WAMBO COAL PTY LTD
2022 ANNUAL REVIEW

1 January – 31 December 2022

Peabody

Name of operation	Wambo Coal Mine
Name of operator	Wambo Coal Pty Ltd
Development consent /Project Approval #	DA 305-7-2003, DA 177-8-2004, EPBC 2003/1138, EPBC 2016/7636, EPBC 2016/7816
Name of holder of development consent	Wambo Coal Pty Ltd
Title/Mining lease #	CL365, CL374, CL397, CCL743, ML1402, ML1572, ML1594, ML1806, A444, EL7211
Name of holder of mining lease	Wambo Coal Pty Ltd
Water licence #	As per **Table 3**
Name of holder of water licence	Wambo Coal Pty Ltd
Forward Program start date	9 March 2022
Forward Program end date	8 March 2025
Annual Review start date	1 January 2022
Annual Review end date	31 December 2022

I, Peter Jaeger, certify that this audit report is a true and accurate record of the compliance status of Wambo Coal Mine for the period 1 January 2022 to 31 December 2022 and that I am authorised to make this statement on behalf of Wambo Coal Pty Ltd.

Note:

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

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

Name of authorised reporting officer	Peter Jaeger
Title of authorised reporting officer	Manager: Environment & Community
Signature of authorised reporting officer	
Date	31/3/23

Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
EPL529	No
DA 305-7-2003	No
DA 177-8-2004	Yes
EPBC 2003/1138	Yes
EPBC 2016/7636	Yes
EPBC 2016/7816	No
CL365	Yes
CL374	Yes
CL397	Yes
CCL743	Yes
ML1402	Yes
ML1572	Yes
ML1594	Yes
ML1806	Yes
A444	Yes
EL7211	Yes
Water licences (as per **Table 3**)	Yes

Compliance Status Key

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

Non-Compliances

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
DA 305-7-2003	B55	Discharge Limits	Non-Compliant	TSS levels exceeded the HRSTS discharge limit on 16 March and 30 March 2022.	Section 10.2
Environment Protection Licence 529	L2.1	Concentration Limits at Discharge Point			
DA 305-7-2003	B66	Performance Indicators	Non-Compliant	Exceedance of groundwater performance indicators at one location	Section 10.1
DA 305-7-2003	B54	Pollution of Waters	Non-Complaint	Floodwaters from Wollombi Brook inundated a sediment control sump at Hales Crossing resulting in release from the Hales Crossing Sump on 8 March and 5 July 2022.	Section 10.3
Environment Protection Licence 529	L1.1				
DA 305-7-2003	B55	Discharge Limits	Non-Complaint	pH levels exceeded the HRSTS discharge limit.	Section 10.2
Environment Protection Licence 529	L2.4	Concentration Limits at Discharge Point			
EPBC 2016/7636	1d	Notification	Non-Compliant	DCCEEW was not notified in writing of changes to the conditions in the Development Consent (Modification 18).	Section 10.4 and Appendix I

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Appendix F	Surface Water Quality Monitoring Data Summary
Appendix G	Annual Stream Flow Monitoring Report
Appendix H	Annual Groundwater Monitoring Report
Appendix I	Annual Compliance Report (EPBC 2016/7636 and EPBC 2016/7816)

1.0 Introduction

The Wambo Coal Mine (the Mine) is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW) (**Figure 1**). The Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

A range of open cut and underground mine operations have been conducted at the Mine since mining operations commenced in 1969. Mining under the current Development Consent (DA 305-7-2003) commenced in 2004 and permitted both open cut and underground operations and associated activities to be conducted. The approved run-of-mine (ROM) coal production rate is 14.7 million tonnes per annum and all product coal is transported from the Mine by rail.

MOD 16 to (DA 305-7-2003) was approved by the Independent Planning Commission of NSW on 29 August 2019 and required development at the Mine to be undertaken in the following stages:

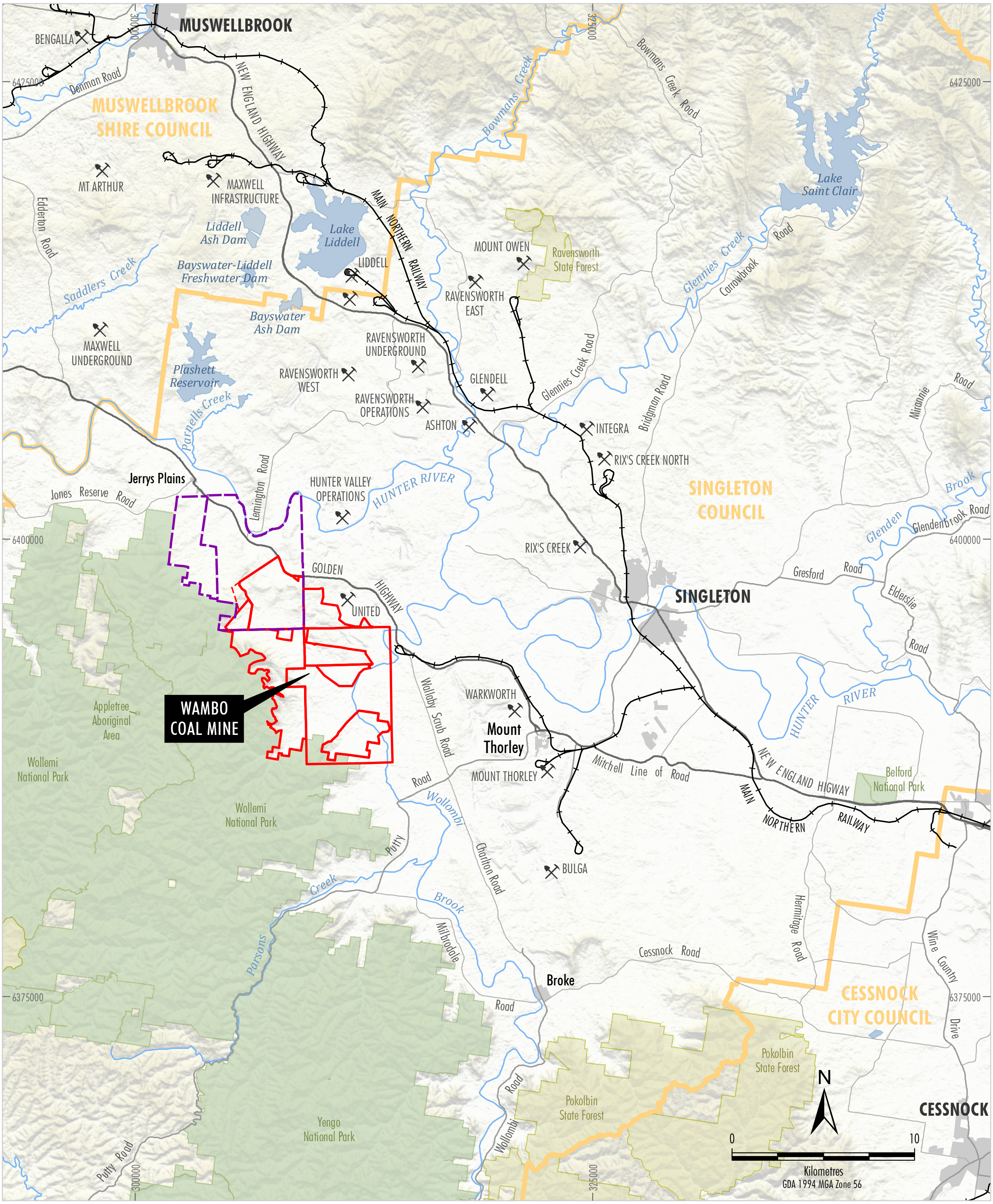
- Phase 1 – open cut mining operations at Wambo open cut mine, underground mining operations at Wambo underground mine and the operation of Wambo mine infrastructure (including minor upgrades to this infrastructure) under DA 305-7-2003.
- Phase 2 – underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure under DA 305-7-2003 and associated surface infrastructure.
- Phase 3 – following the cessation of underground mining operations that includes mine closure.

Phase 2 commenced on 1 December 2020, and open cut operations are now covered under State Significant Development (SSD) 7142. Operations under Development Consent DA 177-8-2004 have not changed following the commencement of Phase 2.

Upon the commencement of Phase 2 under DA 305-7-2003 (MOD 16), WCPL and United Collieries Pty Limited (United) (owned 95 per cent by Abelshore Pty Limited, a wholly owned subsidiary of Glencore Coal Pty Limited [Glencore] and 5 per cent by the Construction, Forestry, Mining and Energy Union [CFMEU]) entered into a 50:50 Joint Venture at the open cut mine. United manages Joint Venture tenements (i.e. open cut operations), and WCPL continues to operate underground mining operations.

Figure 2 shows the approved Mine layout including mining lease boundaries, current operational disturbance footprint and Remnant Woodland Enhancement Areas (RWEAs) for Phase 2. **Figure 3** shows the approved Mine longwall layout for Phase 2.

Operations at the Mine also include a rail spur and loop, coal reclaim and rail loading facility for the Wambo Coal Terminal under Development Consent (DA 177-8-2004) which was granted in 2004.



Source: NSW Spatial Services (2022)

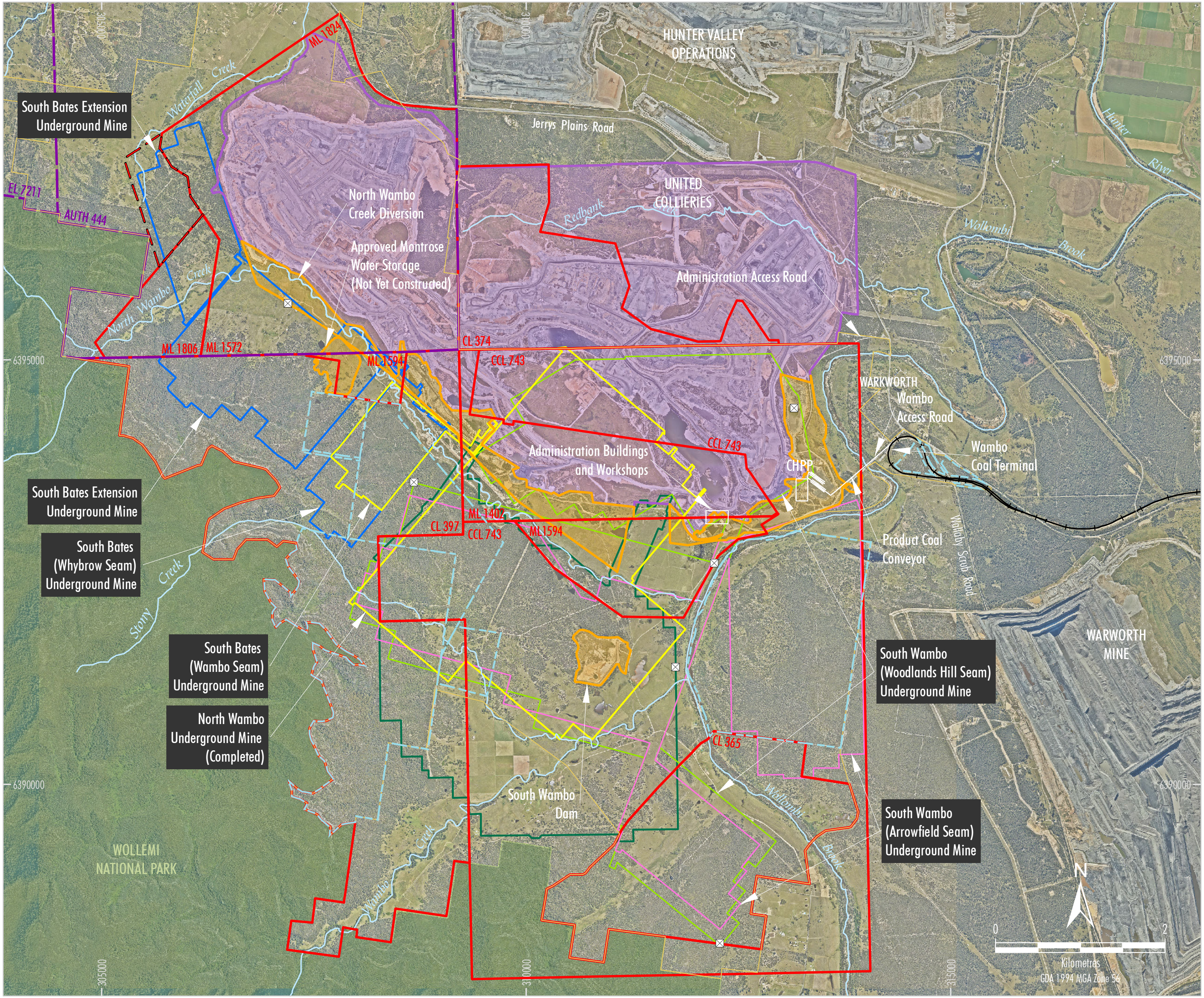
LEGEND

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Proposed Mining Lease Application Area
- Local Government Area
- National Park
- State Forest
- Mining Operation

Peabody
WAMBO COAL MINE

Regional Location

Figure 1



LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Proposed Mining Lease Application Area
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Ventilation Shaft

Underground Mining Areas

- Whybrow Seam
- Wambo Seam
- Woodlands Hill
- Arrowfield Seam
- Previous Underground Workings in Whybrow Seam

\# Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Colleries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: WCPL (Nov, May 2022)

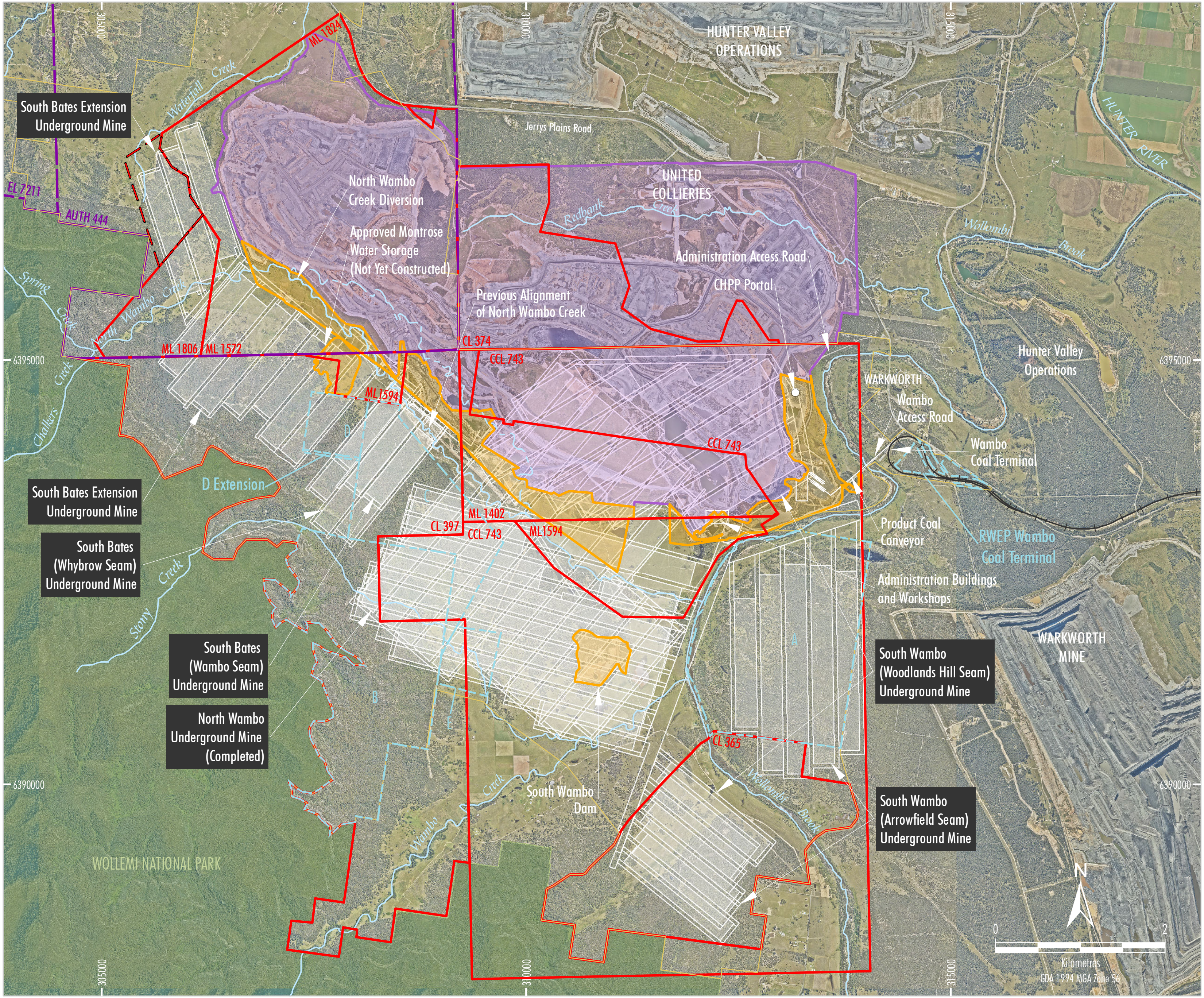
Peabody

WAMBO COAL MINE

Existing/Approved Wambo Coal Mine General Arrangement

Figure 2

WAM-09-15 AR 2022_202A



LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Proposed Mining Lease Application Area
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Existing/Approved Underground Development

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Colleries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2023); NSW Spatial Services (2023)
Orthophoto: WCPL (May 2022)

Peabody

WAMBO COAL MINE

Existing/Approved Wambo Coal Mine

Figure 3

WAM-09-15 AR 2022_203A

This Annual Review details WCPL's environmental and community performance for the reporting period 1 January 2022 – 31 December 2022. This Annual Review has been prepared in accordance with the NSW Department of Planning and Environment's (DPE) *Post-approval requirements for State significant mining developments – Annual Review Guideline – October 2015* (DPE 2015) and WCPL's statutory approvals (**Section 2.1**).

The Annual Review is not intended to be an exhaustive description of WCPL's operations, approvals and activities rather it is a summary of WCPL's compliance status with respect to WCPL's statutory approvals.

This Annual Review is distributed to a range of stakeholders including government authorities, Singleton Council and members of the WCPL Community Consultative Committee (CCC). A copy of the Annual Review will be made available on the Peabody Energy website (www.peabodyenergy.com).

1.1 Mine Contacts

The contact details of key WCPL personnel who are responsible for the environmental management of the Mine are listed in **Table 1**.

Table 1: Contact Details of Key WCPL Personnel

Name	Role	Phone No.
Micheal Alexander	Director Projects & Portfolio Management	(02) 6570 2361
Peter Jaeger	Manager: Environment and Community	(02) 6570 2209

2.0 Approvals

2.1 Current Approvals

WCPL has a number of statutory approvals, leases and licences that regulate activities at the Mine (**Table 2** and **Table 3**). Conditions from WCPL's approvals that specifically relate to this Annual Review are detailed in **Appendix A.**

Table 2: WCPL's Statutory Approvals

Type	Description	Issued By[1]	Issue Date	Expiry Date
Development Consent	DA 305-7-2003[2]	DPE	4/02/2004	31/12/2042
Development Consent	DA 177-8-2004[3]	DPE	16/12/2004	31/08/2042
EPBC Approval[4]	EPBC 2003/1138	DCCEEW	23/11/2004	31/12/2029
EPBC Approval[4]	EPBC 2016/7636	DCCEEW	30/4/2017	1/3/2037
EPBC Approval[4]	EPBC 2016/7816	DCCEEW	4/5/2018	31/12/2039
Mining Lease	ML1402	MEG	23/09/1996	25/07/2035
Mining Lease	ML1572	MEG	21/12/2005	20/12/2026
Mining Lease	ML1594	MEG	1/05/2007	30/04/2028
Mining Lease	ML1806	MEG	11/08/2020	11/08/2041
Mining Lease	ML1824	MEG	29/11/2021	29/11/2035
Consolidated Coal Lease	CCL743	MEG	9/03/1990	14/08/2043
Coal Lease	CL365	MEG	19/09/1990	19/09/2032
Coal Lease	CL374	MEG	6/12/1991	21/03/2026
Coal Lease	CL397	MEG	4/06/1992	4/06/2034
Exploration Licence	A444[5, 6]	MEG	4/10/2007	16/05/2027
Exploration Licence	EL7211[7]	MEG	29/09/2008	29/09/2026
Environment Protection Licence	EPL529	EPA	4/02/2021	-
S101 Approval[8]	Approval to discontinue use of the North East Tailings Dam (NETD)	MEG	3/09/2009	-

1. DCCEEW = Commonwealth Department of Climate Change, Energy, the Environment and Water, MEG = Mining, Exploration and Geosciences, EPA = NSW Environment Protection Authority.
2. DA 305-7-2003 has been modified 18 times since the original approval was granted in 2004. One modification application was withdrawn subsequent to WCPL submitting the application. The latest modification (MOD19), for the South Bates Extension Underground Mine Longwalls 24 to 26 was granted approval in January 2023.
3. DA 177-8-2004 has been modified three times since the original approval was granted in 2004. The last modification (MOD3), for the United Wambo Joint Venture (UWJV), was granted approval in August 2019.
4. EPBC = *Environment Protection and Biodiversity Conservation Act 1999.*
5. A444 is an Authority to Prospect granted under the *Coal Mining Act 1973* and is deemed to be an Exploration Licence for the purposes of the *Mining Act 1992*.
6. A444 is managed by United.
7. EL7211 is managed by United.
8. Section 101 of the *Coal Mine Health and Safety Act 2002.*

Table 3: WCPL's Water Licences

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
Hunter Regulated River Water Source							
WAL 718 (20SL060212)	Hunter River Pump	Perpetuity	1,000 unit shares (high security)	Regulated River (high security)	20AL200631	20WA200632	30/06/2027
WAL 8599 (20SL061206)	Hunter River Pump	Perpetuity	6 unit shares (high security)	Regulated River (high security)	20AL201457	20CA201459	25/09/2028
WAL 8600 (20SL061206)	Hunter River Pump	Perpetuity	868 unit shares (general security)	Regulated River (general security)	20AL201458	20CA201459	25/09/2028
WAL 43299	TBC (extraction via Hunter River pump)	Perpetuity	80 units (general security)	Regulated River (general security)	20AL220689	-	-
WAL 8604 (20BL061206)	Hunter River Pump	Perpetuity	240 unit shares (supplementary water)	Supplementary Water	20AL203044	20CA201459	25/09/2028
Hunter Regulated River Water Source – Shared with United Colliery							
WAL 929 (20SL050661)	Other Pump	Perpetuity	3 unit shares	Domestic and Stock	20AL201147 (NOW Reference Number)	20WA201148	06/12/2027
WAL 1369 (20SL060416)	80 mm CP	Perpetuity	15 unit shares (supplementary water)	Supplementary Water	20AL203071 20AL204246 20AL204247	20CA201654	30/11/2028

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
WAL 15459 (20SL204246)	80 mm CP	Perpetuity	21 unit shares (general security)	Regulated River (general security)	20AL204246	20CA201654	30/11/2028
WAL 1164	100 mm CP	Perpetuity	180 Unit Shares	Regulated River (general security)	20AL201738	20CA201739	30/11/2027
WAL 902	38 mm CP	-	8 ML	Regulated River	20AL201097	20WA201098	30/06/2027
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 18437 (20SL033872)	Wollombi Brook Pump	Perpetuity	366.9 unit shares	Unregulated River	20AL208641	20WA208642	31/07/2032
WAL 23897 (20BL167737)	Well No. 2	Perpetuity	70 unit shares	Aquifer	20AL211371	20WA211372	31/07/2032
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin – North Coast Groundwater Source)							
WAL 42373[2]	-	Perpetuity	1,549 unit shares	Aquifer	20AL219997	20MW065010	-
WAL 41532 (20BL172156)	Dewatering	Perpetuity	98 unit shares	Aquifer	20AL218994	20MW065010	-
20BL168997	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL168998	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL168999	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL169000	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
20BL170638	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172237	Monitoring Bore (GW14, GW18, GW21)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172238	Monitoring Bore (GW12)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172240	Monitoring Bore (GW15)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172242	Monitoring Bore (GW16, GW17)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172244	Monitoring Bore (GW20)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172255	Monitoring Bore (GW22)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172256	Monitoring Bore (GW13)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172257	Monitoring Bore (GW19)	Perpetuity	Groundwater monitoring	NA	-	-	-

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
20BL172332	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173290	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173291	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173292	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173293	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173946	Monitoring	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173999	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	5/12/2023
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214848	-
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214849	-
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214850	-
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214851	-
-	Spearpoints	Perpetuity	Stock/Domestic	Basic Rights	-	20WA215574	-

WAL = water access licence; mm = millimetres.

1. 20BL prefix bore licences with allocations have been replaced with WALs.
2. WAL 42373 was issued in 2019 to consolidate six of WCPL's previous WALs under the North Coast Fractured and Porous Rock groundwater Sources (Sydney Basin – North Coast Groundwater Source) including WAL 39735, WAL 39738, WAL 39803, WAL 41494, WAL 41528 and WAL 41520.

2.2 Changes to Approvals

During the reporting period, the following changes were made to WCPL's approvals:

- DA 305-7-2003 – WCPL lodged an application to modify DA 305-7-2003 under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to allow for optimisation and continued operations of the South Bates Extension Underground Mine through the reorientation of Longwalls 24 and 25, and the addition of Longwall 26 with the DPE in August 2022. This modification application was determined on 25 January 2023.
- Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24 – was submitted to the Department of Planning, Industry and Environment (DPIE) in July 2020 and was approved in April 2021. In December 2022, WCPL advised DPE that longwall 23 was to be shortened in accordance with Schedule 2, Condition A2 of DA 305-7-2003 due to the presence of faulting. DPE approved the revised layout on 19 December 2022. The main report and figures of the Extraction Plan have been revised to reflect the revised layout of the longwall panels (Version E, December 2022).
- ML1402 was renewed on 29 September 2022 until September 2035.
- CCL743 was renewed on 29 September 2022 until September 2043.
- A444 was renewed on 11 August 2022 until May 2027.

2.3 Environmental Management System

WCPL operates an Environmental Management System to manage compliance and advance continual improvement across the Mine. A summary of the status of required management plans is presented in **Table 4**.

In accordance with Schedule 2, Condition D15(a) of DA 305-7-2003, copies of these management plans have been made available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

In accordance with Schedule 2, Condition D6 of DA 305-7-2003, WCPL will review the strategies, plans and programs required under DA 305-7-2003 within three months of the submission of this Annual Review to relevant government regulators. If necessary, the strategies, plans and programs required under this consent must be revised, and submitted to the Planning Secretary for approval within six weeks of the review in accordance with Schedule 2, Condition D7 of DA 305-7-2003

Table 4: Status of WCPL's Environmental Management Plans

Management Plan	Status	Approved Version[1]
North Wambo Underground Extraction Plan for Longwalls 8 to 10A (and associated component plans)	Approved – 2015	April 2015
South Bates Underground Mine Extraction Plan for Longwalls 11 to 16 (and associated component plans)	Approved – 2017	July 2017[2]
South Bates Extension Underground Mine Extraction Plan for Longwalls 17 to 20 (and associated component plans)	Approved – 2019	Revision C (June 2019)[3]
South Bates Extension Underground Mine Extraction Plan for Longwalls 21 to 24 (and associated component plans)	Approved – 2022	Revision E (December 2022)
Forward Program	Resources Regulator Assessment	Forward Program (August 2022)
Environmental Management Strategy	Approved – 2020	Version 7 (November 2020)
Air Quality & Greenhouse Gas Management Plan	Approved – 2020	Version 8 (November 2020)
Noise Management Plan	Approved – 2020	Version 11 (November 2020)
Water Management Plan	Approved – 2020	Version 2 (November 2020)
Groundwater Management Plan	Approved – 2022	Version 4 (December 2021)
Surface Water Management Plan	Approved – 2020	Version 2 (November 2020)
United Wambo and Wambo Site Water Balance	Approved – 2020	Version 2 (August 2020)
United Wambo and Wambo Water Monitoring Plan	Approved – 2022	Version 4 (December 2021)
Erosion and Sediment Control Plan	Approved – 2021	Version 4 (November 2021)
Biodiversity Management Plan (previously the Flora and Fauna Management Plan)	Approved – 2021	Version 4 (December 2021)
Heritage Management Plan	Approved – 2018	Version 5 (July 2018)
Wambo Homestead Complex Conservation Management Plan	Approved – 2019	Version 6 (May 2019)
Pollution and Incident Response Management Plan	Approved – 2022	Version 6 (April 2022)

1. Approved version as at the end of the reporting period.
2. On 11 October 2017, DPE approved the South Bates Underground Mine Longwalls 11 to 16 Extraction Plan with the exception of the Site Water Management Plan (and associated component plans), which were unable to be approved until they were updated in consultation with Department of Industry – Water (DI-Water) (now Department of Primary Industries and Environment – Water [DPIE-Water]). In 2018, the South Bates Extension Underground Mine Longwalls 17 to 20 Extraction Plan (including the Site Water Management Plan which had been updated in consultation with DPIE-Water was approved by DPE.
3. On 4 September 2018, WCPL provided DPE with correspondence explaining that geological structures had been encountered that may require changes to the main headings and finishing ends of Longwalls 18, 19 and 20. Accordingly, WCPL requested that DPE approve the Extraction Plan for Longwalls 17 to 20 for extraction of Longwall 17 only. On 7 September 2018, DPE approved the extraction of Longwall 17 only, on the basis that WCPL would prepare an amended Extraction Plan for Longwalls 18, 19 and 20. On 1 March 2019, WCPL submitted an amended Extraction Plan for Longwalls 17 to 20. DPE approved the amended Extraction Plan on 4 June 2019.

3.0 Operations Summary

3.1 2022 Mining Operations

The Mine operates seven days a week, 24 hours a day on a rotating shift basis. Two shutdowns occurred within the reporting period. Flooding within the vicinity of the Mine ceased all operations on 9 March 2022 to 10 March 2022. An additional shutdown occurred between 24 December 2022 to 26 December 2022 for Christmas.

During the reporting period, the following mining operations were undertaken at the South Bates Extension Underground Mine (current longwall mining area):

- Longwall 21 (completed Feb 2022); and
- Longwall 22 (commenced May 2022).

Table 5 shows the production summary for 2022, compared to the production for 2021 and the forecast production for 2022 and 2023.

Following the commencement of Phase 2 operations on 1 December 2020, production material (including waste rock/overburden, ROM coal/ore, coarse/fine reject and saleable product) from open-cut operations is covered under SSD 7142.

Table 5: Production Summary

<table>
<tr><th>Material</th><th>Unit</th><th>Approved limit</th><th>2021 reporting period (actual)[3]</th><th>2022 reporting period (forecast)[3]</th><th>2022 reporting period (actual)[3]</th><th>2023 reporting period (forecast)[3]</th></tr>
<tr><td colspan="7">Wambo Coal Mine</td></tr>
<tr><td>Waste Rock/ Overburden</td><td>bcm</td><td>-</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>ROM Coal/ Ore</td><td>Mt</td><td>14.7[1]</td><td>2.1</td><td>1.7</td><td>2</td><td>1.9</td></tr>
<tr><td>Coarse Reject</td><td>Mt</td><td>-</td><td>1.49</td><td>1.21</td><td>2</td><td>1.9</td></tr>
<tr><td>Fine Reject (Tailings)</td><td>Mt</td><td>-</td><td>0.60</td><td>0.55</td><td>0.95</td><td>0.85</td></tr>
<tr><td colspan="7">Wambo Coal Terminal</td></tr>
<tr><td>Saleable Product – Mine</td><td rowspan="2">Mt</td><td rowspan="2">15[2]</td><td>1.5</td><td rowspan="2">6.5</td><td rowspan="2">4.9</td><td rowspan="2">4.7</td></tr>
<tr><td>Saleable Product – UWJV</td><td>4.1</td></tr>
</table>

Note: bcm = bank cubic metres, Mt = million tonnes.

1 DA 305-7-2003, Condition A16, Schedule 2.

2 DA 177-8-2004, Condition A8, Schedule 1. Refers to product coal transported off-site.

3 Under Phase 2 of the UWJV, open cut operations are undertaken by United.

During the reporting period, the ROM coal production at the Mine (2 Mt) was slightly higher than the forecast ROM coal production (1.7 Mt). Saleable product coal from the Mine (4.9 Mt) was lower than forecast (6.5 Mt).

No overburden production occurred at the Mine as forecast.

During the reporting period, a total of 4.9 Mt of product coal was transported off-site via rail (no coal was hauled off-site by trucks). A summary of 2022 daily train movements, required by Schedule 2, Condition B29(b) of DA 177-8-2004 is provided in **Appendix B**.

The maximum daily train movements on any one day was eight or less in accordance with Condition A9, Schedule 2 of DA 177-8-2004 (**Appendix B**).

Figure 4 shows the amount of saleable product coal transported off-site on a weekly basis.

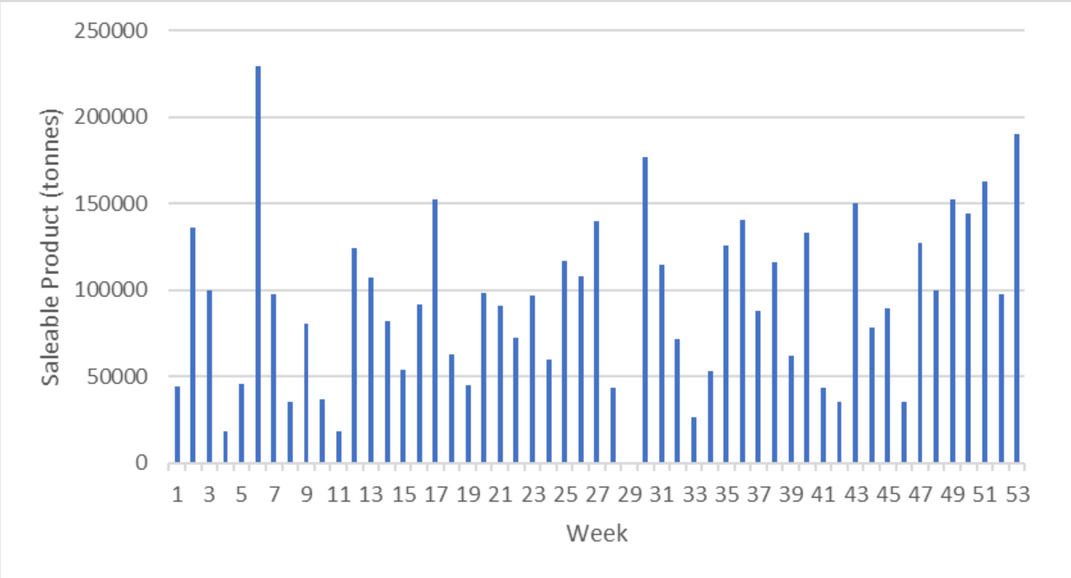


Figure 4: Coal Transported Off-site during the Reporting Period

A total of 549 trains were loaded during the reporting period with 28 trains loaded on Friday evening (between 6 pm to 9 pm) and Sunday morning (between 9 am to 12 am), when the St Phillips Church was in use. In accordance with Schedule 2, Condition A12 of DA 177-8-2004, WCPL took all reasonable steps to minimise train movements within these hours.

3.2 Next Reporting Period

Operations during the next reporting period will be undertaken in accordance with the approved relevant Extraction Plan and will include continued mining at the South Bates Extension Underground Mine, including:

- Longwall 22 (commenced May 2022);
- Longwall 23 (commenced 5 March 2023); and
- Longwall 24 (anticipated to commence in November 2023).

4.0 Actions Required from Previous Annual Review

A number of actions and improvements have been identified in the 2021 Annual Review undertaken by WCPL. Actions and improvements recommended in the 2021 Annual Review and their current status are summarised in **Table 6**. In addition, further information/actions requested by DPE in relation to the 2021 Annual Review are also addressed in **Table 6**.

Table 6: Actions from Previous Annual Review

Action/Improvement required from previous Annual Review	Requested by	Action taken by the Operator	Where Discussed in Annual Review
Re-erect/reconstruct three (3) fallen nest box.	WCPL	Complete Nest Boxes were replaced within the reporting period.	Section 5.6.4
Investigate observed impacts at P315, GW15 and P16.	WCPL	Ongoing An investigation into the exceedance of the electrical conductivity (EC) trigger level at P315 is currently being undertaken. An investigation into GW15 and P16 was undertaken during the reporting period (SLR, 2023).	Section 6.2.3
Preliminary investigations of the surface water quality results (pH) recorded at SW05	WCPL	Complete Investigation concluded the natural variation was the cause of the pH levels at SW05.	Section 6.1.2
Further investigation into increased EC recorded at SW08	WCPL	Ongoing Throughout the period EC at SW08 remained elevated. Wambo are still investigating the cause of the elevated readings and will provide an investigation report to DPE by the end of March 2023.	Section 6.1.2
Continuation of subsidence repair trials	WCPL	Ongoing During the reporting period, continual wet ground conditions resulted in subsidence repairs only occurring on or adjacent to access tracks. As a result, no subsidence trials were conducted in 2022. Existing subsidence remediation was monitored during 2022, with no reoccurring subsidence occurring at trial sites.	Section 5.9.4
Repair subsidence damage to tracks	WCPL	Ongoing During the reporting period, minor subsidence damage to internal access tracks was observed. These were repaired at the time of identification.	Section 5.9.4

Table 6: Actions from Previous Annual Review (continued)

Action/Improvement required from previous Annual Review	Requested by	Action taken by the Operator	Where Discussed in Annual Review
Continue planned 2022 North Wambo Creek Diversion (NWCD) rehabilitation and maintenance works	WCPL	Complete Stages 3 and 4 are scheduled for completion in 2023.	Section 7.2.2
Review of P16 as the part of underground model update	WCPL	Complete The Groundwater Model update was completed by SLR Consulting for Modification 19 of DA 305-7-2003 in August 2022	Section 6.2.4

5.0 Environmental Performance

5.1 Noise

Noise Impact Assessment Criteria for the Mine are defined in Table 4 of DA 305-7-2003 (Schedule 2, Condition B13 and B14) and in EPL529 (Condition L5). Additional noise conditions relating to land acquisition, operating hours, rail noise, noise monitoring and the WCPL Noise Management Plan (NMP) are also detailed in these approval documents.

Global Acoustics (2023) prepared an annual noise monitoring report for the Mine and is presented in **Appendix C**.

5.1.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the relevant approval criteria for noise in relation to sensitive receivers is included in **Table 7**.

Table 7: Impact Assessment Criteria for Noise DA 305-7-2003 (Phase 2 Operations)

Noise Assessment Area	Receiver	Applicable Noise Impact Assessment Criteria			
		Day $L_{Aeq,15minute}$ (dB)	Evening/Night $L_{Aeq,15minute}$ (dB)	Night $L_{Aeq,15minute}$ (dB)	Night $L_{A1,1minute}$ (dB)
Area 1 – North Bulga	R007	37	37	37	47
	All other privately-owned residences	35	35	35	45
Area 2 – South Wambo	R025	39	39	39	49
	All other privately-owned residences	35	35	35	45
Area 3 Warkworth Village	All other privately-owned residences	44	44	43	53
All other areas	All other privately-owned residences	35	35	35	45

The noise impact assessment criteria in DA 305-7-2003 did not apply under meteorological conditions of:

1. *The noise criteria in condition B12 are to apply under all meteorological conditions except the following:*
   a. *where 3°C/100 metres (m) lapse rates have been assessed, then:*
      i. *wind speeds greater than 3 metres per second (m/s) measured at 10 m above ground level;*
      ii. *temperature inversion conditions between 1.5°C/100 m and 3°C/100 m and wind speeds greater than 2m/s measured at 10 m above ground level; or*
      iii. *temperature inversion conditions greater than 3°C/100 m.*
   b. *where Pasquill Stability Classes have been assessed, then:*
      i. *wind speeds greater than 3m/s at 10m above ground level;*
      ii. *stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level;*
      iii. *stability category G temperature inversion conditions.*

Condition L5.1 of EPL529 includes similar noise emission limits to those identified in DA 305-7-2003 for Phase 1 operations. Conditions L5.3 of EPL529 specify that the noise emission limits identified in Condition L5.1 do not apply under meteorological conditions of:

- wind speeds greater than 3 metres per second (m/s) at 10 m above the ground level;
- stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
- stability category G temperature inversion conditions.

Note, the noise criteria in EPL529 have not been updated to reflect Phase 2 of operations, therefore, the noise criteria in the Development Consent (DA 305-7-2003) (which is now more conservative than those in EPL529) have been used to assess compliance in 2022.

As lapse rates were not measured directly, meteorological conditions have been assessed against the Pasquill Stability Classes detailed in Condition 1(b), Appendix 5 of DA 305-7-2003.

In addition to the statutory requirements detailed in DA 305-7-2003, WCPL is also required to meet additional requirements detailed within the WCPL NMP. These requirements include reporting of monthly attended monitoring results on WCPL's website (or when there is an exceedance of criteria) and provision of results to the WCPL CCC.

5.1.2 Performance during the Reporting Period

The noise monitoring network during the reporting period consisted of five attended noise monitoring locations (two of which were coincident with real time noise monitors). During 2022, attended noise monitoring was undertaken monthly at N01, N16, N20A, N21 and N26. For further detail, refer to the WCPL NMP (**Appendix C**).

Noise levels from the Mine were inaudible at all receivers and WCPL complied with relevant noise criteria during all monitoring conducted during the reporting period (**Appendix C**). More detail is provided in **Appendix C**.

Monitoring results were published on the WCPL website and details were provided to the WCPL CCC during meetings, in accordance with the WCPL NMP.

In addition, WCPL complied with all operational requirements detailed in the WCPL NMP.

No complaints were received relating to noise during the reporting period (**Section 8.3**).

WCPL did not receive any written requests for acquisition from landowners during the reporting period.

Based on the performance of the noise management system outlined above, it is considered that the noise management system is effective.

5.1.2.1 Comparison with UWJV EIS Predictions

Phase 2 operations commenced on 1 December 2020, the Mine now only includes underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure under DA 305-7-2003 and associated surface infrastructure. Open cut operations are now managed by United under SSD 7142.

Subsequently, comparison of measured Mine noise levels against the UWJV EIS noise model predictions (which includes open cut operations) was not possible (**Appendix C**).

5.1.3 Trends and Key Management Implications

Global Acoustics (2023) considered that noise levels at most monitoring locations decreased from 2018 to 2020, and site noise levels decreased at most monitoring locations, likely due to mining activity being deeper in pit and therefore more shielded from receptors (**Appendix C**).

From 1 December 2020, open-cut mining is no longer undertaken by WCPL; hence noise emissions have decreased significantly (**Appendix C**).

5.1.4 Implemented or Proposed Management Actions

WCPL will continue to implement the noise management measures detailed in the WCPL NMP, including documenting the timing and scale of any operational changes made in response to adverse conditions or noise alarms from monitoring units.

5.2 Blasting

Since the commencement of Phase 2, no blasting associated with open cut operations is allowed at the Mine in accordance with Condition B21 of DA 305-7-2003. Blasting activities associated with the UWJV open cut operations are managed by United.

5.2.1 Approval Criteria/EIS Predictions and Management Plan Requirements

DA 305-7-2003 and Condition L6 of EPL529 includes blast criteria associated with Phase 1 operations. Condition B21, Schedule 2 of DA 305-7-2003 requires that no blasting associated with open cut operations is undertaken on site during Phase 2.

5.2.2 Performance during the Reporting Period

No blasting was undertaken at the Mine during the reporting period.

5.2.3 Trends and Key Management Implications

No blast-related trends were identified during the reporting period.

5.2.4 Implemented or Proposed Management Actions

No blast-related management actions are currently proposed in the next reporting period. If blasting activities are required, WCPL will develop appropriate blasting management actions.

5.3 Air Quality

Air quality criteria for the Mine are defined in Table 6 of DA 305-7-2003 (Condition B42, Schedule 2) and EPL529 (Condition M2.2). Additional conditions relating to air quality, odour and greenhouse gas emissions, land acquisition, operating conditions and the WCPL Air Quality and Greenhouse Gas Management Plan (AQGGMP) are also detailed in these approval documents.

Airen Consulting (Airen) (2023) prepared an annual air quality monitoring report for the Mine and is presented in **Appendix D**.

5.3.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the approval criteria for air quality applicable during the reporting period is included in **Table 8.**

Table 8: Approval Criteria for Air Quality

Pollutant	Averaging Period	Criterion
Particulate Matter <10 µm (PM_{10})	Annual	[a,c] 25µg/m³
	24 hour	[b] 50 µg/m³
Particulate Matter < 2.5 µm ($PM_{2.5}$)	Annual	[a,c] 8 µg/m³
	24 hour	[b] 25 µg/m³
TSP matter	Annual	[a,c] 90 µg/m³

Note: TSP = total suspended particles, PM_{10} = particulate matter with a diameter less than 10 micrometers, $PM_{2.5}$ = particulate matter with a diameter less than 2.5 micrometers, µg/m³ = micrograms per cubic metre.

a. Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

b. Incremental impact (i.e. incremental increase in concentrations due to the development on its own).

c. Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.

Following the determination of the UWJV, the appropriate EIS documentation to refer to is the UWJV EIS (Umwelt 2016) in regard to air quality predictions.

A summary of the UWJV EIS predictions for air quality is included in **Section 5.3.2.1**, along with WCPL's performance against these predictions during the reporting period. For more information on the UWJV EIS predictions, refer to the UWJV EIS (Umwelt 2016).

In addition to the statutory requirements detailed in **Table 8**, WCPL is also required to meet additional requirements outlined in the WCPL AQGGMP. These requirements include reporting of greenhouse gas monitoring data in the Annual Review (**Section 5.4**).

5.3.2 Performance during the Reporting Period

Air quality monitoring was undertaken during the reporting period in accordance with the WCPL AQGGMP.

During the reporting period, WCPL complied with all statutory conditions relating to air quality, (**Appendix D**). No known adverse impacts resulted due to the non-compliance.

WCPL complied with all additional air quality requirements detailed in the WCPL AQGGMP.

Noted in DA 305-7-2003, determination of compliance against the impact assessment criteria is to exclude "*extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary*". Notwithstanding the above, as no extraordinary events were identified during the reporting period and therefore, the results with and without extraordinary events are the same.

Airen (2023) concluded that:

- In relation to PM_{10}:
  - The 24-hour average PM_{10} concentration did not exceed 50 µg/m^3 at any monitoring locations.
  - The annual average PM_{10} concentration did not exceed the 25 µg/m^3 criterion.
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as PM_{10}.
- In relation to $PM_{2.5}$:
  - The 24-hour average $PM_{2.5}$ concentration did not exceed 25 µg/m^3 at any monitoring locations.
  - The annual average $PM_{2.5}$ concentration did not exceed the 8 µg/m^3 criterion.
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as $PM_{2.5}$.
- In relation to TSP concentrations:
  - The annual average TSP concentration did not exceed the 90 µg/m^3 criterion.
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of TSP.

No complaints were received regarding air quality, odour or greenhouse gases from the Mine during the reporting period (**Section 8.3**).

WCPL did not receive any written requests for acquisition from landowners during the reporting period.

There were no other incidents relating to air quality, odour or greenhouse gases during the reporting period.

Based on the performance of the air quality management system outlined above, it is considered that the air quality management system is effective.

5.3.2.1 Comparison with UWJV EIS Predictions

The UWJV EIS (Umwelt 2016) included predicted cumulative TSP, PM_{10} and dust deposition levels for four operational scenarios (Years 2, 6, 11 and 16). These years approximately translate to 2022, 2026, 2031 and 2036.

A summary of the predicted cumulative annual average TSP, PM_{10} and $PM_{2.5}$ levels for the Year 2 and Year 6 scenarios at the WCPL air quality monitoring sites assessed in the UWJV EIS (Umwelt 2016) air quality assessment, is provided in **Table 9**. The annual average TSP, PM_{10} and $PM_{2.5}$ levels recorded during the reporting period are also provided in **Table 9**.

Table 9: Comparison of UWJV EIS Predictions and 2022 Monitoring Data – Air Quality

Parameter	UWJV EIS Predictions			2022 Monitoring
	Site	Year 2 (2022)	Year 6 (2026)	
Annual Average TSP ($\mu g/m^3$)[1]	HV01	66	63	41.9
	HV02	51	51	31.6
	HV03	52	51	23.8
	HV04	57	54	36.3
Annual Average PM_{10} ($\mu g/m^3$)	AQ01 (PM01)	34	33	13.8
	AQ02 (PM02)	16	16	10.4
	AQ03 (PM03)	17	16	7.9
	AQ04 (PM04)	22	21	12.0
Annual Average $PM_{2.5}$ ($\mu g/m^3$)	AQ01 (PM06)	6	7	4.7
	AQ03 (PM07)	4	3	3.6

Source: After Umwelt (2016) and Airen (2023).

1. TSP is estimated from PM_{10} monitoring data based on the relationship that 33% of TSP is PM_{10}.

The annual average $PM_{2.5}$, PM_{10} and TSP concentrations were below the relevant predicted cumulative annual average concentrations for the Year 2 scenario at all monitoring locations during 2022.

5.3.3 Trends and Key Management Implications

There were no air quality, odour or greenhouse gas management implications arising from WCPL's operations for the reporting period.

5.3.3.1 TSP

A study on co-located TSP and PM_{10} monitors conducted in the Hunter Valley by the NSW Minerals Council (2010) indicated that dust generated from predominately coal mining sources has long-term average PM_{10} concentrations that are approximately 40% of the corresponding TSP concentration (or equivalently, TSP concentrations are approximately 2.5 times PM_{10} concentrations). This ratio was found to be reasonably accurate for long-term averages (e.g. annual averages).

The long-term average ratio of PM_{10} to TSP over the four co-located monitoring sites at the Mine over a six year period was 33% (or equivalently, TSP concentrations are approximately three times PM_{10} concentrations). Using this ratio, TSP levels during the reporting period were lower than those recorded in 2021, as shown in **Table 10** and **Figure 5**. The data shows there was a general increase in recorded TSP levels from 2012 to 2014, with a dip in 2015 and 2016, before increasing again in 2017 and 2018 and then decreasing again in 2019 to 2022.

Table 10: TSP Annual Averages (µg/m^3) (2012-2022)

HVAS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HV01	56.7	64.8	61.0	66.0	54.8	47.8	68.8	77.1	60.0	46.3	62.1	41.9
HV02	48.8	61.4	62.0	58.0	51.5	47.7	61.6	70.8	62.5	46.0	37.9	31.6
HV03	49.0	38.9	41.0	48.0	40.6	39.5	50.0	55.8	45.0	40.5	25.5	23.8
HV04	41.0	58.6	49.0	63.0	60.6	56.6	64.1	75.3	62.5	46.8	40.0	36.3

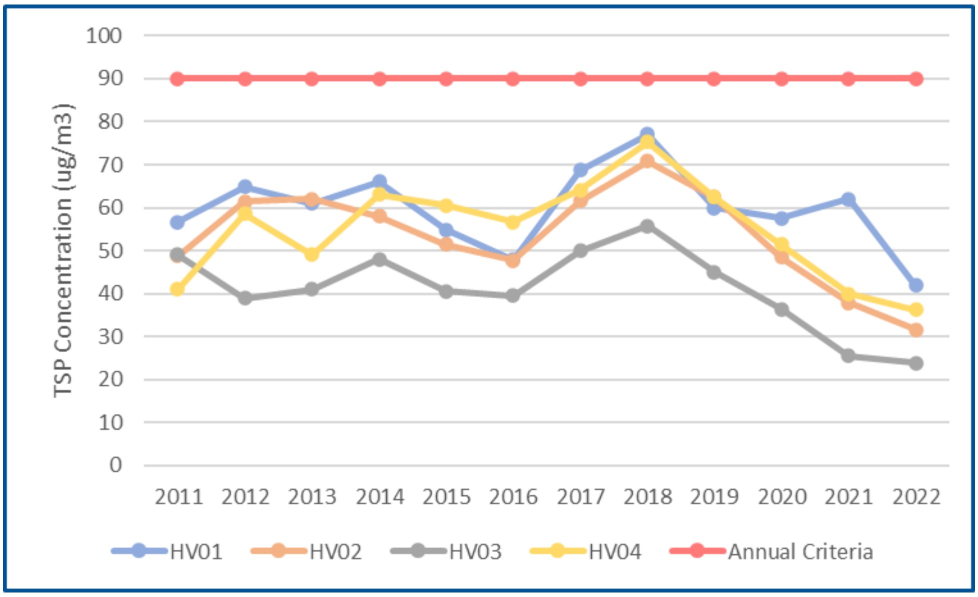


Figure 5: TSP Annual Averages (2012-2022)

5.3.3.2 PM$_{10}$

PM_{10} concentrations recorded by WCPL's four Tapered Element Oscillating Microbalance Analyser (TEOMs) during the reporting period are shown in **Table 11** and **Figure 6**.

The data shows that PM_{10} concentrations remained relatively consistent from 2011 to 2017, with the highest concentrations recorded to date observed in 2018. This is considered to be due to open cut mining moving to a more exposed location in the Montrose Open Cut Pit during 2018.

Table 11: PM$_{10}$ Monitoring Results (2012-2022)

TEOM	2011	2012	2013	2014	2015	2016	2017	2018[1]	2019	2020[2]	2021	2022
Annual Average in µg/m³												
AQ01 (PM01)	16.8	21.0	19.3	18.0	15.7	15.6	20.6	25.7	24.1	21.6	20.5	13.8
AQ02 (PM02)	17.2	21.1	22.3	19.0	16.0	17.5	19.1	23.6	18.8	19.2	12.5	10.4
AQ03 (PM03)	16.7	16.6	16.5	15.3	12.9	14.1	14.6	18.6	25.1	14.7	8.4	7.9
AQ04 (PM04)	16.2	18.3	16.8	17.7	16.5	16.3	17.2	25.1	25.1	19.8	13.2	12.0
Maximum 24-hour Average in µg/m³												
AQ01 (PM01)	49	47	65	55	52	49	66	151.9[1]	59	106.1	66	32.4
AQ02 (PM02)	83	76	97	70	55	49	52	163.5[1]	54	132.5	35	5.8
AQ03 (PM03)	43	47	71	51	43	39	39	143.8[1]	64	137.8	36	8.6
AQ04 (PM04)	43	45	65	56	71	44	49	125.0[1]	73	131.4	99	6.1
Number of Days Above 24-hour Average Criteria												
AQ01 (PM01)	0	0	4	2	1	0	5	15	9	13	0	0
AQ02 (PM02)	2	7	20	2	3	0	2	9	1	13	0	0
AQ03 (PM03)	0	0	1	1	0	0	0	6	9	9	0	0
AQ04 (PM04)	0	0	3	1	2	0	0	12	6	9	0	0

1. If the results on 22 and 23 November 2018 are discounted as they were the result of a state-wide dust storm, the maximum 24-hour averages are; 80.6 µg/m³ at AQ01, 66.0 µg/m³ at AQ02, 58.70 µg/m³ at AQ03 and 70.9 µg/m³ at AQ04.
2. Results shown are inclusive of "extraordinary days".

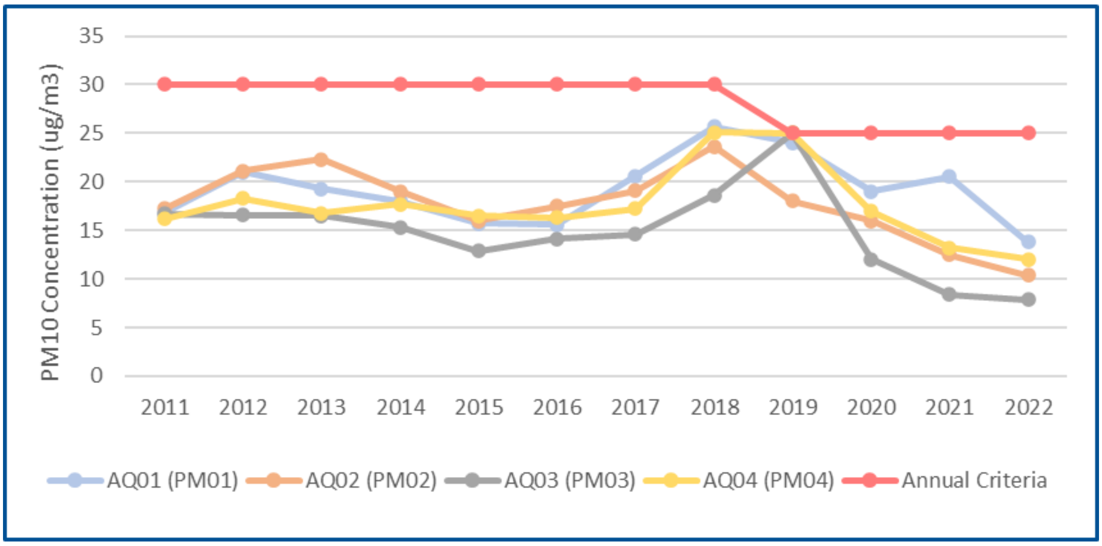


Figure 6: PM$_{10}$ Annual Averages (2012-2022)

5.3.3.3 $PM_{2.5}$

On-site $PM_{2.5}$ data was available from late June 2020 onwards, following installation of the monitors. Results of monitoring during the reporting period are presented in **Table 12.** The data shows that $PM_{2.5}$ concentrations remained relatively consistent between 2020 and 2022.

Table 12: $PM_{2.5}$ Monitoring Results (2020-2022)

TEOM	2020[1, 2]	2021	2022
Annual Average in µg/m³			
AQ01 (PM06)	5.2	5.5	4.7
AQ03 (PM07)	4.2	3.9	3.6
Maximum 24-hour Average in µg/m³			
AQ01 (PM06)	15	14.9	5.9
AQ03 (PM07)	17	28.9	6.8
Number of Days Above 24-hour Average Criteria			
AQ01 (PM06)	0	0	0
AQ03 (PM07)	0	0	0

1. Results available from June 2020 onwards.
2. Results shown are exclusive of “extraordinary days”.

5.3.4 Implemented or Proposed Management Actions

WCPL investigated methods for capturing extraordinary events impacting air quality with an air quality specialist and it was determined that the current industry practice implemented at site will continue.

WCPL will conduct training sessions with the workforce on air quality management strategies for projects which involve civil works during the next reporting period.

WCPL will continue to implement the WCPL AQGGMP during the next reporting period.

5.4 Greenhouse Gas Emissions

There are no approval criteria for greenhouse gas emissions in WCPL’s statutory approvals.

5.4.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the EIS predictions for carbon dioxide (CO_2) emissions is included in **Section 5.4.2**, along with WCPL’s performance against these predictions from 2014 to 2022. For more information on the EIS predictions refer to the EIS (Resource Strategies 2003).

WCPL is required to report greenhouse gas monitoring data in the Annual Review, in accordance with the WCPL AQGGMP.

5.4.2 Performance during the Reporting Period

WCPL calculates and reports on greenhouse gas emissions at the end of every financial year, hence the summary data provided in **Table 13** below is for the period 1 July 2021 to 30 June 2022. Data for the second half of the 2022 reporting period will be included in the 2023 Annual Review.

A total of 75,063 tonnes of carbon dioxide equivalent (CO_2-e) was emitted by the Mine's ventilation systems in 2022, which is lower than the predicted 2,644,503 tonnes CO_2-e. The emissions predictions in the 2003 EIS were based on the assumption that there would be simultaneous mining of two longwalls at the South Wambo Underground Mine (Arrowfield and Bowfield Seams) in conjunction with South Wambo Underground Mine gas drainage occurring during 2021 compared to one mining of one longwall at the South Bates Extension Underground Mine (Whybrow Seam) during the reporting period. In addition, the Whybrow Seam is less gas rich compared to the Arrowfield and Bowfield Seams. For these reasons, the actual emissions are much lower (approximately 72%) than the predicted volumes.

The total greenhouse gas emissions from the Mine's ventilation systems (75,063 tonnes of CO2-e) were lower than predicted ventilation emissions from the South Bates Extension Mine in 2022 (130,000 tonnes of CO2-e) (Todoroski Air Sciences, 2016).

It is also noted that ventilation emissions have been gradually decreasing over the years due to the change from methane (CH_4) rich coal seam gas to CO_2 rich coal seam gas, as the Mine has progressed from the North Wambo Underground Mine to the South Bates (Whybrow and Wambo Seam) Underground Mine. This change is part of a regional gas change that happens to occur across the Wambo lease.

A total of 220,451 tonnes of CO2-e was emitted from the other operations (fuel and electricity consumption) compared to predicted 120,393 tonnes CO_2-e. This is principally higher than the predicted 120,393 tonnes of CO2-e due to inclusion of 161,439 tonnes of CO_2-e from the decommissioned North Wambo Underground Mine that was not considered in the EIS.

The 2021-2022 financial year was the sixth National Greenhouse and Energy Reporting (NGER) year that the Mine had emissions from a decommissioned mine due to North Wambo Underground Mine closing in April 2016. The total emissions emitted from the Mine during the reporting period (295,514 tonnes CO_2-e) is less than in previous reporting periods and the predicted emissions in the EIS (**Table 13**).

5.4.3 Trends and Key Management Implications

Levels of total CO_2 emissions monitored from the main ventilation shafts in 2014 to mid-2016 were indicative of the active mining at the North Wambo Underground Mine.

Following the closing of the North Wambo Underground Mine in 2016, a significant proportion of the CH_4 emissions previously recorded at the main ventilation shaft shifted to being presented under a 'closed mine calculation'. The overall annual emissions from the Mine during the last six reporting periods have remained relatively consistent.

During the reporting period, annual emissions from diesel and other sources (59,012 tonnes CO_2-e) for production related electrical generation significantly reduced from the emissions in 2020 (108,850 tonnes CO_2-e). The relative reduction in emissions is due to transition from open-cut mining operations to underground mining operations. Electricity use during the reporting period remained consistent with the previous years.

Table 13: Comparison of EIS Predictions and Monitoring Data – Greenhouse Gas

Parameter	Monitoring Point	Monitoring Frequency	Emissions Calculated	Calculated CO_2-e tonnes for 2015 – 2016	Calculated CO_2-e tonnes for 2016 – 2017	Calculated CO_2-e tonnes for 2017 – 2018	Calculated CO_2-e tonnes for 2018–2019	Calculated CO_2-e tonnes for 2019–2020	Calculated CO_2-e tonnes for 2019–2021	Calculated CO_2-e tonnes for 2021–2022	EIS predicted CO_2-e tonnes for 2023[1]
Ventilation Systems											
Methane (CH_4)	Main Ventilation Shaft	Real-time continuous	Emission factor to convert from tonnes of CH_4 to tonnes of CO_2-e	618,127	137,521	227,824	145,110	82,427	96,017	57,066	**2,644,503**
Carbon Dioxide (CO_2)	Main Ventilation Shaft	Real-time continuous	Tonnes of CO_2-e	30,552	33,184	43,471	41,007	26,004	28,290	17,997	
Sub-Total				**648,679**	**170,705**	**270,295**	**186,117**	**156,883**	**124,307**	**75,063**	
Other (Fuel, Electrical Power and Other Fugitive Emissions)											
Diesel Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	97,983	97,274	92,034	101,556	108,790	44,451	7340	**120,393**
Oil Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	339 (plus 104 kL not combusted)	44 (plus 206 kL not combusted)	163 (plus 643.5 kL not combusted)	23	15	210	73	
Grease Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	0 (plus 42 kL not combusted)	0 (plus 26 kL not combusted)	0 (plus 67.1 kL not combusted)	0	0	0	1	
Electricity Use	Calculated from invoices	Annually	Emission factor to convert from kWh use to tonnes of CO_2-e	76,506	63,435	64,185	63,213	59,017	55,358	51,598	
ROM Coal Production	Calculated from weight meter and survey	Monthly	Fugitive emissions factor based on ROM production[3]	80,543 (UG Stockpile residual emissions) 24,634 (OC Fugitives)	69,202 (UG Stockpile residual emissions) 518,263 (closed mine calculation) 45,227 (OC Fugitives)	45,880 (UG Stockpile residual emissions) 472,331 (closed mine calculation) 18,231 (OC Fugitives)	46,992 (UG stockpile residual) 355,759 (closed mine calculation) 6,212 (OC Fugitives)	48,402 (UG stockpile residual emissions) 270,118 (closed mine calculation) 25,942 (OC Fugitives)	124,307 (UG stockpile residual emissions) 206,026 (closed mine calculation) 20,635 (OC Fugitives)	161,439 (closed mine calculation, U/G Fugitives))	
Gas Drainage[4]	-	Annually	Tonnes of CO_2-e	-	-	-	0	0	0	0	
Sub-Total				**280,005**	**793,445**	**692,969**	**573,755**	**512,284**	**450,987**	**220,451**	
Total				**928,684**	**964,150**	**963,264**	**759,872**	**669,167**	**575,294**	**295,514**	**2,764,896**

Note: kL = kilolitres, OC = Open Cut, UG = Underground, kWh = kilowatt hours.

1. Refer to Tables 16 and 17 of Appendix B of the WCPL EIS (Resource Strategies 2003).
2. Anomalous results recorded during 2014 for non-combustible grease and oil use are believed to be due to human error in internal accounting procedures.
3. Wambo Open Cut uses Method 2 in situ measured emissions calculations for fugitive emissions. This involves the application of a gas model to as-mined pit shells for the year to generate the measured emissions number.
4. Financial Year 17/18 was the first time that a gas drainage plant was used. The plant was used intermittently.

5.4.4 Implemented or Proposed Management Actions

WCPL did not undertake any targeted energy saving projects during 2022, however energy efficiency is considered during mine planning.

5.5 Meteorology

WCPL is required to maintain a meteorological monitoring station at the Mine and monitor the parameters specified in Condition B50, Schedule 2 (DA 305-7-2003) and EPL529 (Condition M4), using the specified units of measure, averaging period, frequency and sampling method described in the tables.

WCPL maintains the meteorological monitoring station in accordance with AS 2923-1987. The following parameters are monitored by the meteorological monitoring station, in accordance with WCPL's statutory conditions:

- temperature (at 2 m and 10 m);
- rainfall;
- lapse rate[1];
- wind speed (at 10 m);
- wind direction (at 10 m);
- solar radiation (at 10 m);
- humidity; and
- sigma theta.

Table 14 summarises the annual rainfall, temperature and wind direction data for 2022, compared to previous reporting periods.

[1] WCPL calculates the lapse rate from measurements made at 2 m and 10 m, in accordance with DA 305-7-2003.

Table 14: Environmental Performance – Meteorology (2015-2022)

Parameter	2015	2016	2017	2018	2019	2020	2021	2022
Rainfall (mm)	789.49	721.18	442.50	536.2	387.4	966.6	1,188.6	1192.6
Maximum Temperature (°C)[1]	40.8 (Nov)	41.6 (Dec)	46.8 (Feb)	43.8 (Jan)	44 (Jan)	45 (Jan)	38.4 (Jan)	36.5 (Feb)
Minimum Temperature (°C)[1]	-0.85 (June)	-3.4 (July)	-3.5 (July)	-5.5 (July)	-2.9 (Aug)	-1.5 (July)	-2.7 (July)	-1.3 (June)
Mean Temperature (°C)[1]	19.2	18.4	18.5	18.7	19.2	17.9	17.1	16.7
Predominant Wind Direction	S/SE (summer) W/SW (winter)[2]	S/SE (summer) SW (winter)	S/SE (summer) W/SW (winter)	S/SE/E (summer) NW (winter)	E/SE (summer) WNW/NW (winter)	SE (summer) NW (winter)	SE (summer) NW (winter	SE (summer) NW (winter)

Note: °C = degrees Celsius, E = East, SE = South-east, W = West, NW = North-west, S = South, SW = South-west, mm = millimetres.

1. Measured at 2 m above ground.
2. The winter data (2015) was influenced by the use of the Charlton Ridge weather station which may explain the change in weather direction as WCPL's weather station was experiencing software issues.

5.6 Biodiversity

WCPL implemented the Biodiversity Management Plan (BMP) during the reporting period. The BMP encompasses the extraction of Longwalls 17 to 20 and Longwalls 21 to 24. It also addresses the requirements within the Voluntary Conservation Agreements (VCA) prepared under Condition B74 (g), Schedule 2 of DA 305-7-2003, and the requirements of the EPBC Act 1999 approvals (EPBC 2003/1138, EPBC 2016/7636 and EPBC 2016/7816).

The BMP applies to all activities undertaken within WCPL's mining authorisations and approved mining areas that may impact on biodiversity, as well as biodiversity in WCPL's RWEAs and Open Cut Revegetation Areas. The BMP has been developed to:

- identify lands to be managed in accordance with this BMP;
- provide a framework for the management of biodiversity in the RWEAs and Wambo Mining Complex Revegetation Areas;
- provide a clear, concise set of management actions and a schedule for the coordinated and effective delivery of biodiversity enhancement;
- define realistic Completion Criteria for RWEAs and Open Cut Revegetation Areas that can be quantitatively evaluated through a seasonally based monitoring program;
- define a seasonally based monitoring program suitable for determining management success (or otherwise);
- provide suitable contingency measures and associated Trigger Action Response Plans (TARPs) that adequately address any deviation from the Completion Criteria; and
- define the responsibilities for implementing, reviewing and reporting on the BMP.

The BMP also meets the requirement for a Biodiversity Management Plan under Condition B7(f), Schedule 2 of DA 305-7-2003 in support of the Extraction Plan for the South Bates Extension Underground Mine Longwalls 17 to 20 and the Extraction Plan for the South Bates Extension Underground Mine Longwalls 21 to 24.

5.6.1 Approval Criteria/EIS Predictions and Management Plan Requirements

Performance measures for subsidence impacts on biodiversity are detailed in Condition B1, Schedule 2 of DA 305-7-2003 (**Section 5.9.2**). In addition, performance measures for aquatic ecosystems are detailed in Condition B62, Schedule 2 of DA 305-7-2003 (**Section 6.1.1**).

WCPL is required to monitor and report on biodiversity in accordance with the conditions of DA 305-7-2003, DA 177-8-2004, EPBC 2003/1138, EPBC 2016/7636, EPBC 2016/7816 and the approved BMP.

The BMP includes biometric monitoring methodology. In September 2021, the BMP was modified to remove Landscape Function Analysis (LFA) as a monitoring method following recommendations from the Biodiversity and Conservation Division. The floristic performance criteria are provided in **Table 15**.

Table 15: Floristic Performance Criteria for Plant Community Types in RWEAs and Performance Targets for Older Woodland Areas and Rehabilitation Sites

	Attribute[1]									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Rehabilitation										
Older Woodland Areas with a canopy of Sugar Gum	>15	15-40	5-40	5-15	5-10	5-15	<20	1	-	5
Areas of Narrow-leaved Ironbark – Bull Oak – Grey Box open forest	>20	10-40	5-10	15-50	5-10	5-40	<20	1	-	-
RWEAs										
PCT42[2]	>20	10-50	10-50	20-60	1-5	5-30	<10	1	-	-
PCT1658[2]	>20	10-40	10-50	4-20	5-30	5-35	<10	1	-	-
PCT1603[2]	>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-
PCT1604[2]	>35	15-40	5-20	30-50	5-15	5-40	<5	1	-	-
PCT1176[2]	>21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-
PCT1584[2]	>45	15-45	5-40	5-40	10-20	5-20	0	1	-	-

1. NPS = the number of native plant species (native to NSW), NOS (%) (including *E.cladocalyx*) = projected native foliage cover of canopy, NMS (%) (including *A.saligna*) = projected native midstorey cover, NGCG = native groundcover of grasses, NGCS = native groundcover of shrubs, NGCO = native groundcover of other plant types (sedges, herbs etc.), EPC = exotic plant cover, OR = overstorey regeneration over the whole vegetation zone, HBT = hollow bearing trees, FL= length of fallen logs >10 cm diameter within the vegetation plot, PCT = plant community type.
2. PCT42: River Red Gum/River Oak riparian woodland wetland in the Hunter Valley.

   PCT1658: Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area.

   PCT1603: Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter.

   PCT1604: Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the central and lower Hunter.

   PCT1176: Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion.

   PCT1584: White Mahogany – Spotted Gum – Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley.

5.6.2 Performance during the Reporting Period

During the reporting period, WCPL commissioned Eco Logical to monitor the fauna and vegetation structure within the RWEAs and rehabilitation areas. Floristic surveys, bird surveys, LFA and riparian condition surveys were all conducted during Spring 2022 across remnant woodland, general surface and rehabilitation areas. A copy of the Annual Flora and Fauna Monitoring Report prepared by Eco Logical (2023) is included in **Appendix E**.

