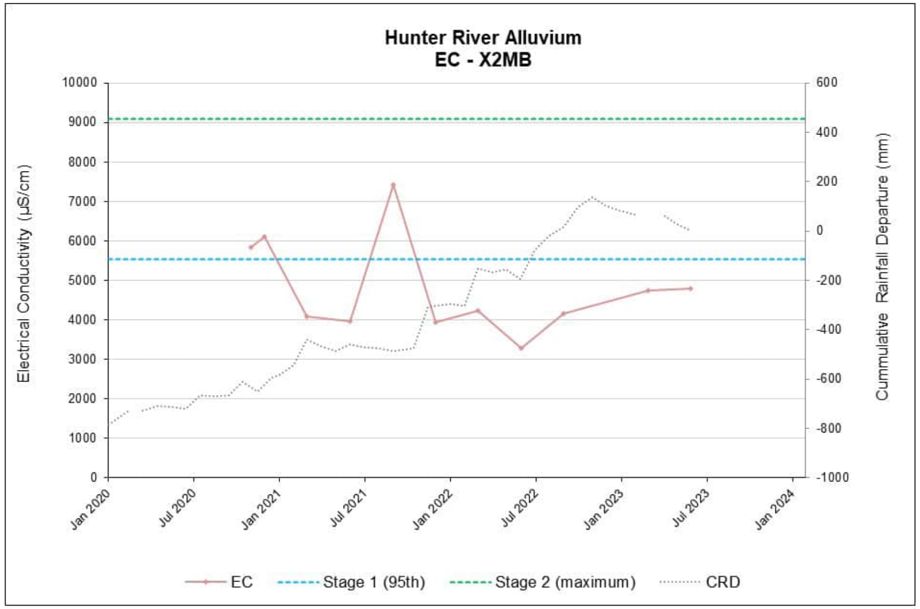




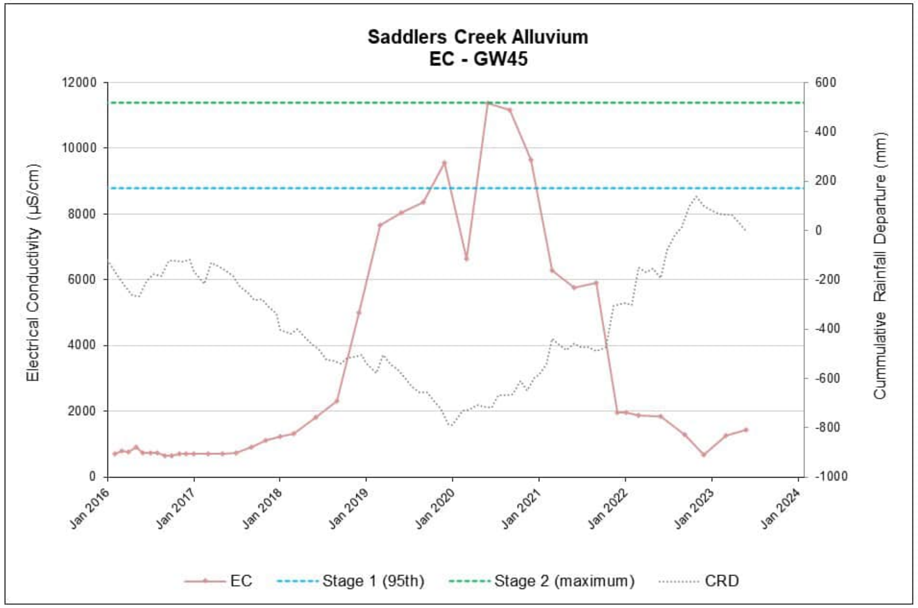




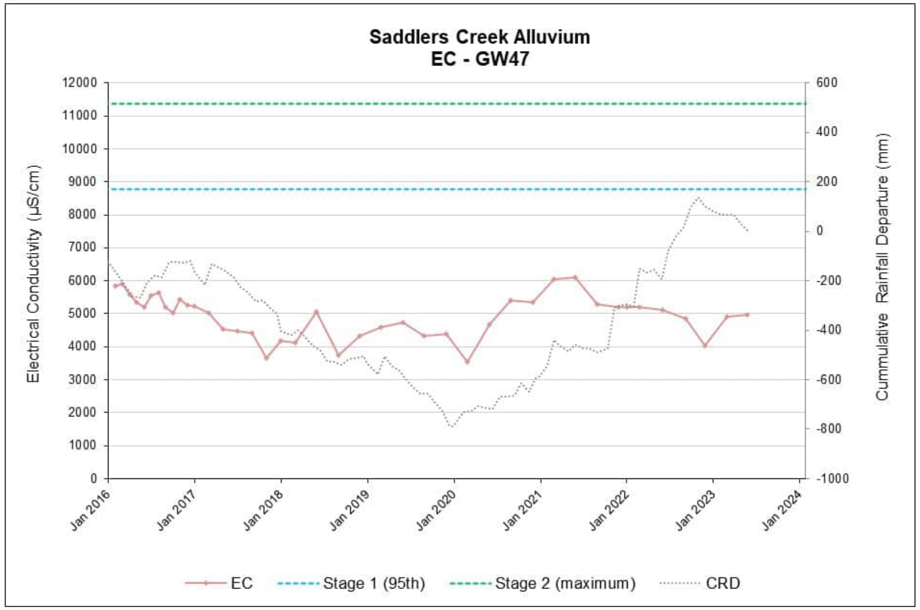
Hunter River Alluvium
EC - X1MB
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD



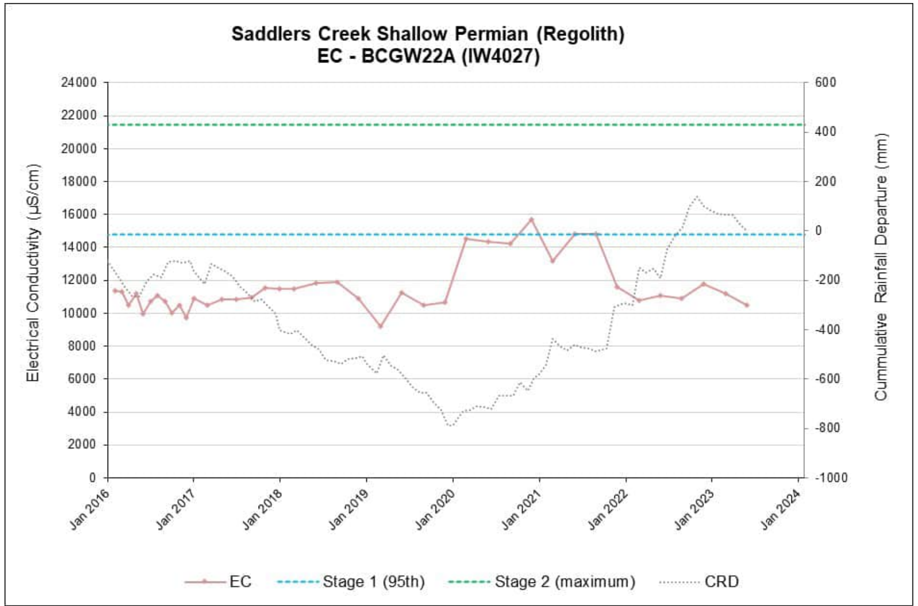
Hunter River Alluvium
EC - X2MB
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

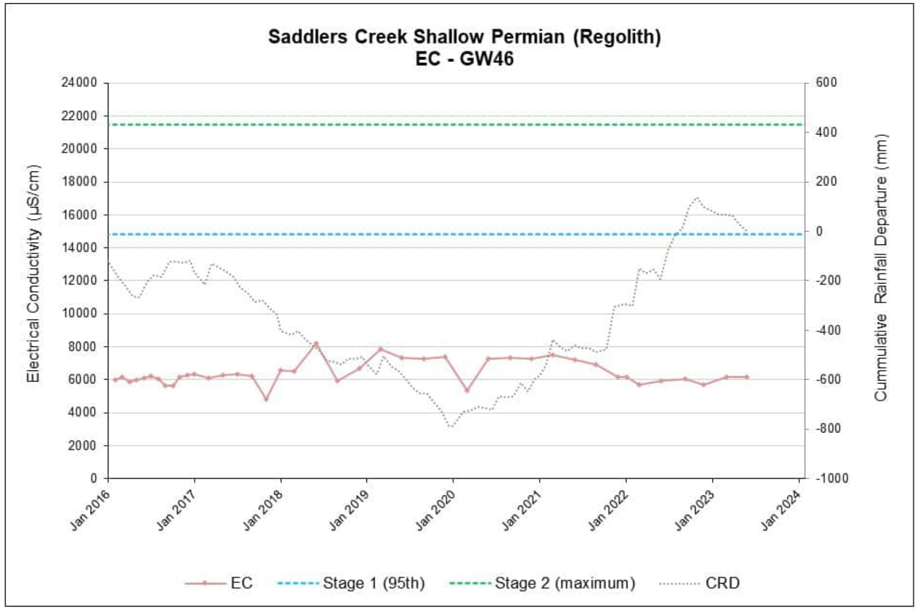


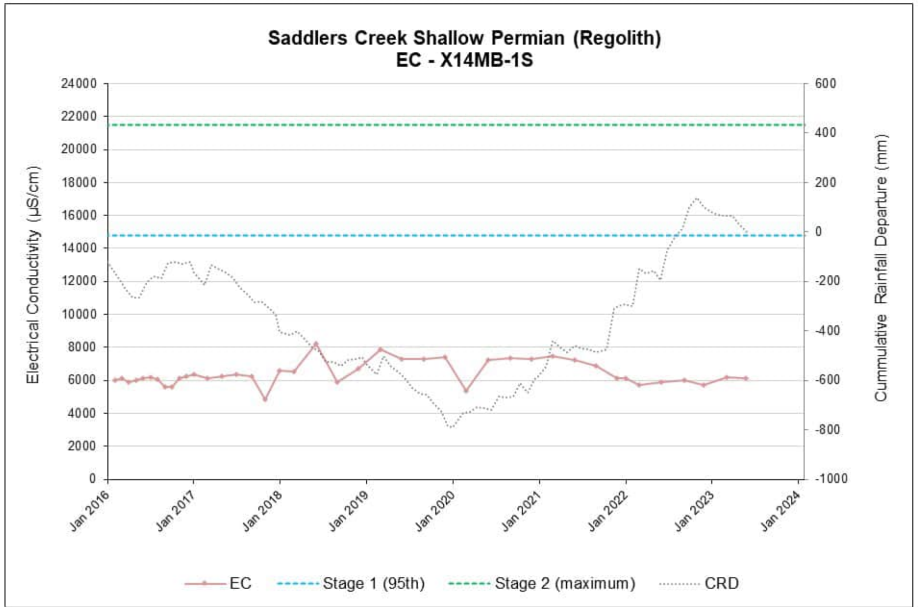
Saddlers Creek Alluvium
EC - GW45
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

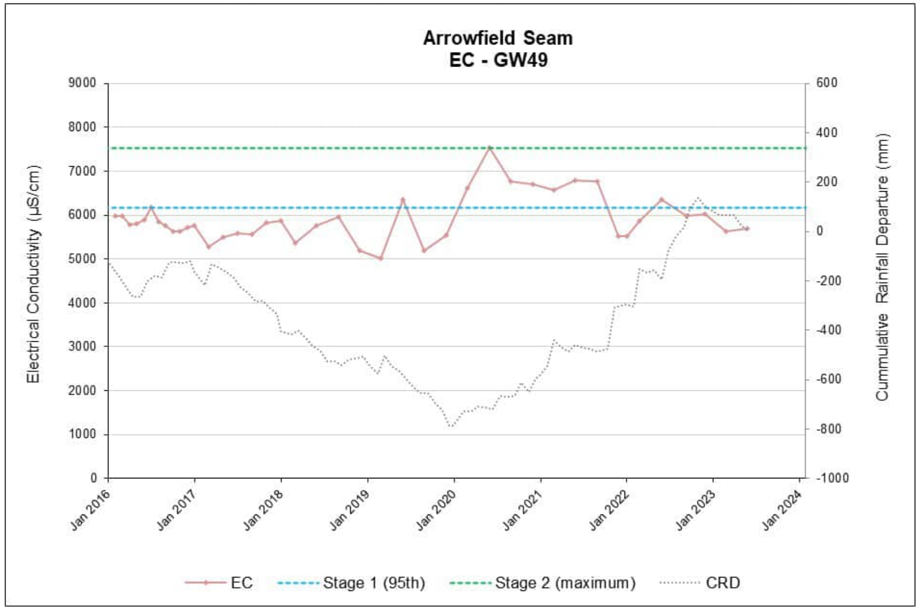


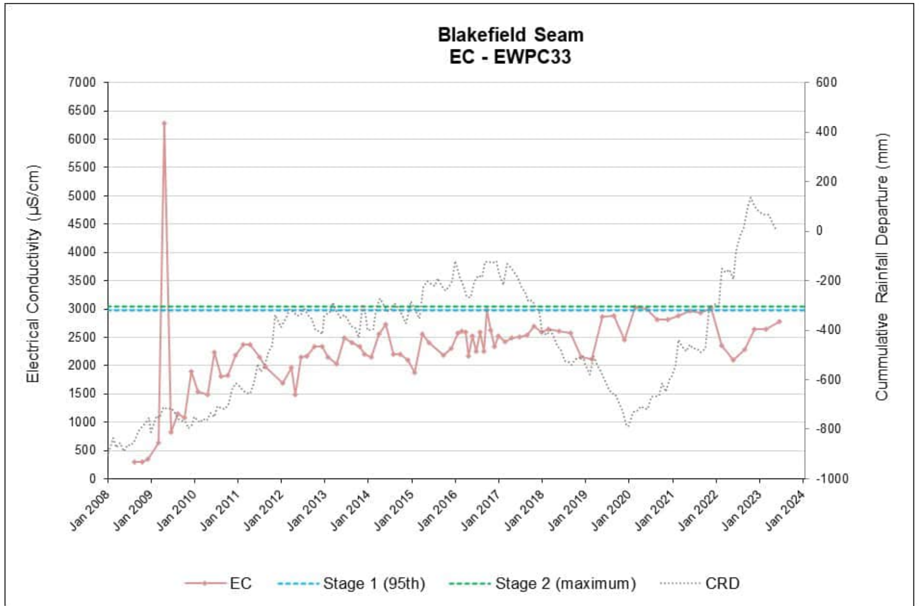
Saddlers Creek Alluvium
EC - GW47
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

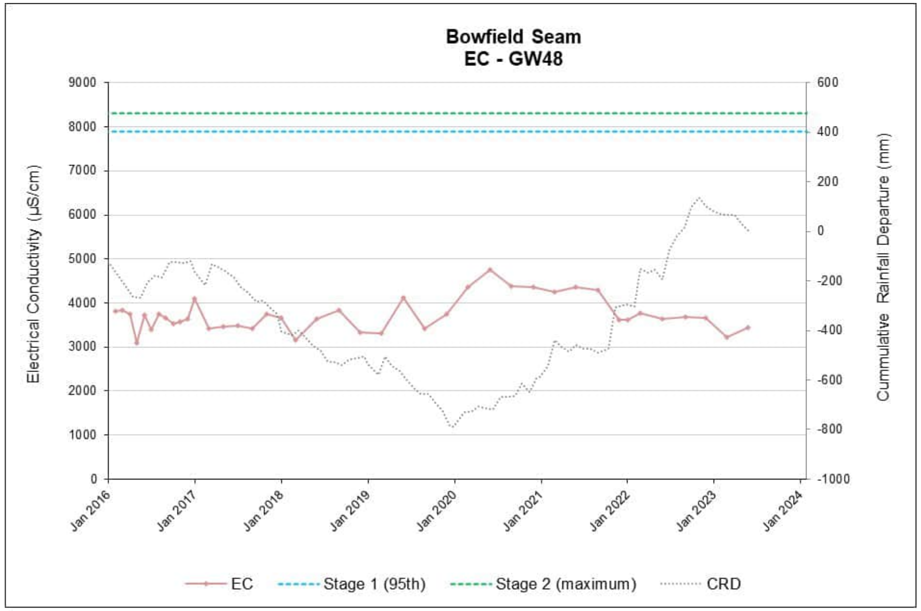

Saddlers Creek Shallow Permian (Regolith)
EC - BCGW22A (IW4027)
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Saddlers Creek Shallow Permian (Regolith)
EC - GW46
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

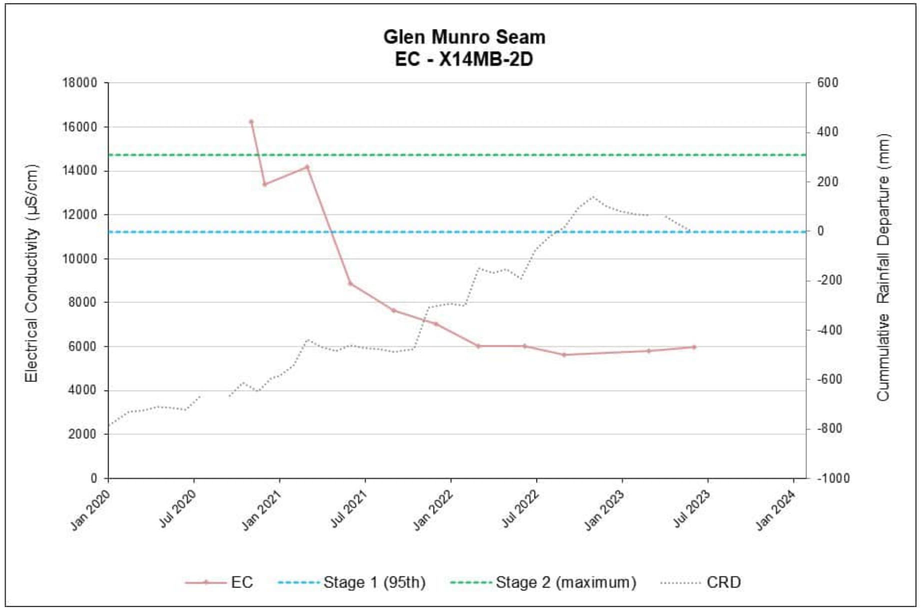

Saddlers Creek Shallow Permian (Regolith)
EC - X14MB-1S
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

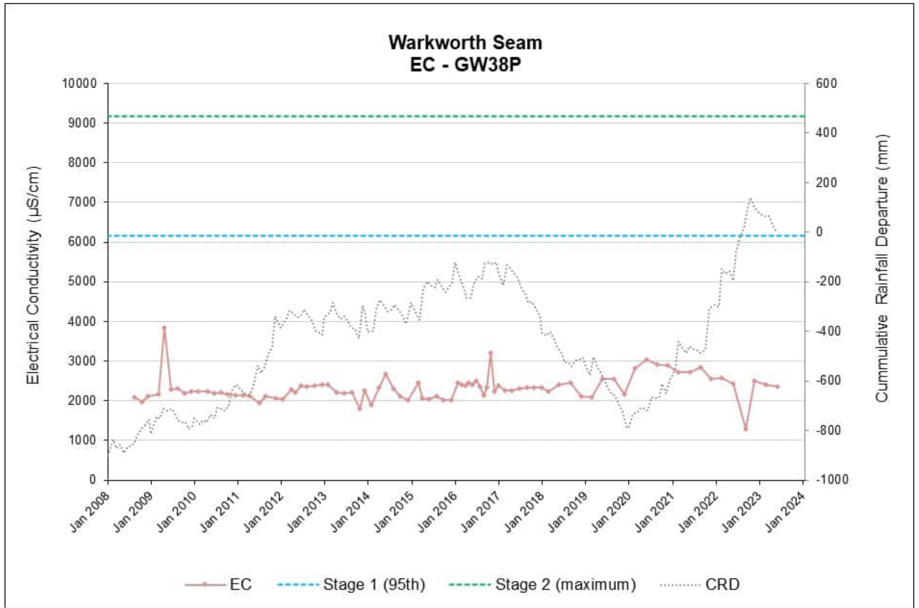

Arrowfield Seam
EC - GW49
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

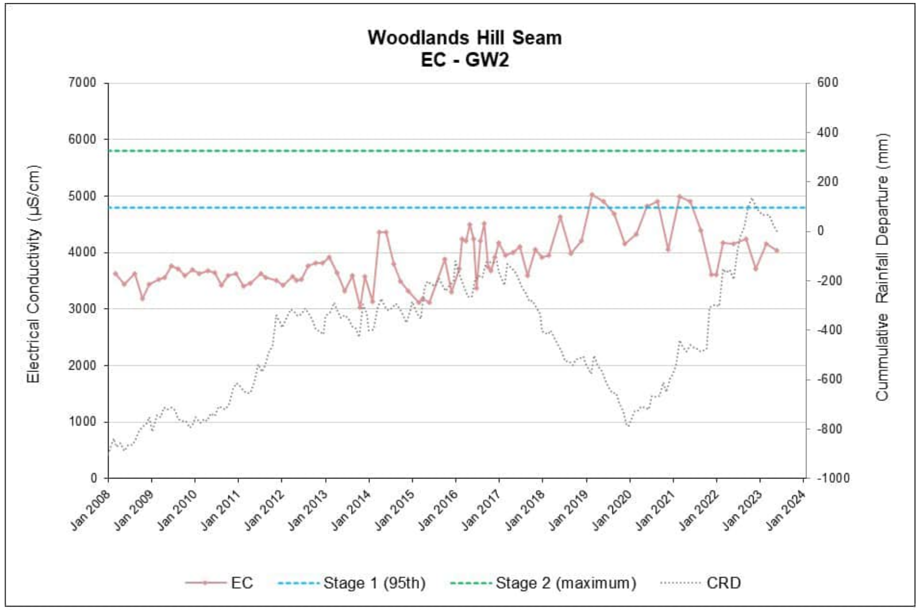

Blakefield Seam
EC - EWPC33
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

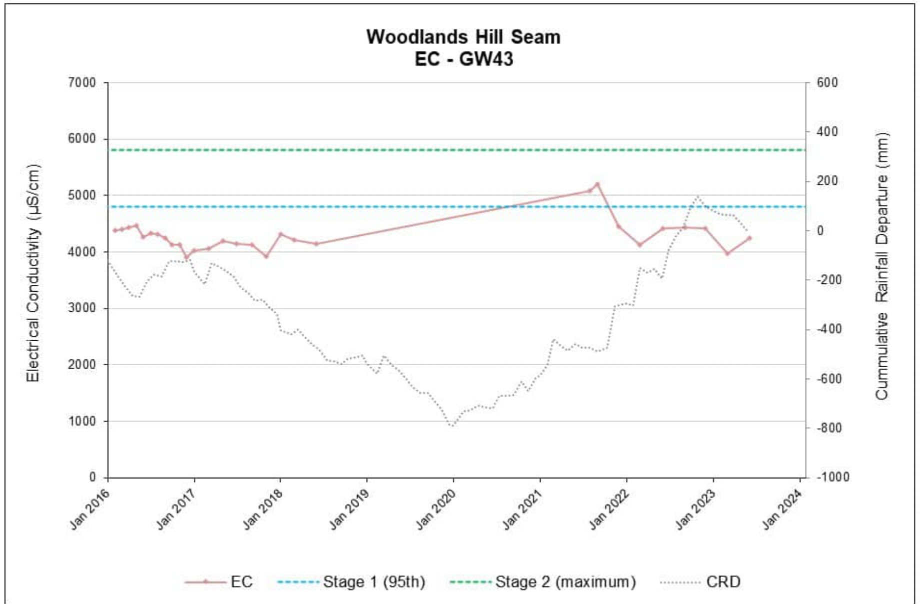

Bowfield Seam
EC - GW48
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Glen Munro Seam
EC - X10MB
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Glen Munro Seam
EC - X14MB-2D
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Warkworth Seam
EC - GW38P
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Woodlands Hill Seam
EC - GW2
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD


Woodlands Hill Seam
EC - GW43
Electrical Conductivity (µS/cm)
Cummulative Rainfall Departure (mm)
EC
Stage 1 (95th)
Stage 2 (maximum)
CRD

Environmental & Social
Consultants

Umwelt (Australia) Pty Limited

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Appendix 3 Community Complaints

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
1	July	20/07/2022	6.39pm	Roxburgh Road	Light	Community Response Line	Complaint not received due to a fault from the phone line carrier not notifying the production number. Rectified now and tested.
2		20/07/2022	10.50pm	Roxburgh Road	Light	Community Response Line	Investigation revealed location of stationary lights, which was switched off to the resident's satisfaction.
3		26/07/2022	6:49pm	Roxburgh Road	Light	Community Response Line	Several lights were altered to mitigate impacts to the complainant's satisfaction.
4		28/07/2022	10:04am	Denman Road	Blast Vibration	Community Response Line	Blast results were in line with our approval.
5	August	03/08/2022	10:15am	Racecourse Road/Sheppard Avenue	Blast	Community Response Line	Investigations revealed that BHP did not blast at this time on this day.
6		07/08/2022	12:41pm	Denman Road	Blast Vibration	Community Response Line	Investigation revealed that caller was calling about historical blasts and not one that had occurred that day. BHP encouraged caller to always call the community response line when impacts occur so they can be identified and mitigated.
7		07/08/2022	12:43pm	Denman Road	Blast Dust	Community Response Line	Investigation revealed that caller was calling about historical blasts and dusts - not one that had occurred that day. BHP encouraged caller to always call the community response line when impacts occur so they can be identified and mitigated.

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
8		07/08/2022	12:44pm	Denman Road	Other	Community Response Line	Investigation revealed that caller was calling about historical impacts from operations. BHP encouraged caller to always call the community response line when impacts occur so they can be identified and mitigated straight away.
9		25/08/2022	11.17PM	Roxburgh Road	Noise	Community Response Line	Investigation revealed that there was no noise exceedances reported during the complaint window.
10		31/08/2022	7.04pm	Roxburgh Road	Light	Community Response Line	Lighting moved to the satisfaction of the complainant.
11	September	15/09/2022	8.09pm	Declined	Light	Community Response Line	Relocated lighting to the satisfaction of the complainant
12	October	04/10/2022	10.01AM	Denman Road	Grader works	Community Response Line	Residents concern around gravel was addressed to the satisfaction of the resident
13		14/10/2022	2.23PM	Denman Road	Blast vibration	Community Response Line	Investigation revealed the blast was within the limits.
14		28/10/2022	7.50AM	Jerrys Plains	Lighting	Community Response Line	Lighting adjusted in response to the call.
15		31/10/2022	11.42AM	Glen Munro Road	Noise	Community Response Line	Investigation revealed the blast was within the limits.

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
16		31/10/2022	11.49AM	Roxburgh Road	Blast vibration	Community Response Line	Investigation revealed the blast was within the limits.
17		31/10/2022	11.49AM	Denman Road	Blast vibration	Community Response Line	Investigation revealed the blast was within the limits.
18	November	06/11/2022	8.04PM	Roxburgh Road	Lighting	Community Response Line	Lighting adjusted to the satisfaction of resident.
19		7/11/2022	6.23AM	Roxburgh Rd	Dust	Community Response Line	Investigations revealed no abnormal dust levels.
20		10/11/2022	10.11AM	Denman Road	Lighting	Community Response Line	Lighting adjusted in response to the call.
21		26/11/2022	8.54AM	Roxburgh Road	Dust	Community Response Line	Results at the nearest monitor indicated 24-hour average dust levels remained within regulatory criteria. Resident notified of investigation.
22		6/01/2023	9.29PM	Roxburgh Rd	Lighting	Community Response Line	*Lighting adjusted in response to the call.*

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
23	January	12/01/2023	10.11am	Anonoymus	Spontaneous Combustion	Regulator	Investigation completed in response to the complaint.
24		14/01/2023	9.56pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
25		15/01/2023	10.01pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
26		16/01/2023	9.52pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call
27		26/01/2023	10.19am	Other	Debris	Community Response Line	Investigation completed to the resident’s satisfaction.
28	February	4/02/2023	9.37pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
29		11/02/2023	9.12pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
30		24/02/2023	1.09AM	Roxburgh Rd, Muswellbrook	Operational Noise	Community Response Line	Nearest real-time monitor did not record any exceedances or distribute any alerts, Caller was advised of investigation and monitoring results.

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
31		27/02/2023	11.40am	Roxburgh Rd, Muswellbrook	Other	Community Response Line	BHP continues to engage with caller on this matter.
32	March	4/03/2023	9.11pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
33		7/03/2023	10.03am	Denman Rd, Muswellbrook	Blast vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
34		10/03/2023	2.58am	Roxburgh Rd, Muswellbrook	Operational noise	Community Response Line	Investigation revealed no unusual mining operations were occurring at the time. Results at the nearest real-time monitor indicated noise levels were within regulatory criteria. Caller was advised of investigation and monitoring results.
35		10/03//2023	8.47pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
36		13/03/2023	11.10am	Roxburgh Rd, Muswellbrook	Dust	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24-hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
37	April	10/04/2023	8.41pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
38		12/04/2023	9.18am	Denman Rd, Muswellbrook	Blast Vibration	Community Response Line	Investigation revealed ground vibration levels were within regulatory criteria. Caller was advised of investigation and results.
39		20/04/2023	9.38pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
40	May	2/05/2023	9.02pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
41		3/05/2023	6.49pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
42		4/05/2023	1.40pm	Racecourse Rd, Muswellbrook	Blast Vibration	Community Response Line	Investigation revealed blast was from a neighbouring mine.
43		6/05/2023	8.06pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
44		12/05/2023	11.56am	Roxburgh Rd, Muswellbrook	Blast Vibration	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results indicated overpressure noise and ground vibration levels were within regulatory criteria. Caller was advised of investigation and monitoring results.

Number	Month	Date	Time	From	Issue	Lodgement type	Investigation and response to caller
45	June	5/06/2023	2.03pm	Denman Rd, Muswellbrook	Blast dust	Community Response Line	Investigation revealed weather conditions were suitable for blasting at the time. Results at the nearest monitor indicated dust levels were not elevated at the time, and the 24-hour average remained within regulatory criteria. Caller was advised of investigation and monitoring results.
46		7/06/2023	5.46pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
47		8/06/2023	5.48pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
48		28/06/2023	6.08pm	Roxburgh Rd, Muswellbrook	Lighting	Community Response Line	Lighting adjusted in response to the call.
49		30/06/2023	6.30pm	Other	Lighting	Community Response Line	Investigation revealed Thiess operations at MAC South were the cause of the issue. MAC OCE worked with Thiess to have lighting adjusted in response to the call.

Appendix 4 Annual Coal Transport Report FY23

Mt Arthur Coal

Annual Coal Transport Report FY23

This report has been prepared in accordance with Schedule 3 Condition 46 of Project Approval 09_0062 MOD 1:

Monitoring of Coal Transport
46. The Proponent shall keep records of the: (a) amount of coal transported from the site in each financial year; (b) number of coal haulage train movements generated by the Mt Arthur mine complex (on a daily basis); and (c) make these records available on its website at the end of each financial year.

For the 12 month period ending 30 June 2023:

- 13.716 million tonnes of export product coal was transported by rail to the Port of Newcastle. This is compliant with Schedule 2 Condition 7(a) of Project Approval 09_0062 MOD 1, which restricts Mt Arthur Coal's coal transport on the Antiene rail spur to a maximum of 27 million tonnes of product coal in a financial year;
- 200,255 metric tonnes of domestic product coal was transported by rail to the Eraring Power Station and Vales Point Power Station. This is compliant with Schedule 2 Condition 7(a) of Project Approval 09_0062 MOD 1, which restricts Mt Arthur Coal's coal transport on the Antiene rail spur to a maximum of 27 million tonnes of product coal in a financial year;
- The total number of train movements was 3,206; and
- The maximum number of train movements in a single day was 20. This is compliant with Schedule 2 Condition 7(b) of Project Approval 09_0062 MOD 1, which restricts Mt Arthur Coal's coal transport on the Antiene rail spur to a maximum of 30 train movements a day.

Date	No. of train movements
1/07/2022	0
2/07/2022	0
3/07/2022	0
4/07/2022	0
5/07/2022	0
6/07/2022	0
7/07/2022	0
8/07/2022	0
9/07/2022	0
10/07/2022	0
11/07/2022	0
12/07/2022	0
13/07/2022	0
14/07/2022	0
15/07/2022	0
16/07/2022	0
17/07/2022	0
18/07/2022	10
19/07/2022	14
20/07/2022	6
21/07/2022	12
22/07/2022	6
23/07/2022	16
24/07/2022	8
25/07/2022	12
26/07/2022	10
27/07/2022	8

Date	No. of train movements
28/07/2022	12
29/07/2022	6
30/07/2022	6
31/07/2022	0
1/08/2022	0
2/08/2022	0
3/08/2022	8
4/08/2022	6
5/08/2022	4
6/08/2022	0
7/08/2022	0
8/08/2022	10
9/08/2022	4
10/08/2022	4
11/08/2022	4
12/08/2022	16
13/08/2022	10
14/08/2022	0
15/08/2022	4
16/08/2022	10
17/08/2022	6
18/08/2022	6
19/08/2022	12
20/08/2022	12
21/08/2022	12
22/08/2022	10
23/08/2022	12

Date	No. of train movements
24/08/2022	10
25/08/2022	8
26/08/2022	8
27/08/2022	10
28/08/2022	8
29/08/2022	12
30/08/2022	16
31/08/2022	16
1/09/2022	14
2/09/2022	12
3/09/2022	6
4/09/2022	14
5/09/2022	10
6/09/2022	10
7/09/2022	10
8/09/2022	10
9/09/2022	8
10/09/2022	0
11/09/2022	0
12/09/2022	0
13/09/2022	6
14/09/2022	8
15/09/2022	6
16/09/2022	8
17/09/2022	2
18/09/2022	12
19/09/2022	10

Date	No. of train movements
20/09/2022	8
21/09/2022	2
22/09/2022	10
23/09/2022	6
24/09/2022	0
25/09/2022	0
26/09/2022	0
27/09/2022	6
28/09/2022	4
29/09/2022	2
30/09/2022	6
1/10/2022	6
2/10/2022	4
3/10/2022	6
4/10/2022	8
5/10/2022	0
6/10/2022	0
7/10/2022	0
8/10/2022	2
9/10/2022	6
10/10/2022	14
11/10/2022	12
12/10/2022	12
13/10/2022	10
14/10/2022	12
15/10/2022	8
16/10/2022	8

Date	No. of train movements
17/10/2022	8
18/10/2022	8
19/10/2022	10
20/10/2022	2
21/10/2022	8
22/10/2022	8
23/10/2022	4
24/10/2022	6
25/10/2022	10
26/10/2022	6
27/10/2022	8
28/10/2022	4
29/10/2022	6
30/10/2022	2
31/10/2022	0
1/11/2022	0
2/11/2022	8
3/11/2022	4
4/11/2022	16
5/11/2022	14
6/11/2022	12
7/11/2022	8
8/11/2022	4
9/11/2022	0
10/11/2022	0
11/11/2022	0
12/11/2022	0

Date	No. of train movements
13/11/2022	0
14/11/2022	0
15/11/2022	0
16/11/2022	0
17/11/2022	0
18/11/2022	4
19/11/2022	12
20/11/2022	10
21/11/2022	12
22/11/2022	6
23/11/2022	0
24/11/2022	0
25/11/2022	4
26/11/2022	14
27/11/2022	12
28/11/2022	10
29/11/2022	12
30/11/2022	12
1/12/2022	10
2/12/2022	14
3/12/2022	12
4/12/2022	14
5/12/2022	12
6/12/2022	16
7/12/2022	10
8/12/2022	12
9/12/2022	8

Date	No. of train movements
10/12/2022	14
11/12/2022	12
12/12/2022	12
13/12/2022	6
14/12/2022	10
15/12/2022	6
16/12/2022	8
17/12/2022	10
18/12/2022	14
19/12/2022	8
20/12/2022	8
21/12/2022	8
22/12/2022	12
23/12/2022	6
24/12/2022	6
25/12/2022	0
26/12/2022	0
27/12/2022	2
28/12/2022	14
29/12/2022	6
30/12/2022	12
31/12/2022	2
1/01/2023	0
2/01/2023	0
3/01/2023	4
4/01/2023	10
5/01/2023	10

Date	No. of train movements
6/01/2023	10
7/01/2023	12
8/01/2023	8
9/01/2023	10
10/01/2023	8
11/01/2023	2
12/01/2023	6
13/01/2023	8
14/01/2023	4
15/01/2023	0
16/01/2023	0
17/01/2023	0
18/01/2023	8
19/01/2023	8
20/01/2023	18
21/01/2023	10
22/01/2023	8
23/01/2023	10
24/01/2023	14
25/01/2023	16
26/01/2023	12
27/01/2023	12
28/01/2023	16
29/01/2023	10
30/01/2023	14
31/01/2023	6
1/02/2023	10

Date	No. of train movements
2/02/2023	10
3/02/2023	6
4/02/2023	6
5/02/2023	14
6/02/2023	8
7/02/2023	0
8/02/2023	0
9/02/2023	0
10/02/2023	4
11/02/2023	2
12/02/2023	10
13/02/2023	10
14/02/2023	10
15/02/2023	12
16/02/2023	12
17/02/2023	10
18/02/2023	6
19/02/2023	10
20/02/2023	10
21/02/2023	14
22/02/2023	12
23/02/2023	14
24/02/2023	16
25/02/2023	14
26/02/2023	18
27/02/2023	12
28/02/2023	10

Date	No. of train movements
1/03/2023	12
2/03/2023	10
3/03/2023	12
4/03/2023	0
5/03/2023	10
6/03/2023	4
7/03/2023	14
8/03/2023	8
9/03/2023	12
10/03/2023	8
11/03/2023	8
12/03/2023	2
13/03/2023	6
14/03/2023	4
15/03/2023	6
16/03/2023	16
17/03/2023	16
18/03/2023	10
19/03/2023	14
20/03/2023	12
21/03/2023	10
22/03/2023	8
23/03/2023	4
24/03/2023	14
25/03/2023	14
26/03/2023	18
27/03/2023	16

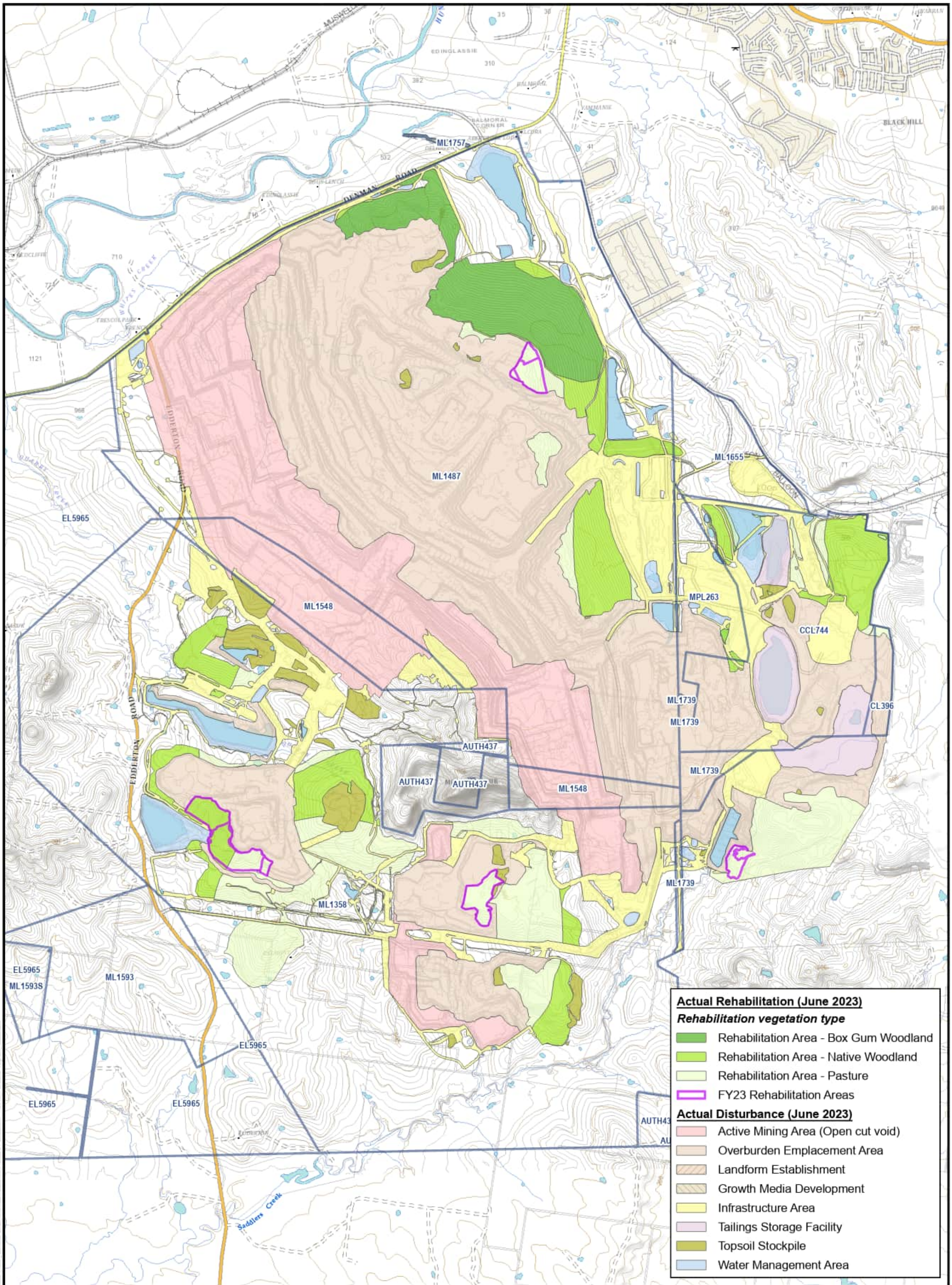
Date	No. of train movements
28/03/2023	12
29/03/2023	18
30/03/2023	4
31/03/2023	12
1/04/2023	20
2/04/2023	16
3/04/2023	16
4/04/2023	0
5/04/2023	2
6/04/2023	0
7/04/2023	14
8/04/2023	14
9/04/2023	18
10/04/2023	14
11/04/2023	20
12/04/2023	12
13/04/2023	16
14/04/2023	16
15/04/2023	18
16/04/2023	18
17/04/2023	10
18/04/2023	10
19/04/2023	14
20/04/2023	10
21/04/2023	14
22/04/2023	16
23/04/2023	20

Date	No. of train movements
24/04/2023	16
25/04/2023	20
26/04/2023	14
27/04/2023	16
28/04/2023	18
29/04/2023	12
30/04/2023	10
1/05/2023	10
2/05/2023	14
3/05/2023	12
4/05/2023	12
5/05/2023	12
6/05/2023	14
7/05/2023	12
8/05/2023	6
9/05/2023	4
10/05/2023	8
11/05/2023	14
12/05/2023	16
13/05/2023	16
14/05/2023	10
15/05/2023	14
16/05/2023	10
17/05/2023	12
18/05/2023	18
19/05/2023	14
20/05/2023	16

Date	No. of train movements
21/05/2023	12
22/05/2023	14
23/05/2023	6
24/05/2023	0
25/05/2023	0
26/05/2023	4
27/05/2023	14
28/05/2023	12
29/05/2023	16
30/05/2023	14
31/05/2023	12
1/06/2023	12
2/06/2023	10
3/06/2023	12
4/06/2023	12
5/06/2023	14
6/06/2023	10
7/06/2023	16
8/06/2023	14
9/06/2023	12
10/06/2023	12
11/06/2023	14
12/06/2023	12
13/06/2023	14
14/06/2023	14
15/06/2023	20
16/06/2023	10

Date	No. of train movements
17/06/2023	14
18/06/2023	12
19/06/2023	10
20/06/2023	14
21/06/2023	14
22/06/2023	8
23/06/2023	16
24/06/2023	14
25/06/2023	20
26/06/2023	18
27/06/2023	14
28/06/2023	16
29/06/2023	14
30/06/2023	16
Total	**3206**
Maximum daily train movements	**20**
Note: Each train entering and exiting the site is classified as two train movements and a day refers to the 24 hours from midnight to midnight the next day	

Appendix 5 Rehabilitation Plan & and Monitoring Results



BHP

Mapping Services Brisbane

Transverse Mercator Projection.
MGA Zone 56. GDA2020 Datum.