Remnant woodland sites within the RWEAs are generally performing well. High diversity of native flora species and an increase in native ground cover was recorded, likely in response to the above average rainfall recorded over the last three years (**Appendix E**).

High exotic cover was recorded in RWEA A and RWEA Rail Loop within the River Red Gum/River Oak riparian woodland wetland in the Hunter Valley (PCT 42) and Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area (PCT 1658). The recorded exotic cover levels failed to meet the performance criteria and VCA targets at several sites (**Appendix E**).

Bird survey results from remnant woodland sites reflected the good condition of these woodland areas with RWEA areas continuing to support a large diversity of birds including several threatened species. Bird diversity and communities were largely consistent with the data available from previous monitoring years and the monitoring data does not indicate any declines in local bird communities (**Appendix E**).

The NWCD met the completion criteria for the Landscape Organisation Index (LOI) based on average scores across all sites. Gully erosion and areas of bare soil exceeding completion criteria were observed. Major remediation works are currently underway in the NWCD to improve drainage, erosion and establishment of native plant communities (**Appendix E**).

Floristic monitoring in the NWCD recorded acceptable native species diversity and native ground cover. Cover of shrubs and canopy were low however this is expected during establishment phase. Significant growth in Eucalypt and Acacia trees and shrubs was observed, including several areas where trees have naturally established along the creek channel. A large proportion of the NWCD remains as grassland and will require additional revegetation efforts to establish the target vegetation communities. An increased number of floristic sites is required to monitor this area (**Appendix E**).

Riparian condition scores for North Wambo Creek, Wambo Creek and Stony Creek were similar to 2021, reflecting the ongoing wetter conditions in 2020 to 2022 following previous drought years from 2017 to 2019 and in response to the reduction/exclusion of grazing. Understorey vegetation cover remains high following higher rainfall in 2020 to 2022, although a high proportion of ground cover contribution is from exotic species, owing to the agricultural disturbance history within these systems. Cattle should continue to be excluded from riparian areas to encourage tree regeneration and prevent erosion. Planting native trees in over-cleared areas to facilitate more rapid regeneration is also recommended (**Appendix E**).

The Melaleuca decora low forest groundwater dependent ecosystem (GDE) community along North Wambo Creek was recorded to be in good condition with scores for most attributes increasing since 2019. This community was undermined during 2019 and 2020, and data collected to date may serve as suitable baseline for this community noting that 2019 was a dry year followed by wetter conditions in 2020, 2021 and 2022. The River Oak riparian tall woodland GDE recorded strong growth and monitored trees appeared in healthy condition, likely in response to the higher rainfall in 2020 to 2022. The extent of the community remains unchanged since originally mapped in 2019, however recruitment of trees and shrubs was observed following three wetter years, and this may translate into expansion of the community in coming years (**Appendix E**).

Floristic and bird monitoring sites established in 2020 in the South Bates Extension Underground Mine area, including reference sites outside of the mining area, were monitored for the second year. Vegetation and bird communities were recorded in good condition and no significant impacts to floristic attributes or bird communities were recorded at sites within areas impacted by undermining to date (**Appendix E**).

Subsidence was observed in several locations across the site including RWEA A and RWEA B, within the Narrow-leaved Ironbark and Slaty Gum communities, however no significant effects on flora and fauna or performance criteria exceedances were recorded (**Appendix E**).

5.6.3 Trends and Key Management Implications

The majority of RWEAs remain in good condition with high numbers of native species, few exotic species present and with low cover and abundance. No major issues were identified that require urgent management (**Appendix E**).

The number of native species generally increased from the previous year and was relatively high in several PCTs. The 2022 results appear to confirm that some lower scores for native species diversity recorded in recent years were a result of the dry conditions, with the increase in 2021 and 2022 in response to higher rainfall (**Appendix E**).

However, as reported in previous years, exotic species cover remains relatively high in riparian and floodplain areas (V1 and V2 plots of RWEA A) and continues to exceed performance criteria and also VCA targets in certain locations. Several weed species listed under the NSW *Biosecurity Act 2015* were observed in these areas that have potential to become problematic in the wider region (e.g. *Olea europaea* subsp. *cuspidata* [African Olive]). WCPL will continue to implement weed management (particularly species listed under the NSW *Biosecurity Act 2015*) to achieve performance criteria in these riparian and floodplain areas.

The Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland (PCT 1658) in RWEA A appears to be suffering from Banksia integrifolia die-off in the mid-storey, first observed in 2019 and continuing this year. This community recorded a higher average number of native species in 2022, compared to 2021 results decreased from previous years. Higher exotic covers were also recorded at some locations. This community occurs on sandy soils, and it is possible the soils suffered more significant drying during the recent dry years than other areas and the rainfall to date has not been sufficient to recharge the soil (**Appendix E**). Future monitoring will continue to record the condition of this community and increased weed control will be applied.

The average number of bird species per site remains consistent with the levels recorded in previous years. Overall diversity across all sites within RWEAs also remains high. Number of birds per survey returned to levels similar to previous years after a lower score was recorded in 2020 (**Appendix E**).

As vegetation and habitat attributes in RWEAs have remained relatively stable over time, variability in diversity and abundance between years is likely explained by a combination of factors such as varying numbers of nomadic and migratory bird species, weather and climate, sampling methods, differences in the skill of observers, the timing of surveys and surveys coinciding with the flowering of trees and also broader landscape scale and seasonal changes across the Hunter Valley. The total number of bird species detected each year has varied over time and the 86 species recorded during 2022 is within the range of previous years. Threatened species appear to be persisting well within the RWEAs, with Grey-crowned Babbler, Speckled Warbler, Little Lorikeet and Varied Sittella all recorded in similar numbers than the previous year (**Appendix E**).

5.6.4 Implemented or Proposed Management Actions

In 2018, 50 nest boxes were installed in five clusters within RWEAs B, C and D. These nest boxes were generally in good condition, with some occupied or showing signs of use. Three nest boxes had fallen to the ground and were replaced in March 2023. Future monitoring should continue to investigate use by the target species and threatened species.

WCPL will continue to give priority to managing weed species listed under the *Biosecurity Act 2015* that have the potential to become problematic in the wider region (e.g. *Olea europaea* subsp. *cuspidata* [African Olive]). A targeted weed survey and update to Annual Weed Treatment Plan is scheduled for 2023, which will record weed issues, incorporating the results of this monitoring program, and outline proposed strategy for weed treatment in 2023/2024 in detail.

Rehabilitation work for the NWCD was not conducted during the reporting period due to the increased rainfall making unsuitable ground conditions.

The NWCD Rehabilitation and Maintenance Plan is updated annually, based on the results of the annual monitoring conducted by Alluvium. WCPL will continue to implement the NWCD Rehabilitation and Maintenance Plan during the next reporting period.

Soil Conservation Services (SCS) finalised Stage 2 works early in 2022. Stage 2 saw the construction or rebuilding of four chutes, amelioration and revegetation works and re-grading of the diversion road in sections to improve drainage. The NWCD Remediation Plan 2022-2023, prepared by SCS in October 2022 provides a priority assessment for the remediation of remaining areas of instability on the NWCD. Work proposed for the next reporting period will include:

- remediation of points of instability downstream of longwalls 13/14 and over longwalls 17/18;
- vegetation monitoring and maintenance in the existing remediation areas;
- amelioration and revegetation;
- re-building of rock chutes; and
- remediation of subsidence impacted areas.

5.7 Heritage

WCPL manages Aboriginal heritage on-site in accordance with the relevant conditions of DA 305-7-2003 and the conditions of Aboriginal Heritage Impact Permits (AHIPs) #2222, #C0001474, #C0002000 and #C0003213. These AHIPs allow for the disturbance and/or salvage of all known and unknown Aboriginal objects within the extent of the relevant AHIP boundaries. Any Aboriginal objects salvaged under these permits are managed in accordance with a Care Agreement.

In 2016, WCPL developed a Heritage Management Plan (HMP) for the Mine, to consolidate all statutory requirements into one document and assist in the management of Aboriginal cultural heritage on-site. The HMP was approved in June 2018 with the Extraction Plan for Longwalls 17 to 20 at the South Bates Extension Underground Mine. The HMP was updated in July 2020 for inclusion with the Extraction Plan for Longwalls 21-24 at the South Bates Underground Mine and was approved by DPE in April 2021.

Consistent with the requirements of the HMP, WCPL has implemented a Surface Disturbance Permit (SDP) procedure and checklist, applicable to all surface works at the Mine. During the SDP assessment process, WCPL will undertake a due diligence assessment to ensure that no artefacts that may have been identified in the area are damaged. South East Archaeology (2022) conducted an addendum to the previously conducted Aboriginal Heritage Due Diligence Investigations on the proposed seismic investigation area in January 2022. No salvage operations were conducted by WCPL during the reporting period.

5.8 Non-Aboriginal Heritage

WCPL is required to prepare a Conservation Management Plan (CMP) for the Wambo Homestead Complex (WHC) in accordance with Condition B89, Schedule 2 of DA 305-7-2003. The current CMP (Version 6) was approved in May 2019.

Maintenance work continued during the reporting period was guided by the Preventative and Cyclic Maintenance Program outlined in Table 15 of the WHC CMP. Maintenance activities conducted at the WHC during the reporting period included general clean-up of the site, additional engineered propping, weed and pest control, erosion and drainage control maintenance, and visual inspections.

Section 57 Standard Exemption 19 works to repair and secure the Kitchen Wing commenced in 2022 and is ongoing. The removal of salt residue with a proprietary chemical poultice system was completed in 2022. This allowed for the filling-in of eroded sandstone, which began in 2022 and is ongoing. The Kitchen Wing roof sheets were lifted in 2022 to inspect the roof rafters and battens, allowing for an assessment to be made regarding for the temporary repair of the Kitchen Wing roof in 2023.

An annual photographic record of the elevations of all structures at the WHC was completed during the reporting period and lodged with the Heritage Branch, Singleton Council and DPE in early January 2023, in accordance with Condition B91, Schedule 2 of DA 305-7-2003. During the reporting period, WCPL undertook no blasting that was within 2 km of the WHC.

In an effort to improve access to studies, reports, plans and surveys that have been prepared for the Wambo Homestead, WCPL created a platform on the Peabody website, specific to the WHC. Content includes '*Wambo Homestead-an artist's impression'* by Vivian Dwyer 2007, an outline of the history of the WHC, a drone fly-over video and black and white archive photographs. The website can be accessed at:
https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Homestead

5.9 Subsidence

During the reporting period, underground mining occurred at Longwalls 21 and 22 of the South Bates Extension Underground Mine. Subsidence monitoring was undertaken in the reporting period for Longwalls 18, 19, 20 and 21.

5.9.1 Relevant Extraction Plans

Longwall mining during the reporting periods was undertaken in accordance with the relevant Extraction Plans, in accordance with Condition B9, Schedule 2 of DA 3095-7-2033. A summary of the Extraction Plan reporting requirements related to subsidence is provided in the subsection below.

5.9.1.1 Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24

The following reporting is required to be undertaken as part of the Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24:

- Incident Report – to be prepared as required and submitted (by email) to DPE (Manager, Mining Projects), NSW Resources Regulator (Subsidence Executive Officer), Subsidence Advisory NSW (District Manager) and other regulators as specified in management plans.
- Subsidence Management Status Reports – to be updated fortnightly and submitted (by email) if new impacts are identified or upon request, to DPE (Manager, Mining Projects) and NSW Resources Regulator (Subsidence Executive Officer).
- Six Monthly Report – to be updated annually for the period 1 January to 30 June and submitted (by email) to DPE (Manager, Mining Projects) and NSW Resources Regulator (Subsidence Executive Officer).

- Annual Review – to be updated annually for the period 1 January to 31 December and submitted (by email and/or post) to DPE (Manager, Mining Projects), NSW Resources Regulator (Subsidence Executive Officer), NSW Resources Regulator (Manager Environmental Sustainability), Subsidence Advisory NSW (District Manager), BCD/EPA (General Contact), DPE-Water (Water Regulation), Singleton Council (General Manager) and WCPL CCC Members.

5.9.2 Approval Criteria/EIS Predictions and Management Plan Requirements

In accordance with Conditions B1 and B4, Schedule 2 of the Development Consent (DA 305-7-2003), WCPL must ensure that there are no exceedances of the Subsidence Impact Performance Measures detailed in Tables 1 and 2 of the Development Consent (**Table 16**).

Table 16: Subsidence Impact Performance Measures[1]

Aspect	Performance Measures[2]
Water – Wollombi Brook	Negligible subsidence impacts and environmental consequences. Release of water from the site only in accordance with EPL requirements.
Land – Low level cliffs within the South Bates Extension Area	Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing that in total do not impact more than 5% of the total face area of such features).
Biodiversity – Wollemi National Park	Negligible subsidence impacts and environmental consequence.
Biodiversity – Warkworth Sands Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – White Box, Yellow Box, Blakely's Red Gum Woodland/ Grassy White Box Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – Central Hunter Valley Eucalypt Forest and Woodland Ecological Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – Conservation Areas (including the proposed Wambo offset area under SSD 7142)	Negligible reduction to previously identified biodiversity credits.
Biodiversity – Threatened Species and Communities	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible Environmental consequences.
Heritage – Wambo Homestead Complex	Negligible impact on heritage values, unless approval has been granted by the Heritage NSW and/or the Minister.
All Built Features (including public infrastructure and all structures on privately-owned land)	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensate.
Public Safety	Negligible additional risk.

1. Note, the Subsidence Impact Performance Measures listed in Table 16 have been modified following the approval of MOD 19 in January 2023.
2. Note, the requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of approval of Modification 9.

Underground mining was undertaken at South Bates Extension Underground Mine Longwalls 21 and 22 during the reporting period. Longwall 22 (completed in January 2023) will be inspected during the next reporting period hence is not considered in this Annual Review.

No longwall panels encroached upon the Wollombi Brook, Warkworth Sands Woodland Community or the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community.

South Bates Extension Underground Mine Longwalls 21 and 22 did not undermine the NWCD.

Longwalls 21 and 22 are offset from the base of the Wollemi National Park escarpment by a minimum 26.5 degree angle of draw. No impacts to the escarpment were observed during the reporting period (**Section 5.9.3**).

WCPL does not have approval for undermining of the WHC and as such no evidence of subsidence related impacts were identified during the reporting period. No impacts to non-Mine built features or threats to public safety resulting from the discussed mining activities were identified during the reporting period.

5.9.3 Performance during the Reporting Period

5.9.3.1 Subsidence Surveys

During the reporting period, WCPL undertook longwall mining in the South Bates Extension Underground Mine Longwalls 21 and 22 (**Section 3.1**). Subsidence monitoring was undertaken in accordance with the South Bates Extension Underground Mine Longwalls 21 to 24 Extraction Plan. Subsidence monitoring was undertaken for Longwalls 18, 19, 20 and 21 (within 10 months of the longwalls being competed). Results for Longwall 22 will be reported in the next Annual Review.

Table 17 summarises the actual versus predicted subsidence results for Longwall 21 at the South Bates Extension Underground Mine. The monitoring shows that the actual maximum subsidence recorded across Longwall 17 to 21 are generally similar but less than the predicted values. This could be partly attributed to the average mining height of Longwall 21 (2.32 m) being less than the subsidence model of 2.8 m and 3.0 m (Mine Subsidence Engineering Consultants [MSEC] 2022).

Table 17: Subsidence Monitoring – Actual versus Predicted for South Bates Underground Mine Longwalls 17 and 21 (8XL-Line)

Parameter	Predicted[1]	Actual[1]	Consistent with Predicted Range
Maximum Vertical Subsidence (mm)	1800	1368	Y
Maximum Tilt (mm/m)	50	30	Y
Maximum Hogging Curvature (km^{-1})	3.0	1.4	Y
Maximum Sagging Curvature (km^{-1})	2.4	1.2	Y

1. *South Bates Extension Underground Mine Subsidence Review Report for the South Bate Extension Underground Mine WYLW21* and *WYLW22* (MSEC 2022).

5.9.3.2 LiDAR Surveys

The changes in surface level due to mining at the South Bates Extension Underground Mine have been measured using Light Detection and Ranging (LiDAR) surveys. The changes in surface level due to the mining of Longwalls 17 to 21 have been determined by taking the differences between the surface levels measured in the LiDAR surveys carried out in May 2018 (before the commencement of Longwall 17) and May 2022 (before the commencement of Longwall 22).

It should be noted that LiDAR surveys have an accuracy in the order of ±50 to ±150 mm. The accuracy of the observed changes in surface levels (i.e. the difference between the two surveys), therefore is in the order of ±100 to ±300 mm.

LiDAR survey results for Longwalls 17 to 21 are as follows (MSEC, 2022):

- The measured changes in surface level are greater than predicted above the south-western ends of Longwall 21 partially due to the effects of the steep slopes beneath the escapement on the LiDAR surveys.
- The measured profile is slightly flatter than the predicted.
- It is considered that the ground movements measured using the LiDAR surveys are consistent with the prediction provided in the South Bates Extension Underground Mine Longwalls 21 to 24 Extraction Plan.
- The subsidence model appears to be providing conservative predictions based on the single-seam mining conditions.
- No changes to the subsidence model are recommended based on the measured subsidence effects from the LiDAR survey.

5.9.3.3 Visual Inspections

Visual inspections were carried out by WCPL during and after the extraction of Longwalls 17 to 21 at the South Bates Extension Underground Mine (WCPL, 2021). The surface cracks were mapped and added to the WCPL's subsidence impacts register.

Cracking was not identified adjacent to the maingate and tailgate of Longwall 21 as observed for the previous longwalls. However, long grass above Longwall 21 made identification of surface deformations more difficult. Cracking was identified in seven locations along and adjacent to the unsealed roads and tracks towards the finishing (i.e. north-eastern) end of the longwall (MSEC, 2022).

The recorded surface crack widths above Longwalls 17 to 21 typically ranges between 10 mm to 50 mm (i.e 89% of cases) which is less than the predicted surface deformation and the majority of the recorded crack width are less than 200 mm (98% of cases), the maximum crack widths are greater than 500 mm, where localised potholing occurred due to weathering and erosion (MSEC, 2022).

It is considered that the recorded surface deformations above Longwalls 17 to 21 are typically within the range assessed. While surface cracking up to approximately 500 mm occurred in isolated locations, these impacts represent less than 1% of the total length of mapped surface cracking above the mining area (MSEC, 2022).

5.9.3.4 Bi-annual Audits of Subsidence Impacts

Bi-annual audits (June 2022 [delayed from May 2022 due to significant rainfall events] and November 2022) of subsidence impacts were undertaken by SLR (SLR, 2022a) during the reporting period to identify new subsidence impacts over the South Bates Extension Underground Mine and to determine the status of known subsidence impacts (e.g. have they self-repaired, are they stable but pose a risk to long-term sustainable land use, or are they deteriorating in condition).

During the reporting period, subsidence monitoring and remediation focused on the South Bates Underground Mine in the vicinity of Longwalls 17, 18, 19 and 20. Of the 48 subsidence sites rehabilitated in 2021, this included 16 sites in and adjacent to the NWCD. The remediation of sites occurred throughout the year and consisted primarily of reactive subsidence remediation. The sites ranged from small potholes to cracks several meters in length. Due to consistent wet ground conditions throughout 2022, a targeted subsidence campaign did not occur due to machinery access into subsidence areas. Subsidence repairs during the reporting period primarily occurred on and adjacent to roads where machinery could access.

The methodology used continues to be fine-tuned with remediation of sites primarily including:

- Excavate the subsided area using an excavator. Store topsoil and subsoil in separate piles for later use.
- Excavate site until no subsurface void is identified or to the limit of the excavator.
- Insert geofabric to line the floor of the excavated pit.
- Backfill the pit using the excavated material mixed with gypsum at 2%.
- Compact the excavated material in layers using the back of the excavator bucket up to surface level.
- Topsoil and seed the disturbed area.

Bi-annual detailed subsidence monitoring will continue to monitor further subsidence, vegetation coverage and weeds in the next reporting period.

5.9.3.5 Remediation of Subsidence Impacts to 'Kharlibe'

In 2018, a Subsidence Remediation Plan (SRP) was developed for the 'Kharlibe' property located in Bulga, approximately 20 km west-southwest of Singleton in the Upper Hunter Valley of NSW.

Between 1991 and 2000, the property was undermined by the former Homestead Mine (owned by WCPL, now a subsidiary of Peabody). The mining occurred within CL 397 and CCL 743 held by WCPL. The longwall mining resulted in the surface of the ground being lowered, and the formation of subsidence cracks – some of which took time to migrate through the alluvium to reach the surface.

Historical subsidence remediation works have been undertaken across the property by various contractors and consultants since the late 1990s. The success of these works was mixed and, in some instances, require remedial works.

In February 2018, the Resources Regulator issued a Notice under section 240 (1)(b) and (c) of the *Mining Act 1992* (Mining Act) that required WCPL to prepare a SRP for Kharlibe. SLR and SCT Operations Pty Ltd (SCT) were approved as suitably qualified experts to prepare the SRP in consultation with the landholder and the Resources Regulator.

A second section 240 Notice was issued by the Resources Regulator on 19 September 2019, requiring WCPL to:

- implement subsidence remediation works and associated works in accordance with the SRP (with timing of works and associated monitoring bound by the Project Gantt Chart); and
- to provide quarterly Subsidence Remediation Reports including field observations, remediation works methodologies and results of any monitoring.

Initial (Phase 1) remediation works were undertaken at two sites on 21 and 22 May 2019. These features included an isolated sinkhole, a close spaced row of sink holes and five small depressions. The purpose of the initial remediation works was to identify constraints and opportunities to guide future remediation works.

The Phase 2 remediation works were undertaken from 17 – 21 June 2019 as they were considered high priority works. These works included the remediation of 20 sites.

Phase 3 remediation works were undertaken from 15 July – 20 December 2019 and included landform design and remediation works. Phase 3 works in 2019 included the remediation of 51 sites, with 33 completed in October to December 2019.

Phase 4 remediation works were undertaken across the Kharlibe property within Stony Creek (Site 99) between 3 – 24 March 2020. Further Phase 4 remediation works were undertaken throughout each quarter of 2020 with both newly treated areas and maintenance works on previously remediated sites occurring.

During the reporting period, Phase 4 works continued across the Kharlibe property. Throughout the reporting period ongoing care and maintenance works and monitoring was conducted across rehabilitated sites. Care and maintenance works included minor remediation works in Quarter 2 with both newly treated areas and maintenance works on previously remediated sites occurring. Due to wet ground conditions throughout the period, remediation works were limited due to machinery access restrictions.

5.9.3.6 Visual Inspections of Wollemi Escarpment (via Drone)

Baseline cliff top mapping of the Wollemi National Park escarpment in the vicinity of the South Bates Underground Mine was undertaken during 2015 utilising an Unmanned Aerial Vehicle (Microdrone MD4-1000) and a high-resolution camera along a designated route. Photos were taken of the cliff top at designated intervals and stitched to form a high-resolution panoramic image which can be used to assess subsidence. The route has been recorded and programmed to be repeatable from year to year.

The cliffs associated with the Wollemi escarpment were visually inspected using drones. The cliffs were inspected in October 2018 (before the extraction of Longwall 17), August 2019 (after the extraction of Longwall 17), August 2020 (after extraction of Longwall 19), April 2021 (after extraction of Longwall 20) and October 2022 (after extraction of Longwall 21). There were no cliff instabilities identified from the drone surveys along the section of escarpment adjacent to Longwalls 17 to 21.

It is noted that a boulder and train was previously observed along these section of escarpment, however the baseline arial photographs show that this occurred before May 2017, and, therefore before the commencement of mining at the South Bates Extension Underground Mine (MSEC 2022).

Two rockfalls have recently been identified along sections of the escarpment located well away from the active longwalls at the South Bates Extension Underground Mine. The starting point of the site is approximately 1.9 km north-west from the maingate of Longwall 21.

5.9.4 Trends and Key Management Implications

It is considered by MSEC (2022) that the observed ground movements for South Bates Extension Underground Mine Longwalls 17 to 21 were consistent with predictions. It is also considered that the impacts on the natural and built environment are similar to those assessed and predicted.

Given the above, WCPL will continue to implement the approved Extraction Plans for South Bates Extension Underground Mine Longwalls 21 to 24 in the next reporting period.

5.9.5 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the approved Extraction Plans for South Bates Extension Underground Mine Longwalls 21 to 24.

WCPL will also continue with the program of works for the remediation of the subsidence impacts identified by the bi-annual subsidence audits in areas away from active subsidence (**Section 5.9.3**).

5.10 Exploration

During the reporting period, no exploration activities were conducted in WCPL's exploration licence and mining lease areas.

Overall, 20 boreholes from the previous drilling programs have been rehabilitated, however, WCPL's final sign-off on drill site rehabilitation is yet to be completed. Rehabilitation of outstanding boreholes will continue when access conditions are suitable.

5.11 Waste

Waste management at WCPL is undertaken by a licensed waste management company under the basic principles of the Total Waste Management System (TWMS). Significant benefits of the TWMS include:

- segregation of waste at the source;
- expansion of recycling capabilities;
- reduction in the risk of contaminating non-hazardous waste;
- comprehensive monthly reports detailing volumes, recycling, disposal and transportation of waste; and
- improved data capture to increase the efficiency and accuracy when reporting.

During the reporting period, a total of 2,649,379 kilograms (kg) of waste was generated by the Mine. Of this, 2,609,379 kg was taken off-site for disposal or recycling Of the waste disposed off-site, 80.58% was recycled.

The total waste sent off-site by the Mine in 2022 (2,610,000 kg) was slightly more than the amount of waste sent off-site in 2021 (2,045,171 kg) and the recycling rate for 2021 (80.6%) was similar to 2020 (81.7%) (**Figure 7**).

As the amount of waste generated during 2022 and 2021 was significantly lower than 2018 to 2020, it is considered that the waste minimisation program at the Mine has been effective during 2021 and 2022.

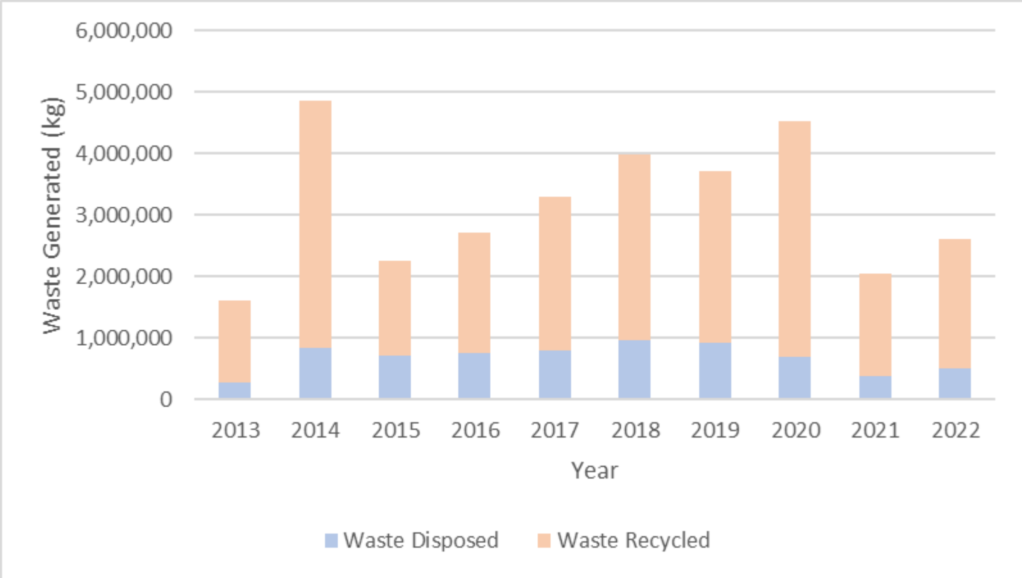


Figure 7: Waste Volumes (2013-2022)

5.12 Visual Amenity and Lighting

All mobile lighting plants are strategically positioned to avoid light being directed towards WCPL's neighbours and other identified potential sensitive receptors.

There were no complaints received during the reporting period relating to lighting impacts from WCPL's mining operations (**Section 8**).

5.13 Contaminated Land

No contaminated land event, that posed a threat of potential or material harm to the environment, occurred during the reporting period. Where possible, any contaminated material is managed on-site in the site bio-remediation area.

5.14 Topsoil Management

During Phase 2 operations at the Mine (i.e. from 1 December 2020), WCPL will no longer undertake topsoil management for significant volumes of topsoil. Topsoil management associated with the Open Cut will be managed by United as a component of the UWJV.

Topsoil will be managed during Phase 2 operations where salvageable quantities are to be stockpiled for future use.

5.15 Weed and Pest Management

WCPL commissioned REM to undertake management and control of weed species within the operational and offset areas at the Mine during 2022. Weed management techniques included spraying and manual removal (cut and paint). During the reporting period, a total of 36.5 days of weed control work at the Mine was undertaken by a two-person crew (REM, 2022a).

Weed management was undertaken in RWEA A, RWEA B, RWEA E, rail loop area and Wambo general areas, including Hales Crossing, areas adjacent to offices and Coal Handling and Processing Plant (CHPP) Area. A summary of the total areas of specific weeds treated by REM (2022a) is provided in **Table 18** and shown in **Figure 8**.

Table 18: Approximate Area of Weeds Treated at the Mine during 2022

Weeds Treated	Area (ha)
African lovegrass and natal grass (dense)	10.27
African boxthorn (sparsely scattered)	5.34
Blackberry, lantana and green cestrum (sparse to medium)	1.00
Bridal creeper (dense)	0.12
Fireweed, thistles, galenia and saligna (medium)	1.79
Lantana, African Boxthorn and natal grass (scattered)	2.93
Mother of millions	8.50
Prickly pear (medium)	2.31
Total	**32.26**

Note: ha = hectares.

During the reporting period, WCPL undertook a vertebrate pest management program as part of the Hunter Local Land Services Pest Species Management program, along with other mines in the area, in Autumn (May and June) and Spring (October and November), targeting wild dogs and foxes. A combination of ground and ejector baiting was used (REM 2022b and 2022c).

The results of the baiting program were considered to be positive due to the high rate of baits being taken by the target species. A total of 59 (in Autumn) and 45 (in Spring) bait locations were set up with a baiting efficiency of 48% and 56%. The baiting efficiency decreased in Autumn compared to the previous year. This trend may reflect decreased targeted populations in the area and may be from bait shy population avoiding taking meat baits (REM 2022b and 2022c).

Fox takes have decreased from 28% and 11% for the preceding two baiting programs respectively to almost 16% and 9% in these programs. Again, the decrease may reflect changing fox populations or a change in foraging patters relating to season (REM 2022b and 2022c).

During the next reporting period, WCPL intends to continue to work with Local Land Services and neighbouring landowners and participate in coordinated pest control programs.

WCPL prepared an Annual Weed Treatment Plan in 2019 which guided weed management activities in 2022 and will continue to do so into the future. Pest and weed management will continue as required on-site and on agistment managed properties throughout the next reporting period.

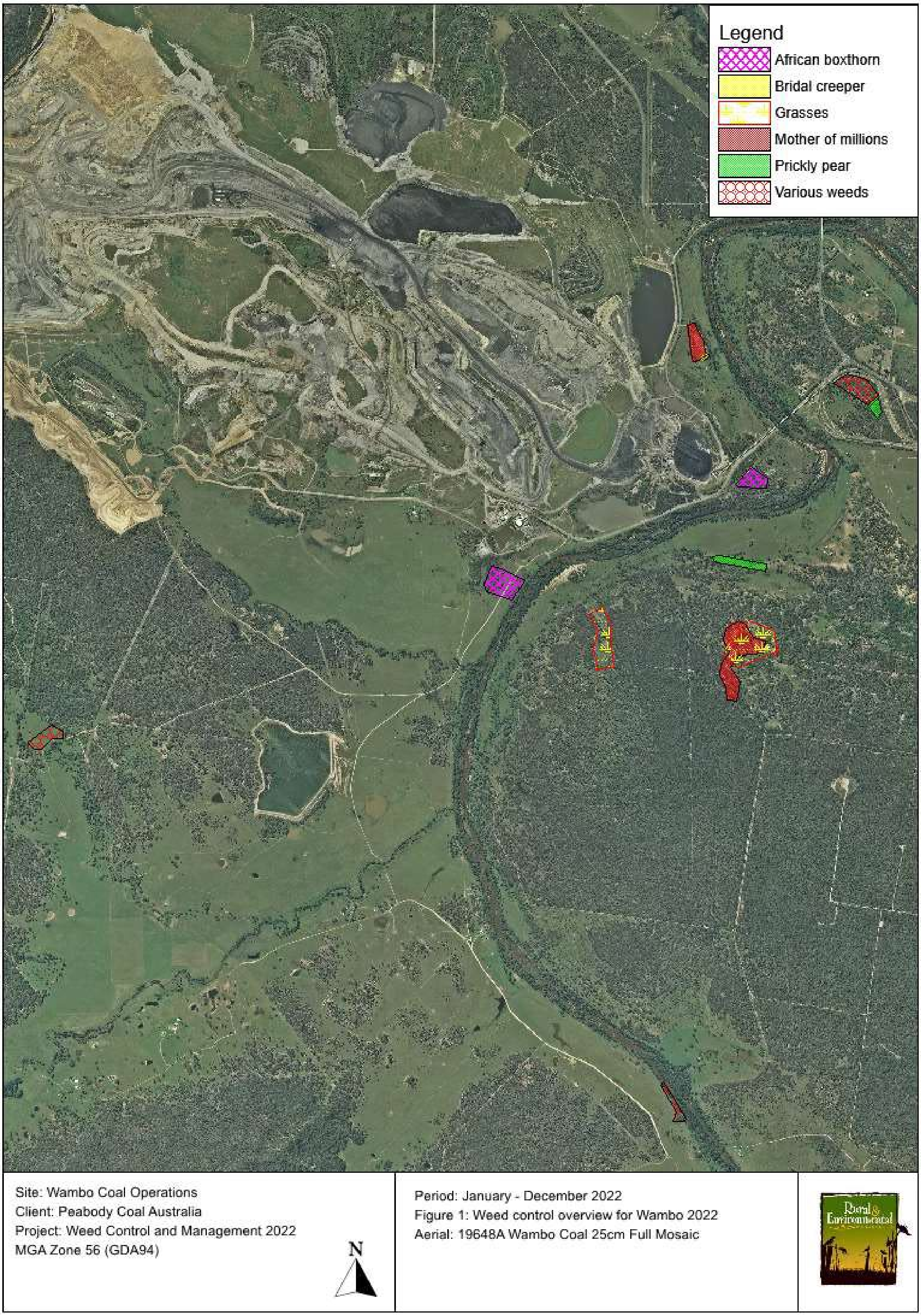


Figure 8: Weed Control Overview for the Mine (REM 2022a)

5.16 Bushfire Management

No grassfires or bushfires were reported within the Mine during the reporting period. WCPL undertakes proactive grass slashing and maintenance around all site infrastructure and boundary fences where practical.

Although Development Consents DA 305-7-2003 and DA 177-8-2004 no longer require a Bushfire Management Plan, hazard reduction and maintenance of fire trails will continue to be conducted as required.

5.17 Spontaneous Combustion Management

Inspections for spontaneous combustion form part of daily WCPL inspections across the two main operating areas (i.e. Underground and CHPP).

No spontaneous combustion events were identified by WCPL during the reporting period.

6.0 Water Management

Water management performance measures for the Mine are defined in Table 8 of Condition B62, Schedule 2 DA 305-7-2003 and Condition L2 of EPL529. Additional conditions relating to water supply, water and salt balances, discharge volume, effluent application to land, monitoring and recording requirements (including for the Hunter River Salinity Trading Scheme [HRSTS]), the NWCD, Chitter Dump Dam, South Wambo Dam, WCPL's Water Management Plan and independent water audits are also detailed in these documents.

WCPL must also operate in accordance with the conditions of various water licences issued under the *Water Management Act 2000* as well as conditions of DA 177-8-2004.

6.1 Surface Water Monitoring

WCPL undertakes surface water monitoring at the Mine in accordance with the approved Surface Water Management Plan (SWMP), which is a component of the WCPL Water Management Plan. The SWMP has been developed to ensure WCPL complies with its statutory conditions relating to surface water monitoring at the Mine.

6.1.1 Approval Criteria/EIS Predictions and Management Plan Requirements

WCPL's EPL529 details the approval criteria for off-site water discharges (**Section 6.3.1**). WCPL has developed impact assessment criteria for surface water quality and stream flow as part of the SWMP.

For the surface water quality criteria (**Table 19**), where actual site-specific water quality monitoring data is available, the criteria have been set based on the 20th and 80th percentile for the available dataset. Where insufficient data is available, WCPL has adopted the applicable Australian and New Zealand Environment and Conservation Council (ANZECC) default guidelines values for slightly to moderately disturbed ecosystems (ANZECC 2000) or the Water Quality Objectives for the Hunter River.

Triggers for the local ephemeral creeks in the SWMP are based on the unexpected absence of flow in climatic situations when flows would be expected. The triggers would be met if there was no flow recorded at the flow monitoring site either on the day or the day after the recorded rainfall was equal to or greater than the nominated amount. Applicable criteria for stream flow are included in **Table 20.**

Table 19: Surface Water Quality Impact Criteria[1,2]

Sampling Site	Parameter[3]	Lower Limit	Upper Limit
SW02 – Wollombi Brook	pH	7.4	8.1
	EC (µS/cm)	599	1,947
	TSS (mg/L)	17 (low flow) to 308 (high flow)[4]	
SW05 – North Wambo Creek	pH	7.3	8.0
	EC (µS/cm)	1,155	2,350
	TSS (mg/L)	53 (low flow) to 1,110 (high flow)[4]	
SW07 – Wambo Creek	pH	7.4	7.9
	EC (µS/cm)	360	724
	TSS (mg/L)	29 (low flow) to 331 (high flow)[4]	
SW08 – Stony Creek	pH	6.8	7.4
	EC (µS/cm)	288	416
	TSS (mg/L)	5 (low flow) to 15 (high flow)[4]	
SW39 – Waterfall Creek	pH	7.3	7.8
	EC (µS/cm)	159	429
	TSS (mg/L)	582 (low flow) to 1,922 (high flow)[4]	

1. From Table 15 of the SWMP.
2. An exceedance occurs when water quality results exceed the impact criteria on three consecutive sampling events.
3. EC = electrical conductivity, TSS = total suspended solids, µS/cm = microSiemens per centimetre, mg/L = milligrams per litre.
4. Low flow condition based on 80th percentile of recorded concentrations and high flow criteria based on maximum recorded concentrations.

Table 20: Surface Water Flow Impact Assessment Condition

Watercourse and Flow Monitoring Site	Daily Rainfall when Flow Commenced on 80% of Recorded Occasions[1]
North Wambo Creek (FM1)	100 mm[2]
Stony Creek (FM13)	20 mm
South Wambo Creek (FM15)	20 mm

1. From Table 14 of the SWMP.
2. Streamflow measurements in North Wambo Creek daily rainfall data from stations adjacent to the catchment have been analysed and indicated a total depth of continuous rainfall depth of approximately 100 mm (can occur over more than one day) is required to generate surface flow in North Wambo Creek upstream of the diversion.

Condition B62 of DA 305-7-2003 and Condition B9 of 177-8-2004 require WCPL to comply with general water management performance measures. Performance indicators relevant to surface water are outlined in **Table 21**.

In addition**,** WCPL is also required to meet additional requirements, in accordance with the SWMP. These requirements include annual reporting on performance against the performance indicators detailed within the SWMP (**Table 22**).

Table 21: Surface Water Performance Measures

Aspect	Performance measure	Performance Indicator/Trigger
Downstream Surface Water Quality	Negligible change in surface water quality (compared to predicted impacts	Surface water quality monitored is outside of the adopted trigger values for at least one parameter for more than two monitoring rounds.
Channel Stability	No increase in areas of instability within watercourses	Channel stability monitoring indicates one or more areas of decreasing stability in watercourses.
Downstream Flooding Impacts	Negligible change in downstream flood access (compared to predicted impacts)	No change to flood inundation of downstream properties in major flood events.
Stream and Riparian Health	Riparian Health	No evidence of significant weed growth or death of vegetation
	Condition of channel	No evidence of significant rill erosion, undercutting or slumping
	Deposition of sediment and debris	No evidence of significant accumulation or deposition, large blockages in channel
	General conditions	No evidence of significant hazards presented to the public, poor aesthetics or feral animals, or geomorphic instability
Surface Water User Supplies	Negligible impact to downstream surface water users (compared to predicted impacts)	• Mining extents / disturbance areas lie within approved boundaries. • Surface water take associated with baseflow impacts is licensed. • No complaints from downstream water users regarding loss of surface water (quality and/or quantity).
Post-mining Water Pollution from Rehabilitated Areas of the Site	Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation	• Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and/or baseline data and does not pose a threat to downstream water quality. • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff.

Table 22: Surface Water Performance Indicators

Performance Indicator
Number of complaints received relating to surface water.
Number of non-compliances relating to surface water.
Number of exceedances of surface water impact assessment criteria[1].
Number of reportable environmental incidents relating to surface water.

1. An exceedance occurs when water quality results exceed the 80th Percentile Trigger Value (**Table 19**) after three consecutive sampling events.

6.1.2 Performance during the Reporting Period

Surface Water Quality

An exceedance of the surface water quality triggers is considered to have occurred when water quality results exceed the impact criteria (**Table 19**) for three consecutive sampling events.

WCPL recorded exceedances of the surface water quality impact criteria during the reporting period, at SW08 for pH and EC (**Table 23**).

Table 23: Summary of Exceedances of the Surface Water Quality Impact Criteria

Site	pH	EC
SW08	August, September and December	June and October to December

In accordance with the TARP for Impacts on Surface Water Quality in the SWMP, WCPL will undertake a preliminary investigation to determine contributing factors for the recorded exceedances of the surface water quality impact criteria (**Table 23**). If the results of the preliminary investigation indicate further works are necessary, WCPL will:

- engage a suitably qualified ecologist or similar to investigate the aquatic environment (where appropriate);
- increase monitoring frequency (where relevant); and
- develop corrective/preventative actions based on the outcomes of the investigation and/or additional monitoring.

WCPL engaged Umwelt (2022) to undertake a preliminary investigation of the recorded pH exceedances of the surface water quality impact criteria at SW02, SW05 and SW07 in 2021. Umwelt (2022) concluded, that as all of the results except for one were within the historical and *Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand*, Canberra, 2018 Default Guideline Value (DGV) ranges, it is highly unlikely that operations at the Mine are related to the pH exceedances and that the exceedances are a result of natural variation.

With regards to the continuing EC exceedance at SW08, WCPL are still investigating the cause and will provide an update to DPE by the end of March 2023.

WCPL reported to the EPA that, due to dry conditions or unsafe access, monthly water quality samples were unable to be collected at the required frequencies at monitoring locations, SW03, SW04, SW05, SW07, SW08, SW27a, SW32a, SW39, and SW41 during the reporting period, resulting in a non-compliance with Condition M2.3 of EPL529 (**Section 9.6**). No known adverse impacts resulted due to the non-compliance.

No complaints relating to surface water quality were received during the reporting period.

A summary of the surface water quality monitoring data is included in **Appendix F.**

Surface Water Flows

AECOM (2022) prepared an annual stream flow monitoring report for the Mine and is presented in **Appendix G**.

The WCPL stream flow monitoring system consists of (**Figure 9**):

- five monitoring stations on North Wambo Creek (US-FM1, FM1, FM2, FM3 and FM4);
- three monitoring stations on South Wambo Creek (FM9, FM15 and FM16);
- two monitoring stations on Wollombi Brook (FM11 and FM10);
- two monitoring stations on Stony Creek (FM12 and FM13); and
- one monitoring station on a major tributary to Stony Creek (FM14).

During heavy rain events within 2022 flow stations FM1 (March), FM3 (July), FM4 (July) and FM9 (March) were damaged, with access stream flow and weather conditions prevented the replacement of the sensors during 2022. Flow Station FM15 was buried beneath significant volume of sand with no data being available for 2022, access stream flow and weather conditions prevented attempts to locate the main sensor, including an unsuccessful attempt in January 2023. The stream bed flow characteristics were damaged around flow stations USFM1, FM1, FM2, FM9 and FM16, with a re-survey of the stream bed undertaken and new theoretical flow curves constructed of use from March 2022 (**Appendix G**).

Table 24 presents a summary of flow events observed at the relevant streamflow monitoring stations on the days during the reporting period when 20 mm or greater rainfall was recorded at the WCPL meteorological station.

There were 15 days during the reporting period that recorded 20 mm or greater of rainfall. FM13 recorded 13 flow events throughout the year. No flow events were recorded at FM15 as the sensor has been buried under significant amounts of sand resulting in no data being available for 2022.

Table 24: Surface Water Flow Results

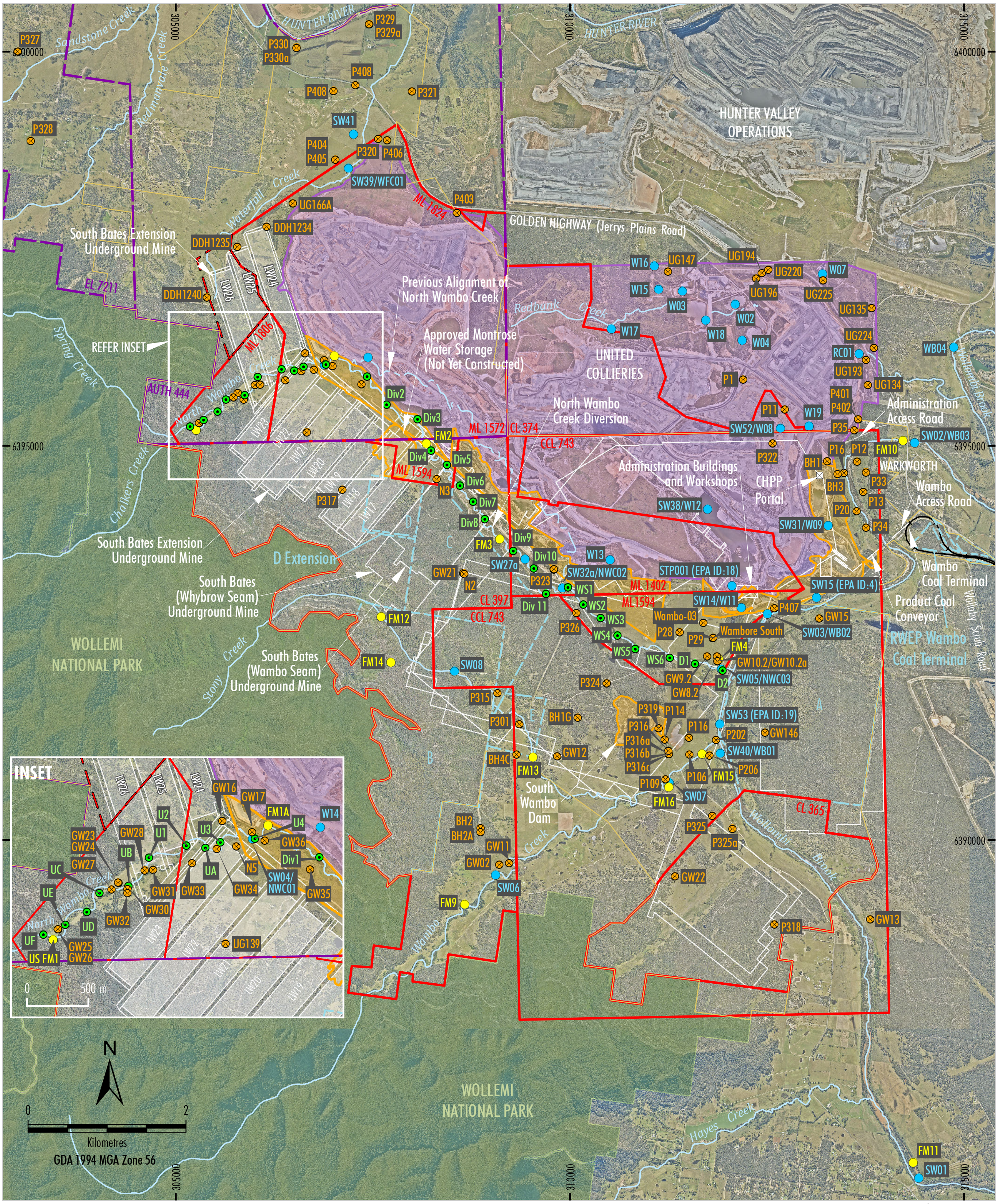
<table>
<tr><th>Date of Rainfall Event</th><th>Rainfall at WCPL Station (mm)</th><th>FM13</th><th>FM15</th></tr>
<tr><td>9/01/2022</td><td>50.2</td><td>No flow event recorded</td><td rowspan="16">Flow monitoring site FM15 sensor has been buried under significant amounts of sand resulting in no data being available for 2022</td></tr>
<tr><td>19/01/2022</td><td>21.6</td><td>Flow event 21/01/2022 10:17 to 10/02/2022 17:07</td></tr>
<tr><td>3/03/2022</td><td>22.0</td><td>No flow event recorded</td></tr>
<tr><td>6/03/2022</td><td>40.0</td><td rowspan="5">Flow event 7/03/2022 10:27 to 10/06/2022 18:47</td></tr>
<tr><td>7/03/2022</td><td>92.8</td></tr>
<tr><td>8/03/2022</td><td>75.4</td></tr>
<tr><td>24/03/2022</td><td>53.8</td></tr>
<tr><td>26/03/2022</td><td>28.6</td></tr>
<tr><td>3/07/2022</td><td>84.0</td><td rowspan="7">Flow event 3/07/2022 13:47 to 25/12/2022 16:07</td></tr>
<tr><td>4/07/2022</td><td>27.0</td></tr>
<tr><td>5/07/2022</td><td>53.0</td></tr>
<tr><td>4/08/2022</td><td>27.0</td></tr>
<tr><td>15/09/2022</td><td>21.8</td></tr>
<tr><td>7/10/2022</td><td>21.4</td></tr>
<tr><td>23/12/2022</td><td>20.8</td></tr>
</table>

6.1.3 Trends and Key Management Implications

WCPL recorded exceedances of the surface water quality impact criteria during the reporting period, at SW02 (for pH), SW05 (for pH), and SW08 for (pH and EC) (**Table 25**).

WCPL undertook additional monitoring and further investigation at SW08 during the reporting period. Throughout the reporting period, the EC at SW08 remained elevated above the criteria. WCPL are still investigating the cause of the elevated readings and will provide an investigation report to DPE by the end of March 2023.

To minimise the potential for the recurrence of not being able to collect monthly waters samples, where samples cannot be collected due to dry conditions, the monitoring site will be revisited for sample collection by WCPL in the event of rainfall of more than 20 mm.



Source: WCPL (2022); NSW Spatial Services (2022)
Orthophoto Mosaic: WCPL (May, Nov 2022)

LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Proposed Mining Lease Application Area
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Approved Underground Mining Area

Monitoring Sites

- Groundwater Monitoring Site
- Surface Water Flow Monitoring Site
- Surface Water Quality Monitoring Site
- Diversion and Subsidence Monitoring Site

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Colleries Pty Ltd under the United Wambo Joint Venture Project.

Peabody

WAMBO COAL MINE

Location of Surface Water and Groundwater Monitoring Sites

Figure 9

6.1.4 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the SWMP. If management actions are required as a result of the required preliminary investigations, WCPL will implement the actions accordingly.

6.2 Groundwater Monitoring

WCPL undertakes groundwater monitoring at the Mine in accordance with the approved Groundwater Management Plan (GWMP), which is a component of the WCPL Water Management Plan. The GWMP has been developed to ensure WCPL complies with its statutory conditions relating to groundwater monitoring at the Mine.

In 2022, the Wambo groundwater model was updated to accommodate the Longwalls 24 to 26 Modification. The modelling noted that the alluvium and shallow weathered rock are less broadly saturated following the construction of the NWCD and interception of alluvial material by the Montrose Open Cut.

6.2.1 Approval Criteria/EIS Predictions and Management Plan Requirements

The GWMP includes triggers for groundwater levels and quality in shallow bores. These triggers have been developed using statistical analysis of baseline monitoring data and data acquired up to 2014 (from a number of monitoring bores on and around the Mine) and the predicted effects presented in the EIS (Resource Strategies 2003) and subsequent Environmental Assessments.

The trigger values are not assessment criteria but are used to initiate investigations into the groundwater levels or groundwater quality as reported by the groundwater monitoring program. A summary of the groundwater triggers for shallow bores, as detailed in WCPL's approved GWMP is included in **Table 25**. In order to avoid false triggering, as a trigger would be initiated 20% of the time due to natural causes, triggers for groundwater level are defined to occur when two consecutive bi-monthly observations (over a 2-month interval) exceed or fall below the specified depth to groundwater.

In addition to the groundwater monitoring triggers detailed in **Table 25,** WCPL is also required to meet additional requirements, in accordance with the GWMP, Extraction Plan for North Wambo Underground Mine Longwalls 8 to 10A, Extraction Plan for the South Bates Underground Mine Longwalls 11 to 16, Extraction Plan for the South Bates Extension Underground Mine Longwalls 17 to 20, and Extraction Plan for the South Bates Extension Underground Mine Longwalls 21 to 24. These requirements include annual reporting on performance against the performance indicators detailed within the GWMP (**Table 26**).

Table 25: Water Quality and Level Trigger Values – Shallow Bores

Bore	Depth to Groundwater (mBTOC[1])		Conductivity (µS/cm)	pH	
	Min (10th percentile)	Max (90th percentile)	Maximum (Three Consecutive Bi-Monthly Exceedances)	Minimum (Two Consecutive Bi-Monthly Exceedances)	Maximum (Two Consecutive Bi-Monthly Exceedances)
P109[2]	4.6	6.7	695	6.5	7.6
P301	NA[5]	NA[5]	9,200	6.1	7.2
P315	NA[5]	NA[5]	552	6.0	7.4
GW08.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW09.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW10.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW15	10.4	11.1	730	6.7	7.2
P16	7.1	7.8	10,832	7.0	7.7
P20	7.1	8.2	10,625	7.0	7.6

1 mBTOC = metres below top of casing.

2 Monitoring has ceased at this location and will recommence once replacement bores are constructed in 2023.

3. GW08.2, GW09.2 and GW10.2 have been installed within unconsolidated strata near North Wambo Creek to serve as replacement bores to GW08 and GW09. Trigger levels for these bores will be established following the collection of baseline data and based on predicted drawdown from the revised groundwater model.

4. ND – Insufficient baseline data to develop meaningful trigger level.

5. NA – trigger level not appropriate for assessing Wambo mining impact at this location.

Table 26: Groundwater Performance Indicators

Performance Indicator
The performance indicators will be considered to have been exceeded if Wambo receives complaints from groundwater users.
The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergences away from the modelled groundwater.
The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria listed in the GWMP (**Table 26)**.
The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria listed in the GWMP (**Table 26**).
Wollombi Brook
The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (**Table 26**).
The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.

Groundwater monitoring data from the Permian monitoring bores is assessed and reviewed as part of the Annual Review. Data is also used to validate the groundwater model.

6.2.2 Performance during the Reporting Period

Monitoring of groundwater levels and quality in alluvial and Permian bores was undertaken in accordance with the GWMP.

SLR (2023) prepared an annual groundwater monitoring report for the Mine and is presented in **Appendix H**.

Above average rainfall conditions occurred at the Mine during the reporting period resulting in flow events in ephemeral watercourses across site, and broad-scale recharge to shallow groundwater systems (**Appendix H**).

The following GWMP trigger value exceedances were recorded during the reporting period (**Appendix H**):

- P315 (Stony Creek Alluvium) – exceedance of EC trigger level.
- GW15 (Wollombi Brook Alluvium) – minimum groundwater level trigger breach.

Consistent with the GWMP, an investigation was commenced (**Section 6.2.3** and **Appendix H**).

No complaints from groundwater users were received during the reporting period.

Groundwater model performance is consistent with previous Annual Review assessments, with generally good matches to absolute observed groundwater levels (**Appendix H**).

SLR (2023) reviewed compliance against the groundwater performance indicators (**Table 26**) and concluded that WCPL was compliant with the exception of the performance indicators for P315. Ongoing investigation into the exceedance of the EC trigger level at P315 is currently being undertaken. An investigation was undertaken during the reporting period into the determination of compliance with the Performance Indicators for GW15 and P16 during the previous reporting period (**Section 6.2.3**).

6.2.3 Trends and Key Management Implications

Groundwater monitoring data collected during the reporting period has been reviewed and assessed against the triggers in the approved GWMP (**Table 26**) by SLR (2023).

During the reporting period exceedances of the EC trigger level were recorded at P315 (Stony Creek Alluvium). The EC increased above the trigger level of 552 µS/cm in February and reached a maximum of 1,424 µS/cm in October before falling back to 1,016 µS/cm in December. This breach of the EC trigger level was the subject of an investigation that concluded that the high rainfall in March 2021 may have resulted in sufficient recharge to the shallow groundwater system to enable the “flushing” of shallow groundwater through fractures in bedrock or dilated bedding planes within the Newcastle Coal Measures resulting from NWU undermining. As EC has continued to increase and exceed trigger limit values in the reporting period following rainfall events similar to those experienced in 2021, it is possible the same process may be occurring and expected to continue if above average rainfall conditions persist into the future.

The following work was undertaken in 2022 to further assess the drivers of water quality change within the Stony Creek alluvium (**Appendix H**):

- Initial analysis and assessment of surface and groundwater conditions (SLR, 2022b) delivered and presented to DPE and the EPA in May 2022.
- Additional locations established which monitor real-time level and quality of groundwater and surface water.
- Additional rounds of sampling for dissolved metals and major ions.
- Site inspections by WCPL staff, hydrogeological consultants, and a subsidence expert.

Exceedances of the minimum groundwater level trigger at GW15 (Wollombi Brook Alluvium) were recorded during the reporting period. Historical observations show a consistent correlation between cumulative rainfall departure and groundwater level at GW15. Groundwater levels went above the minimum trigger level of 51.96 metres Australian Height Datum (mAHD) in June with a value of 54.56 mAHD increasing to a maximum of 55.64 mAHD in December 2022. These exceedances coincide with above average rainfall in 2022 and not with WCPL or other nearby mining activity (**Appendix H**).

SLR (2023) has undertaken periodic reviews of the WCPL vibrating wire piezometer (VMP) monitoring network, both on-site and of the downloaded data. Key findings from the data quality assessment include (**Appendix H**):

- Unreliable data at VWP sites where sensors are within shallow overburden, Whybrow or Wambo seams. Sensors are dry or near-dry, likely associated with WCPL or regional mining activity. It is worth continuing to download these while at least one of the sensors is collecting reliable data, and where recovery/re-saturation is possible.
- As recommended in P202, older sites and unlabelled sites (MG06, MG08, MG09, GW20, U/Fenwick) which are no longer collecting reliable data should be removed from the monitoring network.

WCPL will continue to monitor the bores in accordance with the approved GWMP.

6.2.4 Implemented or Proposed Management Actions

SLR (2023) recommended:

- P106 and P109 replacement bores be constructed in 2023 with a paired standpipe monitoring site.
- VMP identified with persistent poor-quality data should be considered for inspection, and removed from the monitoring network if they cannot be repaired.
- GW10.2 was identified as being damaged (likely from flooding) and should be investigated and repaired as required.
- Updating the groundwater inflow assessment criteria to reflect peak inflow values from contemporary model predictions.

During the next reporting period, WCPL will continue to implement the GWMP.

6.3 HRSTS Discharges

WCPL is permitted to discharge water to the Hunter River in accordance with the conditions of EPL529 and the HRSTS guidelines. These guidelines include the following conditions:

- notification from DPE-Water of discharge opportunity must be received;
- flow of water in Wollombi Brook at the DPE-Water Bulga Gauging Station (FM11) needs to be more than 500 megalitres per day (ML/day);
- pH will be measured continuously throughout the discharge with an inline instrument;
- EC will be measured continuously in µS/cm throughout the discharge with an instrument designed to measure between 0 and 10,000 µS/cm; and
- TSS will be measured once a day during discharge.

A representative sample will be collected every day during discharge and sent to the lab for analysis.

WCPL held 30 credits under the HRSTS at the end of the last reporting period. An additional 31 credits were gained by WCPL during the reporting period and therefore WCPL now hold 61 credits under the HRSTS.

6.3.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the approval criteria for off-site discharges (from EPL529) is included in **Table 27** in accordance with the Schedule 2, Condition B55 of DA 305-7-003.

Table 27: EPL529 Approval Criteria for Off-site Discharge

Parameter	Criteria[1]
pH	6.5-9.5[2]
TSS	120 mg/L[2]
EC	N/A
Volume	250 ML/day

1. Criteria as per EPL529 and DA 305-7-2003.
2. 100^{th} percentile concentration limit.

6.3.2 Performance during the Reporting Period

During the reporting period, WCPL discharged a total of 2838 ML from Licensed Discharge Point (LDP) No.4 to the Hunter River in accordance with the conditions of EPL529 and the HRSTS guidelines. The releases occurred over 90 blocks throughout the period..

During the discharges, WCPL undertook continuous in-line monitoring (EC, pH, turbidity and volume) and collected a grab sample at SW15 to measure TSS every day whilst discharging.

WCPL complied with all approval criteria for off-site discharges during the reporting period with the exception of three exceedances at EPL ID Point 4 on 16 March 2022, 30 March 2022 and 8 September 2022. On 16 March 2022, the grab sample laboratory analysis results exceeded the TSS approval criterion (120 mg/L). On 30 March 2022, the grab sample laboratory analysis results exceeded the TSS approval criterion (120 mg/L). On 8 September 2022, the in-line water quality monitoring system recorded a pH result of 9.51 for one minute, which is above the 100th percentile concentration limit (9.5).

The elevated pH level recorded on 8 September 2022 occurred immediately prior to maintenance activities on the in-line pH probe that subsequently recorded a pH of 9.0 following maintenance.

Notification of all non-compliance was reported to DPE and EPA by WCPL as required by EPL 529 and DA 305-07-2003.

There were no adverse effects from the non-compliance.

6.3.3 Trends and Key Management Implications

An overview of HRSTS releases over time is provided in **Table 28**.

Table 28: Summary of HRSTS Releases

Year	Number of Releases	Release Volume (ML)
2014	1	9.6
2015	6	140.1
2016	11	416
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	4	75.1
2022	90	2,838.5

6.3.4 Implemented or Proposed Management Actions

A written report of the activities undertaken by WCPL under the HRSTS (for the period 1 July 2021 to 30 June 2022) was submitted to the EPA on 29 August 2022 in accordance with Condition R5 of EPL529.

During the next reporting period, WCPL forecasts compliance with the HRSTS requirements, and predicts that, if the opportunity arises, it will use all of its HRSTS credits, as dictated by River Register releases.

6.4 North Wambo Creek Diversion Discharge Flows

The NWCD Plan was approved by the then NSW Department of Planning (now DPE) in April 2008. A requirement of the approval was to comply with the requirements of the then Department of Water and Energy (now DPE-Water). These requirements included reporting on the performance of the NWCD annually in the Annual Review.

During the reporting period, WCPL monitored flow within the North Wambo Creek at five locations:

- US-FM1, approximately 1 km upstream of FM1 (installed in December 2017);
- FM1, upstream of the NWCD;
- FM2, middle of the NWCD, downstream of FM1;
- FM3, middle of the NWCD, downstream of FM2; and
- FM4, downstream of the NWCD.

A review of the flow events at each monitoring site during the reporting period was undertaken by AECOM (2022) (**Appendix G**) and a summary is provided in **Table 29**. Flow monitoring data is included in the AECOM report (**Appendix G**).

Table 29: NWCD Discharge Flow Monitoring – 2022

Flow Monitoring Station	No. of Flow Events Recorded	Maximum Stream Height Recorded (m)	Maximum Theoretical Flow Rate Recorded (ML/day)
US-FM1	1	1.8	4,800
FM1[1]	6	2	10,000
FM2[2]	10	1.6	5,100
FM3[3]	31	1.69	1,920
FM4[3]	13	5.51	795,000

[1] Probable flow events at FM1 was detected through the main pressure sensor only.
[2] Probable flow events at FM2 was detected through the backup pressure sensor only (FM2BU).
[3] Main pressure sensor was damaged/failed during the July 2022 rain event. Results for the main and the backup sensors are listed.

6.5 Water Take

WCPL maintains a variety of WALs under the *Water Management Act 2000* which consist of High, General and Supplementary securities, as detailed in **Table 30**.

During the 1 July 2021 to 30 June 2022 water year, WCPL extracted a total 222 ML of water from the Hunter River (under WAL 718), 0 ML of water from Wollombi Brook (under WAL 18437), 0 ML of groundwater from Wollombi Brook alluvium (under WAL 23897), and 0 ML from porous rock groundwater sources (under WAL 42373). As shown in **Table 31**, all water take during the 2021-2022 water year was less than the allowable limits under the relevant WALs.

No water was used for irrigation purposes between 1 July 2021 to 30 June 2022 (from licence 20WA200632).

6.6 Compensatory Water

WCPL did not provide any compensatory water to any water users during the reporting period.

Table 30: Environmental Performance – Water Take (1 July 2021 to 30 June 2022)

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Passive take/ inflows (ML)	Active pumping (ML)	Total (ML)
Hunter Regulated River Water Source							
WAL 718 (20SL060212)	Hunter River Pump	Perpetuity	1,000 unit shares (high security)	Regulated River (high security)	0	335	335
WAL 8599 (20SL061206)	Hunter River Pump	Perpetuity	6 unit shares (high security)	Regulated River (high security)	0	0	0
WAL 8600 (20SL061206)	Hunter River Pump	Perpetuity	868 unit shares (general security)	Regulated River (general security)	0	0	0
WAL 8604 (20BL061206)	Hunter River Pump	Perpetuity	240 unit shares (supplementary water)	Supplementary Water	0	0	0
Hunter Regulated River Water Source – Shared with United Colliery							
WAL 929 (20SL050661)	Other Pump	Perpetuity	3 unit shares	Domestic and Stock	0	0	0
WAL 1369 (20SL060416)	80 mm CP	Perpetuity	15 unit shares (supplementary water)	Supplementary Water	0	0	0
WAL 15459 (20SL204246)	80 mm CP	Perpetuity	21 unit shares (general security)	Regulated River (general security)	0	0	0
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 18437 (20SL033872)	Wollombi Brook Pump	Perpetuity	366.9 unit shares	Unregulated River	0	0	0
WAL 23897 (20BL167737)	Well No. 2	Perpetuity	70 unit shares	Aquifer	70	0	70
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source)							
WAL 42373[2]	-	Perpetuity	1,549 unit shares	Aquifer	586	0	586
WAL 41532 (20BL172156)	Dewatering	Perpetuity	98 unit shares	Aquifer	0	0	0

1. 20BL prefix bore licences with allocations have been replaced with WALs.
2. WAL 42373 was issued in 2019 to consolidate six of WCPL's previous WALs under the North Coast Fractured and Porous Rock groundwater Sources (Sydney Basin – North Coast Groundwater Source) including WAL 39735, WAL 39738, WAL 39803, WAL 41494, WAL 41528 and WAL 41520.

6.7 Site Water Balance

WCPL reviewed the Site Water Balance at the end of the reporting period, in accordance with the requirements of the Water Management Plan. A summary of the WCPL site water balance for the period 1 January to 31 December 2022 is provided in **Table 31.**

Table 31: Site Water Balance (1 January to 31 December 2022)

Water Sources	Volume (ML)
Hunter River	295
Wollombi Brook	0
United Collieries	5,599
Rainfall/Runoff	2,977
Underground Seepage	405
Dewatering Bores 2A and 4C	0
Total Water Inputs	**9,276**
Water Usage	**Volume (ML)**
Dust Suppression	71
CHPP Consumption	2,858
Underground (net)	387
United Collieries	410
CHPP/UG Potable Water	11
Domestic Usage	0
Total Water Usage	**3,738**
Water Loss	**Volume (ML)**
Evaporation – Mine Water & Tailings Dam	651
HRSTS Discharge	2,839
Reinjection	1,528
Seepage	0
CHPP Process (washdown)	144
Total Losses	**5,161**
Change in storages	**Volume (ML)**
Initial (January 2021)	1,398
Final (January 2022)	4,476
Change in Storage	**+3,078**
Water Balance (ML)	**-2,701**

A total of 295 ML was extracted from the Hunter River and 0 ML was extracted from the Wollombi Brook during the reporting period. This total is above the EIS forecast annual average extraction volume of 106 ML (Resource Strategies 2003).

As 5,599 ML of water was transferred from the United Collieries during the reporting period, this brings the total volume of water imported to approximately 60% of the total water input. This is considerably higher than the EIS forecast of an average of 2.6% (Resource Strategies 2003).

A total of 2,977 ML of runoff from rainfall was intercepted during the reporting period, 788 ML more than intercepted during 2021 (2,189 ML).

Underground seepage represented 4% of total supply compared to the 2003 forecast of 13.8% (Resource Strategies 2003), this is higher than seepage in 2021. The *Wambo Coal Mine Longwalls 24-26 Modification Groundwater Assessment* (SLR, 2022c) predicted that there would be an average seepage of 417 ML per annum (ML/a) and a maximum seepage of 657 ML/a from the combined sources of the South Bates Underground Mine and South Bates Extension Underground Mine. The underground seepage recorded during the reporting period (405 ML) is higher than seepage recorded in 2021 (90 ML) but it is similar to these predictions.

6.7.1 Salt Balance

WCPL reviewed the salt balance at the end of the reporting period, in accordance with the requirements of the Water Management Plan. A summary of the WCPL salt balance for the period 1 January to 31 December 2022 is provided in **Table 32.**

Table 32: Salt Balance (1 January to 31 December 2022)

Inputs	Salt (t)
Raw water- Hunter	120
Raw water- Wollombi	0
Runoff	3,147
Groundwater (ROM coal)	858
Groundwater (Bores)	0
Groundwater (Seepage)	2,584
Transfer from UWJV	10,502
Total	**17,211**
Outputs	**Salt (t)**
Product Coal	667
Dust suppression	249
Release to HRSTS	10,175
Transfer to UWJV	588
Total	**11,679**
Balance	**5,532**

6.8 Erosion and Sediment Control

WCPL has developed an ESCP to address the relevant consent conditions and regulatory requirements.

6.8.1 Performance during the Reporting Period

During the reporting period, WCPL complied with all requirements ESCP under DA 305-7-2003 from 1 January 2022 to 31 December 2022.

Notwithstanding the above, the sediment control sump that collects runoff from the Wambo Rail Load Out Facility (i.e. Hales Crossing Sump) was inundated by floodwaters from the Wollombi Brook on 8 March 2022 and 5 July 2022 after significant rainfall in the Wollombi Brook catchment.

The Hales Crossing Sump was subsequently inspected for structural integrity and pumping infrastructure reinstated and flood water remaining in Hales Crossing Sump was pumped back into the Mine water system.

WCPL notified the DPE and EPA of the incident in accordance with Condition R2.2 of EPL 529 and Condition D8 of DA 305-7-2003.

No complaints were received relating to erosion and sediment control.

6.8.2 Trends and Key Management Implications

No trends or key management implications for erosion and sediment control were identified during the reporting period.

6.8.3 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the approved ESCP.

7.0 Rehabilitation

7.1 Rehabilitation Performance during the Reporting Period

In August 2022, a Rehabilitation Management Plan (RMP) was prepared by WCPL in accordance with the new standard rehabilitation conditions on mining leases imposed through an amendment to the *Mining Regulation 2016*, under the Mining Act. The RMP is available on the Peabody Website and addresses the rehabilitation requirements prescribed in the mining leases and Condition B107, Schedule 2 of DA 305-7-2003.

Rehabilitation Activities at the Mine are conducted in accordance with the RMP.

In accordance with clauses 9 and 13 of Schedule 8A of the *Mining Regulation 2016* and Part 1 of the *Form and Way – Annual Rehabilitation Report and Forward Program for Large Mines* (NSW Resources Regulator, 2021), WCPL will prepare and submit an Annual Rehabilitation Report which describes the rehabilitation activities undertaken throughout 2022.

7.1.1 Status of Disturbance and Rehabilitation

WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities. Due to the nature of this disturbance, there will be minimal progressive rehabilitation reported by WCPL over the coming years (i.e. as the disturbed surface area will be required for the life of the underground mine).

A summary of the proposed and actual rehabilitation activities undertaken in 2022 is provided in **Table 33**.

Table 33: Actual versus Proposed Rehabilitation Activities (2022)

	2022 Proposed	2022 Actual (at 31 December)	2023 Proposed
Total Disturbance (ha)	0	0	0
Total Rehabilitation (ha)	0	0	0
Cumulative Rehabilitation (ha)	121.9	121.9	121.9

During the reporting period, subsidence remediation focused on the monitoring of the South Bates Underground Mine remediation trials undertaken in 2021 in the vicinity of Longwalls 17, 18, 19 and 20. During the reporting period, subsidence areas that were remediated with both geofabric lined trenches and without geofabric lined trenches has shown little difference with no further subsidence in either area.

Works on further remediation on the NWCD were postponed in the reporting period due to several large rainfall events and continued wet ground conditions. Monitoring of works completed previously in 2020 and 2021 was conducted in 2022 with positive results on the continued stability of new drainage structures and increased vegetation coverage.

7.1.2 Agreed Post Rehabilitation Land Use

The agreed post-rehabilitation land use for the Mine is detailed in WCPL's EIS (Resource Strategies 2003), DA 305-7-2003 and the RMP. The final landform for WCPL proposes a balanced rehabilitation outcome which recognises the alternative land uses that exist in the region, and therefore aims to establish the potential for both sustainable agriculture and endemic woodland habitat. The proposed design of final landforms and the revegetation strategy are described in the RMP and in United's RMP.

All rehabilitation activities completed at the Mine are undertaken with consideration to the agreed post rehabilitation land use goals.

7.1.3 Key Rehabilitation Performance Indicators

Table 34 summarises WCPL's rehabilitation status at the end of the reporting period, compared to the previous reporting period.

As outlined above, WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities. As such, there will be minimal progressive rehabilitation reported by WCPL over the coming years.

Table 34: 2022 Rehabilitation Status and Forecast

Annual Reporting Period	2022 (Forecast) (ha)	2022 Actual (at 31 December) (ha)	2023 (Forecast) (ha)
A. Total Disturbance Footprint – Surface Disturbance[1]	323.21	323.21	323.21
B. Total active disturbance[2]	201.31	201.31	201.31
C. Rehabilitation – Land Preparation[3]	0	0	0
D. Ecosystem and Land Use Establishment[4]	121.9	121.9	121.9
E. Ecosystem and Land Use Development[5]	0	0	0
E. Rehabilitation Completion[6]	0	0	0

1. All areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to surface disturbance activities. The total disturbance footprint is the sum of the total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem and land use establishment, ecosystem and land use development and rehabilitation completion (see definitions below). Underground mining operations should not include the footprint of underground mining areas/subsidence management areas in the total disturbance footprint.
2. Includes on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste rock emplacements (active/unshaped/in or out-of-pit), tailings dams (active/unshaped/uncapped) and temporary stabilised areas (e.g. areas sown with temporary cover crops for dust mitigation and temporary rehabilitation).
3. Includes the sum of all disturbed land within a mining lease that has commenced any, or all, of the following phases of rehabilitation – decommissioning, landform establishment and growth medium development.
4. Includes the area which has been seeded/planted with the target vegetation species for the intended final land use. However, vegetation has not matured to a stage where it can be demonstrated that it will be sustainable for the long-term and/ or require only a maintenance regime consistent with target reference/analogue sites. Typically, rehabilitation areas would be in this phase for at least two years (and usually more) before rehabilitation can be classified as being in the ecosystem and land use development phase. This phase does not apply to infrastructure areas that are being retained as part of final land use for the site.
5. Rehabilitation has matured to a level where target revegetation outcomes are on a trajectory towards meeting the approved rehabilitation objectives and rehabilitation completion criteria (as verified by monitoring). This phase includes infrastructure areas that are to be retained for an approved final land use, following completion of all necessary measures to render the infrastructure fit for this purpose (for example structural integrity).
6. The NSW Resources Regulator has determined in writing that the mining area has achieved the approved rehabilitation objectives and approved rehabilitation completion criteria and final landform and rehabilitation plan following the submission of the relevant application by the lease holder.

7.1.4 Renovation or Removal of Buildings

No buildings were renovated or removed during the reporting period.

7.1.5 Trials, Research Projects and Other Initiatives

There were no new trials, research projects or other initiatives undertaking during the reporting period.

7.1.6 Variations in Activities Proposed in the RMP

During the reporting period, rehabilitation was undertaken in accordance with the activities proposed in the WCPL's approved RMP and approved Forward Program (March 2022 – March 2025).

7.1.7 Key Issues That May Impact Successful Rehabilitation

WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities.

Due to the nature of this disturbance, there will be minimal progressive rehabilitation reported by WCPL over the coming years (i.e. as the disturbed surface area will be required for the life of the underground mine).

7.2 Actions for the Next Reporting Period

7.2.1 Rehabilitation Trials, Research Projects and Other Initiatives

The following rehabilitation trials, research projects and other initiatives are proposed over the next reporting period:

- Continuation of subsidence repair trials.
- Continuation of NWCD remediation works, as guided by the NWCD Rehabilitation and Maintenance Plan.

7.2.2 Proposed Rehabilitation in the Next Reporting Period

Rehabilitation work for the Mine proposed during the next reporting period includes continuation of NWCD remediation works, as guided by the NWCD Rehabilitation and Maintenance Plan and continued subsidence remediation works.

8.0 Community

WCPL operates a 24 hour Community Enquiry Line (02 6570 2245), and a dedicated community email account (wambocommunity@peabodyenergy.com), to enable community members to make enquiries or lodge complaints regarding the operation of the Mine.

8.1 Community Engagement Activities and Initiatives

8.1.1 Community Consultative Committee

The WCPL CCC is made up of residents from the surrounding district, a representative of Singleton Council and WCPL management. The CCC representatives act as the point of contact between the mine and the community. The CCC is chaired by an independent chairperson.

During the reporting period WCPL held four CCC meetings:

- Wednesday 2 February 2022;
- Tuesday 3 May 2022;
- Tuesday 2 August 2022; and
- Tuesday 8 November 2022.

Minutes of these meetings are available on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

8.1.2 Newsletters

One community Newsletter was published during the reporting period providing updates about the Longwalls 24 to 26 Modification and the planned exploration activities during the reporting period.

8.1.3 Other Community Engagement Activities

No community information sessions were held during the reporting period.

8.2 Community Contributions

During the reporting period, WCPL contributed to the community through the following:

- Singleton PCYC;
- Singleton Arts and Cultural Centre Exhibition: The Art of being here – Vivien Dwyer;
- Bulga Flood Donation;
- Cancer Council;
- Mates in Mining;
- Hunter Valley Coal Festival;
- Wambo Singleton Hall of Fame; and
- Singleton Business Chambers.

8.3 Community Complaints

WCPL received no community complaints during the reporting period (**Figure 10**). This follows the trend of a significant reduction compared to eighty-three (83) in 2020, compared to forty-six (46) in 2019 and forty-four (44) in 2018. The reduction in complaints associated with the Mine is expected to be due to the commencement of Phase 2 operations which do not include open cut mining operations.

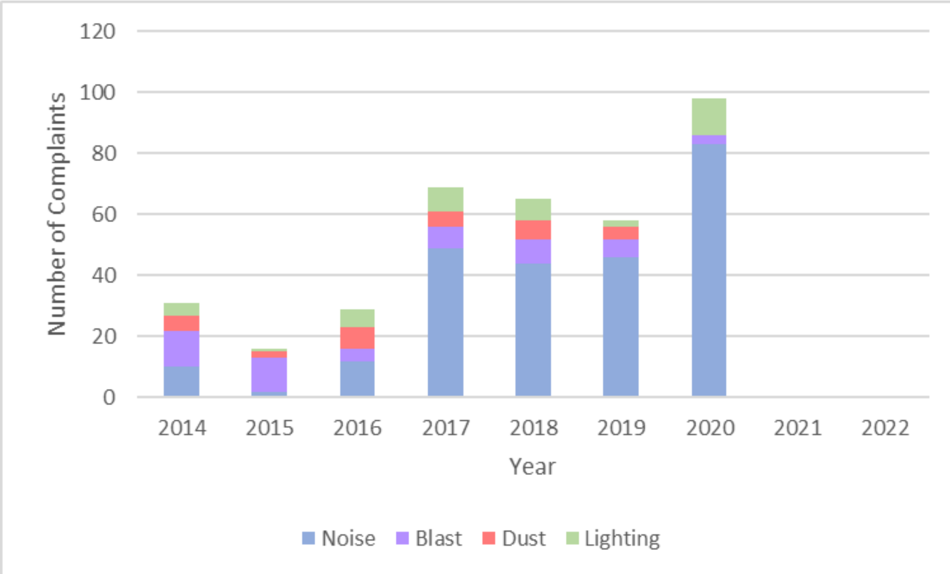


Figure 10: Community Complaints (2014-2022)

9.0 Independent Audits

9.1 2015 Independent Environmental Audit for South Bates Underground Mine Extraction Plan

In 2015, WCPL commissioned an independent audit of subsidence, surface water and groundwater impacts prior to the submission of an Extraction Plan for Longwalls 11 to 13, in accordance with Condition 37, Schedule 4 of DA 305-7-2003 (no longer required by the Development Consent). The report was finalised in June 2015 and submitted to DPE.

All actions from the independent audit were reported as complete in the 2020 Annual Review.

9.2 2016 Independent Rehabilitation Audit for Annual Environment Management Report

In 2015, WCPL commissioned GHD to undertake an independent audit (GHD 2016) of the rehabilitation at the Mine to identify any potential deficiencies of the rehabilitation and improvement strategies. The audit report was finalised in June 2016 and submitted to MEG.

All actions from the independent rehabilitation audit were reported as complete in the 2020 Annual Review.

9.3 2017 Independent Environmental Audit

An Independent Environmental Audit (IEA) was undertaken by Hansen Bailey (2017) in November and December 2017 to assess compliance against DA 305-7-2003 and DA 177-8-2004.

The audit also assessed compliance against EPL529 and ML1572. The audit report was finalised in December 2017 and submitted to DPE in accordance with Condition 7, Schedule 6 (now Condition D11, Schedule 2) of DA 305-7-2003. Following review of the IEA, DPE advised their agency requirements had not been addressed in the audit and requested the IEA be revised to include them. The revised IEA was submitted to DPE on 19 September 2018 and approved 31 January 2019. A copy of the audit report is available on the Peabody Energy website (www.peabodyenergy.com).

Thirty-six (36) non-compliances, comprised of 25 issues, were identified during the audit, including thirteen (13) which were classed as “administrative”. The non-compliances were risk ranked. No high risks were identified during the audit. Eleven issues were identified as low risk and one issue as medium risk. The report also included numerous recommendations for improvement. **Table 35** summarises WCPL’s actions taken to address the remaining continual improvement recommendations.

Table 35: Continual Improvement Recommendations Made by the 2017 IEA for DA 305-7-2003 and DA 177-8-2004

Ref	Description	WCPL Response	Timing
DA 305-7-2003 Continual Improvement Recommendations			
Other			
N/A	• The diversion management program should be implemented to improve the operation of the diversion;	Agreed. The revised NWCD Plan contains a detailed rehabilitation plan including: • Table 13: 5 Year NWCD Rehabilitation and Maintenance Plan. • Appendix C – Detailed Rehabilitation Plan.	Stage 2 works completed in 2021. Stage 3 and 4 works in 2023 will be guided by the NWCD Remediation Plan 2022-2023.
N/A	• Ongoing management is required in order to ensure that soil erosion is minimised and ground cover is given adequate opportunity to become established; and		
N/A	• Rehabilitation of subsided areas of the diversion is required in accordance with an Extraction Plan (or SMP), including repairing surface subsidence cracks and undertaking subsidence remediation where necessary in areas where the diversion has been subsided.		
N/A	The area in RWEA B is rehabilitated to prevent further damage and reduce risks to the surrounding Central Hunter Grey Box-Ironbark Woodland Endangered Ecological Community (EEC) as per Ecological Australia's recommendations.	Most appropriate method of rehabilitation to be determined, in order to reduce impacts if rehabilitation is undertaken with machinery.	Ongoing.
N/A	Subsidence affected sites identified as 'intolerable' by SLR Consulting should be remediated to an acceptable standard as per SLR's recommendations. Photos of completion should be kept within the database along with a report checklist with date and signature demonstrating works were completed.	Most appropriate method of rehabilitation to be determined, in order to reduce impacts if rehabilitation is undertaken with machinery.	Ongoing.

9.4 2019 Independent Environmental Audit for EPBC 2003/1138 and Biodiversity Management Plan

An IEA was undertaken by Cumberland Ecology in 2019 to assess compliance against EPBC Approval 2003/1138, the Biodiversity Offset Strategy (BOS), and the commitments made in WCPL's BMP. The audit report was finalised in January 2020 and submitted to DPE in accordance with Condition 4 of EPBC 2003/1138 and Condition 50, Schedule 4 of DA 305-7-2003 (no longer a requirement under the Development Consent following approval of MOD 16). A copy of the audit report is available on the Peabody Energy website (www.peabodyenergy.com).

Seven (7) non-compliances and three (3) items that were unable to be verified were identified during the audit. All recommendations from this audit have been addressed.

There is no longer a requirement for WCPL to undertake an IEA for EPBC 2003/1138 under DA 305-7-2003. As required by Condition 4 of EPBC 2003/1138 future audits will be undertaken every five years.

9.5 2020 Independent Environmental Audit

An IEA was undertaken by GHD in November of 2020 to assess compliance against DA 305-7-2003 and DA 177-8-2004 and other relevant environmental approvals and licences. The audit was conducted for the period beginning September 2017 to end of November 2020. The audit report was finalised in December 2020 and submitted to DPE in accordance with Condition D11, Schedule 2 of DA 305-7-2003 and was approved on 1 December 2021. A copy of the audit report is available on the Peabody Energy website (www.peabodyenergy.com).

There were no medium or high risk non-compliances identified during the audit. Thirty-one (31) non-compliances were identified, including ten (10) which were classified as "administrative", the remaining twenty-one (21) were classified as "low". The report also included recommendations for improvements. **Table 36** and **Table 37** summarise WCPL's proposed actions to address the outstanding non-compliances and continual improvement recommendations, respectively.

9.6 2020 Pollution Monitoring Data EPA Desktop Audit

As part of the EPA state wide compliance audit program focusing on the requirements for licensees to publish pollution monitoring data, a desktop audit was conducted by the EPA on 11 May 2020. A copy of the audit report is available on the Peabody Energy website (www.peabodyenergy.com).

A number of administrative non-compliances were identified for EPL529 regarding pollution monitoring data. All non-compliances identified by the audit have been addressed.

Table 36: Non-Compliances Requiring Action Identified by the 2020 IEA for DA 305-7-2003 and DA 177-8-2004

Ref	Audit Finding / Risk	Description	WCPL Response	Timing
B105 of DA 305-7-2003 and B26 of DA 177-8-2004	Low	The method for assessing rehabilitation performance using LFA monitoring should be reassessed in line with Tongway and Hindley (2005). TARP and Completion Criteria should be updated in the MOP.	Section 8.1.1 of the RMP (approved 25 November 2020) states 'Over the RMP term, WCPL will review the use of LFA as a monitoring method and transition to alternative monitoring methods for rehabilitated landscape establishment which may include soil monitoring, Biometric Vegetation Assessment and visual assessments. The TARP and Completion criteria will be updated accordingly.	Complete
B108 of DA 305-7-2003	Administrative	The MOP should be updated to include relevant programs and activities to address care and maintenance and mine closure requirements.	Agreed.	Complete
C4 of DA 305-7-2003 and C2 of DA 177-8-2004	Administrative	Provide copies of relevant resident tenancy agreements to the Planning Secretary to confirm satisfaction that the intents of this condition of been met.	Agreed.	By 31 March 2021.
EPL529 Condition M2.3	Administrative	When PM_{10} samplers (TEOM) stop logging data, report the duration and the 24 hour average concentration to see if the downtime would likely of resulted in an exceedance.	Agreed.	As required.

Table 37: Continual Improvement Recommendations Made by the 2020 IEA for DA 305-7-2003 and DA 177-8-2004

Ref	Description	WCPL Response	Timing
B42 of DA 305-7-2003	Calculation of the site incremental impact, and contributions during extraordinary events such as bushfires is undertaken as required for elevated 24 hour concentrations and on an ad-hoc basis for annual averaged concentrations. The site can investigate a method to better capture extraordinary events such as bushfires and exclude this from the data on a regular basis. Increase in site annual averages shows this may be an issue moving forward with climate related events such as bushfires and droughts.	This matter will be discussed with WCPL's appointed air quality expert and an appropriate method to better capture extraordinary events and exclude this from the data will be determined.	Complete
B66 of DA 305-7-2003	Figure 10 of the ESCP would benefit from flow direction arrows indicating is satisfaction of detailed plans for water run-off diversions and catch drains and any reinstated drainage networks on rehabilitated areas of the site.	Agreed.	Complete
B90 of DA 305-7-2003	The CMP should be resubmitted to the Heritage Branch for endorsement/verification of satisfaction, to ensure compliance with the modified requirements of DA 305-7-2003.	Agreed.	Complete – re-submitted to Heritage NSW on 21 April 2021.

9.7 2021 Audit of the Wambo Conservation Agreements

On 25 May 2021, representatives from the NSW Biodiversity Conservation Trust (BCT) conducted a site visit and inspection of the Wambo offset areas subject to Conservation Agreements. A number of recommendations were made following the visit, generally relating to weed and pest management, fencing requirements, and suggested improvements to the annual reporting format. These recommendations will be implemented by WCPL.

10.0 Incidents and Non-compliances during the Reporting Period

The following incidents and non-compliances were identified during the reporting period (refer **Statement of Compliance** at the front of this document):

- Exceedances of groundwater performance indicators (**Section 10.1**).
- TSS levels exceeded the HRSTS discharge limit (**Section 10.2**).
- Floodwaters from Wollombi Brook inundated a sediment control sump at Hales Crossing resulting in release from the Hales Crossing Sump (**Section 10.3**).
- EPBC Approval 2016/7816 non-compliance (**Appendix I**).

10.1 Groundwater Performance Indicators

SLR (2023) reviewed compliance against the groundwater performance indicators (**Table 26**) and concluded that WCPL was compliant with the exception of the performance indicators related to exceedance of EC trigger level at P315 (Stony Creek Alluvium).

An investigation into the increased EC levels was undertaken during the reporting period, and concluded that high rainfall may have resulted in sufficient recharge to the shallow groundwater system. This recharge is believed to have enabled “flushing” of shallow groundwater through fractures in bedrock caused by North Wambo Underground undermining in the Newcastle Coal Measures, leading to an increase in EC (SLR, 2023).

As EC has continued to increase and exceed trigger limit values in the reporting period following rainfall events similar to those experienced in 2021, it is possible the same process may be occurring and expected to continue if above average rainfall conditions persist into the future (SLR, 2023).

Notification of the non-compliance was reported to DPE as required by DA 305-07-2003.

10.2 HRSTS TSS Monitoring

Schedule 2, Condition B55 of DA 305-7-2003 and EPL 529 provides discharge water quality limits for the HRSTS. WCPL complied with all approval criteria for HRSTS discharges during the reporting period with the exception of TSS levels at EPL ID Point 4 on 16 March 2022 and 30 March 2022 and pH levels at EPL ID Point 4 on 8 September 2022.

On 16 March 2022, the grab sample laboratory analysis results exceeded the TSS approval criterion (120 mg/L) which was inconsistent with the in-line turbidity monitoring system that did not detect any significant change in turbidity during this period.

On 20 March 2022, the grab sample laboratory analysis results exceeded the TSS approval criterion (120 mg/L). The in-line turbidity monitoring system detected increasing real time turbidity readings, and the HRSTS discharge was ceased.

On 8 September 2022, the in-line pH monitoring system recorded a pH result of 9.51 at EPL ID Point 4 above the 100 percentile concentration limit (9.5). The pH level of 9.51 was recorded for approximately 1 minute immediately prior to maintenance activities on the in-line pH probe. The probe recorded a pH of 9.0 immediately after maintenance.

An investigation into the TSS exceedance on 16 March 2022 determined that the continuous in-line turbidity monitoring was correctly calibrated and that the difference between the results was likely due to the different location of the continuous in-line turbidity monitoring probe and the grab sample location (SW15).

To minimise the recurrence of the non-compliance, an alarm has been set up to notify operators when turbidity / TSS levels reach a trigger to review discharge.

Notification of the non-compliances were reported to DPE and EPA by WCPL as required by EPL 529 and DA 305-07-2003.

There were no adverse effects from the non-compliance.

10.3 Hales Crossing Sump Inundation

The sediment control sump that collects runoff from the Wambo Rail Load Out Facility (i.e. Hales Crossing Sump) was inundated by floodwaters from the Wollombi Brook on 8 March 2022 and 5 July 2022 after significant rainfall. The contents of the Hales Crossing Sump were inundated by Wollombi Brook therefore not compliant with Condition L1.1 of EPL 529.

The Hales Crossing Sump was subsequently inspected for structural integrity and pumping infrastructure reinstated and flood water remaining in Hales Crossing Sump was pumped back into the Mine water system after both exceedances.

WCPL notified the DPE and EPA of the incidents in accordance with Condition R2.2 of EPL 529 and the DA 305-7-2003.

10.4 EPBC Approval 2016/7816 Non-Compliance

Modifications 18 and 19 to Development Consent (DA 305-7-2003) were approved on 25 January 2022 and 25 January 2023, respectively

The Department was not notified in writing of changes to the conditions in Development Consent (DA 305-7-2003) (Modification 18) within the allocated time period following the conditions being finalised. This has resulted in a non-compliance with Condition 1d of EPBC Approval 2016/7816.

On 27 January 2023, the Department was notified via email to the approved changes to the Development Consent (DA 305-7-2003) as a result of Modification 19.

11.0 Regulator Requests for Information

During the reporting period the DPE made a number of requests for information relating to WCPL operations. On each occasion, WCPL conducted a review of relevant monitoring data and operational activities and provided a summary to DPE.

An overview of the information requested and actions taken is provided in **Table 38**.

Table 38: Regulator Requests for Information

Date of Request	Relevant Agency	Comment
16 December 2022	DPE	Biodiversity Offsets - Report on the status of the long term security arrangement for biodiversity offsets required by the development consent for the mine. Please include information on the type(s) of long term security arrangements that have been implemented and/or are to be implemented for the mine. As required by Condition B79, DA305-7-2003, WCPL lodged a Conservation Bond with DPE in February 2022. The Bond ensures the Biodiversity Offset Strategy is implemented in accordance with the performance and completion criteria in the BMP.
16 December 2022	DPE	Greenhouse Gas - Report on greenhouse gas emissions for the reporting period and include a comparison of actual greenhouse gas emissions against the predictions in the environmental assessment(s) for the mine. Please ensure that the method used to calculate the environmental assessment prediction(s) and annual emissions are calculated the same. GHG emissions are measured on a financial year basis in accordance with National Greenhouse and Energy Reporting System (NGERS) requirements. In the 2021/22 financial year, the total Scope 1 and 2 emissions were 295,521 CO2-e. The total Scope 1 and Scope 2 emissions predicted for 2022 in MOD17 GHG Assessment was 0.32 Mt CO2-e.
16 December 2022	DPE	Greenhouse Gas - Report all reasonable and feasible steps undertaken during the reporting period to improve energy efficiency and reduce greenhouse gas emissions generated by the mine. Steps to improve energy efficiency; 1. Ensure relevant metering/accounting in place to measure GHG emissions; 2. Participation in the Federal Government's Energy Efficiency Opportunities program which included a review of energy usage and identified areas for potential energy efficiency improvement; 3. Regular scheduled maintenance of equipment and plant; 4. Completed longwall panels will be sealed, to reduce methane emissions from the goaf; and 5. Ensure maintenance, calibration and record keeping is undertaken on the main ventilation shaft and fans to allow calculation of GHG emissions.

12.0 Activities to be Reported in the next Reporting Period

The following activities will be undertaken and reported on by WCPL during the next reporting period:

- Construct replacement bores for P106 and P109 with a paired standpipe monitoring site.
- Investigate and repair any damages to GW10.2 as required.
- Update the groundwater inflow assessment criteria to reflect peak inflow values from contemporary model predictions.
- Continue investigations of the surface water quality results recorded at SW08 (EC).
- Remove VMPs which are no longer collecting reliable data (i.e. MG06, MG08, MG09, GW20, U/Fenwick) from the monitoring network.
- Continuation of subsidence repair trials.
- Repair subsidence damage to tracks.
- Continue planned 2023 NWCD rehabilitation and maintenance works.

Where required, updated management plans and strategies will be submitted to relevant government authorities for approval and uploaded to the WCPL website.

13.0 References

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- Rural & Environmental Management Pty Ltd, 2022a. *Wambo Coal Weed Management Services 2022 Summary.*
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- SouthEast Archaeology Pty Ltd, 2021. Wambo Coal Mine-Aboriginal Heritage Due Diligence Investigation Of Drilling Locations, November 2021.
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- Tongway and Hindley, 2005. *Landscape Function Analysis: A System for Monitoring Rangeland Function.*
- Umwelt, 2016. *United Wambo Open Cut Coal Mine Project Environmental Impact Statement*. August 2016.
- Umwelt, 2022. *Stream Flow and Water Quality Impact Assessment Criteria Exceedance Investigation. Wambo Coal Mine.* March 2022.
- Wambo Coal Pty Ltd, 2021. *South bates Extension Underground Mine Extraction Plan Longwalls 21 to 24*.

APPENDIX A

APPROVAL CONDITIONS SPECIFICALLY RELATING TO THE ANNUAL REVIEW

Approval	Condition	Description	Where Addressed
DA 305-7-2003	Condition B49, Schedule 2	For the life of the development, the Applicant must: (a) monitor the greenhouse gas emissions generated by the development; (b) investigate ways to reduce greenhouse gas emissions generated by the development; and (c) report on greenhouse gas monitoring and abatement measures in the Annual Review. to the satisfaction of the Planning Secretary.	Section 5.4
DA 305-7-2003	Condition B53, Schedule 2	The Applicant must report on water extracted or discharged from the site each year (direct and indirect) in the Annual Review, including water taken under each licence. *Note: under the water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development, including during rehabilitation and post mine closure*.	Sections 6.3 to 6.7
DA 305-7-2003	Condition B66, Schedule 2	The applicant must prepare a Water Management Plan for the Wambo Mining Complex to the satisfaction of the Planning Secretary. This Plan must: (a) be prepared by a suitably qualifies and experiences person/s whose appointment has been endorsed by the Planning Secretary; (b) be prepared in consultation with DPIE Water and the EPA; (c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures: … (vi) a protocol to report on the measures, monitoring results and performance criteria identified above, in the Annual Review referred to in condition D10.	Section 6
DA 305-7-2003	Condition B100, Schedule 2	The Applicant must: (a) take all reasonable steps to minimise the water (including coals rejects and tailings) generated by the development; (b) dispose of all waste at appropriately licensed waste facilities; (c) manage on-site sewage treatment and disposal in accordance with the requirements of Council; and (d) monitor and report of the effectiveness of the water minimisation and management measures in the Annual Review referred to in condition D10.	Section 6
DA 305-7-2003	Condition B111, Schedule 2	The Applicant must: (a) keep accurate records of the amount of coal transported from the site (on a daily basis); and (b) include these records in the Annual Review.	Section 3

Approval	Condition	Description	Where Addressed
DA 305-7-2003	Condition D10, Schedule 2	By the end of March each year or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. This review must: (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, including a comparison of these results against the: (i) relevant statutory requirements, limits or performance measures/ criteria; (ii) requirements of any plan or program required under this consent; (iii) monitoring results of previous years; and (iv) relevant predictions in the documents listed in condition A2(c); (c) identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence; (d) evaluate and report on: (i) The effectiveness of the noise and air quality management systems; and (ii) Compliance with the performance measures, criteria and operating conditions in this consent; (e) identify any trends in the monitoring of data over the life of the development; (f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and (g) describe what measures will be implemented over the next calendar year to improve the environmental performance of the development.	This Annual Review
EPBC 2016/7636	Condition 5	The person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Appendix I

Approval	Condition	Description	Where Addressed
EPBC 2016/7816	Condition 5	By 31 March of each year after the commencement of the action, the person taking the action must: publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans and strategies required by conditions D10 and D15 of schedule 2 of the state development consent over the previous calendar year; and provide documentary evidence providing proof of the date of publication to the Department, by email to EPBCMonitoring@environment.gov.au (or another email address as stipulated by the Department). The person taking the action must continue publishing annual compliance reports and make all reports available on their website for the life of the approval, unless agreed in writing by the Minister.	Appendix I
S101 Approval (NETD)	Condition (h)	The North East Tailings Dam shall be reported on within the Annual Environmental Management Report for Wambo Coal. Consideration shall also be given to the rehabilitation performance for this site.	Sections 7.1.6 and 7.2.1
CL365, CL397 ML1806	Condition 3(f)	(f) The lease holder must prepare a Rehabilitation Report to the satisfaction of the Minister. The report must: (i) provide a detailed review of the progress of rehabilitation against the performance measures and criteria established in the approved MOP/RMP; (ii) be submitted annually on the grant anniversary date (or at such other times as agreed by the Minister); (iii) be prepared in accordance with any relevant annual reporting guidelines published on the Department's website at www.resources.nsw.gov.au/environment. Note. The Rehabilitation Report replaces the Annual Environmental Management Report.	This Annual Review
CCL743, ML1402	Conditions 4-5	The lease holder must lodge Environmental Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-General. The EMR must: a) report against compliance with the MOP/RMP; b) report on progress in respect of rehabilitation completion criteria; c) report on the extent of compliance with regulatory requirements; and d) have regard to any relevant guidelines adopted by the Director-General.	This Annual Review

Approval	Condition	Description	Where Addressed
CL374	Condition 3	(1) Within 12 months of the commencement of mining operations and thereafter annually or, at such other times as may be allowed by the Director-General, the lease holder must lodge an Annual Environmental Management Report (AEMR) with the Director-General. (2) The AEMR must be prepared in accordance with the Director-General's guidelines current at the time of reporting and contain a review and forecast of performance for the preceding and ensuing twelve months in terms of: a) the accepted Mining Operations Plan; b) development consent requirements and conditions; c) Department of Environment and Conservation and Department of Planning licences and approvals; d) any other statutory environmental requirements; e) details of any variations to environmental approvals applicable to the lease area; and f) where relevant, progress towards final rehabilitation objectives. (3) After considering the AEMR the Director-General may, by notice in writing, direct the lease holder to undertake operations, remedial actions or supplementary studies in the manner and within the period specified in the notice to ensure that operations on the lease area are conducted in accordance with sound mining and environmental practice. (4) The lease holder shall, as and when directed by the Minister, co-operate with the Director-General to conduct and facilitate review of the AEMR involving other government agencies and the local council.	This Annual Review
Water Licence 20AL200631, 20AL203044, 20AL201457	Condition 1	The licence holder must provide the Minister with figures recording the quantity of water taken via the nominated water supply works approval, when required to do so, and in the form specified by the Minister.	Section 6.5

Approval	Condition	Description	Where Addressed
Water Licence 20WA200632	Condition 9	The account holder must provide the Minister, in the approved form, with the following information when requested: A) A report detailing the quantity of water taken through the authorised work(s) and recorded by the approved measuring device, or where the work does not have a measuring device fitted to it, advise the Minister of the duration of any pumping, and B) Where the water is used for irrigation, the area of land irrigated, the planting date, area and yield of all crops grown on the property for each season. These details must include: i) The volume of water taken from the water source and applied directly to crops and/or pasture; ii) The volume of water taken from the water source and held in on-farm storages; iii) The volume of water taken from on-farm storages and applied to crops (including pasture); iv) The type and area of each crop (including pasture) irrigated; v) The method of irrigation for each class of crop and/or pasture; and vi) The volume of water applied to each individual class of crop and/or pasture.	Section 6.5

APPENDIX B

DAILY TRAIN MOVEMENT SUMMARY

Table B1: Daily Train Movements

Date	No Trains per Day	Date	No Trains per Day	Date	No Trains per Day
1/01/2022	5	16/03/2022	2	13/05/2022	2
2/01/2022	2	17/03/2022	4	14/05/2022	3
3/01/2022	2	18/03/2022	3	15/05/2022	1
4/01/2022	1	20/03/2022	1	16/05/2022	2
5/01/2022	2	21/03/2022	1	17/05/2022	2
6/01/2022	3	22/03/2022	3	19/05/2022	2
7/01/2022	1	23/03/2022	3	20/05/2022	1
8/01/2022	4	24/03/2022	1	21/05/2022	2
9/01/2022	2	25/03/2022	1	23/05/2022	1
10/01/2022	1	26/03/2022	2	26/05/2022	1
11/01/2022	3	27/03/2022	1	27/05/2022	3
12/01/2022	1	28/03/2022	1	28/05/2022	3
13/01/2022	1	30/03/2022	2	29/05/2022	2
15/01/2022	3	31/03/2022	1	30/05/2022	1
17/01/2022	1	1/04/2022	2	31/05/2022	1
22/01/2022	1	2/04/2022	2	2/06/2022	2
28/01/2022	1	3/04/2022	2	3/06/2022	3
29/01/2022	4	4/04/2022	2	4/06/2022	2
30/01/2022	5	8/04/2022	1	7/06/2022	3
31/01/2022	1	9/04/2022	1	8/06/2022	2
1/02/2022	5	10/04/2022	2	9/06/2022	1
2/02/2022	4	11/04/2022	3	10/06/2022	1
3/02/2022	2	12/04/2022	1	12/06/2022	2
4/02/2022	5	13/04/2022	1	13/06/2022	2
5/02/2022	4	16/04/2022	3	14/06/2022	1
6/02/2022	5	17/04/2022	5	15/06/2022	1
7/02/2022	3	18/04/2022	1	16/06/2022	3
11/02/2022	1	19/04/2022	2	17/06/2022	1
12/02/2022	2	21/04/2022	5	18/06/2022	3
13/02/2022	3	22/04/2022	1	19/06/2022	2
19/02/2022	1	23/04/2022	3	20/06/2022	1
22/02/2022	1	24/04/2022	3	21/06/2022	1
23/02/2022	4	25/04/2022	1	22/06/2022	3
24/02/2022	1	27/04/2022	1	23/06/2022	2
25/02/2022	2	28/04/2022	1	24/06/2022	2
26/02/2022	1	30/04/2022	1	25/06/2022	1
27/02/2022	2	1/05/2022	2	26/06/2022	3
1/03/2022	1	2/05/2022	1	27/06/2022	3
3/03/2022	1	3/05/2022	1	28/06/2022	3
8/03/2022	1	4/05/2022	1	29/06/2022	2
10/03/2022	1	9/05/2022	3	30/06/2022	1
14/03/2022	3	10/05/2022	1	1/07/2022	3
15/03/2022	2	12/05/2022	2	2/07/2022	1

Table B1: Daily Train Movements (Continued)

Date	No Trains per Day	Date	No Trains per Day	Date	No Trains per Day
3/07/2022	3	5/09/2022	1	6/11/2022	2
4/07/2022	1	6/09/2022	1	11/11/2022	2
5/07/2022	1	7/09/2022	3	13/11/2022	1
17/07/2022	2	8/09/2022	2	14/11/2022	4
18/07/2022	3	9/09/2022	1	15/11/2022	2
19/07/2022	4	13/09/2022	4	16/11/2022	2
20/07/2022	1	14/09/2022	4	17/11/2022	3
21/07/2022	3	15/09/2022	2	19/11/2022	2
22/07/2022	5	16/09/2022	2	20/11/2022	6
23/07/2022	2	17/09/2022	1	21/11/2022	1
24/07/2022	4	18/09/2022	3	25/11/2022	2
25/07/2022	1	22/09/2022	2	26/11/2022	2
27/07/2022	3	23/09/2022	1	27/11/2022	2
28/07/2022	1	24/09/2022	1	28/11/2022	3
29/07/2022	1	25/09/2022	1	29/11/2022	2
30/07/2022	3	26/09/2022	3	30/11/2022	4
31/07/2022	1	27/09/2022	3	1/12/2022	2
1/08/2022	1	28/09/2022	3	2/12/2022	3
2/08/2022	1	29/09/2022	2	3/12/2022	1
3/08/2022	1	30/09/2022	1	4/12/2022	4
4/08/2022	1	1/10/2022	2	5/12/2022	2
5/08/2022	2	2/10/2022	1	05/12/2021	4
6/08/2022	1	3/10/2022	1	06/12/2021	3
7/08/2022	1	8/10/2022	3	07/12/2021	3
12/08/2022	2	9/10/2022	1	08/12/2021	3
14/08/2022	1	10/10/2022	1	09/12/2021	4
15/08/2022	1	11/10/2022	1	10/12/2021	5
18/08/2022	1	13/10/2022	1	11/12/2021	1
19/08/2022	2	16/10/2022	1	12/12/2021	2
20/08/2022	1	17/10/2022	4	15/12/2021	1
21/08/2022	3	18/10/2022	3	16/12/2021	2
22/08/2022	1	19/10/2022	2	17/12/2021	3
23/08/2022	2	20/10/2022	1	20/12/2021	2
24/08/2022	1	21/10/2022	1	21/12/2021	2
25/08/2022	1	22/10/2022	5	22/12/2021	2
26/08/2022	5	23/10/2022	3	23/12/2021	2
27/08/2022	1	24/10/2022	1	26/12/2021	1
28/08/2022	3	25/10/2022	1	27/12/2021	1
29/08/2022	2	28/10/2022	3	28/12/2021	3
30/08/2022	4	29/10/2022	1	29/12/2021	1
31/08/2022	1	30/10/2022	2	30/12/2021	1
1/09/2022	2	31/10/2022	1	31/12/2021	1
2/09/2022	1	2/11/2022	3		
3/09/2022	3	4/11/2022	1		
4/09/2022	2	5/11/2022	3		

Table B2: Train Movements within Sensitive Service Hours

(Friday 6pm-9pm & Sunday 9am-12am)

Date	Time
Sunday, 2 January 2022	3:10:14 PM
Sunday, 6 February 2022	2:36:42 PM
Sunday, 6 February 2022	9:30:43 AM
Sunday, 6 February 2022	11:25:38 AM
Sunday, 17 April 2022	3:02:09 PM
Sunday, 17 April 2022	8:48:57 PM
Sunday, 17 April 2022	10:47:29 AM
Sunday, 15 May 2022	11:24:19 AM
Sunday, 19 June 2022	9:27:22 PM
Sunday, 3 July 2022	7:56:53 PM
Sunday, 3 July 2022	11:00:39 PM
Sunday, 17 July 2022	11:43:37 AM
Sunday, 7 August 2022	4:47:02 PM
Sunday, 21 August 2022	5:22:14 PM
Sunday, 21 August 2022	11:26:18 AM
Friday, 26 August 2022	8:07:36 PM
Sunday, 18 September 2022	11:46:57 AM
Sunday, 18 September 2022	8:51:13 PM
Sunday, 18 September 2022	11:31:05 PM
Sunday, 2 October 2022	12:57:32 PM
Sunday, 6 November 2022	9:42:48 AM
Sunday, 6 November 2022	8:58:09 PM
Sunday, 20 November 2022	5:36:20 PM
Sunday, 20 November 2022	9:45:28 PM
Friday, 25 November 2022	7:55:31 PM
Sunday, 4 December 2022	4:15:23 PM
Sunday, 4 December 2022	11:08:06 AM
Sunday, 18 December 2022	12:28:22 PM
Total	**28**

APPENDIX C

ANNUAL NOISE MONITORING REPORT

Wambo Coal Mine

Annual Environmental Monitoring Report 2022

Prepared for Wambo Coal Pty Ltd

January 2023

Wambo Coal Mine

Annual Environmental Monitoring Report 2022

Wambo Coal Pty Ltd

E220455 RP1

January 2023

Version	Date	Prepared by	Approved by	Comments
1	2 February 2023	William Moore	Jesse Tribby	Draft
2	2 February 2023	William Moore	Jesse Tribby	Final

Approved by

Jesse Tribby
Senior Acoustical Consultant
2 February 2023

Level 3 175 Scott Street
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Executive Summary

Global Acoustics was engaged by Wambo Coal Pty Ltd to provide an Annual Environmental Monitoring Report for 2022 to compare noise monitoring results against relevant criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around Wambo Coal Mine (WCM) during the reporting period 1 January to 31 December 2022. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

Attended noise monitoring described in this report was conducted monthly in accordance with the relevant development consents, Environment Protection Licence (EPL), and the WCM Noise Management Plan (NMP).

January to December 2022 Compliance

Noise levels from WCM were inaudible at all receivers during 2022 noise monitoring. No modifying factors were applicable to WCM operations. WCM complied with relevant noise criteria during all measurements during 2022 noise monitoring.

Long-Term Noise Trends

From 2018 to 2020, site noise levels decreased at most monitoring locations, likely due to mining activity being deeper in pit and therefore more shielded from receptors. From 1 December 2020, open cut mining was no longer undertaken by WCM and noise emissions decreased significantly.

EIS Comparison

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by United Wambo as part of the United Wambo Joint Venture. United Wambo was solely responsible for noise emissions from United Wambo Join Venture during 2022 noise surveys.

Noise levels from WCM were inaudible at all receivers during all of 2022 noise monitoring. Subsequently, comparison of measured WCM noise levels against noise model predictions was not possible. Additional information is provided in Section 3.5 of this report.

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Tables

Figures

1 Introduction

1.1 Background

Global Acoustics (now part of EMM) was engaged by Wambo Coal Pty Ltd (WC) to provide an Annual Environmental Monitoring Report (AEMR) for 2022, to compare noise monitoring results against modelling predictions and relevant noise criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around WCM during the reporting period 1 January to 31 December 2022. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

1.2 Attended Noise Monitoring Locations

Monitoring locations for WC are detailed in Table 1.1 and shown on Figure 1. It should be noted that Figure 1 shows the actual monitoring positions, not the location of residences.

Table 1.1 Attended noise monitoring locations

Site Reference [1]	EPA Point [2]	Area Description	Properties Represented [3]
N01	N/A	North Bulga	3, 7, 379
N16	20	Jerrys Plains Road	Privately-owned residences near Jerry’s Plains
N20A	21	Redmanvale Road Central	Privately-owned residences near Jerry’s Plains
N21	22	South Wambo	25, 35a
N26	23	Redmanvale Road South	Privately-owned residences near Jerry’s Plains

Notes: 1. Sourced from NMP – WA-ENV-MNP-503, November 2020.

2. Sourced from Environment Protection Licence 529, September 2021.

3. Property numbering is from Appendix 4 of DA 305-7-2003.

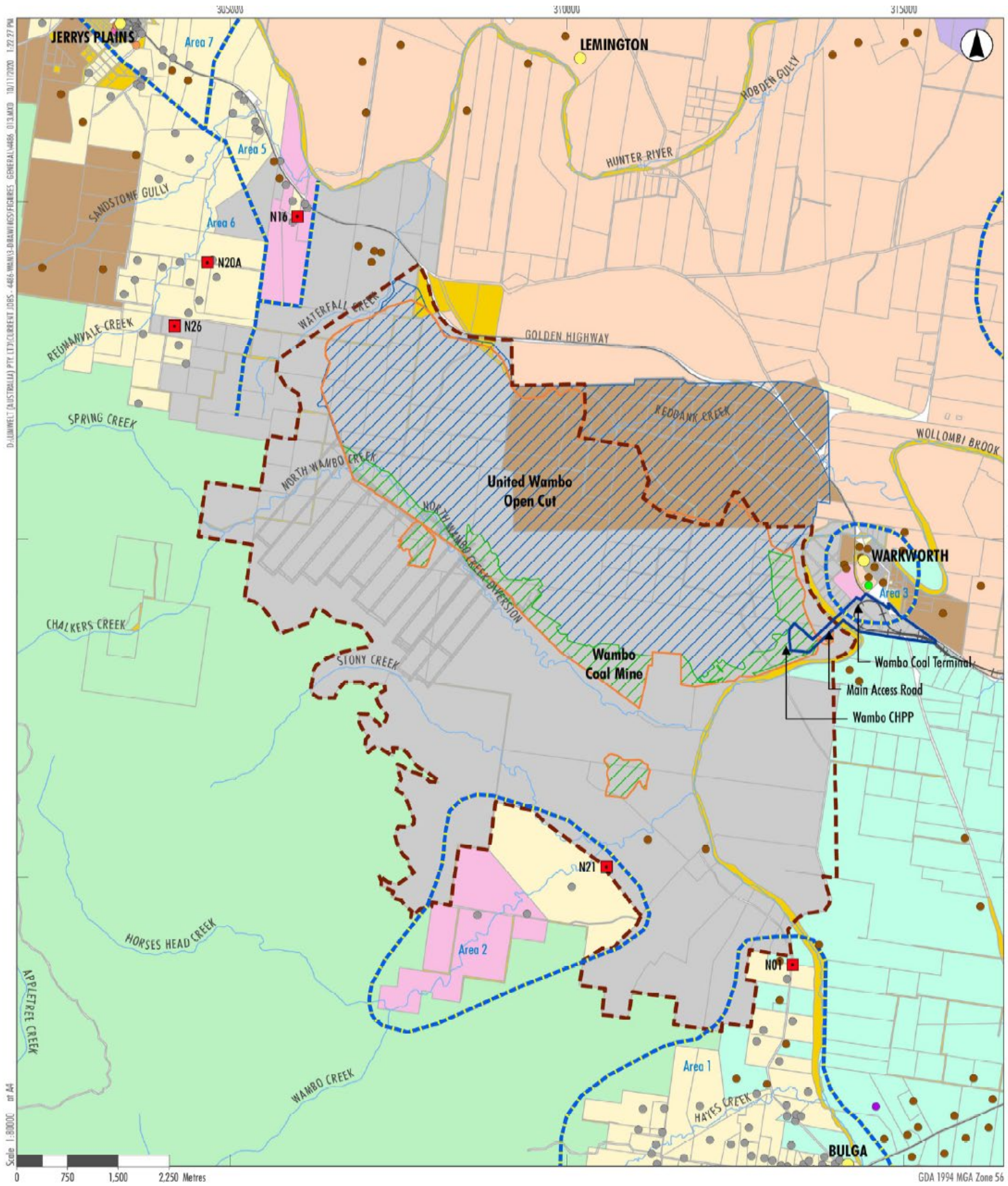

Figure 1 WC noise monitoring locations

1.3 Terminology & Abbreviations

Some definitions of terms and abbreviations which may be used in this report are provided in Table 1.2.

Table 1.2 Terminology and abbreviations

Descriptor	Definition
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise.
L_{Amax}	The maximum A-weighted noise level over a time period.
L_{A1}	The noise level which is exceeded for 1 per cent of the time.
$L_{A1,1minute}$	The noise level which is exceeded for 1 per cent of the specified time period of 1 minute.
L_{A10}	The noise level which is exceeded for 10 percent of the time.
L_{Aeq}	The average noise A-weighted energy during a measurement period.
L_{A50}	The noise level which is exceeded for 50 per cent of the time and the median noise level during a measurement period.
L_{A90}	The level exceeded for 90 percent of the time. The L_{A90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.
L_{Amin}	The minimum A-weighted noise level over a time period.
L_{Ceq}	The average C-weighted noise energy during a measurement period. The "C" weighting scale is used to take into account low-frequency components of noise within the audibility range of humans.
SPL	Sound pressure level. Fluctuations in pressure measured as 10 times a logarithmic scale, with the reference pressure being 20 micropascals.
Hertz (Hz)	The frequency of fluctuations in pressure, measured in cycles per second. Most sounds are a combination of many frequencies together.
AWS	Automatic weather station used to collect meteorological data, typically at an altitude of 10 metres
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude.
Sigma-theta	The standard deviation of the horizontal wind direction over a period of time.
IA	Inaudible. When site noise is noted as IA then there was no site noise at the monitoring location.
NM	Not Measurable. If site noise is noted as NM, this means some noise was audible but could not be quantified.
Day	This is the period 7:00am to 6:00pm.
Evening	This is the period 6:00pm to 10:00pm.
Night	This is the period 10:00pm to 7:00am.
WC	Wambo Coal
WCM	Wambo Coal Mine
WCRS	Wambo Coal Road Spur

2 Regulator requirements and noise criteria

2.1 WCM Development Consent

The most current development consent for WCM is DA 305-7-2003 (MOD 18, 25 January 2022). Schedule 2, Part B of the WCM consent details specific conditions relating to noise generated by WCM.

2.2 WCRS Development Consent

The most current development consent for Wambo Rail Loop is WCRS DA 177-8-2004 (MOD 3, 29 August 2019), last modified to include a rail refuelling facility. Schedule 2, Part B of the WCRS consent details specific conditions relating to noise generated by WCRS.

2.3 Environment Protection Licence

WCM holds Environment Protection Licence (EPL) No. 529 issued by the Environment Protection Authority (EPA) most recently on 30 September 2021.

2.4 Noise Management Plan

Noise monitoring requirements are detailed in the Wambo Coal Noise Management Plan WA-ENV-MNP-503 (NMP, November 2020), prepared in accordance with the WCM and WCRS consents.

2.5 Noise Criteria

Noise criteria detailed in Table 2.1 have been adopted for each monitoring location based on Phase 2 and 3 of the development consent (MOD 18) and the NMP.

Table 2.1 WCM Noise Criteria

Location	WCM Day $L_{Aeq,15minute}$	WCM Evening $L_{Aeq,15minute}$	WCM Night $L_{Aeq,15minute}$	WCM Night $L_{A1,1minute}$
N01 [1]	38	38	38	48
N16	35	35	35	45
N20A	35	35	35	45
N21 [2]	39	39	39	49
N26	35	35	35	45

Notes: 1. Noise criteria for the nearest privately-owned property (R003) have been adopted.

2. Noise criteria for the nearest privately-owned property (R025) have been adopted.

EPL noise criteria have not been updated for Phase 2 and 3 of operations. As noise criteria in the development consent and NMP are now more conservative than those in the EPL, they have been adopted in Table 2.1.

2.6 Meteorological Conditions

Meteorological conditions required for noise criteria to apply are consistent between the consent and EPL.

Appendix 5 of MOD 18 details specific meteorological conditions required for noise criteria to be applicable:

APPENDIX 5 NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in condition B12 are to apply under all meteorological conditions except the following:

   (a) where 3°C/100 metres (m) lapse rates have been assessed, then:

      (i) wind speeds greater than 3 metres/second (m/s) measured at 10m above ground level;

      (ii) temperature inversion conditions between 1.5°C and 3°C/100m and wind speeds greater than 2m/s measured at 10m above ground level; or

      (iii) temperature inversion conditions greater than 3°C/100m.

   (b) where Pasquill Stability Classes have been assessed, then:

      (i) wind speeds greater than 3m/s at 10m above ground level;

      (ii) stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level;

      (iii) stability category G temperature inversion conditions.

As lapse rates (VTG) were not measured directly, meteorological conditions have been assessed against Pasquill stability classes detailed in 1.(b).

Condition L5.5 of the EPL details meteorological conditions required for noise limits to apply:

L5.5 The noise limits set out in condition L5.1 apply under all meteorological conditions except for the following:

a) Wind speeds greater than 3 metres/second at 10 metres above the ground level;
b) Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or
c) Stability category G temperature inversion conditions.

Condition L5.5 is consistent with stability category conditions outlined in Appendix 5, 1.(b) of MOD 18.

2.7 Modifying Factors

The EPA 'Noise Policy for Industry' (NPfI, 2017) was approved for use in NSW in October 2017. For assessment of modifying factors, the NPfI immediately superseded the 'Industrial Noise Policy' (INP, 2000), as outlined in the EPA document 'Implementation and transitional arrangements for the Noise Policy for Industry' (2017). Assessment and reporting of modifying factors have been undertaken in accordance with Fact Sheet C of the NPfI.

3 Methodology

3.1 Overview

Attended environmental noise monitoring was conducted in general accordance with Australian Standard AS1055 'Acoustics, Description and Measurement of Environmental Noise' and relevant NSW EPA requirements. Meteorological data was obtained from the WCM automatic weather station (AWS) which allowed correlation of atmospheric parameters with measured noise levels.

3.2 Attended Noise Monitoring

During this survey, monthly attended monitoring was undertaken during the night period at each location. The duration of each measurement was 15 minutes. Atmospheric condition measurement was also undertaken at each monitoring location.

This survey presents noise levels gathered during attended monitoring that are the result of many sounds reaching the sound level meter microphone during monitoring. Received levels from various noise sources were noted during attended monitoring and particular attention was paid to the extent of WCM/WCRS's contribution, if any, to measured levels. At each receptor location, WCM/WCRS's $L_{Aeq,15minute}$ and $L_{A1,1minute}$ (in the absence of any other noise) was measured directly, where possible, or, determined by frequency analysis.

If the exact contribution of the source of interest (in this case WCM) cannot be established, due to masking by other noise sources in a similar frequency range, but site noise levels are observed to be well below (more than 5 dB lower than) any relevant criterion, a maximum estimate of the potential contribution of the site might be made based on other measured site-only noise descriptors in accordance with Section 7.1 of the NPfI. This is generally expressed as a 'less than' quantity, such as <20 dB or <30 dB.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may also be used in this report. When site noise is noted as IA, no site noise was audible at the monitoring location. When site noise is noted as NM, this means some noise was audible but could not be quantified. If site noise was NM due to masking but estimated to be significant in relation to a relevant criterion, we would employ methods (eg measure closer and back calculate) to determine a value for reporting.

All sites noted as NM in this report are due to one or more of the following reasons:

- Site noise levels were extremely low and unlikely, in many cases, to be even noticed.
- Site noise levels were masked by another relatively loud noise source that is characteristic of the environment (eg breeze in foliage or continuous road traffic noise) that cannot be eliminated by moving closer.
- It was not feasible, nor reasonable to employ methods such as move closer and back calculate. Cases may include, but are not limited to, rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

For this assessment the measured L_{Amax} has been used as a conservative estimate of $L_{A1,1minute}$. The EPA accepts sleep disturbance analysis based on either the $L_{A1,1minute}$ or L_{Amax} metrics, with the LAmax resulting in a more conservative assessment of site noise emissions.

Often extraneous noise events (for example, road traffic pass-bys and dogs) interfere with the measurement of site noise levels in the frequency range of interest. Where required, the sound level meter is paused during these occurrences to aid in quantification of the site only noise.

3.3 Modifying Factors

All measurements were evaluated for potential modifying factors in accordance with the NPfI. Specific methodology for assessment of each modifying factor is outlined in Fact Sheet C of the NPfI.

Assessment of modifying factors is undertaken at the time of measurement if the site was audible and directly quantifiable, such that the site only L_{Aeq} was not "NM" or less than a maximum cut off value (eg "<20 dB" or "<30dB").

If applicable, modifying factors have been reported and added to measured site only LAeq noise levels when meteorological conditions satisfied requirements for site noise criteria to be applicable. Low-frequency modifying factors have only been applied to site-only L_{Aeq} levels if WCM/WCR was the only contributing low-frequency noise source.

3.4 Meteorological Conditions

Meteorological data was obtained from the WCM meteorological station; this was logged at 10-minute intervals. Atmospheric parameters include wind speed, wind direction, rainfall, and sigma theta. When meteorological data is provided in less than 15-minute intervals, an analysis must be conducted to determine the meteorological conditions present for the majority of each measurement period and whether those conditions result in noise criteria being applicable or not.

3.5 Comparison with United Wambo EIS Model Predictions

The MOD 17 environmental assessment (EA) and MOD 16 EIS both reference the noise impact assessment (NIA) prepared in July 2016 to support application for the United Wambo Joint Venture (UWJV) project. The NIA includes noise impacts associated with ongoing operations from both WCM and United Wambo (UW).

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by UW as part of the UWJV. UW was solely responsible for noise emissions from UWJV during 2022 noise surveys.

Noise levels from WCM were inaudible at all receivers during all of 2022 noise monitoring. Subsequently, comparison of measured WCM noise levels against EIS noise model predictions was not possible.

It is feasible for noise emissions from WCM ventilation fans, conveyors, coal preparation plant, and/or rail loop to contribute to total UWJV noise levels, but this did not occur during the reporting period 1 January to 31 December 2022. Unless this occurs, it is recommended that UW noise emissions be compared against model predictions, as it is the primary source of noise emissions for the UWJV.

4 Results

4.1 January 2022

4.1.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.1.

Table 4.1 Measured noise levels – January 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	18/01/2022 01:12	52	50	59	47	47	45	41
N16	17/01/2022 23:30	66	50	58	47	46	43	40
N20A	17/01/2022 22:39	51	39	38	37	37	36	35
N21	18/01/2022 00:42	51	48	55	42	41	39	36
N26	17/01/2022 22:14	48	43	52	41	41	40	39

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.1.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.1.3 Attended Noise Monitoring

Table 4.2 and Table 4.3 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.2 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – January 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	18/01/2022 01:12	0.7	F	38	Yes	IA	Nil
N16	17/01/2022 23:30	0.8	F	35	Yes	IA	Nil
N20A	17/01/2022 22:39	1.1	F	35	Yes	IA	Nil
N21	18/01/2022 00:42	0.2	F	39	Yes	IA	Nil
N26	17/01/2022 22:14	0.9	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.3 $L_{A1,1minute}$ generated by WCM against project approval criteria – January 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	18/01/2022 01:12	0.7	F	48	Yes	IA	Nil
N16	17/01/2022 23:30	0.8	F	45	Yes	IA	Nil
N20A	17/01/2022 22:39	1.1	F	45	Yes	IA	Nil
N21	18/01/2022 00:42	0.2	F	49	Yes	IA	Nil
N26	17/01/2022 22:14	0.9	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.2 February 2022

4.2.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.1.

Table 4.4 Measured noise levels – February 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	24/02/2022 00:15	51	49	47	45	45	43	42
N16	23/02/2022 23:14	47	45	44	42	42	41	40
N20A	23/02/2022 22:25	61	41	40	39	39	38	36
N21	23/02/2022 23:46	49	41	38	37	37	36	34
N26	23/02/2022 22:00	56	49	45	44	43	42	40

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.2.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.2.3 Attended Noise Monitoring

Table 4.5 and Table 4.6 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.5 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – February 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	24/02/2022 00:15	1.1	F	38	Yes	IA	Nil
N16	23/02/2022 23:14	1.3	F	35	Yes	IA	Nil
N20A	23/02/2022 22:25	0.8	F	35	Yes	IA	Nil
N21	23/02/2022 23:46	1.8	F	39	Yes	IA	Nil
N26	23/02/2022 22:00	1.2	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.6 $L_{A1,1minute}$ generated by WCM against project approval criteria – February 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	24/02/2022 00:15	1.1	F	48	Yes	IA	Nil
N16	23/02/2022 23:14	1.3	F	45	Yes	IA	Nil
N20A	23/02/2022 22:25	0.8	F	45	Yes	IA	Nil
N21	23/02/2022 23:46	1.8	F	49	Yes	IA	Nil
N26	23/02/2022 22:00	1.2	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.3 March 2022

4.3.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.7.

Table 4.7 Measured noise levels – March 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	17/03/2022 22:39	51	49	46	45	45	44	43
N16	17/03/2022 23:17	54	53	52	51	51	50	49
N20A	17/03/2022 22:30	52	42	38	37	36	36	35
N21	17/03/2022 22:13	57	55	54	52	52	50	46
N26	17/03/2022 22:03	47	42	41	39	39	38	36

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.3.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.3.3 Attended Noise Monitoring

Table 4.8 and Table 4.9 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.8 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – March 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	17/03/2022 22:39	1.1	F	38	Yes	IA	Nil
N16	17/03/2022 23:17	0.7	F	35	Yes	IA	Nil
N20A	17/03/2022 22:30	0.9	F	35	Yes	IA	Nil
N21	17/03/2022 22:13	0.7	F	39	Yes	IA	Nil
N26	17/03/2022 22:03	0.8	E	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.9 $L_{A1,1minute}$ generated by WCM against project approval criteria – March 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	17/03/2022 22:39	1.1	F	48	Yes	IA	Nil
N16	17/03/2022 23:17	0.7	F	45	Yes	IA	Nil
N20A	17/03/2022 22:30	0.9	F	45	Yes	IA	Nil
N21	17/03/2022 22:13	0.7	F	49	Yes	IA	Nil
N26	17/03/2022 22:03	0.8	E	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.4 April 2022

4.4.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.10.

Table 4.10 Measured noise levels – April 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	20/04/2022 23:06	55	35	33	32	32	31	29
N16	20/04/2022 22:55	50	44	38	35	33	31	29
N20A	20/04/2022 22:26	42	34	28	25	23	22	21
N21	20/04/2022 22:38	49	36	33	32	32	31	29
N26	20/04/2022 22:00	39	32	26	25	23	22	20

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.4.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.4.3 Attended Noise Monitoring

Table 4.11 and Table 4.12 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.11 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – April 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	20/04/2022 23:06	0.6	F	38	Yes	IA	Nil
N16	20/04/2022 22:55	0.2	F	35	Yes	IA	Nil
N20A	20/04/2022 22:26	0.6	F	35	Yes	IA	Nil
N21	20/04/2022 22:38	0.5	F	39	Yes	IA	Nil
N26	20/04/2022 22:00	0.4	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.12 $L_{A1,1minute}$ generated by WCM against project approval criteria – April 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	20/04/2022 23:06	0.6	F	48	Yes	IA	Nil
N16	20/04/2022 22:55	0.2	F	45	Yes	IA	Nil
N20A	20/04/2022 22:26	0.6	F	45	Yes	IA	Nil
N21	20/04/2022 22:38	0.5	F	49	Yes	IA	Nil
N26	20/04/2022 22:00	0.4	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.5 May 2022

4.5.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.13.

Table 4.13 Measured noise levels – May 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	17/05/2022 22:53	49	38	35	33	32	30	27
N16	17/05/2022 23:16	54	41	37	35	32	30	26
N20A	17/05/2022 22:29	43	36	30	29	28	26	24
N21	17/05/2022 22:21	46	40	38	35	35	32	30
N26	17/05/2022 22:01	42	34	27	25	22	21	19

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.5.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.5.3 Attended Noise Monitoring

Table 4.14 and Table 4.15 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.14 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – May 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	17/05/2022 22:53	0.4	F	38	Yes	IA	Nil
N16	17/05/2022 23:16	0.8	E	35	Yes	IA	Nil
N20A	17/05/2022 22:29	0.6	F	35	Yes	IA	Nil
N21	17/05/2022 22:21	0.9	F	39	Yes	IA	Nil
N26	17/05/2022 22:01	0.1	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.15 $L_{A1,1minute}$ generated by WCM against project approval criteria – May 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	17/05/2022 22:53	0.4	F	48	Yes	IA	Nil
N16	17/05/2022 23:16	0.8	E	45	Yes	IA	Nil
N20A	17/05/2022 22:29	0.6	F	45	Yes	IA	Nil
N21	17/05/2022 22:21	0.9	F	49	Yes	IA	Nil
N26	17/05/2022 22:01	0.1	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.6 June 2022

4.6.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.16.

Table 4.16 Measured noise levels – June 2022[1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	30/06/2022 00:05	44	39	36	34	34	33	30
N16	29/06/2022 23:27	45	40	37	33	31	29	26
N20A	29/06/2022 22:35	43	37	32	29	26	23	21
N21	29/06/2022 23:37	44	35	33	32	32	31	28
N26	29/06/2022 22:03	40	34	30	26	24	22	19

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.6.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.6.3 Attended Noise Monitoring

Table 4.17 and Table 4.18 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.17 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – June 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	30/06/2022 00:05	0.7	E	38	Yes	IA	Nil
N16	29/06/2022 23:27	0.5	F	35	Yes	IA	Nil
N20A	29/06/2022 22:35	0.3	F	35	Yes	IA	Nil
N21	29/06/2022 23:37	0.5	F	39	Yes	IA	Nil
N26	29/06/2022 22:03	1.0	E	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.18 $L_{A1,1minute}$ generated by WCM against project approval criteria – June 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	30/06/2022 00:05	0.7	E	48	Yes	IA	Nil
N16	29/06/2022 23:27	0.5	F	45	Yes	IA	Nil
N20A	29/06/2022 22:35	0.3	F	45	Yes	IA	Nil
N21	29/06/2022 23:37	0.5	F	49	Yes	IA	Nil
N26	29/06/2022 22:03	1.0	E	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.7 July 2022

4.7.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.19.

Table 4.19 Measured noise levels – July 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	20/07/2022 23:06	45	43	40	39	38	37	35
N16	20/07/2022 23:19	49	46	44	42	41	39	37
N20A	20/07/2022 22:32	44	41	39	38	38	36	34
N21	20/07/2022 22:39	53	52	48	46	45	42	39
N26	20/07/2022 22:00	50	44	41	39	38	36	34

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.7.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.7.3 Attended Noise Monitoring

Table 4.20 and Table 4.21 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.20 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – July 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	20/07/2022 23:06	1.4	F	38	Yes	IA	Nil
N16	20/07/2022 23:19	1.6	E	35	Yes	IA	Nil
N20A	20/07/2022 22:32	0.8	F	35	Yes	IA	Nil
N21	20/07/2022 22:39	0.2	F	39	Yes	IA	Nil
N26	20/07/2022 22:00	0.8	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.21 $L_{A1,1minute}$ generated by WCM against project approval criteria – July 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	20/07/2022 23:06	1.4	F	48	Yes	IA	Nil
N16	20/07/2022 23:19	1.6	E	45	Yes	IA	Nil
N20A	20/07/2022 22:32	0.8	F	45	Yes	IA	Nil
N21	20/07/2022 22:39	0.2	F	49	Yes	IA	Nil
N26	20/07/2022 22:00	0.8	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.8 August 2022

4.8.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.22.

Table 4.22 Measured noise levels – August 2022[1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	17/08/2022 23:00	43	41	40	39	39	38	35
N16	17/08/2022 23:13	63	61	52	49	41	39	36
N20A	17/08/2022 22:26	43	39	36	34	34	32	29
N21	17/08/2022 22:29	50	49	48	46	46	44	42
N26	17/08/2022 22:00	47	39	34	32	31	28	25

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.8.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.8.3 Attended Noise Monitoring

Table 4.23 and Table 4.24 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.23 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – August 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	17/08/2022 23:00	0.2	F	38	Yes	IA	Nil
N16	17/08/2022 23:13	0.7	E	35	Yes	IA	Nil
N20A	17/08/2022 22:26	0.4	F	35	Yes	IA	Nil
N21	17/08/2022 22:29	0.4	F	39	Yes	IA	Nil
N26	17/08/2022 22:00	0.8	E	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.24 $L_{A1,1minute}$ generated by WCM against project approval criteria – August 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	17/08/2022 23:00	0.2	F	48	Yes	IA	Nil
N16	17/08/2022 23:13	0.7	E	45	Yes	IA	Nil
N20A	17/08/2022 22:26	0.4	F	45	Yes	IA	Nil
N21	17/08/2022 22:29	0.4	F	49	Yes	IA	Nil
N26	17/08/2022 22:00	0.8	E	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.9 September 2022

4.9.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.25.

Table 4.25 Measured noise levels – September 2022[1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	20/09/2022 00:38	47	39	37	35	35	33	31
N16	19/09/2022 23:16	52	46	43	40	39	37	34
N20A	19/09/2022 22:30	45	43	41	40	39	37	35
N21	20/09/2022 00:09	48	42	38	36	36	34	31
N26	19/09/2022 22:00	55	50	48	46	45	44	41

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.9.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.9.3 Attended Noise Monitoring

Table 4.26 and Table 4.27 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.26 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – September 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	20/09/2022 00:38	0.1	F	38	Yes	IA	Nil
N16	19/09/2022 23:16	0.5	F	35	Yes	IA	Nil
N20A	19/09/2022 22:30	0.3	F	35	Yes	IA	Nil
N21	20/09/2022 00:09	0.7	E	39	Yes	IA	Nil
N26	19/09/2022 22:00	0.8	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.27 $L_{A1,1minute}$ generated by WCM against project approval criteria – September 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	20/09/2022 00:38	0.1	F	48	Yes	IA	Nil
N16	19/09/2022 23:16	0.5	F	45	Yes	IA	Nil
N20A	19/09/2022 22:30	0.3	F	45	Yes	IA	Nil
N21	20/09/2022 00:09	0.7	E	49	Yes	IA	Nil
N26	19/09/2022 22:00	0.8	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.10 October 2022

4.10.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.28.

Table 4.28 Measured noise levels – October 2022 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	13/10/2022 23:43	63	58	49	49	48	47	46
N16	13/10/2022 23:51	55	53	52	51	51	50	47
N20A	13/10/2022 22:55	46	44	42	41	41	40	39
N21	13/10/2022 23:18	59	59	58	56	56	53	49
N26	13/10/2022 22:21	51	49	48	46	46	45	42

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.10.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.10.3 Attended Noise Monitoring

Table 4.29 and Table 4.30 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.29 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – October 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	13/10/2022 23:43	1.0	D	38	Yes	IA	Nil
N16	13/10/2022 23:51	1.0	D	35	Yes	IA	Nil
N20A	13/10/2022 22:55	1.1	D	35	Yes	IA	Nil
N21	13/10/2022 23:18	1.2	E	39	Yes	IA	Nil
N26	13/10/2022 22:21	1.5	E	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.30 $L_{A1,1minute}$ **generated by WCM against project approval criteria – October 2022**

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	13/10/2022 23:43	1.0	D	48	Yes	IA	Nil
N16	13/10/2022 23:51	1.0	D	45	Yes	IA	Nil
N20A	13/10/2022 22:55	1.1	D	45	Yes	IA	Nil
N21	13/10/2022 23:18	1.2	E	49	Yes	IA	Nil
N26	13/10/2022 22:21	1.5	E	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.11 November 2022

4.11.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.31.

Table 4.31 **Measured noise levels – November 2022[1]**

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	04/11/2022 00:37	42	37	36	34	34	32	30
N16	03/11/2022 23:18	46	42	40	38	38	36	34
N20A	03/11/2022 22:30	46	40	36	35	34	33	30
N21	03/11/2022 23:36	52	43	32	33	30	29	27
N26	03/11/2022 22:00	43	39	37	35	35	34	32

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.11.2 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.11.3 Attended Noise Monitoring

Table 4.32 and Table 4.33 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.32 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – November 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class 1	Criterion dB	Criterion Applies? 2	WCM L_{Aeq} dB 3,4	Exceedance dB4,5
N01	04/11/2022 00:37	2.0	E	38	Yes	IA	Nil
N16	03/11/2022 23:18	1.3	D	35	Yes	IA	Nil
N20A	03/11/2022 22:30	1.3	E	35	Yes	IA	Nil
N21	03/11/2022 23:36	0.9	F	39	Yes	IA	Nil
N26	03/11/2022 22:00	1.2	F	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.33 $L_{A1,1minute}$ generated by WCM against project approval criteria – November 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class 1	Criterion dB	Criterion Applies? 2	WCM $L_{A1,1min}$ dB 3,4	Exceedance dB 4,5
N01	04/11/2022 00:37	2.0	E	48	Yes	IA	Nil
N16	03/11/2022 23:18	1.3	D	45	Yes	IA	Nil
N20A	03/11/2022 22:30	1.3	E	45	Yes	IA	Nil
N21	03/11/2022 23:36	0.9	F	49	Yes	IA	Nil
N26	03/11/2022 22:00	1.2	F	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

4.12 December 2022

4.12.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.34.

Table 4.34 Measured noise levels – December 2022[1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	1/12/2022 22:49	44	35	34	32	32	30	28
N16	1/12/2022 23:39	45	42	37	35	34	32	30
N20A	1/12/2022 22:08	53	42	40	39	39	37	32
N21	1/12/2022 22:22	43	34	32	30	30	29	26
N26	1/12/2022 22:38	48	47	46	45	45	43	40

Notes: 1. Levels in this table are not necessarily the result of activity at WCM or WCRS.

4.13 Modifying Factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.14 Attended Noise Monitoring

Table 4.35 and Table 4.36 detail noise levels from WCM in the absence of other noise sources. Noise criteria are applicable if weather conditions during the measurement were within parameters outlined in the WCM development consent.