MOUNT ARTHUR COAL

Annual Review - Rehabilitation Plan

Drawn: B. Kleinschmidt	Checked: C. Christensen	Date: 22/08/2023	Version: 1	Appen. 5

TECHNICAL MEMORANDUM

DATE 12.04.2023 **Project No.** PS128697

TO

CC gareth.simpson@wsp.com

FROM Chris Waygood, Sven Dressler, Peter Targett **EMAIL** **christopher.waygood@wsp.com**

MOUNT ARTHUR COLLIERY (MAC): EROSION QUANTIFICATION AND REVIEW OF AREAS REHABILITATED AREAS BY 2022

1.0 SYNOPSIS

WSP Golder has undertaken a desktop assessment of the erosional performance of the rehabilitated landforms at MAC. The methodology uses high density LiDAR and innovative scripting allowing the movement of water to be modelled and erosion to be quantified, both in terms of erosion rates and the depth and length of rills.

The depth and length of rilling then allows a classification of erosion into categories. The assessment found the following:

- 97.3 per cent of the rehabilitation is performing well - only ongoing monitoring is required.
- 2.5 per cent of the area is of slight concern - targeted monitoring is required.
- 0.2 per cent is of concern - qualified persons are required to assess actions and prioritise.

The erosion rates computed can also indicate the erosional trajectory, that is, the change in erosion rates with time. The outcomes have indicated a clear trajectory in most areas from rates of around 20t/ha/year in the first few years, reducing to less than 10t/ha/year by year 3 post rehabilitation, and less than 5t/ha/year 6 years after rehabilitation.

Using the above targets, the site has been categorised as shown in Figure 1.1. This indicates that most of the site is trending towards the long term targets for MAC, with just two areas slightly above required values.

These outcomes suggest that MAC is likely to achieve the long term target erosion rates of less than 5t/ha/year provided the relatively localised problem areas are addressed.

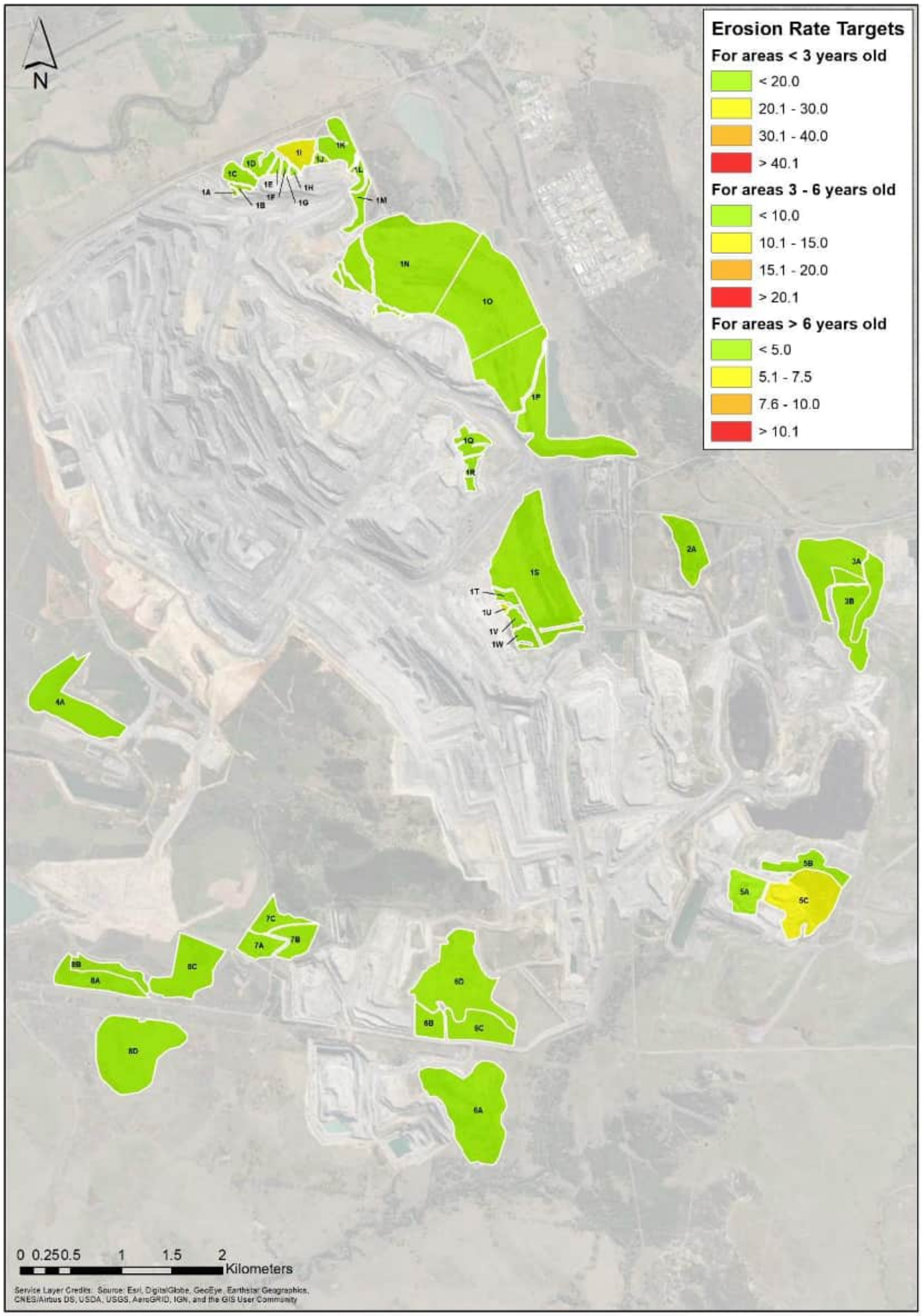


Figure 1.1 - Overall erosion rates compared to the targets for different ages of the rehabilitation

2.0 INTRODUCTION

MAC is an open cut coal mine in the Hunter Valley, and is the largest open cut in New South Wales (NSW). The landforms at MAC in NSW have been constructed using a range of methods, including traditional and (from 2016) geomorphic landforms.

WSP Golder was appointed in 2022 to undertake a desktop assessment of the erosional performance of the landforms. The methodology developed by WSP Golder uses high density LiDAR (twenty points per m^2) and models the movement of water across the surface. The method allows the depth and length of rills associated with scour to be identified by the software, and quantified. From the outputs, MAC is able to assess the rates of erosion since last assessed, and identify rilling that requires intervention. As this is the first such assessment, the erosion rates determined are the average since rehabilitation.

The depth and length of rilling then allows a classification of erosion into categories, typically:

- Areas that are performing well and only ongoing monitoring is required.
- Areas of slight concern that require targeted monitoring.
- Areas of concern where qualified persons assess required actions and prioritise.

The erosion rates computed also indicate the erosional trajectory, that is, the change in erosion rates with time. In the long term this is important to be able to demonstrate long term stability, particularly as rehabilitated surfaces tend to erode at higher rates immediately after construction when vegetation cover is sparse, reducing with time. The outcomes can also flags areas that are not trending towards the target erosion rates.

This work will then be ground truthed, focussing on key areas requiring future action. The desktop assessment also helping to guide future fieldwork - the LiDAR survey penetrates vegetation which can highlight issues that are difficult to spot in the areas of dense vegetation.

The areas included in this project’s scope were supplied by MAC, together with the LiDAR survey (Figure 2.1).

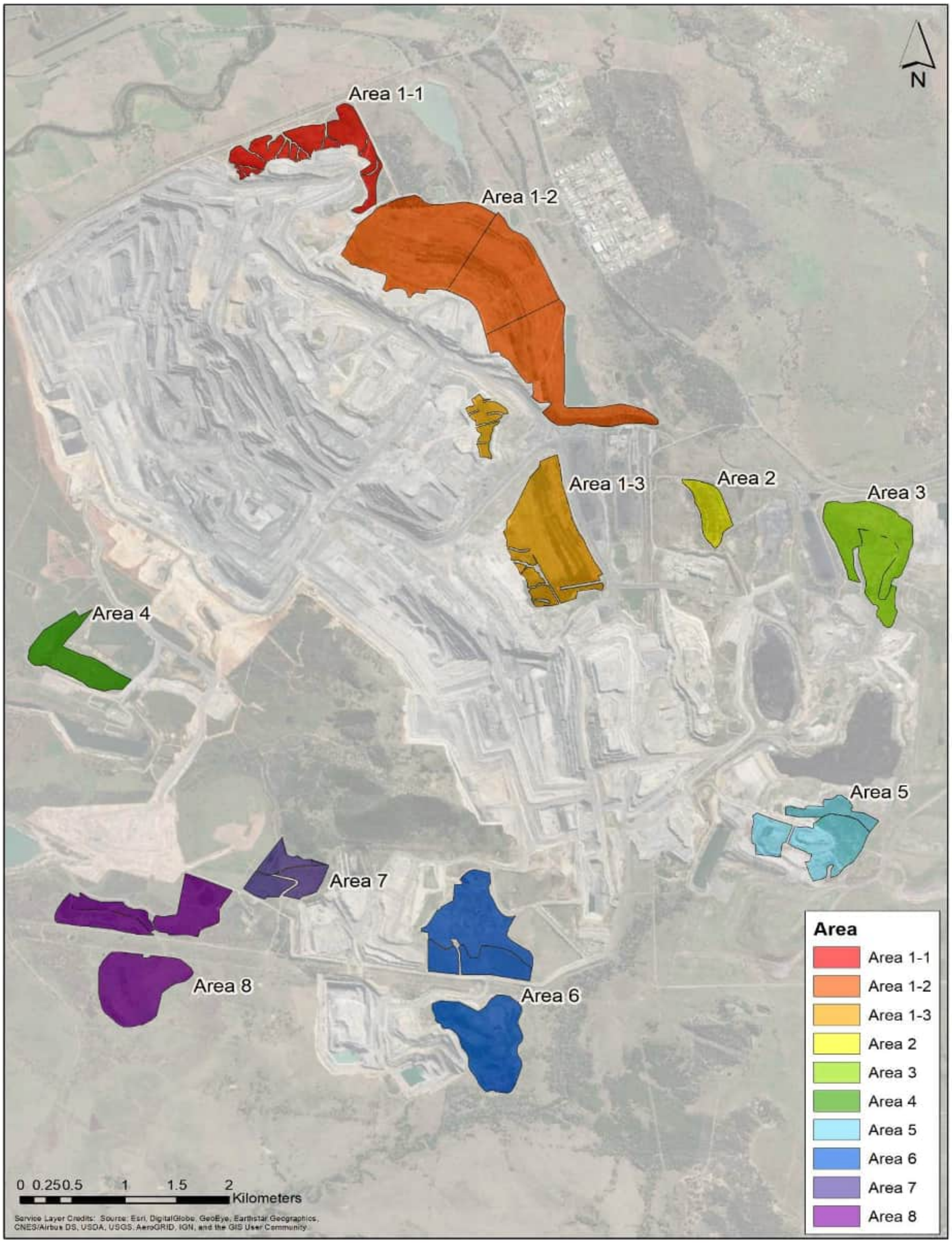


Figure 2.1: Ten areas within MAC included in the erosion quantification and review assessment.

3.0 METHODOLOGY

3.1 Overview

There are several different ways erosion can be quantified. Traditionally the work was undertaken by reviewing aerial surveys and then undertaking field inspections based on rilling observed on the aerial surveys. While the approach was reasonable based on the technology available, it has two fundamental limitations. Firstly, erosion rates could not be quantified. Secondly, this methodology worked better for areas with poor vegetation cover where rills could be more readily identified. Sparsely vegetated areas tend to have higher erosion rates. But significant erosion in vegetated areas can be easily missed.

Using LiDAR to obtain detailed surveys has provided an opportunity to identify and monitor erosion more systematically. The survey can penetrate vegetation by taking readings at different angles. This allows the quantification of changes in the landform between LiDAR surveys.

The determination of erosion rates is complex. For example, changes in the elevation of a typical ground surface can be determined by comparing two LiDAR surveys taken on different dates for that location. However, in the mining environment, changes occur for many reasons other than erosion, including:

- Overburden settles, and the rate of settlement varies with time and by area, depending on when the material was placed and whether the water table has been reestablished after mining.
- Changes can occur due to mechanical equipment, temporary construction, or animal activity.

One approach to address these potential complications is to use machine learning. Computers are 'taught' to recognise changes due to water erosion rather than settlement or disturbance. The process can be costly and requires repetitive verification of the machine learning performance until greater confidence is achieved.

WSP initially considered the above methods, as well as the use of area/slope relationship methods to indentify areas of erosion risk and allow only these areas to be evaluated. However we found that a simpler and more theoretically correct approach was to follow the flow of water on a surface, and then to focus on the higher energy flows that cause erosion. The advantage of this approach is that it only needs one LiDAR surface to identify erosion. The premise is that provided a sufficient volume of rainfall is simulated onto the surface, the rills will fill with water and spill onto the adjacent wider surface. Once flow spills onto the surface, the flow depth remains relatively constant due to the extensive surface area compared to the rill size. Once all the rills have filled with water, the water depth at the rill location approximates the rill depth. The length of any rill can be quantified from the flow path.

Because a flow model is used to identify flow paths, vegetation in the survey can lead to unexpected flow concentrations since the model assumes these are barriers to flow. While LiDAR is able to penetrate some vegetation, thicker vegetation can be retained in the survey and act as a barrier to flow. For this reason, a DTM must be generated. Visually it is relatively easy to identify where vegetation remains in the survey and then to have these areas re-assessed. This can be achieved through desktop investigation of satellite imagery, or groundtruthing.

3.2 Survey

The rehabilitated landform was assessed using high-density LiDAR (20 points/m^2) as a Digital Terrain Model (DTM) with a vertical accuracy of <50 mm (95% confidence). The relative difference in elevation is more important than the absolute elevation.

There is a trade-off between the survey density and the outputs' accuracy. Having 20 points/m^2 implies an average spacing of between 200 mm to 250 mm across the terrain. This survey density may result in small rill features not being identified. However, we have reviewed the optimal density as part of this work and compared the outputs with aerial and ground surveys, and the capturing of the rills is very good even at this density of survey and appears to be fit for purpose. The ground truthing will be used to validate this statement.

The survey was reviewed for any evident vegetation in the final DTM, with an example of the surface outputs shown in (Figure 3.1). The survey for all the sites is included in the APPENDIX A.

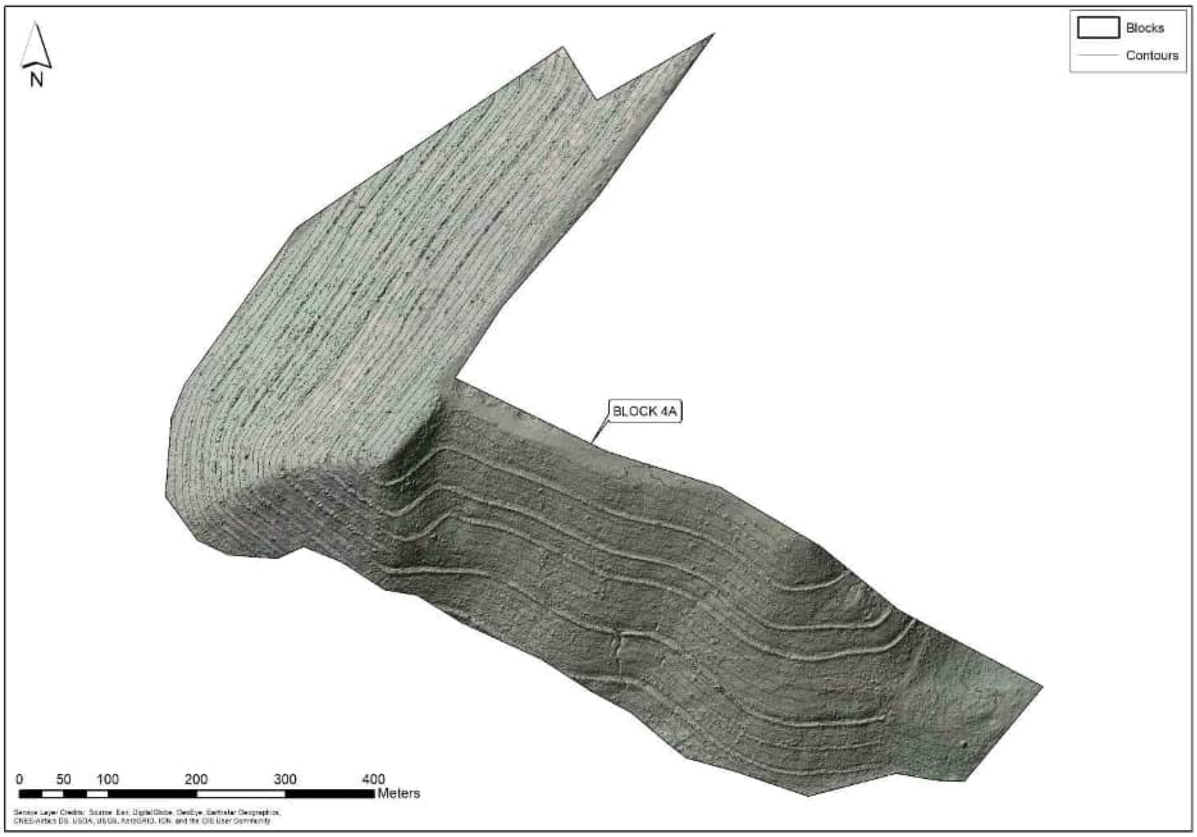


Figure 3.1: DTM of Area 4 - current survey.

3.3 Modelling of flows to quantify rills and erosion

Lisflood (Bates, et al., 2010)(Bates, et al., 2010)(Bates, et al., 2010)~~(Bates, et al., 2010)~~~~(Bates, et al., 2010)~~ was used to simulate a significant rainfall event and model the flow and resultant rilling across the surface. The Lisflood model is a grid-based flow routing model which is also used in the CAESAR-LISFLOOD Landscape Evolution Model (LEM). This model is used widely internationally.

A high rainfall intensity is then applied to the surface to fill all of the rills with runoff. The rainfall event used is not relevant to a particular storm or recurrence interval, but needs only to be sufficient to fill the rills. The Lisflood model used 33mm of rain in 10mins (200 mm/hr) with a high surface roughness to quantify the erosion features. The high roughness helps to ensure the rills are completely filled with water.

The rill depths and lengths were then computed from flow depth, with length assessed by iterative uphill searching to locate the highest point within a particular rill, and then following the flow to the bottom of the rill while recording length of travel.

The modelling outputs flow depths, velocities, and tractive stresses[1]. Water depths that are not related to rilling need to be excluded. These are generally the areas with lower flow velocities and tractive stresses. The following have been excluded from the model:

- Areas where water is ponding but not flowing.

  While the depth of the flow map can highlight areas of risk where water is ponding with potential risks associated with overtopping or overspilling, these are not relevant to the erosion quantification and are excluded from the assessment.

- Areas where flow velocities are low.

  Areas such as contour banks have flow, but with velocities that are low and are not eroding. Typically, anything low flow velocities are excluded from being a low erosion risk.

Based on a visual assessment of the outputs, there is a need to exclude some areas that the modelling cannot automatically exclude. These include:

- Areas with engineered features to prevent erosion such as rock-lined waterways or drop structures.

  These areas have both high flow velocities and shear stresses but are not necessarily eroding because of the rock armouring provided. These features are manually designated and excluded from the model.

- Site-specific features.

  There may be features within a site that pass the automated screening tests that are nevertheless not erosional features. These could be steeper contour banks or drainage lines, and a review of the outputs was undertaken to ensure that the quantification of erosion has been correctly achieved.

3.3.1 Classification of rills

Once the modelling is completed, the identified features are classified using guidelines agreed upon with the client. This involves dividing the area analysed into 10m x 10m grids and determining the maximum length and depth of the rills within each square.

Classification is undertaken using the values given in Table 1, with parameters supplied by MAC. The scoring is based on values used on other sites by other clients, with negative values used to highlight problem areas.

[1] Tractive stress is a shear stress that describes the force applied to the surface by the flow of water.

Table 1: MAC Erosion Classification

Description	Classification	Score
Minor sheet erosion or rills <100mm	Areas that are performing well and only ongoing monitoring is required	5
Rills 100mm<300mm and >10m length		4
Gullies 300mm<500mm and >10m length	Targeted monitoring required	3
Gullies 500mm<1m depth and >10m length	Areas of concern, to be assessed by a qualified person	-2
Gullies >1m and >10m	Areas of concern, to be assessed by a qualified person with prioritised action plan	-5

It is important to note that the above work focuses on sheet, rill, and gulley erosion only; any overland diffuse erosion is not quantified. Overland erosion generally results in a slight incremental lowering of the ground surface over time, typically measured in millimetres. This is of minor concern compared to gulley erosion regarding long-term erosional stability.

3.3.2 Assessment of erosion rates

The erosion rates are calculated by quantifying the volume of material displaced by the rills and converting this to a tonnage using a density of 1.5 t/m^3. This density is considered a reasonable first estimate based on data in the Hunter Valley.

The computed rate is compared to the target rate to identify if the erosion rates are acceptable (taken as 5t/ha/yr). However, it is essential to note the target is the long-term target, and all landforms will experience a variation in erosion rates based on the age of the landform and the climatic conditions experienced. Landforms will erode more in the initial three years (which represents the period of shaping, seeding, and initial germination), reducing with time as the vegetation is established.

An initial target for the landforms was set as follows based on the date of rehabilitation, with the intention of reviewing these targets as more data on the trajectory of the rehabilitated surfaces becomes available for MAC:

- For the first year < 20 t/ha/year
- By year 3 < 10 t/ha/year
- By year 6 < 5 t/ha/year, i.e., the long-term target.

The figures presented in Section 3.4.2 are based on these values. Still, it is essential to note that the trajectory is of more importance than the specific value in one particular area. Erosion rate figures are located in APPENDIX C.

3.4 Outcomes

3.4.1 Flow verification

The first step of erosion quantification is to validate the outputs of the flow modelling. An example of images of the flow depths overlain onto the landform is presented in **Figure 3.2**. The remainder of the images are provided in the APPENDIX B. These images were reviewed as part of the modelling process to ensure that no features of concern are evident in the survey or aerial images that are not being modelled correctly. The flow tracking has adequately captured the features on site.

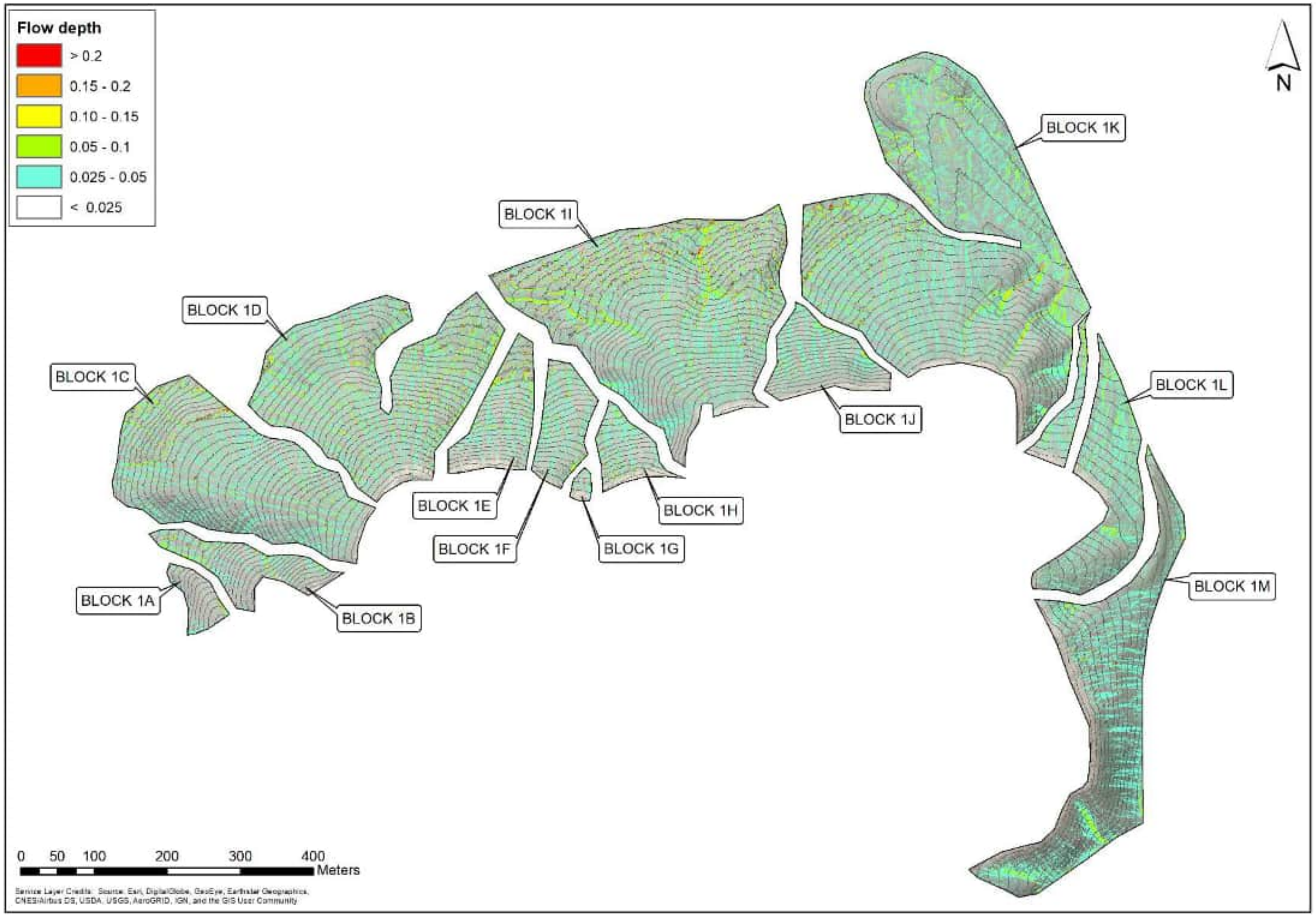


Figure 3.2 : Modelled flow depths for Area 1-1

Checks were made for potentially spurious outcomes, e.g. if vegetation is not excluded from the DTM.

3.4.2 Erosion classification

The outcome of the sheet, rill and gulley erosion classification is presented in Figure 3.3 to Figure 3.12, with the outcomes summarised for each of the areas analysed as a percentage of the area in Table 2.

Table 2: Sheet, Rill and Gulley Erosion Classification for each area

Area Name	Area Total (ha)	Area **(%)** with Score: 5 and 4	**Area (%) with Score: 3**	**Area (%) with Score: -2 and -5**
1-1	44.74	93%	7%	0.49%
1-2	238.58	97%	1%	0.39%
1-3	92.25	98%	2%	0.27%
2	16.6	100%	0%	0.02%
3	63.16	99%	1%	0.03%
4	32.32	97%	3%	0.22%
5	56.91	97%	2%	0.07%
6	127.19	98%	3%	0.16%
7	27.23	99%	1%	0.00%
8	99.58	99%	1%	0.04%

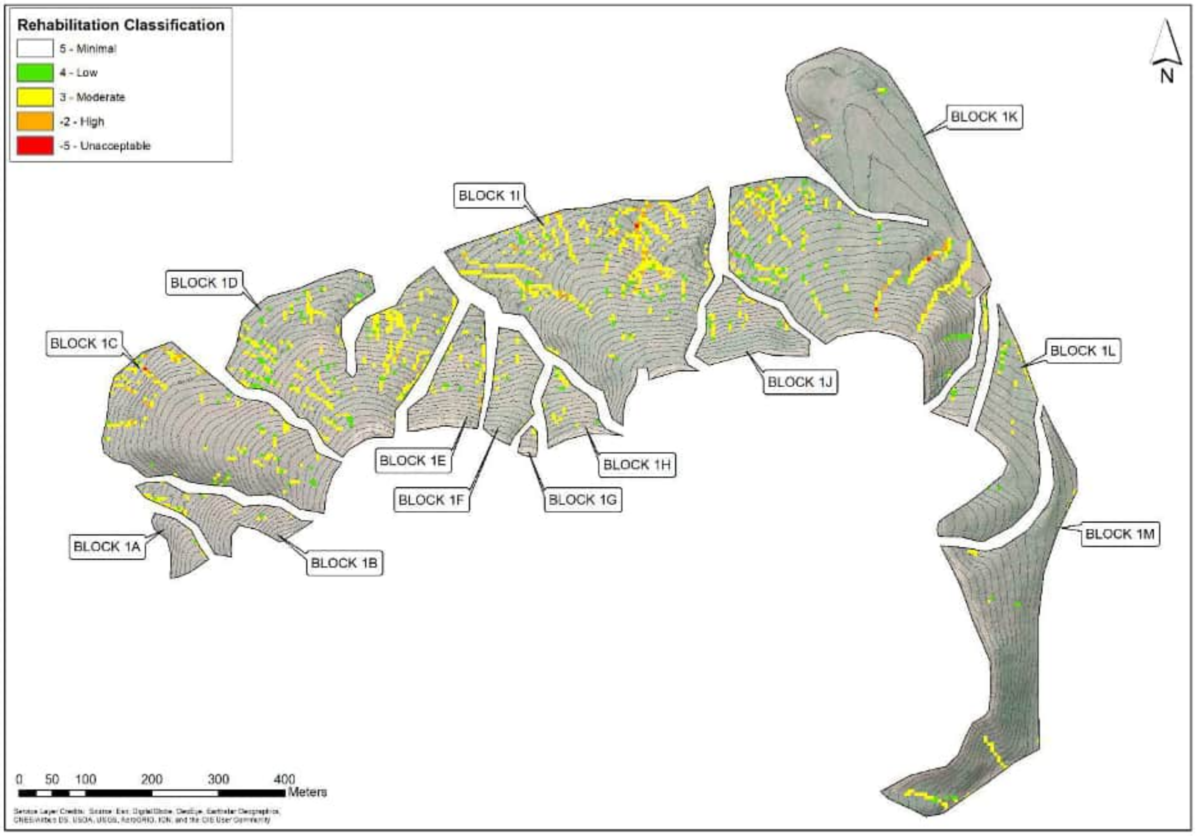


Figure 3.3 Rehabilitation Classification for Area 1-1

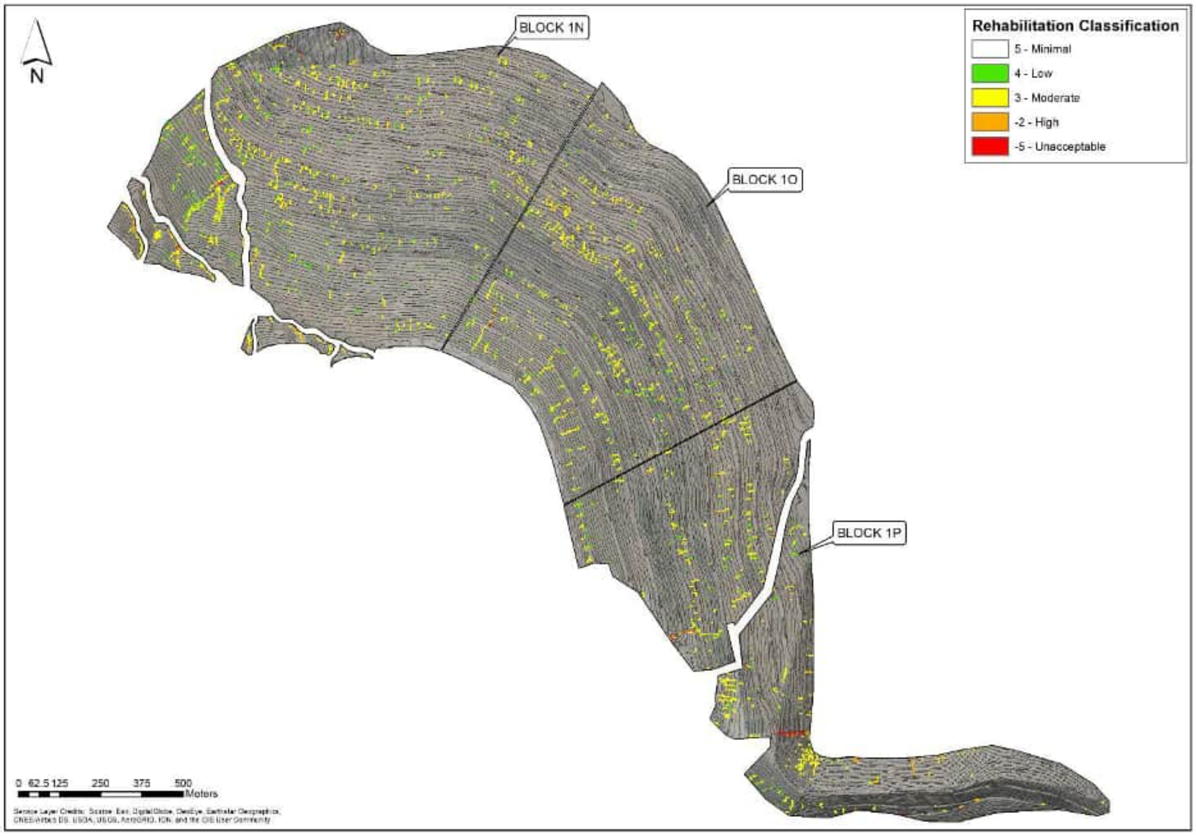


Figure 3.4 Rehabilitation Classification for Area 1-2

Figure 3.5 Rehabilitation Classification for Area 1-3

Figure 3.6 Rehabilitation Classification for Area 2A

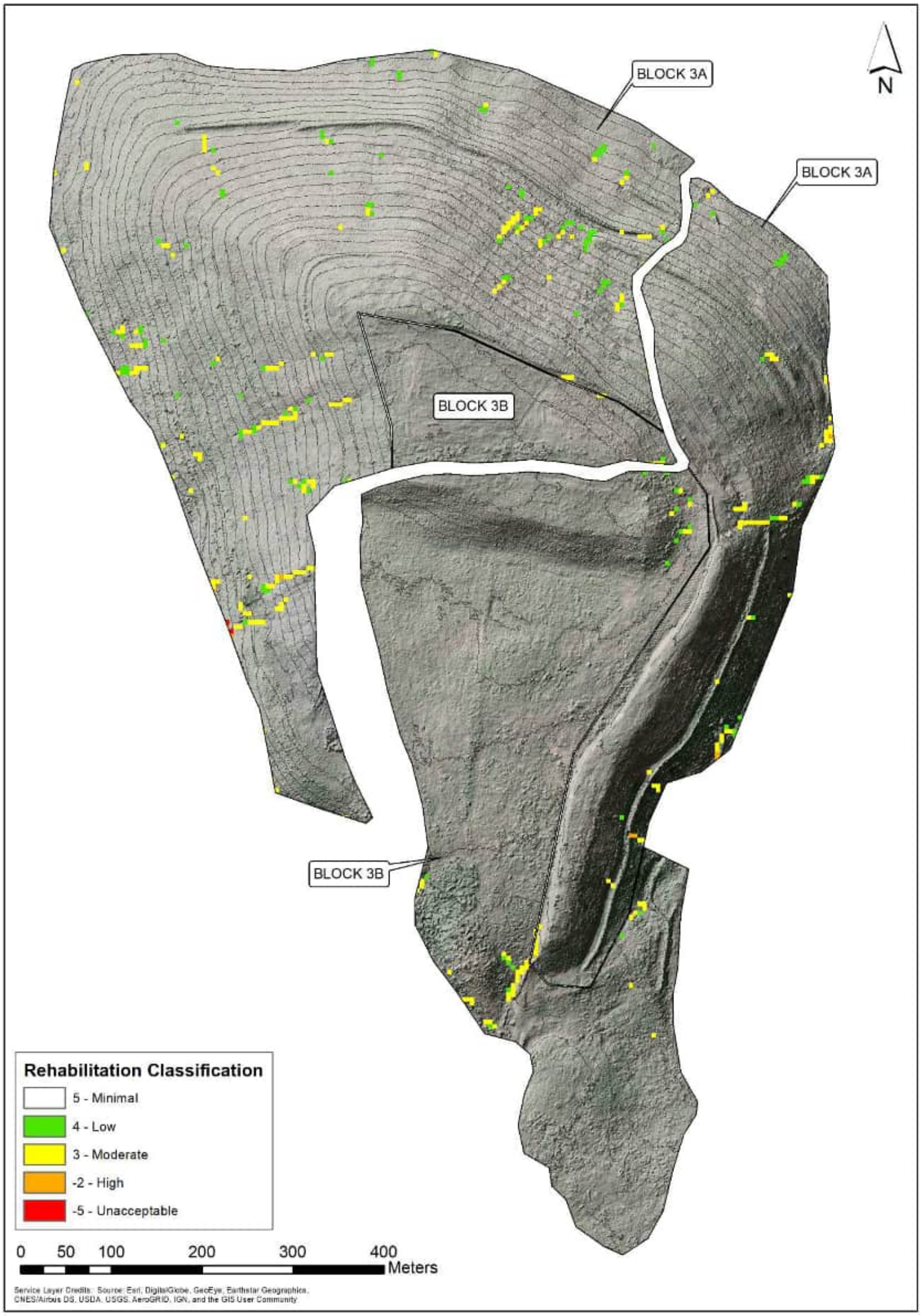


Figure 3.7 Rehabilitation Classification for Area 3

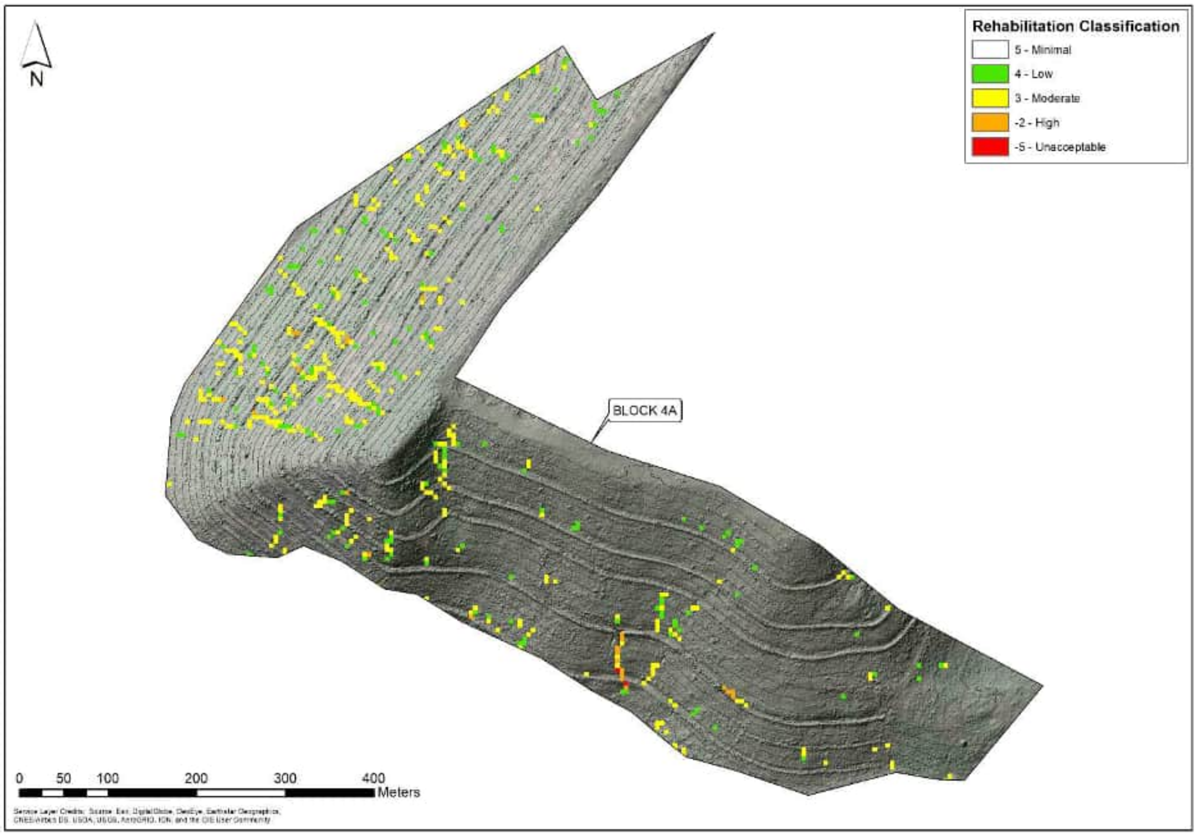


Figure 3.8 Rehabilitation Classification for Area 4

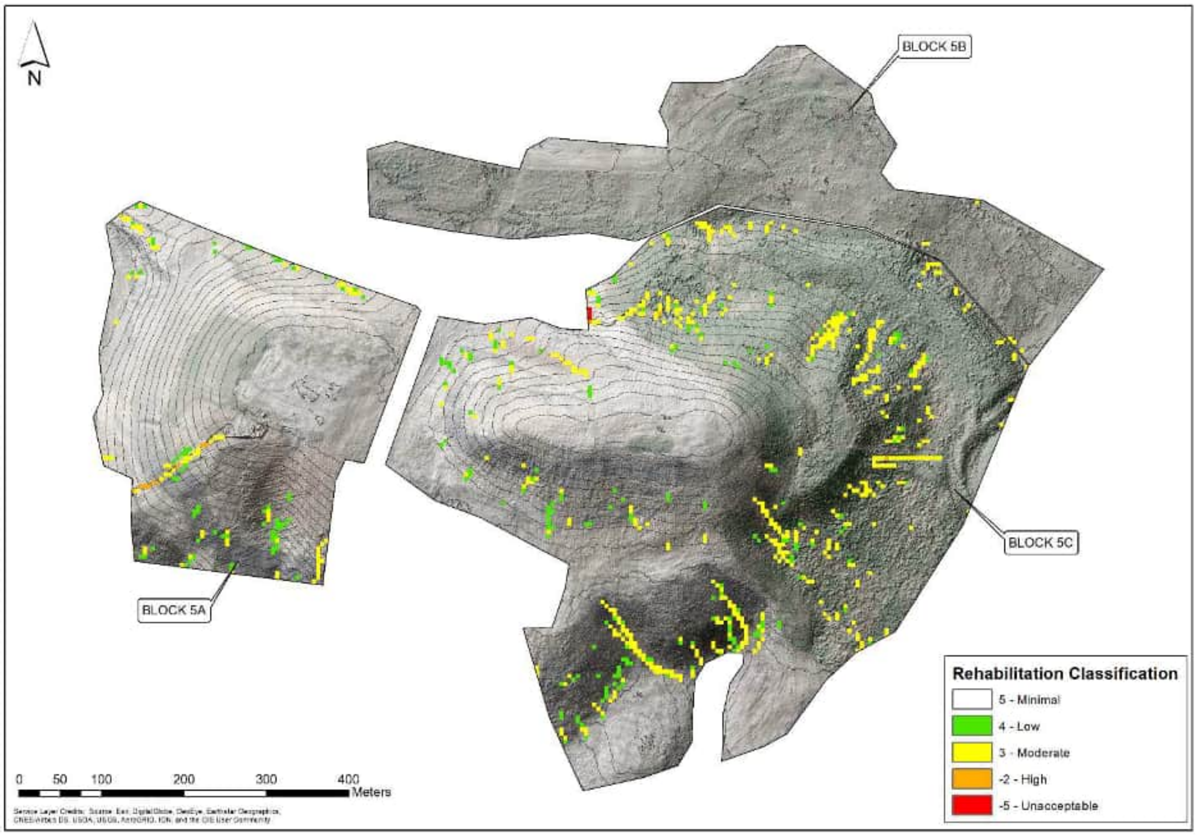


Figure 3.9 Rehabilitation Classification for Area 5

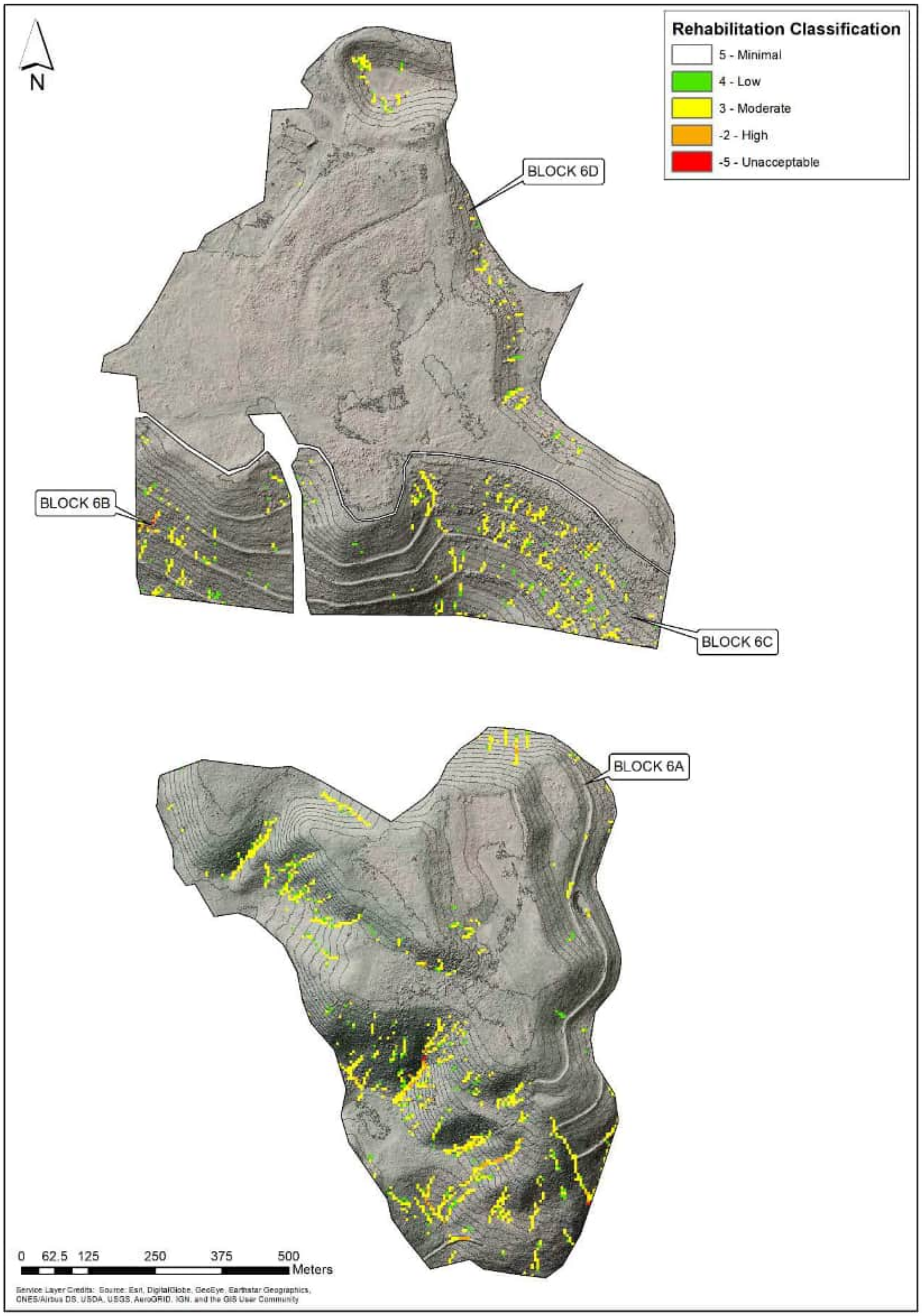


Figure 3.10 Rehabilitation Classification for Area 6

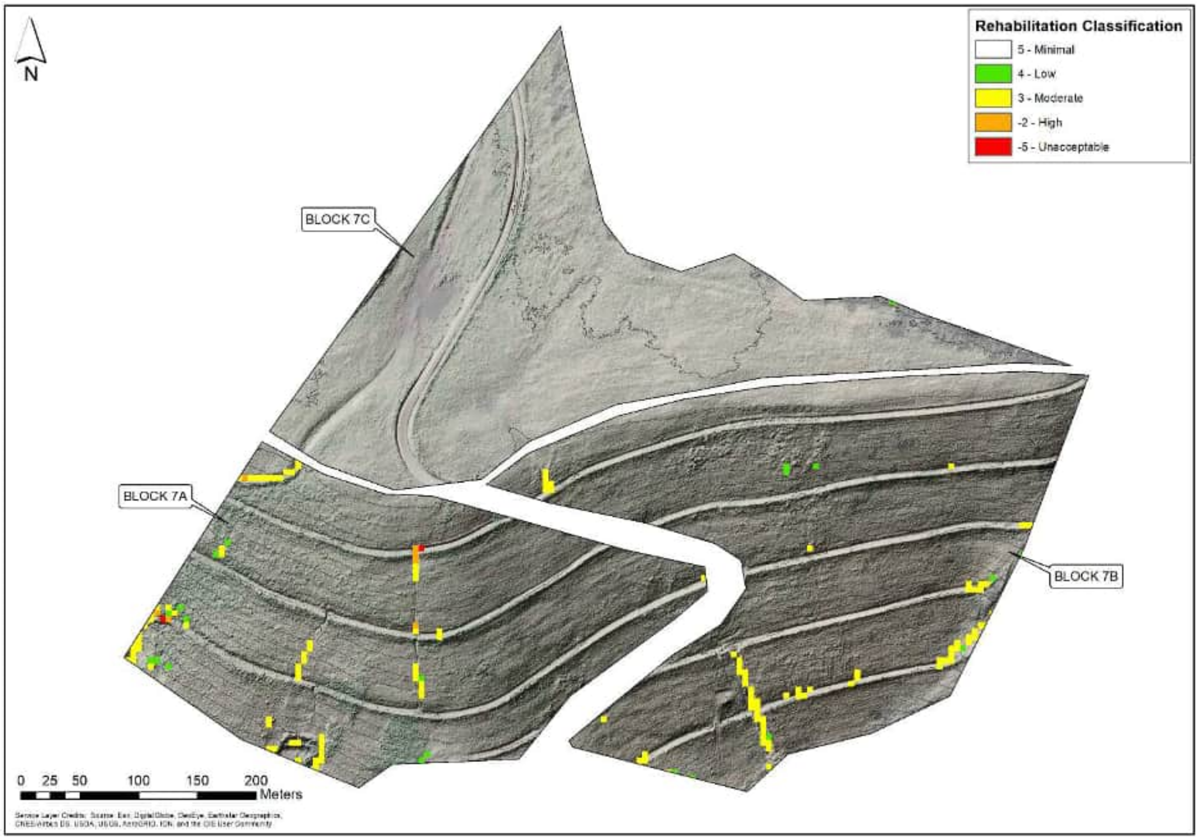


Figure 3.11 Rehabilitation Classification for Area 7

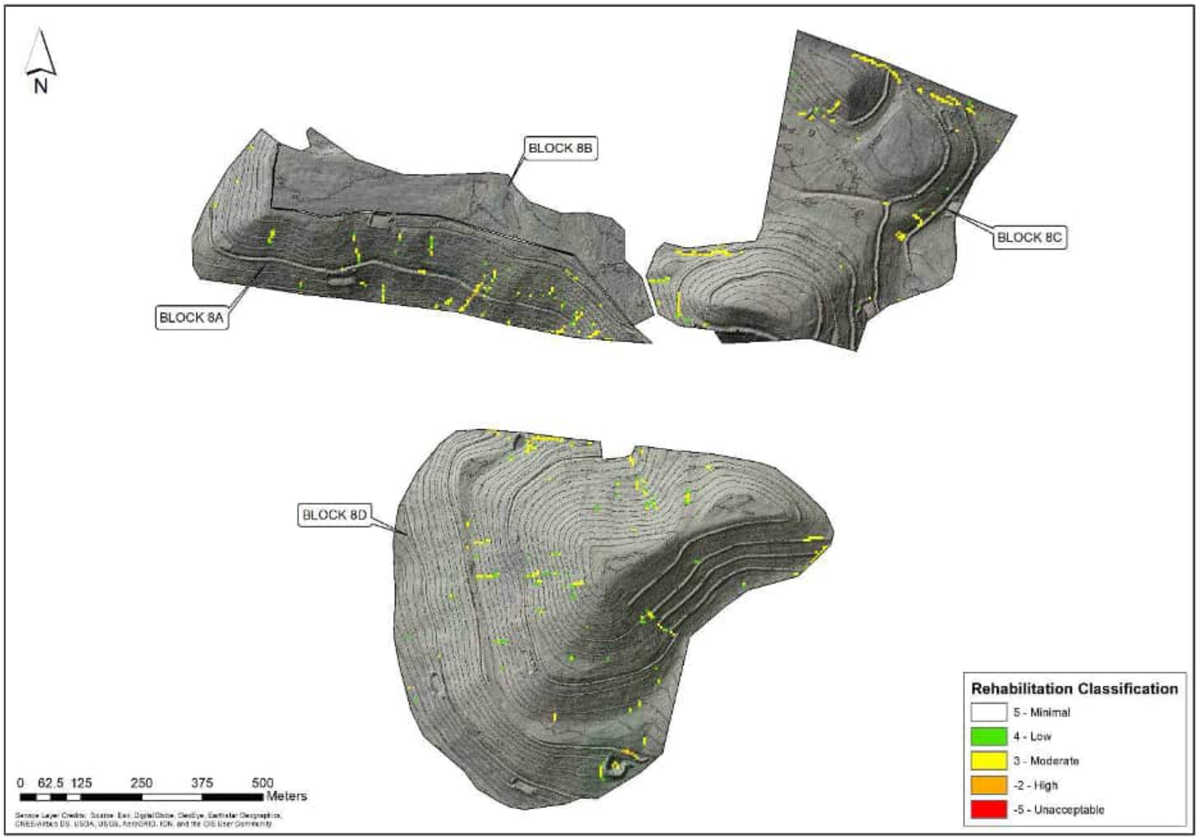


Figure 3.12 Rehabilitation Classification for Area 8

The initial assessment of the sheet, rill and gulley erosion classification for MAC indicates the following:

- Most of the site evaluated (97.3%) is performing well with a “minimal” to “low” risk based on the scoring system.
- Approximately 2.5% of the site requires careful ongoing monitoring.
- About 0.23% of the site requires further work to address issues.

The above is discussed further in Section 3.4.3.

3.4.3 Erosion rate quantification

The computed erosion rates, and years since rehabilitation, for each of the areas are presented in Figure 3.13Figure 3.13 : Erosion rates by polygon

Error! Reference source not found.. In terms of the data, the following should be noted:

- The key issue for this part of the assessment is whether the rehabilitated landforms are trending towards the target of 5t/ha/year.
- Based on the observed trends towards the target erosion rates for this site, the key delineator appears to be the age of the rehabilitation. This aligns with expectations.
- By relating the erosion rates for the different classifications of the erosion, we were able to develop curves that appear to indicate the trends for the better and worse performing landforms, based purely on erosion rates.
- There is no distinction here between different soils, topography, or rehabilitation / seeding methodology. For the geomorphic landforms, the designs are adjusted to suit the different average slopes, but not for the soils. The erodibility assessment for the soils at MAC is still based on the Landloch study in 2014 and probably reflects average soils parameters. The data collected here can be used to assist with the refinement of the materials erodibilty if trends become apparent between the different areas.

The relationship developed by considering the different classifications for erosion and the age of the rehabilitation has then been applied to the average erosion rates as shown in Figure 3.14. This highlights areas that are performing within the current curves for the different classifications taking account the maturity of the rehabilitation.

The respective rates used to generate Figure 3.14 have been indicated in

Table 3, together with the percentage of the surface where potential problems have been identified. On all of the sites, less than 2 per cent of the surface has potential problems requiring intervention.

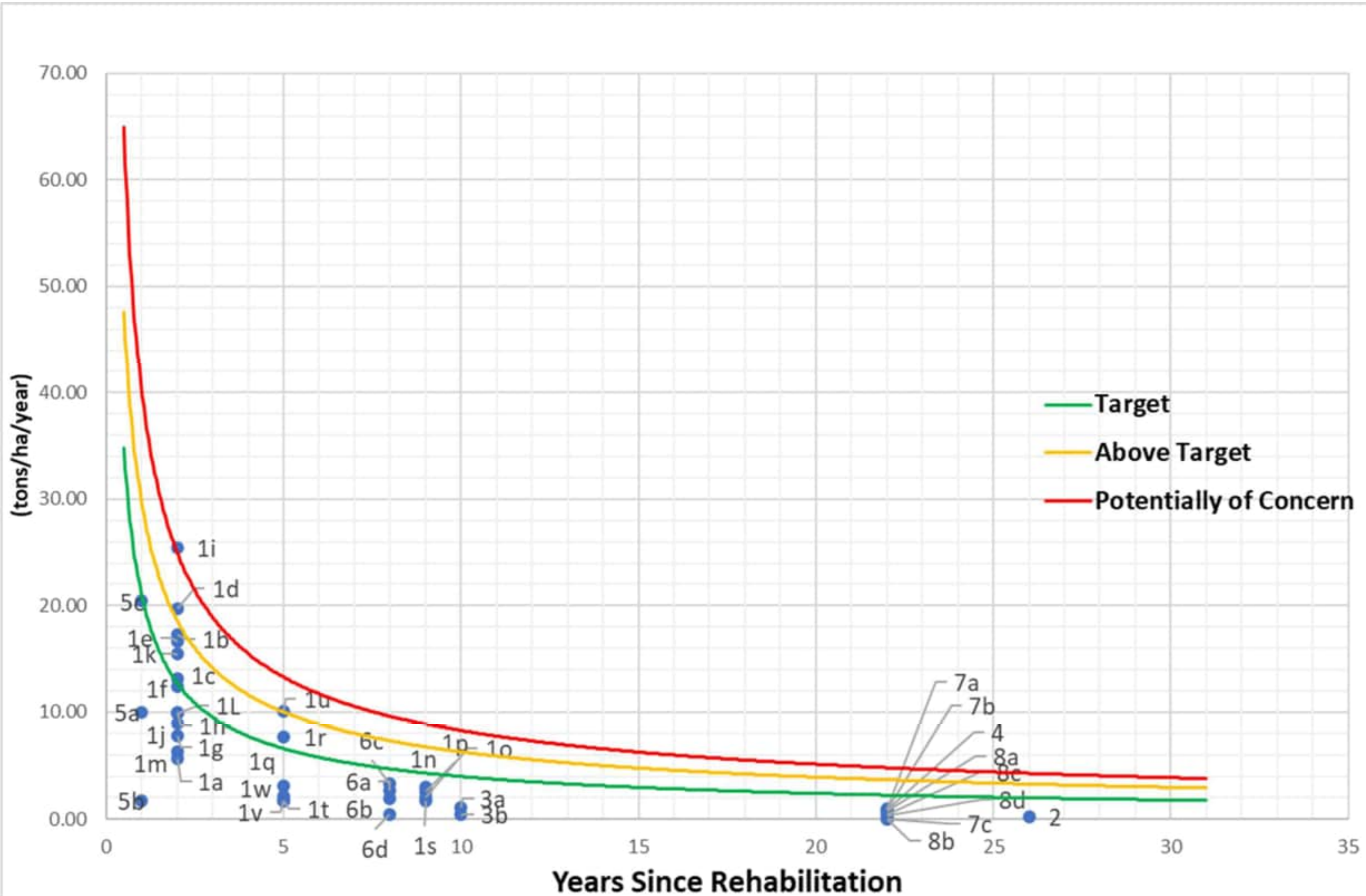


Figure 3.13 : Erosion rates by polygon

Table 3: Modelled rates of erosion for assessed areas

Area name	Area (ha)	Concentrated Erosion Area* (%)	Eroded Volume (tons/ha)	Average Year**	Average Rate (tons/ha/annum)
Area 1-1	43.85	1.83%	337.25	2020	12.97
Area 1-2	237.39	1.44%	68.2	2013	2.53
Area 1-3	75.52	1.53%	147.47	201	4.02
Area 2	16.5	0.60%	7.73	1996	0.30
Area 3	62.47	0.61%	15.48	2012	0.77
Area 4	32.03	1.29%	19.25	2000	0.88
Area 5	56.52	0.82%	32.26	2022	10.75
Area 6	125.18	1.46%	67.29	2014	2.10
Area 7	27.03	0.62%	43.57	2000	0.66
Area 8	98.64	0.57%	36.12	2000	0.41

*Concentrated erosion area refers to the modelled eroded volume as an an area over the total area assessed.
**Average year in reference to polygons which cover rehabilitated areas with different finishing dates.

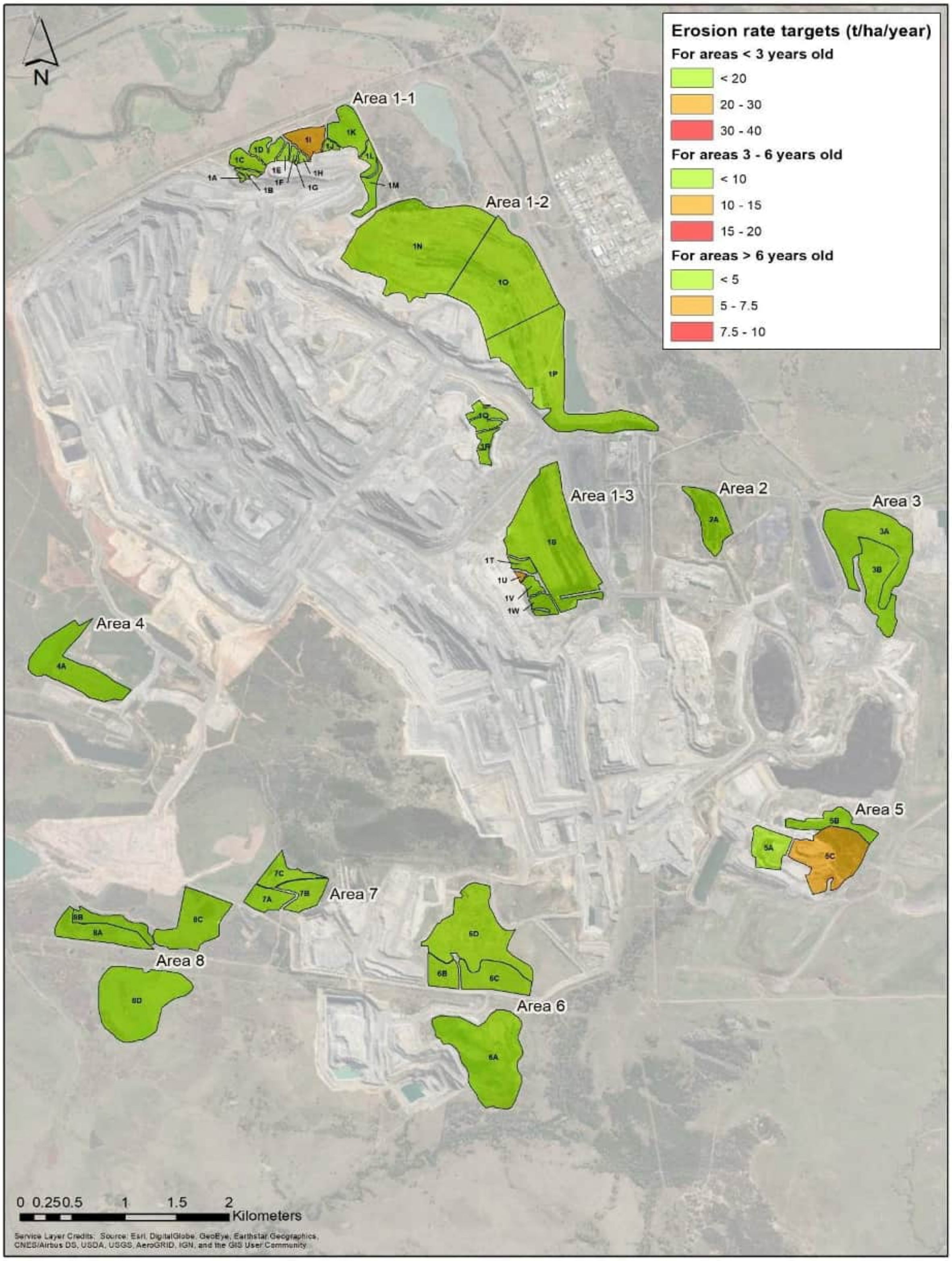


Figure 3.14 : Erosion Rates by Area against time since rehabilitation

3.5 Discussion

Most of the site appears to be forming well in terms of erosion rates. This is based on:

- 97.3 per cent of the site being classified as "minimal" to "low" risk.
- As expected, erosion rates are trending downwards with time, with the older areas well below the 5 t/ha target. Even some of the newer rehabilitated areas are close to the target erosion rates.

There are some areas of concern from an erosion perspective. These areas require verification and may require intervention. Generally, these are areas of drainage that do not currently have rock armouring or contour banks that have failed. Some drains with rock armouring may have been incorrectly included in the assessment. This needs to be verified.

We believe that undertaking a similar study at regular intervals will be of significant value in assessing the potential for long-term "safe and stable" landforms post closure. Variations in the erosion rate can be expected seasonally related to drought and abnormally high rainfall, and a reasonable monitoring cycle is probably around three to four years. This may need to be increased within five years of closure.

We believe the way forwards would be to:

- Undertake fieldwork to review the areas identified as requiring monitoring or intervention. The outputs from the desktop study can guide the fieldwork. A key issue will be to review the high risk areas.
- If necessary, update the outputs to exclude any features that have been incorrectly classified or may have existing rock armouring.
- Classify the required interventions based on risk and priority and implement the necessary construction/maintenance work.

4.0 CONCLUSION

The use of high-density LiDAR to quantify erosion rates using hydrological modelling is a relatively robust and inexpensive method to monitor the performance of a landform in terms of erosion potential. It adds significantly to the level of confidence in the performance of the landform, which will only increase as additional data (including on-site verification) is obtained for the site over time.

Overall, the site is performing well, with approximately 97 per cent being at a minimal to low risk of erosion. There is a need for some maintenance, primarily relating to areas of concentrated flow that do not have rock armouring and some failure of contour banks.

The trends for erosion rates at MAC are on a downward trajectory, generally going from less than 20 t/ha/year in the first year to half that within three years and below the target of 5 t/ha/year by year six post-rehabilitation. Where the average rates are above the targets, there are generally a few specific problem areas that can be addressed, which should address the outliers.

We anticipate that the use of a similar technique on a regular basis will provide a quantitative assessment of the performance of the landform prior to closure. This will allow timeous maintenance, where required. It will also provide a trend curve to present to the Regulator during the closure process.

WSP Australia Pty Limited

Christopher Waygood
Principal Mine Closure Specialist

Gareth Simpson
Principal Mine Closure Consultant

CW/GS/pt

Distribution: [Click here and type distribution list]

Attachments [Click here and type list of attachments]

c:\users\cwaygood\downloads\ps128697-000-m-reva mac erosion rate quant_v2a_20230412.docx