Table 4.35 $L_{Aeq,15minute}$ generated by WCM against project approval criteria – December 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM L_{Aeq} dB [3,4]	Exceedance dB[4,5]
N01	1/12/2022 22:49	1.0	E	38	Yes	IA	Nil
N16	1/12/2022 23:39	0.9	E	35	Yes	IA	Nil
N20A	1/12/2022 22:08	1.4	F	35	Yes	IA	Nil
N21	1/12/2022 22:22	1.3	E	39	Yes	IA	Nil
N26	1/12/2022 22:38	1.2	E	35	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{Aeq,15minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

Table 4.36 $L_{A1,1minute}$ generated by WCM against project approval criteria – December 2022

Location	Start Date and Time	Wind Speed m/s	Stability Class [1]	Criterion dB	Criterion Applies? [2]	WCM $L_{A1,1min}$ dB [3,4]	Exceedance dB [4,5]
N01	1/12/2022 22:49	1.0	E	48	Yes	IA	Nil
N16	1/12/2022 23:39	0.9	E	45	Yes	IA	Nil
N20A	1/12/2022 22:08	1.4	F	45	Yes	IA	Nil
N21	1/12/2022 22:22	1.3	E	49	Yes	IA	Nil
N26	1/12/2022 22:38	1.2	E	45	Yes	IA	Nil

Notes: 1. Stability Class calculated using sigma theta method provided by NPfI.

2. Noise emission limits identified in the above table apply under all meteorological conditions except wind speeds greater than 3 m/s at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level, or stability category G temperature inversion conditions.

3. Site only $L_{A1,1minute}$ attributed to WCM, including modifying factors if applicable.

4. Bold results in red indicate an exceedance of relevant criterion.

5. NA in exceedance column means atmospheric conditions outside conditions specified in development consent, therefore criterion was not applicable, or there is no applicable criterion.

5 Long term noise trends

Site-only L_{Aeq} noise levels measured during monthly attended environmental noise monitoring over a 5-year period from January 2018 to December 2022 have been collated and graphed to summarise WCM long-term noise performance. Less than five years of data was available at three locations due to monitoring commencing at those locations during the 5-year period.

Due to the qualitative nature of some attended noise monitoring descriptors, calculation of site noise statistics such as mean, median, and standard deviation is not always possible. Subsequently, site-only L_{Aeq} noise levels for each monitoring event have been grouped into one of three categories:

- WCM only L_{Aeq} was either inaudible (IA), not measurable (NM), or less than 30 dB, which together are represented by green bars;
- WCM only L_{Aeq} was between 30 dB and the relevant noise criteria for that location (inclusive) represented by blue bars; or
- WCP only L_{Aeq} was greater than the relevant noise criteria for that location, represented by red bars.

For each calendar year, the percentage of occurrence for each of these categories is shown, as well as annual trend lines over the entire five-year period. Figures show site only L_{Aeq} noise levels, including adjustments due to modifying factors, as defined by the EPA NPfI.

Meteorological conditions and applicability of noise criteria have not been considered.

5.1 Noise trend graphs

Site only L_{Aeq} noise levels measured during attended environmental noise monitoring over a 5-year period have been collated and graphed to summarise long-term noise trends. Figure 5.1 to Figure 5.5 provide percentage occurrence information for WCM noise levels at eight monitoring locations.

As meteorological conditions and applicability of noise criteria have not been considered in long-term trend analysis, potential exceedances indicated in the following graphs may not have been applicable depending on weather conditions at the time of monitoring.

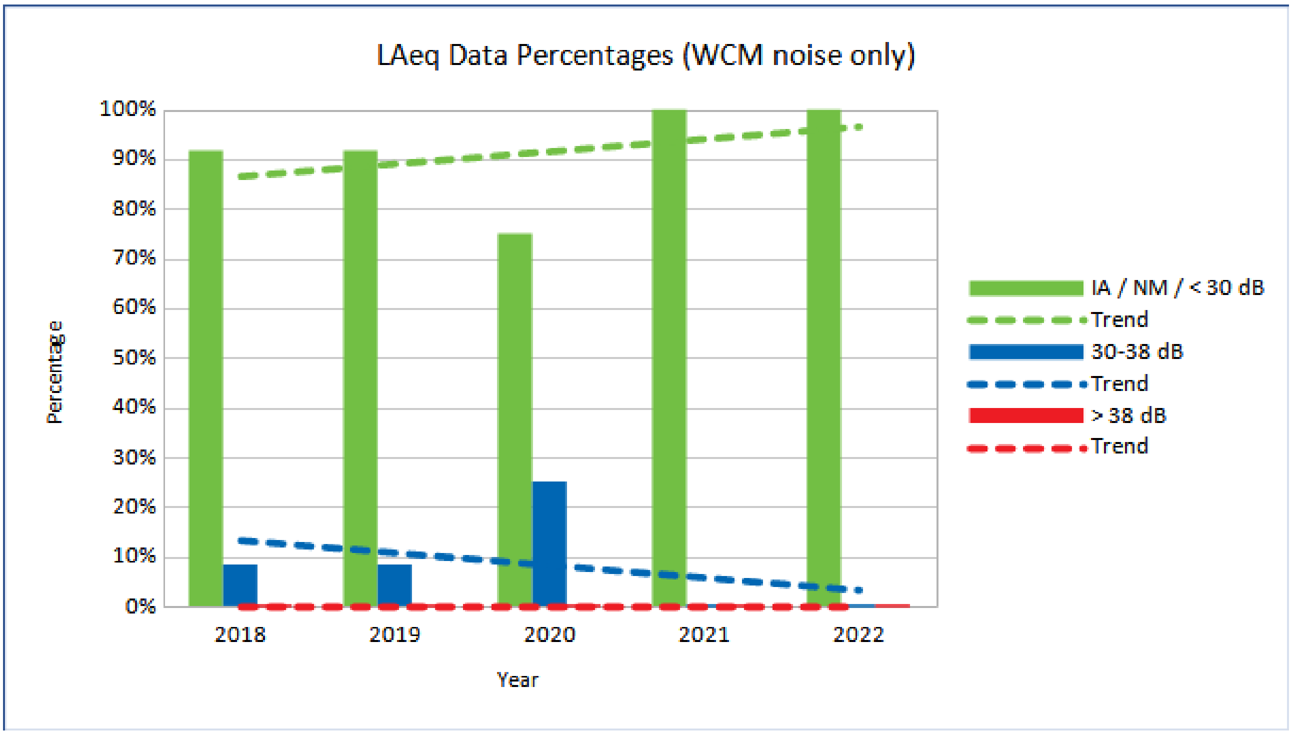

Figure 5.1 Attended noise monitoring data, N01

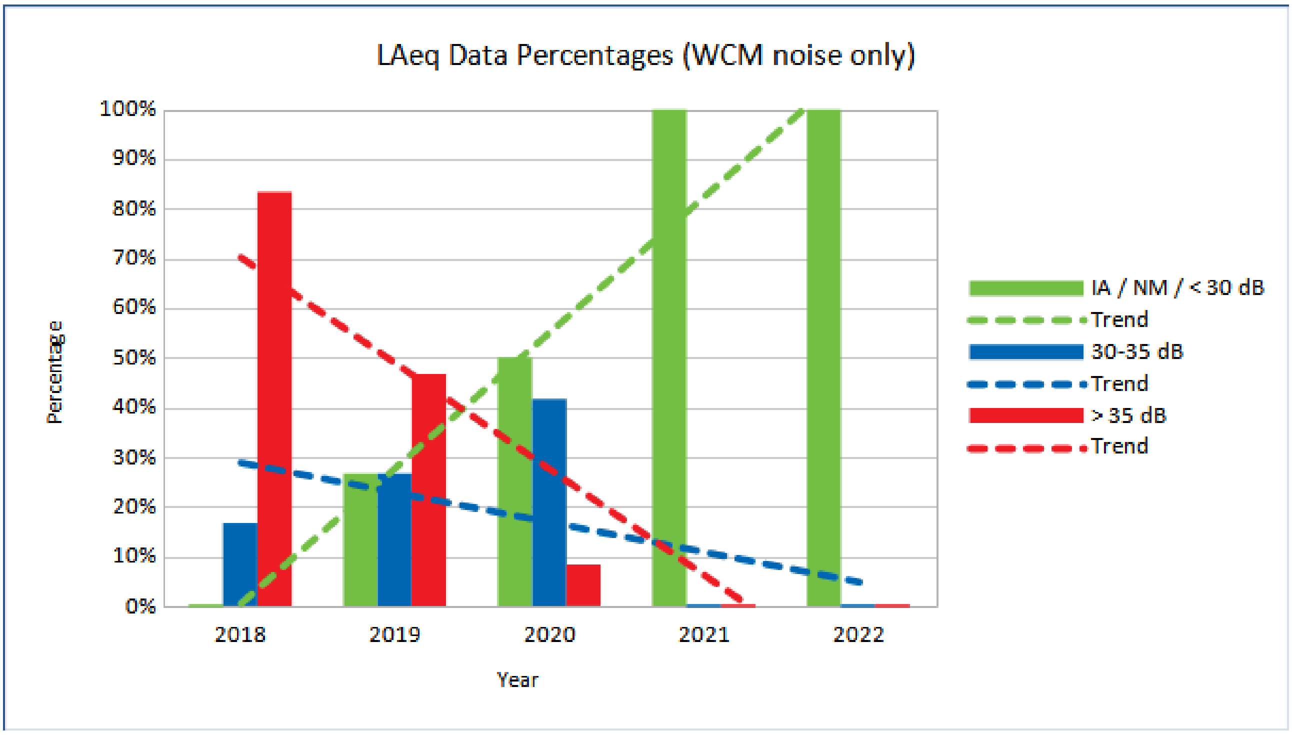

Figure 5.2 Attended noise monitoring data, N16

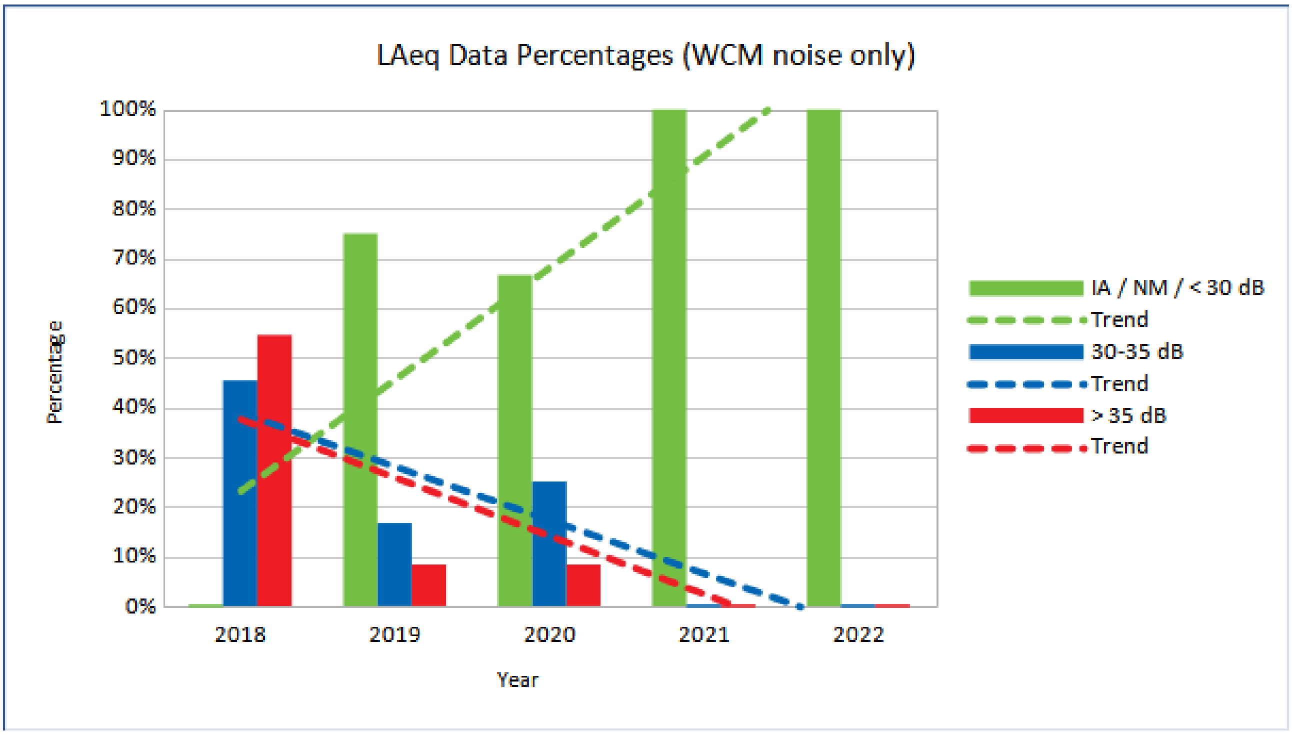

Figure 5.3 Attended noise monitoring data, N20A

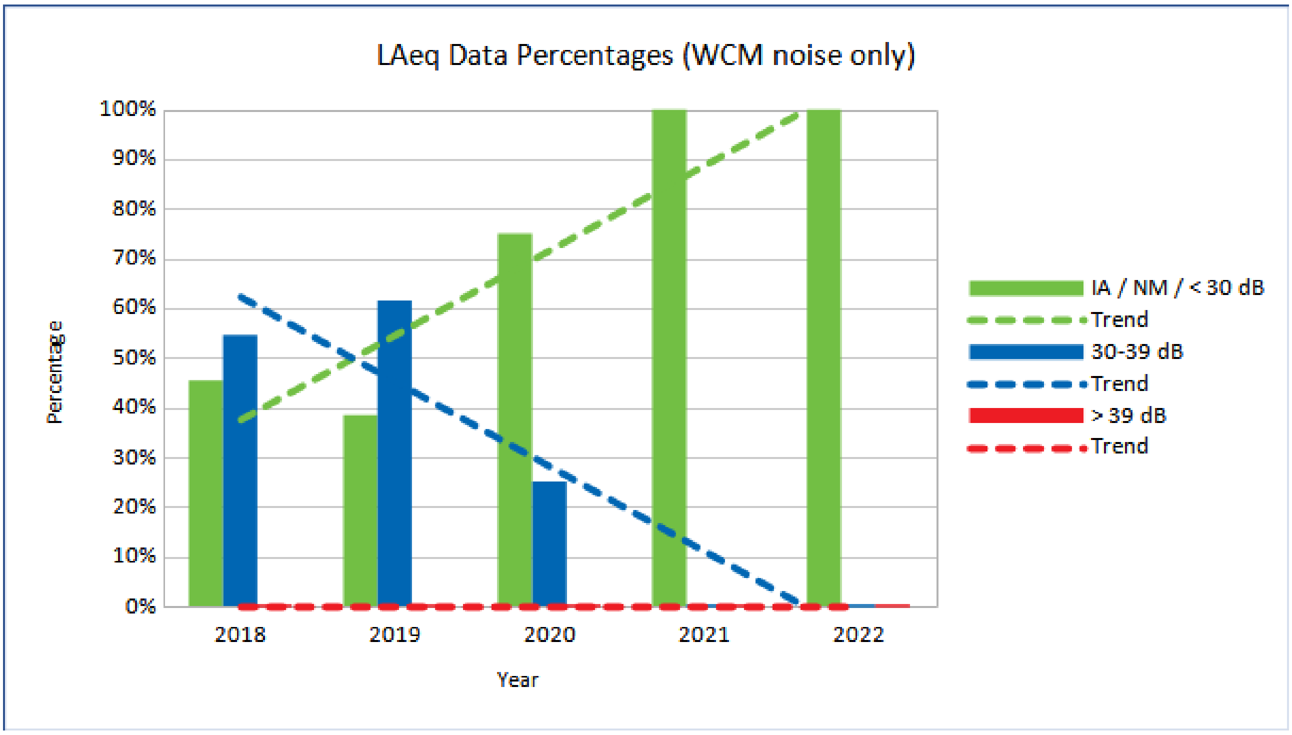

Figure 5.4 Attended noise monitoring data, N21

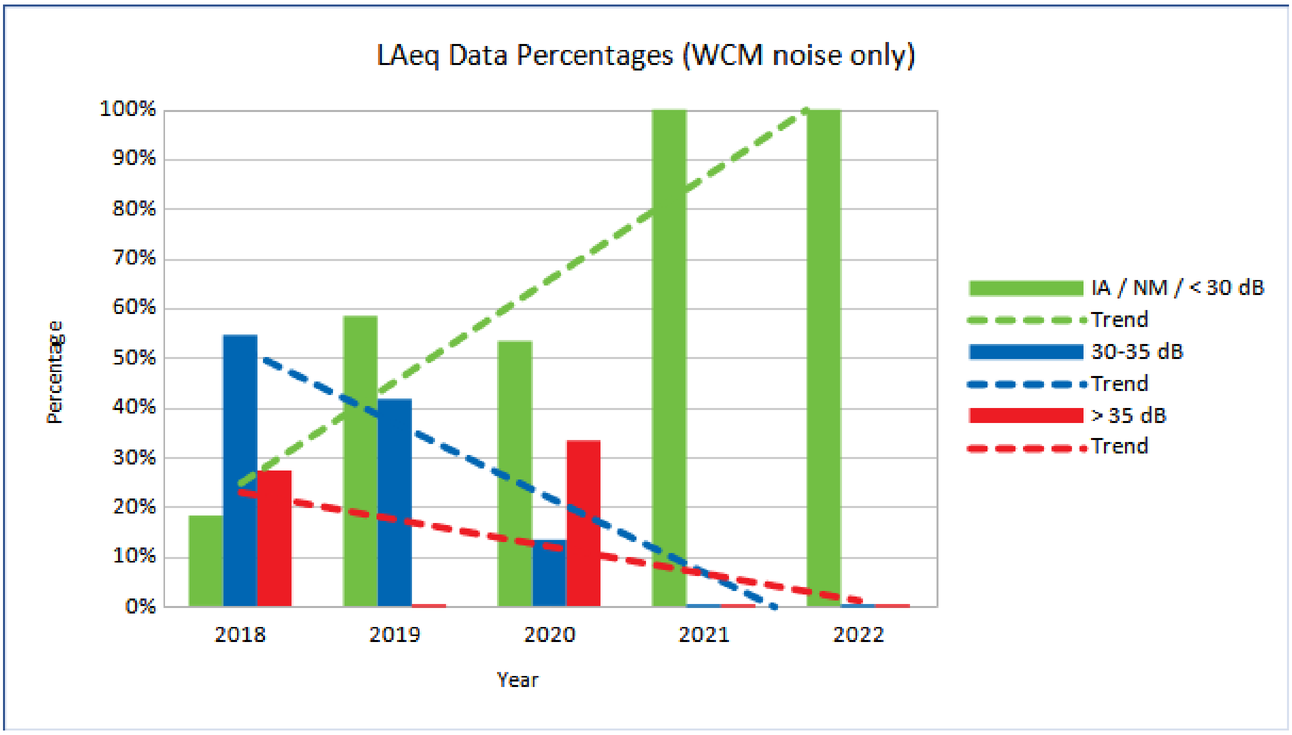

Figure 5.5 Attended noise monitoring data, N26

5.2 Discussion

During the 5-year period analysed, WCM noise levels at most monitoring locations have decreased from 2018 to 2020, likely due to mining activity being deeper in pit and therefore more shielded from receptors.

From 1 December 2020, open cut mining was no longer undertaken by WCM and noise emissions decreased significantly.

6 Summary

Global Acoustics (now part of EMM) was engaged by WC to provide an AEMR for 2022 to compare noise monitoring results against relevant criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around WCM during the reporting period 1 January to 31 December 2022. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

Attended noise monitoring described in this report was conducted monthly in accordance with the relevant development consents, EPL, and the WCM NMP.

6.1 January to December 2022 Compliance

Noise levels from WCM were inaudible at all receivers during 2022 noise monitoring. No modifying factors were applicable to WCM operations. WCM complied with relevant noise criteria during all measurements during 2022 noise monitoring.

6.2 Long-Term Noise Trends

During the 5-year period analysed, WCM noise levels at most monitoring locations decreased from 2018 to 2020, likely due to mining activity being deeper in pit and therefore more shielded from receptors. From 1 December 2020, open cut mining was no longer undertaken by WCM, and noise emissions decreased significantly.

6.3 EIS Comparison

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by UW as part of the UWJV. UW was solely responsible for noise emissions from UWJV during 2022 noise surveys.

Noise levels from WCM were inaudible at all receivers during all of 2022 noise monitoring. Subsequently, comparison of measured WCM noise levels against EIS noise model predictions was not possible. Additional information is provided in Section 3.5 of this report.

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APPENDIX D

ANNUAL AIR QUALITY MONITORING REPORT

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2 March 2023

Attention: James Benson
Wambo Coal Pty Ltd
PMB 1, Singleton NSW 2330

Project number: 22014

Dear James

Review of 2022 air quality monitoring data

I have completed a review of the Wambo Mine air quality monitoring data for 2022. Please see attached for the outcomes.

In summary, it has been concluded that Wambo Coal Pty Ltd was in compliance with its development consent in terms of all relevant air quality indicators in 2022.

Yours sincerely

Shane Lakmaker
Director / Atmospheric Scientist
Airen Consulting

1. Background

The Wambo Mine is Ltd owned and operated by Wambo Coal Pty (Wambo Coal), a subsidiary of Peabody Energy Australia Pty Limited (Peabody). Mining is carried out under Development Consent DA 305-7-2003 as modified. The latest modification to DA 305-7-2003 (Mod 19) permits underground mining, operation of Wambo Mine infrastructure and associated surface development; collectively referred to as Phase 2 under DA 305-7-2003.

Wambo Coal has a network of air quality and meteorological monitoring equipment around the Wambo Mine which is designed to meet relevant conditions of DA 305-7-2003.

Figure 1 shows the meteorological and air quality monitoring network. This network includes:

- One (1) meteorological station referred to as M6.
- Four (4) tapered element oscillating microbalances (TEOM) measuring PM_{10}. Compliance is determined at AQ05 (D5 Kelly formerly AQ01), AQ02 (D2 Caban), AQ03 (D4 Thelander) and AQ04 (D1 Muller).
- Two (2) tapered element oscillating microbalances (TEOM) measuring $PM_{2.5}$. Compliance is determined at AQ05 (D5 Kelly formerly AQ01) and AQ03 (D4 Thelander).

A review of the air quality monitoring data collected in 2022 has been carried out. The main purpose of the review was to determine whether Wambo Coal had complied with the criteria specified in the development consent (DA 305-7-2003). Table 1 shows the relevant development consent criteria.

Table 1 Development consent criteria

Indicator	Averaging period	Criterion
Particulate matter (PM_{10})	24 hour	[b] 50 µg/m³
	Annual	[a,c] 25 µg/m³
Particulate matter ($PM_{2.5}$)	24 hour	[b] 25 µg/m³
	Annual	[a,c] 8 µg/m³
Particulate matter (TSP)	Annual	[a,c] 90 µg/m³

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own).

[c] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.

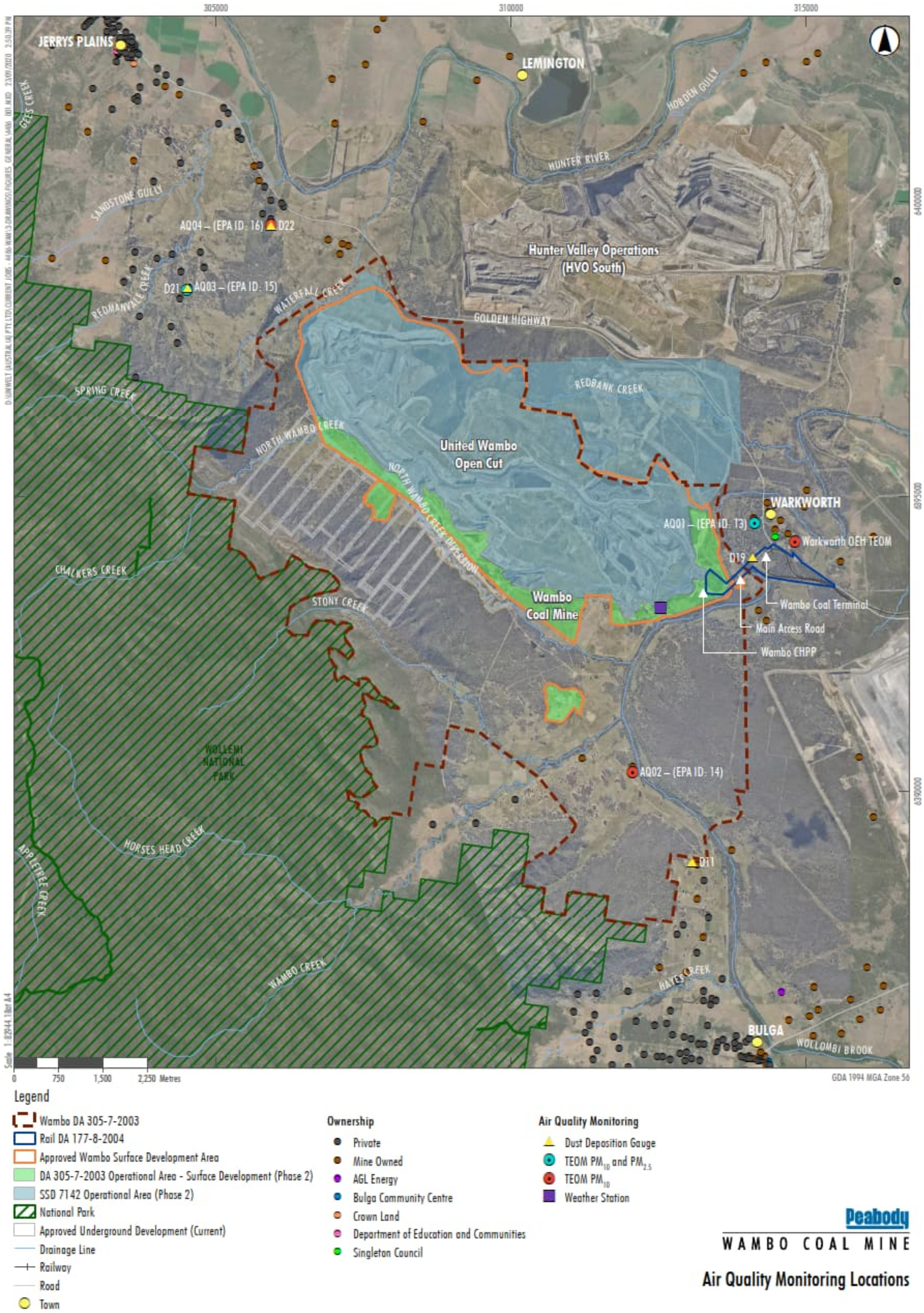

Figure 1 Location of air quality and meteorological monitoring sites

2. Approach to Review

2.1 Extraordinary Events

The Department of Planning and Environment (DPE) has historically identified extraordinary events that are relevant to the Hunter Valley based on the Upper Hunter Air Quality Monitoring Network as well as other factors such as bushfires and dust storms. For example, in 2020 the DPE identified 24 days as extraordinary events. The DPE did not identify any “extraordinary event” days in 2022.

2.2 Particulate Matter (as PM_{10})

Evaluation of PM_{10} involved:

- Obtaining hourly average PM_{10} concentration data from all monitoring sites for 2022 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from the Wambo Mine weather station for 2022 and calculating the contributions from the direction of Wambo Mine to each hourly PM_{10} concentration result.
- Summarising all monitored PM_{10} concentration data and estimated contributions from the direction of Wambo Mine, and making comparisons to the consent criteria.

There is no standard prescribed methodology for determining contributions to air quality from mining operations. The methodology described below is based on the use of concurrent hourly meteorological and air quality monitoring data from suitably located monitoring stations around the mine site to estimate the potential contribution from the direction of the mining operation. This method is referred to as an “upwind / downwind” calculation approach. In this context, “upwind” is a location that collects data representative of background conditions, not influenced by the source of interest, and does not necessarily need to be upwind of the source of interest.

The maximum contributions from the direction of Wambo Mine to each measured hourly average result was calculated by first determining the wind direction ranges which represented a wind from the direction of Wambo Mine towards the monitor. Table 2 shows the wind direction ranges that represented the direction to Wambo Mine from each monitor.

Table 2 Wind directions to Wambo Mine for PM_{10} contribution calculations

Monitor	Direction to Wambo Mine
D1 Muller	Between 130 and 180 degrees from true north
D2 Caban	Between 320 and 10 degrees from true north
D5 Kelly	Between 255 and 300 degrees from true north
D4 Thelander	Between 110 and 140 degrees from true north

The potential contribution from the direction of Wambo Mine to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a “monitor” concentration minus “background” concentration calculation. Table 3 shows the data representing “monitor” and “background” conditions for each monitoring site. The “monitor” concentration minus “background” concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 3 Data for monitor and background PM_{10} calculations

Monitor	Data representing “background” conditions
D1 Muller	D2 Caban
D2 Caban	D1 Muller

Monitor	Data representing “background” conditions
D5 Kelly	D4 Thelander
D4 Thelander	D5 Kelly

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.3 Particulate Matter (as $PM_{2.5}$)

Evaluation of $PM_{2.5}$ involved:

- Obtaining hourly average $PM_{2.5}$ concentration data from all monitoring sites for 2022 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from the Wambo Mine weather station for 2022 and calculating the contributions from the direction of Wambo Mine to each hourly $PM_{2.5}$ concentration result.
- Summarising all monitored $PM_{2.5}$ concentration data and estimated contributions from the direction of Wambo Mine, and making comparisons to the consent criteria.

The maximum contributions from the direction of the Wambo Mine to each measured hourly average result was calculated in the same manner as for the calculated PM_{10} contributions, as described in Section 2.2. Table 4 shows the wind direction ranges that represented the direction to Wambo Mine from each monitor.

Table 4 Wind directions to Wambo mine for $PM_{2.5}$ contribution calculations

Monitor	Direction to Wambo Mine
D5 Kelly	Between 255 and 300 degrees from true north
D4 Thelander	Between 110 and 140 degrees from true north

The potential contribution from the direction of Wambo Mine to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a “monitor” concentration minus “background” concentration calculation. Table 5 shows the data representing “monitor” and “background” conditions for each monitoring site. The “monitor” concentration minus “background” concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 5 Data for monitor and background $PM_{2.5}$ calculations

Monitor	Data representing “background” conditions
D5 Kelly	D4 Thelander
D4 Thelander	D5 Kelly

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.4 Particulate Matter (as TSP)

TSP concentrations were estimated from the measured PM_{10} concentrations assuming that PM_{10} concentrations were 33% of the TSP concentrations, in accordance with the approved Air Quality and Greenhouse Gas Management Plan (Peabody, 2020).

3. Monitoring Results

3.1 Meteorology

Meteorological conditions are important for determining the transport of emissions, and the potential influences on air quality. Rainfall can influence air quality conditions, particularly dust. Figure 2 shows the rainfall data collected by Wambo Coal in the past eight years. Rainfall was well below the long-term average (698 mm) in 2017, 2018 and 2019, coinciding with drought, but exceeded the long-term average in 2020, 2021 and 2022.

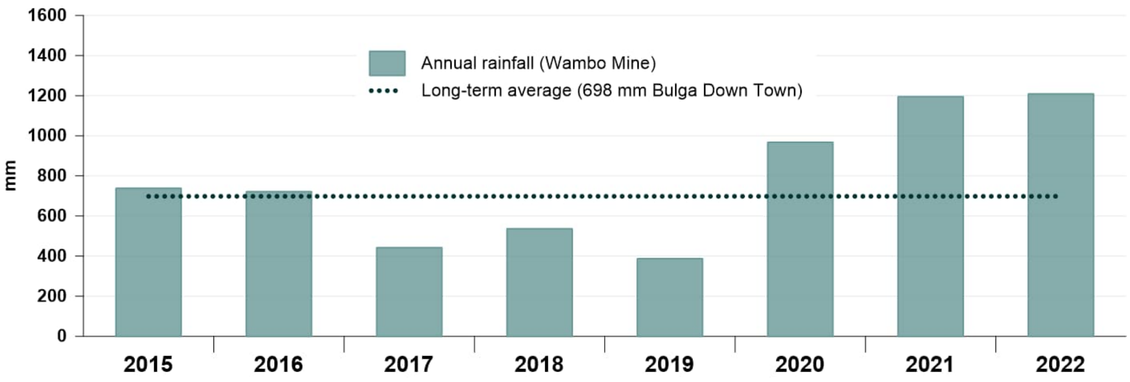

Figure 2 Annual rainfall

Wind-roses have been prepared to summarise the wind speed and wind direction data that were collected in 2022. The wind-roses (Figure 3) show the frequency of wind speeds and wind directions based on hourly records for each location. The circular format of the wind rose shows the direction from which the wind blew and the length of each "spoke" around the circle shows how often the wind blew from that direction. The different colours of each spoke provide details on the speed of the wind from each direction.

It can be seen from Figure 3 that winds in 2022 were from the southeast and northwest. This pattern of winds is common for many parts of the Hunter Valley and reflects the northwest-southeast alignment of the valley.

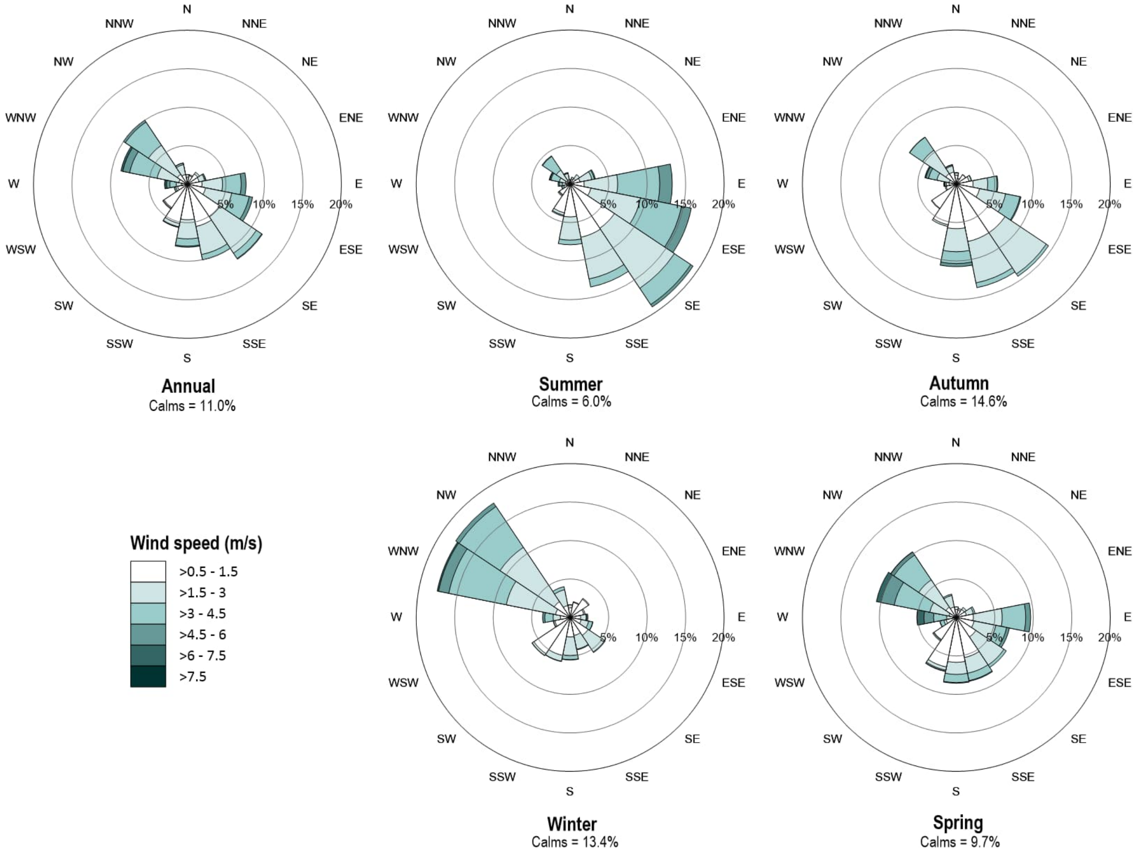

Figure 3 Annual wind-roses from data collected at Wambo Mine in 2022

3.2 Particulate Matter (as PM_{10})

Figure 4 shows the measured 24-hour average PM_{10} concentrations in 2022 from data collected at each compliance monitor. The calculated contributions from the direction of Wambo Mine to each monitoring location have been identified as per the methodology described in Section 2. The contribution from the direction of Wambo Mine is reported in order to assess compliance as the 24-hour average PM_{10} criteria from DA 305-7-2003 relate to an “incremental impact”.

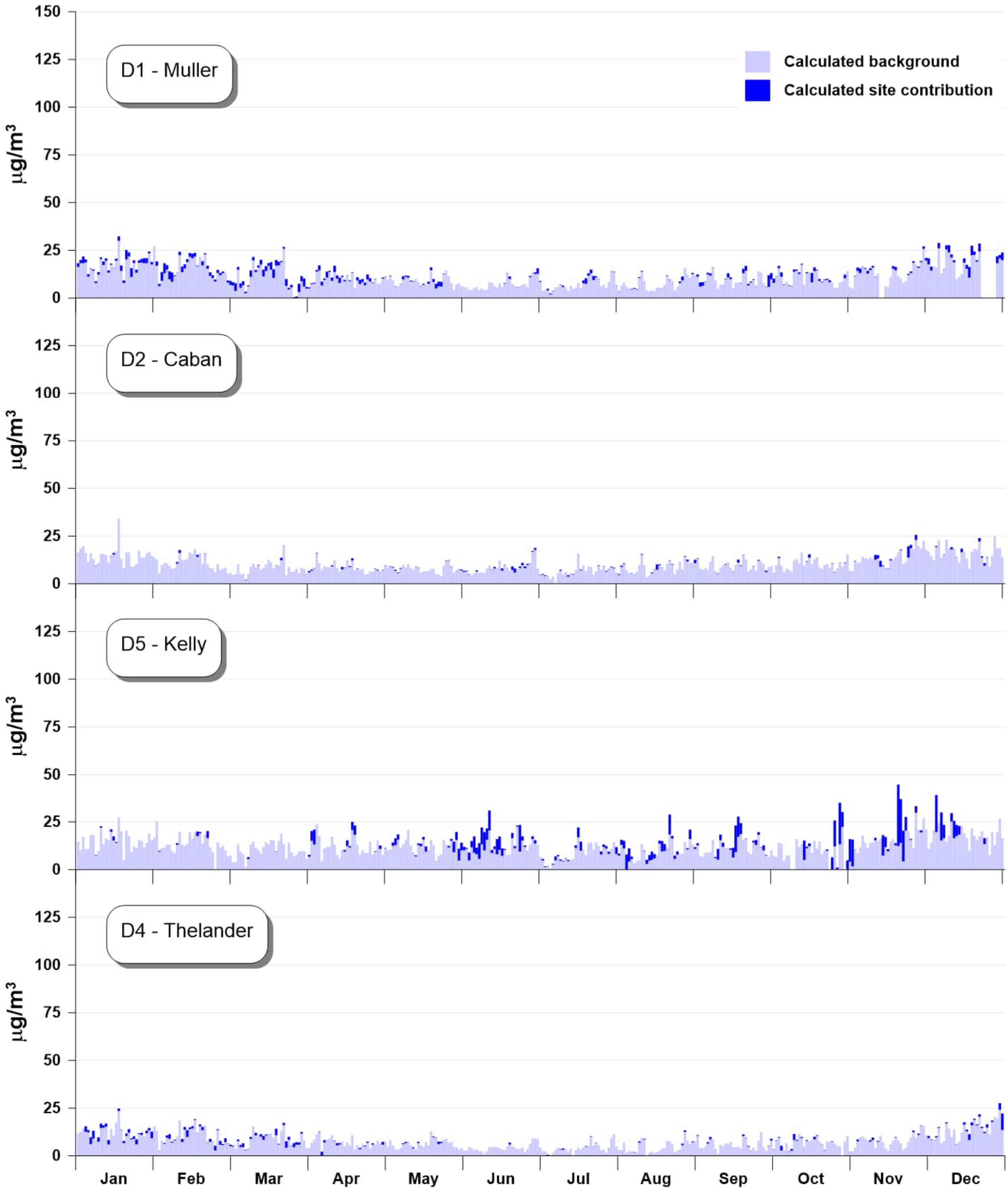

Figure 4 Measured 24-hour average PM_{10} concentrations at Wambo Mine monitors in 2022

Table 6 summarises the measured PM_{10} concentrations. The results have been calculated without extraordinary events (although it is noted that no extraordinary events were identified in 2022). The data in Table 6 show that the PM_{10} concentrations at all monitors were below the 24-hour and annual average criteria. Consequently, the monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as PM_{10}.

Table 6 Summary of PM_{10} concentrations from Wambo Mine monitors in 2022

Statistic	D1	D2	D5	D4	Criterion
Measured maximum 24-hour average due to all sources (µg/m³)	32.3	34.0	44.8	27.6	NA
Calculated maximum 24-hour average due to Wambo Mine (µg/m³)	6.1	5.8	32.4	8.6	50
Measured annual average due to all sources (µg/m³)	12.0	10.4	13.8	7.9	25
Calculated annual average due to Wambo Mine (µg/m³)	1.0	0.2	1.7	0.5	NA

3.3 Particulate Matter (as $PM_{2.5}$)

Figure 5 shows the measured 24-hour average $PM_{2.5}$ concentrations in 2022 from data collected at each compliance monitor. The calculated contribution from the direction of Wambo Mine to each monitoring location is also shown as per the methodology described in Section 2. The contribution from the direction of Wambo Mine is reported in order to assess compliance as the 24-hour average $PM_{2.5}$ criteria from DA 305-7-2003 relate to an "incremental impact".

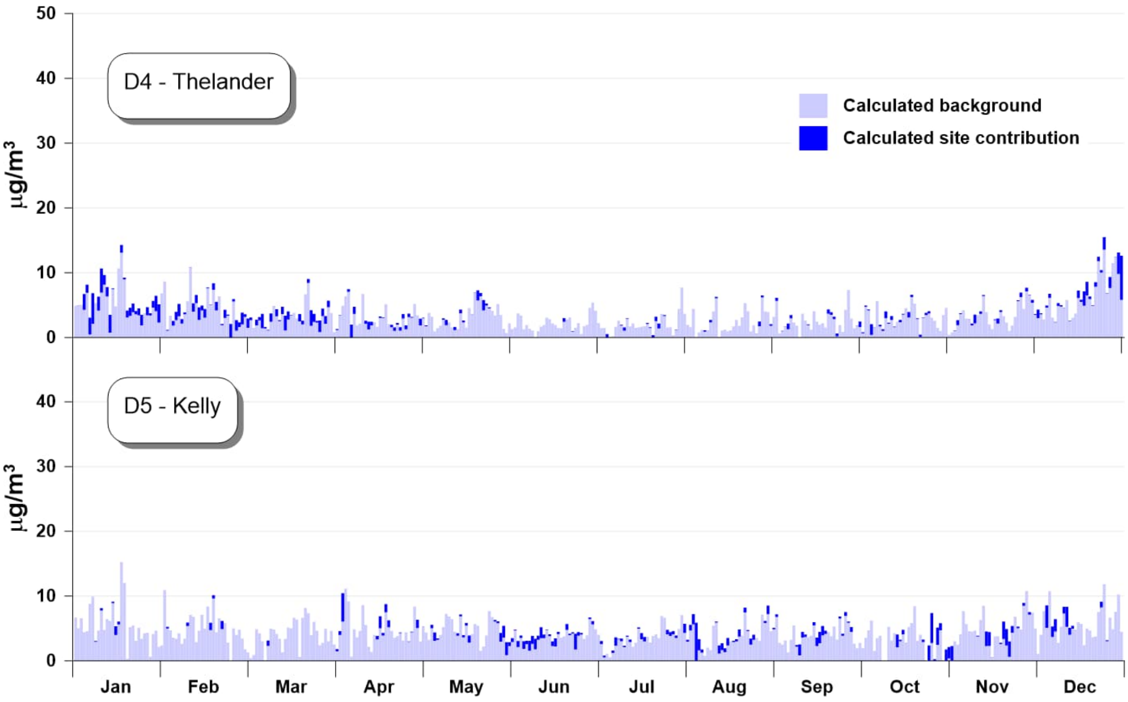

Figure 5 Measured 24-hour average $PM_{2.5}$ concentrations at Wambo Mine monitors in 2022

Table 7 summarises the measured $PM_{2.5}$ concentrations. The data in Table 7 show that the $PM_{2.5}$ concentrations were below the 24-hour and annual average criteria. Consequently, the monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as $PM_{2.5}$.

Table 7 Summary of $PM_{2.5}$ concentrations from Wambo Mine monitors in 2022

Statistic	D5	D4	Criterion
Measured maximum 24-hour average due to all sources (µg/m^3)	15.3	15.5	NA
Calculated maximum 24-hour average due to Wambo Mine (µg/m^3)	5.9	6.8	25
Measured annual average due to all sources (µg/m^3)	4.7	3.6	8
Calculated annual average due to Wambo Mine (µg/m^3)	0.4	0.4	NA

3.4 Particulate Matter (as TSP)

Table 8 shows the estimated annual average TSP concentrations based on the measured PM_{10} data in 2022. The data show that the estimated TSP concentrations were below 90 µg/m^3. These results therefore demonstrate compliance with the development consent in terms of particulate matter as TSP.

Table 8 Summary of TSP concentrations from Wambo Mine monitors in 2022

Statistic	D1	D2	D5	D4	Criterion
Estimated annual average due to all sources (µg/m^3)	36.3	31.6	41.9	23.8	90

4. Conclusions

A review of the Wambo Mine air quality monitoring data from 2022 has been completed. Based on the review it has been concluded that Wambo Coal complied with its development consent (DA 305-7-2003) in terms of air quality impacts at all reportable monitoring sites for data collected in 2022.

5. Reference

Peabody (2020) “Air quality and greenhouse gas management plan”. Document No. WA-ENV-MNP-508. November 2020.

Appendix A Historical summary of air quality around Wambo Mine

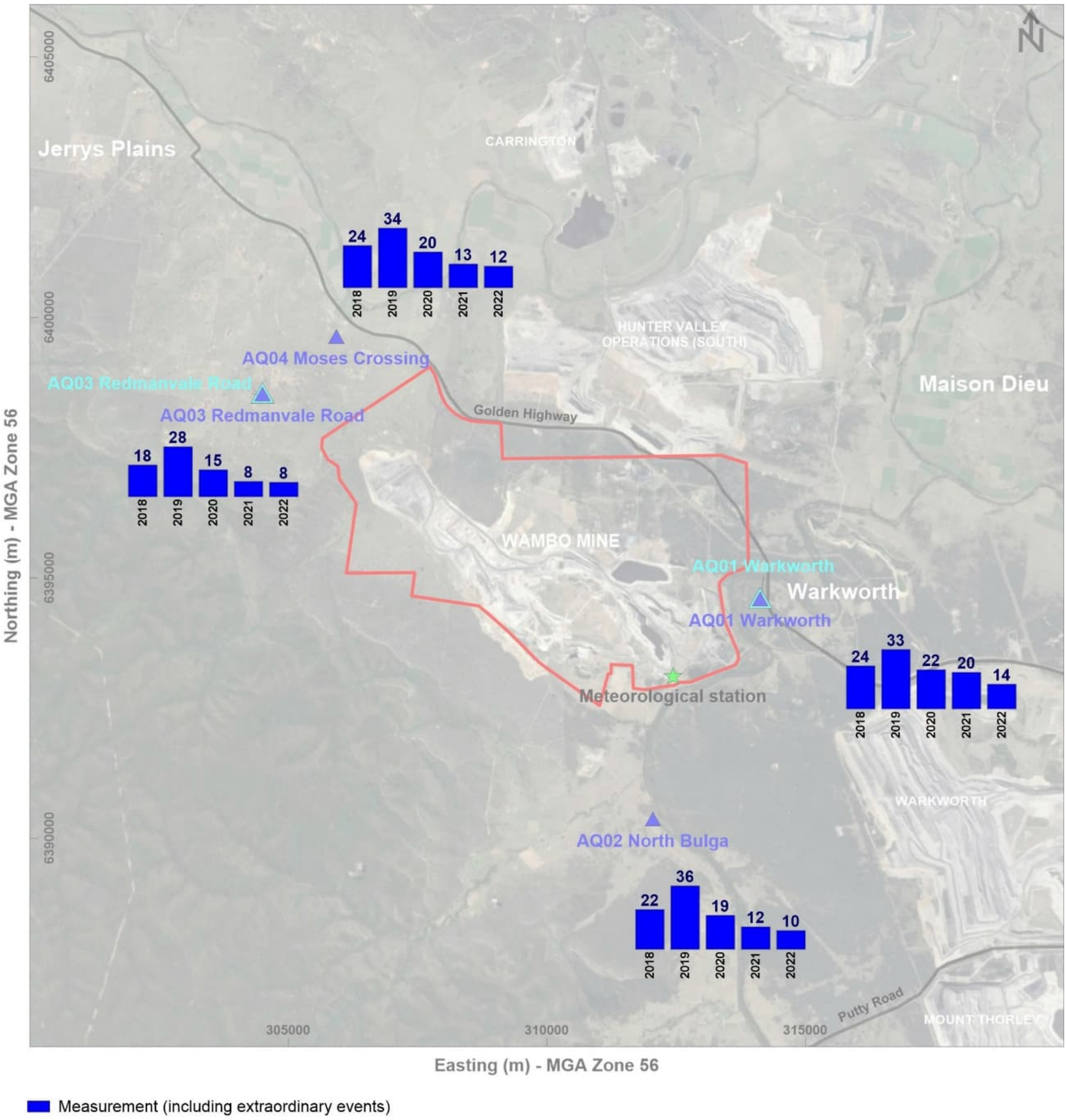

Figure A1 Annual average PM_{10} concentrations at Wambo Mine monitors from 2018 to 2022 ($\mu g/m^3$)

APPENDIX E

ANNUAL FLORA AND FAUNA MONITORING REPORT

Wambo Coal Mine Annual Flora and Fauna Monitoring Report 2022 – Volume 1

Wambo Coal Pty Ltd

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DOCUMENT TRACKING

Project Name	Wambo Coal Mine Annual Flora and Fauna Monitoring Report 2022 – Volume 1
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Abbreviations

Abbreviation	Description
AEMR	Annual Environmental Management Report
BC Act	NSW Biodiversity Conservation Act 2016
BS	Bare soil cover
BOA	Biodiversity Offset Area
BMP	Biodiversity Management Plan
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
DBH	Diameter at Breast Height
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Federal Environment Protection and Biodiversity Conservation Act 1999
EPC	Exotic Plant Cover
FL	The length of Fallen Logs >10 cm diameter
GDE	Groundwater Dependent Ecosystem
HBT	Hollow-bearing Tree
INFI	Infiltration Index
LFA	Landscape Function Analysis
LI	Leaf litter cover
LOI	Landscape Organisation Index
NGCG	Native Ground Cover - Grasses

Abbreviation	Description
NGCO	Native Ground Cover - Other
NGCS	Native Ground Cover - Shrubs
NI	Nutrient Index
NMS	Native Mid-storey Cover – the projected native foliage cover of mid-storey (%)
NOS	Native Overstorey – the projected native foliage cover of canopy (%)
NPS	The number of Native Plant Species
OEH	NSW Office of Environment and Heritage
OR	Overstorey Regeneration
PCT	Plant Community Type
RWEA	Remnant Woodland Enhancement Area
RWEP	Remnant Woodland Enhancement Program
SI	Stability Index
SSA	Soil Surface Assessment
TEC	Threatened Ecological Community
VCA	Voluntary Conservation Area
WCPL	Wambo Coal Pty Ltd
WONS	Weed of National Significance

Executive Summary

The Wambo Coal Mine annual flora and fauna monitoring program was undertaken by Eco Logical Australia (ELA) in 2022. Floristic surveys, bird surveys, Landscape Function Analysis (LFA) and riparian condition surveys were conducted during Spring across both remnant woodland, general surface and rehabilitation areas. Nest box monitoring was conducted in 2022, however winter bird surveys were not undertaken as scheduled and have been postponed until winter 2023, due to high rainfall leading to inaccessible track conditions.

Remnant woodland sites within Remnant Woodland Enhancement Area (RWEA) areas are generally performing well. Overall, native flora species diversity and native ground cover remains high, likely in response to the above average rainfall in the past three years.

High exotic cover was recorded in RWEA A and RWEA Rail Loop within the Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area community and in the River Red Gum / River Oak riparian woodland community. The recorded levels failed to meet the performance criteria and Voluntary Conservation Area (VCA) targets at several sites. Key exotic species in these zones are *Melinis repens*, *Bryophyllum* sp., *Eragrostis curvula*, and *Ehrharta erecta*.

Floristic and bird monitoring sites established in 2020 in the South Bates Extension underground mine area, including reference sites outside of the mining area were monitored for the second year. Vegetation and bird communities were recorded in good condition and no significant impacts to floristic attributes or bird communities were observed at sites within areas impacted by undermining to date.

The *Melaleuca decora* low forest Groundwater Dependent Ecosystems (GDE) community was recorded to be in good condition with scores for most attributes increasing since 2019.

High rainfall and flooding conditions of North Wambo Creek has naturally altered creek geomorphology and associated riparian and in-stream vegetation. Vegetation monitoring plots were not undertaken in this community in 2022, however, monitored trees appear healthy. As expected, following high rainfall, Feral Pig (Sus scrofa) activity appears to have increased in the area, mostly along creeks in the General Surface Area.

One threatened flora species, *Pomaderris cotoneaster* (Endangered under NSW BC Act and Commonwealth EPBC Act) was recorded along North Wambo Creek for the first time.

Overall, high rainfall has generally contributed to improved vegetation condition across the area, however, has also increased exotic plant cover. No detrimental impacts of underground mining have been recorded within the study area.

1. Introduction

Wambo Coal Pty Limited (WCPL) is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW). A range of open cut and underground mine operations have been conducted at WCPL since mining operations commenced in 1969. Mining under the current Development Consent (DA 305-7-2003) commenced in 2004 and permits both open cut, underground operations and associated activities to be conducted. As part of the development consent, a Remnant Woodland Enhancement Program (RWEP) has been established as a biodiversity offset for lands disturbed by open cut coal mining activities. The RWEP aims to conserve local and regional biodiversity by protecting and enhancing the habitat for flora and fauna within these areas through a conservation agreement.

HLA - Envirosciences Pty Ltd initially established a program to monitor the fauna and vegetation structure within the RWEP areas, as well as to monitor stream and riparian condition within North Wambo, Wambo and Stony Creeks, with the aim of measuring and documenting the status and change in ecological condition. Eco Logical Australia (ELA) was commissioned by WCPL to undertake this monitoring program during spring 2022, making this the seventh year that ELA has completed monitoring at this location. This monitoring program is conducted in response to the 2004 Development Consent condition (DA 305-7-2003 Schedule 4 Condition 48) and informs WCPL's Annual Environmental Management Report (AEMR).

ELA's scope of works included:

- Collection floristic and fauna habitat data from established monitoring locations throughout land owned by WCPL, including remnant woodland enhancement areas (RWEA) (otherwise known as Biodiversity Offset Areas (BOA) or Voluntary Conservation Areas (VCA))
- Conducting Landscape Function Analysis (LFA) at established sites along the NWCD
- Conducting riparian condition monitoring at North Wambo, South Wambo and Stony Creeks
- Conducting bird monitoring at established monitoring locations throughout land owned by WCPL, primarily in land set aside as part of the RWEP
- Conducting nest box monitoring
- Monitoring Groundwater Dependent Ecosystems above the South Bates Underground Extension area
- Reporting on any mine subsidence observations and other management issues
- Documenting results and compare to performance criteria or past results (where relevant) and identify what and where management actions may be required
- Providing a summary of management actions.

1.1. Report structure

This report has been set out in the following manner:

- Executive Summary – summary of the key findings of the monitoring works.
- Introduction – provides background information to the current report.

- Remnant woodland enhancement areas (RWEAs) – provides methods, results and interpretation of data, as well as recommendations from flora and bird surveys primarily within RWEA areas.
- Rehabilitation areas – provides methods, results and interpretation of data from LFA and biometric flora survey plots from the NWCD.
- Riparian condition assessment – provides methods, results and interpretation of data, as well as management recommendations for riparian transects at North Wambo, Wambo and Stony Creeks.
- South Bates Underground Extension area – provides methods, results and interpretation of data from monitoring of Groundwater Dependent Ecosystems, flora and birds in the area above the South Bates Underground Extension.
- Mine subsidence observations and other management issues – provides observations of mine subsidence and other management issues on land owned by WCPL.
- Summary of management actions – provides a summary of required and recommended actions.

Raw data and photographs from monitoring site surveys are included in Volume 2**.**

2. Remnant Woodland Enhancement Areas (RWEAs)

2.1. Floristic monitoring

2.1.1. Introduction

The aim of floristic and fauna habitat monitoring is to measure the current condition of vegetation within the RWEAs in terms of floristics and habitat complexity. The results aim to provide direction for the management of these areas and to inform monitoring programs in the future.

2.1.2. Methods

Data was collected by ELA ecologists Liam Scanlan and Alex Yates from September – December 2022. Several field trips were required over this timeframe due to high rainfall creating inaccessible track conditions. A standard biometric plot 50 x 20 m (Figure 1) was used to measure the following parameters and collect data following the BioBanking methodology (DECC 2008a):

- Full floristic species list (including cover abundance scores) in a nested 0.04 ha plot (20m x 20m)
- Canopy regeneration over whole vegetation zone
- Estimation of projected native foliage cover of ground cover from 50 points and canopy and mid-storey layer from 10 points along the 50 m transect
- Occurrence and abundance of weed species in 0.04 ha plot (20m x 20m)
- Number of hollow-bearing trees and length of logs (>10cm diameter) in the plot
- Photograph of each plot (at start of 50 m transect).

The abundance of each species in the 0.04 ha plot was estimated, using a modified Braun-Blanquet scale, as used in previous floristic monitoring at WCPL. These are listed below:

- 1 = few, small cover (<5%)
- 2 = numerous (<5%)
- 3 = 5 – 25%
- 4 = 25 – 50%
- 5 = 50 – 75%
- 6 = >75%.

All vascular plants species were recorded and identified to the lowest taxonomic level possible, with samples of unknown species collected for further identification where possible. Nomenclature followed the Flora of New South Wales (Harden 1992; 1993; 2000; 2002), and any subsequent recent taxonomic changes as presented on PlantNet (RBGDT 2015).

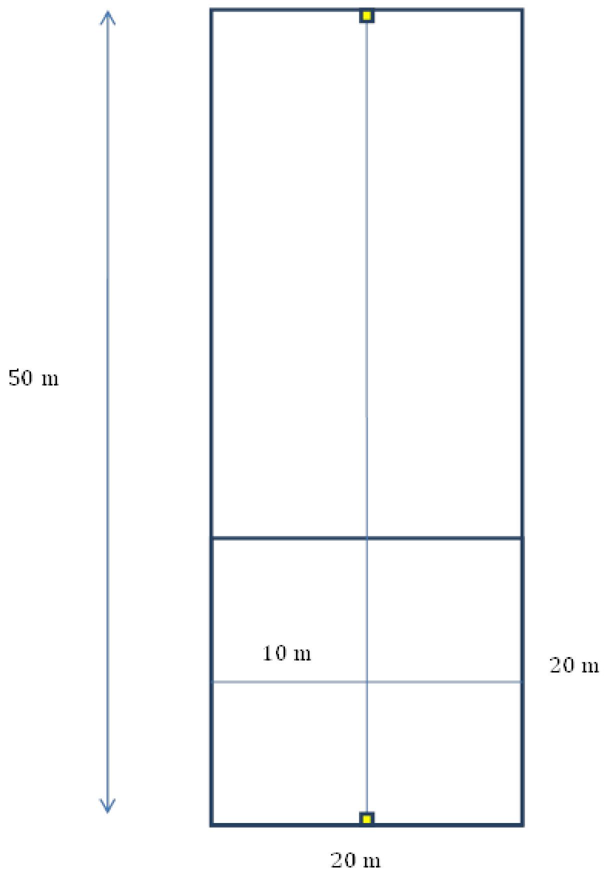


Figure 1: Biometric vegetation plot dimensions

Flora monitoring plots were located within the ten vegetation communities originally mapped and described by Orchid Research (2003). Since this time, a number of changes in vegetation mapping standards in NSW have occurred. Previously a set list of plant communities known as Biometric Vegetation Types (BVT) were used as a state-wide standard by the NSW Office of Environment and Heritage (OEH). These BVTs have now been modified and are now known as Plant Community Types (PCT's). As such, the ten vegetation communities originally mapped and described by Orchid Research (2003) have been converted to their equivalent PCT within this report. Several of these communities are also listed under both State and Federal legislation as Threatened Ecological Communities (TECs) under different nomenclature. Table 1 clarifies the conversion of these vegetation communities.

Data was collected from the 34 locations previously surveyed as part of the RWEP monitoring program. During 2019 and 2020, several additional floristic monitoring plots were added outside of RWEAs in the NWCD and South Bates Extension Underground Mine area as part of the broader Wambo Coal Mine biodiversity monitoring program. These sites are monitored using the same methods described here, with results presented in the relevant sections of this report. All floristic plot locations are shown in Figure 2.

Table 1: Original vegetation classification, PCT classification and TEC status for each monitoring plot in remnant vegetation

<table>
<tr><th>Vegetation Community (Orchid Research 2003)</th><th>PCT</th><th>TEC</th><th>Plot name</th></tr>
<tr><td rowspan="5">River Oak / Rough-barked Apple Forest</td><td rowspan="9">PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley</td><td rowspan="9">Listed as Endangered (E) under the NSW Biodiversity Conservation Act 2016 (BC Act): Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions</td><td>V1-A1</td></tr>
<tr><td>V1-A2</td></tr>
<tr><td>V1-B1</td></tr>
<tr><td>V1-B2</td></tr>
<tr><td>V1-B3</td></tr>
<tr><td rowspan="3">River Red Gum Woodland</td><td>V2-A1</td></tr>
<tr><td>V2-B1</td></tr>
<tr><td>V2-B2</td></tr>
<tr><td>Yellow Box / Blakely’s Red Gum / Rough-barked Apple Forest</td><td>V3-B1</td></tr>
<tr><td rowspan="4">Coast Banksia / Rough-barked Apple / Blakely’s Red Gum Forest</td><td rowspan="4">PCT 1653: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area</td><td rowspan="4">Listed as E under the BC Act: Warkworth Sands Woodland in the Sydney Basin Bioregion, also listed as Critically Endangered (CE) under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as Warkworth Sands Woodland of the Hunter Valley</td><td>V5-B1</td></tr>
<tr><td>V5-B2</td></tr>
<tr><td>V5-B3</td></tr>
<tr><td>V5-B4</td></tr>
<tr><td rowspan="8">Narrow-leaf Ironbark/Grey Box/Bulloak/Honeymyrtle Forest</td><td rowspan="10">PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter</td><td rowspan="10">Listed as E under the BC Act: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position</td><td>V6-A1c</td></tr>
<tr><td>V6-A3</td></tr>
<tr><td>V6-B1</td></tr>
<tr><td>V6-B1c</td></tr>
<tr><td>V6-B2</td></tr>
<tr><td>V6-B2c</td></tr>
<tr><td>V6-B3</td></tr>
<tr><td>V6-B4</td></tr>
<tr><td rowspan="2">Grey Gum/Narrow-leaf/ Ironbark/Bulloak/Honeymyrtle Forest</td><td>V11-B1</td></tr>
<tr><td>V11-B2</td></tr>
<tr><td rowspan="2">Spotted Gum/Narrow-leaf Ironbark/Bulloak/Paperbark Forest</td><td rowspan="2">PCT 1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter</td><td rowspan="2">Listed as E under the BC Act: Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act</td><td>V9-A1</td></tr>
<tr><td>V9-B1</td></tr>
</table>

Vegetation Community (Orchid Research 2003)	PCT	TEC	Plot name
		as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V9-B2
			V10-B1
Slaty Gum/Narrow-leaf Ironbark/Bulloak/Paperbark Forest	PCT 1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Listed as Vulnerable (V) under the BC Act: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V10-A1
			V10-A2
			V10-B3
White Mahogany/Rough-barked Apple Forest	PCT 1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	N/A	V13-B1
Brush Wilga/Native Olive Shrubland	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Listed as E under the BC Act: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	V14-A1
			V14-B1
			V14-B2

Cover/abundance scores for each species within each plot in the RWEAs was provided by WCPL from 2010 onwards, with the exception of woodland rehabilitation sites, which were sampled for the first time by ELA during monitoring undertaken in 2015. Biometric plot data using the current method was collected for the first-time during monitoring undertaken in 2014.

Data was examined for changes in native species richness within each sampled plant community over twelve monitoring periods from 2010 to 2022 and cover of exotic species over the last seven monitoring periods (2016 to 2022). Monitoring point photographs were also compared where possible to determine if major structural elements of each community had changed since the earliest photos available were taken (generally in 2013). Data from each vegetation community was compared to established performance criteria, biometric benchmarks and compared with reference sites outside of the RWEA areas where possible.

Vegetation community condition benchmarks (developed by OEH for each PCT) have been modified to provide realistic, ambitious yet achievable performance criteria for each PCT. Monitoring results can then be compared to these criteria to determine if management actions are likely to be required.

A green, yellow, amber and red colour system has been developed to rank each measured attribute according to performance and management actions required (Table 2). The structure of this table has been derived from the *Terrestrial Biodiversity Assessment Tool – Operational manual* (DECC 2008b). The number of hollow-bearing trees and length of fallen logs have been presented as a measure of fauna habitat attributes. No performance criteria have been set for these attributes in remnant vegetation, as in situations where historical logging or clearing has been intensive, it may take many years for a suitable density of hollows and logs to form naturally.

Table 2: Colour ranking system for floristic attributes and performance targets

Attribute	Red (needs greater improvement)	Orange (in need of improvement)	Yellow (not meeting target but values still acceptable)	Green (excellent – within target range)
Native species richness	0–10%	>10 – <50% of target range	50 – <100% of target range	≥ target range
Native overstorey cover %	0 – 10% or >200% of target range	> 10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native mid-storey cover %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – grasses %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – shrubs %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – other %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Proportion of native overstorey species regenerating	0	0-0.5	0.5-1	1
Exotic cover	>66%	33-66	5-33	0-5%

Several abbreviations for measured attributes are used in tables throughout the following section. An explanation of these is provided below.

- NPS – the number of native plant species
- NOS (%) – projected native foliage cover of canopy
- NMS (%) – projected native mid-storey cover
- NGCG (%) – native groundcover of grasses
- NGCS (%) – native groundcover of shrubs
- NGCO (%) – native groundcover of other plant types (sedges, herbs etc.)
- EPC (%) – exotic plant cover
- OR – proportion of overstorey species regenerating over the whole vegetation zone
- HBT – number of hollow-bearing trees present in the 20 x 50 m vegetation plot
- FL – length of fallen logs >10 cm diameter.

In addition to those performance criteria listed above, Annexure C of the VCAs for the RWEA areas requires that WCPL aim for an exotic plant cover within the Conservation Areas that does not exceed the percentages detailed in Table 3. Target limits for Years 2-5 are used for the ongoing targets as no further limits are presented. Photo-monitoring points established as part of the VCAs in 2013 were compared to photos at the same location during the current vegetation monitoring.

Table 3: Exotic plant cover criteria for VCA areas

RWEA	Aim	Timing
Coal Terminal	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site CT1* - 15% of the foliage cover at monitoring site CT2*.	In Year 1 and at the end of Year 5
RWEAs A, B, C and D	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 70% of the foliage cover at monitoring site A1 within Area A - 20% of the foliage cover at monitoring site A2 within Area A - 30% of the foliage cover at monitoring site A3 within Area A - 10% of the foliage cover at monitoring site A4 within Area A - 5% of the foliage cover at monitoring site B1 within Area B - 5% of the foliage cover at monitoring site B2 within Area B - 5% of the foliage cover at monitoring site C1 within Area C - 5% of the foliage cover at monitoring site D1 within Area D.	In Year 1
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 60% of the foliage cover at monitoring site A1 within Area A - 15% of the foliage cover at monitoring site A2 within Area A - 20% of the foliage cover at monitoring site A3 within Area A - 5% of the foliage cover at monitoring site A4 within Area A - 5% of the foliage cover at monitoring site B1 within Area B - 5% of the foliage cover at monitoring site B2 within Area B - 5% of the foliage cover at monitoring site C1 within Area C - 5% of the foliage cover at monitoring site D1 within Area D.	Years 2-5+

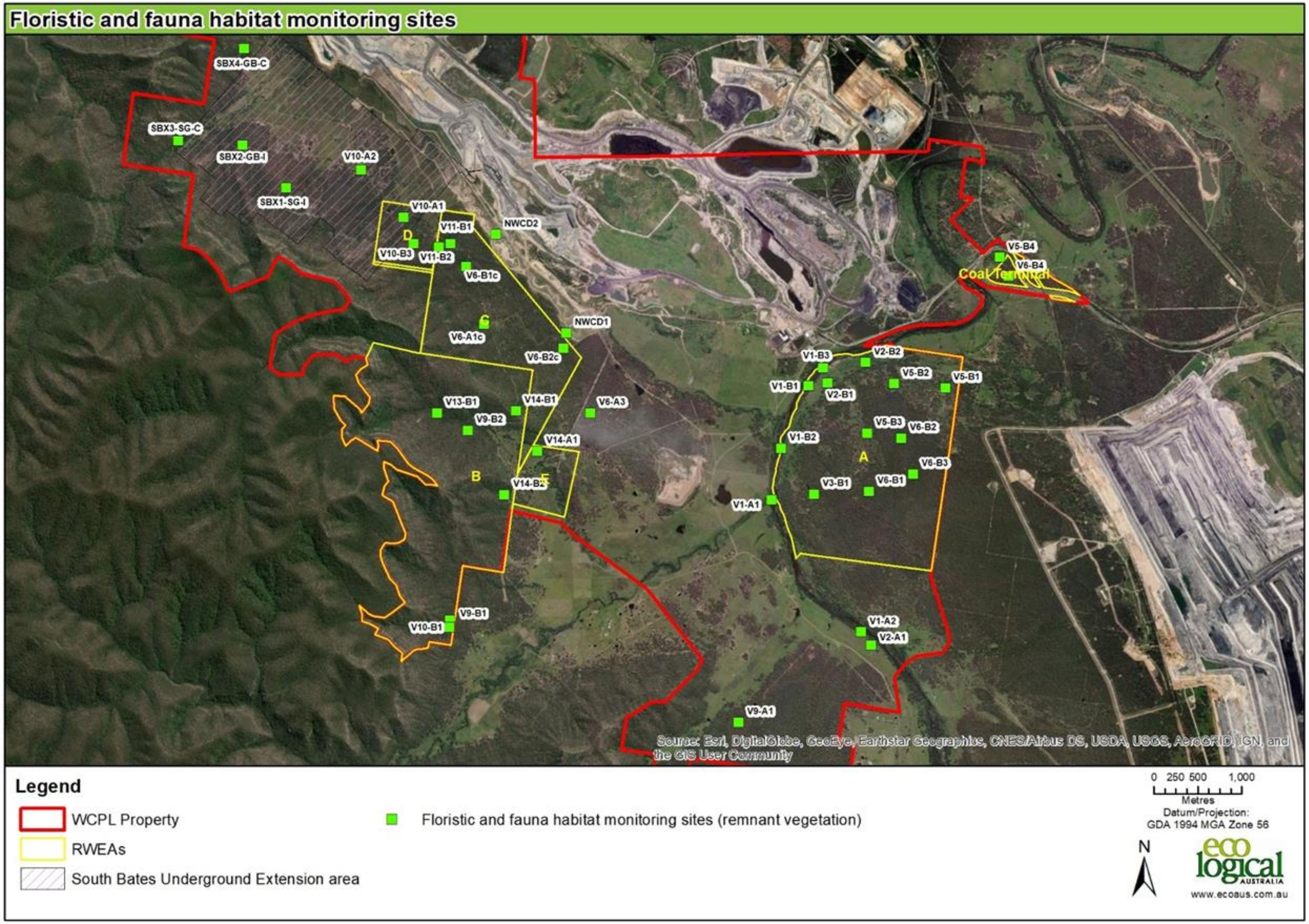


Figure 2: Floristic and habitat monitoring sites and RWEAs

2.1.3. Results

The floristic and biometric data collected during floristic and fauna habitat monitoring is summarised below, with a focus on monitoring features that fell below the performance criteria. The full floristic plot data and other data including plot photographs are provided in Volume 2.

2.1.4. River Red Gum / River Oak riparian woodland wetland in the Hunter Valley

This community is one of the most disturbed vegetation communities on WCPL land, as it occurs on more fertile soils on the banks and floodplains of Wollombi Brook, is naturally disturbed by flood events and has been historically used more intensively for agricultural purposes (Photograph 1).

River Red Gum / River Oak riparian woodland is distinguished by an overstorey of *Eucalyptus camaldulensis* (River Red Gum), *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak), *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus melliodora* (Yellow Box) on floodplains and riparian areas. This PCT conforms to the BC Act listed Endangered Ecological Community (EEC) *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions*. This community also contains the endangered Hunter Valley population of *Eucalyptus camaldulensis* listed under the BC Act.

Photograph 1: River Red Gum / River Oak riparian woodland wetland on North Wambo Creek in 2022 (Site V1-A1 within the Wollombi Brook channel)

Nine monitoring plots are located within this PCT. V1 monitoring sites are located within *Casuarina cunninghamiana* dominated forest along the banks of Wollombi Brook. V2 monitoring sites are located on the partially cleared red gum dominated floodplains of Wollombi Brook and the V3 monitoring site is located in a slightly wetter location on the boundary of the floodplain and sand dunes supporting Warkworth Sands type vegetation.

Three sites (V1-A1, V1-A2 and V2-A1) appear to have been originally intended as reference sites at the commencement of the monitoring program, as they are located outside of the RWEP areas. However, cattle have been fenced out of the immediate riparian zone on Wollombi Brook (including sites V1-A1, V1-A2) and thus treatments for both reference sites and management sites are similar.

Overall, average NMS and EPC were below performance criteria targets in 2022. Targets were met or acceptable for all other performance criteria (Table 5).

2.1.4.1. Native midstorey cover

Native midstorey cover was below the performance criteria target for RWEA monitoring sites in 2022. Average NMS was 0.9% and the target is 10-50%. This is not considered a management concern within these vegetation communities due to the natural disturbance of occasional flooding and inundation. For example, inundation at V3-B1 favours high groundcover of rushes and sedges (Photograph 2 and Photograph 3) and flooding along Wollombi Brook may limit the midstrata (Photograph 4 and Photograph 5).

Photograph 2: Flora monitoring site V3-B1 during 2015

Photograph 3: Flora monitoring site V3-B1 during 2022

Photograph 4: Monitoring site A3 during 2013

Photograph 5: Monitoring site A3 during 2022

2.1.4.2. Exotic Plant Cover

EPC has been recorded since 2014 and results are variable over time (Figure **3**). EPC is similar to 2021 results and although lower than in 2020, was still significantly higher than all other years except 2016, which was notably also a year with higher-than-average rainfall. The trends suggest EPC is related to rainfall. Floristic plot data suggests total exotic plant cover is a result of a combination of both annual and perennial species.

Several priority weeds are present within this PCT, these are listed in Table 4 below, along with their biosecurity duty according to NSW Department of Primary Industries (DPI 2017). Priority weed distribution and abundance was generally similar to previous years. *Senecio madagascariensis* (Fireweed) was recorded at all sites except V1-A1 and has likely responded to the wetter conditions in 2021 and 2022.

Photo monitoring points in this PCT show no obvious changes within this PCT between years 2015 and 2022 (Photograph 2 and Photograph 3), and 2013 and 2022 monitoring (Photograph 4 and Photograph 5), although evidence of recent wetter seasonal conditions is evident in the understorey of some 2022 photos.

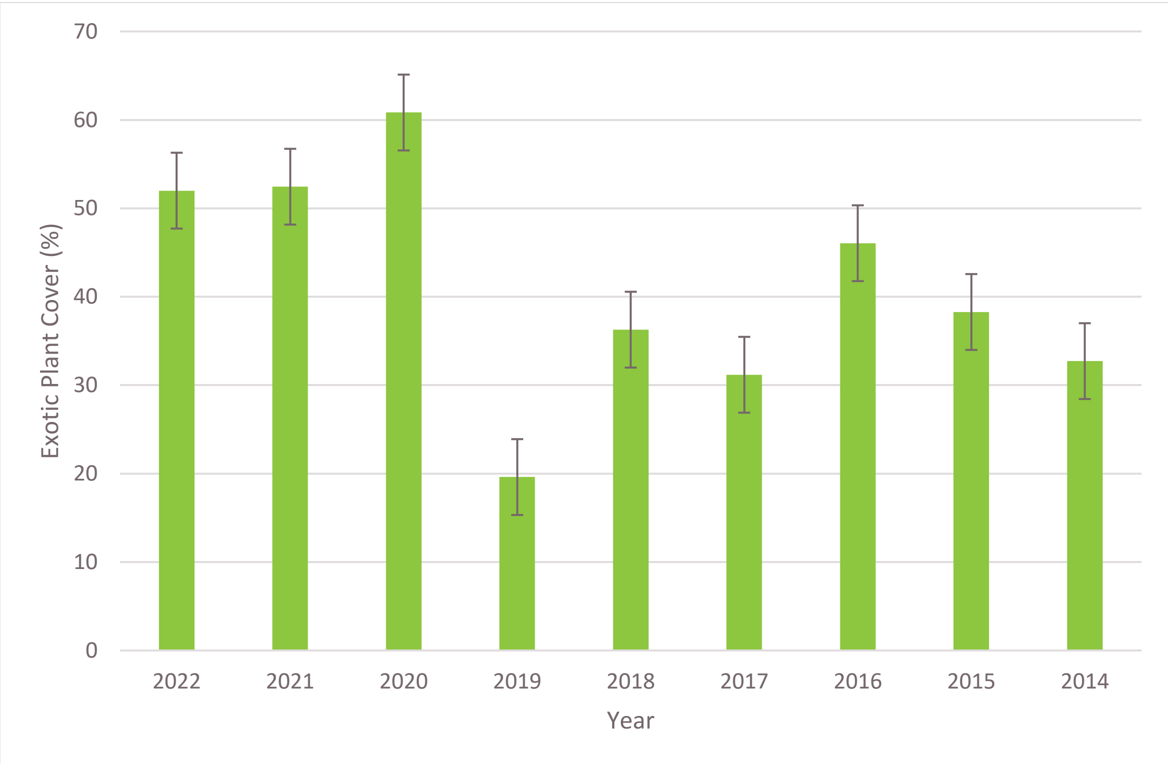


Figure 3: Average EPC within all riparian woodland monitoring sites per year. Error bars represent the standard error of the mean.

Table 4: Declared weeds observed within the River Red Gum / River Oak riparian woodland PCT plots in 2022

Scientific Name	Common Name	Site	Biosecurity duty (NSW Biosecurity Act 2015)
Asparagus asparagoides	Bridal Creeper	V2-B2	Prohibition on dealings - Must not be imported into the State or sold.
Echium plantagineum	Patterson's Curse	V1-A2, V1-B3	Regional Recommended Measure - Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment.
Lycium ferocissimum	African Boxthorn	V1-A2	Prohibition on dealings - Must not be imported into the State or sold.
Olea europaea subsp. *cuspidata*	African Olive	V1-B3, V2-B1, V2-B2	Regional Recommended Measure - Land Area 1: Singleton and Maitland. Land Area 2: outbreaks in Hunter region except Singleton and Maitland. Land Area 1: Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. Land Area 2: Land managers should mitigate spread from their land. Land managers should mitigate the risk of new weeds being introduced to their land. Plant should not be bought, sold, grown, carried or released into the environment.
Salix species	Willows	V1-A1, V1-B1	Prohibition on dealings - Must not be imported into the State or sold.
Senecio madagascariensis	Fireweed	All sites except V1-A1	Prohibition on dealings - Must not be imported into the State or sold.

Table 5: Floristic results and performance criteria for River Red Gum / River Oak riparian woodland wetland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL (m)
River Oak / Rough-barked Apple Forest	PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Outside of RWEP	V1-A1	5	6.2	0	14	0	2	42	1	1	80
		Outside of RWEP	V1-A2	12	19.5	5	60	0	0	72		1	28
		A	V1-B1	11	18	0	0	0	48	0		0	38
		A	V1-B2	17	23.5	0	20	0	88	46		0	16
		A	V1-B3	15	6	2	0	4	20	86		0	12
River Red Gum Woodland		Outside of RWEP	V2-A1	22	20	1.5	56	2	2	42		1	0
		A	V2-B1	16	16	0	20	0	8	90		1	6
		A	V2-B2	24	14.5	3	56	2	0	66		1	18
Yellow Box / Blakely's Red Gum / Rough-barked Apple Forest		A	V3-B1	25	14.5	0.5	66	0	46	24		1	30
Average values for RWEA monitoring sites				18.0	15.4	0.9	27.0	1	35.0	52.0	1	0.5	20.0
Performance criteria				>20	10-50	10-50	20-60	1-5	5-30	<10	1	-	-

2.1.5. Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area

Within WCPL owned land, this community is mostly restricted to the eastern side of Wollombi Brook, primarily within the RWEP area A (Photograph 6). This PCT corresponds to the EPBC Act listed Critically Endangered Ecological Community (CEEC) *Warkworth Sands Woodland of the Sydney Basin Bioregion* and is also listed under the BC Act. This PCT occurs on aeolian sand deposits and is restricted to the Warkworth area.

Banksia integrifolia (Coast Banksia) has been observed to suffer die-back over the past few years and continued to not be recorded as live in any plots in 2021. Live individuals and seedlings were observed more broadly within this PCT during 2022. Monitoring should continue to note the health of this species within the PCT. It is assumed that this die-back was related to pre-2019 drought conditions, and regeneration should occur following the higher rainfall in 2020-2022.

Average NGCG was 52%, well above the performance criteria target of 4-20%. However, this is not considered to be a major concern, with the higher grassy cover likely to be as a result of continued higher rainfall in 2021 and 2022.

Overall, this PCT is performing acceptably, although surveys and ongoing weed control should continue to manage the high EPC.

Photograph 6: Warkworth Sands Woodland within RWEA A in 2022 (Site V5-B2)

2.1.5.1. Exotic plant cover

EPC was higher than the target, driven by sites V5-B2 with and V5-B4. At V5-B2, *Ehrharta erecta* (Panic Veldtgrass) is the dominant exotic, and at V5-B4, *Melinis repens* (Red Natal Grass) contributed a high amount to the EPC.

In recent years, the environmental weed *Bryophyllum* sp. (Mother of Millions) was observed to be abundant in certain locations within this vegetation community, both within RWEA A and inside the Rail Loop area. *Bryophyllum* sp. is listed as a priority weed in the Hunter under the *Biosecurity Act 2015*. It is understood that this species is currently the focus of a weed management program. The progress of the weed management program is evident in 2022 monitoring results, with *Bryophyllum* sp. occurring in V5-B1 only with low cover.

Melinis repens (Red Natal Grass) has also established with high cover in RWEA A in recent years. This species was recorded at all sites, with the highest cover recorded at V5-B4. Although this species is not considered to be a priority weed in the Hunter Region, it has the capacity to threaten this community but outcompeting native groundcover species and is currently being treated on an ongoing basis by land management contractors.

Photo-monitoring point A2 within this PCT shows a minor change in vegetation between the 2013 and 2022 monitoring periods, with a reduction in cover of *Pteridium esculentum* (Bracken) apparent (Photograph 7 and Photograph **8**).

Photograph 7: Photo monitoring point A2 during 2013

Photograph 8**: Photo monitoring point A2 during 2022**

Table 6: Floristic results in regards to performance criteria for Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Coast Banksia / Rough-barked Apple / Blakely's Red Gum Forest	PCT 1658: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	A	V5-B1	34	13	4.5	70	28	14	22	1	1	11
		A	V5-B2	29	13	11.5	68	6	24	44		1	5
		A	V5-B3	35	10.7	17.5	70	36	10	0		1	12
		Rail Loop	V5-B4	29	16.5	4.5	0	34	0	64		1	8
Average values for RWEP and Rail Loop monitoring sites				31.75	13.3	9.5	52	26	12	32.5	1	1	9
Performance criteria				>20	10-40	10-50	4-20	5-30	5-35	<10	1	-	-

2.1.6. Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

This community on land owned by WCPL is generally dominated by the canopy species *Eucalyptus crebra* (Narrow-leaved Ironbark) and occasionally *Eucalyptus moluccana* (Grey Box). A sparse mid-storey or shrub layer of *Allocasuarina luehmannii* (Bull Oak), *Bursaria spinosa* subsp. *spinosa* (Blackthorn) and *Notelaea microcarpa* var. *microcarpa* (Mock Olive), with a grassy understorey is often present. *Eucalyptus punctata* (Grey Gum) and *Melaleuca decora* also occur in some areas.

Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest forms part of the BC Act listed EEC *Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions*. Sections of this community in good condition with a Eucalypt canopy are also likely to be the Central Hunter Valley eucalypt forest and woodland CEEC listed under the EPBC Act.

This community appears to be performing well with generally very low cover of exotic species and high diversity of native species present at each monitoring plot. Performance criteria were met for all other attributes and exceeded for NGCG and NGCS. Exceeded performance criteria by NGCG and NGCS, exceeding the upper limit by 22 and 5.1 respectively, is not considered to be a management concern.

Photo monitoring point A4 (Photograph 10 and Photograph 11) samples this community, and increased grass cover is observable between the 2013 and 2022 monitoring periods.

Subsidence cracking is present at four of the eight monitoring plots within this PCT. However, no impacts to vegetation condition have been observed. Very large cracks are present at site V11-B1 in RWEA C and ELA recommends WCPL inspect this area and undertake remediation of large subsidence cracks if possible.

Photograph 9: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest at WCPL (site V6-A3 in 2022)

Photograph 10: Photo-monitoring point A4 during 2013

Photograph 11: Photo-monitoring point A4 during 2022

Table 7 : Floristic results and performance criteria for Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Narrow-leaf Ironbark / Grey Box / Bulloak / Honeymyrtle Forest	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	C	V6-A1c	49	17.5	5.5	86	12	12	4	1	1	22
		Outside of RWEP	V6-A3	42	11.7	8	66	18	28	0		0	15
		A	V6-B1	29	12.5	4.5	86	0	16	2		1	32
		C	V6-B1c	34	18	10.5	86	16	18	6		0	28
		A	V6-B2	39	10	11	84	6	14	6		1	50
		C	V6-B2c	35	15.5	8	66	46	22	6		0	24
		A	V6-B3	37	10.5	7.5	78	14	10	8		1	35
		Rail Loop	V6-B4	21	25.5	1.5	6	6	18	8		0	6
Grey Gum / Narrow-leaf Ironbark / Bulloak / Honeymyrtle Forest		C	V11-B1	45	13	7	60	24	16	4		0	55
		C	V11-B2	66	8.5	5.5	96	12	30	2		0	28
Average values for RWEP and Rail loop monitoring sites				39.7	14.6	6.8	72	15.1	17.3	5.1	1	0.44	31.5
Performance criteria				>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-

2.1.7. Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter

Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter at WCPL is characterised by an overstorey of *Eucalyptus crebra*, *Corymbia maculata* (Spotted Gum) and *E. moluccana. E. punctata* and *Eucalyptus dawsonii* (Slaty Gum) are also occasionally present. The mid-storey or shrub layer often includes *Melaleuca decora, Bursaria spinosa subsp. spinosa, Allocasuarina luehmannii* and *Olearia elliptica* (Sticky Daisy Bush). This community corresponds to the EEC Central Hunter Ironbark -Spotted Gum – Grey Box Forest listed under the BC Act. Sections of this community in good condition with a Eucalypt canopy are also likely to be the Central Hunter Valley eucalypt forest and woodland CEEC, listed under the EPBC Act.

This PCT is performing well meeting all performance criteria in 2022, meeting or exceeding all performance criteria targets (Table 8). The NPS at the reference site was the highest recorded to date, and average NPS within RWEAs was second highest after 2021 (Figure 4).

Average NGCG was 72%, above the performance criteria of 30-50%. This result is consistent with 2021 cover, which increased significantly from 2020 and is likely a result of increased growth in response to higher rainfall, and not considered to be a management concern. Similarly, NGCS was 29%, above the performance criteria of 5-15%.

Photo-monitoring points in this community show no negative changes in vegetation structure between the 2013 and 2022 monitoring periods (Photograph 12 and Photograph 13) but an increase in ground cover (grasses and grass-like plants) and midstorey foliage cover is evident. Overall, this PCT is performing well, and no additional management actions are required at this stage.

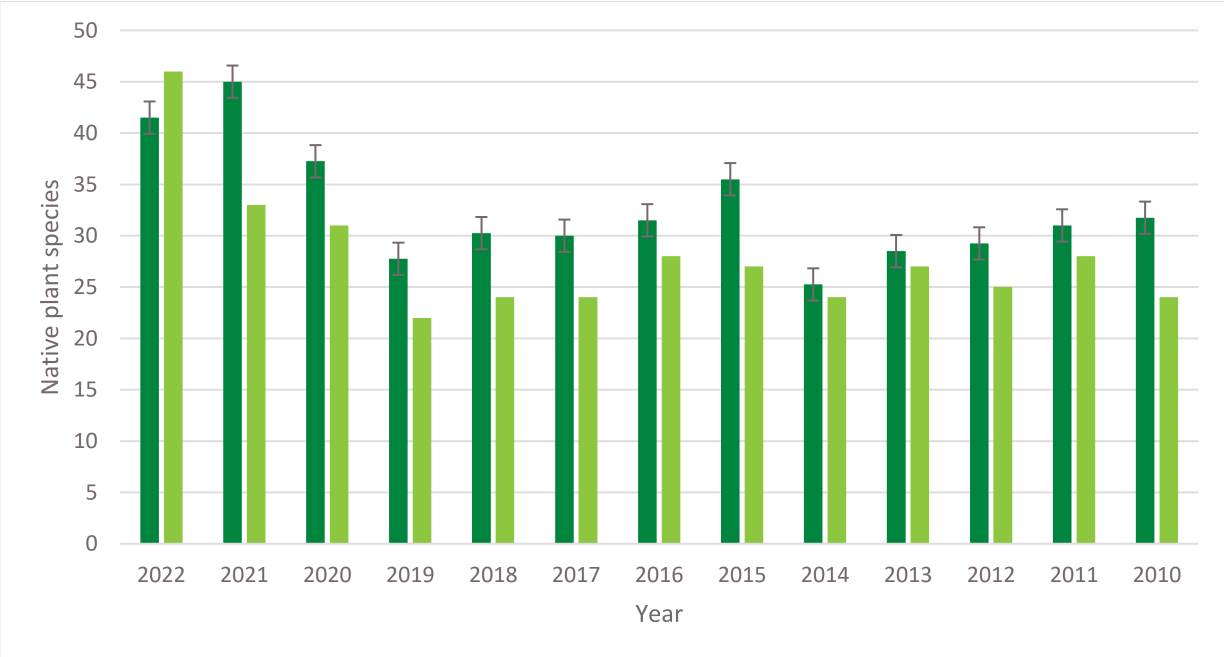


Figure 4: The average number of NPS in Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland within RWEAs (dark green) compared to the recorded number at reference site V9-A1 (light green). Error bars represent the standard error of the mean.

Photograph 12: Photo-monitoring point B2 during 2013

Photograph 13: Photo-monitoring point B2 during 2022

Table 8: Floristic results, performance criteria for Narrow-leaved Ironbark - Grey Box - Spotted Gum woodland at Wambo

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Spotted Gum / Narrow-leaf Ironbark/ Bulloak / Paperbark Forest	PCT1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass of the central and lower Hunter	Outside of RWEP	V9-A1	46	14	12	56	6	18	12	1	1	18
		B	V9-B1	20	9.7	13.5	80	54	8	0		1	25
		B	V9-B2	49	21.5	3.5	68	18	24	2		1	17
		B	V10-B1	51	19	13.5	84	38	2	0		1	36
Average values for RWEP monitoring sites				41.5	16.1	10.6	72	29	13	3.5	1	1	24
Performance criteria				>35	15-40	5-20	30-50	5-15	5-40	< 5	1	-	-

2.1.8. Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion

The canopy of Slaty Box - Grey Gum shrubby woodland is typically dominated by *Eucalyptus dawsonii* and several other species including *E. punctata, E. moluccana* and *E. crebra. Acacia salicina* (Cooba) and *Allocasuarina luehmannii* may form a small tree layer or be part of the upper-most canopy. The shrub layer includes species such as *Olearia elliptica, Acacia cultriformis* (Knife-leaved Wattle), *Canthium odoratum* (Shiny-leaved Canthium), *Notelaea microcarpa var. microcarpa* and *Dodonaea viscosa* subsp. *cuneata* (Wedge-leaf Hopbush). The groundcover is generally sparse to very sparse and can be poor during drier years (Photograph **14**). This community is listed under the BC Act as the EEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion. Sections of this community in good condition with a Eucalypt canopy are also likely to be the Central Hunter Valley eucalypt forest and woodland CEEC under the EPBC Act.

At WCPL, this PCT primarily occurs on the smaller ridge tops and slopes and is patchily distributed at lower elevations. *E. crebra* is often present and may co-dominate the canopy with *E. dawsonii*. This PCT is generally in good condition, particularly on the slopes and ridgetops where historical disturbance from forestry and grazing has been minimal. Occasional occurrences of the priority weed *Opuntia* spp. were observed at low densities, similar to other woodland areas at WCPL.

The monitoring sites in this community are located in or near RWEA D. All performance criteria were met in 2022, excluding average NMS which was 2.5%, below the performance criteria of 5-30%. Average NGCG was again very high (68%) above the target range of 5-30% (Table 9). Average NMS and NGCG outside of the performance criteria are not considered to be management concerns.

Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 14**: A typical example of Slaty Box woodland at WCPL during 2022 (Site V10-B3)**

Table 9: Floristic results, performance criteria for Slaty Box - Grey Gum shrubby woodland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Slaty Gum / Narrow-leaf Ironbark / Bulloak / Paperbark Forest	1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	D	V10-A1	55	12	4.5	82	2	20	0	1	1	28
		Outside of RWEP	V10-A2	40	11.5	2	40	46	10	6		1	12
		D	V10-B3	48	22	0.5	54	36	2	2		1	40
Average values for RWEP monitoring sites				51.5	17	2.5	68	19	11	1	1	1	34
Performance criteria				21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-

2.1.9. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley

At WCPL, this community occurs along Stony Creek and is sheltered by steep sandstone escarpments to the south and a large ridgeline to the north. This PCT is in good condition with many native species and occasional large remnant trees with hollows. One monitoring plot (V13-B1) samples this PCT (Photograph 15).

This monitoring site met or exceeded all performance targets. NGCO was 78%, exceeding the performance criteria of 5-20%e (Table 10), though this is not considered a management concern.

Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 15: White Mahogany - Spotted Gum - Grey Myrtle forest at V13-B1 in 2022

Table 10: Biometric scores and performance criteria for White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest at Wambo

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
White Mahogany / Rough-barked Apple Forest	PCT 1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	B	V13-B1	64	18	30	44	16	78	0	1	1	35
Performance criteria				>45	15-45	5-40	5-40	10-20	5-20	0	1	-	-

2.1.10. Brush Wilga/Native Olive Shrubland

The monitoring plots within this PCT are dominated by the shrubs *Notelaea microcarpa var. microcarpa, Geijera salicifolia* (Brush Wilga), *Olearia elliptica* and the small tree *Brachychiton populneus* (Kurrajong) (Photograph 16). Occasional *Eucalyptus crebra* or *E. moluccana* are present as canopy species. The PCT sampled by floristic monitoring may be a partially derived community, resulting from the historic removal of overstorey species in Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest combined with a south facing aspect. These areas are in good condition, with a large number of native species and few exotic species.

NGCG, NGCS and NGCO were above the target range (Table 11). This is not considered a management concern, as the high score likely reflects the upper range of natural fluctuation in relation to environmental conditions such a rainfall. Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 16: Brush Wilga/Native Olive Shrubland at V14-B2 in 2022

Table 11: Biometric scores and performance criteria for Brush Wilga/Native Olive Shrubland at WCPL

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Brush Wilga/Native Olive Shrubland	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Reference site/ now within RWEA E	V14-A1	48	3	42.5	76	10	44	28	1	1	8
		B	V14-B1	46	8	27.5	72	4	48	16		1	30
		B	V14-B2	53	13.5	17	80	24	64	8		0	7
Average values for RWEP monitoring sites				49.5	10.8	22.3	76	14	56	12	1	0.5	18.5
Performance criteria				>30	5-40	5-40	30-50	5-10	10-40	<5	1	-	-

2.1.11. Conservation agreement requirements and photo monitoring points

Annexure C of the VCAs requires that WCPL aim for an exotic plant cover within the Conservation Areas that does not exceed the EPC percentages detailed in Table 3. Target limits for Years 2-5 are used for the ongoing targets as no further limits are presented.

Five of the ten monitoring plots exceeded the exotic cover limits for the 2–5-year targets (Table 12). The sites exceeding limits are located within RWEA A and RWEA Rail Loop.

Table 12: Exotic plant cover at monitoring sites in regard to VCA targets

RWEA	Site Code for VCA	Corresponding flora monitoring plot	Exotic cover limits yr 1	Exotic cover limits yrs 2-5	Total exotic cover from biometric plots in 2022
Coal Terminal (Rail Loop)	CT1	V6-B4	5	5	8
Coal Terminal (Rail Loop)	CT2	V5-B4	15	15	64
A	A1	V2-B1	70	60	90
A	A2	V5-B1	20	15	22
A	A3	V1-B2	30	20	46
A	A4	V6-B1	10	5	2
B	B1	V13-B1	5	5	0
B	B2	V9-B1	5	5	0
C	C1	V11-B1	5	5	4
D	D1	V10 -B3	5	5	2

At Site A1, within the riparian zone of Wollombi Brook in RWEA A, very high exotic cover (90%) was recorded, consistent with 2021 monitoring. This exceeds the target limit of 60%, which is a high target reflective of the disturbed condition of the site. *Ehrharta erecta* (Panic Veldtgrass) was dominant, with eighteen other common exotic flora species also recorded. This site has previously had exotic cover as high as 95% in 2014. The high cover in 2022 is a result of strong growth of ground cover vegetation in response to rainfall and surface water flows in the Wollombi Brook channel. Tree planting is recommended in this area with the strategy to shade out the exotic ground covers over time and improve fauna habitat.

At Site CT2 within the Rail Loop, major fluctuations in exotic cover over time has also occurred. High exotic cover (64%) was recorded in 2022, a minor decrease from 82% which was recorded in 2021. No exotic cover was recorded from 2017-2019, and very high exotic cover (52%) was recorded in 2016. The exotic cover at this site is dominated by *Melinis repens*. It is suspected that the variation in cover of *M. repens* is driven by rainfall, with 2016, 2020-2022 all being higher than average rainfall years, and 2017-2019 being relatively dry years. The data from floristic plot V5-B4 is used as a reference for CT2 results. Plot V5-B4 is technically outside of the RWEA Loop Area although the area receives the same management treatment. Photo monitoring from CT2 indicates actual exotic cover at the site may be higher than at V5-B4 due to higher cover of *E. erecta*, and continuation of current weed management is recommended throughout this general area.

Site CT1, monitored at V6-B4, was only 3% over the exotic cover limit of 5%, however this is the highest amount since monitoring commenced. This site recorded nine common exotic species with low cover. The increase in exotic cover at this site is likely related to high rainfall conditions in 2021 and 2022. As the exotic species recorded are all relatively low threat, no targeted management action is recommended.

At Site A3, monitored at V1-B2, recorded total exotic cover of 46% with dominant exotic species of *E. erecta* and *Pavonia hastata*. Total exotic cover at this site has remained relatively stable since 2015, with an average exotic cover from 2014-2022 of 48%. The year 2020 recorded 94% cover, which has steadily decreased in 2021 and 2022.

Site A2, monitored at V5-B1, recorded total exotic cover of 22% with dominant exotic species of *Richardia humistrata* and *E. erecta*. Total exotic cover at this site has varied over time. The result in 2022 represents the second highest exotic cover recorded to date, however it is a decrease from 2020, as is similar to results recorded in 2016 and 2018.

Exotic cover is very low or zero at the remaining sites (A4, B1, B2, C1 and D1) and all these fell below the exotic cover limits.

Comparison of photo-monitoring sites between 2013 and 2022 monitoring show no major changes in vegetation over this time period. Wetter conditions during the 2022 are apparent in some photographs, with more green vegetative growth visible in the understorey, but in general, no major changes in species composition or structure are apparent. Dry conditions were observed and reported in previous years (2017-2019). These observations correspond to the floristic data collected within biometric plots with higher ground cover scores recorded across most PCTs during 2022.

2.1.12. Floristic monitoring discussion and recommendations

The majority of remnant woodland areas remain in good condition with high numbers of native species, few exotic species present and with low cover and abundance. No major issues were identified that require urgent management. However, as reported in previous years, exotic species cover remains relatively high in riparian and floodplain areas and continues to exceed performance criteria and also VCA targets in certain locations. Continued weed management will be required to achieve performance criteria in these riparian and floodplain areas.

The number of native species generally increased from the previous year and was relatively high in several PCTs. The 2021 results appear consistent with previous findings that some lower scores for native species diversity recorded in recent years were a result of the dry conditions, with the increase in 2021 and 2022 in response to higher rainfall.

Several weed species listed under the Biosecurity Act 2015 were observed in these areas that have potential to become problematic in the wider region e.g. *Bryophyllum* sp., *Olea europaea* subsp. *cuspidata*, or have the potential to severely alter and degrade vegetation community composition e.g. *Melinis repens*, *Eragrostis curvula* and *Ehrharta erecta*. It is recommended to give priority to species such as this in the mine's weed control program. As discussed in previous monitoring reports, planting of canopy species should be considered in RWEA A, where natural regeneration is unlikely to occur in a reasonable timeframe (i.e. the open grassland areas of on the Wollombi Brook floodplain). Once established, these plantings may also reduce issues with exotic flora species in these areas.

Climatic conditions are considered to be a major factor in the fluctuation of results observed over time. Annual rainfall data from 2022 from Bulga (Down Town) (BOM 2022) shows that high rainfall was recorded in 2020, 2021 and 2022. This follows below average rainfall for 2017, 2018 and 2019. This data corresponds to the generally higher diversity and cover of native flora species observed in 2021 and 2022, and the lower scores reported in the previous dry years. Similar increased native diversity and exotic cover were reported in 2016 which was also a year of above average rainfall.

The Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland (in RWEA A) appears to be suffering from *Banksia integrifolia* die-off in the mid-storey, first observed in 2019 and continuing this year. This community recorded a higher average number of native species in 2021, compared to 2020 results decreased from previous years. Higher exotic covers were also recorded at some locations. This community occurs on sandy soils, and it is possible the soils suffered more significant drying during the recent dry years than other areas and the rainfall to date has not been sufficient to recharge the soil. This community is listed as a CEEC under the EPBC Act, future monitoring should continue to record the condition of this community.

Melinis repens, and to a lesser extent *Eragrostis curvula* and *Ehrharta erecta*, have established within the RWEA A and the Rail Loop, likely in response to high rainfall since 2019. Increased weed control has been undertaken in response, with trials being undertaken by weed management contractors to assess the effectiveness of herbicide application. It is recommended that weed control is continued.

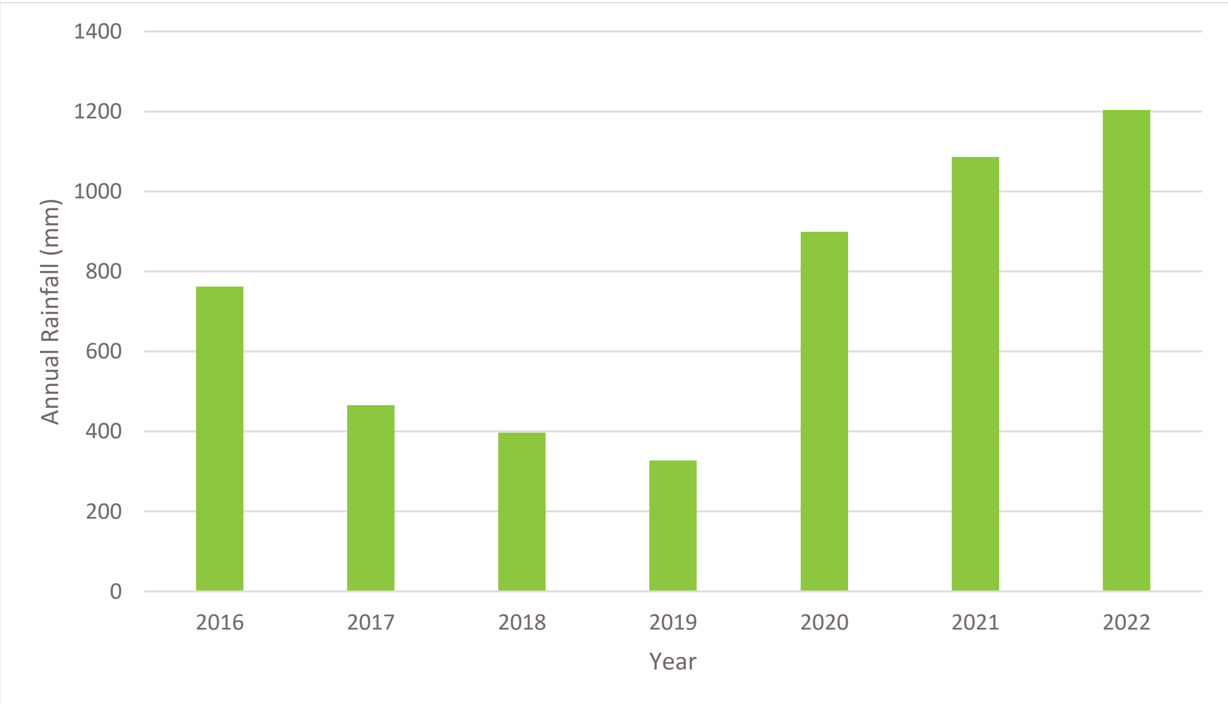


Figure 5: Annual rainfall data for Bulga (Down Town) (Bom 2022)

2.2. Bird monitoring within RWEAs

2.2.1. Introduction

The bird monitoring program is a requirement of the current Development Consent conditions and has been designed in an effort to measure the performance of the WCPL RWEP. The consent conditions (DA 305-7-2003) specify that "Terrestrial fauna surveys should be conducted to monitor the usage of enhancement areas by vertebrate fauna. Monitoring may include fauna species diversity and abundance or, alternatively, the use of indicator species to measure the effectiveness of enhancement measures".

Methods, results (including a comparison with previous monitoring), and interpretation of results, are included below.

Data from previous year's bird surveys are limited to:

- RPS Australia East (RPS) 2009. Annual Ecological Monitoring Report. Remnant Woodland Enhancement Monitoring Program Riparian and Bed and Bank Stability Monitoring, Stoney Creek, South Wambo Creek and North Wambo Creek. Prepared for Wambo Coal Pty Limited
- Niche 2014b. EMP010 Monitoring 2014 – Indicator Species (birds). Prepared for Wambo Coal Pty Limited
- Eco Logical Australia (ELA) 2015-2021. Wambo Coal Mine Flora and Fauna Monitoring Reports Prepared for Wambo Coal Pty Ltd.

2.2.2. Methods

2.2.2.1. Bird monitoring surveys

Bird monitoring during spring 2022 was consistent with the seven previous monitoring events in methods and general timing of surveys. During the survey, two observers spent 10 minutes recording birds seen and heard within 50 m radius (0.8 ha) of a central point, followed by an additional 10 minutes searching the balance of a 2 ha plot, and recording the total numbers of birds detected (seen and heard). One morning and one afternoon survey was conducted per site.

The thirty (30) sites (Figure 6) were surveyed by ELA ecologists Liam Scanlan, Daniel McKenzie and Alex Yates between September – December 2022. Several field trips were required over this timeframe due to high rainfall creating inaccessible track conditions.

The total number of bird species recorded each year 2007-2022, average number of bird species per 20-minute bird survey, average number of birds per survey, bird density and the distribution and relative abundance of threatened species were examined. Broad comparisons between the bird species recorded in previous years and the current year were also made.

2.2.2.2. Targeted winter bird survey

Winter bird surveys targeting Swift Parrot and Regent Honeyeater is undertaken every second year and was scheduled to be undertaken in 2022. The winter bird surveys were not undertaken in 2022 due to high rainfall creating inaccessible track conditions. To compensate, a winter bird survey will be undertaken in 2023.

Figure 6: Bird monitoring locations and remnant woodland enhancement areas

2.2.3. Results

2.2.3.1. Bird monitoring surveys

The 2022 monitoring recorded a total of 86 bird species from 26 monitoring sites during formal bird surveys of RWEAs. This number is higher than the median from all 26 sites in previous monitoring periods (2007-2021) (Figure 9).

130 bird species have been recorded during timed bird surveys over the last six years, with 86 of these recorded in 2022, including three species not previously recorded during bird monitoring surveys.

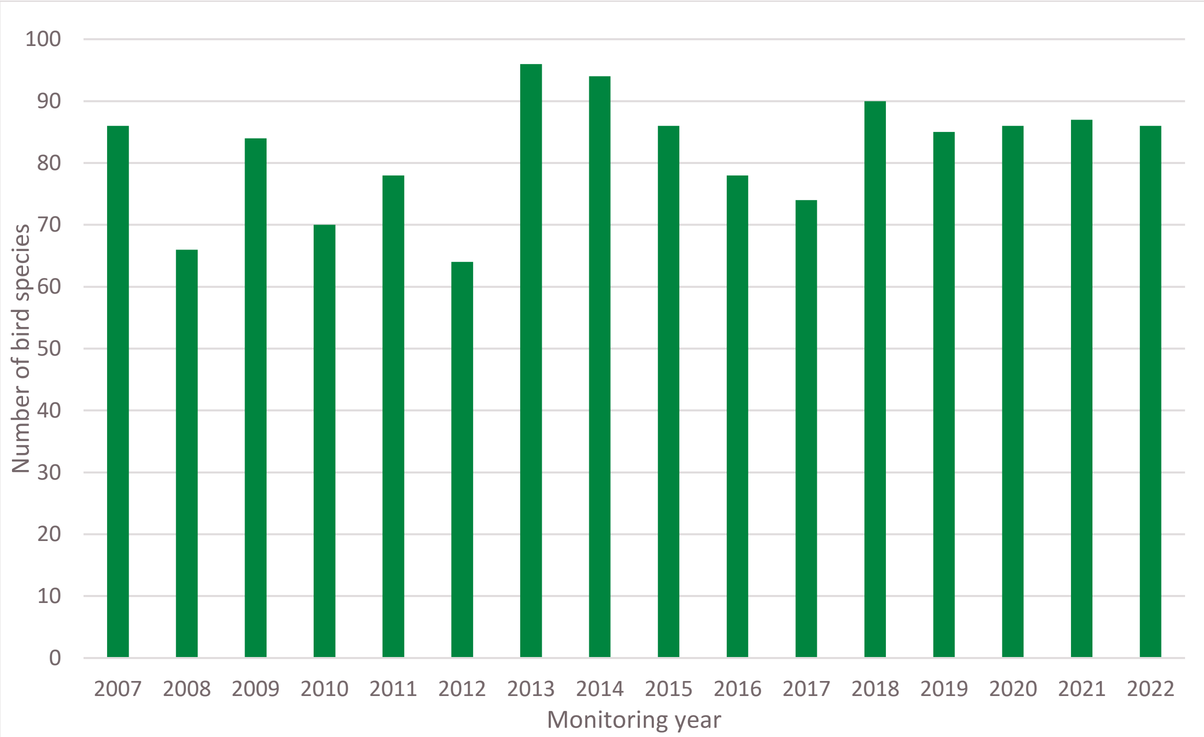


Figure 7: Number of bird species recorded at monitoring plots 2007 – 2022

In 2022, the average number of bird species per 20 minute bird survey (12.3) and bird species per site (19.5), was slightly higher than 2021 and similar to the previous years with available data (2015-2020) (Figure 10 and Figure 11).

The average number of birds recorded per survey was 27.9 in 2022, translating to a bird density of 14.0 birds/ha/20 mins. This represents an increase from the previous year (27.4 birds per survey), and is similar to the other years before 2021, with records ranging from 25.5 to 27.9 (Figure 14). Numbers of birds were not presented in RPS (2009), and it is assumed only bird species were recorded.

The most species-diverse site during 2022 was BP7 recording 30 species over the two surveys. BP3 and BP26 each recorded 29 species. Other species-diverse sites included BP8 (26 species), BP9 (24 species) and BP10 (24 species). BP23 had the lowest species diversity in 2022, with nine species recorded.

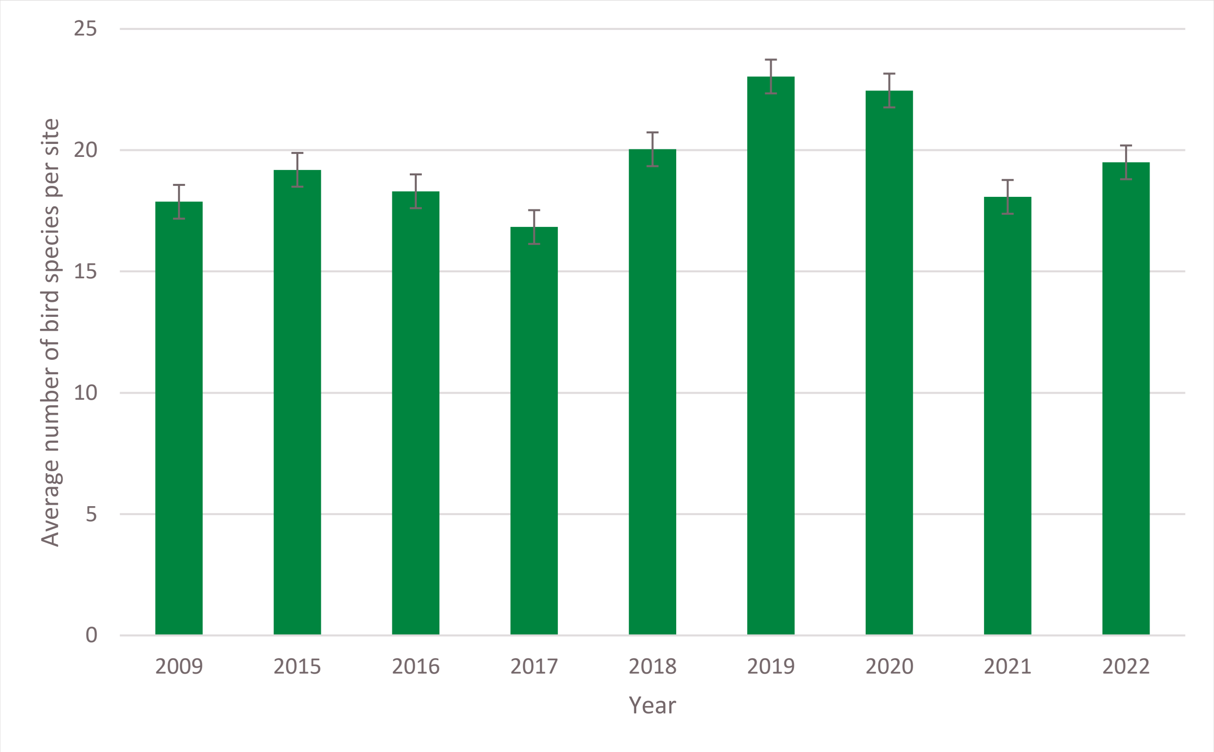


Figure 8: Average number of bird species recorded per monitoring site during 2009 and 2015-2022. Error bars represent the standard error of the mean.

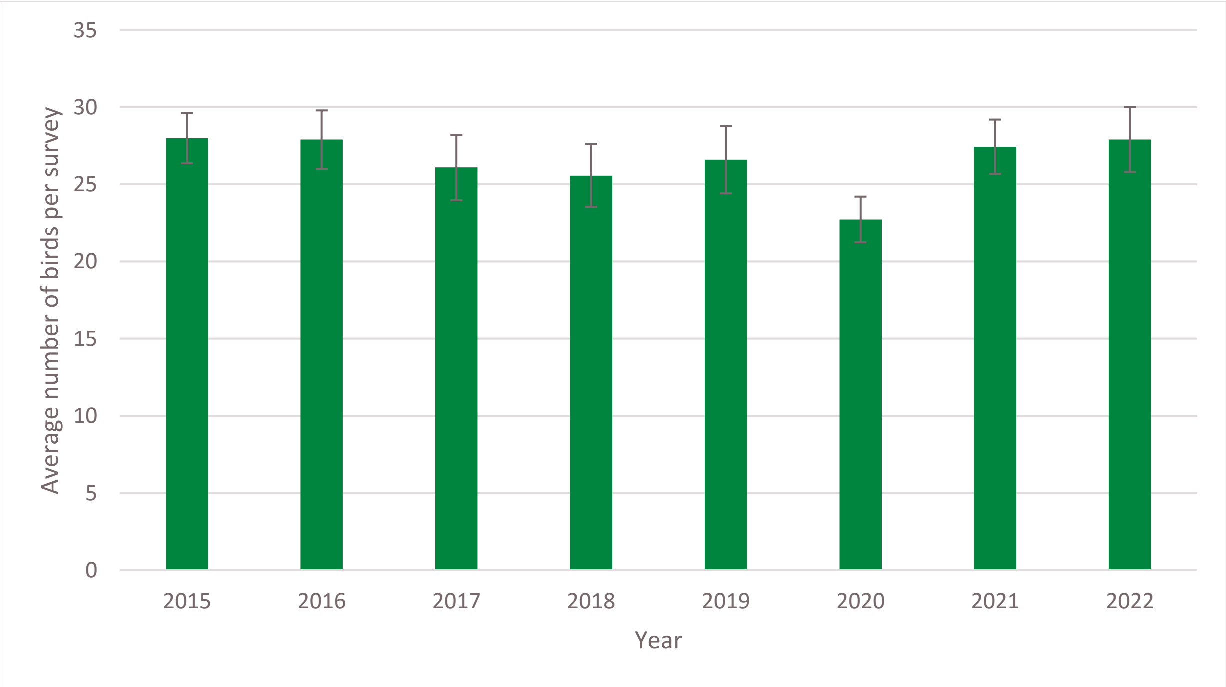


Figure 9: Average number of birds recorded per survey (2015-2022). Error bars represent the standard error of the mean.

Bird assemblages over time were not compared statistically, however, assemblages appear broadly similar to the previous seven years and also to data from 2009 monitoring. When comparing the 20 most widely recorded species from each year, the results from 2022 contain an average of 12.2 of the same species recorded in the top 20 for previous years. The most widely recorded species in 2022 were Yellow-faced Honeyeater (*Lichenostomus chrysops*), Superb Fairy-wren (*Malurus cyaneus*) and Rufous Whistler (*Pachycephala rufiventris*), all of which were also widely recorded in previous years. Two species were recorded in the top 20 widely recorded species for the first time; being White-naped Honeyeater (*Melithreptus lunatus*) and Eastern Whipbird (*Psophodes olivaceus*).

Five threatened species listed under the BC Act were recorded during 2022 surveys; being Dusky Woodswallow (*Artamus cyanopterus*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), Varied Sittella (*Daphoenositta chrysoptera*), Speckled Warbler (*Chthonicola sagittata* and Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*). These threatened species are part of a group that are regularly recorded during the monitoring surveys, with between five and eight threatened bird species annually recorded between 2014 to 2022.

Comparison of numbers of individuals of threatened species during the 2015-2022 monitoring periods and the number of sites they were recorded at during the 2009 and 2014 to 2021 monitoring periods was undertaken. Grey-Crowned Babbler was recorded at fewer sites than the previous year, with five individuals across three sites. Speckled Warbler was recorded from five sites, a decrease from the previous year, and a total of 6 individuals were recorded which is the lowest number of individuals recorded for this species. Varied Sittella was recorded from two sites with eight individuals recorded, which is a decrease from the previous year. Results for Dusky Woodswallow and Brown Treecreeper are within the range of previously recorded values.

2.2.4. Bird monitoring discussion

RWEA and other remnant woodland sites at WCPL continue to support a large diversity of bird species and no introduced bird species were detected within RWEA areas.

The average number of bird species per site remains consistent with the levels recorded in previous years. Overall diversity across all sites within RWEAs also remains high. Number of birds per survey returned to levels similar to previous years after a lower score was recorded in 2020 and it was recommended to continue monitoring this statistic.

As vegetation and habitat attributes in RWEA areas have remained relatively stable over time (see previous section), variability in diversity and abundance between years is likely explained by a combination of factors such as varying numbers of nomadic and migratory bird species, weather and climate, sampling methods, differences in the skill of observers, the timing of surveys and surveys coinciding with the flowering of trees and also broader landscape scale and seasonal changes across the Hunter Valley. The total number of bird species detected each year has varied over time and the 86 species recorded during 2022 is within the range of previous years.

Threatened species appear to be persisting well within the RWEAs, with Grey-crowned Babbler, Speckled Warbler, Little Lorikeet and Varied Sittella recorded in similar numbers than the previous year.

2.3. Nest box monitoring

2.3.1. Introduction

In 2018, a total of 50 nest boxes were installed in five clusters within RWEAs B, C and D (Figure 10). The nest boxes were installed in response to recommendations made in the 2015 Independent Environmental Audit, however no recommendations regarding monitoring were made.

In 2019, ELA recommended the establishment of a nest box monitoring program to document the use and effectiveness of the nest boxes and ensure they are maintained in usable condition. The BMP now details that nest boxes are to be inspected every two years. In November 2020, initial nest box inspections occurred representing the first survey of the next boxes since their installation. All 50 nest boxes were reinspected in September 2022 which represents the second round of monitoring to occur within the RWEA since the nest boxes were installed.

2.3.2. Methods

Nest box inspections were conducted by ELA ecologists Liam Scanlan and Daniel McKenzie on the 19th, 20th and 21st September 2022. Nest boxes were inspected using a GoPro Hero7 camera attached to an extendable fibreglass pole. The camera was connected and controlled via Bluetooth where the surveyor could take photographs and video.

Due to their open bottom design, microbat boxes were inspected visually from the ground using binoculars, with the inside of the box illuminated by torchlight. Details of species presence, indications of usage, and any maintenance issues were recorded.

2.3.3. Results

Four (8%) of the 50 nest boxes were occupied when inspected, one containing two Brushtail Possum (*Trichosurus vulpecula*), one containing a single Brushtail Possum, and one containing a single Gould's Wattle Bat (*Chalinolobus gouldii*). An additional 22 (44%) nest boxes showed signs of use. Twenty-four (48%) of the 50 nest boxes showed no evidence of usage. Three nest boxes had fallen to the ground and were replaced in March 2023.

Details of the three replacement nest boxes are provided below.

- Feather tail glider box installed on a Grey Box. RWEA B. 32.606458° S, 150.960143° E
- Feather tail glider box installed on a Grey Box. RWEA B. 32.606210° S, 150.959935° E
- Microbat box installed on a Spotted Gum. RWEA B. 32.592319° S, 150.960589° E

Nest box monitoring results are presented in Table 13, with inspection photographs in Volume 2.

Table 13: Nest box inspection results 2022

Box ID	RWEA	Nest Box Type	Tree Species	Height (m)	Aspect	Northing	Easting	Fauna Species	Notes
1	D	Glider	Slaty Gum	3.5	NW	6394218	307696	-	Not occupied, potential nest
2	D	Small Parrot	Slaty Gum	3.5	W	6394231	307730	-	Not occupied, entrance chewed, leaves present
3	D	Small Parrot	Slaty Gum	3.5	SE	6394292	307785	-	Not occupied, minor chewing.
4	D	Glider	Ironbark	4	NW	6394328	307746	-	Not occupied, chewing present on outside, leaf nest inside
5	D	Microchiropteran Bat	Slaty Gum	4.5	S	6394277	307747	-	Not occupied, no evidence of use
6	D	Microchiropteran Bat	Slaty Gum	2.9	N	6394217	307720	-	Not occupied, box slipped down from 5m to 2.9m
7	D	Galah	Slaty Gum	3.2	W	6394189	307726	-	Not occupied, box fallen from 5m to 3.2m
8	D	Galah	Slaty Gum	4	NW	6394298	307752	Common Brushtail Possum	Occupied by 1x Common Brushtail Possum
9	D	Pygmy Possum	Ironbark	3	S	6394312	307822	-	Not occupied, moderate chewing, leaves present
10	D	Pygmy Possum	Slaty Gum	3	SW	6394195	307769	-	Not occupied, leaves present
11	C	Small Parrot	Grey Box	3.5	NW	6393256	308564	-	Not occupied, chewing inside and outside
12	C	Small Parrot	Ironbark	3.5	W	6393198	308596	-	Not occupied, chewing present on outside. Insect molt found inside
13	C	Glider	Grey Box	3	E	6393262	308624	-	Not occupied, minor scratching/chewing present
14	C	Microchiropteran Bat	Ironbark	5	S	6393229	308601	-	Not occupied, no evidence of use
15	C	Microchiropteran Bat	Ironbark	5.5	W	6393278	308664	-	Not occupied, no evidence of use
16	C	Pygmy Possum	Grey Box	3	S	6393244	308689	-	Entrance and lid obstructed by termite nest
17	C	Galah	Ironbark	5	W	6393205	308574	-	Not occupied, minimal evidence of use
18	C	Pygmy Possum	Ironbark	3	W	6393204	308625	-	Not occupied, insect use present
19	C	Galah	Ironbark	5.5	W	6393218	308640	-	Not occupied, potential bird scats present
20	C	Glider	Grey Box	3	E	6393279	308587	-	Not occupied, minor marks around entrance, spider webs present
21	B	Pygmy Possum	Ironbark	3	SW	6392720	308929	-	Not occupied, entrance chewed
22	B	Pygmy Possum	Ironbark	3	SW	6392678	308927	-	Not occupied, evidence of minor use
23	B	Microchiropteran Bat	Ironbark	5	NW	6392628	308900	-	Not occupied, no evidence of use
24	B	Small Parrot	Ironbark	4.5	W	6392604	308870	-	Not occupied, heavily chewed, European Honeybees present
25	B	Microchiropteran Bat	Ironbark	4.5	W	6392641	308928	-	Not occupied, no evidence of use
26	B	Glider	Ironbark	3.5	N	6392612	308852	-	Not occupied, chewing, few leaves present
27	B	Glider	Ironbark	3.5	W	6392656	308831	-	Not occupied, entrance chewed, few leaves present
28	B	Galah	Ironbark	5.5	W	6392691	308840	Common Brushtail Possum	Occupied by 2x Common Brushtail Possums

29	B	Galah	Ironbark	5	SW	6392728	308933	Common Brushtail Possum	Occupied by 1x Common Brushtail Possum
30	B	Small Parrot	Ironbark	5	S	6392717	308894	-	Not occupied, entrance chewed
31	B	Galah	Ironbark	5	NW	6392064	308729	-	Not occupied, no evidence of use
32	B	Galah	Ironbark	5	W	6392098	30867	-	Not occupied, no evidence of use
33	B	Pygmy Possum	Ironbark	3	W	6392077	308686	-	Not occupied, leaf nest present in nest box
34	B	Pygmy Possum	Grey Box	3	E	6392126	308664	-	Not occupied, grubs and wood chips present
35	B	Small Parrot	Grey Box	4	SW	6392042	308632	-	Not occupied, entrance chewed
36	B	Small Parrot	Ironbark	4.5	E	6392021	308735	-	Not occupied, entrance chewed, spider webs present at entrance.
37	B	Microchiropteran Bat	Ironbark	5.5	W	6392018	308653	-	Not occupied, grubs and spider webs present
38	B	Microchiropteran Bat	Ironbark	3	W	6392060	308702	-	Not occupied, no evidence of use
39	B	Glider	Spotted Gum	4	SW	6392025	308629	-	Nest box on ground. Needs replacing back to 4m
40	B	Glider	Spotted Gum	4	NW	6392067	308629	-	Not occupied, no evidence of use
41	B	Microchiropteran Bat	Spotted Gum	5	E	6390496	308641	Gould's Wattled Bat	Occupied by 1x Gould's Wattled Bat
42	B	Microchiropteran Bat	Spotted Gum	5	SW	6390494	308587	-	Not occupied, no evidence of use
43	B	Galah	Spotted Gum	4	W	6390459	308571	-	Nest box on ground. Needs replacing back to 4m
44	B	Galah	Spotted Gum	5	W	6390504	308602	-	Nest box on ground. Needs replacing back to 5m
45	B	Pygmy Possum	Spotted Gum	3	W	6390438	308629	-	Not occupied, no evidence of use
46	B	Pygmy Possum	Grey Box	3	SW	6390499	308685	-	Not occupied, spiders present
47	B	Glider	Ironbark	3	SW	6390525	308617	-	Not occupied, minor chewing, huntsman spider present
48	B	Glider	Spotted Gum	4.5	SW	6390493	308658	-	Not occupied, chewing present
49	B	Small Parrot	Ironbark	4	W	6390441	308609	-	Not occupied, chewing present
50	B	Small Parrot	Spotted Gum	5	W	6390478	308734	-	Not occupied, tree is dead

2.3.4. Nest box monitoring discussion

This report represents the first inspection of nest boxes within the RWEAs since their installation in 2018. Nest boxes were generally in good condition, with some occupied, others with signs of use and three of the 50 requiring re-installation/replacement after falling.

All four of the occupied nest boxes contained common species, including Common Brushtail Possum and Gould's Wattled Bat, which are not a target of the nest box program. Future monitoring should continue to investigate potential use by other species, in particular the target species and threatened species.

Evidence of usage was recorded in a higher number of boxes than those that were occupied. Inspection earlier in spring may increase the likelihood of detecting other species using nest boxes for breeding.

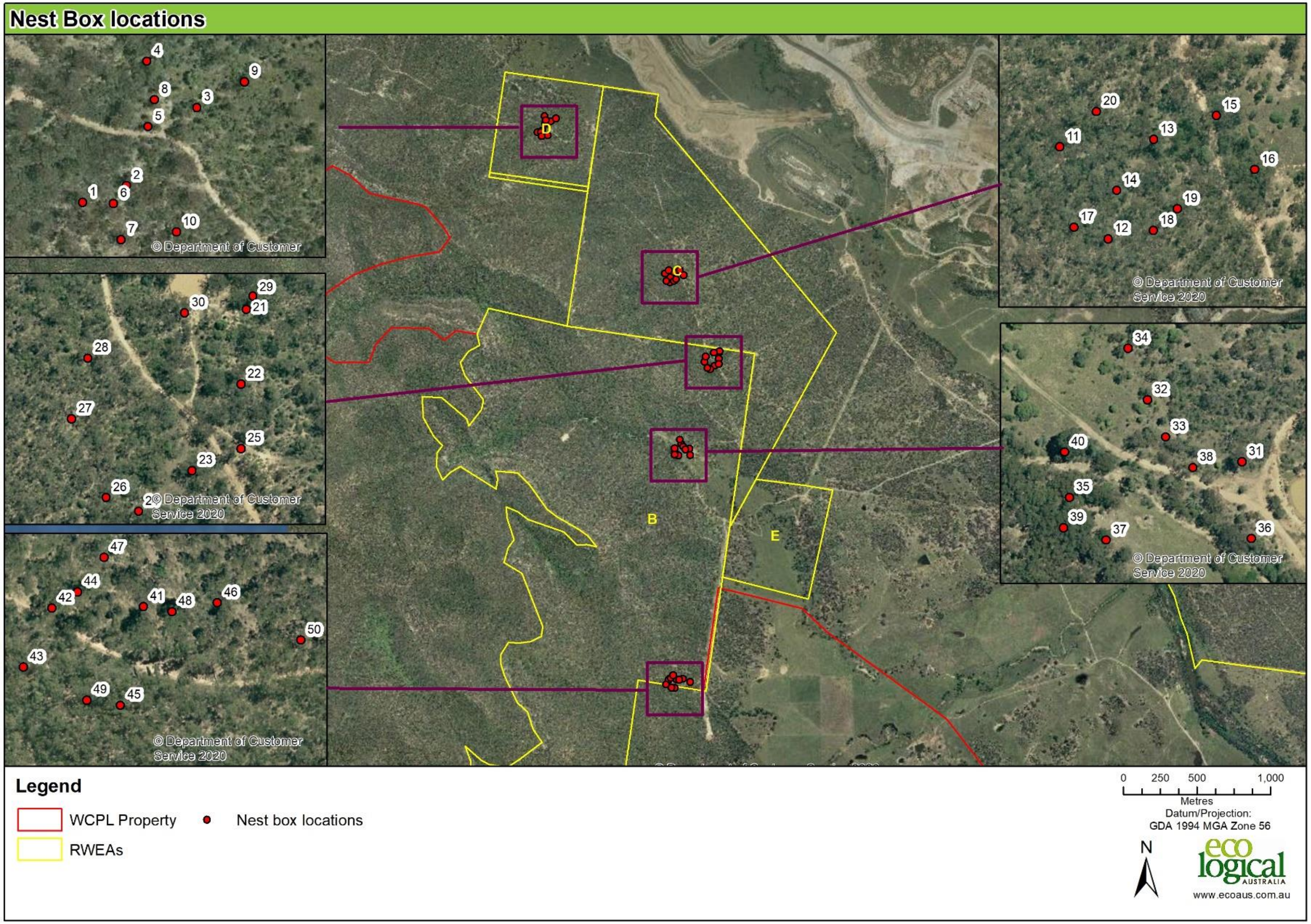


Figure 10: Nest box locations

3. Rehabilitation areas

3.1. Introduction

Rehabilitation areas are monitored using a combination of LFA and biometric plots. The rehabilitation objectives for the NWCD (WCPL 2015) include:

- To establish pasture species consistent with the revegetation strategy
- Tree species established along creek lines consistent with the riparian zone
- Creek diversion stable and will not present a greater safety hazard than surrounding land
- Creek diversion able to shed water safely without causing excessive erosion, jeopardising landform integrity or increasing pollution of downstream watercourses
- All watercourses subject to subsidence impacts shall be hydraulically and geomorphologically stable, with riparian vegetation established that is the same or better than prior to commencement of mining.

Completion criteria for the NWCD have been developed using previous monitoring results from relatively undisturbed and natural landscapes surrounding the mine. These are listed in each results table below.

Additional completion criteria for these rehabilitation areas are listed in the Mining Operations Plan (WCPL, 2015) and include ensuring that:

- Minimum 70% of area has a vegetative cover
- No single bare area >20m2
- Biometric monitoring confirms exotic cover <33%
- No tunnel or gully erosion is to be present
- Rill erosion is to be limited to <200 mm deep and/or <200 mm wide.

LFA monitoring at WCPL focusses on scores for Landscape Organisation, Stability, Infiltration/Runoff and Nutrient Cycling. Landscape organisation relates to the proportion of the transect occupied by patches - patches being landscape elements that are relatively permanent and provide stable, resource accumulating structures, such as grassy tussocks and other ground cover, leaf litter and logs. Therefore, a larger Landscape Organisation Index (LOI) number implies a more stable transect that traps water and nutrients and is less prone to soil erosion.

A Soil Surface Assessment (SSA) is completed for each patch type on each LFA transect. Five ‘query zones’ are selected for each patch type where possible. Scores are recorded for rain splash protection, vegetation cover, plant litter cover, cryptogam cover (cover of algae, mosses and liverworts, lichen and fungi), crust brokenness, erosion type and severity, deposited materials, surface roughness, surface nature and the stability and texture of the soil. These soil surface indicators are then used to give Stability, Infiltration/Runoff and Nutrient Cycling scores for each transect.

Stability is defined as the ability of the soil to withstand erosive forces, and to reform after disturbance. The stability index is derived from data collected during the SSA’s, such as crust broken-ness, surface resistance, slake tests, erosion type and severity, deposited materials, cryptogam cover, rain splash protection and leaf litter cover.

Infiltration concerns the way water interacts with soil to become soil water (and becomes available for plants) or runoff water where water is lost from the system or transports materials (such as soil, nutrients and seed) away. Scores for vegetation cover, surface roughness, slake tests, litter cover, origin and decomposition, surface resistance to disturbance and soil texture contribute to the infiltration index.

Nutrient cycling is defined as how efficiently organic matter is cycled back into the soil. Scores for vegetation cover, litter cover, origin and decomposition, cryptogam cover and surface roughness contribute to nutrient cycling values.

3.2. Methods

3.2.1. LFA

LFA data was collected from a total of nine monitoring sites, including eight in the riparian rehabilitation areas at the NWCD and one reference site in riparian pasture near South Wambo Creek (site 14R) (Figure 13). LFA methods followed the method for Landscape organisation and SSA, as provided in Tongway and Hindley (2004). LFA data was collected by ELA ecologists Liam Scanlan, Daniel McKenzie and Alex Yates between September – December 2022. Several field trips were required over this timeframe due to high rainfall creating inaccessible track conditions.

Previously monitored woodland and pasture rehabilitation sites are located on land no longer managed by WCPL and have now been excluded from the monitoring program. As such, these sites were not monitored by ELA in 2022.

Raw numerical values from previous years were available for Landscape organisation, Stability, Infiltration and Nutrient cycling indices. Creek diversion sites were first sampled at the completion of the creek diversion construction and subsequent seeding in 2008, with additional sites added in 2015 after an extension to the creek diversion. Trends in these values over time along with general field observations were used to inform management recommendations.

Performance criteria have previously been developed from a range of scores from previous monitoring years from nearby sites with relatively undisturbed riparian habitat. The following colour system is used to highlight the performance of each LFA site as shown below in Table 14.

Table 14: Colour system highlighting the performance of each LFA site

Green	Yellow	Orange	Red
Area generally meets or exceeds target values and values do not show trend of decline over time – where monitoring sites are meeting targets and values are relatively consistent, reduce monitoring to infrequent LFA when changes in landscape or management practices occur i.e. fire or grazing)	Area generally falls below target values but within 75% of targets or appears to be on a trajectory of improvement without the need for management intervention – further monitoring required	Area generally falls between 75% and 50% of target values or shows little sign of improvement over several monitoring events – further monitoring and possibly management actions required	Area falls below 50% of target and is unlikely to improve without management actions or shows trend of decline which is unlikely to improve without management actions

3.2.1.1. Future use of LFA

The use of LFA for future monitoring of rehabilitation areas is currently under review following recommendations made by the BCD of the NSW DPIE on the Wambo Coal Mine Phase 2 RMP. BCD suggested the use of LFA should be reconsidered as recent peer reviewed articles have indicated LFA may not be appropriate for monitoring post mining landscapes (Erskine et al. 2013).

Any changes to the proposed monitoring methodology for rehabilitation at the Wambo mine will be incorporated into an updated BMP for approval prior to implementation. As LFA is the currently approved monitoring methodology it has been continued in 2022.

3.2.2. Floristic monitoring

Floristic monitoring is undertaken using the BioMetric plots as described in Section 2.1.2. Two new sites were established within the NWCD in 2020 (Figure 2).

Floristic monitoring targets for the NWCD have been derived from the NWCD Revegetation Management Plan (Cumberland Plains Seeds 2019) and are based on a combination of Benchmark Values for River Red Gum/ River Oak riparian woodland wetland in the Hunter Valley and Narrow-leaved Ironbark– Grey Box – spotted gum shrub grass open forest of the central and lower hunter. The exotic plant cover target has been modified to match the performance criteria for the NWCD from the Wambo Mining Operation Plan (WCPL, 2015).

Refinement of floristic monitoring locations and target values within the NWCD may be appropriate following additional remediation and revegetation works planned during 2020-2025 under the NWCD Management Plan (WCPL, 2020). The original intention of the NWCD was to establish riparian vegetation, however analysis of soils and water flows has indicated that a combination of woodland and riparian vegetation is more appropriate (WCPL, 2020). Additional monitoring to assist in identifying success or issues with early-stage revegetation was recommended in the NWCD Revegetation Management Plan (Cumberland Plains Seeds, 2019). This monitoring was undertaken by Cumberland Plains Seeds in 2021 and is reported separately in the NWCD Monitoring Report (Cumberland plains Seeds, 2021).

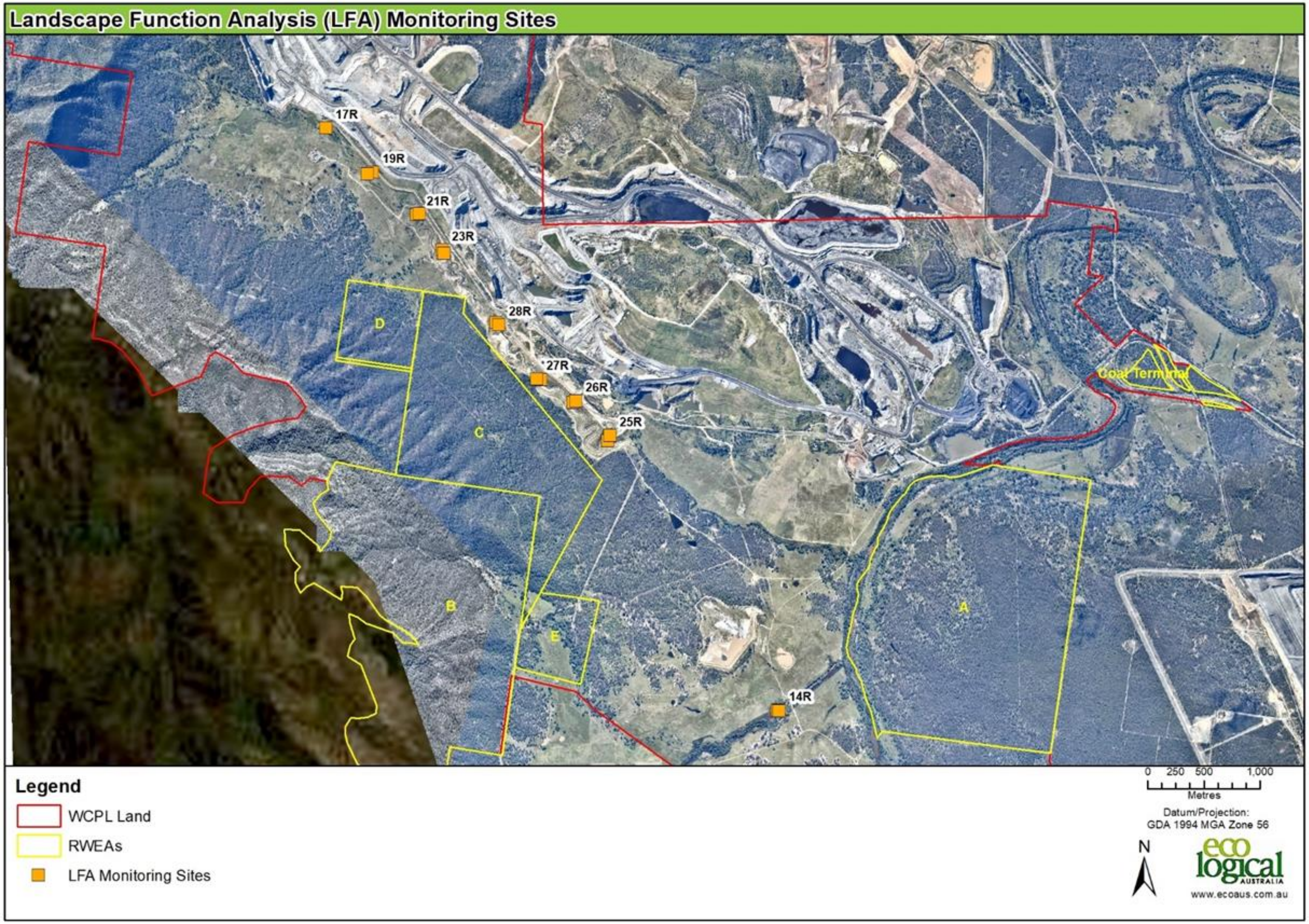


Figure 11: Landscape Function Analysis monitoring sites

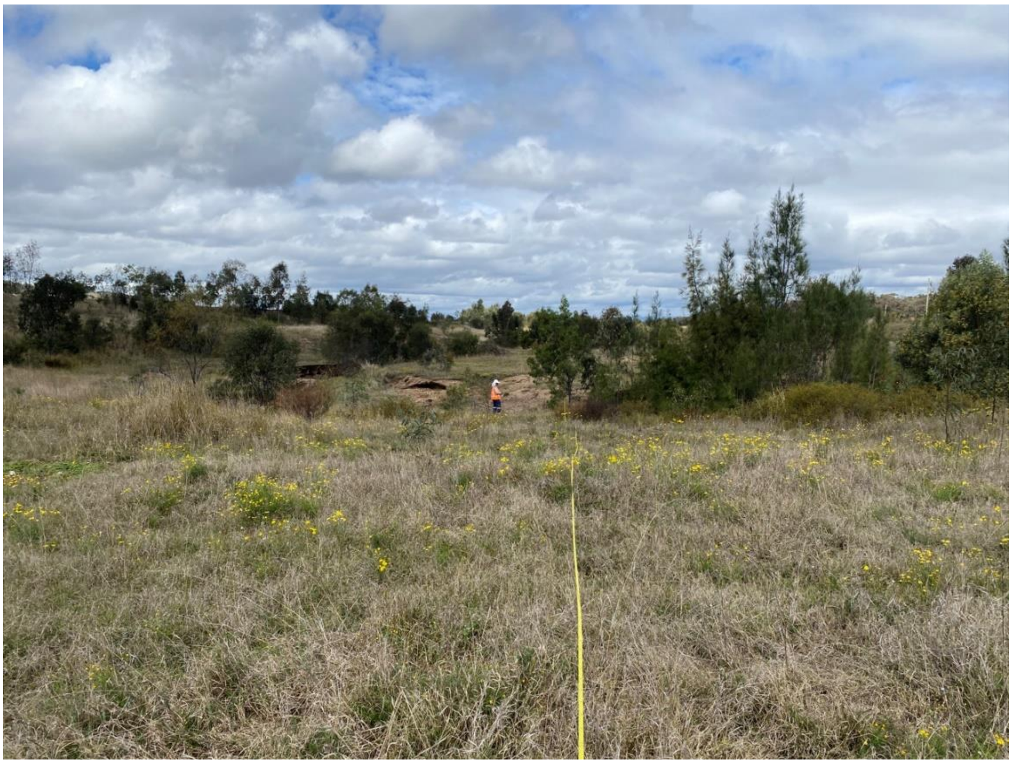
3.3. Results

3.3.1. North Wambo Creek Diversion

3.3.1.1. Landscape Function Analysis

Monitoring sites within the NWCD area are variable in condition (Table 15), with monitoring sites described in Table 16. Most monitoring sites are open pasture areas and generally have low diversity of native plant species and consist of predominantly low grass, primarily *Cynodon dactylon* (Common Couch), with tussocks of *Chloris gayana* (Rhodes Grass) and S*etaria* sp. Native *Acacia* spp. and *Eucalyptus* spp. saplings and shrubs continue to develop in the south of the diversion area as a result of direct seeding works and are present in some transects, particularly sites 25R, 26R and 27R, and some trees are now up to 7 m tall. Natural establishment of *Casuarina cunninghamiana* and *Eucalyptus* spp. in the creek bed, particularly in the north of the creek diversion, also continues (Photograph 17). Erosion was observed in some areas of the creek channel, including gully erosion (Photograph 18).