APPENDIX A

Survey

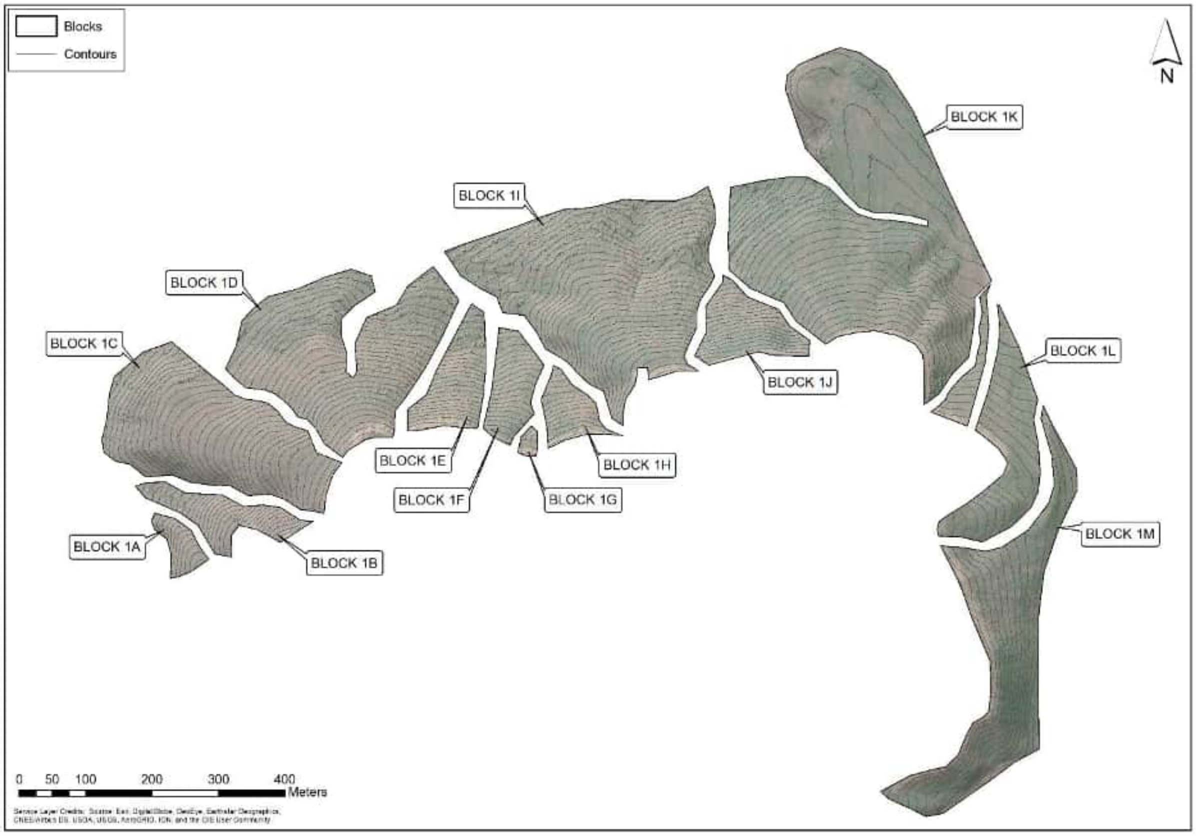


Figure 4.1 Area 1-1 Survey

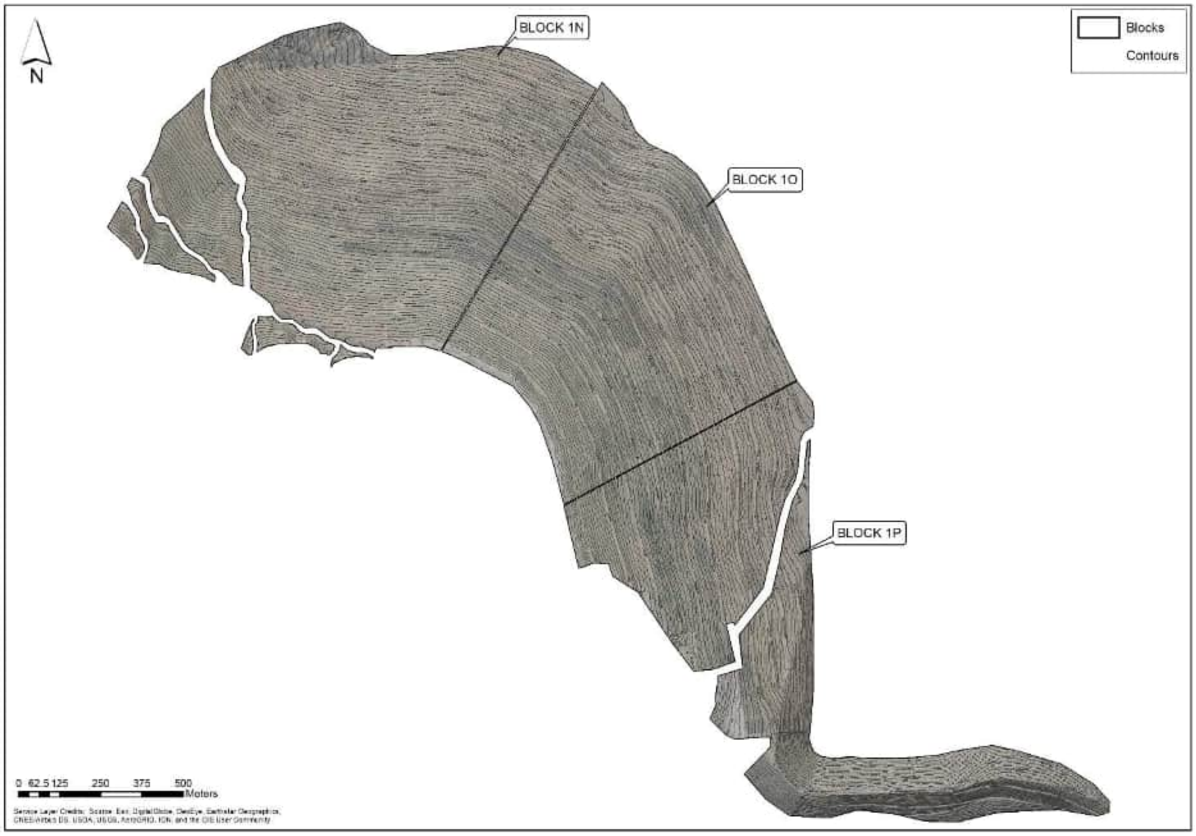


Figure 4.2 Area 1-2 Survey

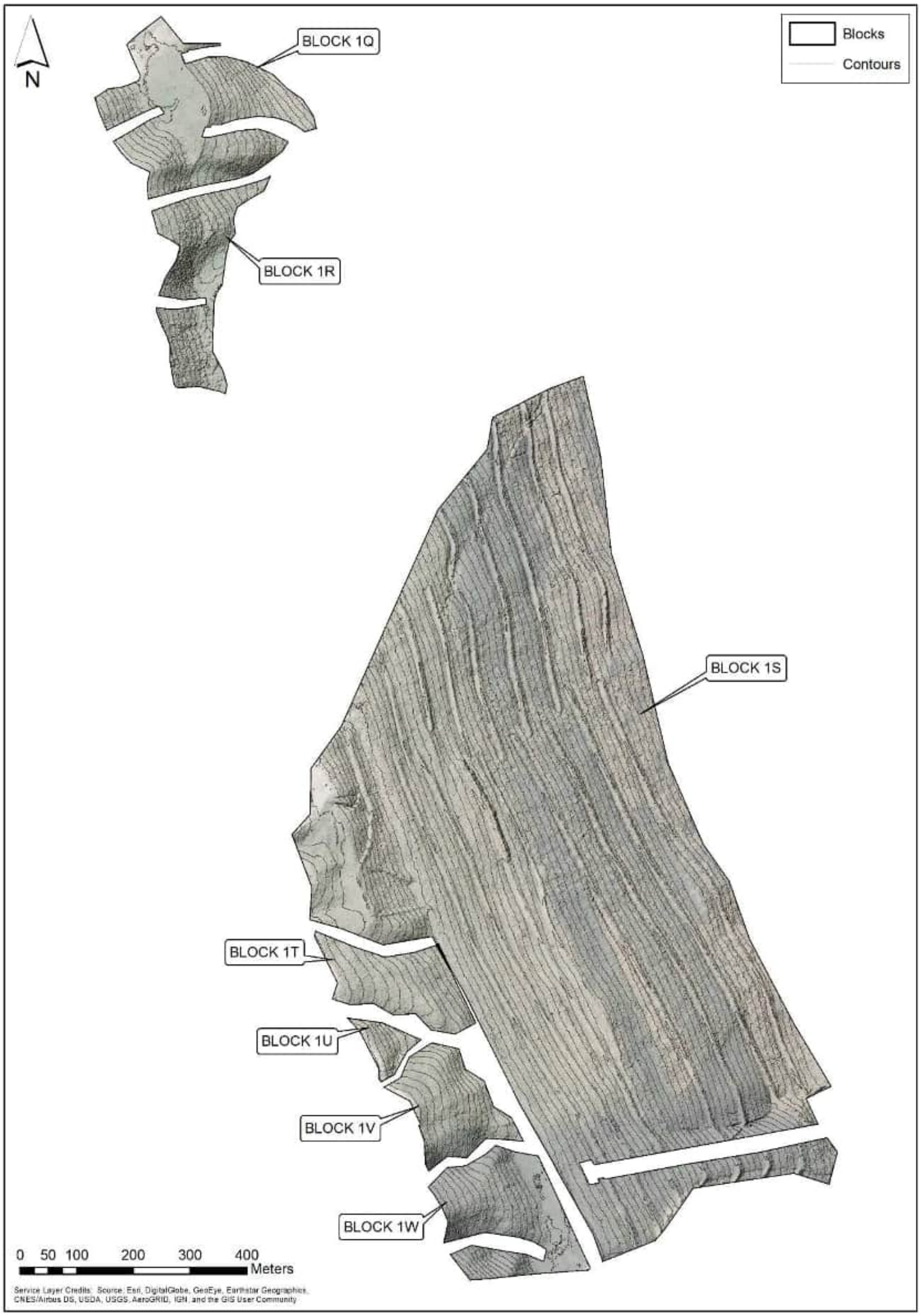


Figure 4.3 Area 1-3 Survey

Figure 4.4 Area 2 Survey

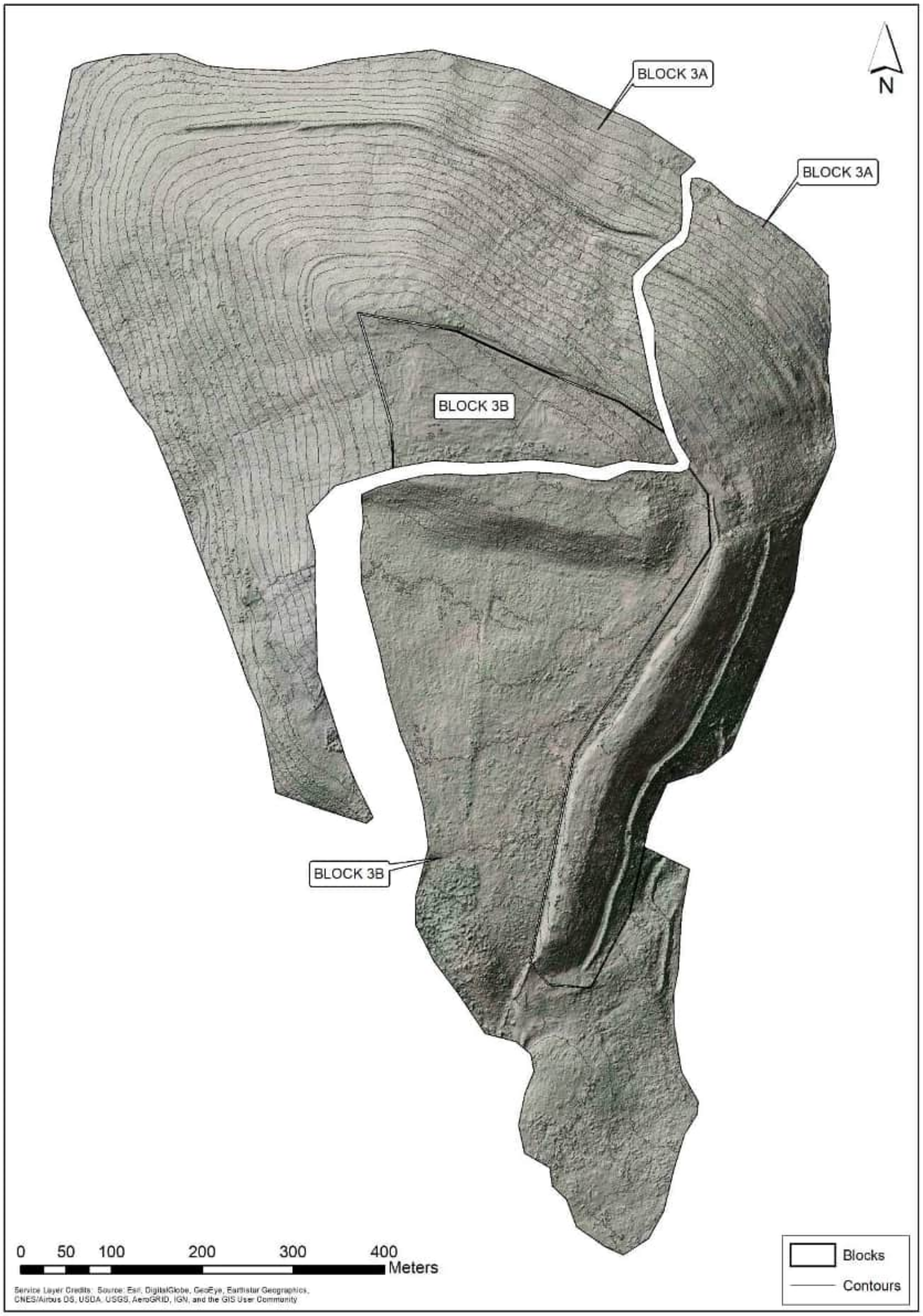


Figure 4.5 Area 3 Survey

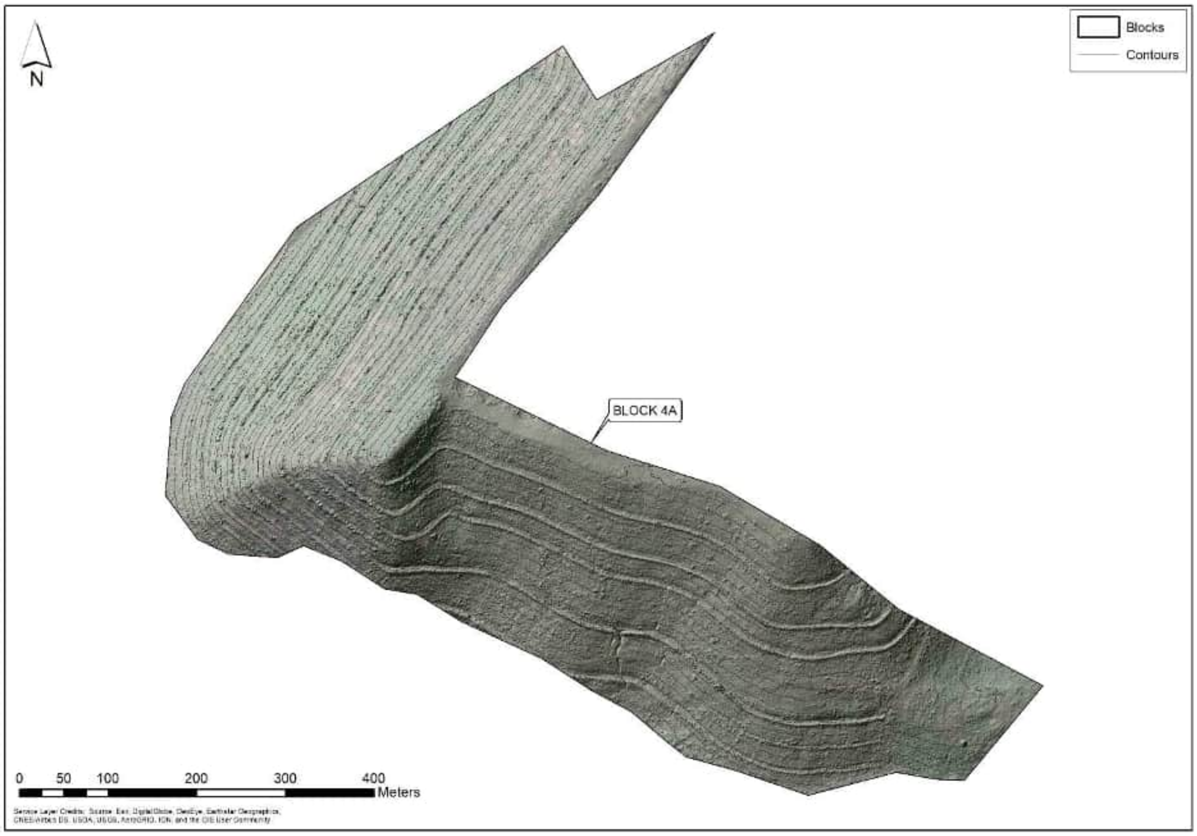


Figure 4.6 Area 4 Survey

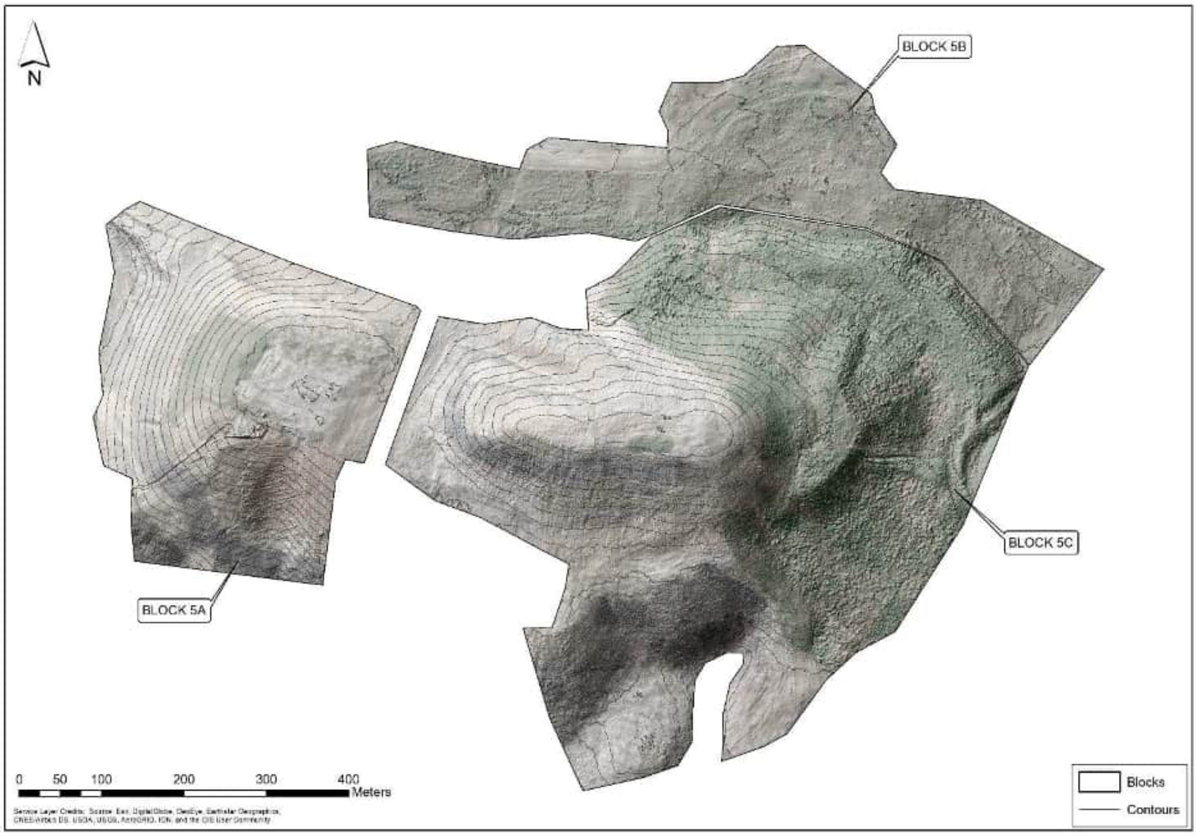


Figure 4.7 Area 5 Survey

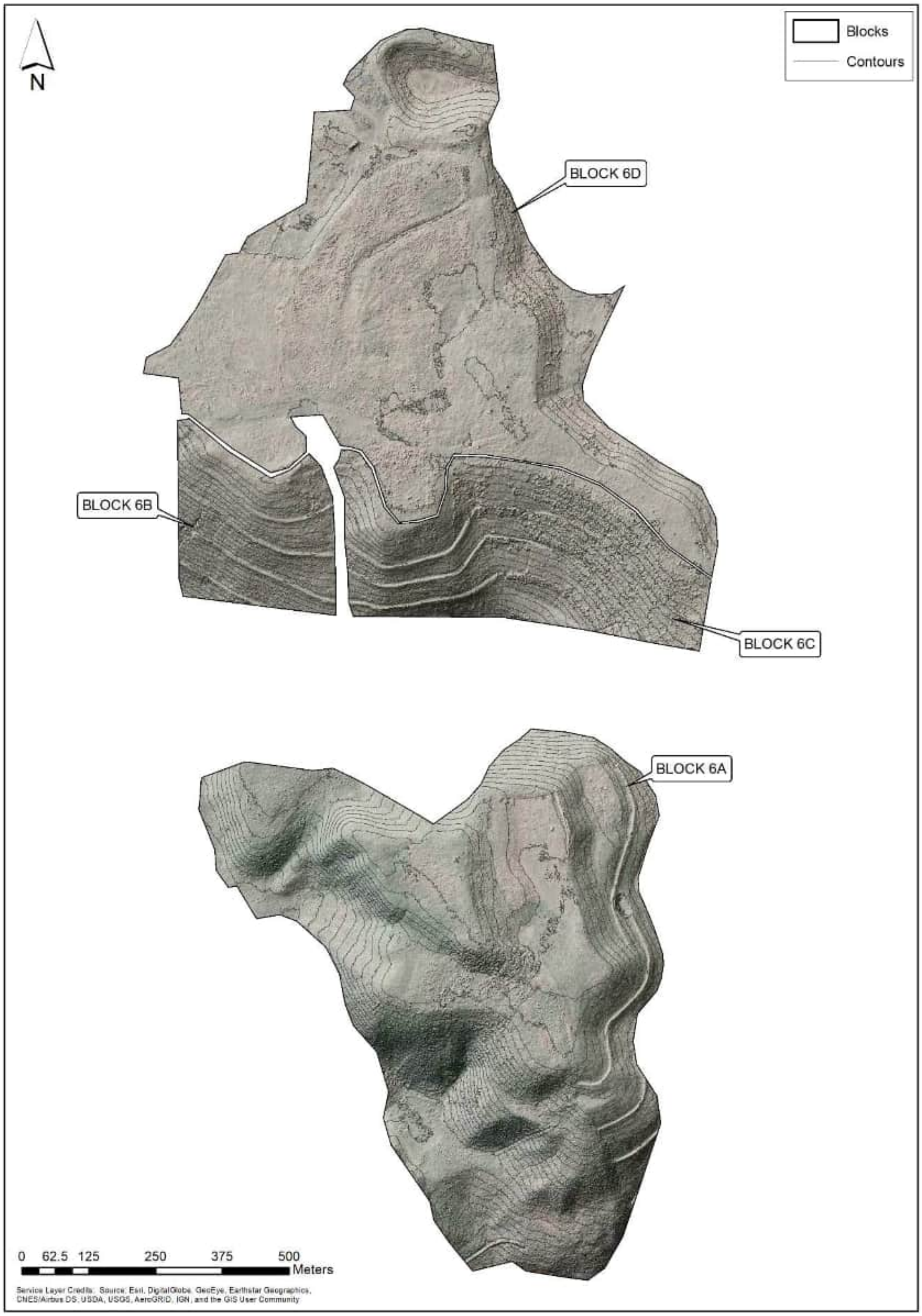


Figure 4.8 Area 6 Survey

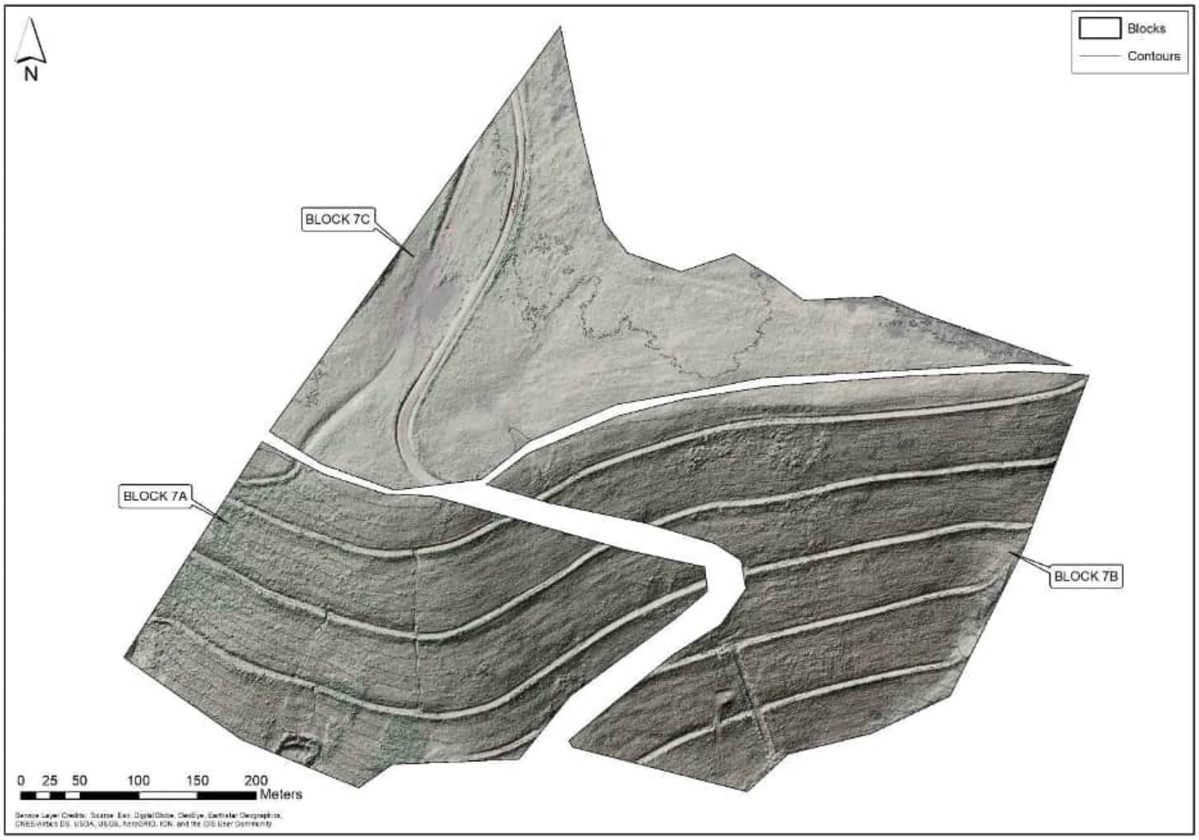


Figure 4.9 Area 7 Survey

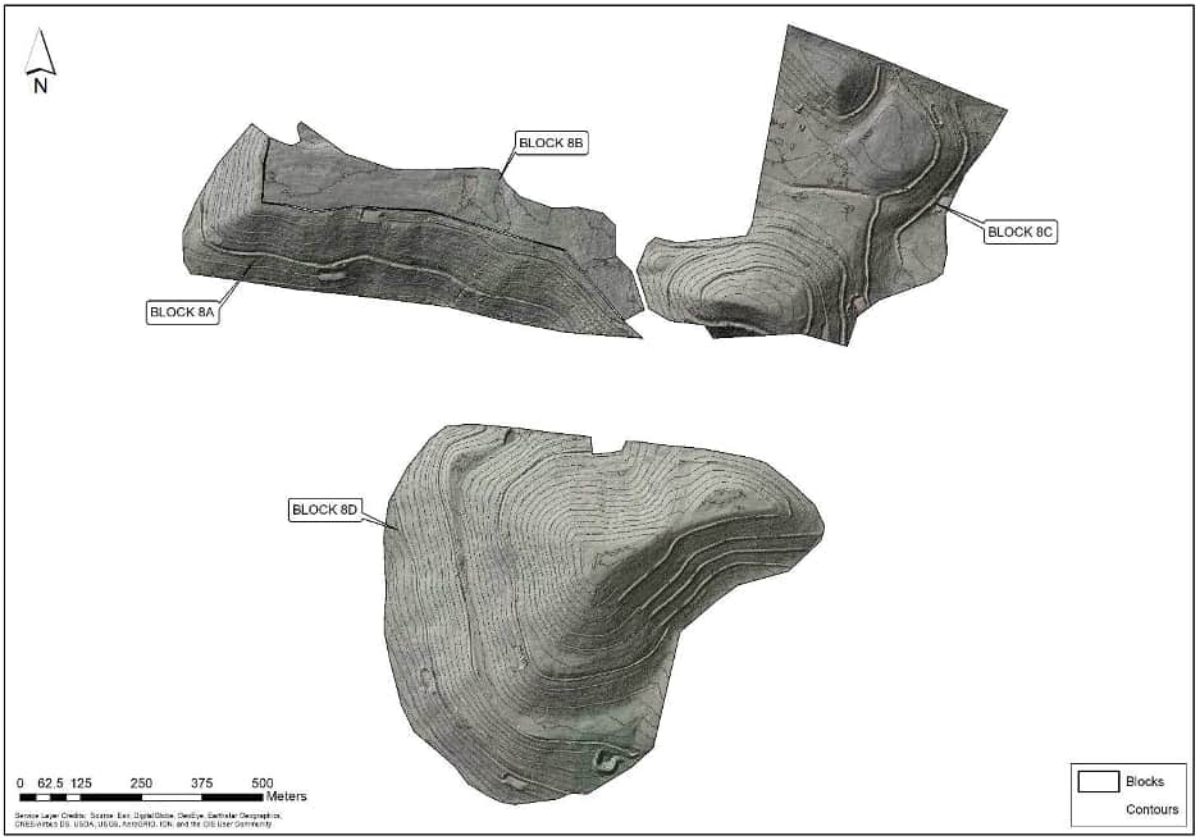


Figure 4.10 Area 8 Survey

APPENDIX B

Flow Depths

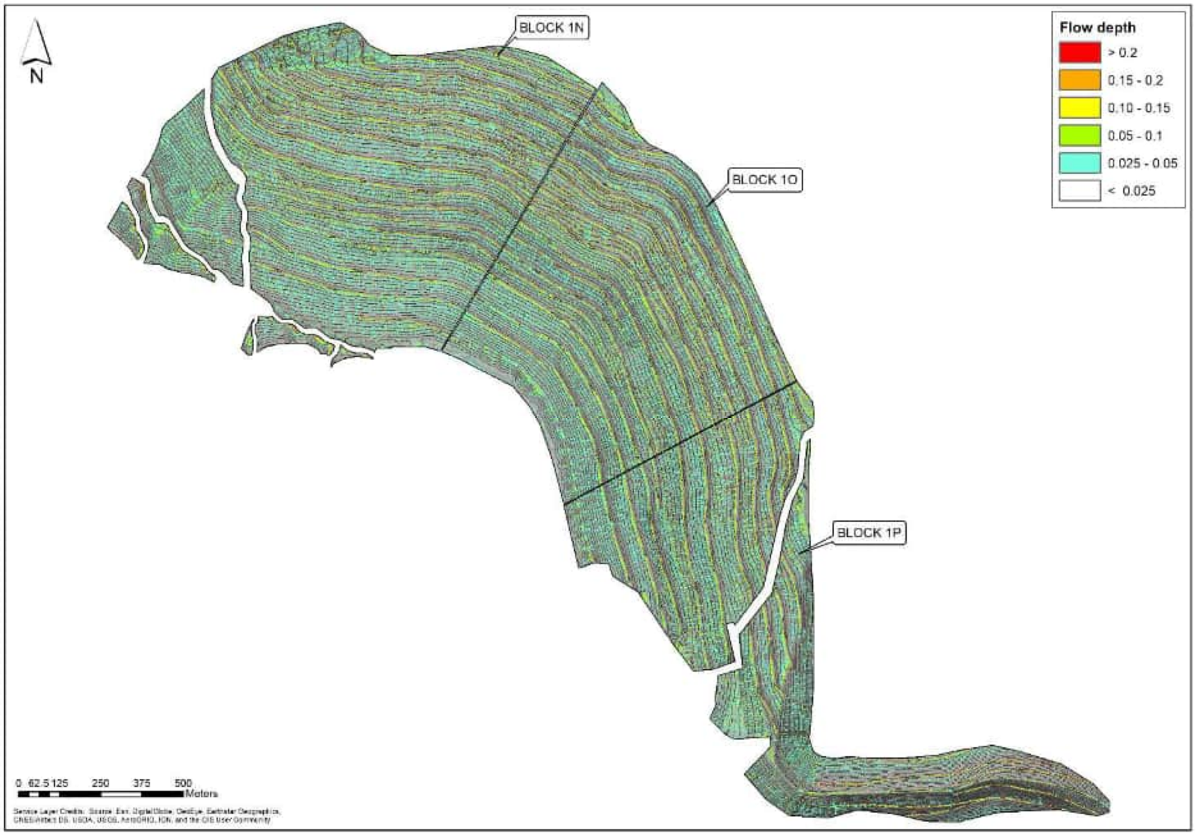


Figure 4.11 Area 1-2 Flow depth against survey.

Figure 4.12 Area 1-3 Flow depth against survey

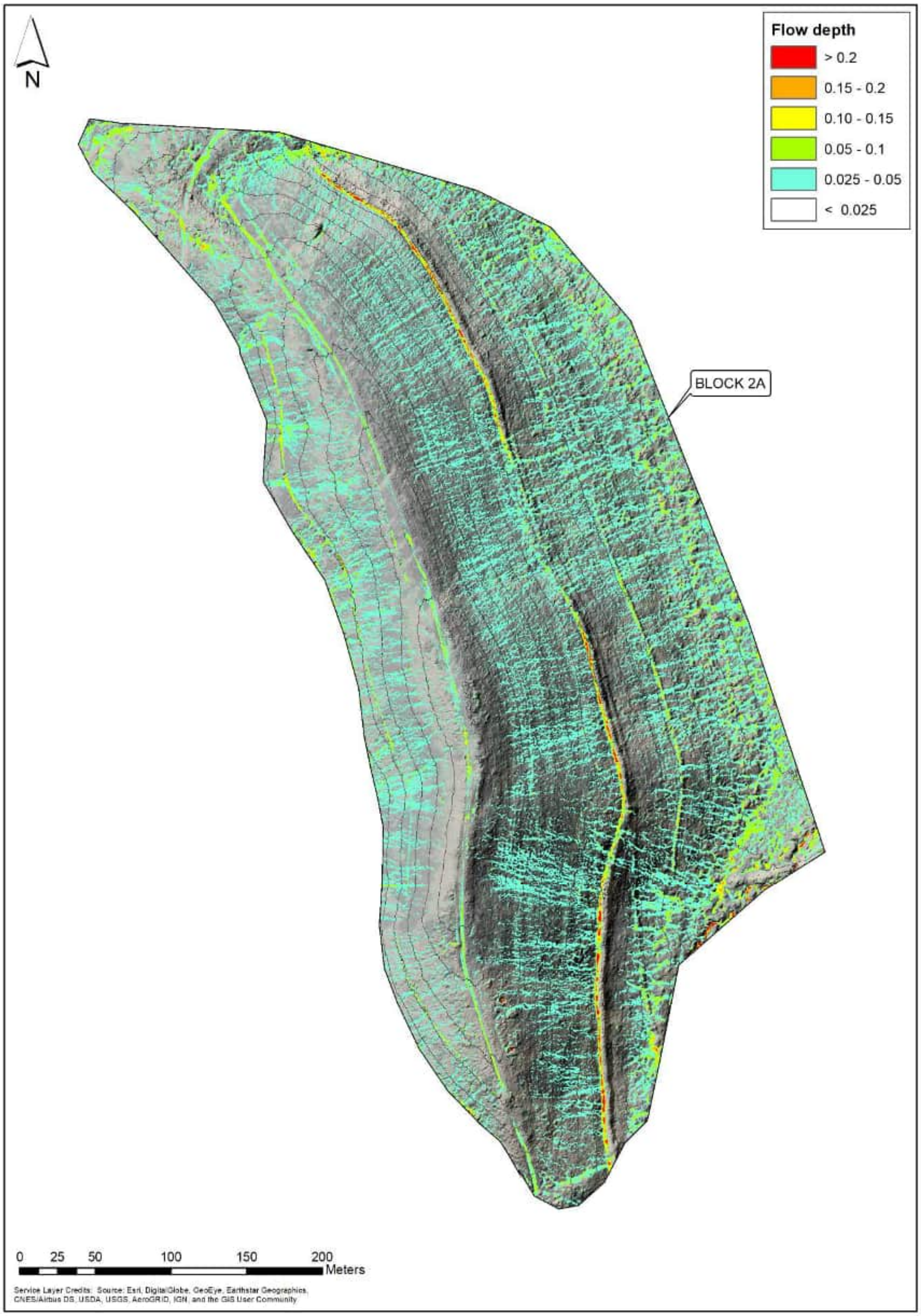


Figure 4.13 Area 2 Flow depth against survey

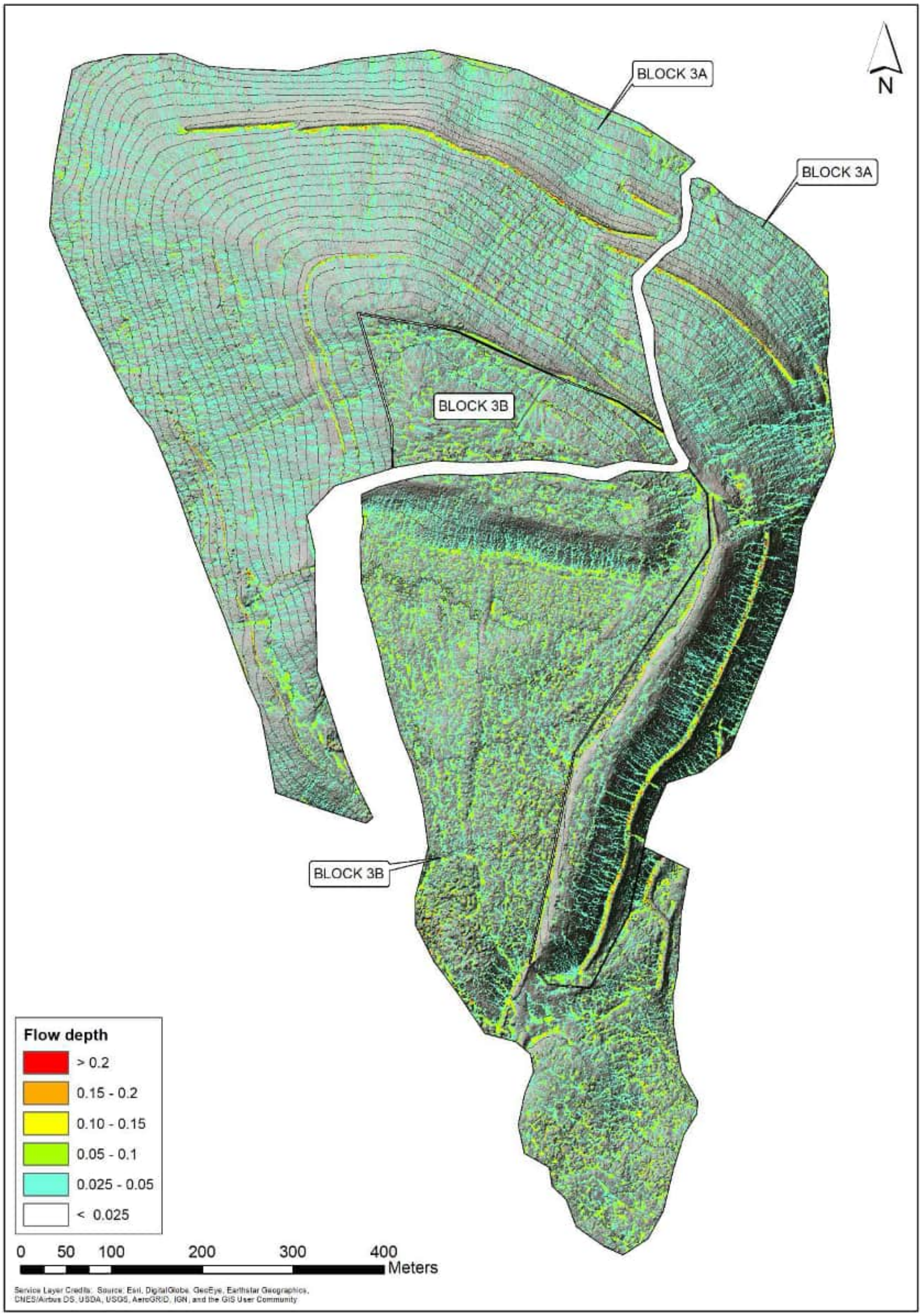


Figure 4.14 Area 3 Flow depth against survey

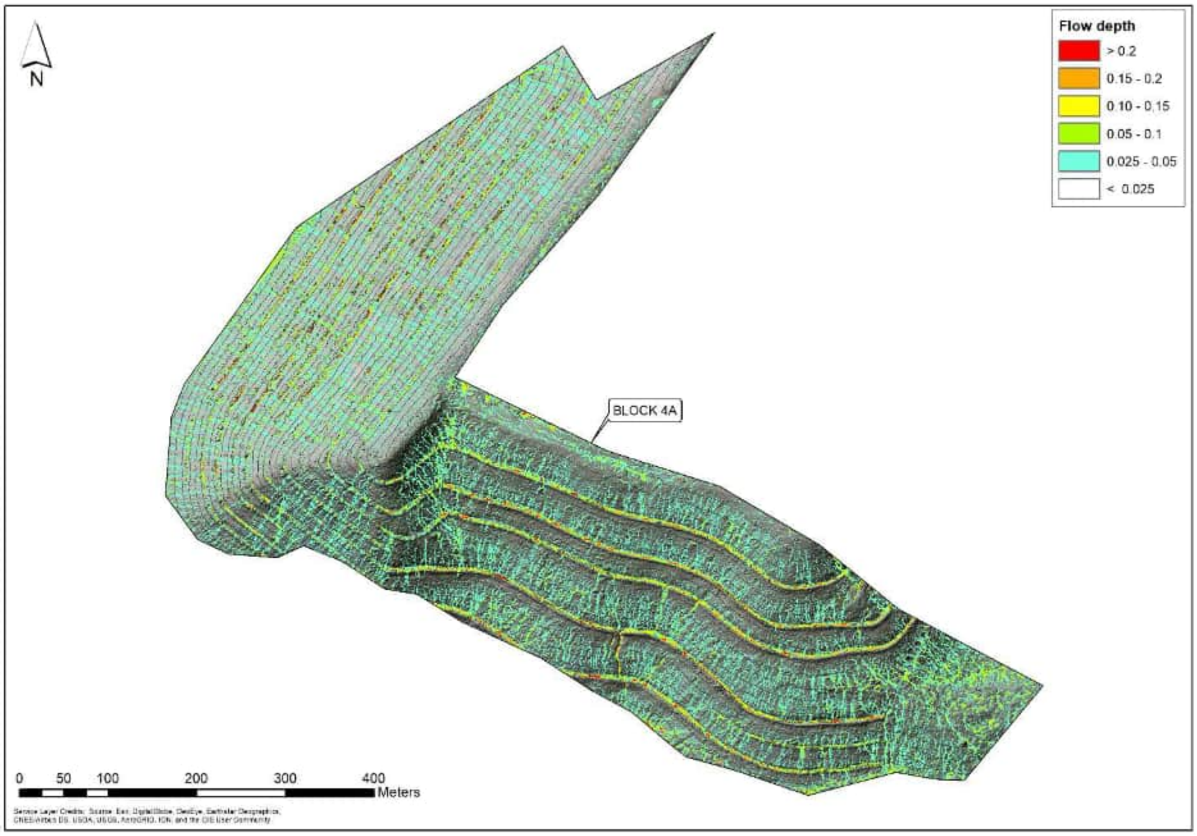


Figure 4.15 Area 4 Flow depth against survey

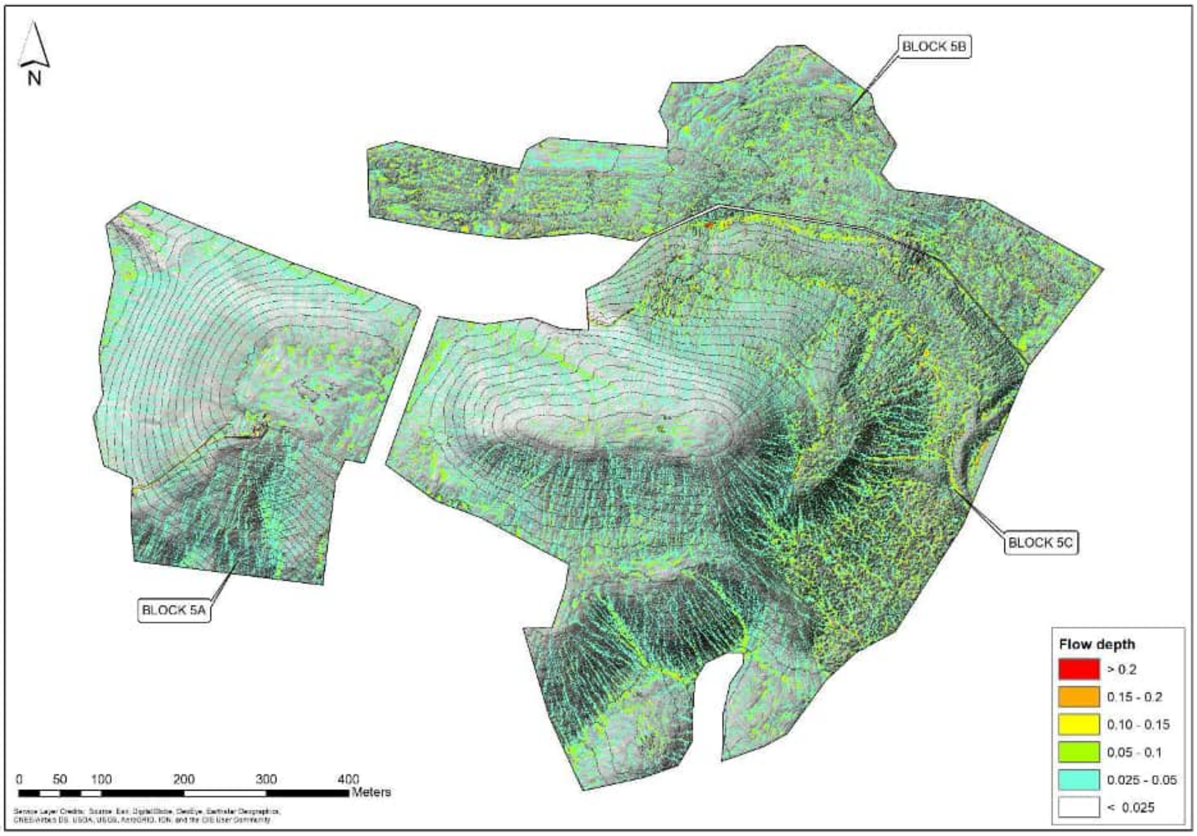


Figure 4.16 Area 5 Flow Depth

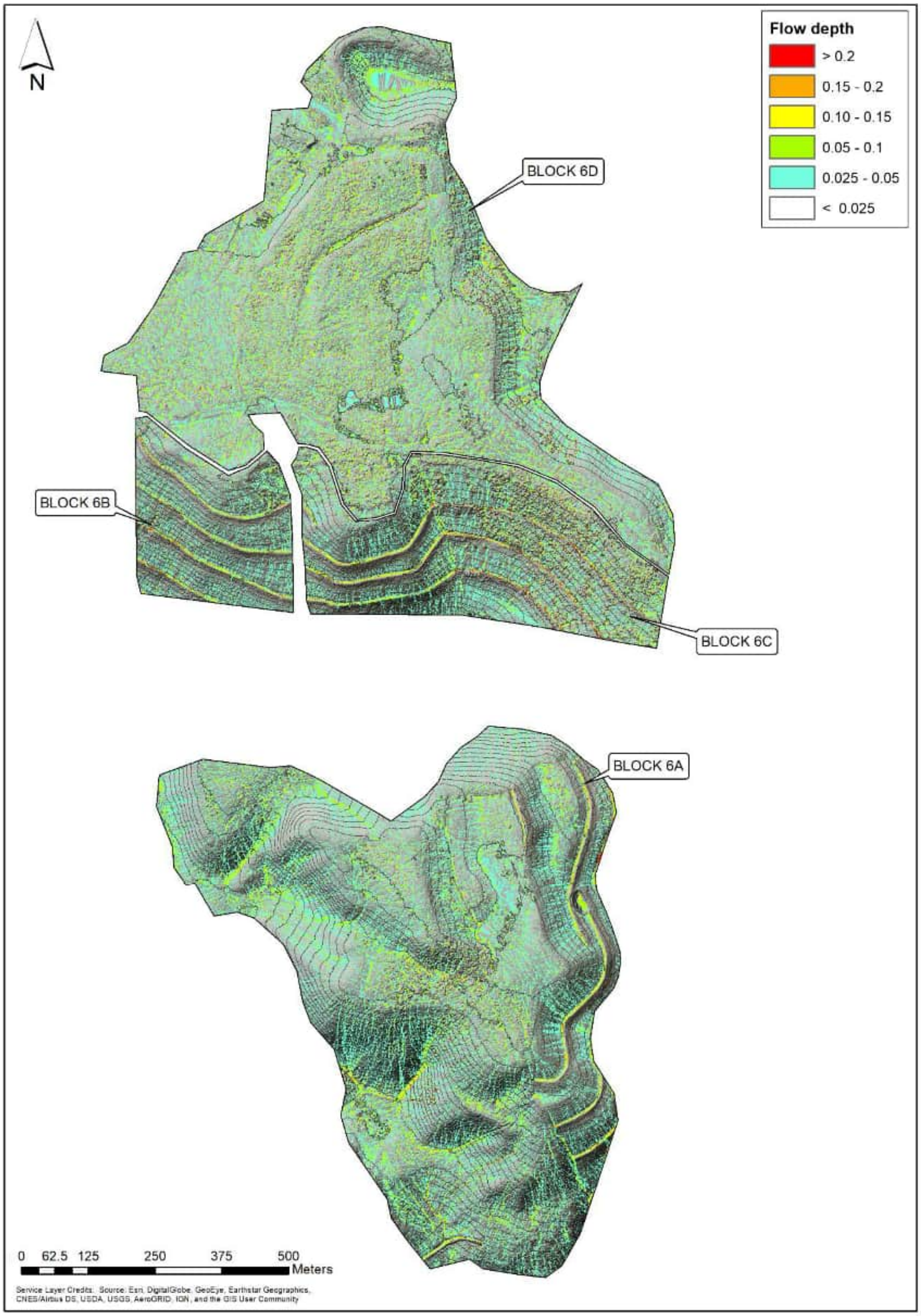


Figure 4.17 Area 6 Flow Depth

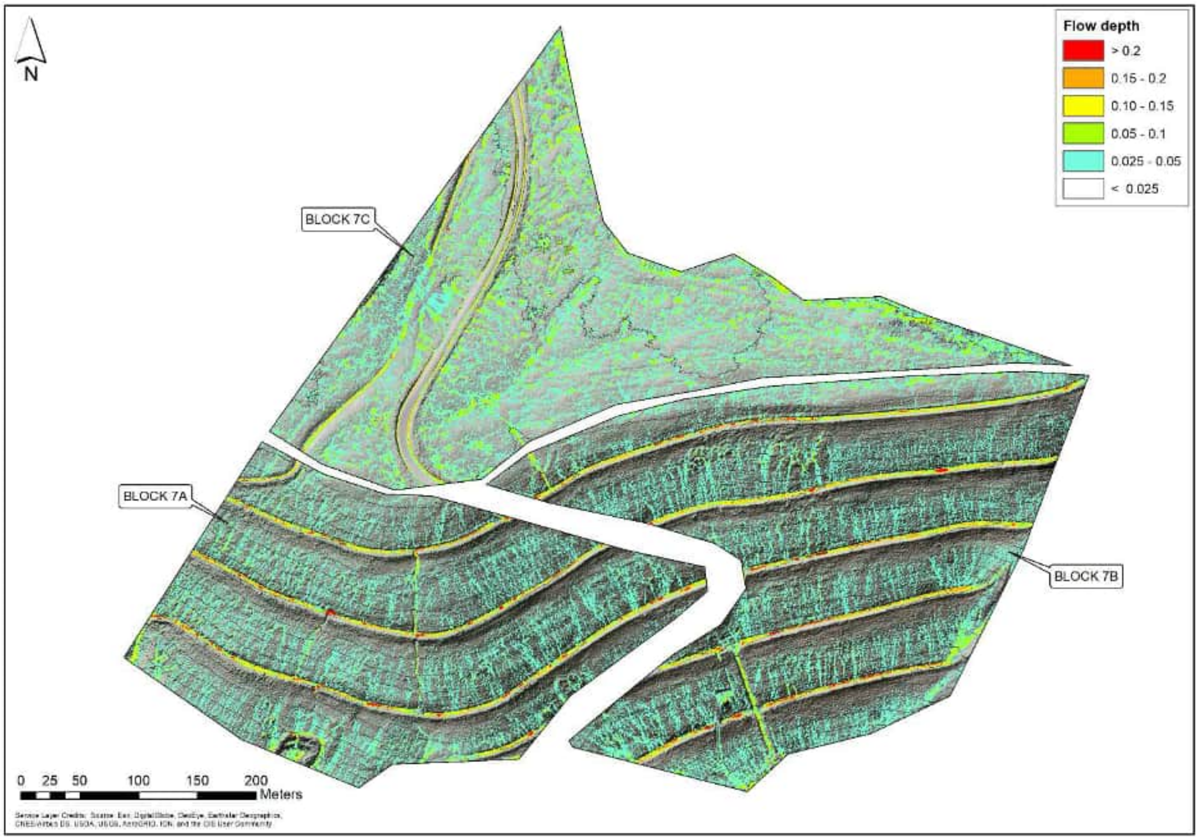


Figure 4.18 Area 7 Flow Depth

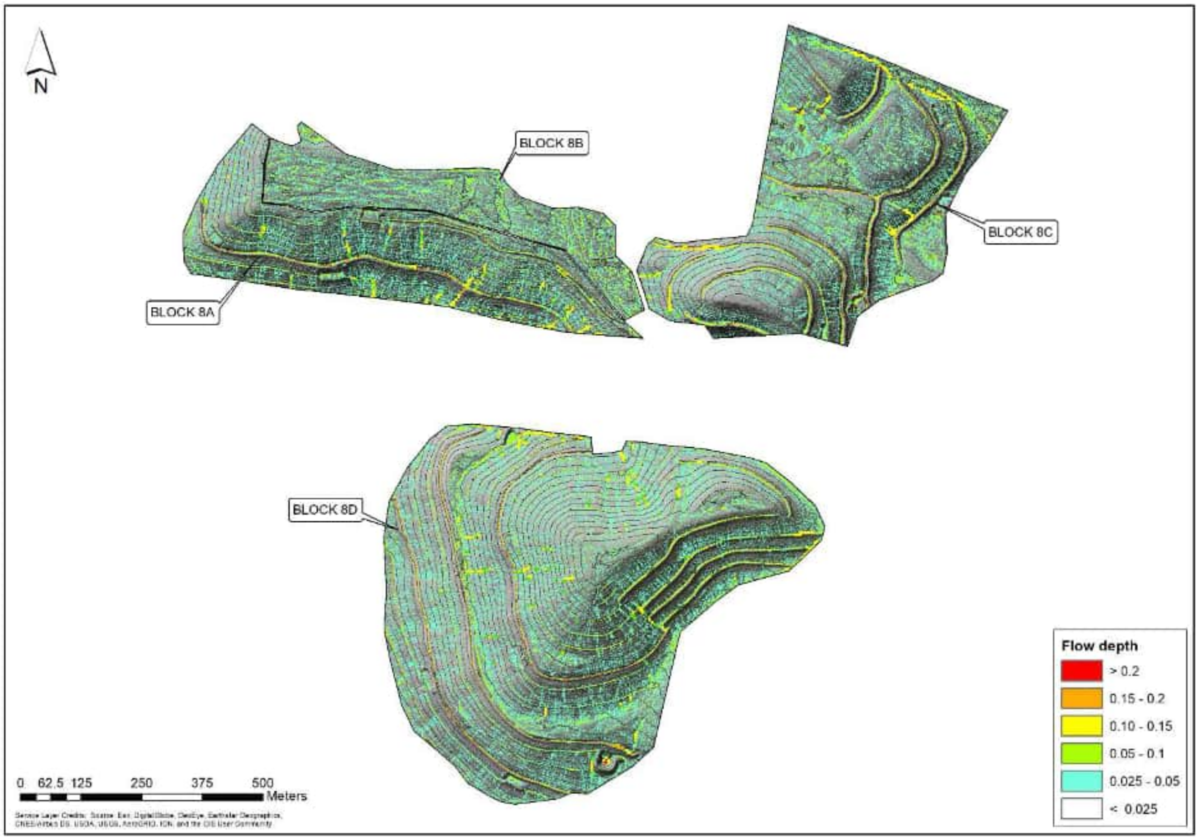


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Figure 4.19 Area 8 Flow Depth

APPENDIX C

Erosion Rates.

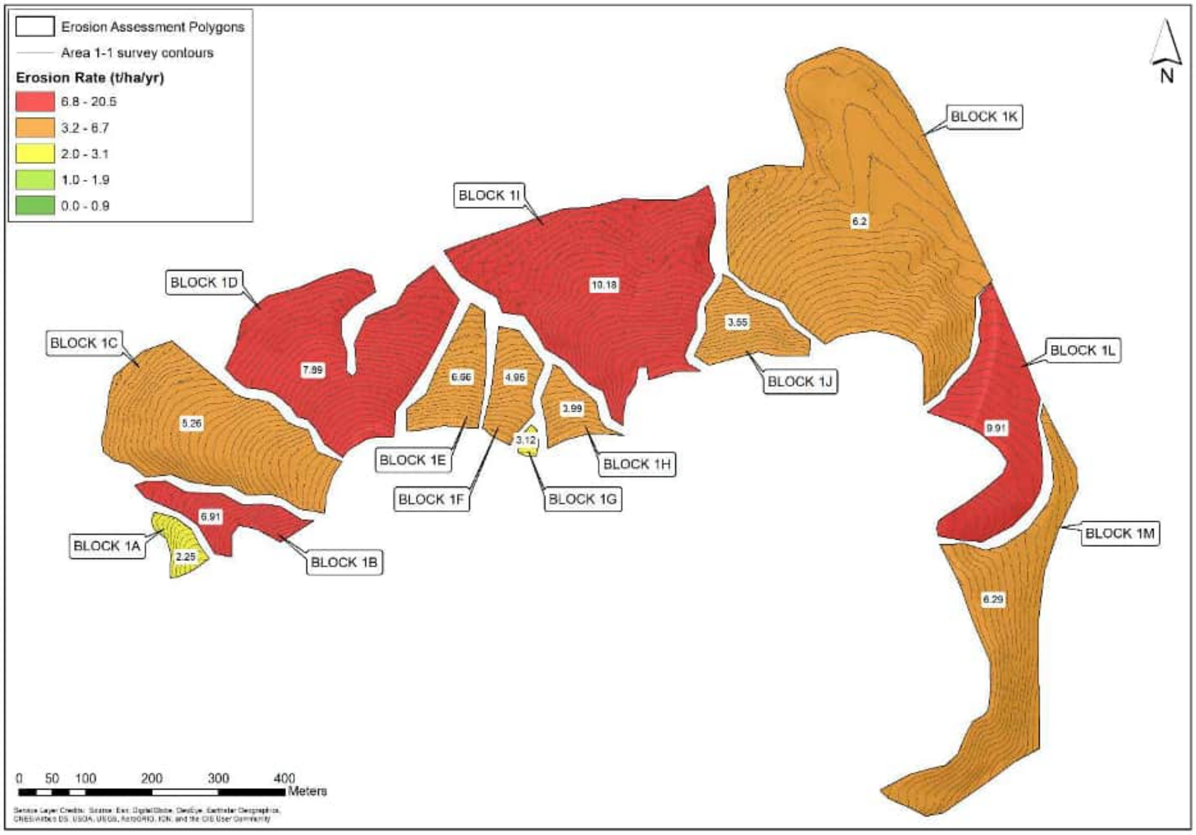

Figure 4.20 : Erosion rates for Area 1-1

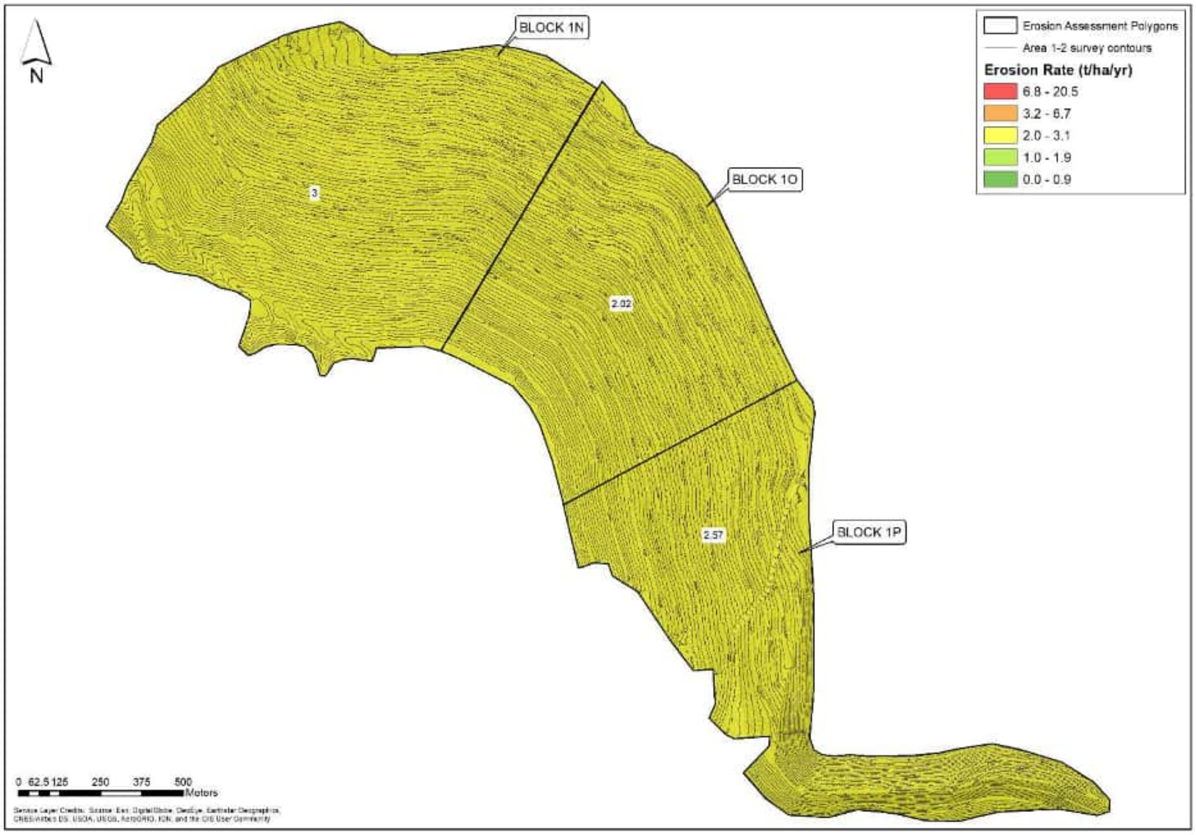

Figure 4.21 : Erosion rates for Area 1-2

Figure 4.22 : Erosion rates for Area 1-3.