It is important to note that significant soil remediation works have been undertaken at the NWCD during 2020 and 2021 by the NSW Soil Conservation Service and vegetation rehabilitation is continuing with land management contractors.



Photograph 17: North Wambo Creek Diversion during 2022 showing canopy regeneration near the channel (site 23R)

Photograph 18: Gully erosion within the North Wambo Creek Diversion (near site 23R) in 2022

Table 15: North Wambo Creek Diversion LFA results in 2022 (Transects are listed by location - upstream to downstream)

Monitoring Plot	LOI	ST	INFI	NI
17R	1.00	57.7	49.0	39.5
19R	1.00	55.3	43.0	34.6
21R	0.96	51.0	39.5	32.7
23R	1.00	62.7	42.0	36.5
28R	0.66	54.8	29.4	23.9
27R	1.00	55.7	35.2	27.3
26R	1.00	67.8	39.3	36.1
25R	0.79	49.2	35.6	24.8
Average score	0.93	56.78	39.13	31.93
Target score	>0.84	>62	>41	>37
14R (reference site)	1.0	57.7	49.0	39.5

The average LOI score was 0.93 and was above the performance target (>0.84). The scores show an overall increase compared to the previous three years, and significantly higher than the four years before that (2015-2018).

Site 23R previously recorded the lowest LOI score, due to a bare slope in the middle of the transect in previous years. However, this site scored 1, the maximum score, reflecting that recolonization of grass species is occurring on the bare patch at this site.

Site 23R and adjacent areas have issues with erosion (also noted in previous reports), with rills, scalds and eroding creek banks recorded close by. Several rills and areas of gully erosion exceed the depth specified in the completion criteria in regard to erosion control (WCPL 2015). In 2020 and 2021, soil remediation works were being undertaken in the vicinity of these areas.

Sites 17R, 19R, 23R, 28R, 27R, 26R, and 14R all recorded an LOI score of 1, reflecting that the entire transects were covered in resource accumulating patches (Figure 12). The increases observed this year are likely a result of expansion of existing ground covers over small patches of bare soil, occurring in response to relatively high rainfall.

The average stability index at creek diversion sites in 2022 was 56.78% and did not meet the performance target (62%), however the score is very close to the analogue site (57.7%) and has remained stable over time (Figure 13).

The average infiltration index was 39.13% and fell below the performance target of 41%. This is a slight increase from the previous years (Figure 14). The majority of sites recorded increases due to the higher cover of grasses or remained stable. The changes in infiltration score at these sites reflect the relative propensity for water to run-off from the site rather than enter the system as soil-water. Analogue site 14R achieved the target score, as well as 17R, 19R and 23R.

The average nutrient index was 31.93% and fell below the performance target of 37%. This result is a slight increase from the previous year (Figure 15). All sites recorded higher or similar nutrient index scores than in 2021, except for site 26R which recorded a slightly lower score. The decrease in nutrient index at this site suggests the system is less efficient at cycling organic matter back into the soil. This result is caused by changes in nutrient indicators such as litter and cryptogam cover, perennial basal cover and surface roughness. Analogue site 14R achieved the target score, as well as site 17R.

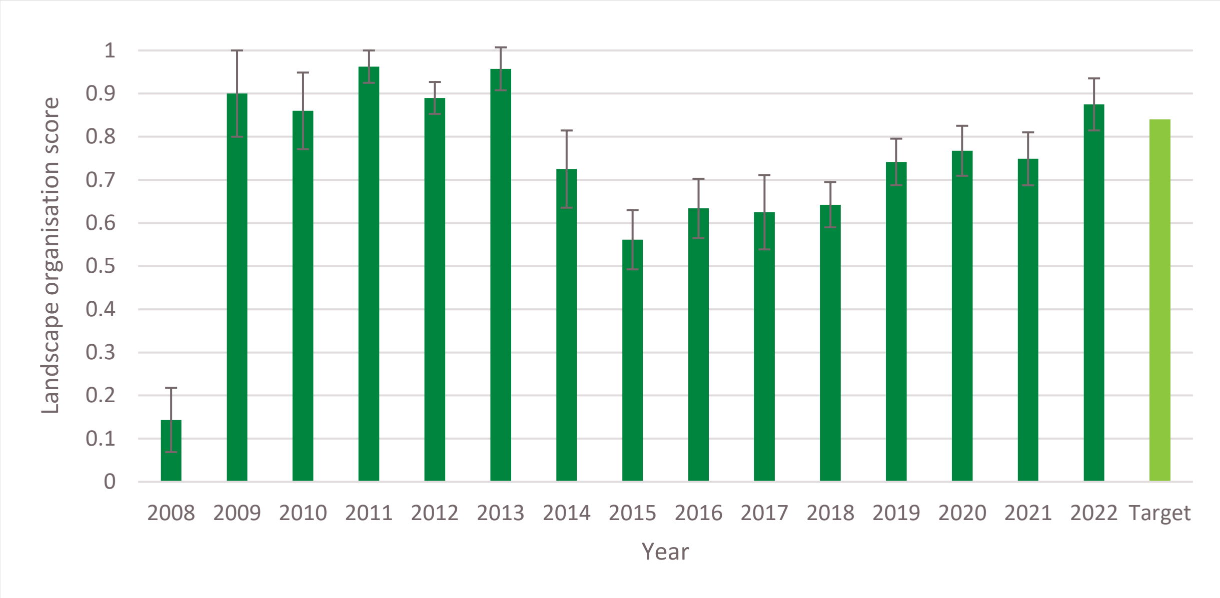


Figure 12: Average landscape organisation scores from the creek diversion sites. Note: Average scores from 2015 onwards incorporate four additional sites (25r, 26R, 27R and 28R). Error bars represent standard error of the mean. Only 3 sites 19R, 21R and 23R were sampled in 2008. The target bar represents completion criteria for the Landscape Organisation Index.

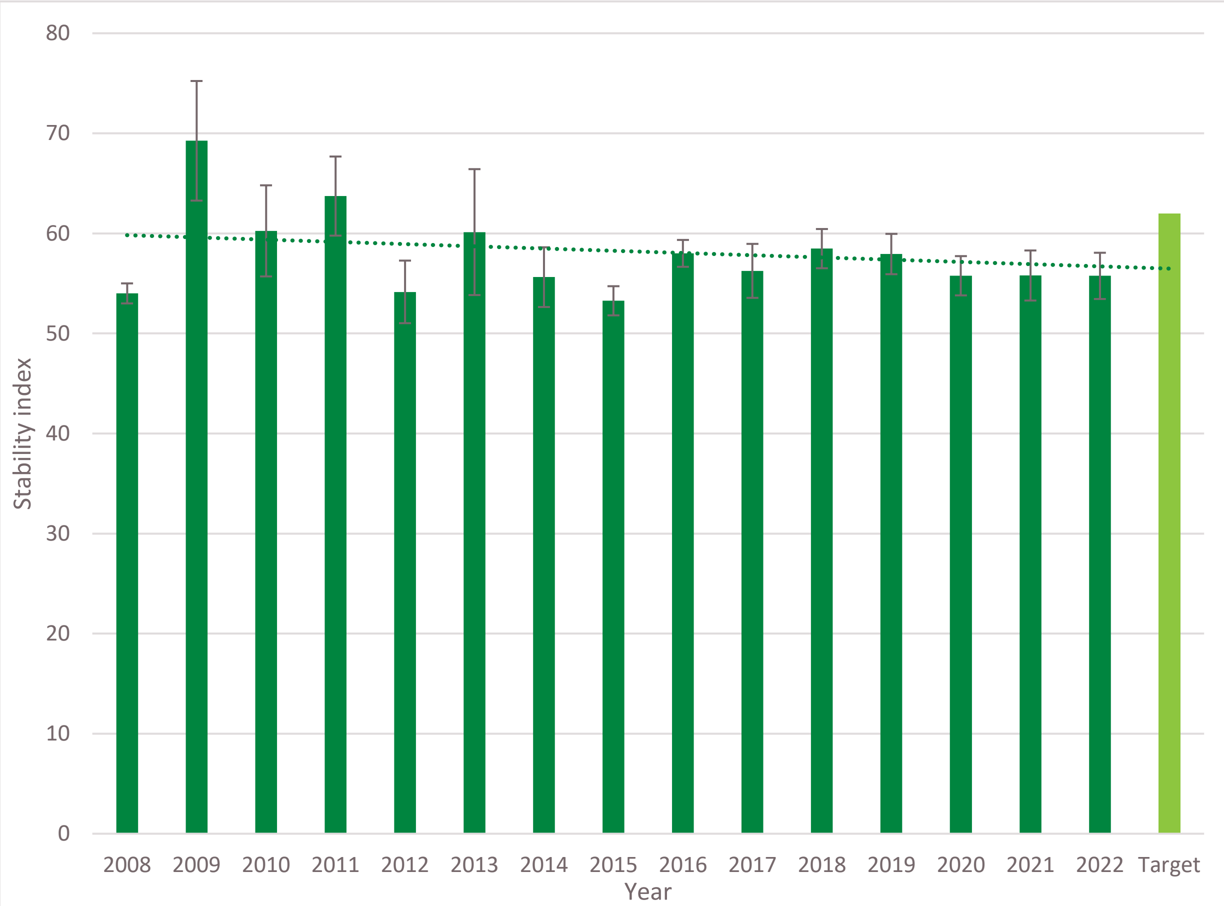


Figure 13: Average stability index values from the creek diversion sites. Note: Values are derived from sites 17r, 19r, 21r and 23r each year since 2009-2014. Average scores from 2015 onwards incorporate four additional sites (25r-28r). Error bars represent standard error of the mean. Only sites 19R, 21R and 23R were sampled in 2008. The target bar represents completion criteria for the Stability Index.

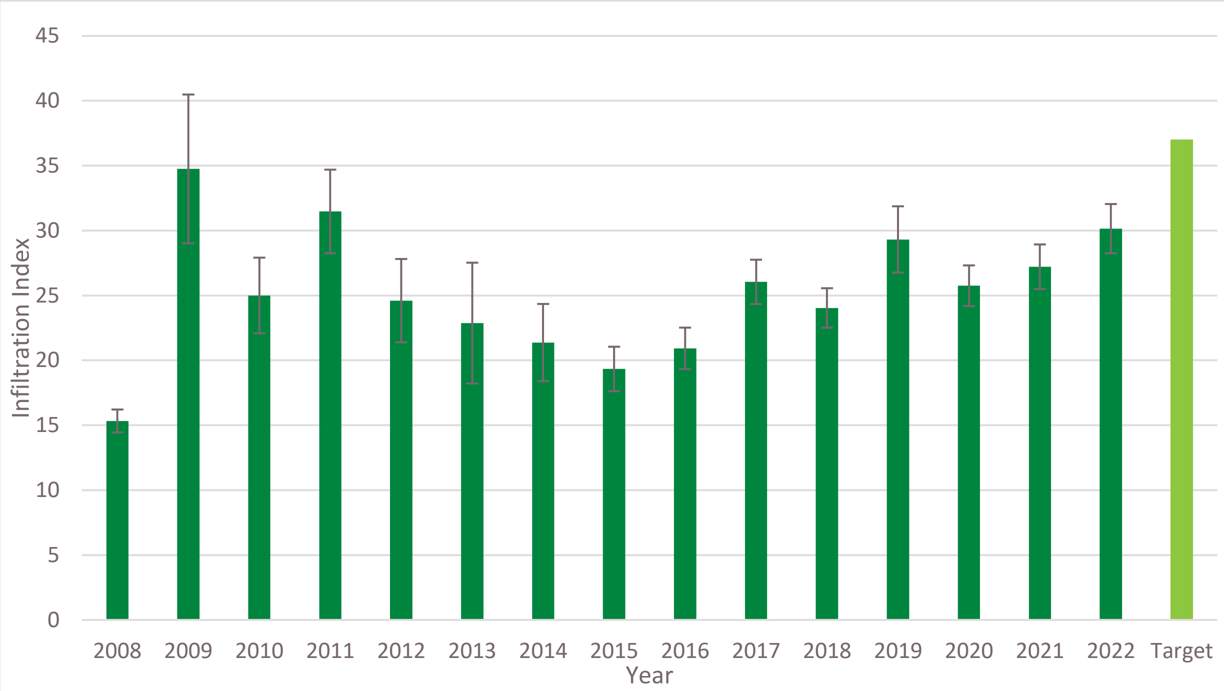


Figure 14: Mean infiltration index values from the creek diversion sites. Note: Values are derived from sites 17r, 19r, 21r and 23r each year between 2009 -2014. Average scores from 2015 onwards incorporate four additional sites (25r-28r). Error bars represent standard error of the mean. Only sites 19R, 21R and 23R were sampled in 2008. The target bar represents completion criteria for the Infiltration Index.

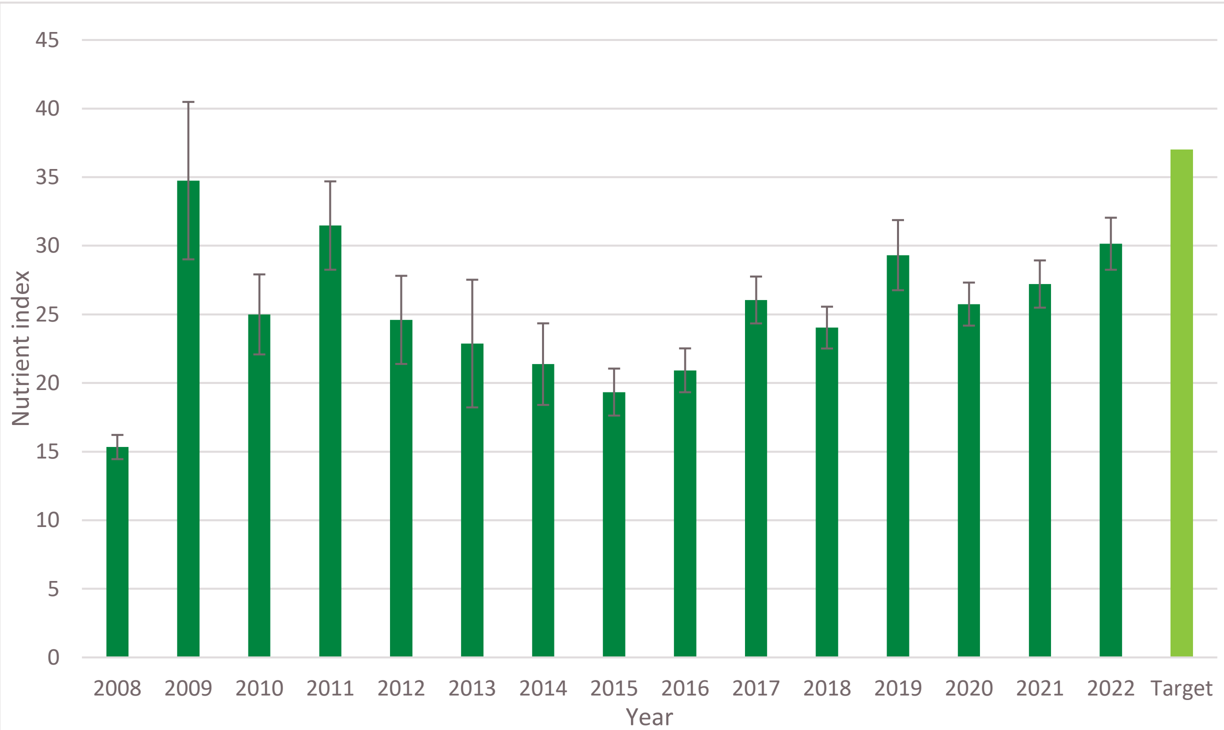


Figure 15: Mean nutrient index values from the creek diversion sites. Note: Values are derived from sites 17r, 19r, 21r and 23r each year between 2009 -2014. Average scores from 2015 onwards incorporate four additional sites (25r-28r). Error bars represent standard error of the mean. Only sites 19R, 21R and 23R were sampled in 2008. The target bar represents completion criteria for the Nutrient Index.

Table 16: Site description of each creek diversion LFA transect

Transect	Notes	Photograph
17R	This transect consists of relatively flat ground covered in pasture with a combination of grassy patches (primarily *Cynodon dactylon*) and grass tussocks (primarily exotic *Setaria sphacelata* and *Chloris gayana*), together the entire transect.	
19R	Transect relatively flat and comprised primarily of low grass (*Chloris gayana*) and *Galenia pubescens* with a low amount of bare soil. The bare ground was present as numerous small interpatch areas. Young *Eucalyptus* and *Acacia* species continue to develop on creek banks downstream.	
21R	Transect relatively flat grassland dominated by annual exotics and low grass. An increase in annual cover and decrease in bare ground was recorded from the previous year.	

Transect	Notes	Photograph
23R	Low grass occurs over much of the transect, similar to recent years, with shrubs also covering some areas. Large bare patches of stony soil occur towards the middle and end of transect where there is a slope (not visible in photo). Bare soil patches cover a high proportion of the area. Some areas of active erosion including some >30cm deep rills occur in the surrounding area. The creek bank is in this area has been undercut. Regenerating *Casuarina cunninghamiana* (up to 8m) and some Eucalypts and *Acacia* sp. are present in and near the channel.	
28R	Transect primarily samples the relatively steep eastern creek bank. The majority of this transect was ripped to control *Galenia pubescens* and erosion prior to the 2017 monitoring. The dominant patches were low grass and tussocks, with tussocks present on the lower slopes and flat at the end of the transect. Grass cover has increased since previous years suggesting the slope is stabilising.	
27R	Transect samples the relatively steep western bank of the NWCD. The majority of this transect was ripped to control *Galenia pubescens* and erosion prior to the 2017 monitoring. Low sparse grasses and logs dominate the flat area adjacent to the creek channel. The transect is dominated by low grass, tussocks and logs, and shrubs and trees has continued to establish.	

Transect	Notes	Photograph
26R	Transect samples the relatively steep eastern bank to the edge of the creek channel. Low grass and tussocks dominated this transect in 2020. Bare soil areas and logs make up the remainder. The transect remained similar to previous years. *Acacia* spp. shrubs are continuing to establish on some sections of the bank near this transect.	
25R	This slope is relatively steep with low grass dominating 58% of the transect and having the highest contribution to soil stability. Shrubs, tussocks and logs are also present, with tussocks and logs dominant on the lower bank. *Acacia* sp. and Eucalyptus shrubs and small trees are continuing to develop in and near this transect.	

3.3.1.2. Floristic monitoring

Two floristic monitoring sites were established within the NWCD area in 2020 (Figure 2; Photograph 19 and Photograph 20). Results of the 2022 floristic monitoring are presented in Table 17.

Results in relation to the performance criteria were mixed. NGCG exceeded the target and OR was recorded at both sites which is a positive result.

Native species richness has decreased since 2021, however, was similar to 2020 levels and the target has not been reached. EPC was above the target, at the highest level to date. Interrogation of floristic plot data suggests a significant proportion of the EPC is attributable to annual species such as *Lysimachia arvensis* (Scarlet Pimpernel), *Chloris gayana* (Rhodes grass) and *Setaria* spp. This is not an unexpected result, as the rehabilitation is still in early stages and it is expected that exotic groundcover will decrease as shrub and tree cover develops. NOS and NMS targets were not met however these are likely to take longer to reach for these rehabilitation areas.

These results represent the second floristic monitoring undertaken within the NWCD since the sites were established in 2020. Ongoing monitoring will provide further insights into the vegetation condition and trajectory. Inclusion of additional monitoring sites and methods is likely to assist assessment of the vegetation condition and performance.

Table 17: Biometric scores for NWCD moniotring sites and performance criteria

PCT	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Target: PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	NWCD1	10	0	0	42	0	0	94	1	0	75
	NWCD2	17	0	0	82	0	0	82	0	0	2
Average 2020		14.5	0	0	26	0	3	50	1	0	35
Average 2021		19	0.25	0.4	34.6	0.05	0.15	28.65	1	0	38.5
Average 2022		14	0	0	62	0	0	88	1	0	39
Performance criteria		>20	10-50	10-50	20-60	1-5	5-30	<33	1	-	-

Photograph 19: NWCD Biometric Plot 1 in 2022

Photograph 20: NWCD Biometric Plot 2 in 2022

3.4. Conclusion and recommendations

3.4.1. North Wambo Creek Diversion

The NWCD met the completion targets for LOI based on average scores across all sites. Almost all individual sites met this target with the exception of 28R and 25R, which were 78% and 94% of the target respectively.

For all other indices, the scores were within at least 85% of the target values.

Casuarina and *Eucalyptus* spp. have continued to develop within the creek channel and patches of Acacia and Eucalyptus shrubs are present in places, particularly in the downstream reaches of the NWCD, and appear to have grown significantly in the past three years of higher rainfall. Nevertheless, a large proportion of the creek diversion remains primarily open pasture with high cover of exotic species. Riparian vegetation is considered unlikely to be 'better' than prior to the diversion and the proposed net increase in riparian vegetation (which included establishing *Angophora floribunda*, *Casuarina cunninghamiana* and a selection of native grasses in the riparian zone) (Resource Strategies, 2003) is yet to be achieved.

Floristic monitoring resampled the two plots established in 2020 for the second time. Sites achieved targets for native ground cover of grasses and are showing good signs of native species diversity. Sites did not meet targets for shrub and canopy cover, however these are expected to take longer to achieve. The sites also had high exotic plant cover which is not unexpected due to the high light environment of the early-stage rehabilitation, and high rainfall has likely favoured exotic grasses which have outcompeted native species.

Some areas of erosion that exceed completion criteria targets are present, with some gully erosion, deeper rills and large areas of bare soil observed. Significant soil remediation works have been undertaken within the NWCD in 2020 and 2021 by the Soil Conservation Service and works are continuing. The works include several new rock chutes manage drainage and erosion and ripping to stabilise soil and are likely to lead to significant improvement to the condition of the NWCD over time.

Monitoring should continue, although it is noted that LFA monitoring is proposed to be replaced by the monitoring undertaken by Cumberland Plains Seeds to assess vegetation establishment following recommendations from DPIE. This change in methodology should be incorporated into the next update of the site BMP.

Additional floristic monitoring sites are likely to be required to fully characterise the vegetation performance along the NWCD. Floristic monitoring sites should be established across the full range of revegetation areas, i.e. if the final revegetation plan includes multiple target communities such as woodland and riparian areas. In areas of newly established revegetation additional monitoring methods may also assist in assessing success and provide data to guide future works, if required. This early-stage monitoring should be undertaken using the tailored vegetation establishment monitoring methods (Cumberland Plains Seeds 2020), before transitioning to BioMetric plot monitoring once vegetation has established.

In light of the currently active management works, no further management actions are currently recommended, however ongoing active management including soil stabilisation, planting native species and weed control will be required following completion of the current works.

4. Riparian condition assessment

4.1. Introduction

The riparian monitoring program is a requirement of the 2004 Development Consent conditions. The objective of the monitoring program is to evaluate how the riparian environment is responding to management initiatives (such as cattle exclusion) and document any impacts arising from mine subsidence.

North Wambo Creek drains the mid and eastern sections of the North Wambo Underground Mine development area and flows south-east into Wollombi Brook, approximately 600 m south of the mine (Figure 16). North Wambo Creek has been highly disturbed both by historic and present grazing activities and by the NWCD. The North Wambo Creek diversion channels the creek around the open-cut mining operation, flowing downstream into Wollombi Brook.

Stony Creek drains from Mount Wambo in a north-east direction and meanders across the western boundary of coal lease (CL) 397 near the south-western boundary of the North Wambo Underground Mine and passes in a south-easterly direction through the existing underground development area of WCPL to join Wambo Creek. Wambo Creek then runs east to join Wollombi Brook. Much of the riparian zone along Wambo Creek has been disturbed by historic agricultural activities.

4.2. Methods

Field sampling for the riparian monitoring was undertaken in September, October and November 2022. The *Rapid Appraisal of Riparian Condition* method (RARC), developed by Jansen et. al. (2005) and used during the 2016 to 2020 monitoring, was utilised during the 2022 survey period. Using this method, an overall score is obtained at each monitoring site by examining the width of riparian vegetation, proximity to large patches of native vegetation, vegetation cover, debris (leaf litter, standing dead trees and fallen logs) and other features (native canopy and understory regeneration, tussock grasses and reeds on creek banks). Areas monitored were:

- North Wambo Creek
- (South) Wambo Creek
- Stony Creek.

Methods followed Jansen et. al. (2005) with four 40 m long cross-section transects sampled at each monitoring site (an approximate 500 m length of riparian zone). Three monitoring sites were measured along each creek. The location of monitoring sites and transects is illustrated in Figure 16 with photographs presented in Volume 2.

The three creeks and sample sites were compared in regard to the following sub-indices:

- *Habitat* - longitudinal continuity of canopy vegetation (> 5 m wide); width of riparian canopy vegetation; and proximity to nearest patch of native vegetation > 10 ha

- *Cover* - vegetation cover and structural complexity
- *Native* - dominance of native species versus exotic species
- *Debris* - leaf litter; standing dead trees; hollow-bearing trees; and fallen logs
- *Features* - other indicative features such as regeneration, presence of large native tussock grasses (e.g. *Austrostipa* spp.) and reeds.

The five sub-indices were assessed across the three separate reaches of each creek and were combined to create a *Total Score.* Site photos and scores from previous monitoring reports (ELA (2016 to 2021) were compared. Although not directly comparable due to differing site locations and methodologies, data and photos from Niche (2014d) and RPS (2009) were also reviewed.

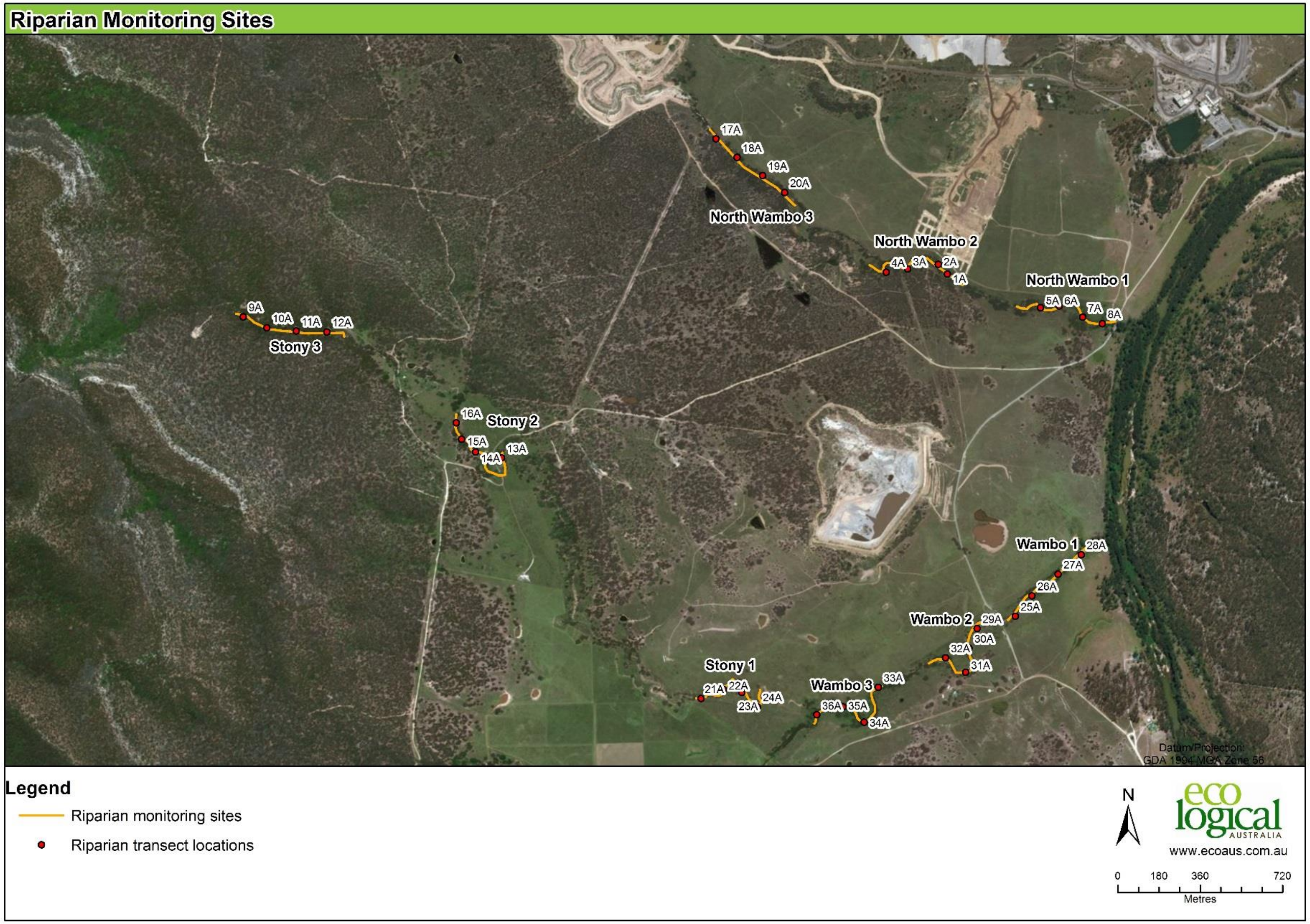


Figure 16: Location of riparian monitoring cross-sections and transects

4.3. Results

The results of the riparian condition monitoring are presented below, with raw data included in Volume 2.

The average total score for Stony Creek and North Wambo Creek were similar to the 2021 results. North Wambo Creek and South Wambo Creek recorded a decline in the average total score compared to 2021. Stony Creek recorded an increase in the average total score compared to 2021 and recorded its highest score in 2022 (Figure 17).

South Wambo Creek remains the lowest scoring creek system based on the sub-indices measured.

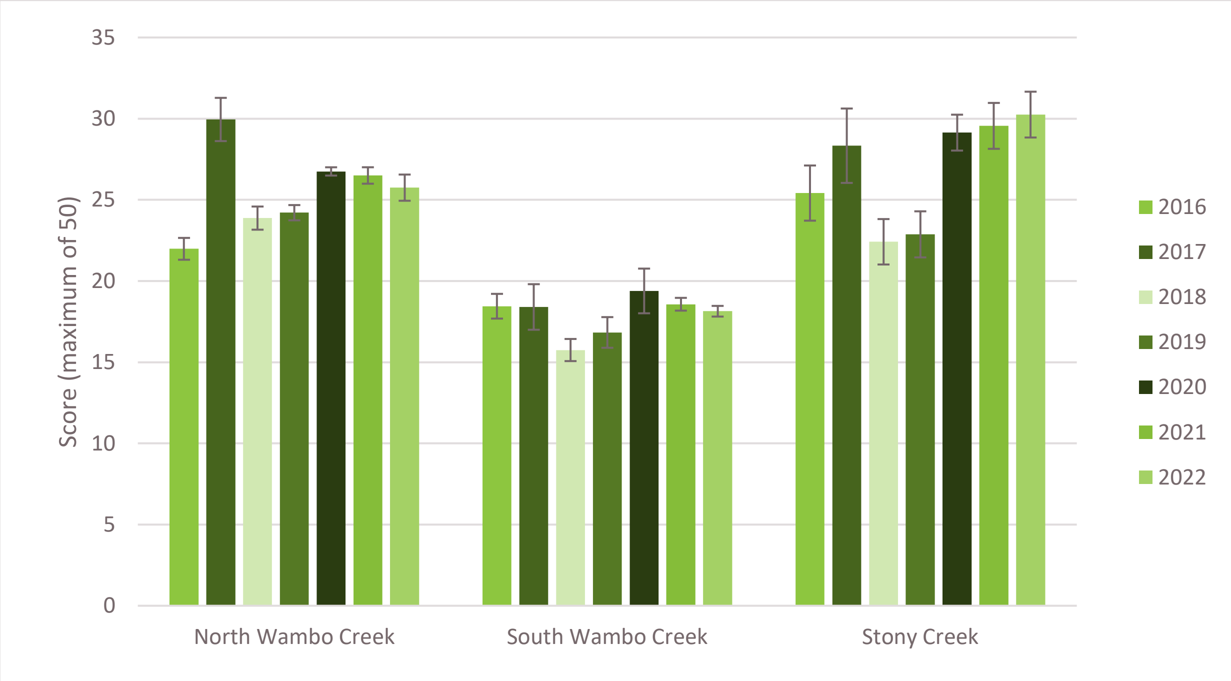


Figure 17: Average "Total Score" for North Wambo Creek, South Wambo Creek, and Stony Creek, from surveys in 2016 - 2022. Error bars represent the standard error of the mean.

4.3.1. North Wambo Creek

North Wambo Creek recorded similar scores for all sub-indices to previous years. This site has acceptable scores for habitat, cover and debris.

4.3.2. South Wambo Creek

South Wambo Creek has consistently been the lowest scoring site. In 2022 South Wambo Creek recorded similar scores to 2021 for cover, a slight drop in scores for natives and an increase in features and debris.

Casuarina cunninghamiana regeneration was recorded within South Wambo Creek which is a positive sign for canopy recruitment for riparian habitat.

Site 3 recorded a decline in natives and cover scores. Evidence of feral pigs was observed within site 3 of South Wambo Creek for the third consecutive year. Pig disturbance reduces the ground cover, regeneration and destabilises the soils leaving these areas more prone to erosion, which may be attributable to the low scoring (Photograph 21).

No evidence of recent cattle grazing was recorded in this area. Grazing pressure reduces the ground cover and destabilises the soils leaving these areas more prone to erosion. In previous years cattle grazing had impacted riparian condition scores along South Wambo Creek.

Photograph 21: Evidence of pig disturbance within site 3 of South Wambo Creek from in October 2022.

4.3.3. Stony Creek

Stony Creek recorded increases for all indices excluding habitat. These results may reflect the gradual regeneration of riparian vegetation in the lower reaches and an increase in ground cover vegetation following the wetter years 2020-2022.

The habitat score remained the same as in 2019 and 2020. The habitat score is controlled by features which change over longer periods of time such as canopy connectivity and proximity to large patches of native vegetation and has always remained at the maximum score at Stony Creek 3 where the site is within high condition native vegetation.

There remains large variability in the habitat sub-index between longitudinal transects at Stony Creek which reflects the differences in vegetation and habitat features between the cleared lower reaches at Stony Creek 1 (Photograph 22) and the heavily forested upper reaches observed at Stony Creek 3 (Photograph 23).

It is unclear whether cattle have been excluded from the lower reaches of Stony Creek at Stony Creek 1. No evidence of recent cattle grazing was recorded, however there was no fencing that would prevent cattle accessing the riparian area. In previous years cattle grazing had impacted riparian condition scores along lower reaches of Stony Creek.

Photograph 22: Stony Creek 1 predominately cleared vegetation

Photograph 23: Stony Creek 3 heavily forested vegetation

4.3.4. General observations

Overall scores at all creeks were similar to previous years and conditions were similar to 2021 which had also received higher rainfall than previous years. Higher ground cover, containing a mix of native and exotic species remains present, particularly due to an increase in ground cover following drought in the previous years. The change in ground cover from 2019 to 2022 can be seen in Photograph 24 and Photograph 26. Monitoring photographs taken in 2022 were also similar to 2021 (Photograph 25).

No evidence of recent subsidence impacts was observed at North Wambo Creek, South Wambo Creek, or Stony Creek during the 2022 riparian condition survey.

Site scores from available past monitoring reports (Niche (2014) and RPS (2009)) show similar results for Stony Creek (particularly the upper reaches) being regarded as in good condition, North Wambo Creek as being either in good or moderate condition and South Wambo creek being in moderate condition. General comparison of riparian area photos from 2022 with those from 2014 show that the riparian vegetation remains similar, with seasonal variation in ground cover in response to rainfall the most obvious change over time.

Photograph 24: Transect 14 at Stony Creek 2 in 2022 showing higher ground cover following higher rainfall in 2021 and 2022

Photograph 25: Transect 14 at Stony Creek 2 in 2021 showing high ground cover following higher rainfall

Photograph 26: Transect 14 at stony Creek 2 in 2019 showing drought impacted ground cover

4.4. Riparian condition conclusions and recommendations

Similar scores to the previous year for all creeks reflect the ongoing wetter conditions in 2020-2022 following previous drought conditions from 207-2019 and the reduction/exclusion of grazing. Understorey vegetation cover remains high following higher rainfall in 2020, 2021 and 2022, although a high proportion of ground cover contribution is from exotic species.

Sub-indices relating to more permanent features such as habitat connectivity, tree canopy and logs and hollows remained similar.

Exclusion of cattle from riparian areas has been recommended in previous monitoring reports and no evidence of cattle grazing was recorded in 2022. Cattle should continue to be excluded from riparian areas to encourage tree regeneration and prevent erosion.

Plantings of trees in over-cleared riparian areas (that are unlikely to regenerate naturally with cattle exclusion) will also be beneficial to riparian area and the surrounding environment.

5. South Bates Extension Underground Mine area

5.1. Floristic monitoring

5.1.1. Introduction

Floristic monitoring of the South Bates Extension underground mine area was added to the annual biodiversity monitoring program in 2020 and was continued in 2022. The purpose of this monitoring is to measure the current condition of vegetation in terms of floristics and habitat complexity and identify whether any adverse impacts from undermining are occurring through comparison with previous years (2020 and 2021). The results aim to provide direction for the management of these areas and to inform future monitoring programs.

5.1.2. Methods

Floristic monitoring is undertaken using the BioMetric plots as described in Section 2. The monitoring was undertaken on by ELA ecologists Liam Scanlan and Alex Yates on 26th October and 16th November.

Four new sites were established in 2020 to sample the two dominant PCTs in the South Bates Extension area. Data from two existing monitoring plots that are also within the South Bates Extension area were also used for analysis. Of the new sites, two were established outside of the approved mining area and are intended as reference sites. A summary of the monitoring sites is presented in Figure 2.

Table 18 and site locations are shown on Figure 2.

Table 18: Floristic monitoring sites for the South Bates Extension Underground Mine

Plant Community Type (PCT)	TEC	Plot name	Type	Site age
PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Listed BC Act, E: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	SBX2-GB-I	Impact	2 years
		SBX4-GB-C	Reference	2 years
PCT 1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Listed BC Act, V: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V10-A1	Impact	Existing
		V10-A2	Impact	Existing
		SBX1-SG-I	Impact	2 years
		SBX3-SG-C	Reference	2 years

Performance targets for the same communities within the RWEP areas have been adopted as an indication of good condition vegetation for reference. Reference sites outside of the approved mining area are used as a comparison for assessing seasonal variation factors.

5.1.3. Results and discussion

Floristic data from sites added in 2020 and existing monitoring sites within the South Bates Extension Underground Mine area indicate the vegetation and habitat features are in good condition with most attributes meeting the performance criteria (Table 19).

Both sites within Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest have not been undermined to date and therefore data collected in 2020 is considered to be baseline data. NMS was 1.5 at both sites, slightly below target of 5-10. The low NMS at this site is likely to represent natural variation within the community.

Of the four sites within the Slaty Box - Grey Gum shrubby woodland, two (V10-A1 and V10-A2) have been undermined and two (SBX1-SG-I and SBX3-SG-C) are acting as current reference sites. At undermined sites, NOS was 11.5 and 12 respectively, slightly below the target of 15-40. This is not considered to be a management concern, as all strata at these sites appear to have healthy growth.

NMS was below performance criteria of 5-30 at 5 out of the 6 sites monitored including the reference sites. NMS was 1.5 at both sites within PCT 1603, and ranged from 2-11 at PCT 1176.

grass cover high at V10-A1. Site V10-A2 scored slightly lower for canopy cover, however review of plot photographs (Photograph 27) shows canopy in good condition, with all trees healthy and no observable impacts to the canopy from undermining.

Exotic plant cover was slightly above the performance criteria by 1% at V10-A2. Exotic species recorded at this site were *Lysimachia minima*, *Lysimachia arvensis*, *Conyza bonariensis* and *Bromus catharticus*. The increase in exotic plant cover is likely related to higher rainfall in 2021 and 2022. It is noted that a small stream intersects this monitoring site, increasing moisture availability which appears to be favouring exotic species, and the slightly elevated EPC is unlikely to be related to the underground mining activities.

Photograph 27: Site V10-A2 in 2022 with canopy in good condition

5.1.4. Conclusions and recommendations

Floristic monitoring results for vegetation communities within the South Bates Extension underground reveal vegetation is in good condition, generally meeting performance targets. No evidence of mine subsidence impacting native vegetation condition were detected. Relatively minor changes in native and exotic plant species are likely related to rainfall levels in 2021 and 2022 and are expected to show some level of fluctuation in future conditions of higher or lower rainfall.

It is recommended monitoring continue in this area, including the use of reference sites to allow comparison including impacts of seasonal variation.

Table 19: BioMetric scores from South Bates Extension floristic monitoring sites in 2021

Plant Community Type (PCT)	Plot Name	Site type	Mining status	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	SBX2-GB-I	Impact	Not yet mined	58	21.5	1.5	76	42	24	0	0	1	12
	SBX4-GB-C	Reference	Outside mining area	46	19	1.5	78	30	14	0	2	1	48
Performance criteria				>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-
1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	V10-A1	Impact	Undermining has occurred	55	12	4.5	82	2	20	0	1	1	27
	V10-A2	Impact	Undermining has occurred	40	11.5	2	40	46	10	6	1	1	12
	SBX1-SG-I	Impact	Not yet mined	35	16.5	2	18	42	0	0	0	1	35
	SBX3-SG-C	Reference	Outside mining area	47	18.5	11	24	40	24	0	0	1	20
Performance criteria				21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-

5.2. Bird monitoring

5.2.1. Introduction

Bird monitoring of the South Bates Extension underground mine area was added to the annual biodiversity monitoring program in 2020 and continued in 2022. The purpose of this monitoring is to use bird diversity and abundance as an indicator of health of the local fauna populations and identify whether any adverse impacts from undermining are occurring. The results aim to provide direction to management of these areas and for the monitoring program in the future.

5.2.2. Methods

Bird monitoring survey methods are the same as described in Section 2.1.2. Surveys were undertaken by ELA ecologists Liam Scanlan and Daniel McKenzie from September – December 2022. Several field trips were required over this timeframe due to high rainfall creating inaccessible track conditions.

Four new bird monitoring sites (BP27-BP30) in the South Bates Extension Underground Mine area were established in 2020, and one existing bird survey site (BP26) is within the South Bates Extension Underground Mine area. Of the new sites, two were established outside of the approved mining area and are intended as reference sites. Bird survey site locations are shown on Figure 6. The current progress of mining in the South Bates Extension area means that of the five sites only BP26 is currently in an area that has been undermined (Table 20). As such, current data from all four new sites can be considered baseline data for comparison after mining occurs.

Table 20: Bird monitoring sites within the South Bate Extension underground mine area

Site	Mining status	PCT
BP26	Undermining has occurred	1176: Slaty Box - Grey Gum shrubby woodland
BP27	Reference site (outside mining area)	1176: Slaty Box - Grey Gum shrubby woodland
BP28	Reference site (outside of mining area)	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest
BP29	Not yet undermined	1176: Slaty Box - Grey Gum shrubby woodland
BP30	Not yet undermined	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest

5.2.3. Results

The highest diversity of birds, and second highest abundance of birds, was recorded at BP26 (Figure 18), which is currently the only impact site. This site also recorded the highest diversity and abundance of species in 2020 and 2021.

One threatened bird species was recorded at the monitoring sites, with two Dusky Woodswallow recorded at site BP26.

Figure 18: Bird monitoring results for sites in the South Bates Extension underground mine area in 2022

5.2.4. Conclusions and recommendations

Bird surveys recorded data at four sites established in 2020 and one existing site associated with the South Bates Extension underground mine area. One of the five sites was located above an area which had been undermined to date. This site (BP 26) recorded the highest diversity and the second highest abundance of bird species and also had a threatened bird species recorded. As such, there is no indication that the undermining is having a detectable impact on bird species within this area.

Continued monitoring is recommended in this area, including the use of reference sites to allow comparison including impacts of seasonal variation. Progress of underground mining activities should be corelated to site locations annually to ensure results are appropriately analysed as baseline, or impact once undermining progresses.

5.3. Groundwater Dependent Ecosystem monitoring

5.3.1. Introduction

Monitoring of GDEs is a new component to the annual biodiversity monitoring program initiated in 2019. The GDE Vegetative Assessment Report (Hunter Eco, 2019) identified two likely GDEs in the area above the South Bates Underground Extension:

- River Oak riparian tall woodland
- M*elaleuca decora* low forest

The South Bates Underground Extension has the potential to impact groundwater in the vicinity of the two GDEs. Hunter Eco (2019) recommended the establishment of a GDE monitoring program including:

- Vegetation condition and extent assessed by aerial imagery and on-ground inspection over time
- Document tree height and diameter at breast height (DBH) of selected River Oak saplings and mature trees

5.3.2. Methods

GDE monitoring was undertaken by ELA ecologists Liam Scanlan and Alex Yates on 27th October. Several methods were used to monitor GDEs, as described below.

5.3.2.1. Vegetation survey plots

Two vegetation monitoring plots (standard biometric plot 50 x 20 m - refer to (Section 2)), previously surveyed in 2019, 2020 and 2021, are located in each GDE (Figure 22). Vegetation structure and function data compliant with the Biodiversity Assessment Method (BAM) plot method (current standard method for ecological impact assessment) was also collected.

5.3.2.2. Photo monitoring points

At each photo monitoring plot, images were captured at 0, 90, 180, and 270 degrees, as well as one at the ground. A total of eight photo monitoring points were surveyed (Figure 22).

5.3.2.3. Tree measurements

Thirty *Casuarina cunninghamiana* trees (15 mature trees and 15 saplings) were selected for monitoring across the River Oak riparian tall forest GDE area along North Wambo Creek in 2019 (Figure 24). Each tree was permanently marked with a numbered metal tree tag and the DBH was measured. The point of DBH measurement (1.3m above the ground) was sprayed with paint so that the measurement location can be replicated during subsequent monitoring. In 2020, 2021 and 2022 the DBH for each tree was re-measured. Tree 10 (sapling) could not be relocated in 2022 and is thought to have been displaced by flooding and therefore there is no DBH or crown extent data for this tree in 2022.

Crown extent was assessed for each tagged tree. Crown extent was assessed as the percentage of the assessable crown (all live and dead branches on the tree) in which there are live leaves. Two observers each recorded a crown extent estimate from opposite sides of the tree to the nearest 5%, and the average of the two scores was recorded.

5.3.2.4. Mapping of vegetation extent

Mapping the extent of the River Oak riparian tall woodland community along the upper reach of North Wambo Creek was completed in GIS at 1:1000 scale using georeferenced aerial imagery (NearMap, 2022). Polygons were drawn with reference to Rapid Data Points (RDPs) and photos collected during the monitoring survey and using comparison to aerial imagery from 2019 (NearMap) when the community extent was first mapped in detail.

5.3.3. Results

The results of the GDE monitoring are presented below, with raw data and all photographs included in Volume 2.

5.3.3.1. Vegetation survey plots

Two monitoring plots were surveyed in *Melaleuca decora* low forest (Figure 22). BioMetric data from each plot is presented in Table 21.

The two plots within the River Oak riparian tall woodland GDE were not surveyed due to natural flooding conditions of North Wambo Creek which altered creek geomorphology and riparian vegetation (Photograph 28 and Photograph 29). At the scale of a monitoring plot, these differences would be drastic, and would not reflect the vegetation condition of the GDE.

The BioMeteric results from the *Melaleuca decora* low forest GDE indicated the community is in good condition, with the majority of scores such as average NPS increasing or remaining stable since 2020 and 2021, likely as a result of the increased rainfall since 2019 (Figure 19).

EPC was zero along the BioMetric transect at GDE2, a reduction from 2021 levels when 16% was recorded. At GDE1, EPC increased from 0 in 2021 to 6 in 2022.

Table 21: BioMetric data for GDE monitoring plots in 2022

GDE	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL	LI
***Melaleuca decora* low forest**	GDE1	39	11	16	84	12	34	6	1	1	30	74
	GDE2	42	10	13.5	92	44	14	0	1	1	20	82
	Average	41	11	15	88	28	24	3	1	1	25	78
River Oak riparian tall woodland	GDE3	-	-	-	-	-	-	-	-	-	-	-
	GDE4	-	-	-	-	-	-	-	-	-	-	-
	Average	-	-	-	-	-	-	-	-	-	-	-

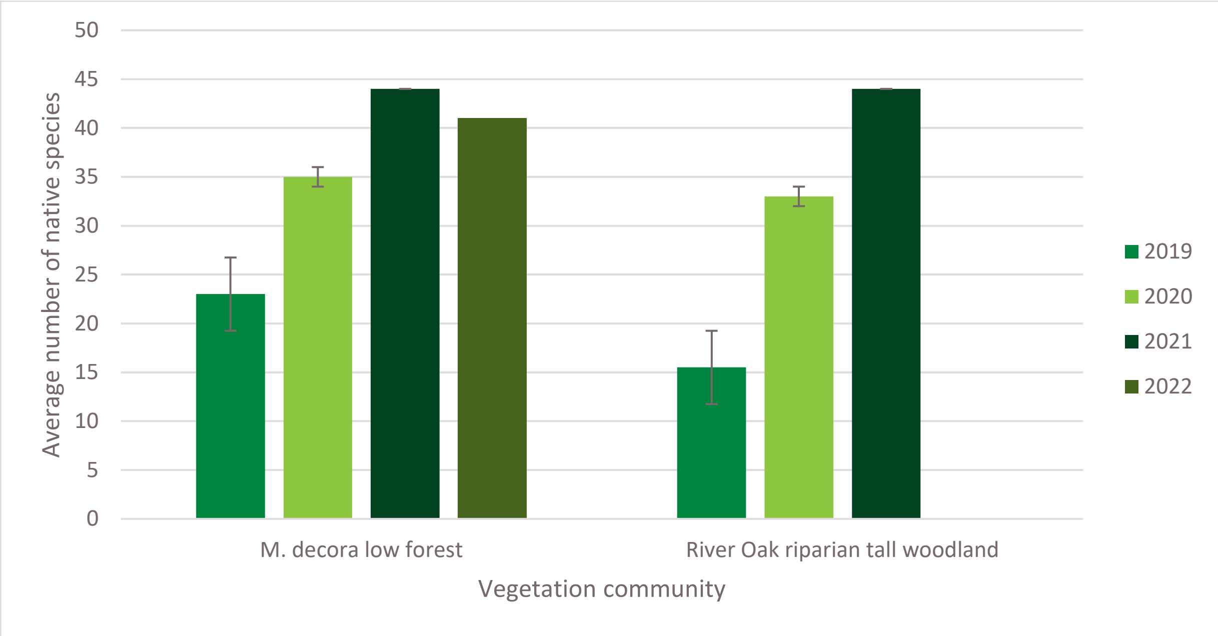


Figure 19: Average number of native species within each GDE over time from 2019-2022

Photograph 28: GDE P3 monitoring plot along North Wambo Creek in 2019

Photograph 29: GDE P3 monitoring plot along North Wambo Creek in 2021 in flooded conditions. Approximate location of transect shown in white.

5.3.3.2. Photo monitoring points

Review of images from photo monitoring points show GDE vegetation in good condition in 2022. A noticeable increase in ground cover vegetation is visible in both *Melaleuca decora* low forest and River Oak riparian tall woodland GDE communities since site establishment in 2019 (Photograph 30 - Photograph 33).

Photograph 30: GDE Photo monitoring point M2 (facing north) in *Melaleuca decora* low forest in 2019

Photograph 31: GDE Photo monitoring point M2 (facing north) in *Melaleuca decora* low forest in 2021

Photograph 32: GDE Photo monitoring point M7 (facing north) in River Oak riparian tall woodland in 2019

Photograph 33: GDE Photo monitoring point M7 (facing north) in River Oak riparian tall woodland in 2022

5.3.3.3. Tree measurements

Individual tree measurements from 2022 are presented in Table 22. The average DBH for River Oak trees increased in the saplings (2 cm) and slightly increased in mature trees (1 cm) (Figure 20). This suggests the trees have received good access to water over the past two years. Sapling growth is expected to be greater than mature trees. Two individual sapling trees (Trees 15 and 20) recorded smaller DBH in 2022 than the previous year, this was a result of a portion of bark falling away and Tree 15 being pushed over by flood waters. In all cases trees appear healthy, with the exception of Tree 19 which shows signs of rot in the basal hollow.

The average canopy extent increased by 3% for mature River Oak trees and increased by 3% for saplings (Figure 21). This result indicates that tree health has generally improved or maintained from the previous year.

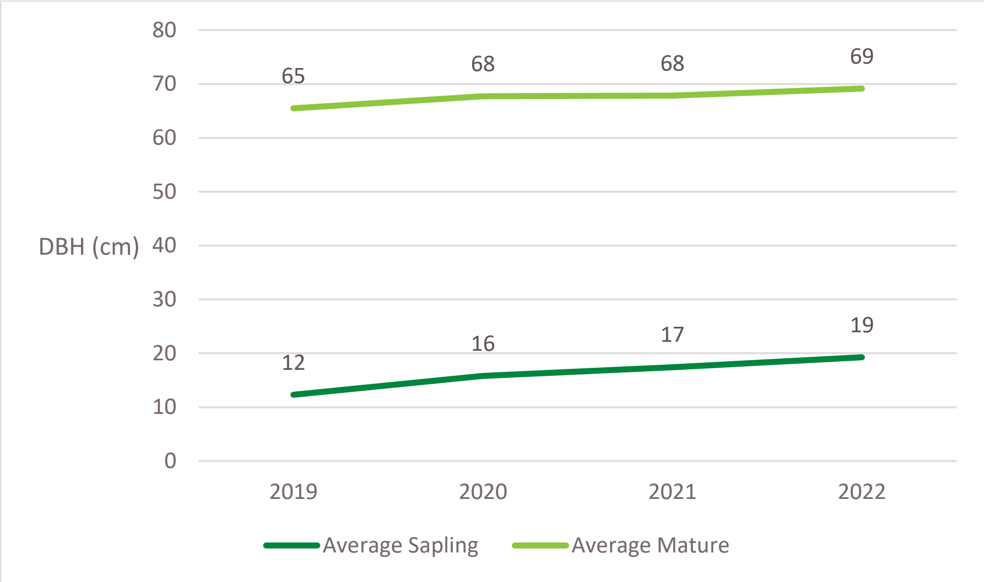


Figure 20: Change in DBH over time of measured trees within the GDE River Oak riparian tall woodland GDE

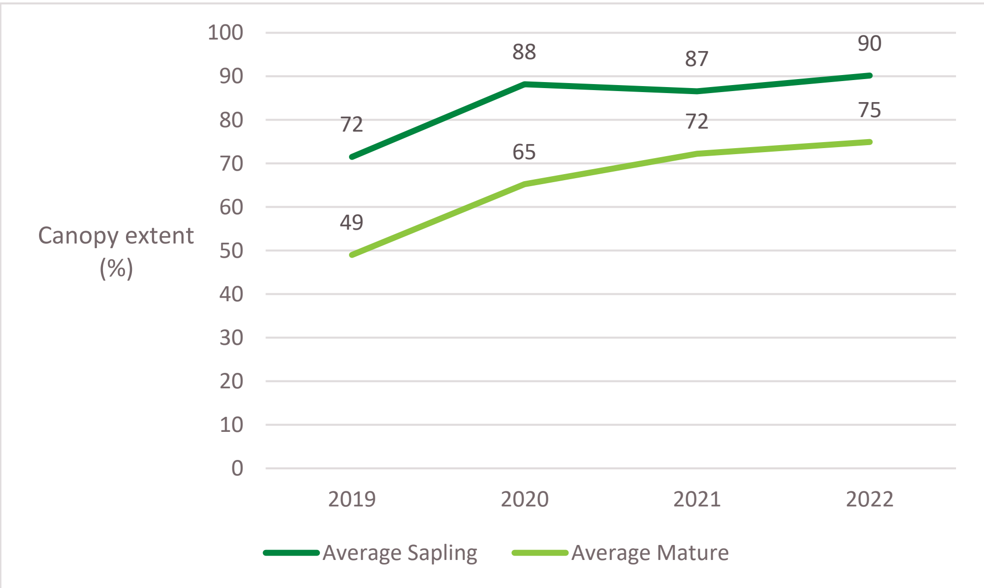


Figure 21: Change in canopy extent over time of measured trees within the GDE River Oak riparian tall woodland GDE

Table 22: River Oak tree monitoring results in 2022

Tree Tag No.	Age class	DBH (cm)	Canopy Extent (%)	Easting	Northing
1	Mature	75.5	88	306275	6395900
2	Mature	40.4	88	306164	6395894
3	Sapling	32.5	100	306090	6395881
4	Mature	87	99	306050	6395868
5	Mature	33.5	28	305952	6395693
6	Mature	102	85	305964	6395705
7	Sapling	25.5	93	305811	6395612
8	Sapling	18.3	100	305753	6395618
9	Mature	61.5	80	305785	6395619
10	Sapling	--	--	305529	6395440
11	Sapling	32.2	88	305470	6395438
12	Mature	65.8	100	305442	6395439
13	Sapling	7	98	305380	6395409
14	Mature	60	38	305379	6395410
15	Sapling	8.5	73	305573	6395454
16	Sapling	13.5	100	305587	6395457
17	Sapling	13.4	60	305593	6395493
18	Mature	105	78	305566	6395521
19	Mature	80	98	305571	6395591
20	Sapling	20	100	305607	6395612
21	Mature	115	85	305338	6395325
22	Mature	61.2	90	305307	6395248
23	Sapling	22.8	75	305264	6395213
24	Mature	52.5	43	305218	6395224
25	Sapling	28.5	93	305202	6395237
26	Mature	51	80	305171	6395235
27	Sapling	23.4	95	305038	6395194
28	Mature	46.8	85	305035	6395190
29	Sapling	15	100	305021	6395183
30	Sapling	9	90	305004	6395173

5.3.3.4. Mapping of River Oak riparian tall woodland vegetation extent

No change in extent of River Oak riparian tall woodland was observed in the field or observable in the aerial imagery. The total area of the GDE remains 5.07 ha (Figure 23).

5.3.4. Conclusions and recommendations

Ongoing monitoring of these sites is required to assess whether any impacts to GDEs occurs as a result of planned mining activities in this area.

Floristic monitoring recorded generally increased scores for both GDEs surveyed. Similar to 2020 and 2021, high rainfall in 2022 is likely to be the major factor in these results and photo monitoring clearly shows increased vegetation cover, particularly in the understorey of both areas.

For the *Melaleuca decora* low forest GDE, it may be appropriate to use data collected during 2019, 2020, 2021 and 2022 as the baseline conditions for the community. This area was undermined during 2019 and 2020, and no obvious impacts have occurred, and any adverse effects to vegetation are unlikely to have been detectable yet. As such future monitoring surveys may be considered as post impact surveys and compared to the 2019, 2020, 2021 and 2022 results.

GDE tree monitoring within River Oak riparian tall woodland recorded tree growth and increased or similar canopy extent, suggesting continued good health of the trees following ongoing high rainfall in 2022.

The River Oak riparian tall woodland remains approximately 1km from the closest mined portion of the South Bates Underground Extension mining area. As such, there may be no current impacts from undermining and the current data will serve as a baseline for reference once mining activities occur in the vicinity of the community. Variation in results between the dry year in 2019 and wetter years in 2020, 2021 and 2022 is likely to be useful to understand the natural changes which occur in the community when attempting to determine whether any future changes observed are the result of mining impacts or natural variation.

No discernible change in the extent of the River Oak riparian tall woodland GDE was recorded. Changes to the extent of the community are likely to take place over the course of several years. The wetter years in 2020, 2021 and 2022 may have provided suitable conditions for the spread and germination of canopy and mid storey species which in the coming years may result in an increase in the extent of the community.

Monitoring should continue to assess for impacts to the *Melaleuca decora* low forest GDE and to continue collecting baseline and future impact data for the River Oak riparian tall woodland GDE. Several groundwater monitoring wells have been established in the vicinity of the GDE along North Wambo Creek and the data from these is also likely to assist with determining whether any impacts to GDEs are likely to occur.

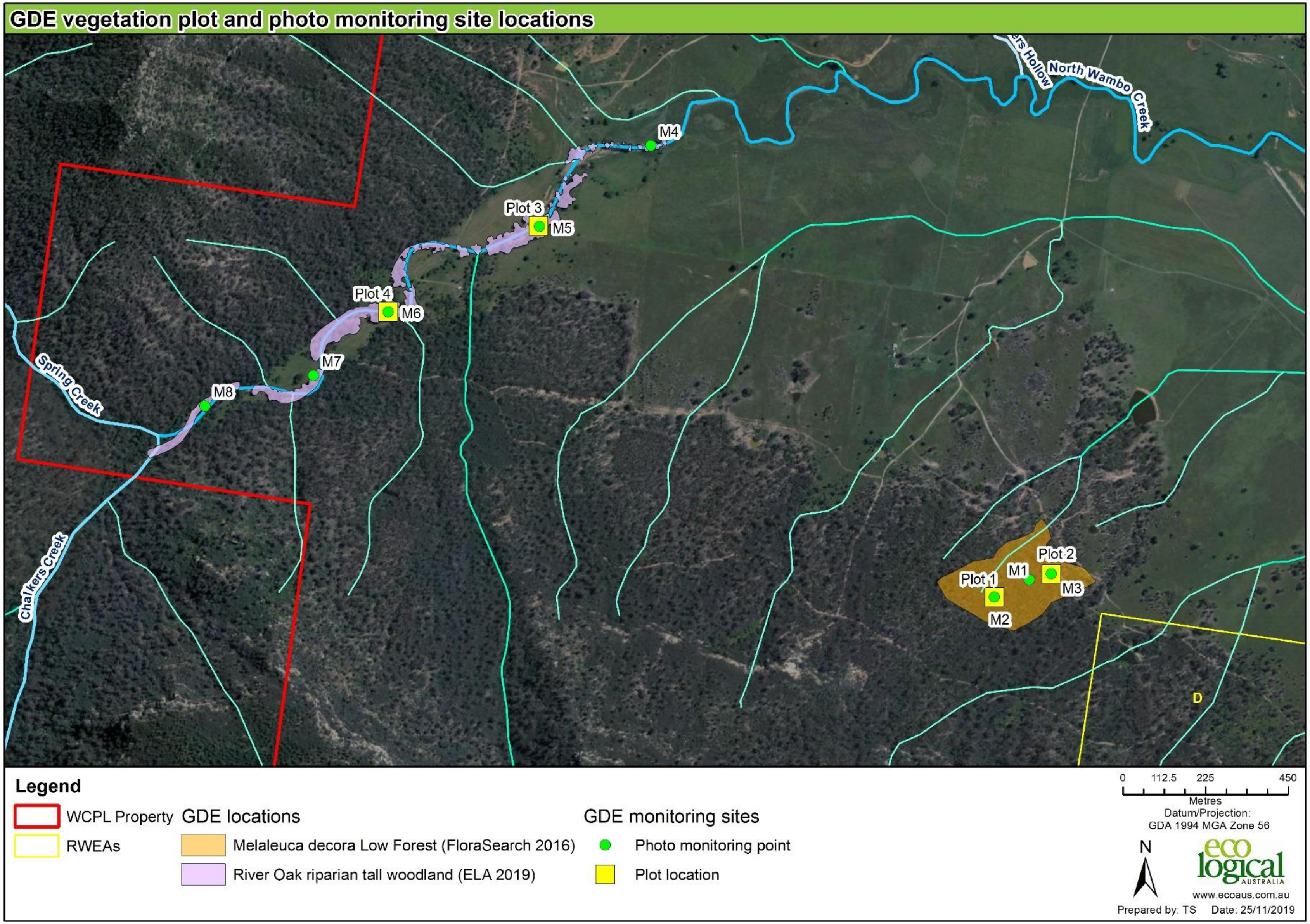


Figure 22: GDE monitoring site locations

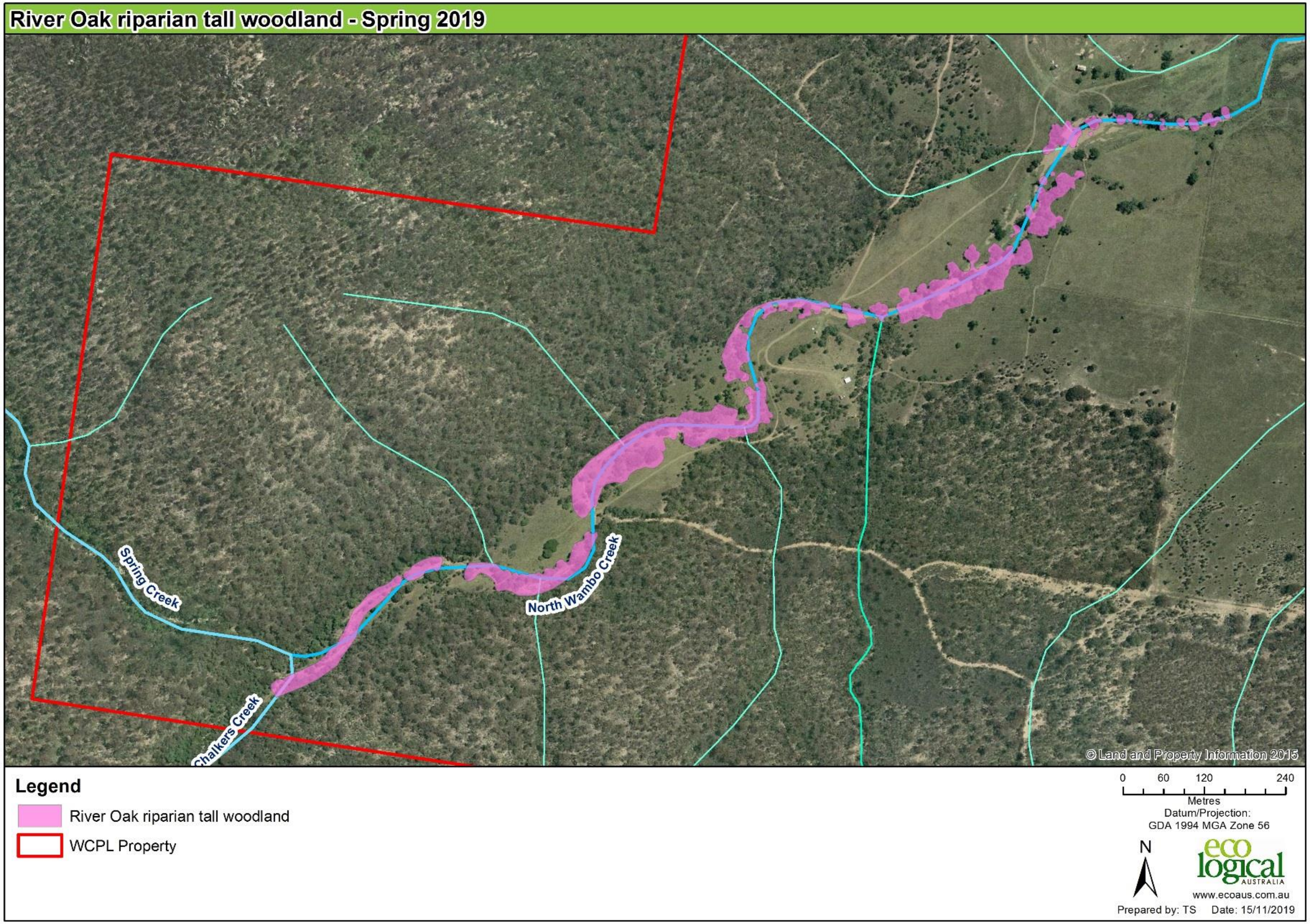


Figure 23: Extent of River Oak riparian tall woodland mapped in spring 2019, unchanged in 2021 and 2022

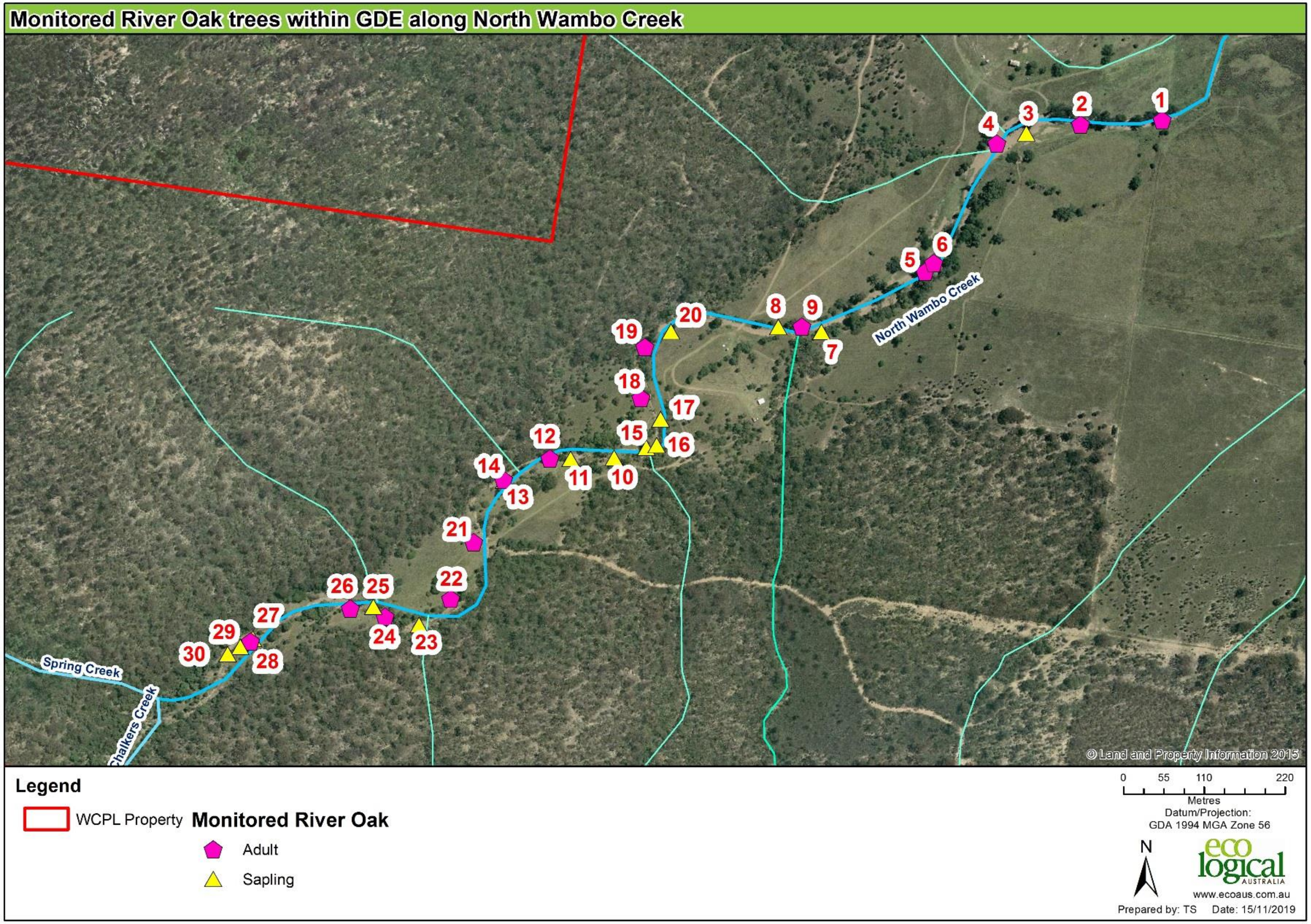


Figure 24: Monitored River Oak trees along North Wambo Creek

6. Mine subsidence observations and other management considerations

Mine subsidence and land management issues observed during the 2022 monitoring surveys across the RWEAs and rehabilitated landforms are summarised in Table 23 and mapped on Figure 25.