Figure 4.23 : Erosion rates for Area 2

Figure 4.24 Erosion rates for Area 3

Figure 4.25 Erosion rates for Area 4

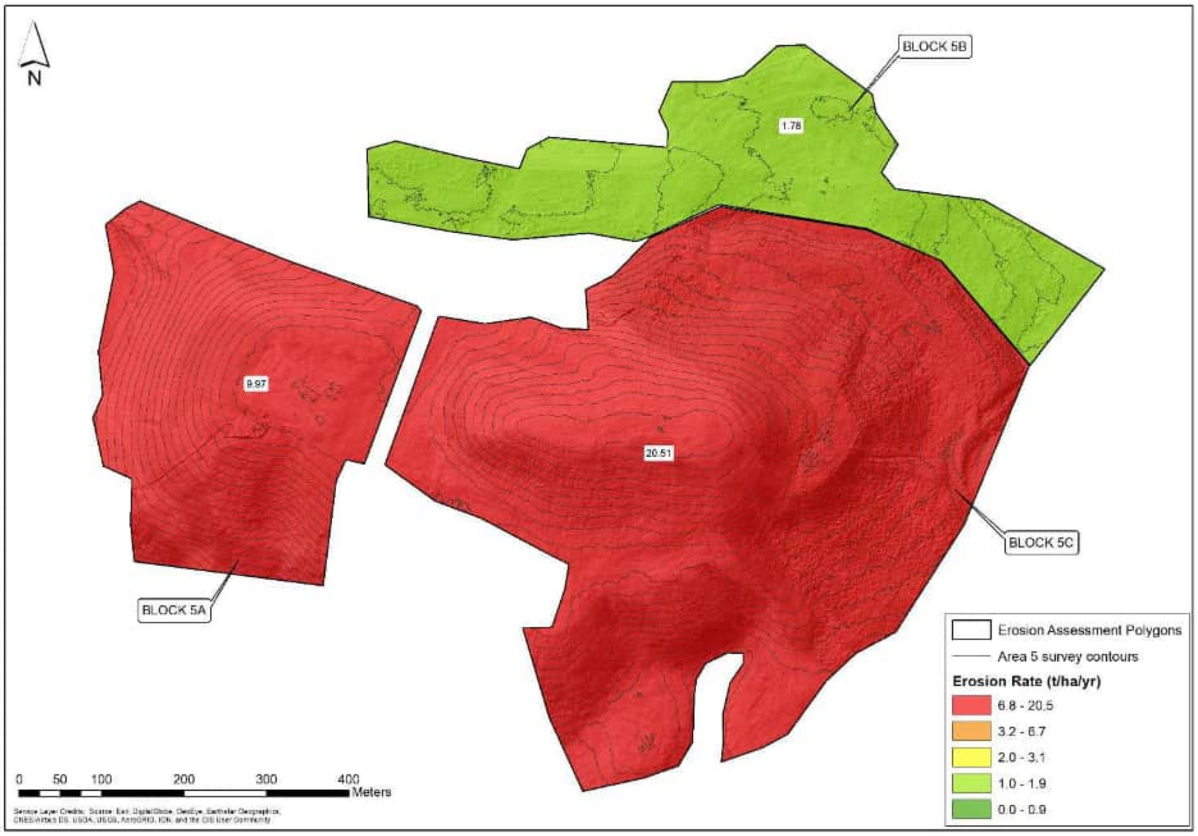

Figure 4.26 Erosion rates for Area 5

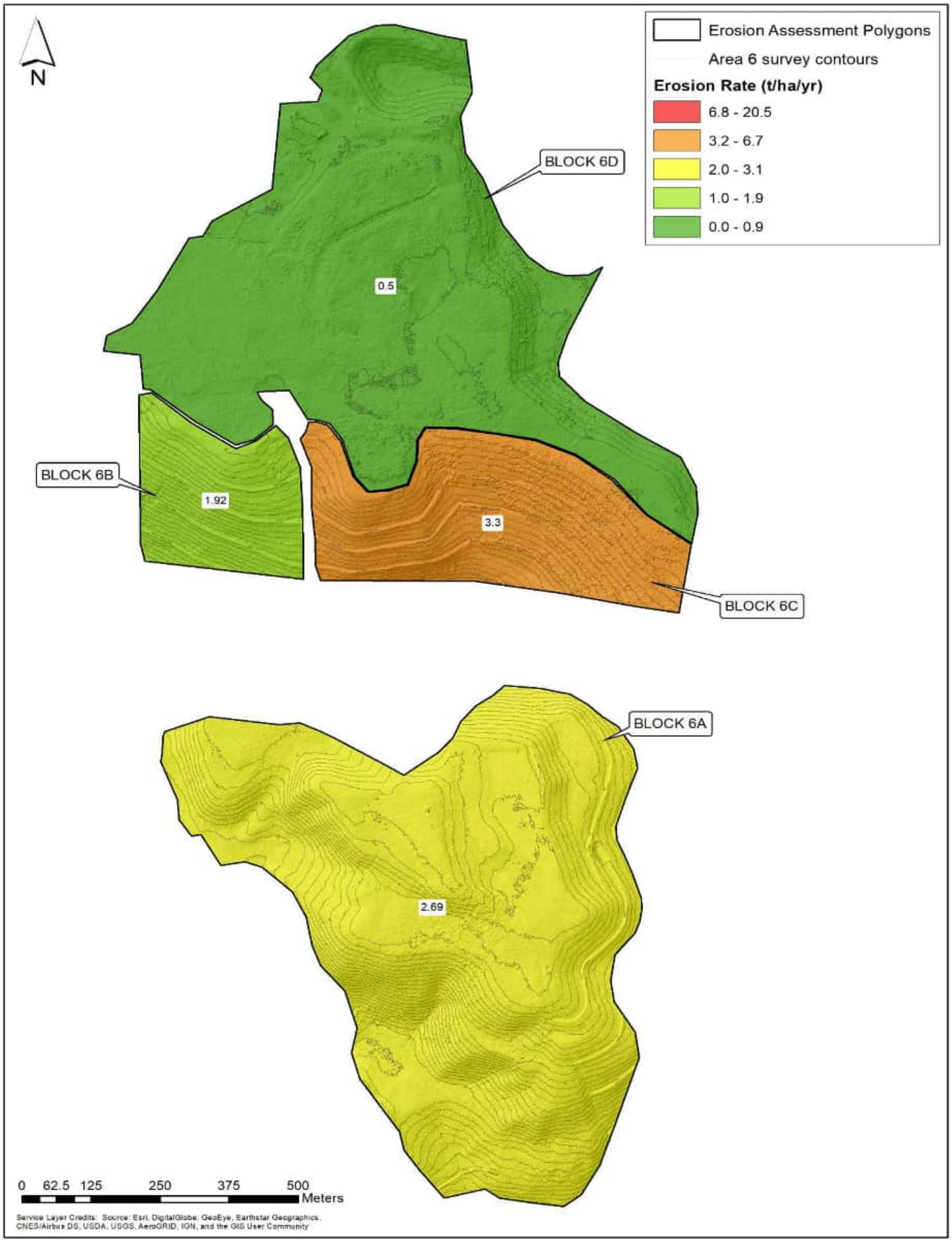

Figure 4.27 Erosion rates for Area 6

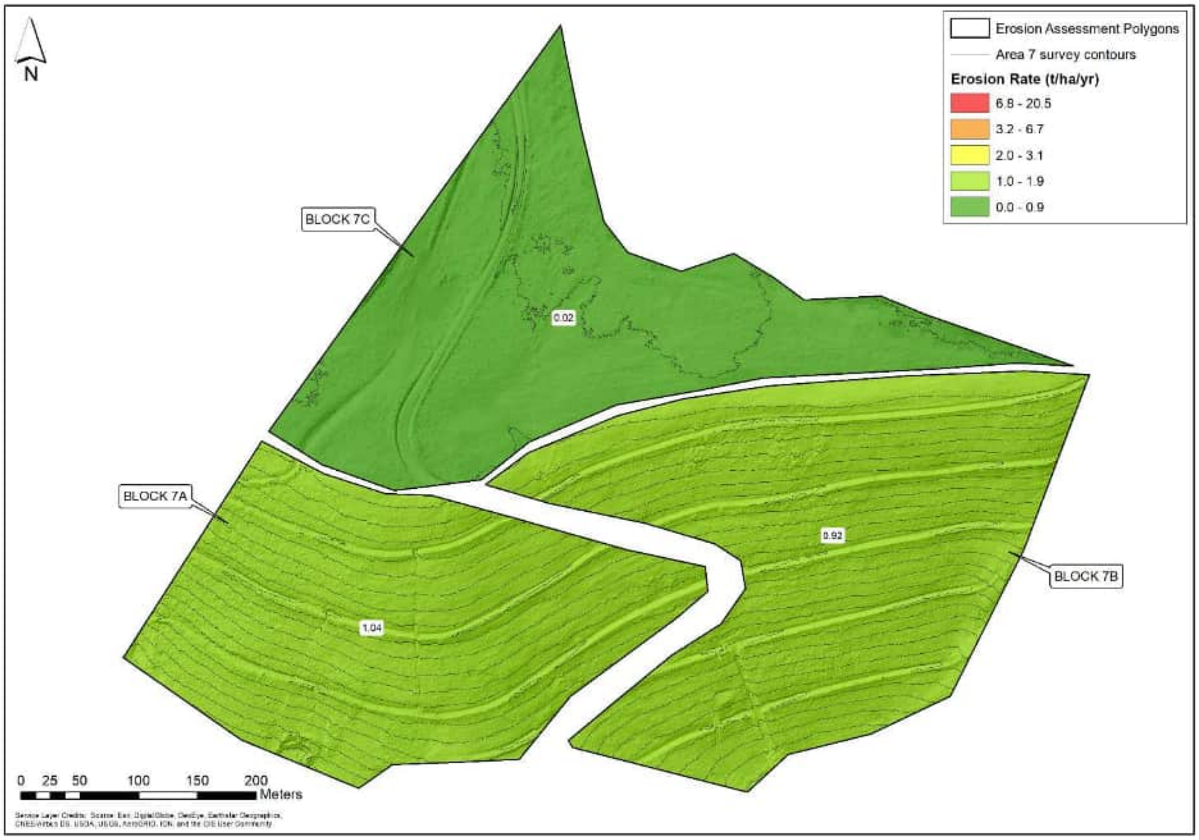

Figure 4.28 Erosion rates for Area 7

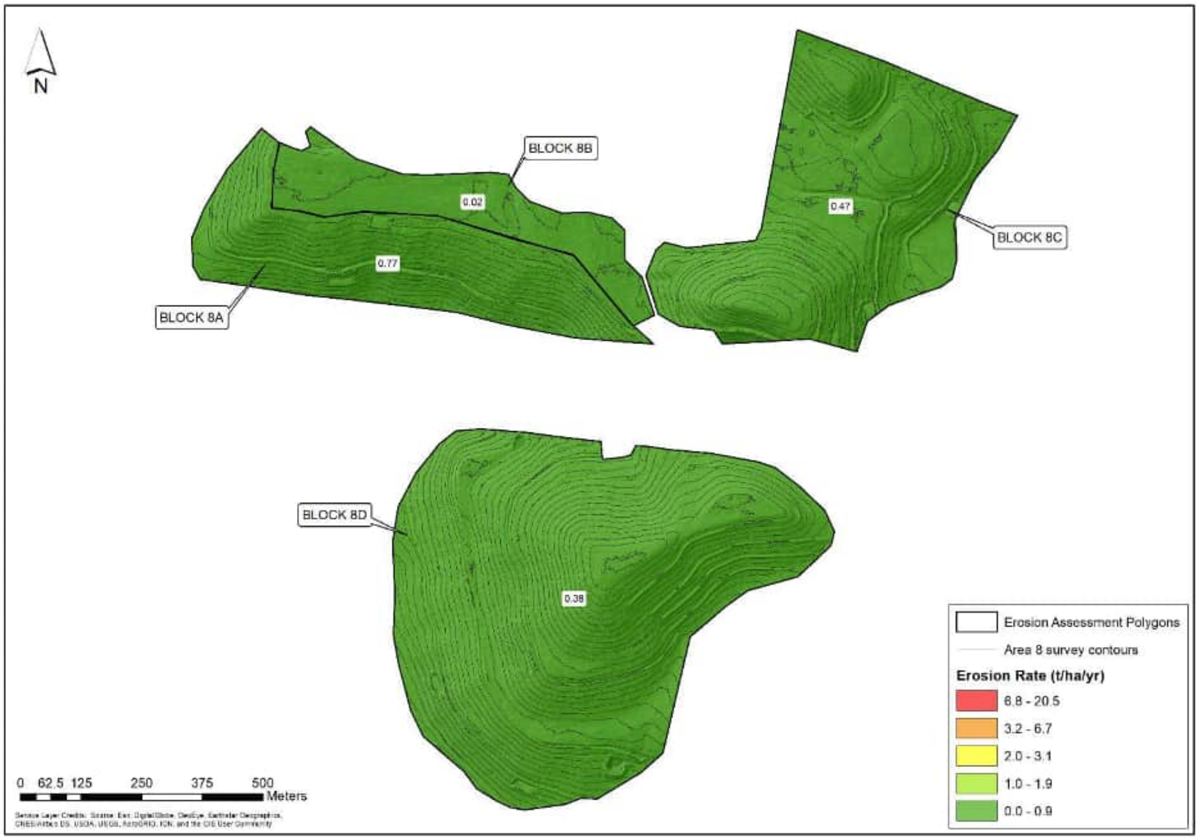

Figure 4.29 Erosion rates for Area 8

Appendix 6 Baiting & Weed Management Reports

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Mt. Arthur Coal - Mineco Weed Treatment Report

July 22 – March 23

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1. Contents

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Abbreviations and Acronyms

BEMC Bushfire Environmental Management Consultancy

MAC Mount Arthur Coal

WMP Weed Management Plan

LLS Local Land Services

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Title:	Mt Arthur Coal – Mineco Weed Treatment Report
Description:	Weed Control Activity Summary
Created By:	Dave Rae Drae@mineco.net.au 0436 323 545
Prepared For:	Jonathon Deacon Principal Environment Mt Arthur Coal / NSW Energy Coal

2. Summary

Following on from the FY21 land management program Mineco continued to provide environmental support to Mt. Arthur Coal (MAC). A weed management plan (WMP) was devised by Mineco in July 2021 to direct efforts for the following 12 months with input from Mt. Arthur Coal HSE department and Bushfire Environmental Management Consultancy (BEMC). The plan was based upon site survey work conducted during June and July of 2021. Plant species to be controlled were identified in consultation with site land use objectives, Biosecurity Act 2015 and publications from Local Land Services (LLS).

i. Aims

The objective of the WMP was to map out weed targets and break the expansive site down into regions of varying priority. Priority was assigned to protect areas that had already received investment in improvement or to areas earmarked for revegetation. This would allow Mineco to plan resource requirements more effectively and ensure that weeds were controlled with the view to improving native biodiversity on site. This weed management report aims to capture the work conducted in line with the MAC WMP for FY23. Variations to the plan are also captured here where priority weeds presented themselves outside the scope of the original surveys conducted to develop the MAC WMP.

The techniques utilised for managing weeds by areas was determined to support the MAC Rehabilitation Strategy (2018). Final land use allocations can be broadly broken down into pasture or native vegetation corridors. Native vegetation areas required more selective application of control measures to protect the diversity of species found within and ensure minimal negative impact of control measures. Pasture areas were more suitable for broad acre spraying as lower species diversity made identifying herbicide that would not impact on the crop mix used more feasible. Identifying areas suitable for boom spraying to deliver highest control efficiency was undertaken but also limited by factors such as access, slope and ground cover.

This document aims to capture the activities undertaken between 1st July 22 and 20th March 2023. Record keeping of weed management techniques is critical to future planning of an economical integrated management approach. Avoidance of herbicide resistance in weed populations on site should always be taken into consideration requiring review of past control efforts. Reporting on weed activity areas should also, over time, begin to show that changes of weed populations on site and the efficacy of specific control measures.

Work captured in this report falls under two categories; Treatment of a target area such as the existing rehabilitated structures identified in the MAC WMP (e.g. VD1-N1) or as a campaign targeting specific species of plant. A section of this document will be attributed to each of the treatment polygons worked in during the survey period and the campaigns. These sections will detail the species identified in the MAC WMP 2022, if the weed was treated, the treatment method employed and the approximate coverage of area treated in that polygon or campaign.

Each polygon worked in over the survey period will have a figure provided for the rough area where work has been done. In most cases this will be expressed as two figures. First as “Area treated”, meaning how much of the polygon saw some form of treatment. The second figure referred to as “Area Handled” accounts for some species requiring follow up treatments which is important to consider for resource allocation purposes. By this means there will be cases where the area handled is greater than the total area of the polygon but does not insinuate that every hectare of the polygon was treated. Take the following example:

A field of 15 Hectares needs to be boom sprayed for Heliotropium amplexicule (Blue Heliotrope). The operator notices while working that one corner of the field has no occurrence of the weed and does not spray this area. Upon viewing the GPS field coverage on a map it is found only 12Ha of the area was sprayed. With blue heliotrope being notoriously difficult to eradicate it is decided that a follow up spray is warranted which subsequently occurred over 5Ha where the plant remained. In this example the coverage of treated area is 12Ha, but the area handled is 12Ha + 5 Ha = 17Ha. We can see here how an area of 15Ha may require 17Ha worth of machine and personnel time. Where possible both figures are provided.

ii. Methodology

The capture of information tracking weed management at MAC was conducted via ground truthing, garmin GPS, daily activity reports and daily herbicide usage forms. Initial ground survey was conducted by Mineco in conjunction with BEMC to determine where weed populations were occurring. Visual weed identification was recorded and relative densities over the area estimated and used to break specified areas into treatment polygons. As often as possible when weed treatment was executed the area was logged using hand held GPS units. Trace of path was logged for most spraying and in the case of African olive and African boxthorn waypoints were taken of individual plants as treatment occurred.

In accordance with Australian Pesticide and Veterinary Medicines Authority (APVMA) requirements daily herbicide usage is recorded. This is recorded against each treatment area to summarise the type and cumulative amount of herbicide used. to assist MAC in tracking historic herbicide usage for purpose of tracking treatment efficacy and any resistance issues that arise in future.

iii. Weed Treatments

Treatment of weeds at Mount Arthur was conducted with a variety of chemical and mechanical agents. The methods of weed control employed at MAC over the report period are summarised below.

iv. Mechanical

Slashing

Slashing is an economical method of treating large areas of pasture and minor vegetation by cutting plants off at a set height above ground. The slasher is drawn and powered by a tractor in the case of the weed management conducted as part of this program. Tractor drawn slashers deliver high power capable of levelling agricultural weeds as well as ease of maintenance. Slashing was only chosen as a control option in areas that lacked native saplings or were seeded with the MAC pasture mix. Slashing of weeds prior to seeding can be an effective means of breaking the plants life cycle by preventing development of viable seed on maturing plants. Slashing was also a useful tool for reducing vegetation height prior to boom spraying of broad leaf herbicide. In many areas agricultural weeds such as Purple top (Conyza bonariensis) were tall enough to interfere with spray boom extension and needed to be reduced initially.

Physical Removal

To treat prickly pear this method was deployed on site due to its low density but wide spread presence appearing in most surveyed areas. This involved comprehensively chipping root matter out of the ground using a mattock or spade. Collection of the entire plant was then undertaken with all matter being removed to an active area of earthworks for deep burial on site.

Rolling

Rolling involves the use of a steel drum drawn behind a tractor with blades running perpendicular to the direction of travel. The steel blades serve to perforate the ground improving soil water retention as opposed to runoff or pooling. The cutting action of the blades against the ground also disrupts plant growth and can form a layer of compost. Where slashing may not be feasible due to fire risk or rocky ground rolling can be utilised as a stand alone control method or to prepare the ground for follow up herbicide application by lowering ground cover level.

Mulching

Where African boxthorn and African olive were deemed to be growing most densely a tracked mulcher was utilised to clear the ground. The tracked unit was operated remotely to avoid hazards associated with operators working in cabin on sloping terrain. Many boxthorn plants were too large to economically cut down and treat via the cut stump method due to grass growing through the plants. The mulcher relies on a front mounted rotating drum with tungsten carbide inserts to desiccate groundcover. The mulcher was able to cut through the plants easily but required follow up herbicide treatment to supress regrowth once the trunk of the plant could be accessed.

v. Herbicide

Knapsack

15 Litre knapsacks allow for liquid spot spraying low density plants where low volumes of herbicide are expected to be used for the day. The knapsack consists of a storage tank worn like a back pack and a spraying hand piece, pressure is supplied through a hand operated pump. They have an advantage over items like the high volume spray rigs as they can be deployed as far from the daily work area as the operator can safely walk. This makes them particularly useful in wooded areas as there is no trailing cable to limit work area or become entangled on trees and ground cover.

Handgun

High volume liquid application device powered and supplied by a vehicle mounted spray rig. A hand piece with a trigger allows an operator on foot to spot spray or broadcast a jet over wider areas. Good surface area coverage is easily achieved which is critical to herbicide efficacy. This method is limited to areas where spray rig vehicle can be parked up close enough for the hand gun hoses to reach.

Boom Spray

An array of nozzles mounted on a boom arm that runs perpendicular to the direction of travel are used to deposit liquid herbicide on plants. This offers a high level of control over the amount of herbicide applied per hectare and good coverage beneath the width of the boom. Pressure is supplied to the system by a PTO coupling or an independent tray mounted motor. Due to its deployment on a vehicle care must be to ensure boom spraying is not conducted in an area containing native ground cover and saplings if the area is targeting native vegetation for it's final land use. Many selective herbicides will still have a detrimental effect on off target native species and individual plants cannot be targeted easily.

Cut Stump / cut and paint

Treatment of African boxthorn (Lycium ferocissimum) and African olive (Olea europaea subsp. Cuspidata) was primarily undertaken via this method during the survey period. Cutting of the trunk is achieved with polesaws, chainsaws or telescopic pruning saw for smaller stems and roughly 10-15cm above ground level. Most useful on woody trunked weeds that prove difficult to control by foliar spraying. The benefit of the cut stump method is that it directly prevents the plant from contributing more seed to the soil even if the applied herbicide requires follow up treatments to kill the plant. Triclopyr based herbicide needs to be applied to the cut stump as soon as possible for most effective control.

Weed Wiping

A technique where herbicide is painted directly to the foliage of a plant with a wicking medium. Can be undertaken by hand or with a trailing unit pulled by a tractor / quad or light vehicle.

Basal Bark Spraying

Herbicide is applied directly to the bark of the target plant rather than sprayed over the foliage. Usually recommended for woody weeds with stem/trunk width less than 5cm diameter. Care must be taken by operator to sufficiently cover all bark up to a meter above ground level and is sensitive to damp conditions.

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Often due to the difficulty in accessing the stems of African boxthorn it is more time effective to rely on the cut stump method.

Figure 1: Weed Species indentified in MAC Operational Area

Scientific name	Common name	Life Cycle Habit	Priority
Acacia saligna	Golden wreath wattle	Perennial	Medium
Asphodelus fistulosus	Onion weed	Annual to Biennial	Medium
Brassica sp.	Wild turnip / mustard weed	Annual	Low
Bryophyllum sp.	Mother of millions	Perennial	HIGH
Brassica nigra	Black mustard	Annual	Low
Carthamus sp.	Thistle	Annual	Low
Cenchrus clandestinus	Kikuya	Perennial	Medium
Cenchrus longispinus	Spiny Burr Grass	Annual	Low
Cechrus sp.	Grass sp.	Annual	Low
Chloris gayana	Rhodes grass	Perennial	Medium
Conyza bonariensis	Flax-leaf Fleabane	Annual	Low
Cortaderia sp.	Pampas grass	Perennial	HIGH
Datura sp.	Thornapple	Annual	Medium
Echium plantagineum	Paterson's curse	Annual	HIGH
Galenia pubescens	Galenia	Perennial	Medium
Gomphocarpus fruticosus	Narrow leaf cotton bush	Perennial	Medium
Heliotropium amplexicaule	Blue Heliotrope	Perennial	HIGH
Hyparrhenia hirta	Coolatai grass	Perennial	HIGH
Hypericum perforatum	St Johns wort	Perennial	HIGH
Lycium ferocissimum	African boxthorn	Perennial	HIGH
Melinis repens	Red natal grass	Short lived perennial	Low
Malva sp.	Mallow	Biennial to perennial	Medium
Olea europea cuspidata	African Olive	Perennial	HIGH
Opuntia sp.	Prickly pear	Perennial	HIGH
Panicum sp.	Panic grass	Perennial	Low
Phytolacca octandra	Inkweed	Short lived perennial	Medium
Senecio madagascariensis	Fireweed	Short lived perennial	Low
Sida rhombifolia	Paddys lucerne	Perennial	Medium
Solanum linnaeanum	Apple-of-sodom	Perennial	Medium
Sorghum halepense	Johnson grass	Perennial	HIGH
Tagetes minuta	Stinking roger	Annual	Low
Verbena bonariensis	Purple top	Perennial	Low
Xanthium Spinosum	Bathurst Burr	Annual	Medium
Xanthium Occidentale	Noogoora Bur	Annual	Medium

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3. Weed Treatment Activity

vi. VD1

Weed treatment in VD1 was focused on the areas identified as highest priority in the MAC WMP 2022. The priorities were assigned for this area based upon the expectation that a tubestock revegetation program was projected for the exotic grass land that characterised the upper slopes of VD1. In preparation for this the revegetation area was assigned highest priority (VD1-N1) and efforts focussed on clearing this area of priority broadleaf weeds. Areas directly adjoining this revegetation polygon were attributed priority for treatment with descending levels of urgency proportional to their distance from VD1-N1. Some weed treatment was also carried out in lower priority regions due to wet weather access restrictions to the highest points of the hill. An overview of the treatment polygons can be seen in Figure 2: VD1 Treatment Polygon Overview.

The plan to use the available tube stock in the VD1-N1 area was changed in late September. At time of writing there are plans in place that will involve some surface disturbance to the VD1 structure. Rather than preparing VD1 for the tubestock the plan changed to focus more on supressing heavy infestations of African boxthorn. The goal was to heavily reduce the population prior to any ground disturbance to limit the effect of mature bushes contributing seed to turned over ground which would see the population increase drastically.

The current goal for the VD1 structure is to achieve a box woodland ecological community (MAC Biodiversity Management Plan 2019). Outside of the established revegetation areas the greatest challenge will be breaking up the domination of exotic grasses such as Cenchrus clandestinus (Kikuyu) and Chloris gayana (Rhodes grass). These grasses are currently providing erosion control and groundcover which out competes other broad leaf weeds. The removal of broad areas of this grass should be approached in an integrated fashion when more native revegetation work is able to be carried out. As no revegetation work was to occur in this survey period it was decided to not actively target the wide spread exotic grass species to prevent creating a larger problem by exposing topsoil and having no native vegetation to replace it with.

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Figure 2: VD1 Treatment Polygon Overview

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VD1-N1

Figure 3: VD1-N1 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD1-N1	Coolatai Grass	Spot Spray	Roundup Ultramax	October
	African Boxthorn	Cut Stump / basal Bark	Vigilant II / Garlon 600	July - continuing
		Mulching		
	Prickly Pear	Physical Removal	Nil	July - continuing
	Fireweed	Not Treated	N/A	N/A
	Golden wreath wattle	Not Treated	N/A	N/A
	Kikuyu	Not Treated	N/A	N/A
	Rhodes Grass	Not Treated	N/A	N/A
	Paddys Lucern	Spot Spray	Grazon Extra	October - December
	Galenia	Spot Spray	Grazon Extra	July - continuing
	Blue Heliotrope	Spot Spray	Grazon Extra / metsulfuron	October - continuing

Size (Ha)	***49***
Handled (Ha)	***76***
Coverage (Ha)	***37***

VD1-N1	
Herbicide Used	**Volume (L)**
Grazon	7.2
Vigilant II	0.4
Wetter 600	0.07
PicTric	3.6
Garlon 600	4.3
Roundup Ultramax	2.76
Metsulfuron (g)	40
Dinkydye	0.25
Diesel	126

Figure 4: VD1-N1 Treatment Tracks Shows the areas covered by land management teams in the work conducted in VD1-N1 treatment area. General spraying was conducted using a spray rig's hand guns and knapsacks. This targeted the dense galenia patches, blue heliotrope, mustard weed, coolatai grass and paddy's lucern. As the herbicides were appropriate multiple weeds were targeted with each days spraying.

The bulk of the effort in VD1-N1 focused on the African Boxthorn. Given the amount of area surveyed in the course of works for the year it was concluded that VD1-N1 contained the densest population of African Boxthorn in VD-1. Methods employed involved cut stump treatment with a pole saw in a two man team with the second man applying herbicide. Many plants in this area grew so densely the polesaw was unable to access the trunks effectively. It was found that the mulcher unit needed to be mobilised to treat these areas. The mulching of boxthorn will be discussed in detail in a further section of this report.

Large patches of coolatai grass were also identified and had received some treatment commencing in October. Due to higher priorities (chiefly the St. John's Wort out break and the African Olive campaign) The coolatai grass received relatively little attention. It can be found at the crest of the hill trending down slope in sparse patches to larger outbreaks in open ground. Area for follow-up purposes displayed in Figure 5: Coolatai Grass Treatment Area. Due to proximity to revegetated areas this would be ideally treated via slashing and weed wiping to avoid off target damage.

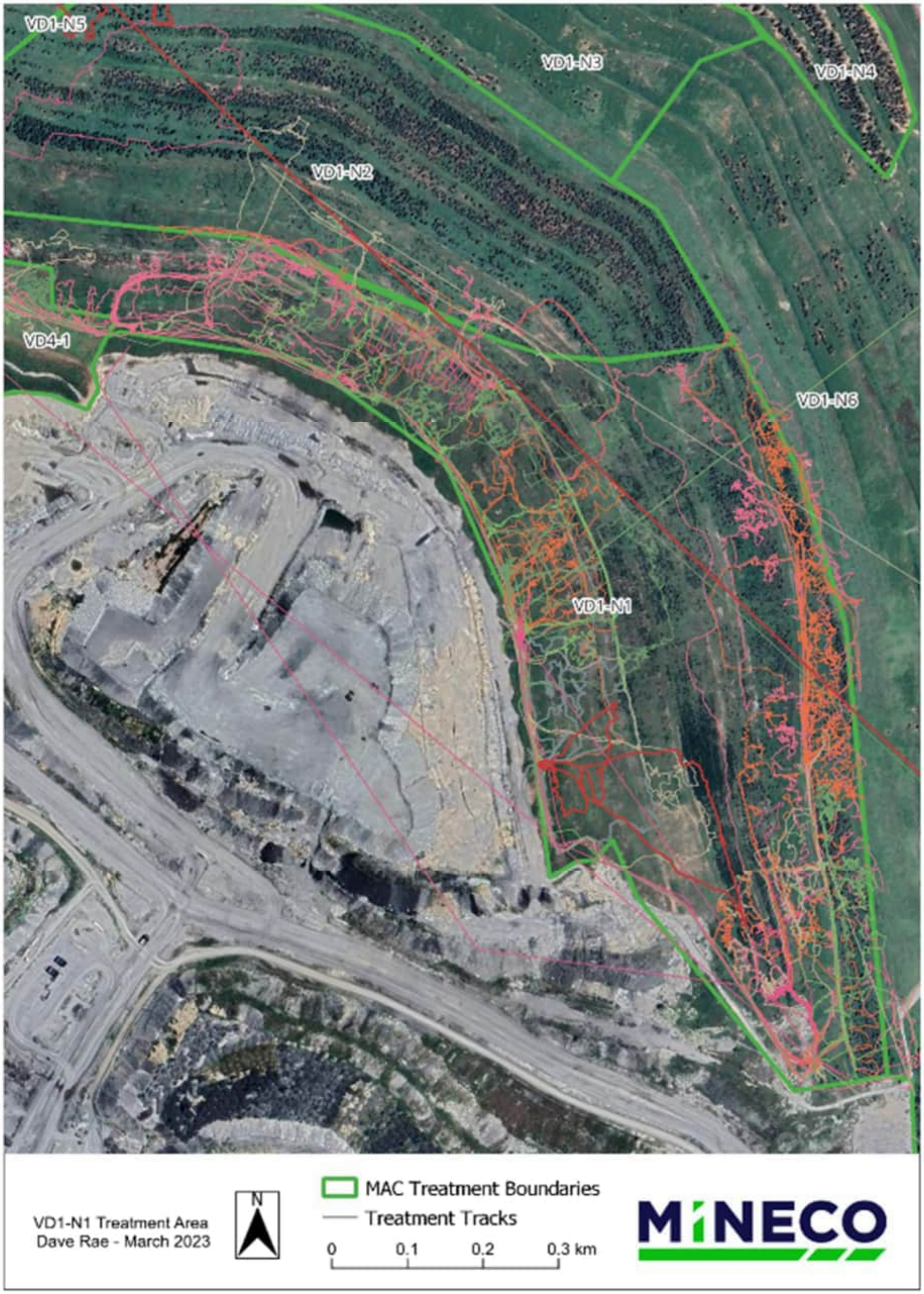

Figure 4: VD1-N1 Treatment Tracks

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Figure 5: Coolatai Grass Treatment Area

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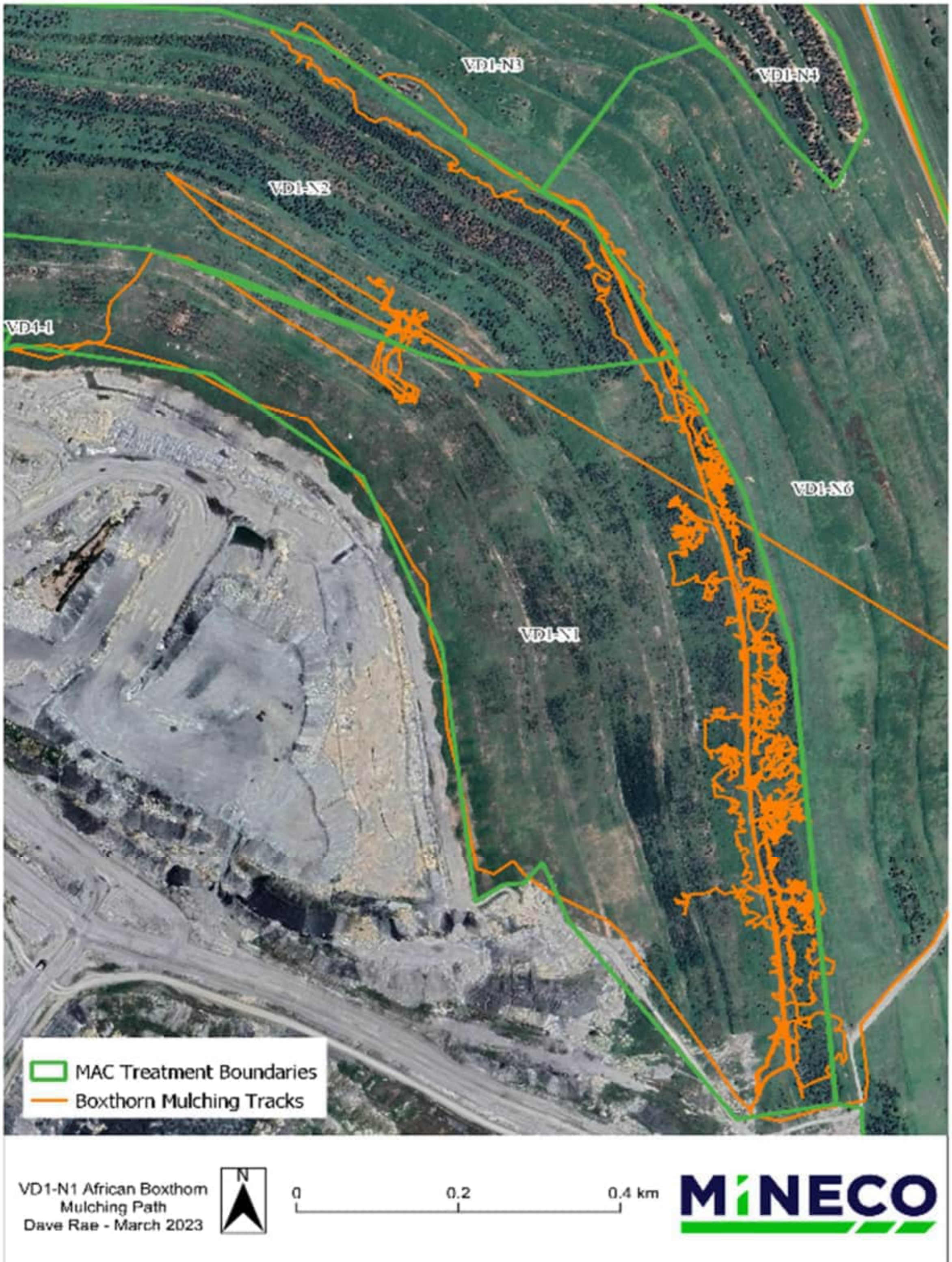
Figure 6: Mulched Boxthorn Tracks VD1-N1



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VD1-N2

VD1-N2 consists of an established revegetation zone in the mid contours of the VD-1 structure. Treatment in this area was primarily undertaken with knapsack due to the uneven ground making access with a spray rig difficult. The dense vegetation has controlled exotic grasses which are only able to grow on the contour banks. Golden wreath wattle exists most heavily in this area and was likely introduced with the native revegetation under earlier biodiversity objectives. The density of stems in this area is greater than required for current objectives so golden wreath wattle removal should be conducted as a means of improving the ecological community.

Galenia, blue heliotrope and African boxthorn were found to grow in dense patches spread throughout wooded areas where the ground is bare of native ground cover. Treatment tracks walked can be seen in . The St. John's Wort and Johnson grass listed in the MAC WMP 2022 were not found, likely misidentified due to the season initial surveys were conducted.

Figure 7: VD1-N2 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD1-N2	Coolatai Grass	Not Treated	N/A	October
	African Boxthorn	Cut Stump	Vigilant II/Garlon 600	August / November
		foliar spray	Grazon Extra	August
	Prickly Pear	Physical Removal	Nil	August
	Fireweed	Not Treated	N/A	N/A
	Golden wreath wattle	Not Treated	N/A	N/A
	Kikuyu	Not Treated	N/A	N/A
	Rhodes Grass	Not Treated	N/A	N/A
	Paddys Lucern	Spot Spray	Grazon Extra	August
	Galenia	Spot Spray	Grazon Extra	August
	Blue Heliotrope	Spot Spray	Grazon Extra / metsulfuron	August
Size (Ha)	***29***			
Handled (Ha)	***18***			
Coverage (Ha)	***18***			

VD1-N2	
Herbicide Used	**Volume (L)**
Grazon	2.7
Vigilant II	0.05
Wetter 600	0.02
PicTric	0
Garlon 600	0.1
Roundup Ultramax	0
Metsulfuron (g)	14
Dinkydye	0
Diesel	3

Figure 8: VD1-N2 Treatment Tracks

VD1-N3

Little work was conducted in the VD1-N3 polygon due to more urgent priorities arising and no attention for this poly was directed by the MAC WMP 2022 for the first 12 months. Some spraying was conducted closest to the boundary with VD1-N2 with the goal of identifying if there were any risks to the VD1-N2 polygon. No significant outbreaks of priority weeds were identified. Over the area sprayed only galenia and prickly pear were encountered.

Figure 9: VD1-N3 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD1-N3	Coolatai Grass	Not Treated	N/A	N/A
	African Boxthorn	Not Treated	Vigilant II/Garlon 600	N/A
		Not Treated	Grazon Extra	N/A
	Prickly Pear	Physical Removal	Nil	July
	Fireweed	Not Treated	N/A	N/A
	Golden wreath wattle	Not Treated	N/A	N/A
	Kikuyu	Not Treated	N/A	N/A
	Rhodes Grass	Not Treated	N/A	N/A
	Paddys Lucern	Not Treated	Grazon Extra	N/A
	Galenia	Spot Spray	Grazon Extra	July
	Blue Heliotrope	Not Treated	Grazon Extra / metsulfuron	N/A
Size (Ha)	***17***			
Handled (Ha)	***2***			
Coverage (Ha)	***2***			

VD1-N3	
Herbicide Used	**Volume (L)**
Grazon	1.275
Vigilant II	0
Wetter 600	0.015
PicTric	0
Garlon 600	0
Roundup Ultramax	0
Metsulfuron (g)	3
Dinkydye	0
Diesel	0

Figure 10: VD1-N3 Treatment tracks

VD1-N5

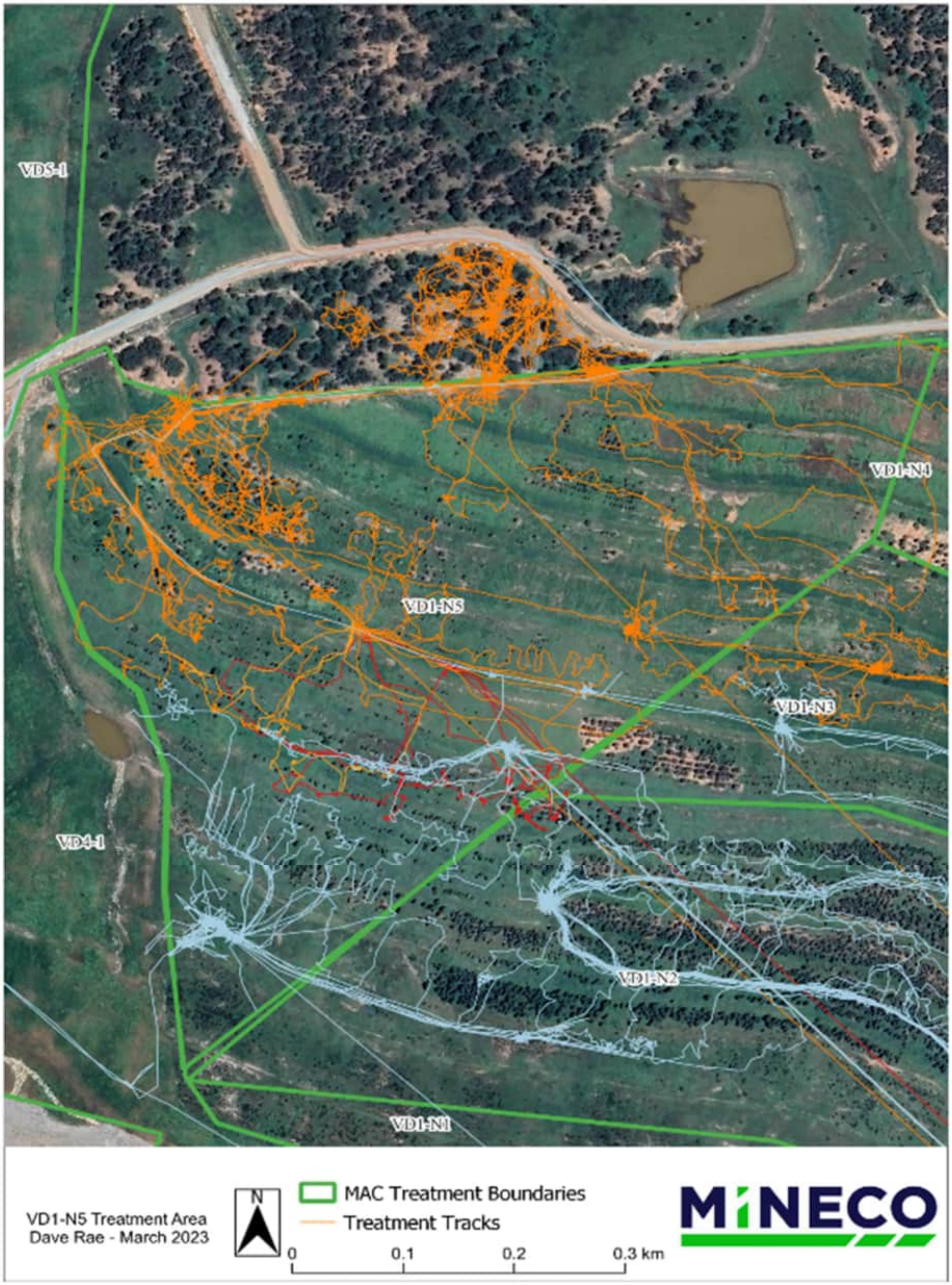
VD1-N5 received spot spraying during July prior to the development of the MAC WMP 2022. It was also targeted during weather events that prevented access to the higher priority areas due to steep clay tracks becoming slippery. Spot spraying identified some weeds such as Paterson's curse that were not picked up on the initial inspection. Galenia grows in the open grassy areas of this polygon, other priority weeds (African boxthorn, blue heliotrope and Paterson's curse) occurred directly on the contour banks.

Figure 11: VD1-N5 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD1-N5	Paterson Curse	Spot Spray	Grazon Extra	July
	African Boxthorn	Cut Stump	Vigilant II	July - September
	Prickly Pear	Physical Removal	Nil	July - continuing
	Fireweed	Not Treated	N/A	N/A
	Golden wreath wattle	Not Treated	N/A	N/A
	Kikuyu	Not Treated	N/A	N/A
	Rhodes Grass	Not Treated	N/A	N/A
	Thistle Sp.	Spot Spray	Grazon Extra	July - September
	Galenia	Spot Spray	Grazon Extra / metsulfuron	July - August
	Blue Heliotrope	Spot Spray	Grazon Extra / metsulfuron	July - August
Size (Ha)	***31***			
Handled (Ha)	***25.2***			
Coverage (Ha)	***20***			

VD1-N5	
Herbicide Used	**Volume (L)**
Grazon	5.2
Vigilant II	0.06
Wetter 600	0.138
PicTric	0
Garlon 600	0
Roundup Ultramax	0
Metsulfuron (g)	10
Dinkydye	0
Diesel	0

Figure 12: VD1-N5 Treatment tracks



vii. VD4-1

VD4-1 is another area designated as woodland corridor. Seed mix was broadcast into this area and currently canopy species saplings can be seen germinating. There is also a wide spread of native groundcover beginning to compete for space. To minimise impact on the native species presenting in VD4-1 spotspraying was exclusively utilised in this area. Boom spraying of Grazon Extra being inappropriate due to the native pea taking hold. The work conducted under this report period was a follow up to a previous treatment of the area by Mineco in FY22.