Table 23: Mine subsidence and other land management observations recorded during 2022 Spring monitoring (# corresponds to the labels on Figure 25)

#	Type	Location	Notes
1	Subsidence cracking	RWEA B	Previously filled in. Crack length 1m, crack width 1m
2	Subsidence cracking	RWEA C	Across track. Known subsidence - taped off
3	Subsidence cracking	RWEA C	Relatively minor. Crack length unknown, width up to 20 cm
4	Subsidence cracking	RWEA C	Minor subsidence across track
5	Subsidence cracking/Erosion	North Wambo Creek Diversion	Severe subsidence/erosion. Length 20m, width 5m
6	Erosion	North Wambo Creek Diversion	Erosion
7	Erosion	North Wambo Creek Diversion	Erosion
8	Subsidence cracking	RWEA C	6 holes of subsidence in vicinity
9	Subsidence cracking	RWEA C	Crack length 1m, width 15 cm
10	Subsidence cracking	RWEA C	Crack length 4m, width 1m
11	RWEA C	RWEA C	Previous recorded, slightly larger than previous year
12	Erosion	North Wambo Creek Diversion	Erosion along creek
13	Erosion	North Wambo Creek Diversion	Erosion along creek
14	Subsidence cracking/Erosion	North Wambo Creek Diversion	Currently minor hole in ground, may increase over time
15	Erosion	General surface area	Deep erosion beside track
16	Minor track washout	General surface area	Erosion along track, may require future maintenance but still easily passable
17	Erosion	General surface area	Erosion increased in size since last year
18	Erosion	General surface area	Length 25 m, width 2.5 m
19	Subsidence cracking	RWEA C	Length unknown, width up to 1.5 m
20	Subsidence cracking	RWEA C	Length unknown, width up to 1.5 m
21	Subsidence cracking	RWEA C	Length unknown, width up to 30 cm
22	Track maintenance recommended - washed out and wombat hole	RWEA A	Track badly washed out with wombat hole

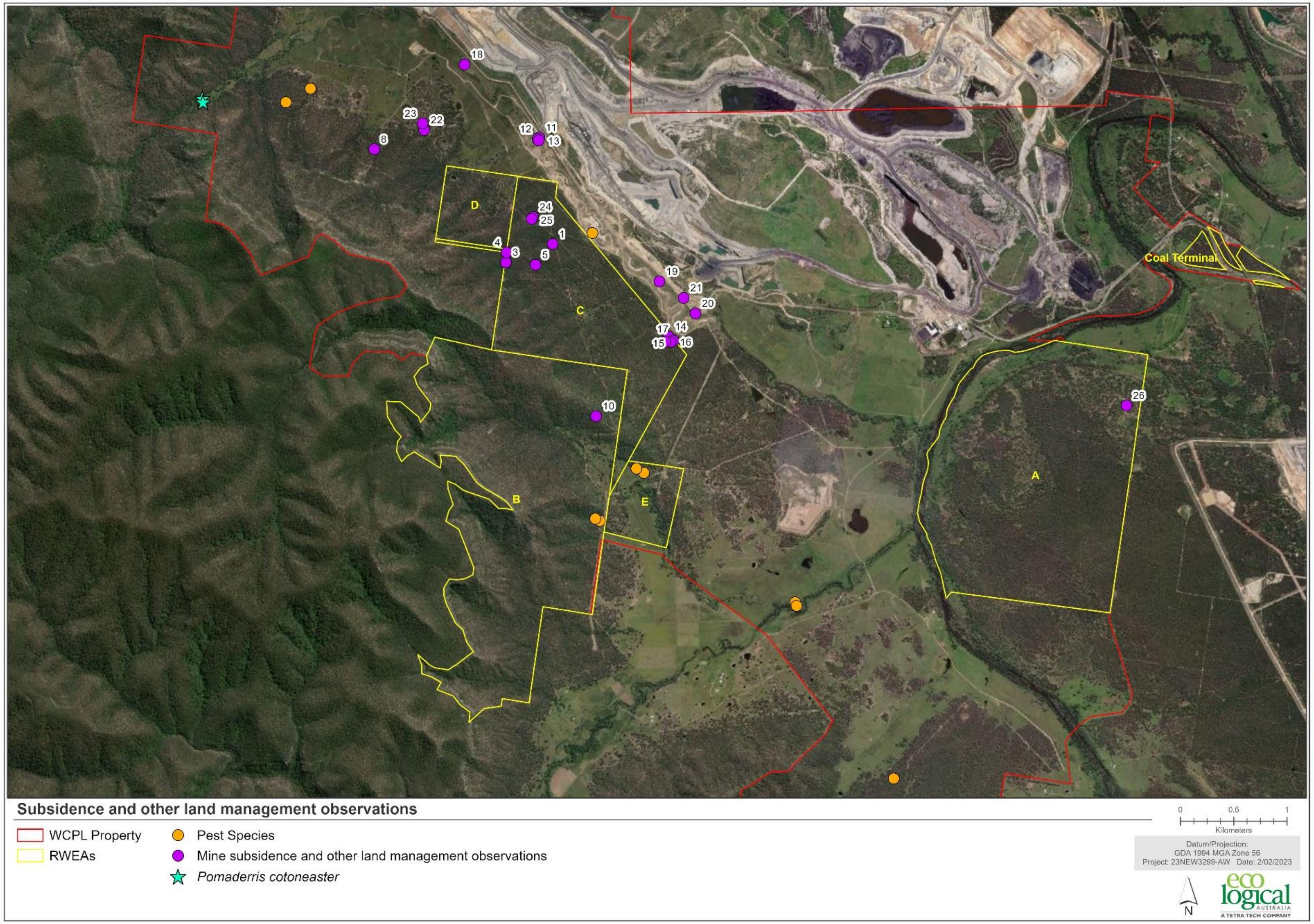


Figure 25: Subsidence and other land management observations from spring 2022 monitoring surveys

6.1. Remnant woodland enhancement areas

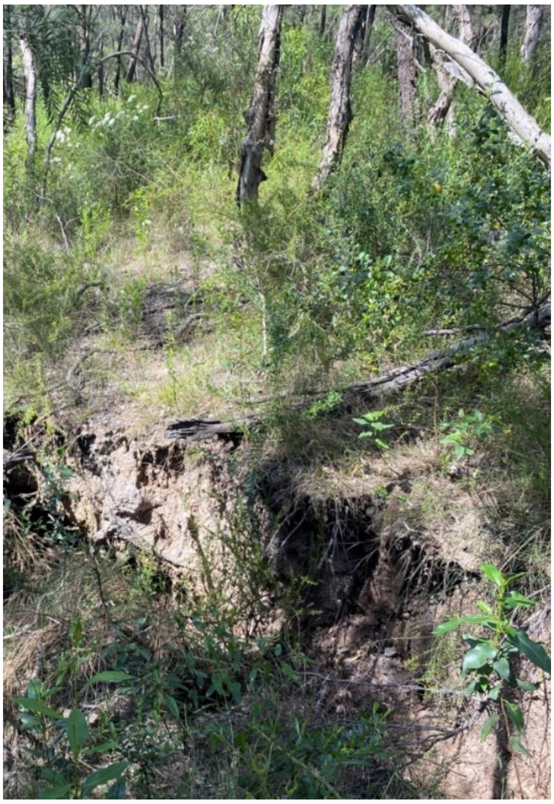
6.1.1. Subsidence observations

Subsidence cracks were noted during flora field work within RWEA A and RWEA B, within the Narrow-leaved Ironbark and Slaty Gum communities. The largest subsidence cracks were noted near flora site V11-B1, as per recent years (Photograph 34 - Photograph 37). These cracks appeared larger in 2022, however the cracking was not having any observable significant impacts on vegetation at the current time, with the adjacent trees and shrubs showing no visible signs of stress or damage.

Several other occurrences of subsidence were noted, most of which have been previously reported.

Photograph 34: Large subsidence cracks near flora monitoring site V11-B1 (in 2019)

Photograph 35: Large subsidence cracks near flora monitoring site V11-B1 (in 2019)



Photograph 36: Large subsidence cracks near flora monitoring site V11-B1 (in 2022)

Photograph 37: Large subsidence cracks near flora monitoring site V11-B1 (in 2022)

6.1.2. Other management observations

Several areas of erosion were noted along tracks and within the North Wambo Creek diversion. This is not unexpected when considering the high rainfall experienced in 2021 and 2022.

High rainfall has also likely created favourable conditions for feral pigs. Anecdotally, there has been a high amount of feral pig activity (e.g. direct observations and signs of digging), generally along creeks in the general surface area in 2022 (Figure 25).

One threatened flora species, Pomaderris cotoneaster (Endangered under NSW BC Act and Commonwealth EPBC Act) was recorded along North Wambo Creek for the first time (Figure 25). No additional monitoring activities or surveys are proposed for this species, however any potential threatening processes observed in the future (e.g. weeds) and/or opportunities for conservation should be documented in future monitoring reports.

6.1.3. Performance criteria and results

Performance criteria and findings during the 2022 monitoring for subsidence impacts are presented in Table 24, which is based on Table 20 in the *Wambo Coal Biodiversity Management Plan* (WCPL 2017). These performance criteria exclude any impacts and consequences of mining that occurred prior to February 2011 in accordance with Condition 22, Schedule 4, of Development Consent DA 305-7-2003.

Table 24: Subsidence performance measures, indicators and 2022 findings

Biodiversity feature	Performance measure	Performance indicator (WCPL 2017)	2022 findings
Wollemi National Park	Negligible subsidence impacts and environmental consequences	The performance indicators will be considered to have been exceeded if conventional vertical subsidence exceeds 20 millimetres (mm) or the limit of survey accuracy (whichever is greater) at the base of the Wollemi National Park escarpment. The performance indicators will be considered to have been exceeded if visual inspections identify cliff or rock face instability at the Wollemi National Park escarpment.	N/A - Vertical subsidence as the base of escarpment or cliff or rock face instability not inspected as part of the flora and fauna monitoring program in 2022.
Other species, populations or communities listed under the Biodiversity Conservation Act 2016 or Environmental Protection and Biodiversity Conservation Act 1999	Minor cracking and ponding of the land surface or other impact. Negligible environmental consequences.	The performance indicator will be considered to have been exceeded if annual monitoring at flora monitoring sites V6-B1c and V11-B1 or bird monitoring sites (BP14, BP16, BP20, BP21) above Longwalls 11 to 16 indicate a statistically significant downward trend or change between monitoring periods not observed at analogue/reference sites.	Bird monitoring sites above longwalls do not show a downward trend or a decrease not observed at other reference sites (Figure 26). Subsidence cracks were recorded at both sites V6-B1c and V11-B1. No significant vegetation damage was observed at these sites. Flora monitoring site V6-B1c showed a decrease in NPS, to levels consistent with 2020 monitoring, and V6-A3 V11-B1 showed stability in NPS relative to 2021, indicating no significant

Biodiversity feature	Performance measure	Performance indicator (WCPL 2017)	2022 findings
			effect of undermining was recorded (Figure 27). Vegetation at these sites and in the wider area remains in relatively good condition.
Warkworth Sands Woodland Community		The Warkworth Sands Woodland Community is absent from the South Bates Underground Mine area. Monitoring and performance indicators relevant to mine subsidence in the Warkworth Sands Woodland Community will be addressed in future revisions of the BMP prior to any extraction under the Warkworth Sands Woodland Community	Area not currently undermined – no subsidence observations.
White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community		The White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community is absent from the South Bates Underground Mine area. Monitoring and performance indicators relevant to mine subsidence in the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community will be addressed in future revisions of the BMP prior to any extraction under the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community.	Area not currently undermined – no subsidence observations.
Central Hunter Valley Eucalypt Forest and Woodland Ecological Community		Minor cracking and ponding of the land surface or other impact. Negligible environmental consequences.	No additional observations of damage to this community beyond that described in the 2016 flora and fauna monitoring report (ELA 2016). Predominantly minor surface cracks observed.

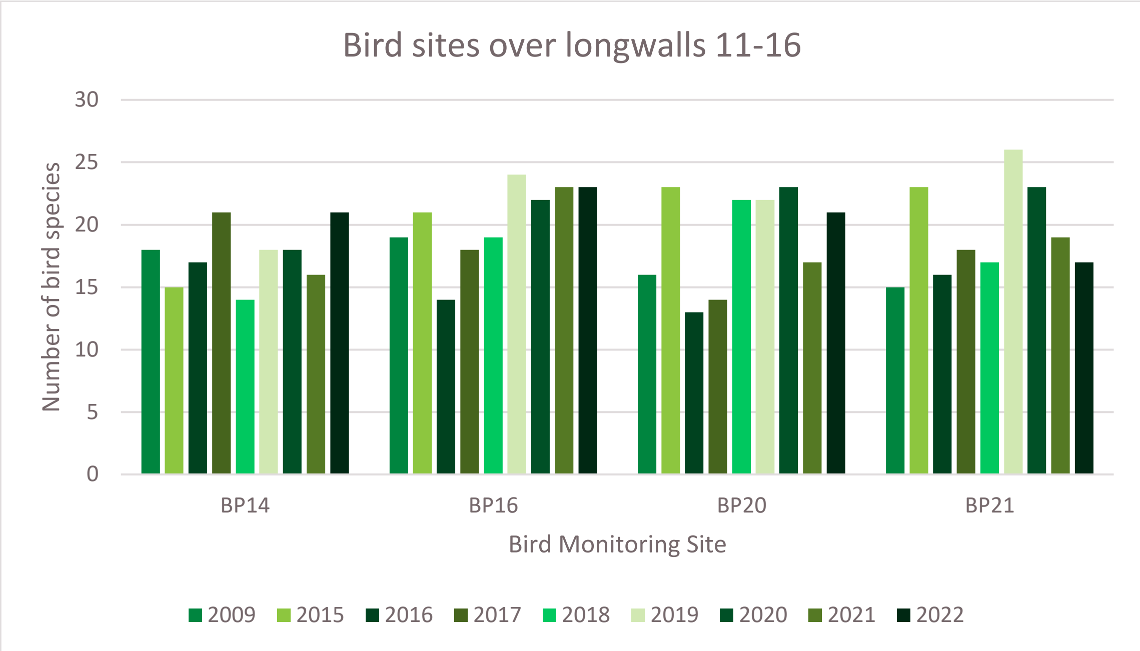


Figure 26: Total number of bird species recorded at sites located over longwalls 11 to 16 in 2009 and 2015-22

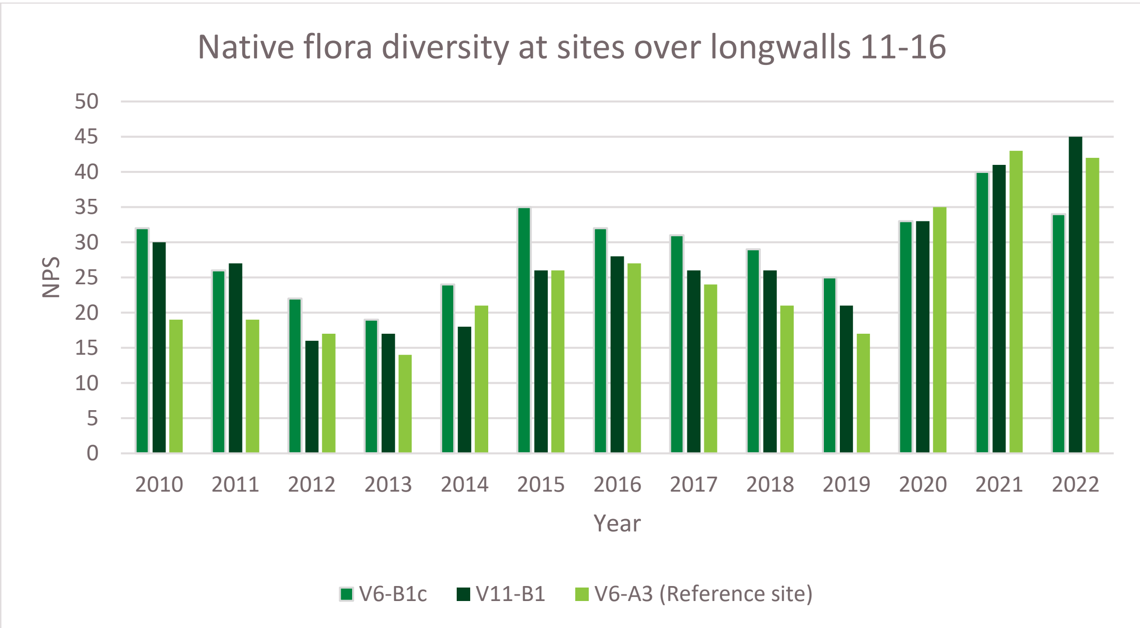


Figure 27: Average number of native flora species recorded at sites located over longwalls 11-16 and reference site 2010-2022

6.1.4. Conclusion and recommendations

Monitoring data or general observations do not indicate any exceedance of the performance criteria or any significant effects on biodiversity values at this stage, however future monitoring should continue to document and assess subsidence impacts across the site.

6.2. Rehabilitation areas and other land

The condition of rehabilitated land has been discussed in Section 3, however, some relevant opportunistic observations relating to land management and biodiversity were made while traversing the mine site.

One or two Feral Pigs (*Sus scrofa*) were observed in the general surface area at three locations (Figure 25) and evidence of feral pig activity was recorded at a further three locations in RWEA B, RWEA E and during the riparian assessments.

Along the NWCD erosion and subsidence issues were observed in the same or similar locations to previous years. These issues/areas are under current active management by the NSW Soil Conservation Service and land rehabilitation contractors.

6.3. Weed issues

Environmental weeds have been discussed in previous sections. Exotic annual species have increased in abundance in 2022 following higher than average rainfall. Management of weeds across WCPL land should continue, particularly for priority weeds and Weeds of National Significance (WONS), to prevent their spread.

A targeted weed survey and update to Annual Weed Treatment Plan is scheduled for 2023, which will record weed issues, incorporating the results of this monitoring program, and outline proposed strategy for weed treatment in 2023/2024 in detail.

7. Summary of management actions required

A summary of the management actions required and recommended to be undertaken by WCPL based on the results of the 2022 annual biodiversity monitoring program is provided in Table 25.

Table 25: Summary of management actions required

Area/Feature	Performance criteria	Result	Action required
RWEA A and Rail Loop	Exotic plant cover limits within RWEA A and Rail Loop **Targets** • Rail Loop CT2: 15% • RWEA A A1: 60% • RWEA A A2: 15% • RWEA A A3: 20%	Exotic plant cover at CT2 (Rail Loop), and A1, A2, and A3 (RWEA A) exceeded targets **Results** • Rail Loop CT2: 64% • RWEA A A1: 90% • RWEA A A2: 22% • RWEA A A3: 46%	Conduct annual weed survey and review of weed management activities success. Update Annual Weed Treatment Plan. Continue weed management in RWEA A and Rail Loop in accordance with Updated Weed Treatment Plan – increased weed management effort is recommended. Consider planting native trees in over-cleared riparian areas
RWEA A and Rail Loop	**Performance target:** • Exotic Plant Cover (<10%)	**Average exotic plant cover:** • PCT 42 sites within RWEA A was 52 • PCT 1658 within Rail Loop was 64	Continue weed management in RWEA A and Rail Loop in accordance with Updated Weed Treatment Plan – continued increased weed management effort is recommended.
North Wambo Creek Diversion	**Mining Operations Plan:** No tunnel or gully erosion is to be present	Gully erosion observed in creek diversion near 23R	Current active management in progress by NSW Soil Conservation Service. Continue active management of creek diversion to encourage establishment of native species and address erosion issues.
North Wambo Creek Diversion	**Mining Operations Plan:** No single bare area >20m^2	Several areas of bare soil larger than 20m^2 observed along creek diversion	

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APPENDIX F

SURFACE WATER MONITRING DATA SUMMARY

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW01	10 January	7.3	713	6	-
SW01	20 January	7.3	612	8	Suspended fines
SW01	24 February	7	304	5	-
SW01	4 March	6.7	148	34	Suspended fines
SW01	7 March	6.9	147	-	-
SW01	25 March	6.8	205	44	-
SW01	28 April	7.2	455	11	-
SW01	31 May	7.3	502	8	-
SW01	30 June	7.4	685	6	Suspended fines
SW01	4 July	7.2	355	112	-
SW01	5 August	7.2	520	13	-
SW01	16 September	7.4	618	7	-
SW01	10 October	7.0	177	81	-
SW01	28 November	7.4	612	13	-
SW01	23 December	7.4	777	12	-
SW01	28 December	7.7	815	10	-
SW02	10 January	7.4	631	8	-
SW02	20 January	7.4	640	8	-
SW02	24 February	7	300	10	Suspended fines
SW02	4 March	7	175	19	-
SW02	7 March	6.8	152	-	-
SW02	25 March	6.9	170	60	-
SW02	28 April	7.2	455	<5	-
SW02	31 May	7.5	497	<5	-
SW02	30 June	7.4	688	<5	-
SW02	4 July	7.3	377	114	-
SW02	5 August	7.4	500	14	-
SW02	16 September	7.4	618	8	-
SW02	10 October	7.1	197	75	Suspended solids
SW02	28 November	7.5	583	12	-
SW02	23 December	7.6	836	7	-
SW02	28 December	7.5	780	14	Suspended fines
SW03	10 January	7.4	664	15	-
SW03	20 January	7.4	627	10	-
SW03	24 February	7	310	6	-
SW03	4 March	6.8	173	26	Suspended fines
SW03	8 March	7.4	147	60	-
SW03	25 March	7.0	183	47	-
SW03	28 April	7.4	458	6	-
SW03	31 May	7.3	499	8	-
SW03	30 June	7.4	686	10	-
SW03	4 July	8.1	171	142	-
SW03	5 August	7.4	462	17	-
SW03	16 September	7.6	625	10	-
SW03	10 October	7.1	193	77	Suspended solids

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW03	28 November	7.5	586	14	Suspended fines
SW03	23 December	7.5	808	12	-
SW03	28 December	7.5	793	17	Suspended fines
SW04	10 January	-	-	-	No Flow - Shallow pool.
SW04	20 January	-	-	-	No Flow - pool
SW04	24 February	-	-	-	Dry
SW04	4 March	-	-	-	Dry
SW04	8 March	-	-	-	Unsafe access - flooded
SW04	25 March	7.0	192	9	-
SW04	28 April	7.4	340	<5	Suspended fines
SW04	31 May	-	-	-	No flow - Pool
SW04	30 June	-	-	-	Dry
SW04	4 July	7.2	138	36	-
SW04	5 August	7.4	325	<5	-
SW04	16 September	7.7	377	8	Suspended fines/solids, sand, very minimal water in creek
SW04	10 October	7.2	204	<5	-
SW04	28 November	7.3	394	<5	-
SW04	23 December	-	-	-	Dry
SW04	28 December	-	-	-	Dry
SW05	10 January	7.1	309	238	-
SW05	20 January	-	-	-	No Flow - pool
SW05	24 February	-	-	-	-
SW05	4 March	-	-	-	Dry
SW05	8 March	7.2	134	73	-
SW05	25 March	7.2	186	37	-
SW05	28 April	-	-	-	Pool
SW05	31 May	-	-	-	No flow - Pool
SW05	30 June	-	-	-	No Flow (Pool)
SW05	4 July	7.5	126	215	-
SW05	5 August	7.3	377	93	-
SW05	16 September	7.4	1777	16	-
SW05	10 October	7.3	199	16	-
SW05	28 November	-	-	-	No Flow - Pool
SW05	23 December	-	-	-	Dry
SW05	28 December	-	-	-	Dry
SW06	10 January	6.9	326	<5	-
SW06	20 January	7.0	289	<5	-
SW06	24 February	7	311	<5	-
SW06	4 March	6.9	124	7	Suspended fines
SW06	7 March	7	128	144	-
SW06	25 March	6.8	139	18	-
SW06	28 April	7	303	<5	-
SW06	31 May	6.9	285	<5	Suspended solids
SW06	30 June	7.0	360	<5	-

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW06	4 July	7.2	107	82	-
SW06	5 August	7.2	165	6	-
SW06	16 September	7.1	268	<5	Suspended fines
SW06	10 October	6.8	139	<5	-
SW06	28 November	7.0	300	<5	-
SW06	23 December	6.9	359	<5	-
SW06	28 December	7.0	372	<5	-
SW07	10 January	7.3	465	<5	-
SW07	20 January	7.5	444	<5	-
SW07	24 February	7.4	507	<5	-
SW07	4 March	6.9	136	6	Suspended fines
SW07	8 March	-	-	-	Unsafe access - flooded
SW07	25 March	-	-	-	Unsafe access - flooded
SW07	28 April	7.4	404	<5	-
SW07	31 May	7.4	412	<5	-
SW07	30 June	7.4	517	<5	-
SW07	4 July	7.2	113	143	Taken before second crossing
SW07	5 August	7.4	315	25	-
SW07	16 September	7.5	415	52	-
SW07	10 October	7.2	212	10	-
SW07	28 November	7.5	450	<5	-
SW07	23 December	7.5	522	<5	-
SW07	28 December	7.5	540	<5	Suspended fines
SW08	24 February	-	-	-	Unsafe access
SW08	4 March	7.6	2800	<5	Suspended fines
SW08	8 March	-	-	-	Unsafe access - flooded
SW08	25 March	7	251	15	-
SW08	28 April	8.2	2070	<5	-
SW08	31 May	7.3	2410	<5	Sample collected from second crossing
SW08	30 June	8.0	3390	<5	-
SW08	4 July	7.5	200	89	SW08a, first crossing
SW08	5 August	7.6	1198	<5	Sample collected at 1st crossing
SW08	16 September	8.1	2780	<5	Sample taken at sample point
SW08	10 October	7.2	428	8	-
SW08	28 November	8.0	1427	<5	Sample collected from sample point
SW08	23 December	7.9	3100	8	-
SW08	28 December	8.1	3190	<5	Sample collected from original location
SW08(B)	30 June	7.1	1750	<5	EC checked
SW08(B)	5 August	-	-	-	No access
SW08(B)	16 September	-	-	-	No access, boggy
SW08(B)	10 October	-	-	-	No access
SW08(B)	28 November	7.4	788	<5	-
SW08(B)	23 December	7.4	1694	<5	-
SW08(B)	28 December	7.7	1782	<5	-
SW08a	10 January	7.8	546	<5	-

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW08a	20 January	7.9	821	<5	-
SW27a	10 January	-	-	-	No Flow - pool
SW27a	20 January	-	-	-	No Flow - pool
SW27a	24 February	-	-	-	Dry
SW27a	4 March	-	-	-	Dry
SW27a	8 March	-	-	-	Unsafe access - flooded
SW27a	28 April	-	-	-	Dry
SW27a	31 May	-	-	-	Dry
SW27a	30 June	-	-	-	Dry
SW27a	4 July	7.3	135	310	-
SW27a	5 August	7.8	410	108	-
SW27a	16 September	8	1169	32	-
SW27a	10 October	7.4	202	23	-
SW27a	28 November	-	-	-	No Flow - Pool
SW27a	23 December	-	-	-	Dry
SW27a	28 December	-	-	-	No Flow (pool)
SW32a	10 January	-	-	-	No Flow - pool
SW32a	20 January	-	-	-	Dry
SW32a	24 February	-	-	-	Dry
SW32a	4 March	-	-	-	Dry
SW32a	8 March	-	-	-	Unsafe access - flooded
SW32a	25 March	7.3	189	34	-
SW32a	28 April	-	-	-	No flow
SW32a	31 May	-	-	-	Dry
SW32a	30 June	-	-	-	Dry
SW32a	4 July	7.3	138	316	-
SW32a	5 August	7.9	353	123	-
SW32a	16 September	8	650	74	-
SW32a	10 October	7.5	20-3	21	-
SW32a	28 November	-	-	-	Dry
SW32a	23 December	-	-	-	Dry
SW32a	28 December	-	-	-	Dry
SW39	10 January	-	-	-	Dry
SW39	20 January	-	-	-	Dry
SW39	24 February	-	-	-	Dry
SW39	4 March	-	-	-	Dry
SW39	7 March	-	-	-	No Flow (pool)
SW39	25 March	-	-	-	No Flow (pool)
SW39	28 April	-	-	-	Dry
SW39	31 May	-	-	-	Dry
SW39	30 June	-	-	-	No Flow (Pool)
SW39	4 July	7.5	76	76	-
SW39	5 August	7.3	108	29	-
SW39	16 September	7.4	115	28	Susp solids
SW39	10 October	-	-	-	Pooled water

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW39	28 November	-	-	-	No Flow - Pool
SW39	23 December	-	-	-	Dry
SW39	28 December	-	-	-	Dry
SW40	10 January	7.3	674	12	-
SW40	20 January	7.4	634	10	Suspended fines
SW40	24 February	7	279	8	-
SW40	4 March	6.8	166	24	Suspended fines
SW40	8 March	6.8	86	112	-
SW40	25 March	6.8	179	41	-
SW40	28 April	7.1	458	9	-
SW40	31 May	7.3	503	<5	-
SW40	30 June	7.4	695	6	-
SW40	4 July	6.9	60	24	-
SW40	5 August	7.2	416	24	-
SW40	16 September	7	484	13	-
SW40	10 October	6.9	178	75	-
SW40	28 November	7.4	590	10	Suspended fines
SW40	23 December	7.5	764	7	-
SW40	28 December	7.5	802	13	-
SW41	10 January	-	-	-	No Flow - pool
SW41	20 January	-	-	-	No Flow - pool
SW41	24 February	-	-	-	Dry
SW41	4 March	-	-	-	Dry
SW41	7 March	7.1	169	100	-
SW41	25 March	-	-	-	No Flow (pool)
SW41	28 April	-	-	-	No flow/pooled water
SW41	31 May	7.4	173	31	-
SW41	30 June	-	-	-	No Flow (Pool)
SW41	4 July	7.2	75	15	-
SW41	5 August	7.1	107	36	-
SW41	16 September	7.2	126	33	Suspended solids
SW41	10 October	7	114	12	-
SW41	28 November	7.1	178	61	-
SW41	23 December	-	-	-	Dry
SW41	28 December	-	-	-	No Flow (pool)
US FM1	10 January	7.5	375	9	Suspended fines
US FM1	20 January	7.5	382	<5	-
US FM1	24 February	7.3	490	<5	-
US FM1	4 March	7.1	531	<5	Suspended fines
US FM1	8 March	-	-	-	Unsafe access - flooded
US FM1	25 March	7.2	178	8	-
US FM1	28 April	7.6	386	<5	-
US FM1	31 May	7.5	477	<5	-
US FM1	30 June	7.4	585	<5	-
US FM1	4 July	7.2	142	59	-

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
US FM1	5 August	7.5	318	<5	-
US FM1	16 September	7.5	485	<5	-
US FM1	10 October	7.3	192	<5	-
US FM1	28 November	7.5	453	<5	-
US FM1	23 December	7.5	639	<5	-
US FM1	28 December	7.8	684	<5	-

APPENDIX G

ANNUAL STREAM FLOW MONITORING REPORT

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13 March 2023

Commercial-in-Confidence

Nicole Dobbins
Environmental Advisor
Wambo Coal Pty Ltd.
ABN: 13 000 668 057
PMB 1
Singleton NSW 2330

Dear Nicole,

Report on stream flow events along North Wambo, South Wambo and Stoney Creeks for the period 1 January to 31 December 2022.

Please find contained within this report a summary of probable flow events which occurred along North Wambo, South Wambo and Stony Creeks from and inclusive of 1 January to 31 December 2022.

1.0 Locations, Configurations and Observations

The flow monitoring network now comprises of eleven flow monitoring stations. These flow monitoring stations are distributed along the following creeks: -

- North Wambo Creek has five flow monitoring stations;
- South Wambo Creek has three flow monitoring stations, and;
- Stony Creek has two monitoring stations with an additional flow monitoring station located on a major tributary to Stony Creek.

Details of the location (**Table 1, Table 2, Figure 1** and **Figure 2**), configuration (**Table 3**) and observations (**Table 4**) for each flow monitoring station are provided below.

Table 1 Flow Station Locations

Station ID	Location	Easting	Northing
FM1	North Wambo Creek adjacent to the mine	307014	6396139
USFM1	North Wambo Creek upstream of mine	305257	6395201
FM2	Midway along old North Wambo Creek diversion	308217	6395056
FM3	Midway along new North Wambo Creek diversion	309226	6393663
FM4	North Wambo Creek upstream of the confluence of Wollombi Brook	311906	6392160
FM15	South Wambo Creek upstream of the confluence of Wollombi Brook	311814	6391224
FM16	South Wambo Creek upstream of washout of Wambo Mine Road	311279	6390673
FM9	South Wambo Creek downstream	308666	6389176
FM12	Stony Creek upstream of proposed area to be mined	307711	6392744
FM14	Major tributary of Stony Creek upstream of proposed area to be mined	307723	6392242
FM13	Stony Creek downstream of proposed area to be mined	309537	6391090

Table 2 Atmospheric Pressure Correcting Station Locations

Station ID	Location	Easting	Northing
PM2	Midway along old North Wambo Creek diversion at Flow Station FM2 data logging housing	308196	6395042
PM6	South Wambo Creek upstream of washout of Wambo Mine Road inside the data logger housing for old Flow Station FM6	311253	6390711
PM8	Stony Creek upstream on the old Flow Station FM8 infrastructure	307996	6392278
PM7	Stony Creek downstream on the old Flow Station FM7 infrastructure	309400	6391443

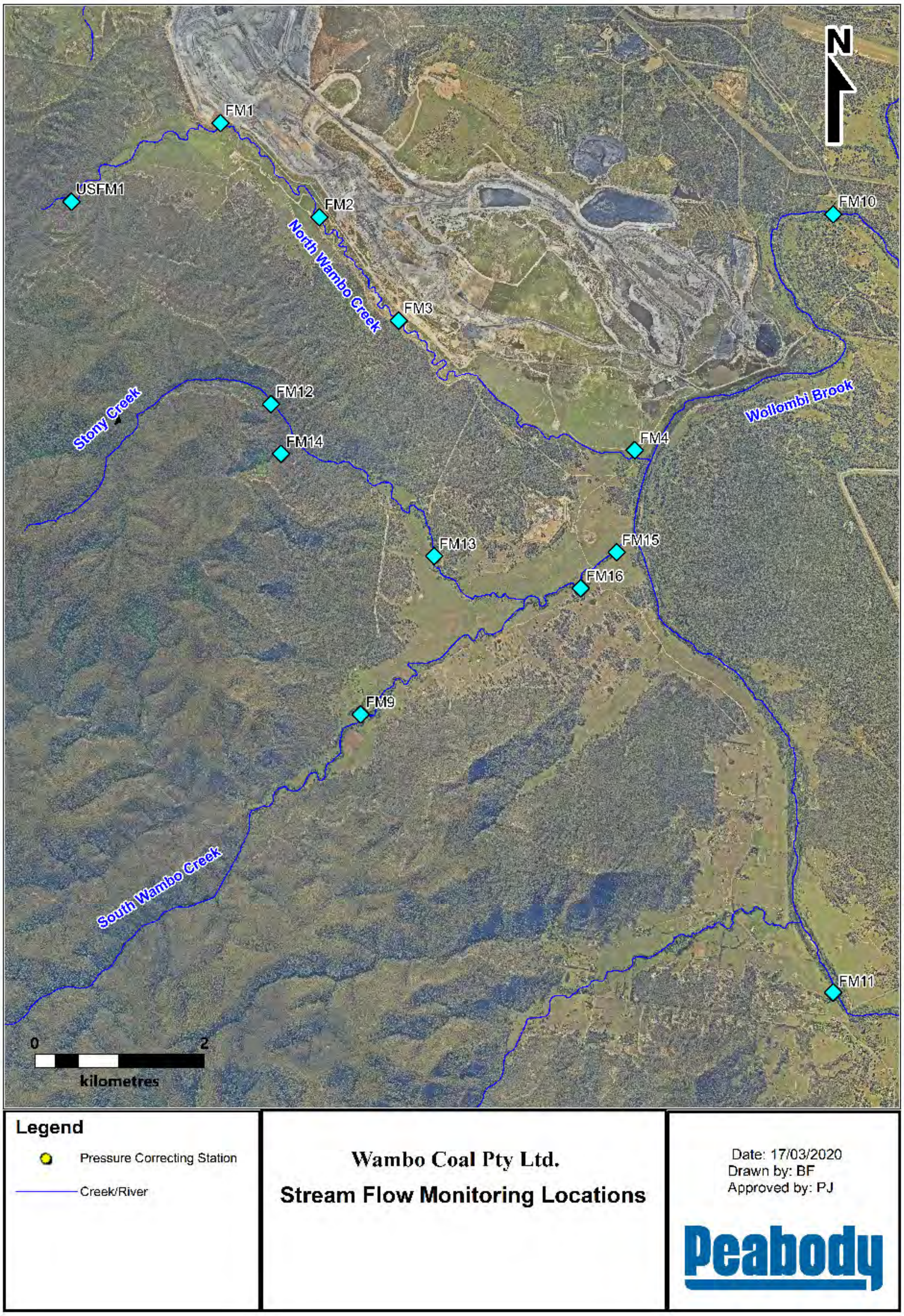

Figure 1 Stream Flow Locations

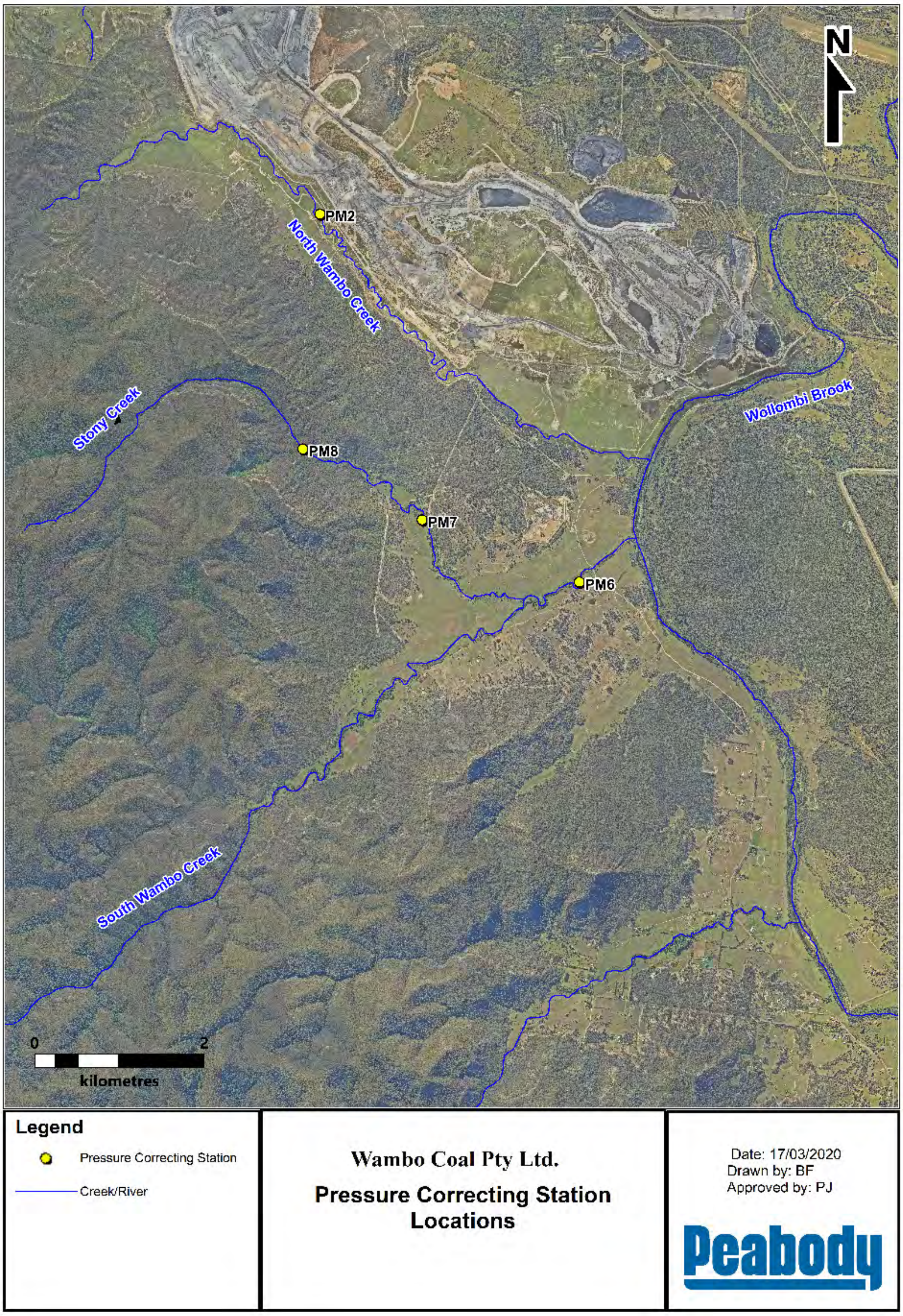

Figure 2 Pressure Correcting Station Locations

AECOM

Table 3 Monitoring Location Equipment Configurations

Station ID	Equipment	Corresponding Correction Station
FM1	Campbell Scientific (CSA) CS451 SDI-12 pressure transducer connected to a CSA CR800 series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged hourly. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
USFM1	Insitu Rugged TROLL 100 absolute pressure sensor. Data is logged at 10-minute intervals	**PM2**
FM2	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM3	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM4	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM15	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM16	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM9	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM12	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM8**
FM14	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM8**
FM13	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM7**
PM2	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM6	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM8	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM7	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A

Table 4 Monitoring Location General Observations

Station ID	Observations
FM1	Originally located at the top of North Wambo Creek upstream of surface water monitoring site SW04; re-located approximately 300 to 400m further downstream in December 2017 – downstream of surface water monitoring site SW04
USFM1	New station installed on North Wambo Creek during December 2017; located approximately 1 kilometre upstream of the original site of FM1
FM2	Located downstream from relocated Flow Station FM1 approximately midway along the old North Wambo Creek diversion. A backup pressure sensor was installed at this location in August 2020.
FM3	Originally located on North Wambo Creek between the old Wambo Underground Surface Infrastructure and the Open Cut Overburden: relocated in May 2013 to approximately midway along the new diversion of North Wambo Creek downstream of Flow Station FM2. A backup pressure sensor was installed at this location in August 2020.
FM4	Located at the Wambo Mine Road culvert which crosses North Wambo Creek upstream of the confluence of North Wambo Creek and Wollombi Brook
FM15	Located on South Wambo Creek just upstream of the confluence of South Wambo Creek and Wollombi Brook; relocated to approximately 100 to 200m downstream in December 2016
FM16	Located on South Wambo Creek approximately 200 to 300 metres up stream of the washout on Wambo Mine Road
FM 9	Located approximately 2 kilometres upstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer
FM12	Re-located during September 2018 approximately 50 metres downstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer
FM14	Installed in December 2015
FM13	Re-located during September 2018 approximately 50 metres upstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer.
PM2	In November 2018 data collection it was identified that this BaroTROLL failed during October 2018. A replacement sensor was installed on 24 January 2019
PM6	N/A
PM8	N/A
PM7	N/A

2.0 Methodology

The results represent a theoretical flow and have been calculated using polynomial equations derived from theoretical flow rating curves. These theoretical flow curves were constructed from data received by AECOM from Wambo Coal and Environmental Instrument Solutions with the exception of the relocated Stony Creek flow monitoring station and the new monitoring station FM9 on South Wambo Creek. Theoretical flow curves generated by AECOM were utilised to calculate theoretical flow along Stony Creek and its tributary when probable flow events occurred.

The data for each theoretical flow rating curve has been generated from cross and long section surveys. From the surveys a cross sectional area and the wetted perimeter for various theoretical stream heights were derived.

From these derived values the hydraulic radius was calculated for each theoretical stream height. The hydraulic radius is calculated as follows:

Rh = A/P

Where:-

Rh = Hydraulic Radius

A = Calculated cross section area for a give stream height

P = Calculated wetted perimeter for a given stream height

The stream slope was calculated from the long section surveys and the Manning's coefficient of rugosity was determined from the conditions observed in the stream bed and surrounding flood plain.

These values were then entered into the Manning's equation and a theoretical stream velocity was calculated. The Manning's equation is as follows: -

$V = (Rh^{2/3} X Sw^{1/2})/n$

Where: -

Rh = Hydraulic radius for a given stream height

Sw = Stream slope derived from the long section survey

n = Manning's coefficient of rugosity

The Manning's coefficient of rugosity was sourced from AS 3778.3.3 - 2001 *"Measurement of water flow in open channels, part 3.3: Velocity - area methods – Measurement by slope – area methods".*

The theoretical velocity, derived from the Manning's equation, was then multiplied by the calculated cross-sectional area for a given stream height to give a theoretical flow rate Q. The resultant theoretical flow rates were calculated for a series of stream heights and graphed to generate theoretical flow rating curves. **Appendix B** contains these theoretical flow rating curves for each Flow Monitoring Stations.

The data collected from each Flow Station was presented as a pressure reading in kPa. This pressure was converted to a stream height in metres using the following equation: -

Stream Height (m) = Stream Height (kPa) X 0.101972 (m/kPa)

The calculated stream height was then compared to the cease to flow point at each site. The cease to flow point was identified in conjunction with the long section surveys and represents a point in the reach/stream which the height of the stream must attain before it starts to flow.

The relative level of the cease to flow point was compared to the relative level of the sensor at each station. The difference in height between the cease to flow point and the sensor was calculated. This difference was used to screen the data collected from each station for probable flow events.

Once a flow event had been recognised at a flow monitoring station the resultant stream height was applied to the polynomial equation derived from theoretical flow rating curve, for that flow station, to give a theoretical stream flow rate for the identified flow event at the station. In some instances, more than one polynomial equation was required; see flow rating curves in **Appendix B**.

3.0 Results

Probable flow events for the period 1 January to 31 December 2022 for each flow station (including backup sensors) are presented in the following tables. All results displayed in respect to stream flow are theoretical and should be treated as such.

- Upper North Wambo Creek – Flow Monitoring Station USFM1 (**Table 5)**;
- North Wambo Creek adjacent to the mine – Flow Monitoring Station FM1 (
- **Table** 6**)** – note that probable flow events were detected by the main pressure sensor only;
- North Wambo Creek midway along old diversion – Flow Monitoring Stations FM2BU (**Table 7**) – note that probable flow events were detected by the backup pressure sensor only;
- North Wambo Creek midway along new diversion – Flow Monitoring Stations FM3 (**Table 8**) and FM3BU (**Table 9**) – note that the main pressure sensor failed during the July 2022 rain event;
- North Wambo Creek upstream of Wollombi Brook – Flow Monitoring Stations FM4 (**Table 10**) and FM4BU (**Table 11**) – note that the main pressure sensor was washed away during the July 2022 rain event;
- South Wambo Creek upstream of washout of Wambo Mine Road – Flow Monitoring Station FM16 (**Table 12**);
- Stony Creek upstream of proposed area to be mined – Flow Monitoring Station FM12 (**Table 13**);
- Major tributary of Stony Creek upstream of proposed area to be mined – Flow Monitoring Station FM14 (**Table 14**); and
- Stony Creek downstream of proposed area to be mined – Flow Monitoring Station FM13 (**Table 15**).

Table 5 Flow Monitoring Station USFM1 Upper North Wambo Creek – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2022 0:02	31/12/2022 23:52	360	0.24	1.8	0.47	41	56	4800

Table 6 Flow Monitoring Station FM1 North Wambo Creek – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	7/03/2022 12:10	6/05/2022 4:20	60	0.34	1.9	3.7	320	110	9600
2	4/07/2022 0:50	28/08/2022 11:10	55	0.32	2.0	2.9	250	120	10000
3	7/10/2022 23:00	7/11/2022 15:40	31	0.14	0.52	0.49	42	5.9	510
4	7/11/2022 20:00	8/11/2022 10:20	0.6	0.0052	0.009	0.0054	0.47	0.0094	0.82
5	12/11/2022 18:00	28/11/2022 16:00	16	0.14	0.68	0.67	57	12	1000
6	28/11/2022 22:40	29/11/2022 8:20	0.4	0.0042	0.0079	0.0043	0.37	0.0082	0.71

Table 7 Flow Monitoring Station FM2BU North Wambo Creek Mid Old Diversion – Summary of Results – 4 August to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	9/01/2022 3:47	15/01/2022 9:57	6.3	0.068	0.37	0.084	7.3	0.86	74
2	15/01/2022 17:37	16/01/2022 15:07	0.9	0.011	0.036	0.01	0.87	0.035	3.1
3	19/01/2022 10:57	21/01/2022 6:57	1.8	0.013	0.045	0.012	1	0.046	4
4	7/03/2022 10:27	18/03/2022 19:47	11	0.34	1.6	4.4	380	59	5100
5	24/03/2022 7:47	15/04/2022 15:37	22	0.25	0.86	2	170	17	1400
6	3/07/2022 14:47	22/07/2022 13:27	19	0.32	1.5	4.4	380	52	4500
7	4/08/2022 23:27	9/08/2022 11:47	4.5	0.047	0.099	0.06	5.2	0.22	19
8	13/08/2022 3:07	15/08/2022 13:37	2.4	0.024	0.045	0.015	1.3	0.045	3.9
9	7/10/2022 18:07	17/10/2022 6:37	9.5	0.12	0.49	0.66	57	5.5	470
10	21/10/2022 2:07	28/10/2022 18:37	7.7	0.075	0.2	0.17	14	0.92	80

Table 8 Flow Monitoring Station FM3 North Wambo Creek Mid New Diversion – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	9/01/2022 2:50	9/01/2022 12:00	0.382	0.0928	0.259	0.111	9.62	0.509	44
2	4/03/2022 15:00	4/03/2022 17:30	0.104	0.0129	0.0238	0.00609	0.526	0.0117	1.02
3	6/03/2022 2:50	6/03/2022 7:20	0.188	0.033	0.08	0.0202	1.75	0.0578	5
4	7/03/2022 1:10	7/03/2022 5:00	0.16	0.00549	0.00959	0.00246	0.213	0.00436	0.377
5	7/03/2022 7:40	15/03/2022 15:50	8.34	0.329	1.69	1.76	152	22.2	1920
6	24/03/2022 6:50	6/04/2022 3:00	12.8	0.256	0.79	0.694	60	5.36	463
7	7/04/2022 21:10	7/04/2022 23:10	0.0833	0.00148	0.00401	0.000647	0.0559	0.00177	0.153
8	8/04/2022 9:20	11/04/2022 17:30	3.34	0.0847	0.167	0.0772	6.67	0.209	18
9	5/05/2022 9:50	5/05/2022 11:00	0.0486	0.000699	0.00129	0.000303	0.0262	0.000561	0.0484
10	12/05/2022 20:10	13/05/2022 19:20	0.965	0.00681	0.0165	0.00309	0.267	0.00781	0.675

Table 9 Flow Monitoring Station FM3BU North Wambo Creek Mid New Diversion – Summary of Results – 4 August to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	8/01/2022 1:19	8/01/2022 16:59	0.653	0.035	0.063	0.0191	1.65	0.0405	3.5
2	9/01/2022 3:09	9/01/2022 16:09	0.542	0.077	0.268	0.0956	8.26	0.549	47.4
3	15/01/2022 17:09	15/01/2022 18:59	0.0764	0.0286	0.0468	0.0151	1.3	0.0269	2.32
4	4/03/2022 15:19	4/03/2022 17:19	0.0833	0.00891	0.0227	0.00415	0.359	0.0111	0.963
5	6/03/2022 3:19	6/03/2022 6:29	0.132	0.0388	0.0818	0.0233	2.01	0.06	5.18
6	7/03/2022 9:29	15/03/2022 8:29	7.96	0.331	1.69	1.77	153	22.2	1920
7	23/03/2022 16:59	23/03/2022 17:59	0.0417	0.00885	0.0192	0.00411	0.355	0.00924	0.799
8	24/03/2022 7:09	5/04/2022 19:49	12.5	0.256	0.837	0.712	61.5	6.03	521
9	8/04/2022 8:29	11/04/2022 6:59	2.94	0.0779	0.157	0.0664	5.73	0.185	16
10	3/07/2022 12:49	18/07/2022 8:39	14.8	0.348	1.65	1.94	167	21.8	1890
11	4/08/2022 19:49	5/08/2022 5:09	0.389	0.0436	0.103	0.0283	2.44	0.0869	7.5
12	5/08/2022 20:39	6/08/2022 8:59	0.514	0.0222	0.0431	0.0112	0.971	0.0242	2.09
13	13/08/2022 2:09	13/08/2022 3:59	0.0764	0.0136	0.0311	0.00659	0.569	0.0161	1.39
14	15/09/2022 16:39	16/09/2022 15:59	0.972	0.0396	0.0695	0.0224	1.94	0.0468	4.04
15	17/09/2022 9:39	17/09/2022 15:49	0.257	0.0254	0.0489	0.0132	1.14	0.0285	2.47
16	18/09/2022 11:39	18/09/2022 15:09	0.146	0.00484	0.0152	0.00218	0.188	0.00716	0.618
17	22/09/2022 2:29	22/09/2022 17:59	0.646	0.0194	0.0526	0.00973	0.841	0.0315	2.72
18	23/09/2022 10:59	23/09/2022 16:09	0.215	0.0224	0.0524	0.0118	1.02	0.0313	2.7
19	5/10/2022 22:19	6/10/2022 0:59	0.111	0.0131	0.0213	0.00617	0.533	0.0104	0.894
20	7/10/2022 15:49	8/10/2022 5:39	0.576	0.0532	0.157	0.0424	3.67	0.186	16.1
21	8/10/2022 19:49	14/10/2022 17:09	5.89	0.15	0.423	0.265	22.9	1.45	125
22	20/10/2022 13:29	20/10/2022 14:59	0.0625	0.00438	0.0143	0.00197	0.17	0.00669	0.578
23	21/10/2022 7:29	26/10/2022 16:49	5.39	0.0791	0.157	0.0636	5.49	0.186	16.1
24	1/11/2022 0:19	1/11/2022 3:09	0.118	0.0109	0.0244	0.00514	0.444	0.0121	1.05
25	1/11/2022 5:29	1/11/2022 7:09	0.0694	0.00638	0.0152	0.00289	0.25	0.00716	0.618
26	12/11/2022 18:29	18/11/2022 20:49	6.1	0.129	0.614	0.27	23.3	3.18	275
27	23/12/2022 22:09	24/12/2022 13:59	0.66	0.0396	0.0833	0.0227	1.97	0.0616	5.32
28	24/12/2022 15:19	24/12/2022 17:19	0.0833	0.0134	0.0232	0.00633	0.547	0.0114	0.988

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Table 10 Flow Monitoring Station FM4 North Wambo Creek upstream of the confluence of Wollombi Brook – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	9/01/2022 9:10	9/01/2022 20:20	0.465	0.0422	0.0974	0.0963	8.32	0.268	23.1
2	7/03/2022 10:40	15/03/2022 18:10	8.31	1.04	2.99	144	12500	655	56600
3	24/03/2022 8:30	5/04/2022 13:10	12.2	0.27	1.42	1.63	141	31	2680
4	21/10/2022 16:10	26/10/2022 7:10	4.63	0.0353	0.0982	0.073	6.31	0.271	23.4
5	14/11/2022 6:40	18/11/2022 10:10	4.15	0.137	0.686	0.617	53.3	5.06	438

Table 11 Flow Monitoring Station FM4BU North Wambo Creek upstream of the confluence of Wollombi Brook – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	9/01/2022 8:45	10/01/2022 0:55	0.674	0.0459	0.113	0.106	9.18	0.334	28.8
2	7/03/2022 10:25	16/03/2022 9:35	8.97	0.983	3.01	138	11900	681	58900
3	16/03/2022 16:15	16/03/2022 21:45	0.229	0.00617	0.0162	0.0091	0.786	0.0255	2.21
4	24/03/2022 6:45	5/04/2022 22:45	12.7	0.27	1.43	1.63	141	31.4	2710
5	8/04/2022 13:55	11/04/2022 9:15	2.81	0.0589	0.141	0.149	12.9	0.461	39.8
6	3/07/2022 14:55	19/07/2022 1:15	15.4	1.13	5.51	871	75200	9200	795000
7	4/08/2022 18:05	6/08/2022 19:35	2.06	0.0253	0.11	0.0552	4.77	0.319	27.6
8	13/08/2022 1:45	13/08/2022 22:15	0.854	0.0155	0.0429	0.0264	2.28	0.0853	7.37
9	22/09/2022 5:15	22/09/2022 18:15	0.542	0.0139	0.0469	0.0228	1.97	0.096	8.29
10	7/10/2022 17:15	14/10/2022 11:45	6.77	0.118	0.487	0.475	41.1	2.96	256
11	21/10/2022 16:05	25/10/2022 23:25	4.31	0.0416	0.104	0.0879	7.59	0.296	25.6
12	26/10/2022 4:45	26/10/2022 9:35	0.201	0.0087	0.0171	0.013	1.12	0.0272	2.35
13	14/11/2022 5:05	18/11/2022 8:35	4.15	0.133	0.651	0.584	50.5	4.65	402

Table 12 Flow Monitoring Station FM16 South Wambo Creek upstream of the washout of Wambo Mine Road – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2022 0:04	31/12/2022 23:54	365	0.198	3.96	2.84	246	389	33600

Table 13 Flow Monitoring Station FM12 Stony Creek upstream of the proposed area to be mined – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2022 0:08	15/02/2022 9:38	45.4	0.0236	0.0869	0.0251	2.16	0.169	14.6
2	15/02/2022 16:58	15/02/2022 21:28	0.19	0.00212	0.00558	0.00121	0.105	0.00345	0.298
3	16/02/2022 0:58	16/02/2022 12:28	0.48	0.00317	0.00793	0.00191	0.165	0.0052	0.449
4	16/02/2022 19:48	26/02/2022 10:38	9.6	0.00432	0.0143	0.0027	0.233	0.0108	0.935
5	27/02/2022 3:28	27/02/2022 7:38	0.17	0.00265	0.00905	0.00157	0.136	0.0061	0.527
6	28/02/2022 0:08	28/02/2022 8:58	0.37	0.00246	0.00762	0.00144	0.124	0.00496	0.428
7	1/03/2022 18:28	2/03/2022 6:58	0.52	0.00225	0.00793	0.0013	0.113	0.0052	0.449
8	3/03/2022 3:38	4/03/2022 9:38	1.25	0.00301	0.00854	0.00178	0.154	0.00568	0.491
9	4/03/2022 15:38	5/03/2022 11:48	0.84	0.00387	0.0122	0.00239	0.206	0.00886	0.766
10	5/03/2022 20:08	31/12/2022 23:58	301.2	0.0652	1.20	0.231	19.9	24.2	2090

Table 14 Flow Monitoring Station FM14 Major tributary of Stony Creek upstream of the proposed area to be mined – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2022 0:03	25/01/2022 12:03	24.5	0.0198	0.0512	0.00317	0.274	0.00546	0.472
2	25/01/2022 19:23	26/01/2022 5:03	0.40	0.00288	0.00687	0.000666	0.0576	0.0015	0.13
3	26/01/2022 6:33	26/01/2022 9:23	0.12	0.00273	0.0084	0.000627	0.0542	0.00179	0.155
4	7/03/2022 10:53	30/06/2022 12:43	115.1	0.130	0.538	0.110	9.52	2.49	215
5	30/06/2022 16:13	1/07/2022 11:43	0.81	0.0527	0.0868	0.00574	0.496	0.00947	0.819
6	1/07/2022 15:53	2/07/2022 10:03	0.76	0.036	0.0522	0.00455	0.394	0.00551	0.476
7	2/07/2022 19:53	2/07/2022 23:43	0.16	0.00572	0.012	0.00123	0.106	0.00238	0.206
8	3/07/2022 14:03	9/12/2022 9:53	158.8	0.178	0.608	0.278	24.1	3.41	295

Table 15 Flow Monitoring Station FM13 Stony Creek downstream of the proposed area to be mined – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	21/01/2022 10:17	10/02/2022 17:07	20.3	0.0609	0.0895	0.0454	3.92	0.071	6.14
2	11/02/2022 3:57	11/02/2022 11:57	0.33	0.0159	0.0275	0.0107	0.924	0.0189	1.63
3	12/02/2022 3:07	12/02/2022 10:27	0.31	0.0172	0.0285	0.0116	0.998	0.0195	1.69
4	7/03/2022 10:37	10/06/2022 18:47	95.3	0.171	1.35	0.269	23.3	12.3	1070
5	11/06/2022 4:57	11/06/2022 17:57	0.54	0.0131	0.0332	0.00874	0.755	0.0231	1.99
6	12/06/2022 5:47	12/06/2022 9:47	0.17	0.00793	0.014	0.00523	0.452	0.00929	0.803
7	3/07/2022 13:47	25/12/2022 16:07	175.1	0.139	1.16	0.170	14.7	8.38	724

A summary of total monthly rain fall data presented in **Table 16** below was derived from the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area.

Table 16 Monthly Total Rainfall Data at Wambo Coal Meteorological Station – 1 January to 31 December 2022.

Month	Wambo Coal's Meteorological Station Total Rainfall (mm)	Number of Days Rain Fell in the Month
January	122.6	13
February	76.0	21
March	383.2	24
April	47.2	22
May	42.4	18
June	7.0	4
July	202.2	12
August	54.6	12
September	76.4	17
October	97.8	19
November	52.2	7
December	31.0	4

A second rainfall monitoring station was installed at location FM2 during April 2021. Rainfall data for this monitoring location for 2022 is presented in **Table 17** below. There are no monthly rainfall totals for January and July 2022 due to data loss from the monitoring station for the period 5 to 17 January 2022 and all of July 2022. Rainfall measurements at FM2 were consistent with those at the Wambo Coal Meteorological Station for all months where data was available.

Table 17 Monthly Total Rainfall Data at FM2 location – 1 May to 31 December 2022

Month	FM2 Monitoring Location Total Rainfall (mm)	Number of Days Rain Fell in the Month
January	-	-
February	56.6	18
March	312.2	21
April	43.0	18
May	46.8	21
June	8.6	7
July	-	-
August	54.4	13
September	79.2	19
October	126.0	18
November	87.6	8
December	51.4	5

Daily rainfall data was used to cross reference the raw data collected from the Flow Monitoring Stations to help identify periods where a flow event may have occurred.

Appendix C contains, where theoretical flow events were recognised, annual graphical depictions of stream height and theoretical flow in conjunction with daily and cumulative rainfall.

The results presented in the above tables should be read with the following qualifying statements in mind: -

- All flow events represent a theoretical flow and have been derived from stream height data. The stream height data was then applied to polynomial equations derived from theoretical flow rating curves to give a theoretical flow. These theoretical flow rating curves were generated using cross and long section surveys in conjunction with the Manning's equation. These theoretical flow rating curves were constructed by AECOM in 2019 on data provided by Environmental Instrument Solutions;
- North Wambo, South Wambo and Stony Creeks are ephemeral and as such only flow after significant rainfall events, therefore the theoretical flow rating curves in **Appendix B** have not been calibrated/checked against actual physical measurements of flow using a current meter;
- Some flow events may have been overlooked due to, but not limited to, poor data quality, data missing, inconsistent data, sensor failure or loss, logger failure, power supply problems and changes to stream bed characteristics, and;
- The three flow monitoring stations installed on Stony Creek and its associated tributary have been positioned such as to be outside a proposed underground mine area and designed to monitor stream flow and any associated effect of underground mining on stream flow. These stations were installed by AECOM on 7 December 2016 and replace flow monitoring stations 7 and 8.

4.0 Recommendations

During the period 1 January to 31 December 2022 the following issues were encountered with the stream monitoring network as a result of the significant rain which fell during March and July 2022 and the subsequent flows which occurred across the whole flow monitoring network.

- Flow Station USFM1:-
    - The stream bed flow characteristics were changed, and a re-survey of the stream bed was undertaken. From the re-survey new theoretical flow curves were constructed and used to calculate theoretical flow from March 2022.

- Flow Station FM1:-
    - The backup pressure sensor was washed away during the March 2022 rain event. Access, stream flow and weather conditions prevented the replacement of the backup sensor during 2022.
    - The stream bed flow characteristics were changed, and a re-survey of the stream bed was undertaken. From the re-survey new theoretical flow curves were constructed and used to calculate theoretical flow from March 2022.
- Flow Station FM2:-
    - The main pressure sensor failed with no data for 2022. Access, stream flow and weather conditions prevented the replacement of the main sensor during 2022.
    - The stream bed flow characteristics were changed, and a re-survey of the stream bed was undertaken. From the re-survey new theoretical flow curves were constructed and used to calculate theoretical flow from March 2022.
    - Changes to the stream bed caused by the large flow events recorded during 2022 has meant that the original location of both the main sensor and the backup sensor are no longer in the main flow path. During the re-survey of the stream bed in February 2023 a suitable new location for the main and backup sensors was identified.
- Flow Station FM3:-
    - The main pressure sensor was washed away during the July 2022 rain event. Access, stream flow and weather conditions prevented the replacement of the main sensor for the majority 2022.
    - An attempt to replace the main pressure sensor was made during December 2022 where it was found that the sensor cable protective conduit was either blocked or damaged.
- Flow Station FM4:-
    - The Flow Station's data logger and battery we damaged beyond repair by flood water during the July 2022 rain event and as a result all data after the last data collect event was lost. The main pressure sensor was unaffected and is currently operational. A replacement data logger and battery were installed during December 2022.
- Flow Station FM9:-
    - The pressure sensor was washed away during the March 2022 rain event with no data available for 2022. Access, stream flow and weather conditions prevented the replacement of the main sensor during 2022.
- Flow Station FM16:-
    - The stream bed flow characteristics were changed, and a re-survey of the stream bed was undertaken. From the re-survey new theoretical flow curves were constructed and used to calculate theoretical flow from July 2022.
- Flow Station FM15:-
    - The pressure sensor has been buried beneath significant volume of sand with no data available for 2022. Access, stream flow and weather conditions prevented attempts to locate the main sensor during 2022. A further attempt was made in January 2023 but was unsuccessful.

Subsequent visual inspections of the other flow stations in the flow monitoring network did not indicate any significant damage to the station hardware in additional to what has been mentioned above, however stream bed flow characteristics did change at flow stations FM9 and FM15.

It is recommended that over the coming reporting period, 1 January 2023 to 31 December 2023, that during the repairs and re-establishment that part of this work a resurvey of the stream bed characteristics is undertaken.

If you have any questions or require any clarification of aspects in this report, please contact us in the Singleton office.

Yours faithfully

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encl: Appendix A - Flow Station Field Sheets and Station Data Logger Status Sheets.
Appendix B - Theoretical Flow Rating Curves.
Appendix C - Stream Height, Theoretical Flow, Daily and Cumulative Rainfall Charts.

Addendum: Comparison of Flow Monitoring Data with the Surface Water Monitoring Plan (SWMPV2)

SWMPV2 states:

"Flow impact assessment criteria for the local mine site ephemeral creeks are based on the unexpected absence of flow in climatic situations when flows would be expected. The impact assessment criteria would be met if there was no flow recorded at the flow monitoring site either on the day or the day after the recorded rainfall was equal to or greater than the nominated amount. The resulting runoff generating rainfall values are given in Table 14" of the SWMPV2 which has been reproduced as **Table 18** below.

Table 18 Surface Water Flow Impact Assessment Condition

Watercourse and flow monitoring site	Daily rainfall when flow commenced on 80% of recorded occasions
North Wambo Creek – FM1*	100mm
South Wambo Creek – FM15**	20mm
Stony Creek – FM13	20mm

*Revised Wambo SWMP V2 (approved 20 November 2020) removed North Wambo Creek performance indicator of 20mm daily rainfall at location FM4 replacing with performance indicator of rain event total of 100mm at location FM1 effective 21 November 2020.

* Flow monitoring site FM15 sensor has been buried under significant amounts of sand resulting in no data available for 2022.

Table 19 below lists the dates from 1 January to 31 December 2022 when 20mm or greater of 24 hour rainfall was recorded at the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area and corresponding flow events at flow monitoring sites FM15 and FM13.

Table 19 Dates of Daily Rainfall Greater than 20mm and Corresponding Flow Events

<table>
<tr><th>Date</th><th>24 hour Rainfall (mm)</th><th>Site FM15</th><th>Site FM13</th></tr>
<tr><td>9/01/2022</td><td>50.2</td><td rowspan="15">Flow monitoring site FM15 sensor has been buried under significant amounts of sand resulting in no data available for 2022</td><td>No flow event recorded</td></tr>
<tr><td>19/01/2022</td><td>21.6</td><td>Flow event 21/01/2022 10:17 to 10/02/2022 17:07</td></tr>
<tr><td>3/03/2022</td><td>22.0</td><td>No flow event recorded</td></tr>
<tr><td>6/03/2022</td><td>40.0</td><td rowspan="5">Flow event 7/03/2022 10:37 to 10/06/2022 18:47</td></tr>
<tr><td>7/03/2022</td><td>92.8</td></tr>
<tr><td>8/03/2022</td><td>75.4</td></tr>
<tr><td>24/03/2022</td><td>53.8</td></tr>
<tr><td>26/03/2022</td><td>28.6</td></tr>
<tr><td>3/07/2022</td><td>84.0</td><td rowspan="7">Flow event 3/07/2022 13:47 to 25/12/2022 16:07</td></tr>
<tr><td>4/07/2022</td><td>27.0</td></tr>
<tr><td>5/07/2022</td><td>53.0</td></tr>
<tr><td>4/08/2022</td><td>27.0</td></tr>
<tr><td>15/09/2022</td><td>21.8</td></tr>
<tr><td>7/10/2022</td><td>21.4</td></tr>
<tr><td>23/12/2022</td><td>20.8</td></tr>
</table>

Table 20 below lists the periods from 1 January to 31 December 2022 when accumulated rainfall greater than 100mm was recorded at the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area and corresponding flow events at flow monitoring site FM1.