The area has been to date cleared of all mature boxthorn plants. It is expected there may be more on the northern boundary between VD4-1 and VD1-N5. Walkthroughs of the area should be conducted in accordance with the MAC WMP 2022 to identify any new plants emerging. Inkweed tends to present around the habitat structures installed in the rehab, with thorough follow-up treatments the inkweed should be controlled effectively within 2 years. Onion weed exists most heavily besides the access track leading across the north of the VD4-1 rehab area. This has been treated with Troller herbicide, note the onion weed presented earlier than expected sprouting in late June. Low densities of onion weed throughout the rehab should be sought out to improve control.

A broad outbreak of perennial rye grass has occurred, likely transported into the rehab on vehicles. The outbreak occurs South of the main access track through VD4-1. This may benefit from weed wiping in early spring once it extends above the other ground cover.

Figure 13: VD4-1 Treatment tracks

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD4-1	Coolatai Grass	Spot Spray	Roundup Ultramax	December
	Onion Weed	Spot Spray	Troller	August
	African Boxthorn	Cut Stump	Garlon 600	July - continuing
	Mustard Weed	Physical Removal	Grazon Extra/ Metsulfuron/Pictric	August - September
	Thistle	Spot Spray	Grazon Extra/ Metsulfuron/Pictric	August
	Inkweed	Spot Spray	Grazon Extra/ Metsulfuron/Pictric	August - December
	Mallow	Spot Spray	Grazon Extra/ Metsulfuron/Pictric	August - September
	Galenia	Spot Spray	Grazon Extra/ Metsulfuron/Pictric	August - December

Size (Ha)	***28***
Handled (Ha)	***21.5***
Coverage (Ha)	***20***

VD4-1	
Herbicide Used	**Volume (L)**
Grazon Extra	31.05
Vigilant II	0
Wetter 600	0
PicTric	11.75
Garlon 600	0.175
Roundup Ultramax	0.2
Metsulfuron (g)	376
Dinkydye	0
Diesel	4
Brushwet	1.6
Penetrant	4.7
Troller	0.84

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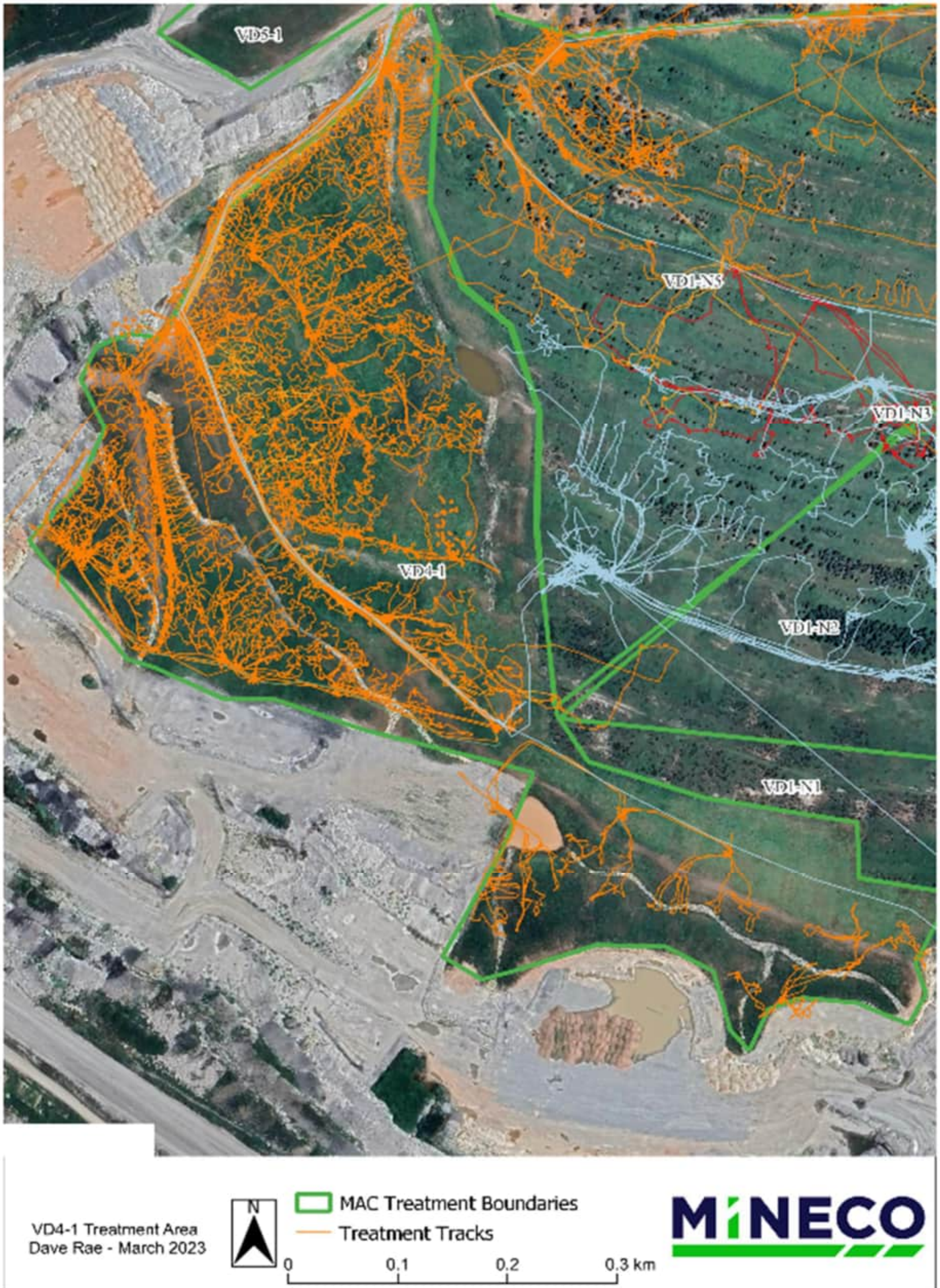
Figure 14: VD4-1 Treatment tracks



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viii.CD-1

CD1-S1

CD1-S1 is a woodland corridor area that has been well protected from the encroachment of weeds present in many other areas. Broadleaf weed occurrence is light, exotic grasses mostly dominating the open areas. These exotic grasses look to be giving way to the canopy species in the revegetated sections as the natives start to colonise outward. The initial pass of CD1-1 focussed on targeting perennial weeds susceptible to Grazon Extra in September. Follow up work in this area must be timed for dry weather due to the steep access track. The Northern end of CD1-S1 had some light patches of African boxthorn as well as some large onion weed patches. Large areas across the top of the structure were surveyed during this period but no significant infestations of priority weeds were encountered that were suitable to treat at that time. Spot spraying was conducted here using knapsacks for the wooded areas and the spray rig where open terrain did not interfere with hand gun hoses.

Figure 15: CD1-S1 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
CD1-S1	Coolatai Grass	Spot Spray	Roundup Ultramax	September
	African Boxthorn	Cut Stump	Garlon 600	September
		Foliar Spray	Grazon Extra/ Metsulfuron	
	Thistle	Spot Spray	Grazon Extra/ Metsulfuron	September
	Fireweed	Spot Spray	Grazon Extra/ Metsulfuron	September
	Galenia	Spot Spray	Grazon Extra/ Metsulfuron	September
Size (Ha)	***40***			
Handled (Ha)	***30***			
Coverage (Ha)	***30***			

CD1-S1	
Herbicide Used	**Volume (L)**
Grazon Extra	13
Garlon 600	0.4
Metsulfuron (g)	120
Diesel	12

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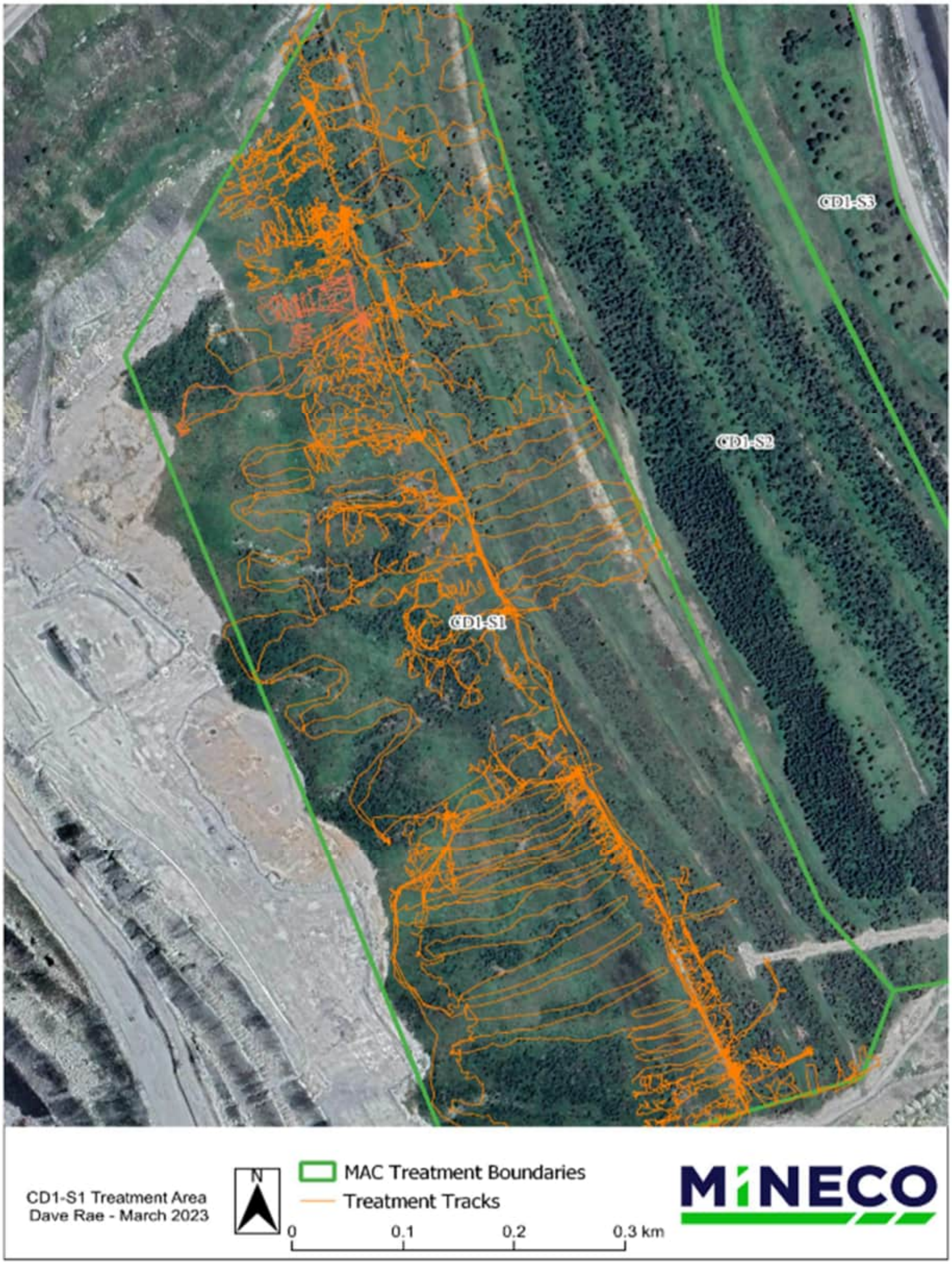
Figure 16: CD1-S1 Treatment Tracks



CD1-S2

CD1-S2 is a heavily revegetated area. The highest concern in this area is the large population of African boxthorn embedded in the dense timber at the Northern end. The boxthorn is interspersed amongst the native vegetation making treatment time slow. This will require a significant amount of effort to treat but given the overall quality of the CD1 structure follow-up efforts could be focussed here.

Figure 17: CD1-S2 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
CD1-S2	Mustard Weed	Spot Spray	Grazon Extra/ Metsulfuron	September
	African Boxthorn	Cut Stump	Garlon 600	September
		Foliar Spray	Grazon Extra/ Metsulfuron	
	Thistle	Spot Spray	Grazon Extra/ Metsulfuron	September
	Fireweed	Spot Spray	Grazon Extra/ Metsulfuron	September
	Galenia	Spot Spray	Grazon Extra/ Metsulfuron	September
Size (Ha)	***33***			
Handled (Ha)	***21***			
Coverage (Ha)	***21***			

CD1-S2	
Herbicide Used	**Volume (L)**
Grazon Extra	7.25
Garlon 600	0.4
Brushwet	0.74
Diesel	12
Metsulfuron(g)	55

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Figure 18: CD1-S2 Treatment Tracks

ix. Drayton Void (D-1)

Drayton void is a new area of pasture rehab whose initial earthworks and seeding concluded in June 2022. The area was seeded with Mount Arthur Coal seed mix then observed for sign of weeds that may have contaminated the topsoil used in this area. The highest priority weed found was noogoora bur and boom spraying was conducted to break the plants life cycle. Boom spraying was targeted to where the weed was found to be growing actively in the rehab. Areas showing no sign of the bur were avoided. It is also known that mustard weed is present in this topsoil, however it was not suitable for spraying during December. A boom spray of Drayton Void should be considered targeting this weed in April – May 2023.

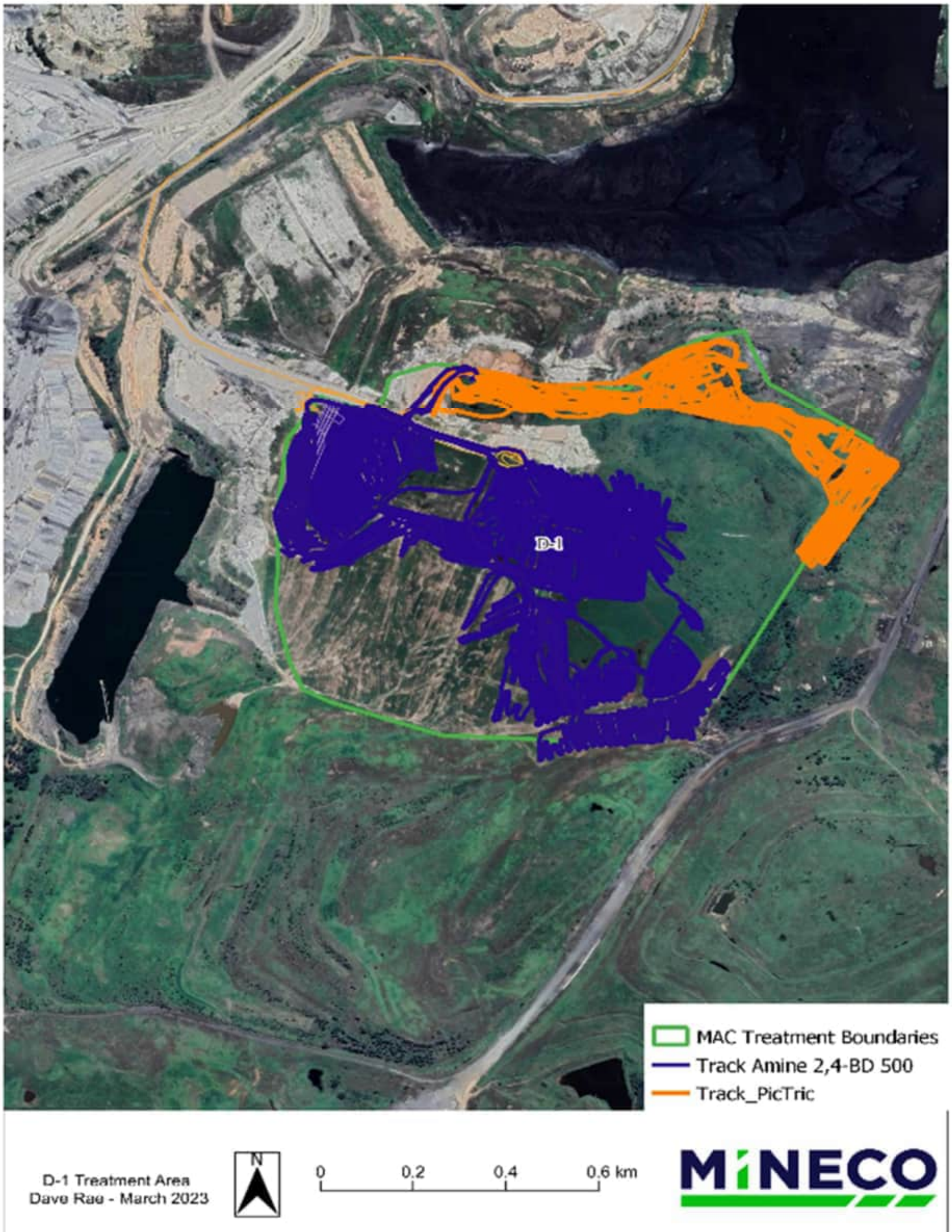
Additional control of agricultural weeds and African boxthorn was conducted north of the Drayton Void rehab area by first slashing the ground cover and boom spraying with broad leaf treatment. Labourers followed up the rolling with knapsacks to basal bark spray the African boxthorn.

Figure 19: D-1 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
D-1	Noogoora Burr	Boom Spray	Amine 2,4-DB 500	December
	African Boxthorn	Basal Bark	Garlon 600	December
	Thistle Sp.	Boom Spray	Amine 2,4-DB 500	December
	Thistle Sp.	Boom Spray	PicTric	January
	Purple Top	Rolling	Nil	January
	Stinking Roger	Rolling	Nil	January
Size (Ha)	***90***			
Handled (Ha)	***60***			
Coverage (Ha)	***60***			

D-1	
Herbicide Used	**Volume (L)**
Amine 2,4-DB 500	48.05
Garlon 600	0.4
PicTric	16.5
Diesel	12
Penetrant	0.58

Figure 20: D-1 Treatment Tracks



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x. Saddler Creek (S-1)

Saddlers creek is another area currently designated as pasture for the mine rehabilitation plan. The ground cover is dominated by Phalaris Aquatica (Harding grass, canary grass). Crossing the terrain in a light vehicle or on foot is hazardous due to the obstruction the grass causes. The Phalaris was rolled in February 2023 to allow access for land management workers to enter with the mulcher and polesaws to begin working on the significant African boxthorn population in the structures west. The density of African boxthorn in the worst effected areas was greater than 1000 stems per hectare. The mulched areas have been followed up by spot spraying exposed stems while mulching is conducted. The maps below outline the areas these techniques were employed in.

The northern portion of the Saddlers Creek rehab has a remaining dense population of African boxthorn. This covers approximately 10Ha to the North of where the tractor has already conducted rolling. Continued efforts in this site should focus on consolidating gains made with the mulcher to prevent seedlings becoming established. This may be achieved through knapsack spot spraying. Further mulching may be warranted in the northern area or pulling the boxthorn with a machine bucket.

No St. John's wort was identified in this area when it came into season but the adjoining slope was seen to have some isolated patches which were spot sprayed once found. The area around the base of the S-1 polygon should be assessed in October 2023 for ingress of St. John's wort from the adjacent saddlers creek offset.

Figure 21: S-1 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
S-1	African Boxthorn	Basal bark/ cut stump	Garlon 600	January - February
		Mulching	Nil	January - Ongoing
	Thistle Sp.	Rolling	Amine 2,4-DB 500	December
	Galenia	Spot Spraying	PicTric	January
	Purple Top	Rolling	Nil	January
	Flax Leaf Flea Bane	Rolling	Nil	January
Size (Ha)	***42***			
Handled (Ha)	***22***			
Coverage (Ha)	***19***			

S-1	
Herbicide Used	**Volume (L)**
Garlon 600	3.34
PicTric	2
Diesel	98

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Figure 22: S-1 Tractor Rolling

Figure 23: S-1 Spot Spraying & Cut Stump Tracks

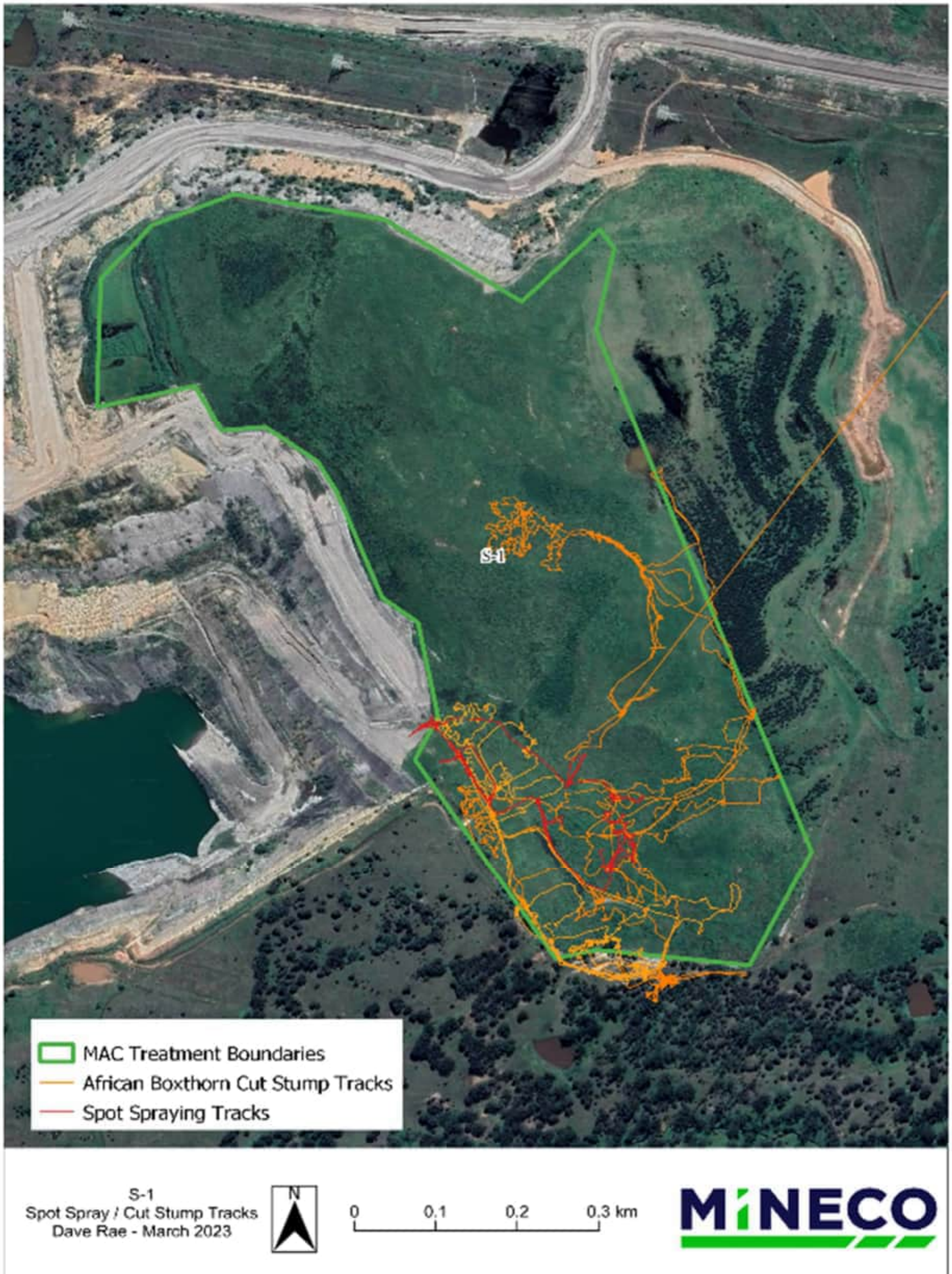

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Figure 24: S-1 African boxthorn mulching tracks

xi. VD-5

VD5-1

VD5-1 is the southerly portion of the VD5 rehabilitation structure which adjoins a remnant vegetation area. VD5-1 had previously been seeded with native woodland mix however this has been slow to emerge. The area suffers from heavy infestations of galenia which carpet roughly 7Ha of the area. Young African boxthorn plants are also scattered throughout the area which have been treated via the cut stump method. To allow for boom spraying of the galenia roughly 4Ha of area suitably bare of native saplings was slashed. Boom spraying of this area then followed. Work was conducted in late February.

The southernmost portion of VD5-1 is too steep to safely operate the tractor on. This area is heavily covered in stinking roger and would benefit from using a tracked mulching unit to supress it prior to seed set. The hillside was completely covered in stinking roger in 2022 however its appearance in 2023 appears to be slowed. This area also has heavy galenia cover.

Figure 25: VD5-1 Treatment table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD5-1	African Boxthorn	Basal bark/ cut stump	Garlon 600	February
	Coolatai Grass	Slashing	Nil	February
	Galenia	Boom Spray	PicTric	February
Size (Ha)	***10***			
Handled (Ha)	***3.6***			
Coverage (Ha)	***5.5***			

VD5-1	
Herbicide Used	**Volume (L)**
Garlon 600	0.6
PicTric	6
Diesel	18

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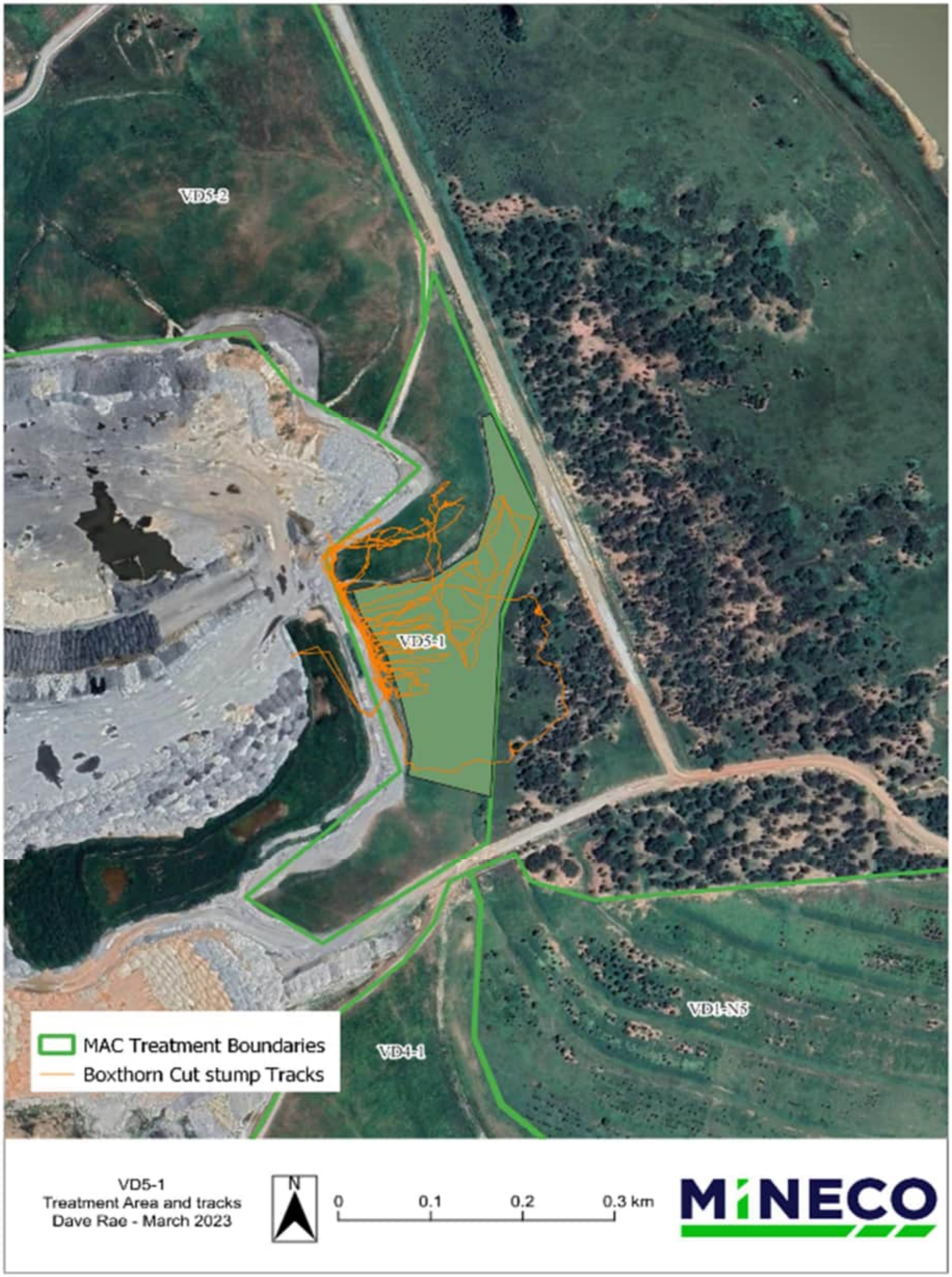
Figure 26: VD5-1 Treatment tracks



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VD5-2

VD5-2 consists of a Northerly facing slope with a small amount of established native revegetation work. The Eastern portion of this region was targeted first for removal of thick galeina carpeting the area and African boxthorn patches. The flat area in the east which received treatment may be a good candidate for ongoing tubestock planting if the galenia can be controlled due to it's ease of access through the area, proximity to a light vehicle road and existing historic irrigation infrastructure left to the West.

Figure 27: VD5-2 Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
VD5-2	African Boxthorn	Basal bark/ cut stump	Garlon 600	December - February
	Coolatai Grass	Slashing	Nil	February
	Galenia	Boom Spray	PicTric	February
Size (Ha)	***57***			
Handled (Ha)	***11***			
Coverage (Ha)	***7.3***			

VD5-2	
Herbicide Used	**Volume (L)**
Garlon 600	0.765
PicTric	2.75
Diesel	23

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Figure 28: VD5-2 Rolling and Boxthorn treatment

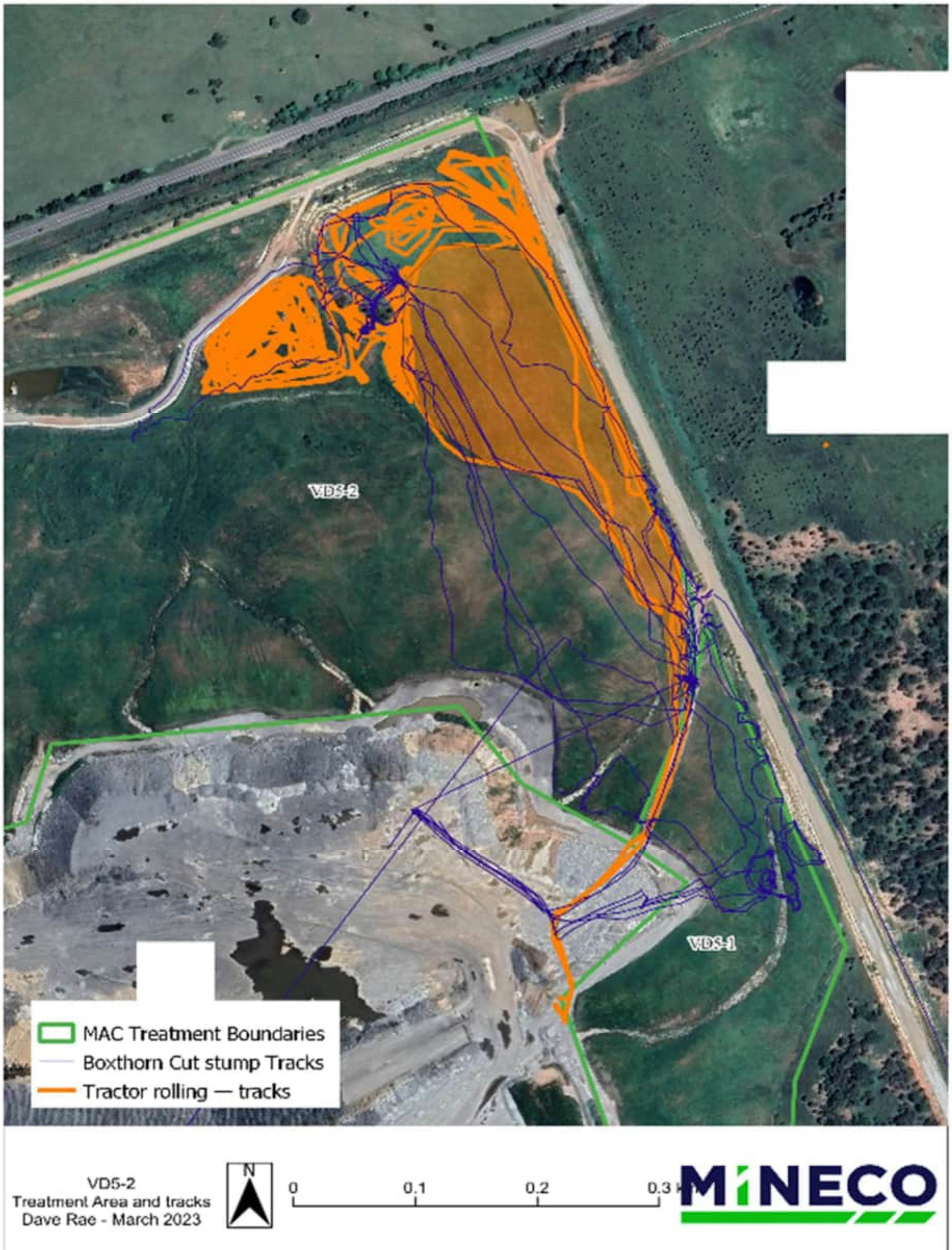

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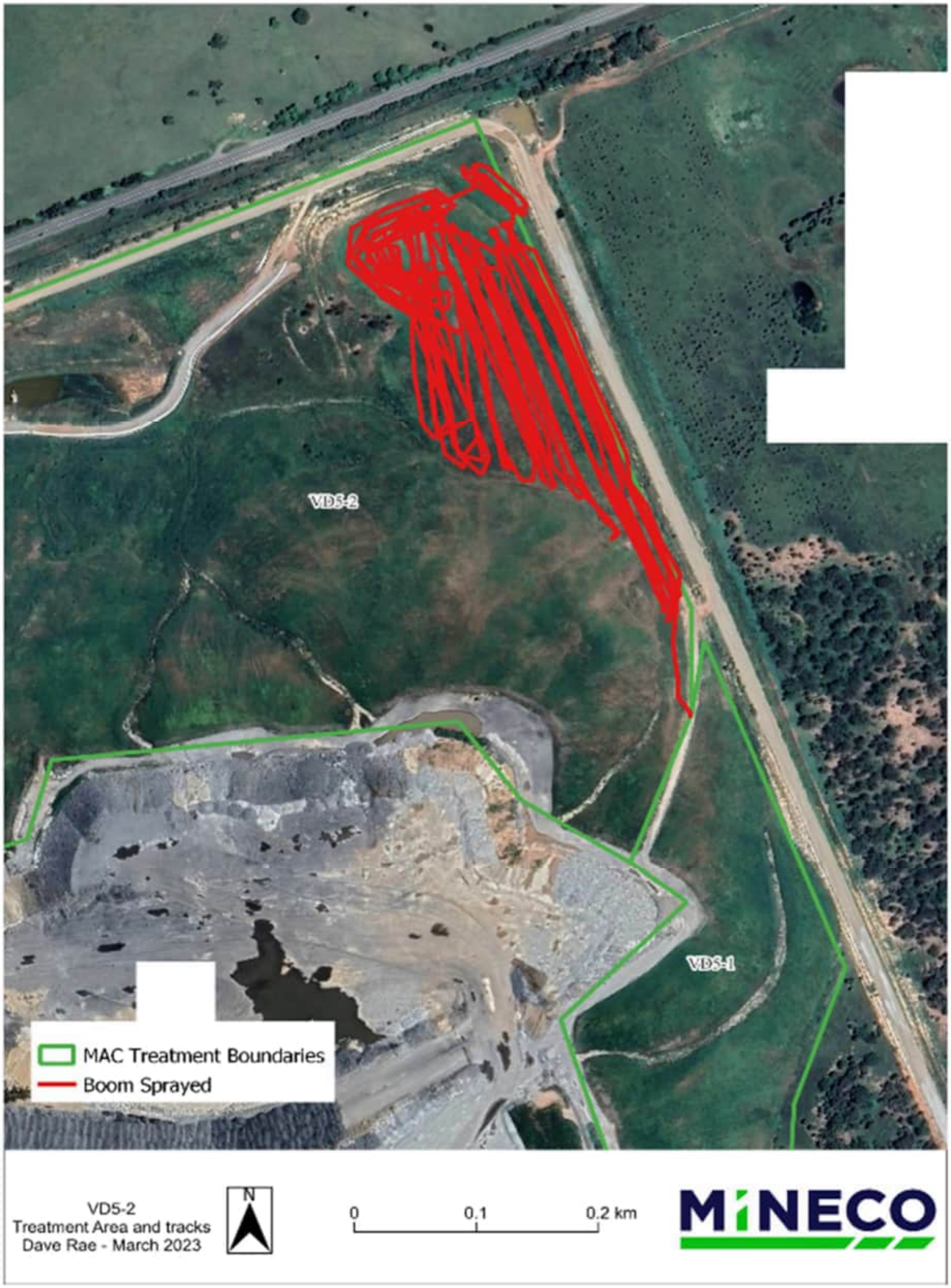
Figure 29: VD5-2 Boom Spraying



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xii. African Boxthorn

African boxthorn is a priority weed for the region and poses risk to the mines rehabilitation strategies. The plant is able to form dense stands that shade out ground cover species and provide habitat for pest animals such as pigs, wild dogs, rabbits and rats. The thorns of the plant are particularly dangerous and must be considered when planning treatment options to protect operators.

Where plants are loosely spaced throughout other vegetation it was found most economical to treat on foot by basal bark spraying or the cut stump method. The plants were cut using a polesaw with a maximum reach of 4m to keep operators clear of the thorns. Where plants were too dense (visually assessed to be greater than 400 stems per hectare) the tracked mulcher was deployed to bring them under control. There are still many areas left that would benefit from mulching due to their density. Another factor to be considered is the size of the plant. The largest plants often have kikuyu or other exotic grasses growing up through them which jams the saws or makes it difficult to locate the main stem. These plants are also good candidates for mulching rather than treatment on foot.

Mulched plants are found to have a tendency to reshoot. Given the risks faced by workers on foot near the mulcher herbicide treating the mulched areas was conducted once the mulcher had passed through the area. The tracks that have been mulched should be monitored for regrowth.

Through the course of works on site individual plants were logged while being treated so follow up work could be planned to consolidate efforts and supress regrowth or germination of new plants. The heat map featured below shows areas that most plants were found in. The waypoint file provided with this report indicates these locations and was used to produce the heat map below.

As Figure 30: Treated African Boxthorn Heat Map shows the greatest number of plants were treated in the Southern region of VD1, The Out of Pit Dump Revegetation area, Saddlers Creek rehab and the boundaries of the topsoil stockpiles in Belmont. The weed occurs broadly across site but these areas have been targeted to start reducing the largest populations. Many plants were treated outside the indicated areas on site but their density is below the threshold of the heat map.

Garlon 600 applied to the cut stump of the plants was found to be the most effective treatment method and could be deployed at all times of year. Vigilant II paste applicators were effective but difficult to use as workers needed to get very close to the plant to apply the herbicide. Foliar spraying with Grazon Extra was the least effective. To date nearly 55L of Garlon 600 and has been used in the treatment of African olive on site. As measured by waypoints 6260 plants have been treated. This does not include plants that have been treated with the tracked mulcher.

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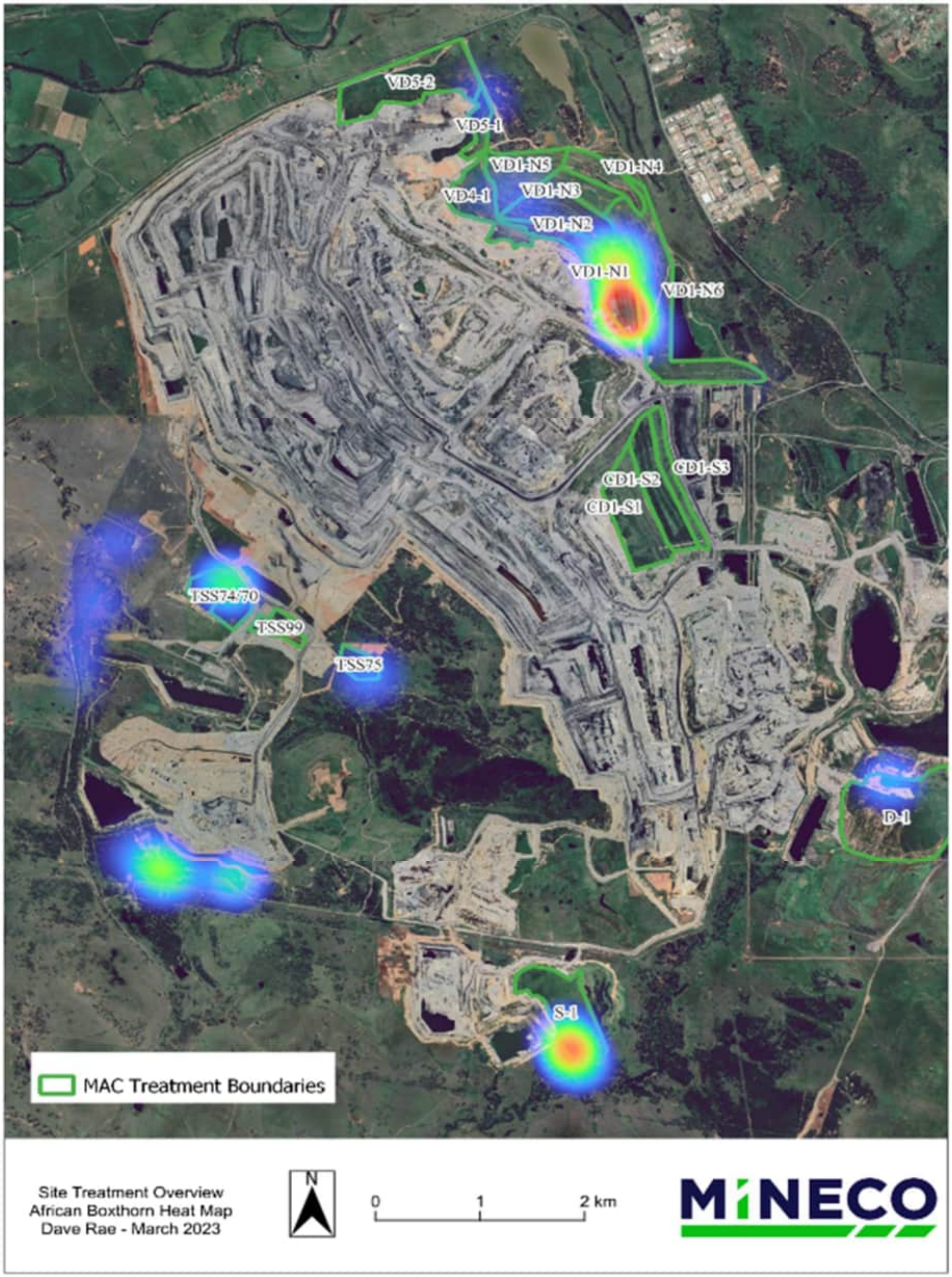
Figure 30: Treated African Boxthorn Heat Map



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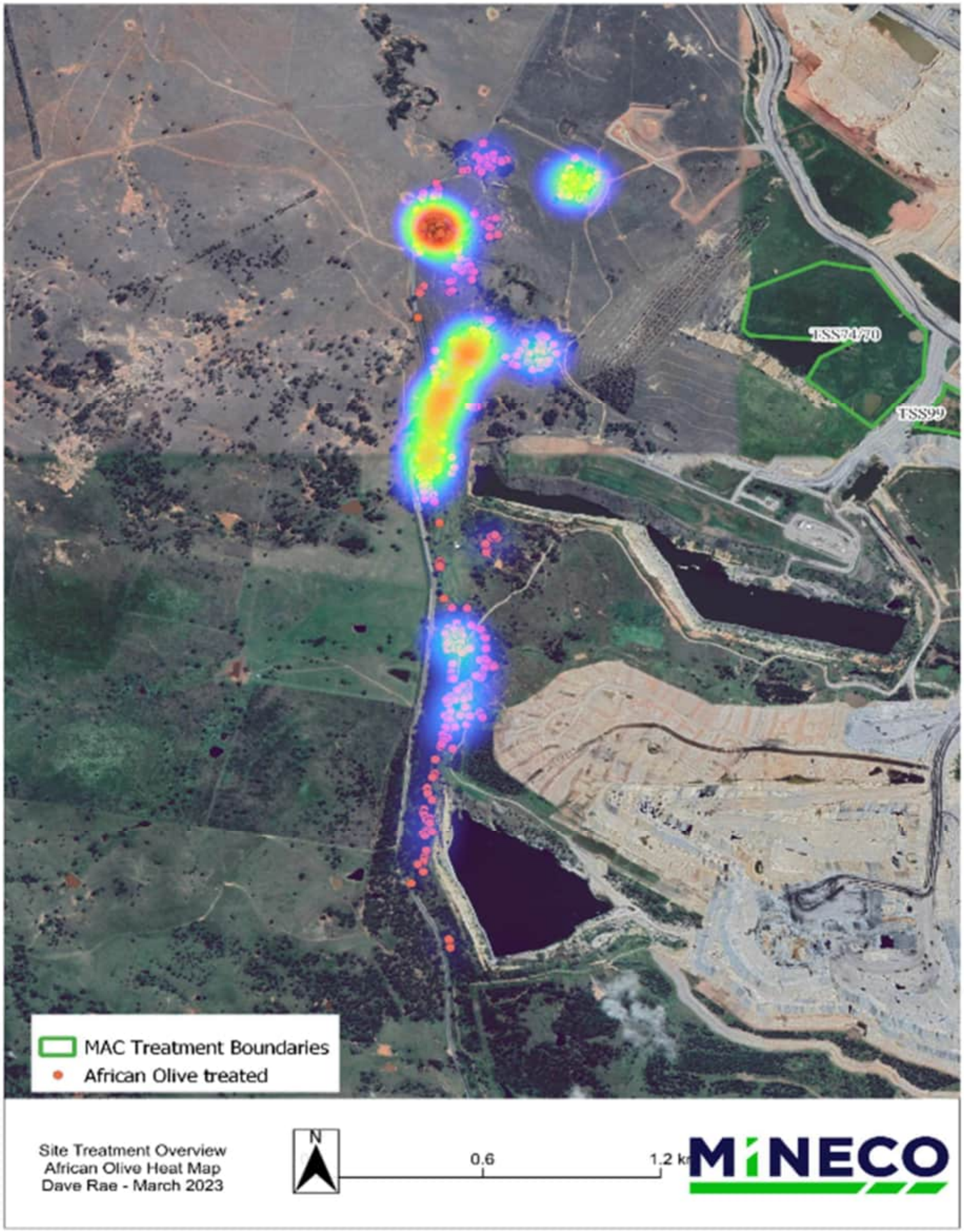
xiii. African Olive

African olive was highlighted to MAC by the LLS in July as part of a regional effort to reduce the weeds impact in rural areas. The population appeared to stem from an old property that once existed near the Calool core sheds as this area was home to the most mature trees. The population spread southward along the MAC boundary against Edderton Rd. This represented an area nearly 200Ha in size that the woody weed may have spread into. This same area is also a habitat of the native mock olive notelaea macrocarpa and effort needed to be made to distinguish the lookalikes apart.

Treatment was mostly conducted by the cut stump method and Garlon 600 applied. Some basal bark spraying was utilised on the trees at the core sheds. It was thought best not to fell these trees due to their size and proximity to the amenities blocks. They are currently showing distress from the herbicide treatment but will likely require retreatment. Treatment of African olive started at the core sheds and then progressed down the site boundary toward the Mt Arthur Access Rd. From there the teams proceeded east away from the site boundary.

Follow up inspection of this area should be undertaken to spot and retreat any plants that are reshooting or were missed. Nearly 1600 plants were removed during this campaign spanning from September to November. This figure does not include plants removed by the tracked mulcher on the 3 days it spent operating on the Edderton rd boundary looking for this weed. Continued work on the plant was interrupted to address the St. John's wort that began to bloom in late October. Given the short viability period of African olive seed in the soil (~3 years) control of this weed should be achievable by retracing the previously treated areas for regrowth control and walkovers of adjacent areas that have not been previously assessed. In treating these plants 6L of Garlon 600 was used.

Figure 31: African Olive Treatment Heat Map



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xiv. St. John's Wort

St. John's Wort is another species of concern in the region. It is poisonous to livestock and can spread easily due to sticky seeds that will attach to machinery and animals that move through it while it is in seed. The weed has not been identified as having entered MAC rehab to significant degree. Small patches were found in VD-5 and at the foot of VD1 next to the dirty water dam. St. John's wort mainly appears around the site boundary. The scale of the outbreak visible in January 2022 was dwarfed by the magnitude that appeared in October 2022. Originally it was projected to require treatment over 30Ha of area, when the final treatments were conducted in January 2023 116 Ha had been sprayed including re surveying and spraying for missed plants.

Routine cleaning of vehicles was highly important during this period, relying heavily on the high temperature high pressure washing unit at the Mineco yard to decontaminate vehicles operating near the outbreaks.

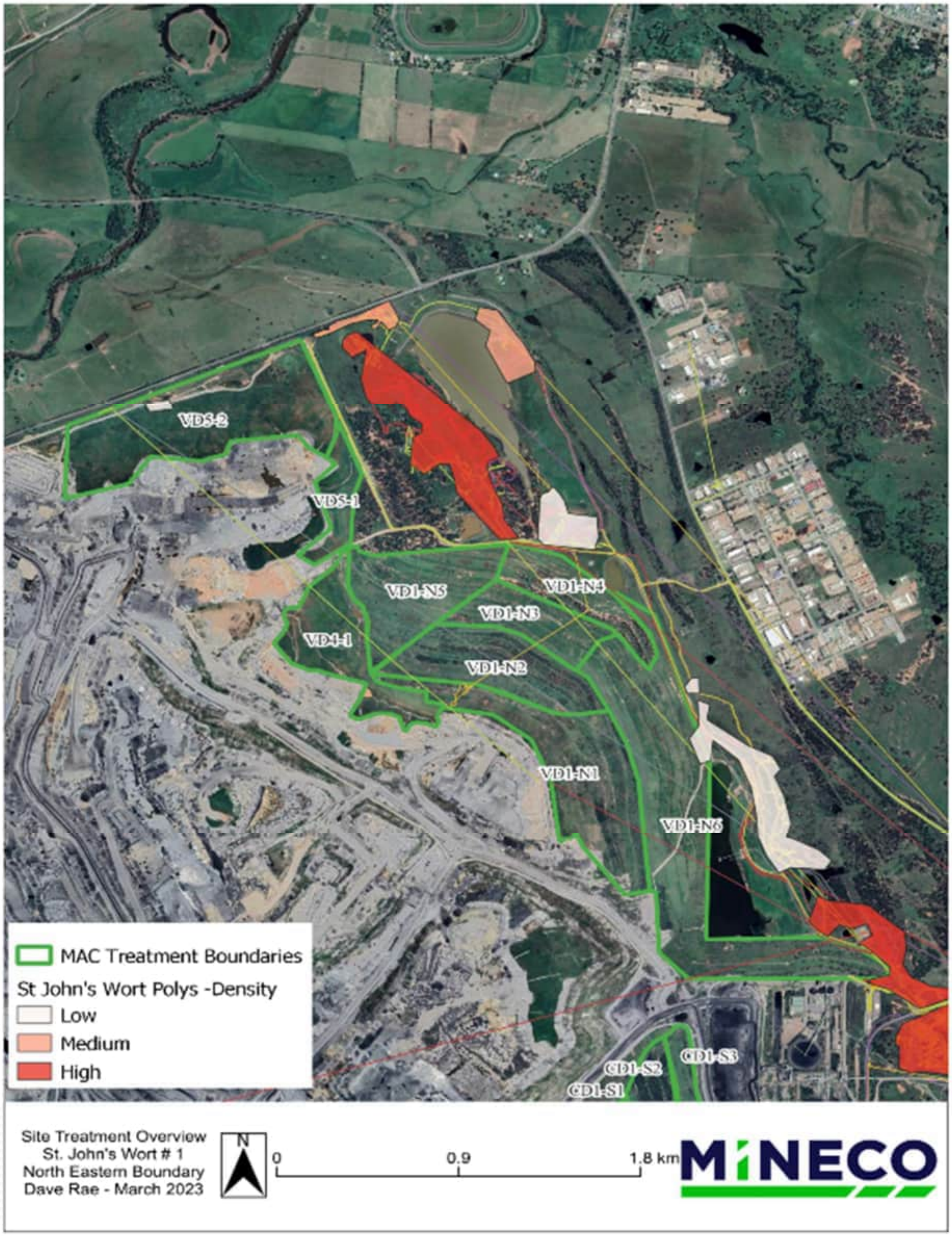
Figure 32: St. John's Wort Treatment Table

Polygon Info	Species (common name)	Treatment Used	Herbicide	Timing
MAC	St. John's Wort	Spot Spray, boom spray	Grazon Extra	October - January
		Spot Spray, boom spray	Metsulfuron	October - January
Size (Ha)	*N/A*			
Handled (Ha)	*116*			
Coverage (Ha)	*N/A*			

St. John's Wort	
Herbicide Used	**Volume (L)**
Grazon Extra	77.75
Metsulfuron (g)	708
Brushwet	14.9

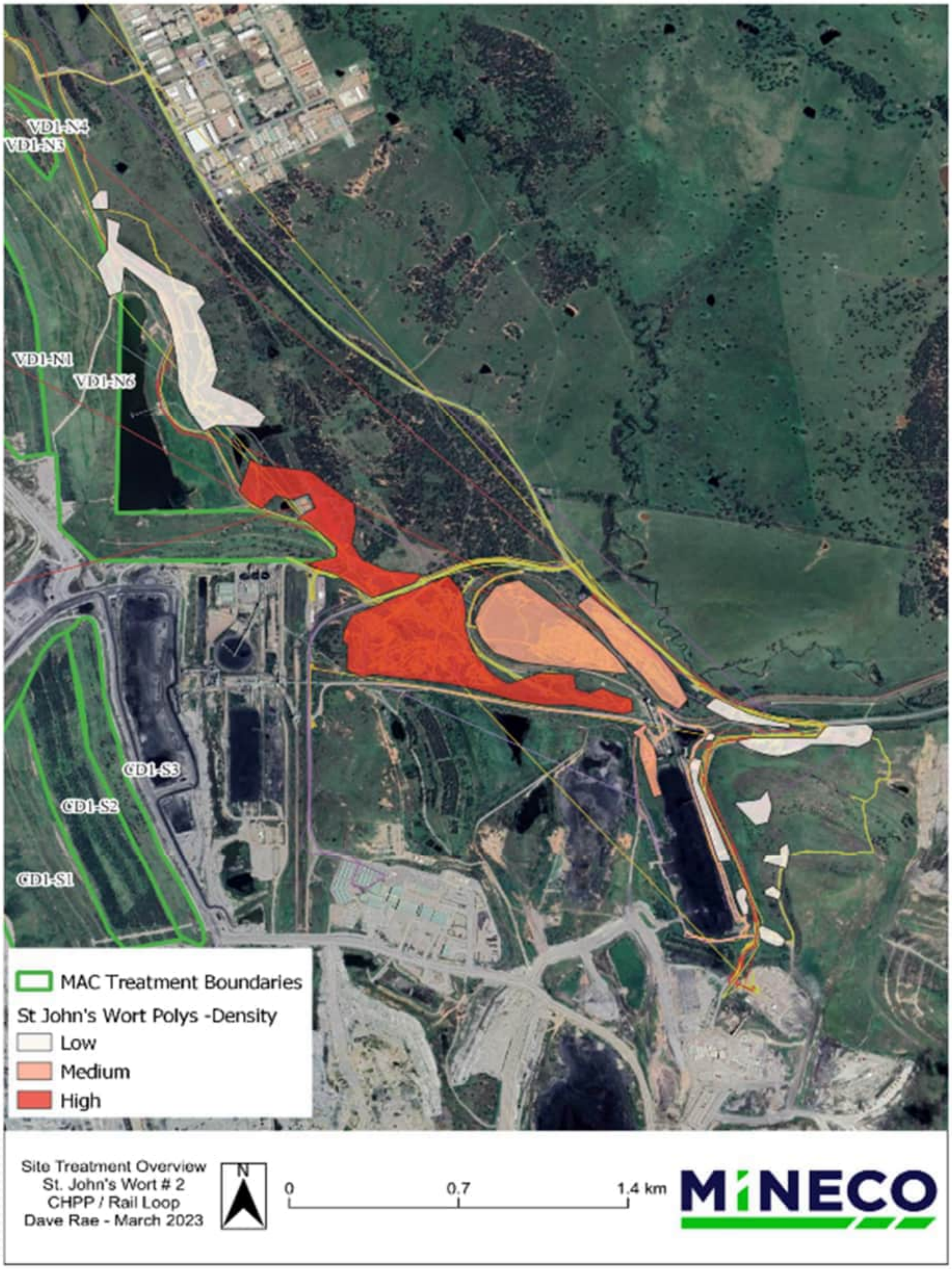
MINECO PTY LTD
ABN 36 160 263 276
28 Strathmore Rd
Muswellbrook NSW 2333
Ph: 0439 842 767
E: admin@mineco.net.au

Figure 33: St. Johns Wort Map 1



MINECO PTY LTD
ABN 36 160 263 276
28 Strathmore Rd
Muswellbrook NSW 2333
Ph: 0439 842 767
E: admin@mineco.net.au

Figure 34: St. John's Wort Map 2



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ABN 36 160 263 276
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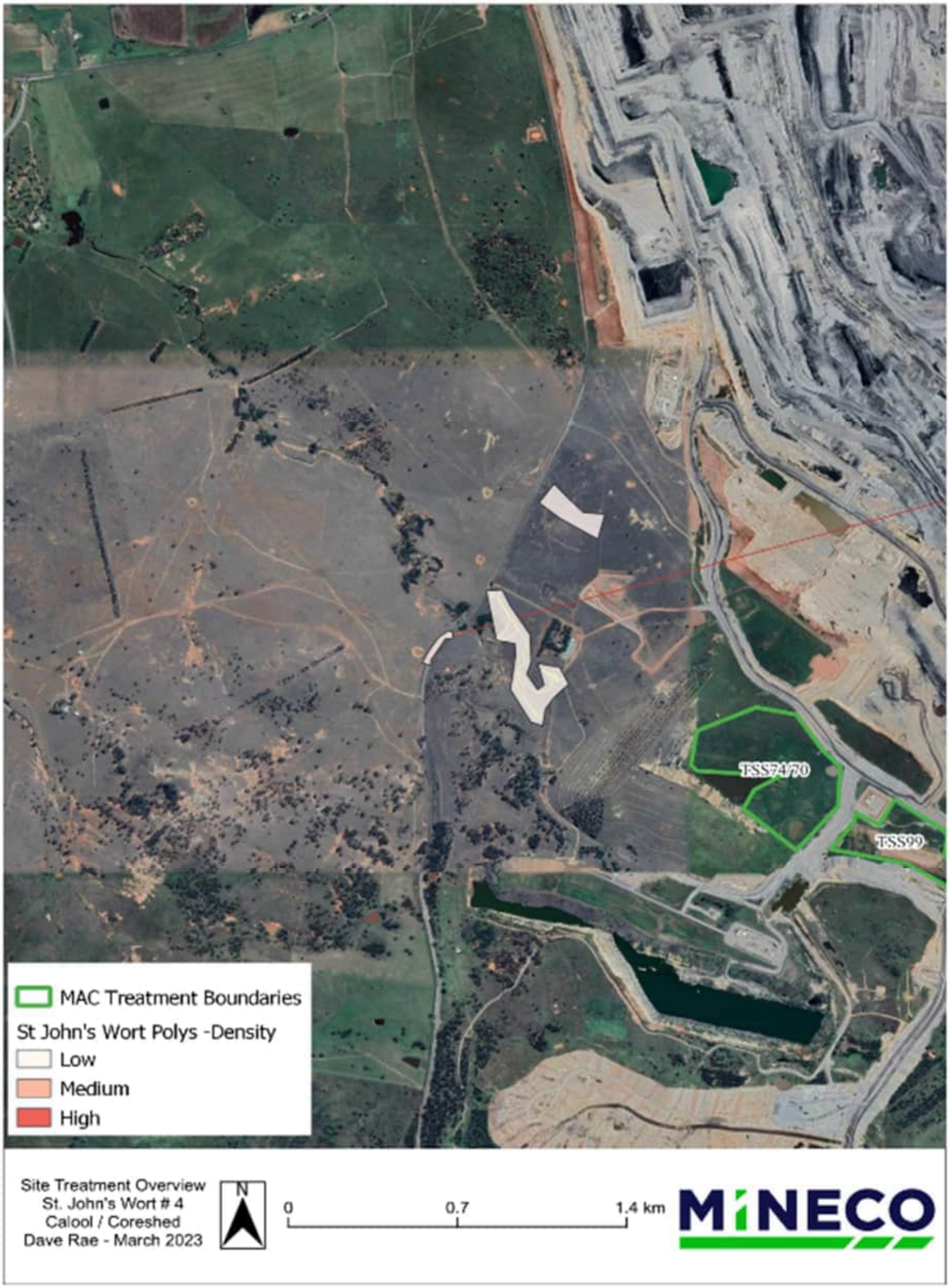
Ph: 0439 842 767
E: admin@mineco.net.au

Figure 35: St. John's Wort Map 3

Figure 36: St. John's Wort Map 4



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Ph: 0439 842 767
E: admin@mineco.net.au

Figure 37: Polygon treatment Progress

Polygon	Month																						
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
S-1																								
D-1																								
TSS099, TSS070 and TSS074-1																								
VD5-1																								
VD5-2																								
VD4-1																								
VD1-N1																								
VD1-N2																								
VD1-N3																								
VD1-N4																								
VD1-N5																								
VD1-N6																								
CD1-S1																								
CD1-S2																								
CD1-S3																								

Blue cells roughly indicate timing of treatment activity conducted

Orange cells indicate Suggested timing

4. References

MAC-ENC-MTP-047 (2018) Rehabilitation strategy

MAC-ENC-MTP-050 (2019) Biodiversity Management Plan

Hunter Valley Energy Coal Mt Arthur Coal - Weed Control Plan (2022)

NSW DPI (2021) Grasses of NSW by Harry Rose, Carol Rose, Tocal College, Paterson

NSW DPI (2021) Pasture "weeds" of Coastal NSW by Harry Rose, Carol Rose, Tocal College, Paterson

NSW DPI (2023). NSW WeedWise. NSW Department of Industry, 4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150. https://weeds.dpi.nsw.gov.au/

Land Management Monthly Report

May 2023

CLIENT: BHP

SITE: Mount Arthur Coal (MAC)

MONTH: May 2023

Overview:

The land management team currently consisted of 2 people monitoring and controlling target species in new and existing rehabilitation areas. Due to the inaccessible nature of the work areas, land management is carried out on foot using hand and power tools to control invasive populations. Where physical removal of target species in impractical, chemical foliar or stem application is utilised to prevent further spread and regrowth.

Area Covered:

Over the month of May, the Land Management team covered an area of **35.82Ha.**

Target Species Encountered	
Species	**Common Name**
Acacia Saligna	Golden Wreath Wattle
Lycium Ferocissimum	African Box Thorn
Cortaderia Sellona	Pampas Grass
Chloris Gayana	Rhodes Grass
Megathyrsus Maximus	Guinea Grass
Phytolacca octandra	Ink Weed
Galenia	Carpet Weed
Opuntia SP	Prickly Pear Cactus

DESCRIPTION OF WORK			
Zone	**Type of work**	**Weed description**	**Work Description**
CD1	Primary	woody	Cutting and painting *Lycium Ferocissimum* and *Acacia saligna*
VD1	Maintenance	Woody and exotic grasses	Cutting and painting *Lycium Ferocissimum* and *Acacia saligna.* *Exotic grasses including Megathyrsus maxima*
OOPD Topsoil Stockpile	Maintenance	Broad leaf	Spraying broadleaf weeds

Observation:

As winter is starting to set in there is noticeably less new growth on invasive and native species. This has reduced the effectiveness of foliar sprays and slowed down work as individual plants have to be cut and painted to eradicate them.

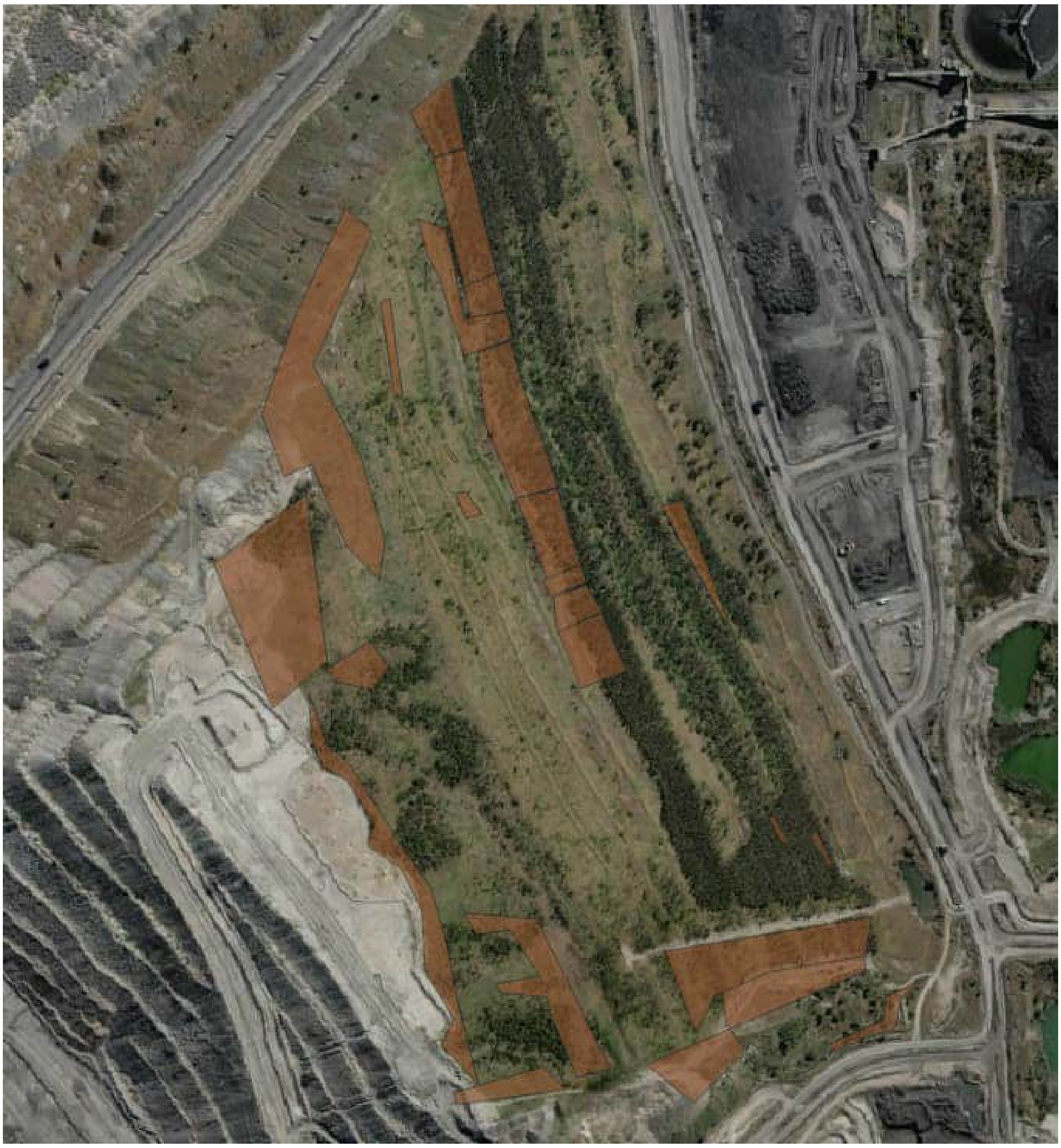
Many target species have gone to seed and there will be follow up required in the subsequent years due to the built up seed bank stored in the soils.

Generally the rehabilitated land is in great condition with select weed management required and with sufficient ongoing control measures there should be no need for wide spread clearing of overgrown target species.

Herbicides Used		
Brand	**Active Ingredient**	**Diluted Quantity**
Gazron Extra	Aminopyralid Picloram Triclopyr	195L
Roundup Biactive	Glyphosphate	545L

Area covered at VD1

Area covered at CD1



Area covered at OOPD Topsoil Stockpile

Area covered between EME Pad and Core sheds

Spraying Cortaderia Sellona

Spraying exotic grasses

Spraying Cortaderia Sellona and removing seed heads

Spraying Cortaderia Sellona

Removing Box Thorn

Painting Box Thorn stem after cutting back

Data extract from QGIS System for May 2023

Operator	Herbicide	Weather conditions	Treatment Method	DeltaT	Temp Degrees celcius	Humidity %	Weed Sp 1	Weed Sp 2	Weed Sp3	Weed Sp1 density	Weed Sp2 density	Weed Sp3 density	Start time	Finish time	Herbicide rate (%)	Location	Quanity herbicide used (L)	Notes	Reference Number	Area (Ha)
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		19	34	Lycium ferocissimum	Acaia saligna		LOW	LOW		2023-05-24T07:01:01.000	2023-05-24T15:01:09.000	66	CD1-S1	6	Brushcut and paint using glyph mets. Maccas farewell smoko	19	3.85526914
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer		0	0	Lycium ferocissimum			MED			2023-05-11T07:00:53.000	2023-05-11T09:55:13.000	0.5	CD1-S1	35	No dye so will need follow up	10	3.13307025
Kieran Fellowes	Roundup biactive	Fine			0	0	Lycium ferocissimum			LOW			2023-05-29T13:33:12.000	2023-05-29T14:41:11.000	2		30	Roundup n mets @2g/10L	22	2.67687696
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer		20	50	Opuntia sp	Galenia	Lycium ferocissimum	LOW	LOW	LOW	2023-05-02T09:00:22.000	2023-05-02T11:30:40.000	0.5	VD1-N1	20	Swept though rehab area under canopy	3	2.22992186
Kieran Fellowes	Roundup biactive		Backpack Sprayer		18	69	Lycium ferocissimum			LOW			2023-05-15T12:15:32.000	2023-05-15T13:15:40.000	1	CD1-S2	20	Glyph plus 1g mets	12	2.02691712
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		18	0	Phytolacca octandra	Galenia		HIGH	MED		2023-05-09T09:28:44.000	2023-05-09T15:53:41.000	2	VD1-N1	100	Glyph + mets weather getting abit cold not ideal time o year	8	1.83956774
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer		0	0	Lycium ferocissimum	Galenia		HIGH	LOW			2023-05-08T13:45:29.000	0.5	VD1-N1	60	Followed up mulcher works with grazon n glyph mix	7	1.82103189
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer		19	55	Lycium ferocissimum			MED			2023-05-11T10:29:05.000	2023-05-11T12:29:18.000	0.5	CD1-S1	20	5m sweep along top edge with glyph grazon	10	1.52332957
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			MED			2023-05-23T07:45:48.000	2023-05-23T14:51:11.000	66	CD1-S3	5	2 brushcutter operators. Boxthorn Med to high	18	1.51040808
Kieran Fellowes	Roundup biactive		Backpack Sprayer	6	0	0							2023-05-03T14:45:16.000	2023-05-03T16:15:13.000	2		20	Swept through spraying for braod leaf weeds and problem gras	4	1.44783965
Kieran Fellowes	Roundup biactive		Backpack Sprayer	6	0	0							2023-05-03T14:45:16.000	2023-05-03T16:15:13.000	2		20	Swept through spraying for braod leaf weeds and problem gras	4	1.44783965
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		21	55	Cortaderia sellona	Lycium ferocissimum	Chloris gayana	MED	LOW	LOW	2023-05-12T13:01:37.000	2023-05-12T14:01:35.000	2	CD1-S1	0	Treated patch of pampas moving from low to med. mets for box	11	1.41518397
Kieran Fellowes	Roundup biactive		Backpack Sprayer	5	0	0							2023-05-03T09:17:35.000	2023-05-03T13:00:49.000	2		60	Braod leaf weeds	4	1.21006688
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer	6	21	43	Lycium ferocissimum	Chloris gayana	Megathyrsus maxima	HIGH	LOW	LOW	2023-05-05T07:30:10.000	2023-05-05T12:56:31.000	0.5	VD1-N1	50	Follow up sprayed boxthorn after mulcher used grazon + glyph	6	1.15669211
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum						2023-05-18T07:30:16.000	2023-05-18T15:03:35.000	66	CD1-S3	5	CnP with brushcutter using glyph n mets as per9907	15	1.03373604
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			HIGH			2023-05-22T07:04:35.000	2023-05-22T15:20:32.000	66	CD1-S3	5	Cut and paint with brushcutter while offsider used hamd tool	17	0.81680906
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Lycium ferocissimum			HIGH				2023-05-26T13:05:48.000	66	CD1-S3	13	Dense area brushcutters working well	21	0.75301054
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			HIGH			2023-05-31T07:29:54.000	2023-05-31T15:29:52.000	66	CD1-S3	6	From high to med density	24	0.68561719
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		0	1	Phytolacca octandra			MED			2023-05-04T13:05:58.000	2023-05-04T15:23:55.000	2		50		5	0.60568183
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Lycium ferocissimum			MED			2023-05-17T11:40:50.000	2023-05-17T15:07:20.000	66	CD1-S3	2	Bit slow due to dull blade, better suited to chainsaw	14	0.55563488
Kieran Fellowes	Grazon Extra				0	0	Lycium ferocissimum			LOW			2023-05-11T07:30:43.000		0.5		0		10	0.45605608
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Lycium ferocissimum						2023-05-15T07:35:39.000		0	CD1-S3	0.1	CnP small boxthorn	12	0.39750094
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Acaia saligna			HIGH			2023-05-16T08:01:16.000		66	CD1-S1	1	Cut and paint with brushcutter	13	0.3879298
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		18	48	Cortaderia sellona	Lycium ferocissimum		HIGH	MED		2023-05-10T08:30:15.000	2023-05-10T13:23:12.000	2	CD1-S1	100	Large pampas infestation near cd requires drone to finish	9	0.38780011
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		0	0	Cortaderia sellona								0		10		2	0.35703627
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			HIGH			2023-05-30T10:27:15.000	2023-05-30T15:27:13.000	66	CD1-S3	5	Dense and messy	23	0.34560606
Kieran Fellowes	Roundup biactive	Overcast	Backpack Sprayer		0	0	Lycium ferocissimum			HIGH			2023-05-01T14:50:43.000	2023-05-01T15:26:16.000	2	VD1-N1	10	Follow up from mulcher work	2	0.30617698
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			HIGH			2023-05-19T08:49:53.000		66	CD1-S3	1.2	CnP with brushcutters	16	0.29470243
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer	6	24	51	Megathyrsus maxima			MED			2023-04-28T10:00:12.000	2023-04-28T12:57:25.000	2	VD1-N5	20	Targeting guinea grass in area of native grasses	1	0.26892419
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		19	55	Cortaderia sellona	Lycium ferocissimum		HIGH	LOW		2023-05-11T14:48:29.000	2023-05-11T15:47:37.000	2	CD1-S3	20		10	0.26875798
Kieran Fellowes	Roundup biactive	Overcast	Backpack Sprayer		0	0	Cortaderia sellona	Phytolacca octandra		LOW	LOW		2023-05-02T12:31:19.000	2023-05-02T13:01:37.000	2	VD1-N1	10	Pampas infestation low to med with some mature inkweed	3	0.20489361
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		0	0	Lycium ferocissimum			LOW			2023-05-10T14:01:42.000		0		0		9	0.19162843
Kieran Fellowes	Roundup biactive	Fine	Cut and Paint		0	0	Lycium ferocissimum			HIGH			2023-05-29T09:52:48.000	2023-05-29T09:52:46.000	0	CD1-S3	4	Fergus shat himself had to leave early	22	0.17081189
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Acaia saligna			HIGH			2023-05-17T08:47:06.000	2023-05-17T09:47:19.000	66	CD1-S2	0.1	Used brushcutter for cut an paint of saligna	15	0.08037023
Kieran Fellowes	Grazon Extra	Fine	Backpack Sprayer		0	0	Lycium ferocissimum			HIGH				2023-05-11T14:52:50.000	0.5	CD1-S3	10	Just emptied packs before switching chem	10	0.05575242
Kieran Fellowes	Roundup biactive	Overcast	Cut and Paint		0	0	Lycium ferocissimum			MED			2023-05-15T09:01:47.000		0	CD1-S3	0	Cut and painted a few small boxthorn while waiting for fog	12	0.04248223
Kieran Fellowes	Roundup biactive	Fine	Backpack Sprayer		0	0	Cortaderia sellona								0		1	Followed up pampas regrowth in previously treated area	3	0.03887028
	Roundup biactive	Fine			0	0	Lycium ferocissimum			MED			2023-05-10T14:56:41.000		2		10		9	0.01761085
Kieran Fellowes	Roundup biactive		Backpack Sprayer	6	0	0							2023-05-03T13:17:27.000	2023-05-03T13:17:28.000	2		10	Datura	4	0.00475043

Land Management Monthly Report

June 2023

CLIENT: BHP

SITE: Mount Arthur Coal (MAC)

MONTH: June 2023

Overview:

The land management team currently consisted of 3 people monitoring and controlling target species in new and existing rehabilitation areas. Due to the inaccessible nature of the work areas, land management is carried out on foot using hand and power tools to control invasive populations. Where physical removal of target species is impractical, chemical foliar or stem application is utilised to prevent further spread and regrowth.

Area Covered:

Over the month of June, the Land Management team covered an area of **14.86Ha.**

Cumulative area for FY23 treated – **50.68 Ha**

Target Species Encountered	
Species	**Common Name**
Lycium Ferocissimum	African Box Thorn
Cortaderia Sellona	Pampas Grass
Acacia Saligna	Golden Wreath Wattle

DESCRIPTION OF WORK			
Zone	**Type of work**	**Weed description**	**Work Description**
CD1	Maintenance	woody	Cutting and painting *Lycium Ferocissimum*

Herbicides Used		
Brand	**Active Ingredient**	**Diluted Quantity**
Garlon	Triclopyr	28.3L
Weedmaster Duo	Glyphosphate	45L

Observation:

As winter has set in there is noticeably less new growth on invasive and native species. This has reduced the effectiveness of foliar sprays and slowed down work as individual plants have to be pruned and painted to eradicate them.

African Box Thorn was the dominant invasive species encountered this month with pockets of infestation varying in density from scattered plants to dense thickets. All weeds encountered were hand pulled if small enough to do so or cut and painted at the stems.

Generally the rehabilitated land is in great condition with select weed management required and with sufficient ongoing control measures there should be no need for wide spread clearing of overgrown target species.

Discussion:

Compared to last month there was considerably less area treated. This was largely due to the change in control measures utilised as well as the type of vegetation working in. In May there were several grass species targeted on open slopes allowing for ease of travel and spraying of isolated pockets of target species. In June the Box Thorn required far more effort per plant to eradicate and the access proved more difficult, working amongst the emerging canopy. Slashing each Box Thorn and painting the stump is the most effective form of treatment for the size and time of year while also preserving the surrounding vegetation. The pesticide usage also dropped off significantly which reflects the transition from spraying wide areas to isolated pockets and manual removal of infestations.

Area covered near Denman Rd

Area covered at CD1

Cutting back Box Thorn

spraying severed stem of Box Thorn

Scattered Box Thorn

Pocket of Acacia Saligna

Cutting down Acacia Saligna

Painting Acacia Saligna stem after cutting

Native Rattus fuscipes (Bush Rat) sighting

Data extract from QGIS System for June 2023

fid	Supervisor	Date	Reference number	Location	Weather	Temp degrees celcius	Humidity	DeltaT	Treatment method	Weed sp1	Herbicide used	2nd Herbicide used	Rate 1	Rate 2	Quantity (L)	Notes	Density	Wind speed (km/h)	Wind direction	Area (Ha)
1		1/06/2023	25			0	0	0							0		MED	0		1.675373
2		2/06/2023	26			0	0	0		Lycium ferocissimum					6	Very close to finishing out first sweep of the worse boxthorn sections	MED	0		0.418349
3		5/06/2023	27			0	0	0							0			0		0.521246
4		6/06/2023	28			0	0	0		Lycium ferocissimum					0			0		0.815471
5		7/06/2023	0			0	0	0		Lycium ferocissimum					0		MED	0		0.80938
6	Kieran Fellowes	8/06/2023	30	CD1-S3	Rain	15	86	0		Lycium ferocissimum	Weedmaster duo	Metsulfuron	66%	1g/1L	2		HIGH	0		0.299072
7	Kieran Fellowes	8/06/2023	30	CD1-S3	Rain	15	86	0		Lycium ferocissimum	Weedmaster duo	Metsulfuron	66%	1g/1L	1		MED	0		0.221107
8	Kieran Fellowes	8/06/2023	30	CD1-S3	Rain	15	80	0		Lycium ferocissimum	Weedmaster duo	Metsulfuron	66%	1g/1L	3	Rate as per permit9907	MED	0		1.149519
9	Kieran Fellowes	9/06/2023	32	CD1-S3	Fine	0	0	0	Cut n Paint	Lycium ferocissimum	Weedmaster duo	Metsulfuron	66%	1g/1L water	8	Cut and paint usimg brushcutters 3 operators till 9am	MED	0		0.650209
10	Kieran Fellowes	9/06/2023	31		Fine	0	0	0	Cut n Paint	Lycium ferocissimum	Weedmaster duo	Metsulfuron	66%	1g/1L water	4	Dense patches of boxthorn under old trees	LOW	0		2.825079
11	Kieran Fellowes	13/06/2023	32	CD1-S3	Overcast	16	65	4		Lycium ferocissimum	Garlon		3.30%		8	Some light rain	HIGH	13	NW	0.733386
13	Kieran Fellowes	13/06/2023	32		Fine	16	65	4	Basal bark	Lycium ferocissimum	Garlon		3.30%		0.3	Small area near drillers sheds	MED	13	NW	0.108735
14	Kieran Fellowes	14/06/2023	34	CD1-S3	Fine	15	44	6	Cut n Paint	Lycium ferocissimum	Weedmaster duo		66%		13	Lots of large individuals. Cutting and painting with brush cutters	HIGH	20	W	1.713969
15	Kieran Fellowes	15/06/2023	34	CD1-S3	Fine	15	46	6	Cut n Paint	Lycium ferocissimum	Weedmaster duo		66%		6	Finished off this contour. Had a few interuotions i.e crew had to go home and virtual meeting	HIGH	21	W	0.848267
16	Kieran Fellowes	16/06/2023	0	CD1-S3	Fine	16	52	6	Cut n Paint	Lycium ferocissimum	Weedmaster duo		66%		8		HIGH	6	NW	0.868592
17	Kieran Fellowes	19/06/2023	41	CD1-S3	Fine	14	44	5	Basal bark	Lycium ferocissimum	Garlon		3.30%		20	Basal bark mix.	HIGH	17	NW	1.209342

Hunter Valley Energy Coal

1080 Wild Dog Baiting Feb/Mar 2023

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Title	Hunter Valley Energy Coal- 1080 Wild Dog Baiting Feb/Mar 2023
Description	Summary of Mineco Summer wild dog baiting activity
Created By	Dave Rae Drae@mineco.net.au 0436 323 545
Prepared For:	Jonathon Deacon Principal Environment Mt Arthur Coal / NSW Energy Coal

Table of Contents

FIGURES

Abbreviations and Acronyms

APVMA	Australian Pesticide and Veterinary Medicines Authority
Agvet	*Agricultural and Veterinary Chemicals Code Act 1994*
BMP	Biodiversity Management Plan
GIS	Geographic Information Systems
HSEC	Health Safety Environment Community
LGA	Local Government Area
LLS	Local Land Services
MAC	Mt Arthur Coal
OEH	Office of Environmental Heritage
PCO	Pesticide Control Order

Executive Summary

Mineco P/L has been engaged to provide land management services to Mount Arthur Coal mine within the operational areas. This scope included vertebrate pest control activities as required. Due to a large number of wild dog sightings around crib huts at the beginning of February a targeted program was conducted.

Although a late summer baiting program is not standard for site it was thought that a round of baiting preceding the local region's LLS coordinated program could be of benefit while dog activity was visibly high. Multiple fox sightings had also been taking place on site. Follow up baiting during the regional Follow up baiting during the Hunter Valley mines Spring baiting program should result in a significant impact on the local wild dog population.

This report outlines the baiting activity and the results of the work conducted. Maps are included for visualisation of the baiting locations and the uptake of baits over two rounds of baiting. The observational data and examples of images from trail cameras used for monitoring during the program is also included.

Reducing the wild dog and fox population at Mt. Arthur is undertaken as part of the mines obligation to community wellbeing and onsite biodiversity management. The impact of such introduced predators on the local environment cannot be understated and stands in direct competition with MAC's objectives to develop remediated landscapes suitable for sustained habitation by native flora and fauna. Mt. Arthur Coal's commitment to managing feral species is outlined in the site Biodiversity Management Plan which requests annual control programs and reporting on the activities effectiveness. Although no incidence of dog interaction resulting in worker injury has been recorded on site the potential remains high. Wild dogs and foxes can cause distraction to machine operators which may pose much greater risk to worker safety than a simple dog/pedestrian interaction. This report aims to capture the most recent control measures taken to reduce these risks to the community, environment and MAC workers.

1 PROGRAM METHODOLOGY

1.1 OUTLINE

Due to the wide ranging nature of wild dog communities it was decided that a swift response to the increased dog sightings was required. If delayed there was potential that the wild dogs may move to a more remote part of their territory either off site or somewhere unseen and the opportunity for population reduction would be lost.

As the location the dogs were most frequently sighted was a high traffic area containing both pedestrian areas and heavy vehicle corridors the decision to conduct a round of baiting was made as there were no safe areas to conduct a shoot.

The baiting was conducted in alignment with the NSW Pesticide Control Order 2020 (PCO) for 1080 bait products Schedule 1.

1.2 SCOPE AND OBSERVATION

Frequent dog sightings were being reported over the open mine channel by workers alerting each other to the presence of the wild dogs. The animals were beginning to be seen around the Crib Hut 19 area where heavy vehicle operators park up for breaks during shift. The Mineco Land Management team had also sighted dogs on site routinely around the release dam structures at the base of the VD1 rehabilitated areas. Given the distance between these areas it was decided to apply baits to the entire site similar to the 2022 Autumn dog baiting program to account for dogs roaming between the high frequency areas. 50 Bait locations were identified for the scope of the program to be baited twice with baits replaced after a week.

1.3 OBJECTIVES

The programs primary aim was to reduce the population of wild dogs on site. As there is no official record of the numbers of dog and fox sightings on site the success of the program would have to be measured by observing what had likely taken the 1080 baits. Another factor to consider is if there was a reduction in anecdotal reports of dogs following the program via the HSEC team and the mine 2-way channel.

1.4 PUBLIC NOTIFICATION

As outlined in PCO 2020 public notification is required prior to commencing a baiting program to alert people to the risk of injuring livestock or other domestic animals if entering the MAC boundary. Notice was provided to the community via newspaper and boundary signage. Signage from the LLS was utilized on all entry points to the baited tenements. Advertisement was made via the Newcastle Herald to ensure broad reach of the notification. Figure 1: Newspaper Notification and *Figure 2:* Boundary Notification show the notifications used in line with section 5.2 of schedule 1 in the PCO 2020.

Figure 1: Newspaper Notification

PUBLIC NOTIFICATION
1080 Wild Dog and Fox Baiting

Dear Landholder,

A 1080 baiting program for the purpose of controlling wild dogs and foxes is to be carried out on the Mt Arthur Coal mine site, including surrounding buffer land, Saddlers Creek Conservation Area and Thomas Mitchell Drive Conservation Area. The Baiting Program will involve the use of poison baits containing Sodium fluoroacetate (1080).

Baits will be laid on **Tuesday, 21 February 2023** and collected on **Wednesday 8 March 2023.**

Visitors and neighbours are warned not to take domestic pets and working dogs into these areas.

No baits will be placed within 500 metres of domestic residences.

For further information regarding the baiting program please call

Mt Arthur Coal
COMMUNITY RESPONSE LINE
1800 882 044

Figure 2: Boundary Notification

1.5 BAITS

Baits were provided by the Singleton LLS branch after providing the prospective baiting locations for the program. After review of the locations and the completion of a risk assessment baits were released to Mineco's authorized person who had competed the LLS vertebrate pesticide induction training. Baits were received and stored in accordance with the PCO 2020 in a lockable storage fridge free of other foodstuffs or sensitive items prescribed in the PCO. Baits consisted mainly of lamb hearts with a small number of kangaroo steaks that had the 1080 liquid applied to them.

These baits are provided a dosage of poison designed to be lethal to wild dogs specifically. The 1080 poison contains sodium fluoroacetate as the active ingredient which is naturally occurring in a variety of native flora. It is thought that native fauna having evolved alongside the plants bearing the chemical have developed a tolerance to the substance where as invasive species have not. As such a wild dog only needs to ingest 1/3 of a 6mg bait to have achieved an LD_{50} dosage whereas a lace monitor would need to consume 71 whole baits in a single sitting for a lethal amount to be ingested.

1.6 Bait Placement

Bait placement around site was based of historic data from previous programs and current anecdotal evidence of wild dogs habits. Baits were buried in a shallow hole with a small pad cleared around the site to allow for evidence to be left by any attending animals. Paw prints, scat an fur were all used to identify what likely removed a bait if not trail cameras were present at the site. Most baits were placed besides light vehicle tracks as the dogs prefer moving over the open ground rather than the rough scrub where possible. This also helps avoid off target uptake by other species that do not frequent the light vehicle tracks i.e. goannas. In many locations unfortunately no sign was left at bait pads due to the soil not being fine enough and forming rough aggregates over much of site. These soil types do not preserve animal tracks well.

Bait locations were inspected after a week and the condition of the pad was assessed. Record was made if the bait had been removed and if any animal sign that pointed to the species that removed the bait or attended the site was present. Any remaining baits were removed and buried in accordance with the PCO 2022, 500mm deep and clear of any watercourses. All baits were replaced with fresh baits that had been collected the day prior and pads reformed to cover the baits. The second round of baits were removed a week later and the same observations performed.

Interpretation of animal signs was obscured during round one by a heavy downpour that occurred on the evening of the baits being laid and again two days later. The second rain event may have washed away some good prints left in mud provided by the initial rain on the 21/2/23.

Figure 4: Dog Baiting Locations Feb/March 2023 shows the distribution of baits on site. Baiting was concentrated on the area subject to the most sightings in the lead up to the baiting period. 50 baits were placed on the first round of baiting and 48 on the subsequent round. These quantities allowed for a concentration where the dogs were expected to be active as well as around the perimeter of site and the Saddlers creek areas to the South. It was expected that a group of dogs must have been living in the scrub at the base of Mt. Arthur giving the easy access to the Belmont crib hut areas.

Figure 3: Baiting dates and Quantities

Baits laid	21/02/2023	1/03/2023
Baits Collected	28/02/2023	8/03/2023
Number of Baits	50	48

Figure 4: Dog Baiting Locations Feb/March 2023

2 Baiting Results

The baiting yielded the following outcomes based off the placement of cameras and the interpretation of animal sign left at the bait burial pads.

The species thought to have removed the bait from the pads are identified in *Figure* 5 and *Figure* 6 below. Cases of bait shyness were recorded where the bait was found within the mound but there was evidence of visitation by a dog. Primarily the mound was well excavated and paw marks were left in the disturbed ground.

Unknown takes were recorded where the bait was found to be missing from the pad but no distinct sign was left by the animal that removed it. To ensure the correct area was checked for the bait bamboo skewers were pushed into the ground within 20cm of the bait. This was to prevent false reporting of bait takes.

Baits not taken were disposed of on site in accordance with the PCO 2020

2.1 Results tables

Figure 5: Wild Dog Baiting results

Result	Round 1	Round 2
Dog	11	3
Bait Shyness	3	7
Fox	2	1
Pig	1	2
Crow	1	0
Goanna	0	1
Unknown	15	18
Not Taken	17	16

Figure 6: Totalled Results as percentage

Baits Laid	98	**Percentage**
Wild Dog Takes	14	14.3
Fox Takes	3	3.1
Other takes	5	5.1
Bait Shyness	10	10.2
Not taken	33	33.7
Unknown takes	33	33.7

2.2 Mapped Results

The below figures show the distribution of the results across the baiting area. Raw data will be attached in the appendix of this report for inclusion in MAC GIS database.

Figure 7: Baiting Results Map Round 1

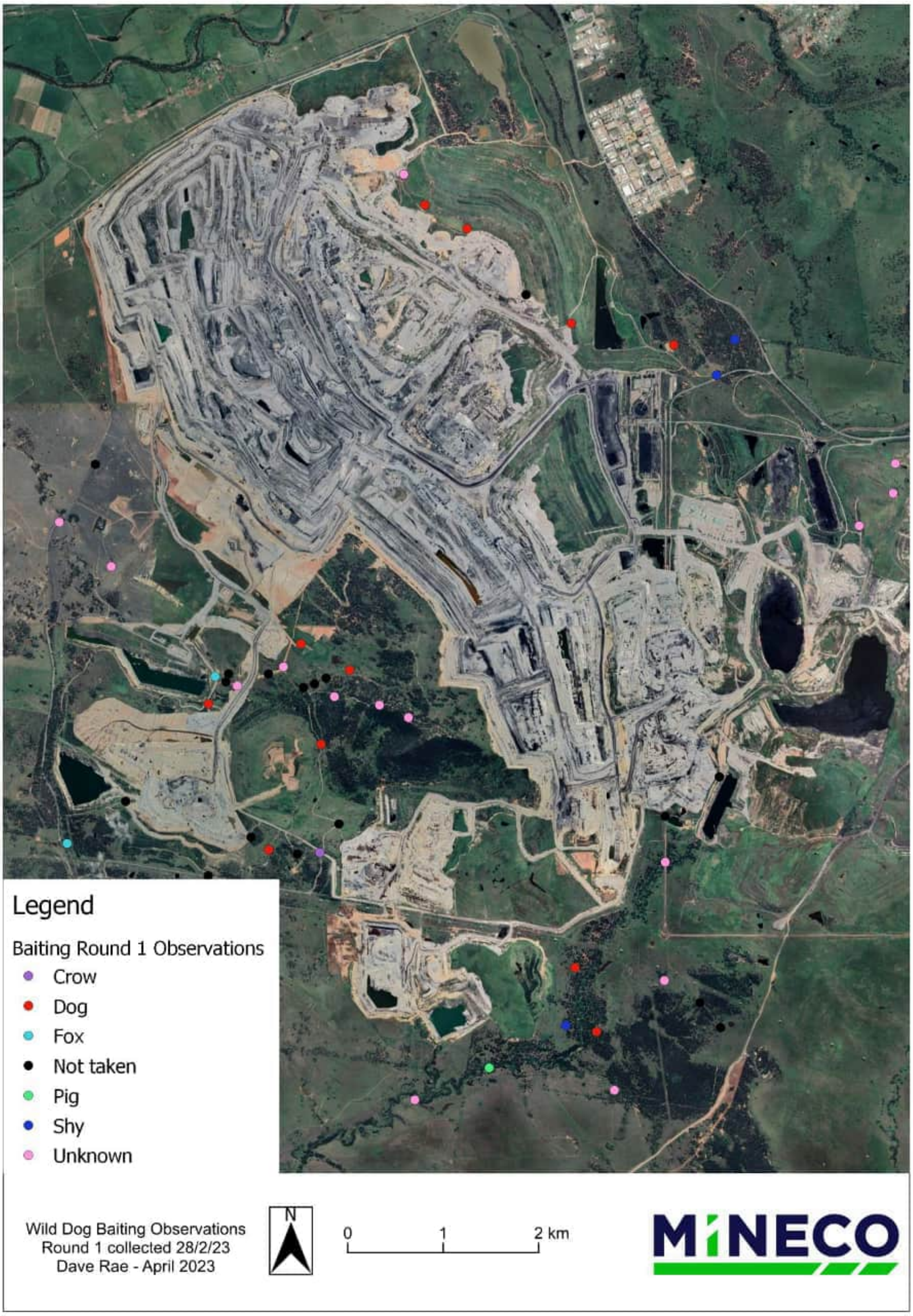
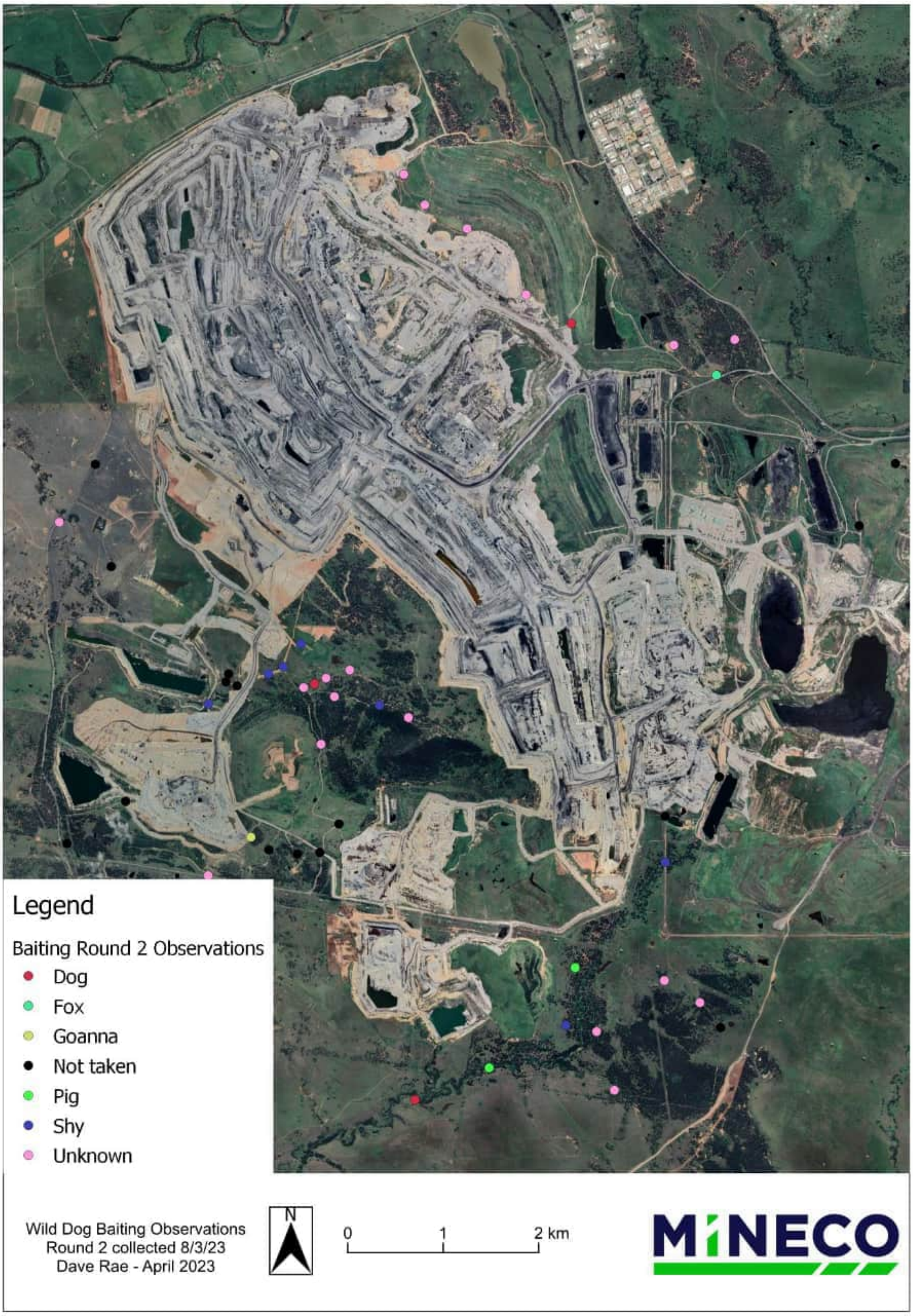


Figure 8: Baiting Results Map Round 2



3 DISCUSSION OF RESULTS

A total of 14 baits were clearly identifiable as having been removed by wild dogs. With a large number of the takes being unidentifiable (listed as unknown) this figure is likely to be somewhat higher. Traditionally baiting is conducted later in the year when non target species such as goannas or lace monitors which will scavenge baits become dormant. It is likely that these large lizards have also contributed in higher proportion to the takes than was able to be identified in field.

The reduction in dog takes by 42% between the first and second round of baiting would seem to indicate that there was a reduction in dogs on site to retrieve the baits. The increase in bait shyness however shows that a population of dogs that has interacted with poisoned dogs may be developing on site. Additionally the large rainfall experienced on site during the baiting period may have had some effect on the efficacy of the baits. Ingesting of sub lethal doses may have contributed to the higher bait shyness identified in the second round. However the Centre for Invasive Species Solutions (CISS) claim there is no evidence that sub lethal doses lead to bait shyness. According to CISS wild dogs do not have the capacity to associate becoming ill hours after consuming a sub lethal dose with the bait.

Given the large proportion of unidentifiable takes it is difficult to draw concrete conclusions about roughly one third of the baits removed from their mounds. There were even cases particularly in the second round where baits were removed from mounds with cameras present and the camera was not triggered. These same cameras were able to capture images of kangaroos moving through the baited area. This may have been caused by fast visits by scavenging birds not presenting much of a target for the cameras motion or Passive Infra Red (PIR) sensors.

There has been a noticeable reduction in anecdotal reports of dog and fox sightings reported to the land management supervisor. The Land management team who regularly witness dogs traversing the boundary areas an in the rehab have also rarely seen any wild dog movement during their normal work in field. In light of this it is concluded that the program successfully reduced the wild dog population at MAC.

The May baiting should be conducted in conjunction with the rest of the mines in the area at the direction of the LLS. This additional observation point would be useful to see if there is a reduction in wild dog activity and bait uptake when compared to previous programs run at the same time.

4 APPENDIX

4.1 OBSERVATIONS

Figure 9: Observations Round 1 28/3/23

BAIT ID	Removed	Animal	Notes
549	Y	Dog	Dog seen on cam 7, rain affected pad, Camera 7 VD-1
550	N		
551	N	Shy	gravel and clay dug at but not taken
552	N	Shy	clayey ground, rain affected, dug at but not taken
553	Y	Dog	Dog scat next to hole, completely dug away, rain effected
554	Y	Unknown	compacted clay, no prints rain effected
556	Y	Dog	Dog prints in debris, completley dug up
555	Y	Dog	Dog prints in debris, completley dug up
557	N		
558	Y	Unknown	partially dug up, fine soil, rain effected
559	Y	Unknown	partially dug up, fine soil, rain effected
560	N		
561	Y	Dog	completley dug up, prints on pad, Camera 8, LV road behind crib hut 19
565	N		
563	N		
564	Y	Fox	Fox prints on pad
562	Y	Dog	Dog prints in debris, completley dug up
566	N		
567	Y	Crow	Crow prints on pad, beak marks
568	N		
569	Y	Dog	Camera, dug up area, Cam 8 road behind crib hut 19
570	Y	Unknown	Dug up, clay area, rain effected
598	Y	Unknown	no distinct signs, gravely area
597	Y	Unknown	clayey soil, rain effected
571	Y	Unknown	Gravely ground, no marks left
572	Y	Dog	Prints on pad
573	N		
574	N		
576	Y	Pig	trotter prints, rubs on nearby trees
575	Y	Unknown	grass and compacted clay
577	Y	Unknown	dry dusty soil / grass no prints
578	Y	Dog	Camera 10, Camera 10 in offset area
579	Y	Dog	dog paw prints, completley dug up mound
580	N	Shy	Dog scrapings at site, bait still in ground
581	Y	Unknown	rain effected
582	N		
583	N		
584	Y	Unknown	hidden next to cement pier, grass ground, no sign left
585	N		
586	N		
587	Y	Unknown	no prints, stony ground, pad lightly disturbed
588	Y	Unknown	no definite signs, stoney grassy ground
589	Y	Unknown	compacted clay, no prints rain effected
590	N		camera 8, no dogs seen
591	Y	Unknown	silty area washed over during rain, no prints left
592	Y	Fox	Fox prints on pad, pad dug up
593	N		
594	N		camera captured no activity, Campark T-85 In scrub below mt arthur
595	Y	Dog	Dug up, prints on pad and in area
596	N		

Figure 10: Observations Round 2 8/3/23

BAIT ID	Removed	Animal	Notes
549	Y	Dog	confirmed camera 7
550	Y	Unknown	no distinct signs, area well dug up
551	Y	Unknown	no distinct signs
552	Y	Fox	Fox droppings on pad, dug up bait taken
553	Y	Unknown	Area dug up, animal fur left in bait area
554	Y	Unknown	no distinct sign, well dug up, hard clayey ground
555	Y	Unknown	no distinct sign, well dug up
556	Y	Unknown	no distinct sign, well dug up
557	N		
558	Y	Unknown	no distinct sign, well dug up
559	N		
560	N		
561	N	Shy	Dog attended location and dug at pad, confirmed on camera
562	Y	goanna	goanna tracks over pad, pad pulled apart
563	N		
564	N		
565	N		
566	N		
567	N		
568	Y	Unknown	mound excavated by something, no definits sign
569	N	Shy	Attended by fox, confirmed on camera
570	Y	Unknown	Hard ground surrounding pad, pad well dug up but no prints
571	Y	Unknown	Bait removed but no marks on pad, not much disturbance to pad
572	Y	Unknown	no distinct sign
573	N		
574	Y	Unknown	no distinct sign
575	Y	Dog	Dog hair and well dug up pad
576	Y	Pig	pig trotter marks in mound
577	Y	Unknown	
578	Y	Unknown	camera did not capture anything and no marks in mound
579	Y	Pig	trotter marks in pad, well excavated
580	N	Shy	Bait at site uncovered, partially gnawed
581	Y	Unknown	no distinct sign, pad dug up
582	Y	Unknown	no distinct sign, pad dug up well and material pushed about
583	N		
584	N	Shy	Bait at site uncovered, partially gnawed
585	N		
586	N		
587	N		
588	N/A		not baited on round 2
589	N		Camera on bait but not taken
590	N		Camera on bait but not taken
591	N		
592	N/A		not baited on round 2
593	Y	Dog	dog prints in sand, well excavated
594	Y	Unknown	camera did not capture anything and no marks in mound
595	Y	Unknown	Area dug up but no distince sign
596	N	Shy	Fox prints on sandy pad, bait not taken
597	N	Shy	Dog prints left on pad, and pad pawed at
598	N	Shy	Something had dug at mound but bait remained

4.2 PHOTOGRAPHS

A selection of images from the trail cameras is included here.

Figure 11: Dog removing bait at location 578 round 1

Figure 12: Fox investigating bait location 549 round 1

Figure 13: dog removes bait at location 569 at Belmont Topsoil Stockpile

Figure 14: Dog investigates bait on Round 2 but does not take on light vehicle road behind crib hut 19

Note: Date on this camera setup was incorrect actual date 03/03/2023.

Figure 15: Feral cat investigating location 569

4.3 Coordinates of Bait Locations

Figure 16: Bait coordinates

Bait ID	lat	lon	ns1:ele
549	-32.324489	150.873614	239.644791
550	-32.321782	150.868572	318.826813
551	-32.326005	150.891808	237.098694
552	-32.329354	150.889777	232.645966
553	-32.326521	150.885038	223.972443
554	-32.310459	150.854967	279.884735
555	-32.313335	150.857304	299.013977
556	-32.315569	150.86201	322.612427
557	-32.337748	150.820608	188.438599
558	-32.34319	150.816606	168.72879
559	-32.34737	150.822369	180.815567
560	-32.358221	150.835138	219.560471
561	-32.36028	150.833198	221.180893
562	-32.372825	150.83794	231.107849
563	-32.369455	150.823988	224.400436
564	-32.373417	150.817454	188.383087
565	-32.374006	150.839923	208.964478
566	-32.374391	150.843119	194.616364
567	-32.374258	150.845604	214.465317
568	-32.358752	150.843799	271.376526
569	-32.35463	150.843511	238.715607
570	-32.361569	150.855473	399.587158
571	-32.359603	150.847234	310.824829
572	-32.364085	150.845745	280.861023
573	-32.371584	150.847738	240.582001
574	-32.376446	150.833169	230.384399
575	-32.397533	150.856184	149.949646
576	-32.394518	150.864466	166.392303
577	-32.396626	150.878412	176.987122
578	-32.391108	150.876432	171.640472
579	-32.385097	150.874045	190.522827
580	-32.390541	150.873001	178.308411
581	-32.386314	150.883978	209.803787
582	-32.388388	150.887941	207.788315
583	-32.390732	150.89022	206.363174
584	-32.375176	150.884078	187.733719
585	-32.370849	150.88407	196.71402
586	-32.367153	150.890097	222.718048
587	-32.343529	150.905678	251.449692
588	-32.340466	150.909448	270.494446
589	-32.337675	150.909713	237.562943
590	-32.357469	150.835441	225.307419
591	-32.358584	150.836396	230.056076
592	-32.357716	150.833945	217.233444
593	-32.358404	150.845012	284.945282
594	-32.357863	150.846303	279.33017
595	-32.357096	150.84894	268.583405
596	-32.357468	150.839882	263.443909
597	-32.356797	150.841555	271.298859
598	-32.360401	150.852246	378.442871

5 REFERENCES

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BHP - Mt Arthur Coal

1080 Wild Dog & Fox - Baiting May/June 2023

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Title	BHP – Mt Arthur Coal - 1080 Wild Dog & Fox Baiting May/June 2023
Description	Summary of IRONRIDGE CONTRACTING Winter wild dog baiting activity
Created By	Dave Lucano
Prepared For:	BHP – Mt Arthur Coal

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Abbreviations and Acronyms

APVMA	Australian Pesticide and Veterinary Medicines Authority
Agvet	*Agricultural and Veterinary Chemicals Code Act 1994*
BMP	Biodiversity Management Plan
GIS	Geographic Information Systems
HSEC	Health Safety Environment Community
LGA	Local Government Area
LLS	Local Land Services
MAC	Mt Arthur Coal
OEH	Office of Environmental Heritage
PCO	Pesticide Control Order

Executive Summary

IRONRIDGE CONTRACTING PTY LTD has been engaged by ROBSON CIVIL PROJECTS PTY LTD to provide vertebrate pest control activities as required to Mount Arthur Coal mine within the operational areas.

This round of baiting coincides with the LLS annual mine baiting program. Follow up baiting during the Hunter Valley mines Spring baiting program should result in a significant impact on the local wild dog population.

This report outlines the baiting activity and the results of the work conducted. Maps are included for visualisation of the baiting locations and the uptake of baits over two rounds of baiting. The observational data and examples of images from trail cameras used for monitoring during the program is also included.

Reducing the wild dog and fox population at Mt Arthur is undertaken as part of the mines obligation to community wellbeing and onsite biodiversity management. The impact of such introduced predators on the local environment cannot be understated and stands in direct competition with MAC's objectives to develop remediated landscapes suitable for sustained habitation by native flora and fauna. Mt Arthur Coal's commitment to managing feral species is outlined in the site Biodiversity Management Plan which requests annual control programs and reporting on the activities effectiveness. Although no incidence of dog interaction resulting in worker injury has been recorded on site the potential remains high. Wild dogs and foxes can cause distraction to machine operators which may pose much greater risk to worker safety than a simple dog/pedestrian interaction. This report aims to capture the most recent control measures taken to reduce these risks to the community, environment and MAC workers.

1 PROGRAM METHODOLOGY

1.1 OUTLINE

IRONRIDGE CONTRACTING was engaged by ROBSON CIVIL PROJECTS to conduct the winter Baiting Program using 1080 poison baits targeting the Wild Dog and Fox population that inhabit the mine site of Mt Arthur Coal operations.

The baiting was conducted in alignment with the NSW Pesticide Control Order 2020 (PCO) for 1080 bait products Schedule 1.

1.2 SCOPE AND OBSERVATION

Due to the land area of the Mt Arthur Coal operations and previous baiting efforts and observations from site personnel it was decided to employ 50 - 1080 poison baits. The 50 Bait locations were identified across the site to ensure an even coverage and distribution of baits. The scope of the program requires each bait location to be baited twice with baits replaced after a week.

1.3 OBJECTIVES

The programs primary aim was to reduce the population of wild dogs on site. As there is no official record of the numbers of dog and fox sightings on site the success of the program would have to be measured by observing what had likely taken the 1080 baits. Another factor to consider is if there was a reduction in anecdotal reports of dogs following the program via the HSEC team and the mine 2-way channel.

1.4 PUBLIC NOTIFICATION

As outlined in PCO 2020 public notification is required prior to commencing a baiting program to alert people to the risk of injuring livestock or other domestic animals if entering the MAC boundary. Notice was provided to the community via newspaper and boundary signage. Signage from the LLS was utilized on all entry points to the baited tenements. Advertisement was made via the Newcastle Herald to ensure broad reach of the notification. Figure 1: Newspaper Notification and *Figure 2:* Boundary Notification show the notifications used in line with section 5.2 of schedule 1 in the PCO 2020.

Figure 1: Newspaper Notification

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Dear Landholder,

A 1080 baiting program for the purpose of controlling wild dogs and foxes is to be carried out on the Mt Arthur Coal mine site, including surrounding buffer land, Saddlers Creek Conservation Area and Thomas Mitchell Drive Conservation Area.

The Baiting Program will involve the use of poison baits containing Sodium fluoroacetate (1080).

Baits will be laid on **Thursday, 18 May 2023** & collected on **Friday, 2 June 2023**. Visitors and neighbours are warned not to take domestic pets and working dogs into these areas.

No baits will be placed within 500 metres of domestic residences.

For further information regarding the baiting program please call

Mt Arthur Coal
COMMUNITY RESPONSE LINE
1800 882 044

Figure 2: Boundary Notification

1.5 BAITS

Baits were provided by the Singleton LLS branch after providing the prospective baiting locations for the program. After review of the locations and the completion of a risk assessment baits were released to IRONRIDGE CONTRACTING's authorized person who had competed the LLS vertebrate pesticide induction training. Baits were received and stored in accordance with the PCO 2020 in a lockable storage fridge free of other foodstuffs or sensitive items prescribed in the PCO. Baits consisted of: Venison steaks, lamb hearts and kangaroo steaks that had the 1080 liquid injected into them.

These baits are provided a dosage of poison designed to be lethal to wild dogs specifically. The 1080 poison contains sodium fluoroacetate as the active ingredient which is naturally occurring in a variety of native flora. It is thought that native fauna having evolved alongside the plants bearing the chemical have developed a tolerance to the substance where as invasive species have not. As such a wild dog only needs to ingest 1/3 of a 6mg bait to have achieved an LD_{50} dosage whereas a lace monitor would need to consume 71 whole baits in a single sitting for a lethal amount to be ingested.

1.6 BAIT PLACEMENT

Bait placement around site was based of historic data from previous programs and current anecdotal evidence of wild dogs habits. Baits were buried in a shallow hole with a small pad cleared around the site to allow for evidence to be left by any attending animals. Paw prints, scat an fur were all used to identify what likely removed a bait if not trail cameras were present at the site. Most baits were placed besides light vehicle tracks as the dogs prefer moving over the open ground rather than the rough scrub where possible. This also helps avoid off target uptake by other species that do not frequent the light vehicle tracks i.e. goannas. In many locations unfortunately no sign was left at bait pads due to the soil not being fine enough and forming rough aggregates over much of site. These soil types do not preserve animal tracks well.

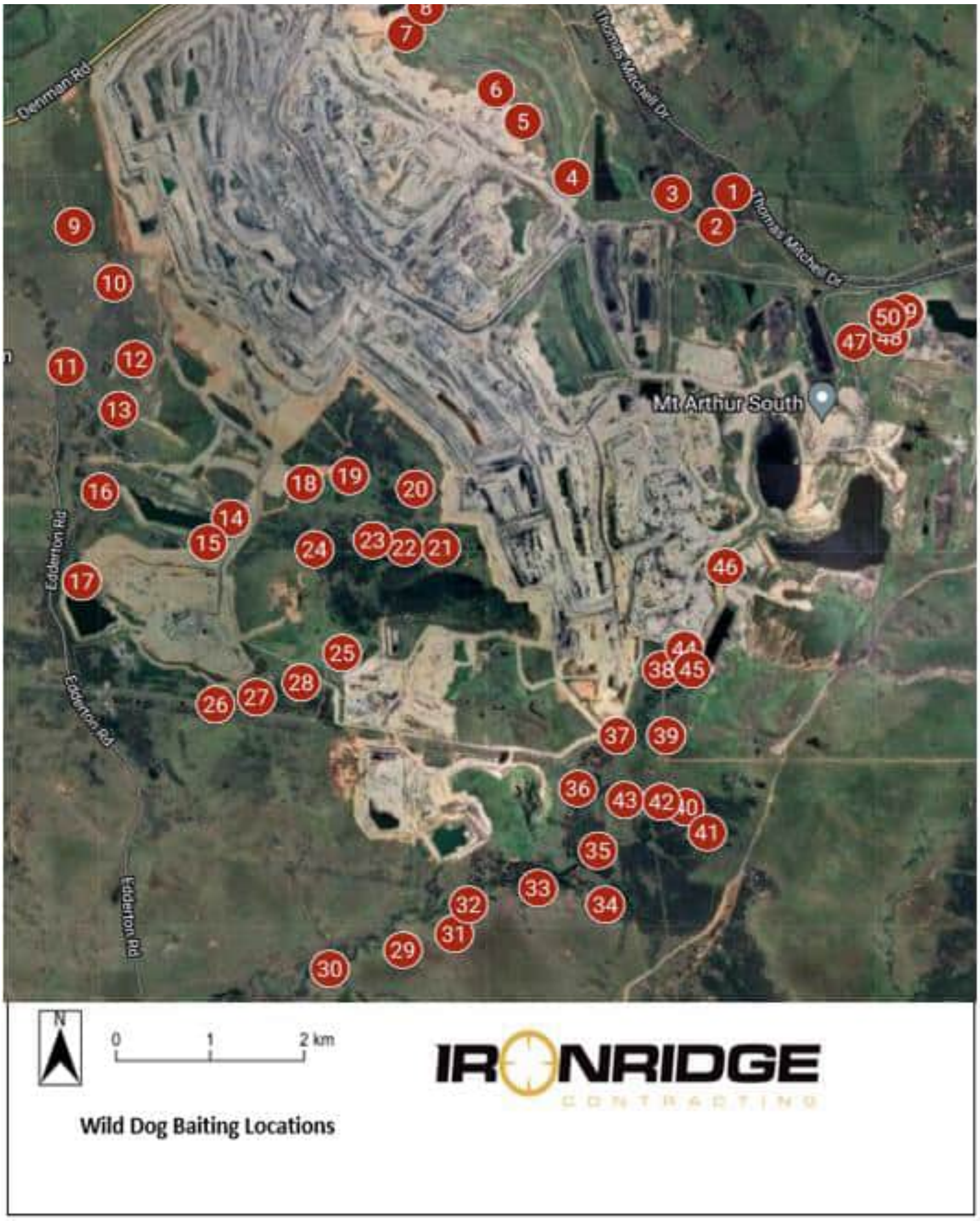
Bait locations were inspected after a week and the condition of the pad was assessed. Record was made if the bait had been removed and if any animal sign that pointed to the species that removed the bait or attended the site was present. Any remaining baits were removed and buried in accordance with the PCO 2022, 500mm deep and clear of any watercourses. All baits were replaced with fresh baits that had been collected the day prior and pads reformed to cover the baits. The second round of baits were removed a week later and the same observations performed. During the baiting program there were a number of small rain events that hampered the animal track identification process due to rain drops disturbing the formed pads.

Figure 4: Dog Baiting Locations May/June 2023 shows the distribution of baits on site. 50 baits were placed on the first round, the first round was carried out over 2 days to allow for the installation of 15 trail cameras. 50 baits were then placed over 1 day on the subsequent round. These quantities allowed for a even distribution of baits across site where the dogs were expected to be active as well as around the perimeter of site and the Saddlers creek areas to the South.

Figure 3: Baiting Dates and Quantities

Round	**1**	**1**	**2**
Baits laid	18/05/2023	19/05/2023	26/05/2023
Baits Collected	26/05/2023	26/05/2023	2/06/2023
Number of Baits	25	25	50

Figure 4: Dog Baiting Locations May/June 2023



2 BAITING RESULTS

The baiting yielded the following outcomes based off the placement of 15 trail cameras and the interpretation of animal sign left at the bait burial disturbance pads.

The species thought to have removed the bait from the pads are identified in *Figure* 5 and *Figure* 6 below. Cases of bait shyness were recorded where the bait was found within the mound but there was evidence of visitation by the target animals. Primarily the mound was well excavated and paw marks were left in the disturbed ground along with scat in some cases.

Unknown takes were recorded where the bait was found to be missing from the pad but no distinct sign was left by the animal that removed it from the burial site, this was due to the pad disturbed by rain or by a non-target species entering the disturbance pad area.

Baits not taken were disposed of on site in accordance with the PCO 2020

2.1 RESULTS TABLES

Figure 5:Wild Dog Baiting results

Result	Round 1	Round 2
Wild Dog	4	4
Fox	8	7
Pig	5	2
Unknown	12	10
Bait Shyness	2	4
Not taken	18	22
Birds	1	2

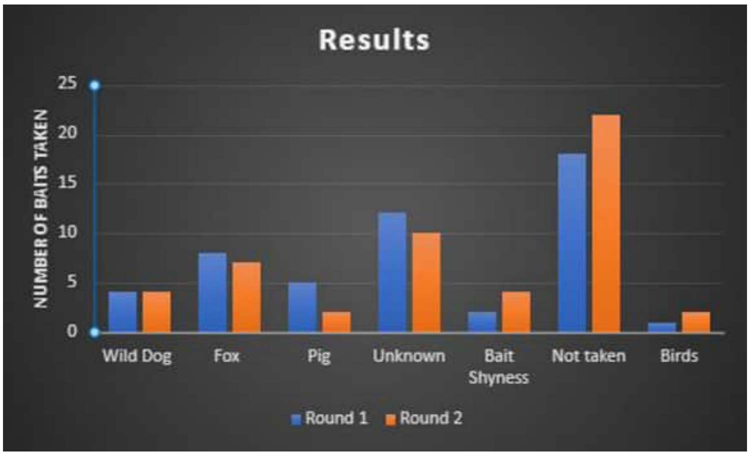


Figure 6: Totalled Results as percentage

Baits Laid	100	Percentage
Wild Dog Takes	8	8%
Fox Takes	15	15%
Bait Shyness	6	6%
Not taken	40	40%
Unknown takes	22	22%
Non Target Species	9	9%

2.2 Mapped Results

The below figures 7 and 8 show the distribution of the results across the baiting area.

Figure 7:Baiting Results Map Round 1

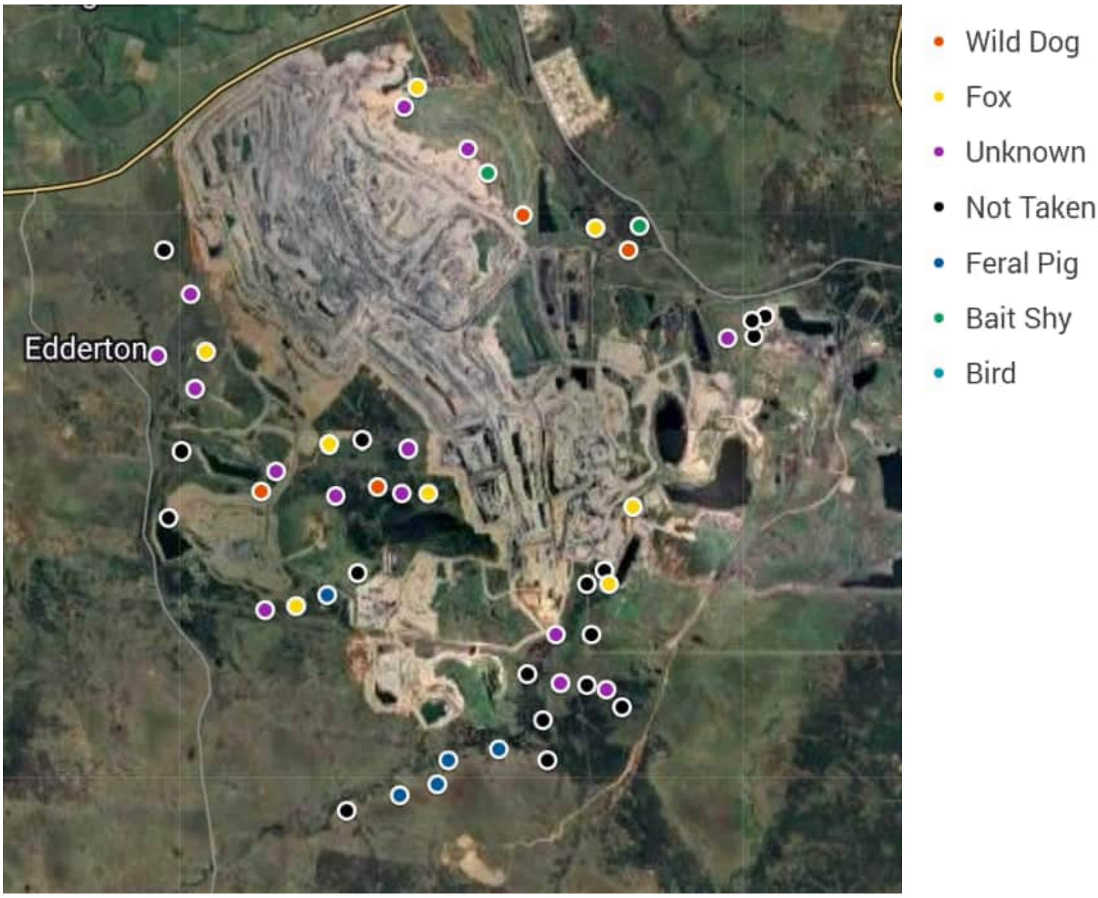
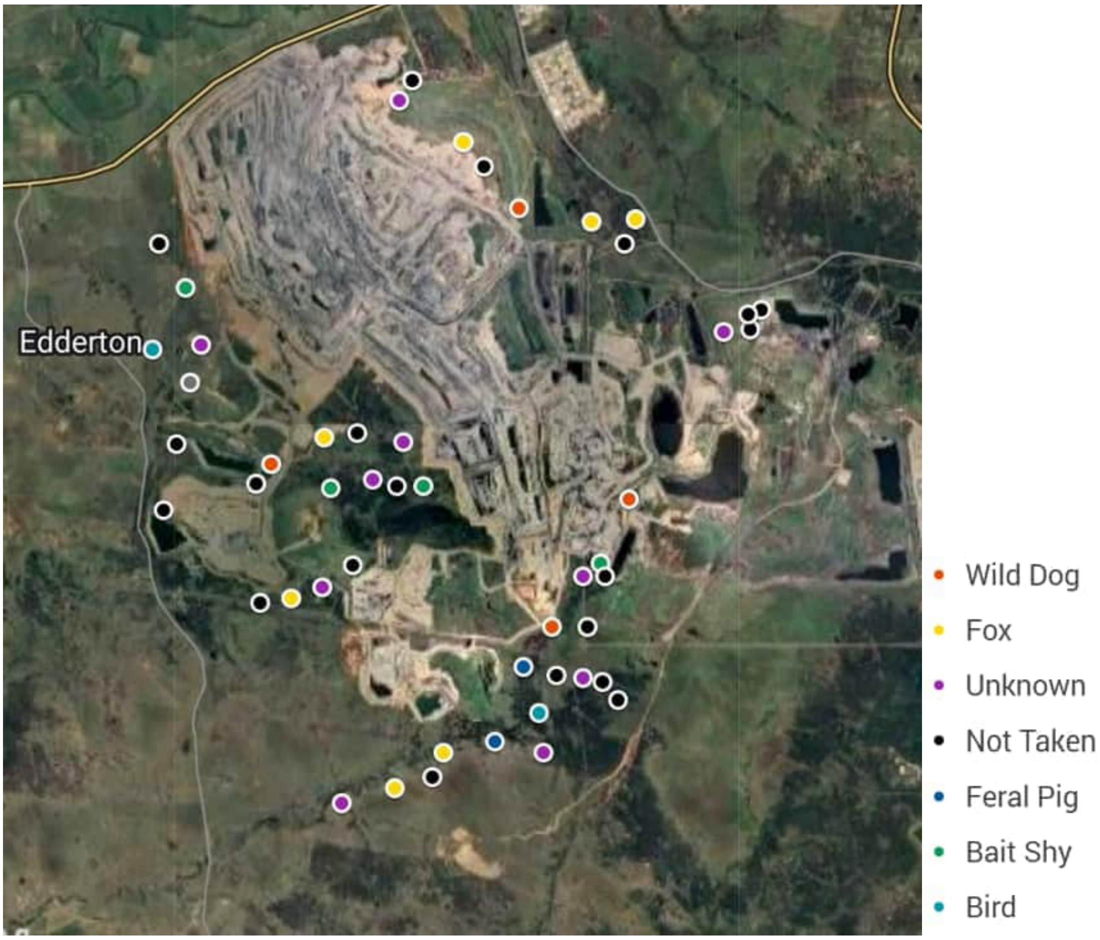


Figure 8: Baiting Results Map Round 2



3 DISCUSSION OF RESULTS AND RECOMEDATIONS

A total of 23 baits were clearly identifiable as having been removed by wild dogs and foxes over the baiting program. With the use of the additional cameras it gave a better indication of what actually took the bait. Most sites with cameras installed were visited by a variety of target and non-target animals over the weeks during the baiting rounds 1 and 2. Each animal leaves sign from visiting the bait site and disturbs the bait station mound. This makes the identification process harder to establish what animal has taken the bait if you are solely relying on foot prints in the bait station mound.

It appears that the 2023 1080 wild dog and fox baiting programs have had a large impact on the wild dog and fox population at MAC. There has been a noticeable reduction in anecdotal reports of dog and fox sightings reported to the land management supervisor. The Land management team who regularly witness dogs traversing the boundary areas an in the rehab have also rarely seen any wild dog movement during their normal work in field. In light of this it is concluded that the program successfully reduced the wild dog population at MAC.

During the bait program there was a large number of Feral pigs and Feral cats observed on the trail cameras. The main concentration of the Feral Pigs was seen in the Saddlers Creek Conservation area and the main conservation of Feral Cats was around the core shed area, this is likely due to the large amount of rabbits that inhabit this area. It would be recommended to carry out a feral pig and feral cat eradication program to bring these numbers down to an acceptable level.

3.1 Photographs

A selection of images from the trail cameras is included here.

Figure 9:Wild dogs investigating bait at location 32 round 1

Figure 10: Fox taking bait at location 18 round 1

Figure 11: Pigs taking bait at location 32 round 1

Figure 12: Pig taking bait at location 29 round 1

13: Fox taking bait at location 1 round 2

Figure 13: A large number of feral cats observed throughout the program.

3.2 COORDINATES OF BAIT LOCATIONS

Figure 14: Bait coordinates

Name;Latitude;Longitude
B1;;-32.326070688;150.891766548
B2;;-32.329316281;150.889856815
B3;;-32.326197613;150.884857178
B4;;-32.324547576;150.873548985
B5;;-32.319071414;150.867948532
B6;;-32.31589799;150.864987373
B7;;-32.310385035;150.854902267
B8;;-32.307791654;150.85700511
B9;;-32.32929815;150.817480087
B10;;-32.334973127;150.821793079
B11;;-32.34322206;150.81653595
B12;;-32.342605682;150.824196339
B13;;-32.347409692;150.822350979
B14;;-32.358267627;150.835053921
B15;;-32.360714561;150.832586288
B16;;-32.355584986;150.820398331
B17;;-32.364375775;150.818338394
B18;;-32.354714923;150.84335804
B19;;-32.354080497;150.848464966
B20;;-32.355313092;150.85580349
B21;;-32.361167689;150.858743191
B22;;-32.361095189;150.854666233
B23;;-32.360352056;150.850975513
B24;;-32.36127644;150.844452381
B25;;-32.371534652;150.84769249
B26;;-32.376572712;150.833380222
B27;;-32.375865951;150.838057995
B28;;-32.374379922;150.842971802
B29;;-32.400889178;150.854451656
B30;;-32.40271899;150.846147537
B31;;-32.399276739;150.86022377
B32;;-32.396305427;150.861897469
B33;;-32.394783498;150.869772434
B34;;-32.396305427;150.877261162
B35;;-32.391051039;150.876467228
B36;;-32.384944693;150.874149799
B37;;-32.379744008;150.87865591
B38;;-32.373093219;150.883612633
B39;;-32.379671523;150.884084702
B40;;-32.386829188;150.886445045
B41;;-32.38923911;150.888826847
B42;;-32.386249348;150.88363409
B43;;-32.386031907;150.879471302
B44;;-32.371117822;150.886294842
B45;;-32.373111341;150.887067318
B46;;-32.362943932;150.890865326
B47;;-32.340810911;150.905478001
B48;;-32.340448327;150.90944767
B49;;-32.338399698;150.909297466
B50;;-32.337819547;150.911142826

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