Table 20 Dates of Rain Event Rainfall Greater than 100mm and Corresponding Flow Events

Dates	Total Rainfall (mm)	Site FM1
6/03/2022 to 9/03/2022	220.4	Flow event 7/03/2022 12:10 to 6/05/2022 4:20
24/03/2022 to 31/03/2022	120.4	
3/07/2022 to 7/07/2022	182.8	Flow event 4/07/2022 0:50 to 28/08/2022 11:10

Appendix A

Flow Station Field Sheets & Data Logger Status Sheets

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	22.6.22	1000	RuggedTroll	-	-	-	-	100	36	yes	yes	yes	slow flow	0 215mm	Data wrap on 215m
Old FM1	North Wambo	22.6.22	1040	RuggedTroll	-	-	-	-	~~100~~ 100	27	yes	yes	yes		0	Data wrap on New logger
FM1 New Location	North Wambo	22.6.22	1118	CS-CR800	13.5	14.14	yes		-	-	yes	yes	~~yes~~	~~Dry~~	0	
FM1 New Location BU	North Wambo	22.6.22	1130	RuggedTroll	-	-	-	-	100	36	yes	yes	yes	Dry	0	Data wrap on New logger
FM2	North Wambo	22.6.22	1240	CS-CR200	21.42	13.33	yes	No	-	-	yes	NO	yes	Dry	0	
FM2 BU	North Wambo	22.6.22	1210	RuggedTroll	-	-	-	-	81	14	yes	yes	yes	Dry	0	
BarroLogger NWC	North Wambo	22.6.22	1300	BaroTroll	-	-	-	-	100	21		yes	yes	-	-	Data wrap on New barrologger
FM3	North Wambo	22.6.22	0840	CS-CR200	20.17	12.90	✓	N	-	-	Y	Y	Y	Dry	0	
FM3 BU	North Wambo	22.6.22	0910	RuggedTroll	-	-	-	NO	81	14	yes	yes	yes	Dry	0	
FM4	North Wambo	22.6.22	0800	CS-CR200	14.01	13.21	yes	NO	-	-	yes	yes	yes	Dry	0	
FM4 BU	North Wambo	29.4.22	1350	RuggedTroll	-	-	-	-	96	26					0	Data wrap on New logger
FM12 SCUP	Stoney	27.4.22	1150	RuggedTroll	-	-	-	-	25	3	Yes	Yes	Yes	Mod flow	0 17mm	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary	9.6.22	1100	RuggedTroll	-	-	-	-	28	4	yes	yes	yes	mod flow	0	Data wrap on
Stoney Ck Up Barro	Stoney	9.6.22	145	BaroTroll	-	-	-	-	28	4	yes	yes	yes	-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
Upstream old FM1	North Wambo	25.7.22	1040	RuggedTroll	-	-	-	-	100%	37%	yes	yes	yes	mod flow	0.70mm	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo	25.7.22	1150	CS-CR200	13.42	13.41	yes	No	-	-	yes	yes	yes	-	0 -	
FM3 BU	North Wambo	25.7.22	1145	RuggedTroll	-	-	-	NO	84%	15%	yes	yes	yes	trickle	0 -	
FM4 BU	North Wambo	25.7.22	1305	CS-CR200					- 100%	- 28%	Yes	Yes	Yes	Slow flow	0	
FM4 ~~BU~~	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

29.4.22 Old FM1 - Water level too high. Could not access logger. Photo taken.

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	13.9.22	1040	RuggedTroll	-	-	-	-	100%	38%	Yes	Yes	Yes	Mod flow	0 195/196	Data wrap on
Old FM1	North Wambo	13.9.22	1135	RuggedTroll	-	-	-	-	-	-	-	-	-	-	0	Data wrap on New logger f/s gone, flooded sand,
FM1 New Location	North Wambo	13.9.22	1150	CS-CR800	Normal	13.96	NA	N	-	-	Yes	Yes	Yes	Dry, sand	0	Heavy sand deposition
FM1 New Location BU	North Wambo	13.9.22	1150	RuggedTroll	-	-	-	-	-	-	-	-	-	-	0	Data wrap on New logger gone
FM2	North Wambo	13.9.22	1245	CS-CR200	21.00	13.07	NA	N	-	-	Yes	No	Yes	Dry	0	with sensor failed
FM2 BU	North Wambo	13.9.22	1245	RuggedTroll	-	-	-	-	90%	16%	Yes	Yes	Yes	Dry	0	
BarroLogger NWC	North Wambo	13.9.22	1330	BaroTroll	-	-	-	-	100%	29%	Yes	Yes	Yes	-	-	Data wrap on New barrologger
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-.	Data wrap on
FM3	North Wambo	13.9.22	945	CS-CR200	-	-	-	-	-	-	-	-	-	-	0	sensor failed, no data
FM3 BU	North Wambo	13.9.22	945	RuggedTroll	-	-	-	-	90%	16%	Yes	Yes	Yes	Dry	0	
FM4	North Wambo	13.9.22	850	CS-CR200	20.24	13.55	N	N	-	-	Yes	Yes	Yes	Low flow	0105/97	logger & new battery installed 2/9/22
FM4 BU	North Wambo	13.9.22	850	RuggedTroll	-	-	-	-	100%	29%	Yes	Yes	Yes	low flow	0	Data wrap on debris needs to be removed
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	09/12/22	1330	RuggedTroll	-	-	-	-	100%	40%	Yes	Yes	yes	flowing	~~X~~ 190	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM1 New Location	North Wambo	09/12/22	1250	CS-CR800	fully charged	13.91v	slight dust	No	-	-	Yes	Yes	Yes	Dry	0	Needs Relocation
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo	09/12/22	1400	RuggedTroll	-	-	-	-	100%	18%	yes	yes	yes	Dry	0	
BarroLogger NWC	North Wambo	09/12/22	1415	BaroTroll	-	-	-	-	100%	31%	yes	yes	yes	-	-	Data wrap on ~~New barrologger~~
FM3	North Wambo	09/12/22	1120	CS-CR200	-	-	-	-	-	-	-	-	-	-	0	New sensor installed-X
FM3 BU	North Wambo	09/12/22	1115	RuggedTroll	-	-	-	~~[illegible]~~ No	18%	100%	yes	yes	yes	Dry	0	
FM4	North Wambo	09/12/22	0850	CS-CR200	19.16v	13.51v	Dusty	No	-	-	Yes	Yes	Yes	Dry	0	-
FM4 BU	North Wambo	09/12/22	0905	RuggedTroll	-	-	-	-	100%	31%	Yes	Yes	Yes	Dry	0	Data wrap on ~~New logger~~
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
~~FM13~~ SCDown Barro	Stoney	09/12/22	1030	RuggedTroll	-	-	-	-	50%	08%	yes	Yes	yes	-	0	Data wrap on
FM13 Stoney Ck Down ~~Barro~~	Stoney	09/12/22	0950	BaroTroll	-	-	-	-	50%	08%	Yes	yes	yes	- Flowing	- 300mm	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
Upstream old FM1	North Wambo	19.1.23	1520	RuggedTroll	-	-	-	-	100%	53%	yes	yes	yes	Slow	0.200mm	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo	19.01.23	1450	CS-CR800		14.15	Yes	No	-	-	Yes	Yes	Yes	Dry	0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo	19.01.23	1415	CS-CR200		13.56	Yes	No	-	-	yes	Yes	yes	Dry	0	
FM2 BU	North Wambo	19.01.23	1355	RuggedTroll	-	-	-	-	100%	19%	yes	yes	yes	dry	0	
BarroLogger NWC	North Wambo	19.1.23	1600	BaroTroll	-	-	-	-	100%	32%	yes	yes	yes	-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo	19.01.23	1315	RuggedTroll	-	-	-	No	100%	19%	Yes	yes	yes	Dry	0	
FM4	North Wambo	19.01.23	0820	CS-CR200		13.22	Yes	No	-	-	Yes	Yes	Yes		0	
FM4 BU	North Wambo	19.01.23	0830	RuggedTroll	-	-	-	-	100%	32%	yes	yes	yes	Dry	0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney	19.01.23	1120	RuggedTroll	-	-	-	-	53%	9%	Yes	Yes	Yes	Dry	0	Data wrap on
Stoney Ck Down Barro	Stoney	19.01.23	1200	BaroTroll	-	-	-	-	53%	9%	yes	yes	yes	-	-	Data wrap on - ~~Barro no Power~~
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

* Stoney Ck down - Bring star picket to mark location (Next visit after 09/12/22)*
- Bring Shovel/Spade (Next visit after 19/01/23)*

Check sensor heights
X

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on New barrologger
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo	20/1/23	830	RuggedTroll	- Station sensor lost - unable to find. Since July 2022. However still flowing.										0	Data wrap on
FM15 (FM5)	South Wambo	20/1/23	900	RuggedTroll	- Unable to find sensor - buried under sand + gravel - stream flowing										0	Data wrap on
FM16 (FM6)	South Wambo	20.1.23	0955	RuggedTroll	-	-	-	-	100%	48%	yes	yes	yes	flowing	0	Data wrap on
Barro Logger SWC	South Wambo	20.1.23	1020	BaroTroll	-	-	-	-	100%	48%	yes	yes	yes	-	-	Data wrap on
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

60248386 - FM1 CR800 Data Logger Status Summary
9/12/2022 12:59:36 PM

Datalogger Information
Reported Station Name: 6722
OS Version: CR800.Std.27
OS Date: 131010
OS Signature: 6757
PakBus Address: 801
Security Settings(1): 0
Security Settings(2): 0
Security Settings(3): 0
Panel Temperature: 29.85 °C
Memory: 4194304 bytes
CPU Drive Free: 425984 bytes
USR Drive Free: 0 bytes
Watchdog Errors: 0

Program Information
Current Program: CPU:WaterLevel_V2_10min.CR8
Start Time: 20/04/2021 10:53:46 AM
Run Signature: 26077
Program Signature: 44714
Results for Last Program Compiled: Warning: Variable WaterLvlRaw out of bounds.
Memory Free: 19720 bytes

Program Errors
Program Errors: 0
Skipped Scans: 0
Skipped Slow Scans: 0
Skipped System Scans: 0
Skipped Records in Tenmin: 0
Skipped Records in Hourly: 0
Skipped Records in Daily: 0
Skipped Records in BatteryData: 0
Variable Out of Bounds: 751644 - There is a program error.

Battery Information
Battery Voltage: 13.91
Lithium Battery: 3.34
Number of times the datalogger's 12V supply has dropped below operating threshold: 0
Number of times voltage has dropped below 5V: 0

60248386 - FM4 CR200 Data Logger Status Summary
9/12/2022 8:54:27 AM

Datalogger Information
OS Version: v04
OS Date: 010306
PakBus Address: 4
Watchdog Errors: 0

Program Information
Current Program: WaterLevel_CSA.

Program Errors
Skipped Scans: 0
Variable Out of Bounds: 0

Battery Information
Battery Voltage: 13.50

RF Information
Radio Address: 0
Network Address: 0
Hop Sequence: 0
Power Mode: NO_RF
Signal Level: 0

Appendix B

Stream Theoretical Flow Rating and Profile Curves

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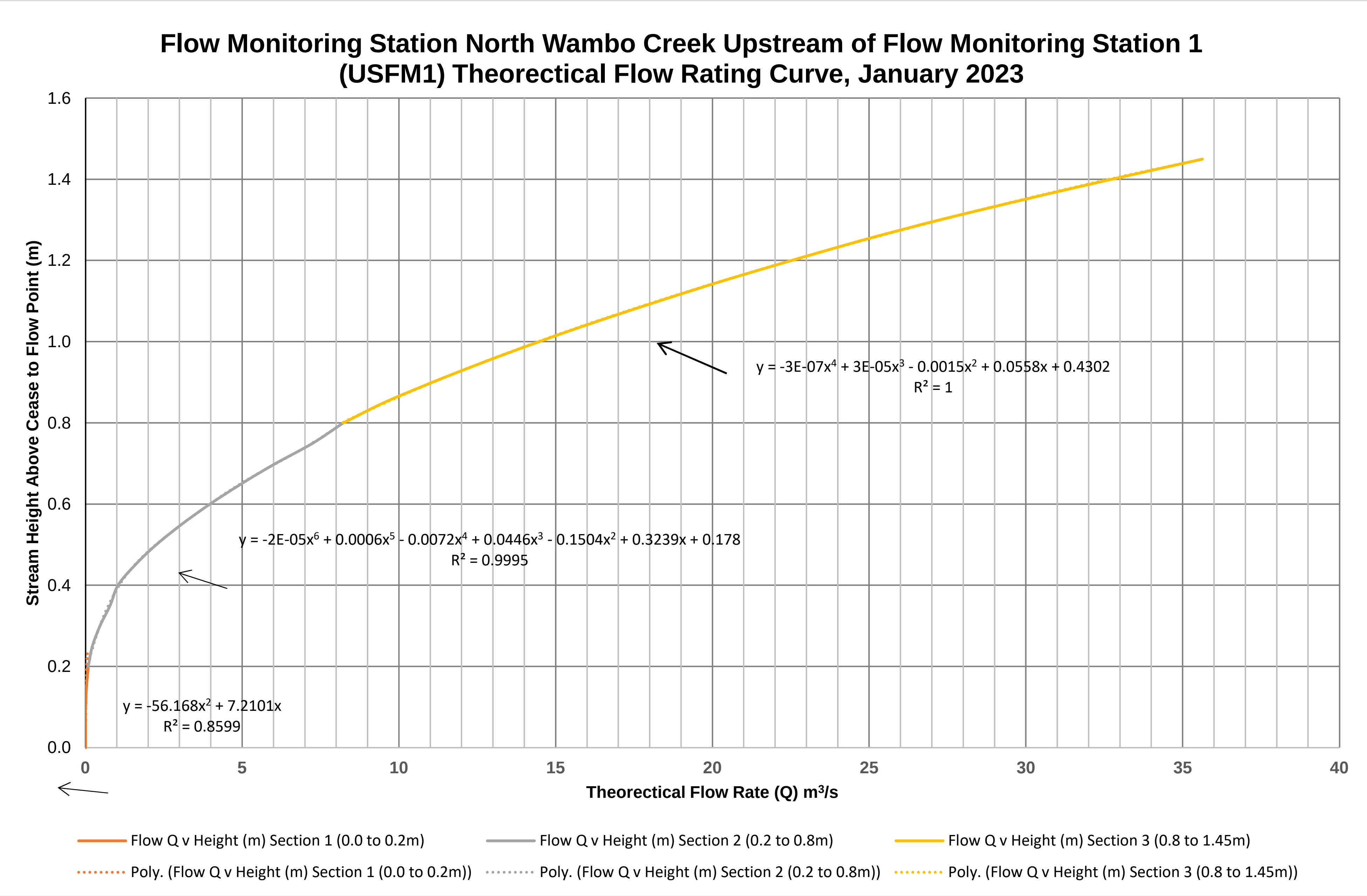
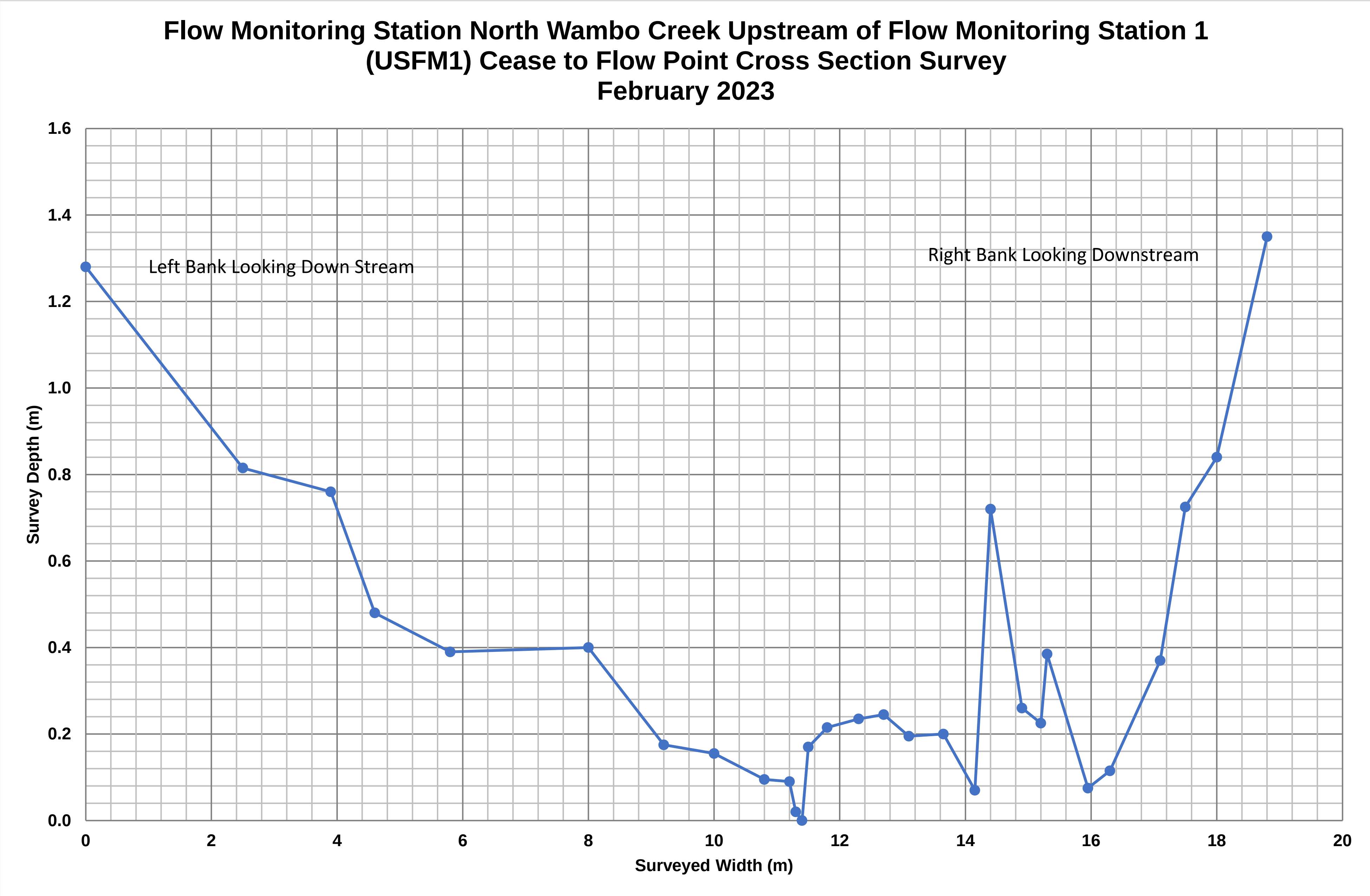
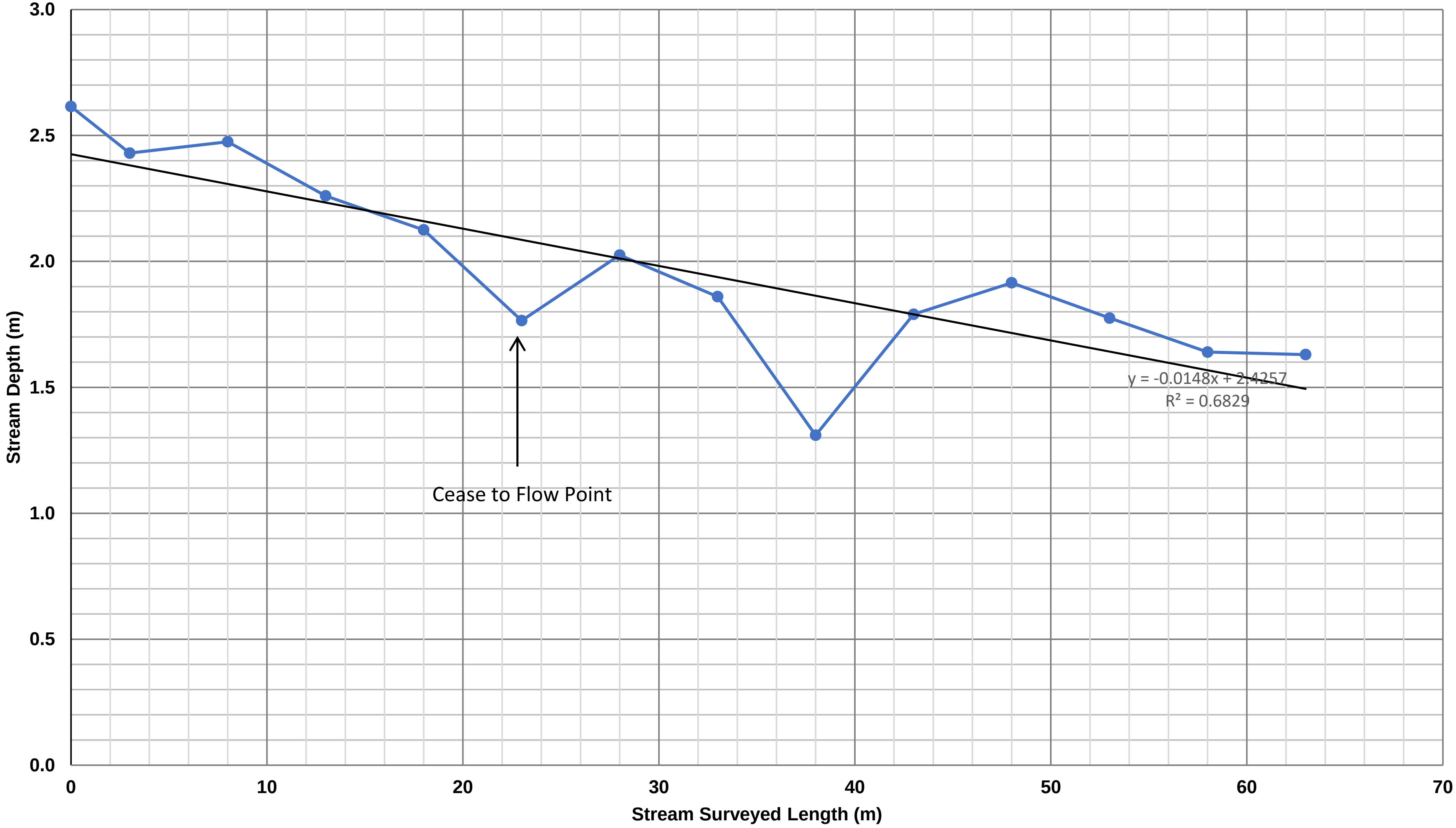
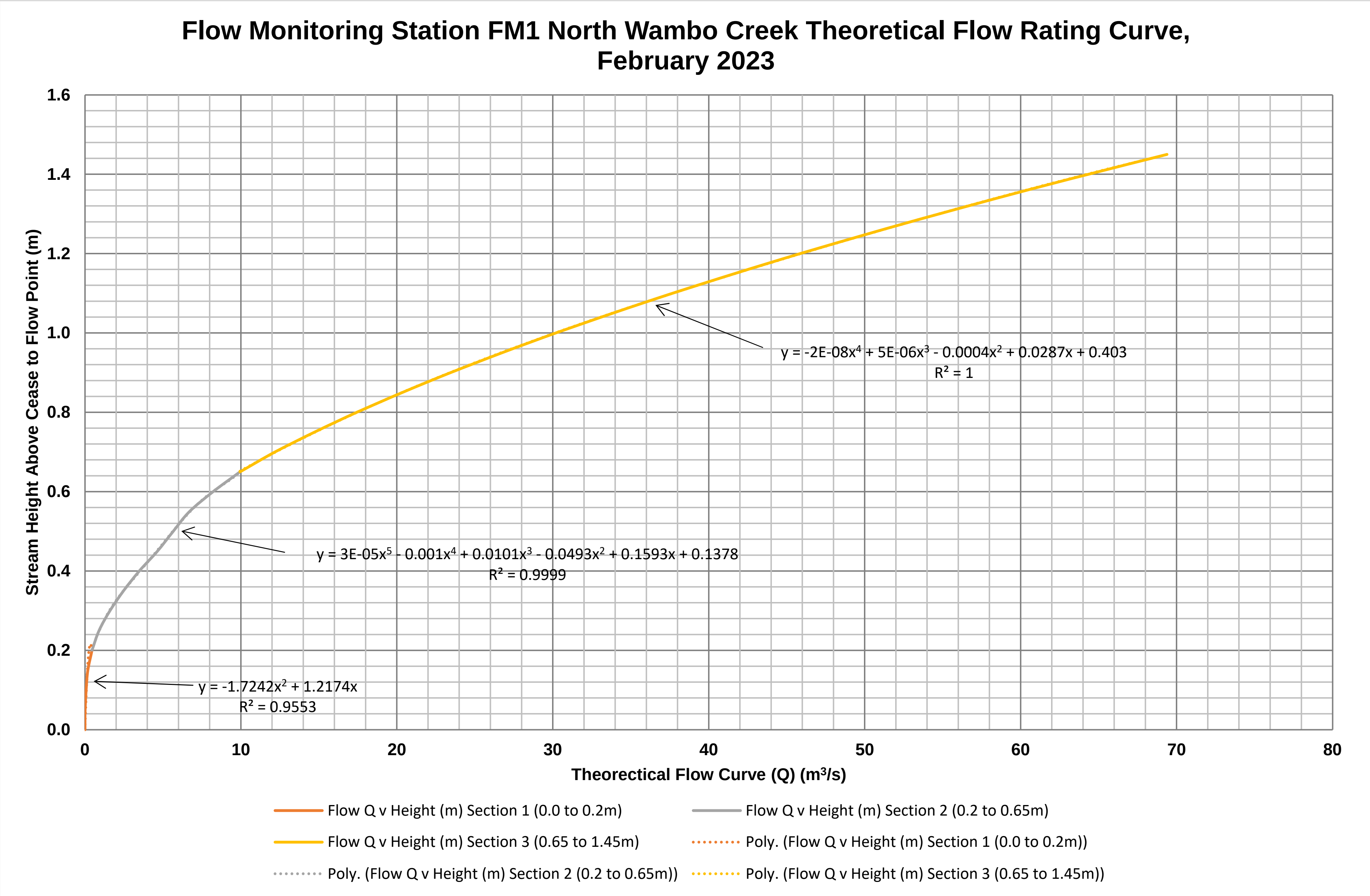


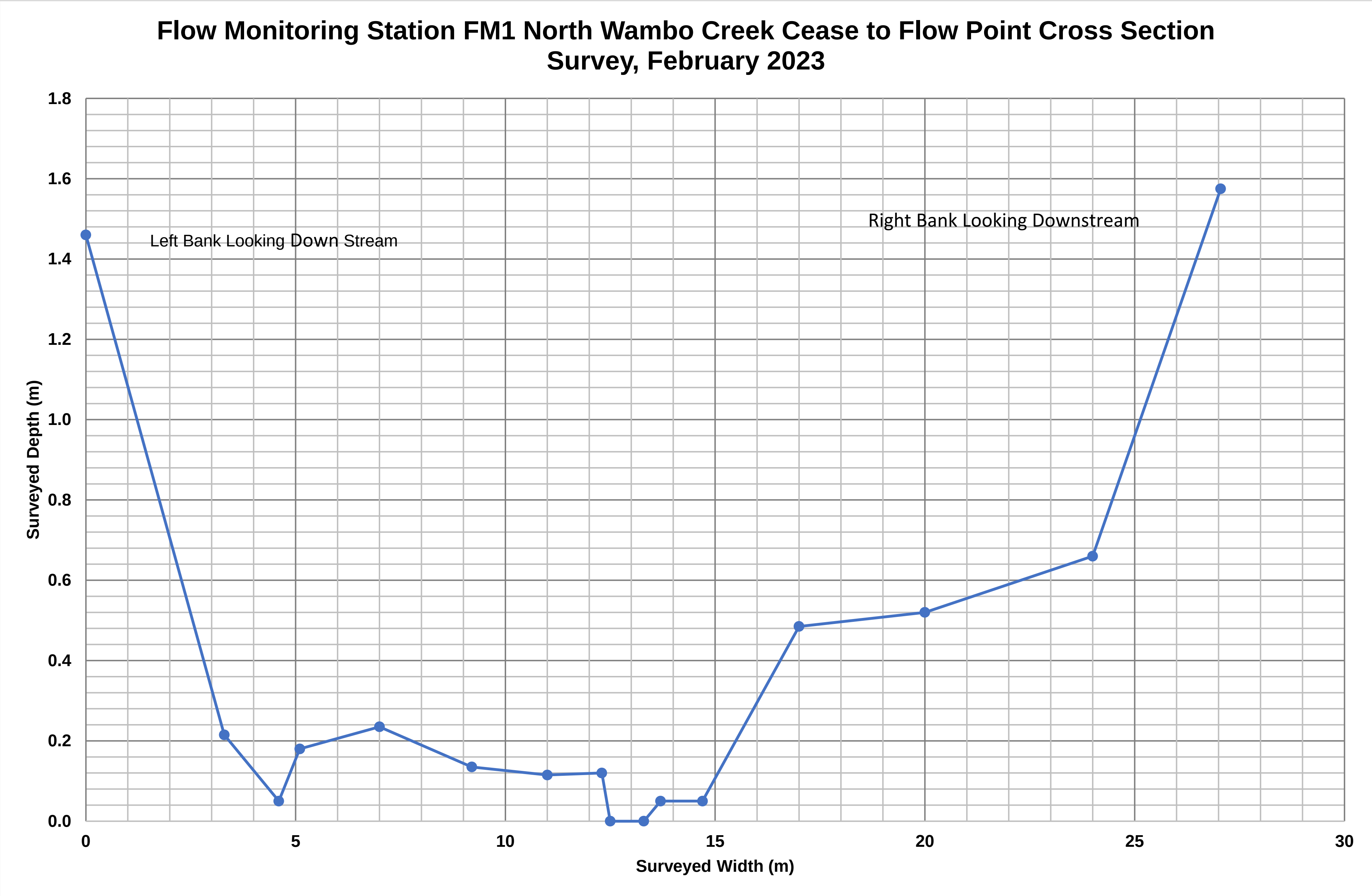
Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1 (USFM1) Theoretical Flow Rating Curve, January 2023
Stream Height Above Cease to Flow Point (m)
Theorectical Flow Rate (Q) m³/s
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
5
10
15
20
25
30
35
40
y = -3E-07x⁴ + 3E-05x³ - 0.0015x² + 0.0558x + 0.4302
R² = 1
y = -2E-05x⁶ + 0.0006x⁵ - 0.0072x⁴ + 0.0446x³ - 0.1504x² + 0.3239x + 0.178
R² = 0.9995
y = -56.168x² + 7.2101x
R² = 0.8599
Flow Q v Height (m) Section 1 (0.0 to 0.2m)
Flow Q v Height (m) Section 2 (0.2 to 0.8m)
Flow Q v Height (m) Section 3 (0.8 to 1.45m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.2m))
Poly. (Flow Q v Height (m) Section 2 (0.2 to 0.8m))
Poly. (Flow Q v Height (m) Section 3 (0.8 to 1.45m))

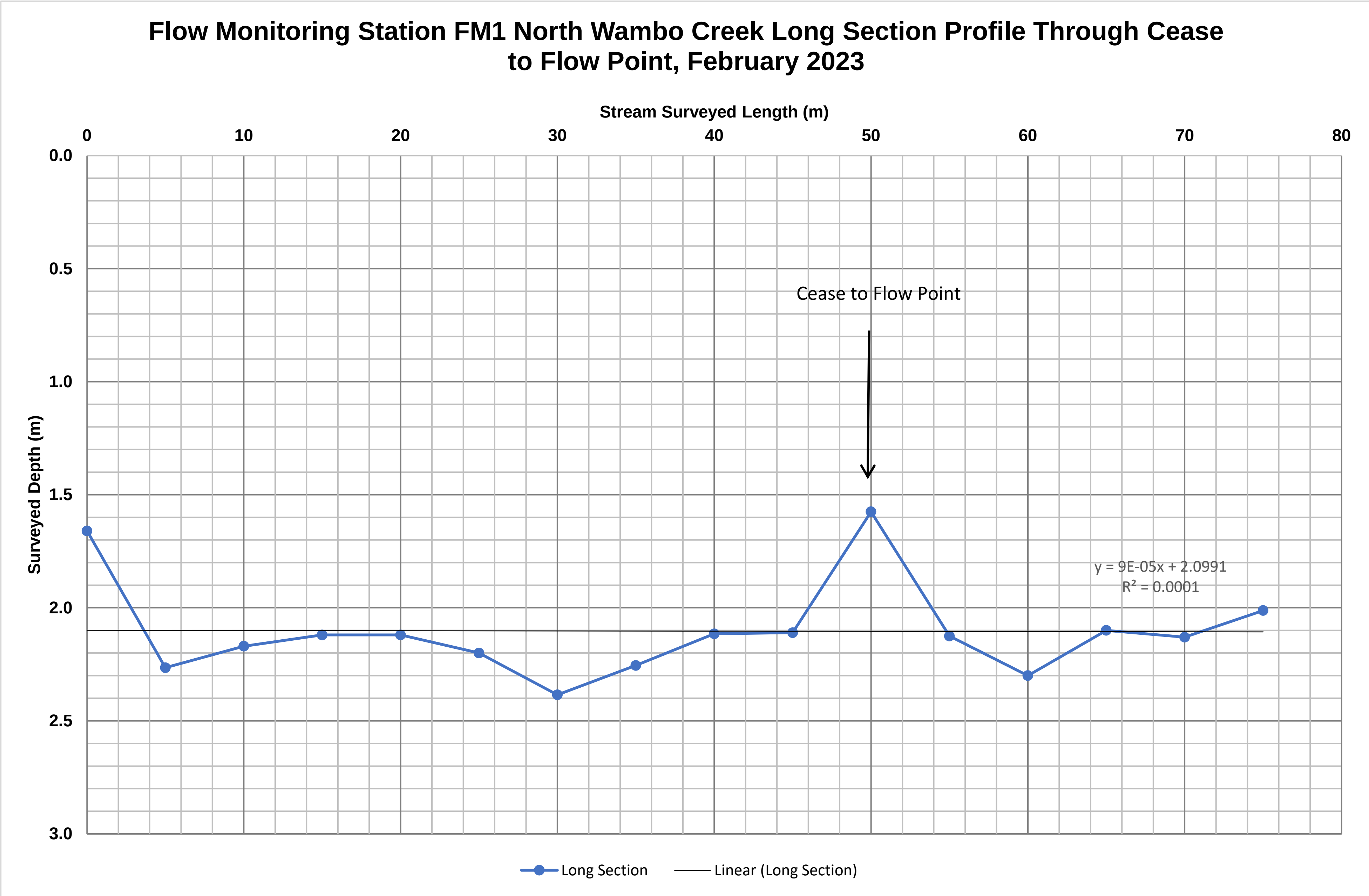

Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1
(USFM1) Cease to Flow Point Cross Section Survey
February 2023
Left Bank Looking Down Stream
Right Bank Looking Downstream
Survey Depth (m)
Surveyed Width (m)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20

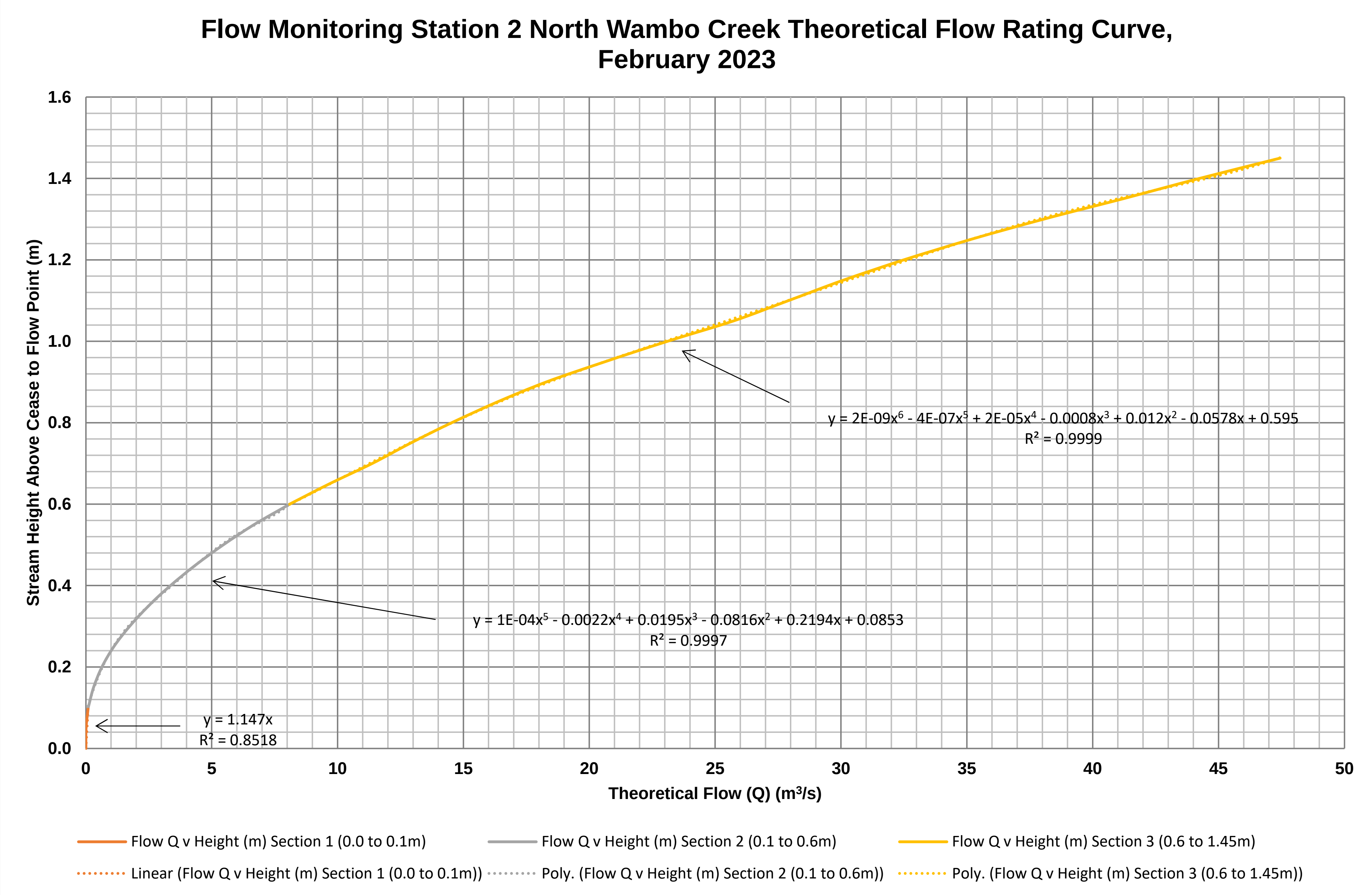
Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1 (USFM1) Long Section Profile Through Cease to Flow Point February 2023



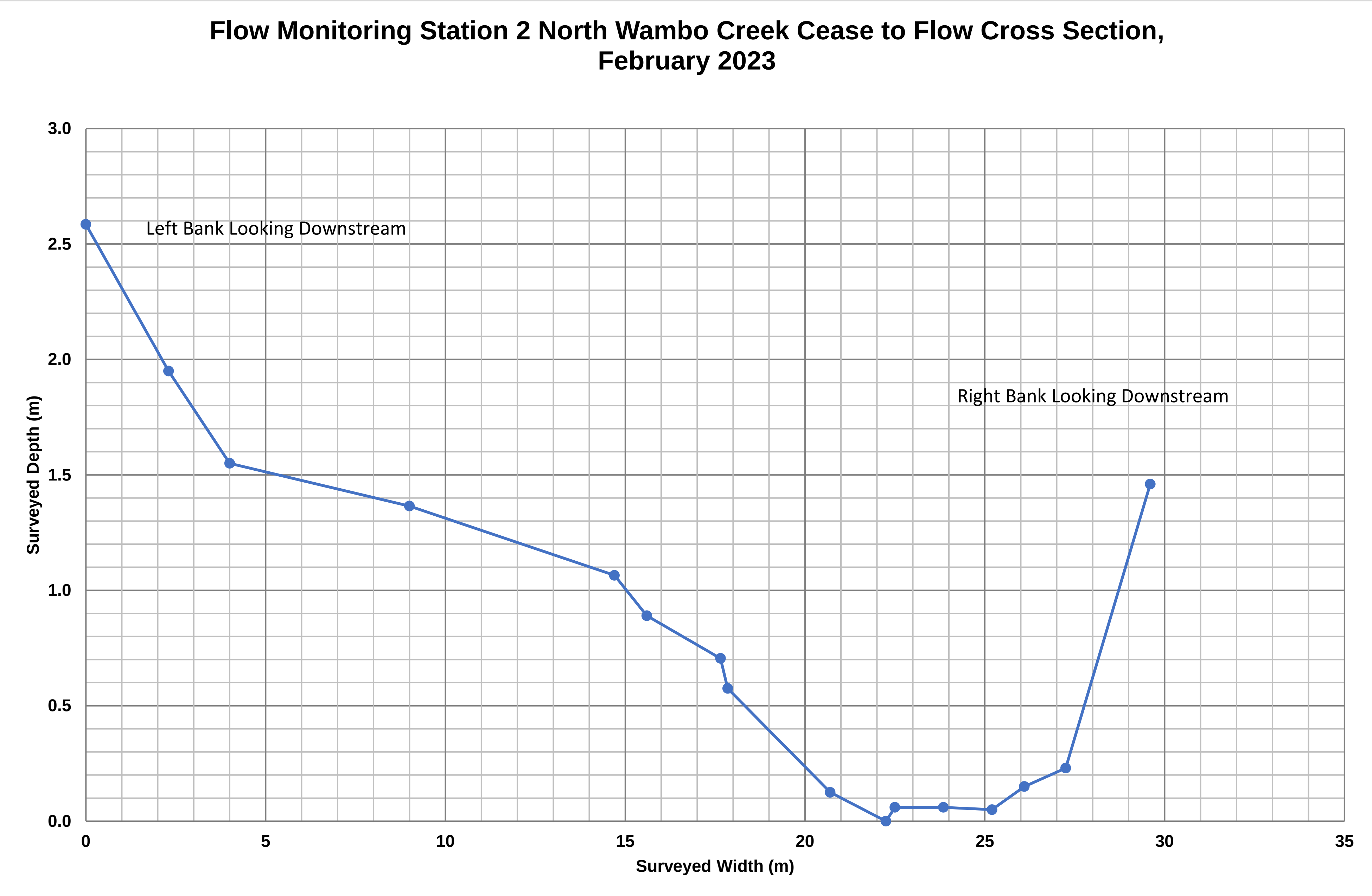

Flow Monitoring Station FM1 North Wambo Creek Theoretical Flow Rating Curve, February 2023
Stream Height Above Cease to Flow Point (m)
Theorectical Flow Curve (Q) (m³/s)
y = -2E-08x⁴ + 5E-06x³ - 0.0004x² + 0.0287x + 0.403
R² = 1
y = 3E-05x⁵ - 0.001x⁴ + 0.0101x³ - 0.0493x² + 0.1593x + 0.1378
R² = 0.9999
y = -1.7242x² + 1.2174x
R² = 0.9553
Flow Q v Height (m) Section 1 (0.0 to 0.2m)
Flow Q v Height (m) Section 2 (0.2 to 0.65m)
Flow Q v Height (m) Section 3 (0.65 to 1.45m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.2m))
Poly. (Flow Q v Height (m) Section 2 (0.2 to 0.65m))
Poly. (Flow Q v Height (m) Section 3 (0.65 to 1.45m))

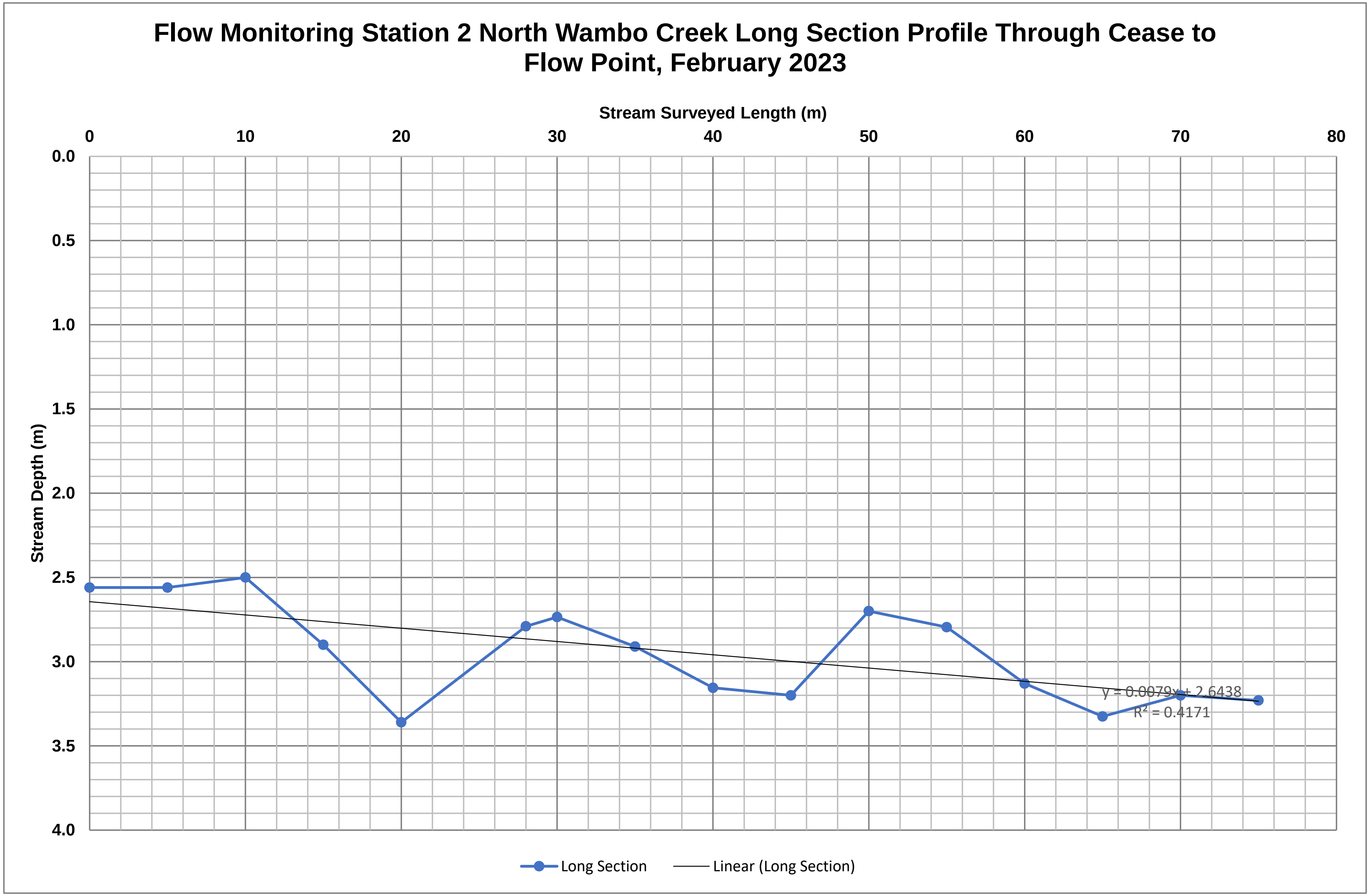

Flow Monitoring Station FM1 North Wambo Creek Cease to Flow Point Cross Section Survey, February 2023
Left Bank Looking Down Stream
Right Bank Looking Downstream
Surveyed Depth (m)
Surveyed Width (m)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30


Flow Monitoring Station FM1 North Wambo Creek Long Section Profile Through Cease to Flow Point, February 2023
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
Surveyed Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Cease to Flow Point
y = 9E-05x + 2.0991
R² = 0.0001
Long Section
Linear (Long Section)

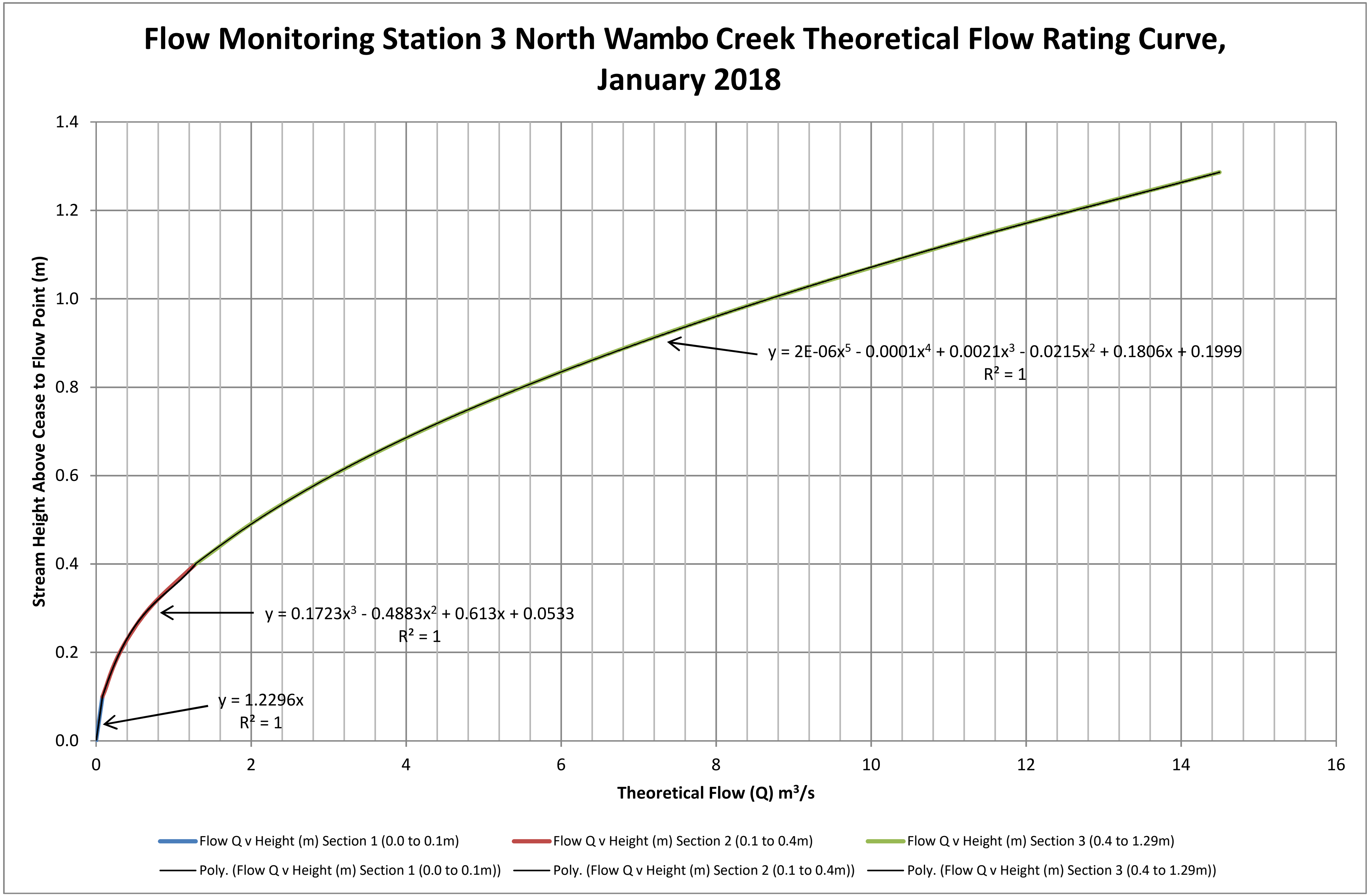


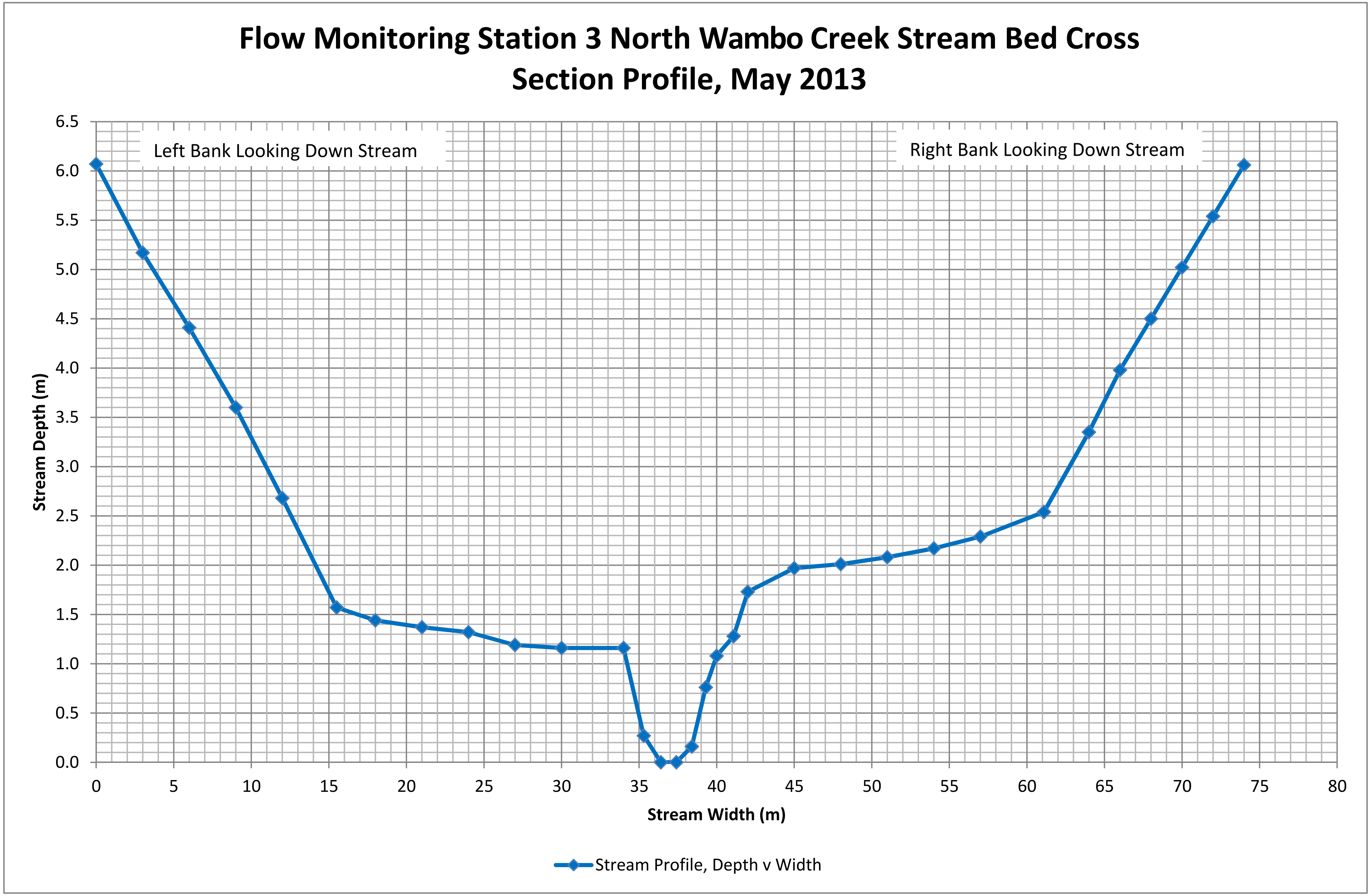
Flow Monitoring Station 2 North Wambo Creek Theoretical Flow Rating Curve, February 2023
Stream Height Above Cease to Flow Point (m)
Theoretical Flow (Q) (m³/s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
5
10
15
20
25
30
35
40
45
50
y = 2E-09x⁶ - 4E-07x⁵ + 2E-05x⁴ - 0.0008x³ + 0.012x² - 0.0578x + 0.595
R² = 0.9999
y = 1E-04x⁵ - 0.0022x⁴ + 0.0195x³ - 0.0816x² + 0.2194x + 0.0853
R² = 0.9997
y = 1.147x
R² = 0.8518
Flow Q v Height (m) Section 1 (0.0 to 0.1m)
Flow Q v Height (m) Section 2 (0.1 to 0.6m)
Flow Q v Height (m) Section 3 (0.6 to 1.45m)
Linear (Flow Q v Height (m) Section 1 (0.0 to 0.1m))
Poly. (Flow Q v Height (m) Section 2 (0.1 to 0.6m))
Poly. (Flow Q v Height (m) Section 3 (0.6 to 1.45m))


Flow Monitoring Station 2 North Wambo Creek Cease to Flow Cross Section,
February 2023
Left Bank Looking Downstream
Right Bank Looking Downstream
Surveyed Depth (m)
Surveyed Width (m)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35

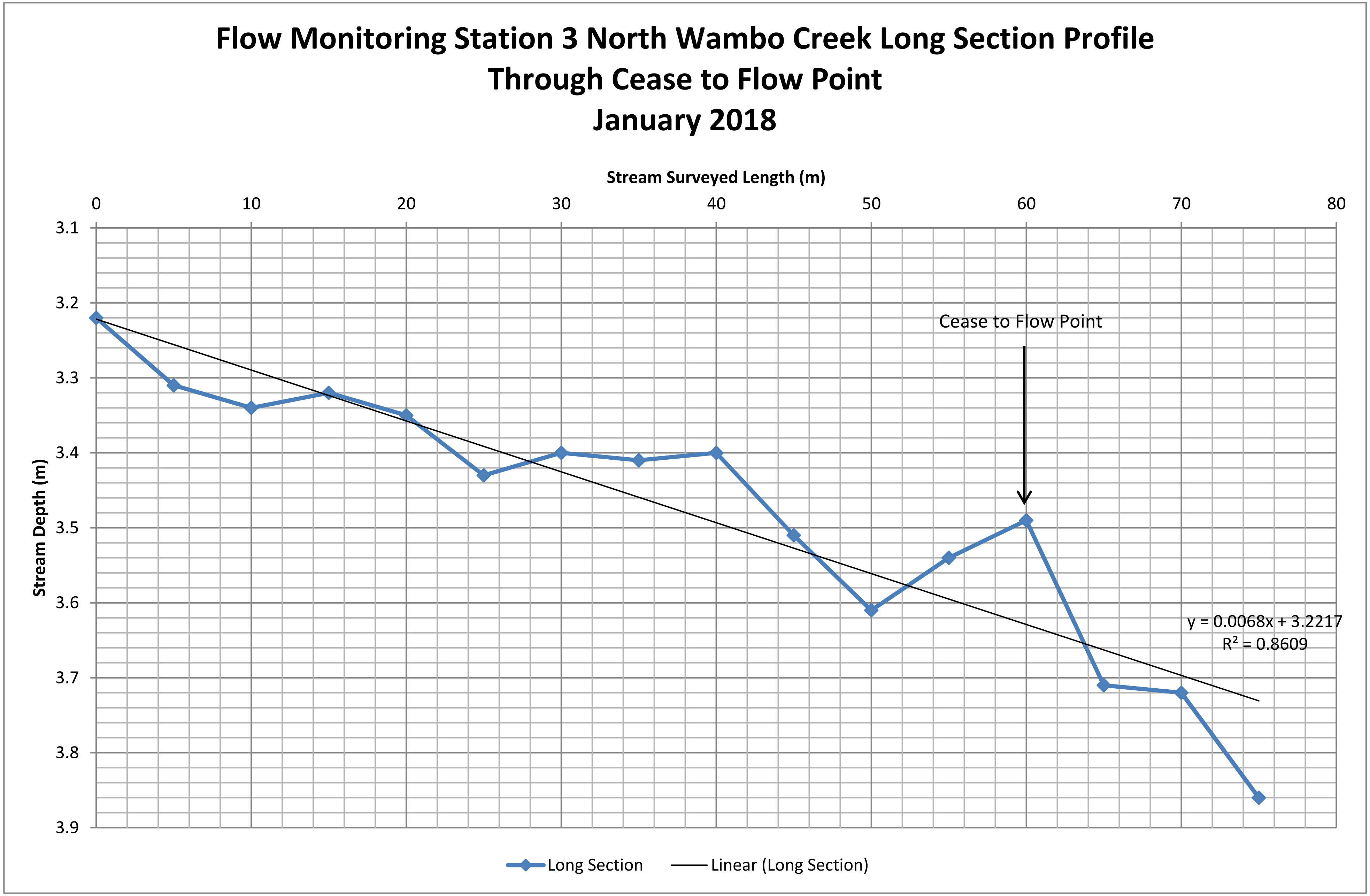


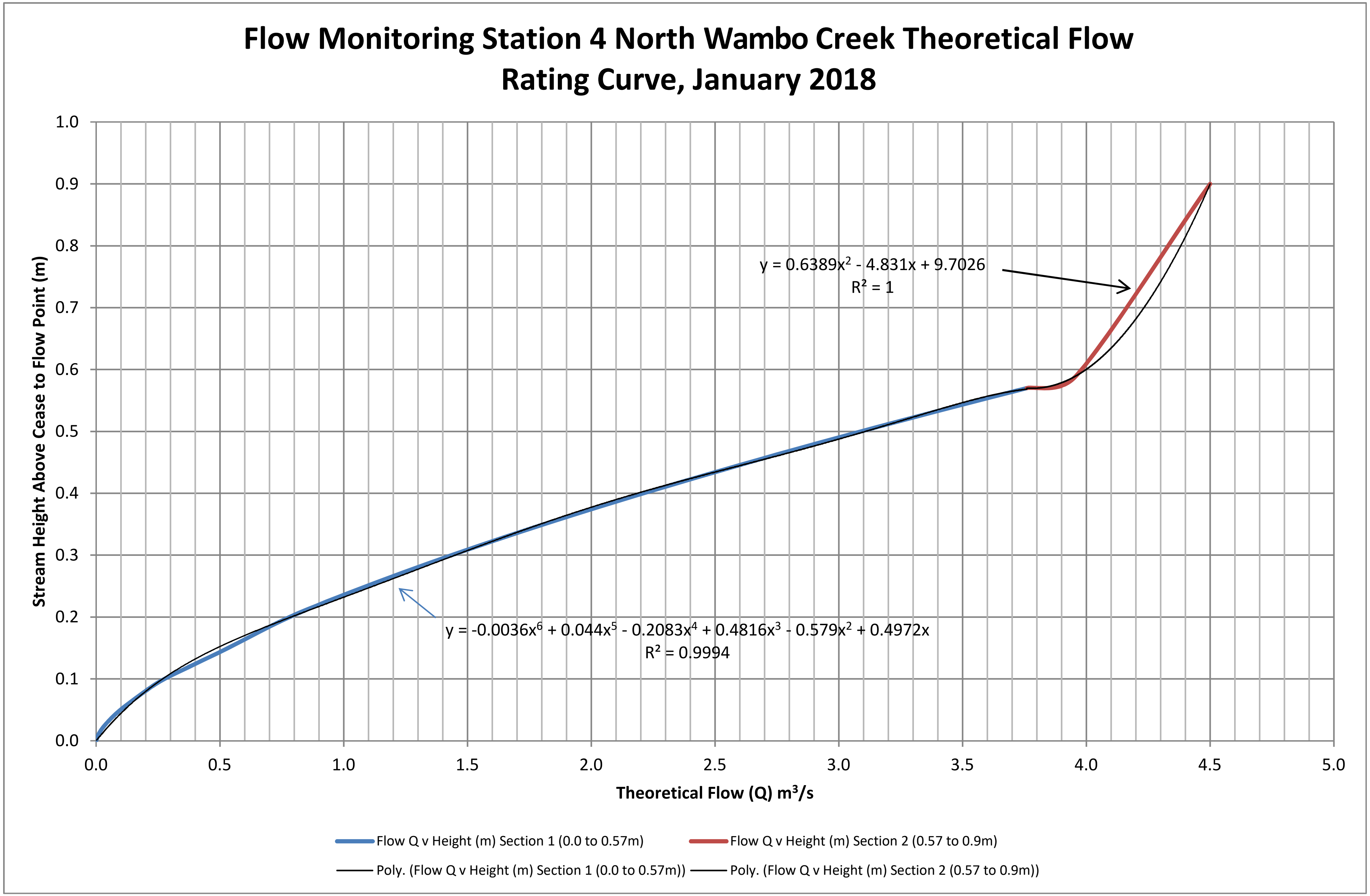
Flow Monitoring Station 2 North Wambo Creek Long Section Profile Through Cease to Flow Point, February 2023
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Stream Depth (m)
y = 0.0079x + 2.6438
R² = 0.4171
Long Section
Linear (Long Section)


Flow Monitoring Station 3 North Wambo Creek Theoretical Flow Rating Curve, January 2018
Stream Height Above Cease to Flow Point (m)
Theoretical Flow (Q) m³/s
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
y = 2E-06x⁵ - 0.0001x⁴ + 0.0021x³ - 0.0215x² + 0.1806x + 0.1999
R² = 1
y = 0.1723x³ - 0.4883x² + 0.613x + 0.0533
R² = 1
y = 1.2296x
R² = 1
Flow Q v Height (m) Section 1 (0.0 to 0.1m)
Flow Q v Height (m) Section 2 (0.1 to 0.4m)
Flow Q v Height (m) Section 3 (0.4 to 1.29m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.1m))
Poly. (Flow Q v Height (m) Section 2 (0.1 to 0.4m))
Poly. (Flow Q v Height (m) Section 3 (0.4 to 1.29m))

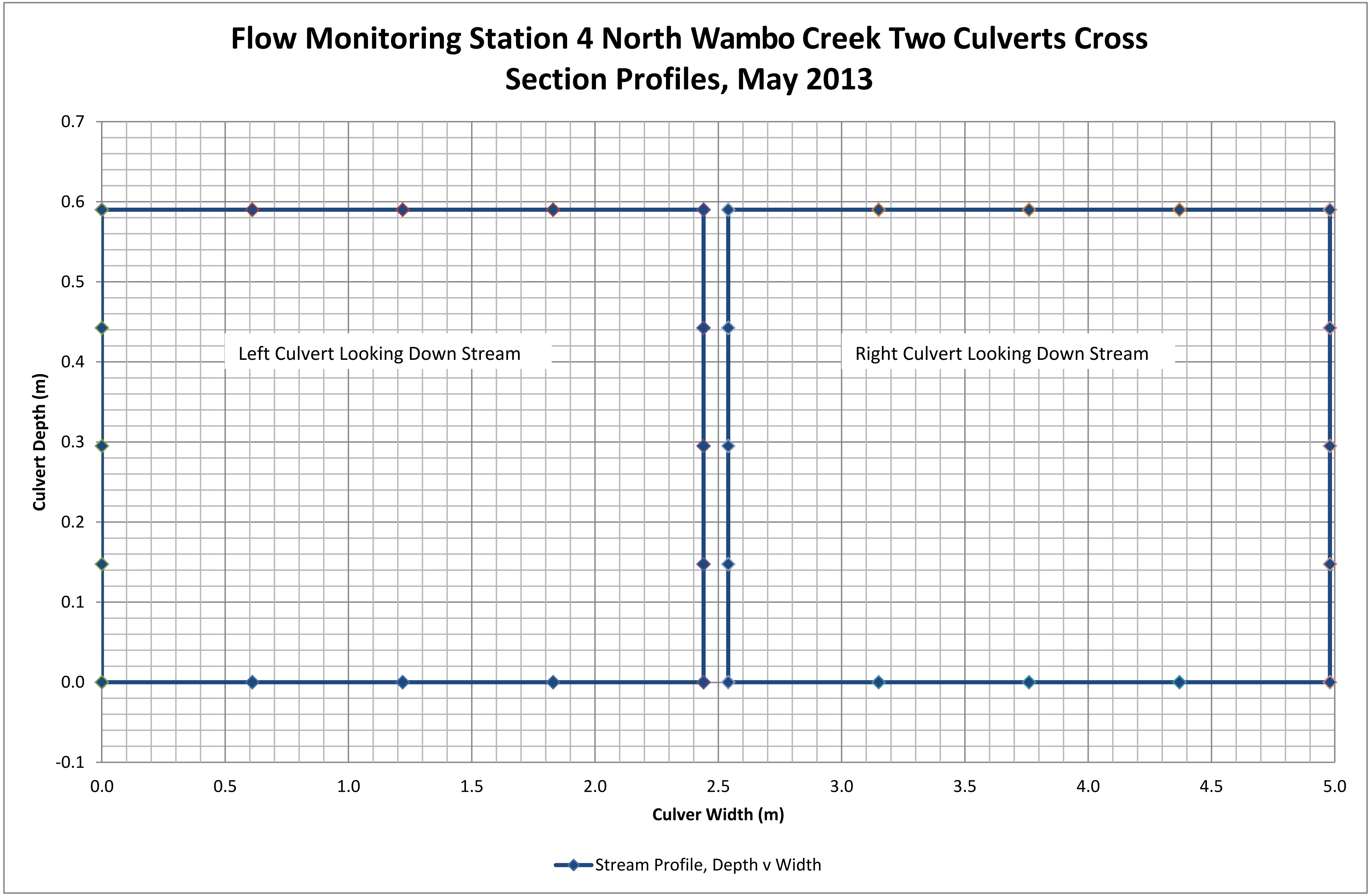


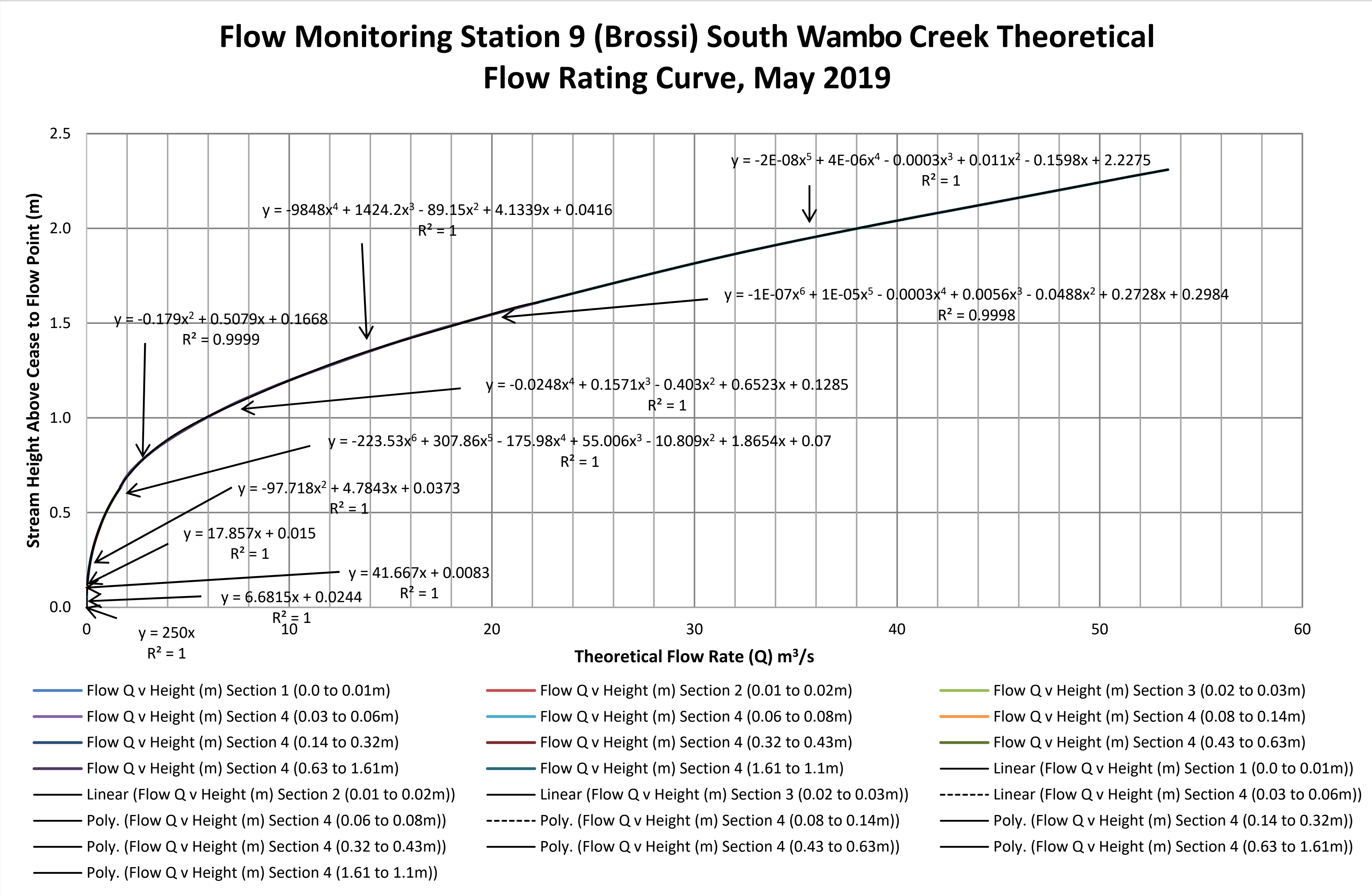
Flow Monitoring Station 3 North Wambo Creek Stream Bed Cross Section Profile, May 2013
Left Bank Looking Down Stream
Right Bank Looking Down Stream
Stream Depth (m)
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Stream Width (m)
Stream Profile, Depth v Width


Flow Monitoring Station 3 North Wambo Creek Long Section Profile
Through Cease to Flow Point
January 2018
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
Stream Depth (m)
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
Cease to Flow Point
y = 0.0068x + 3.2217
R² = 0.8609
Long Section
Linear (Long Section)

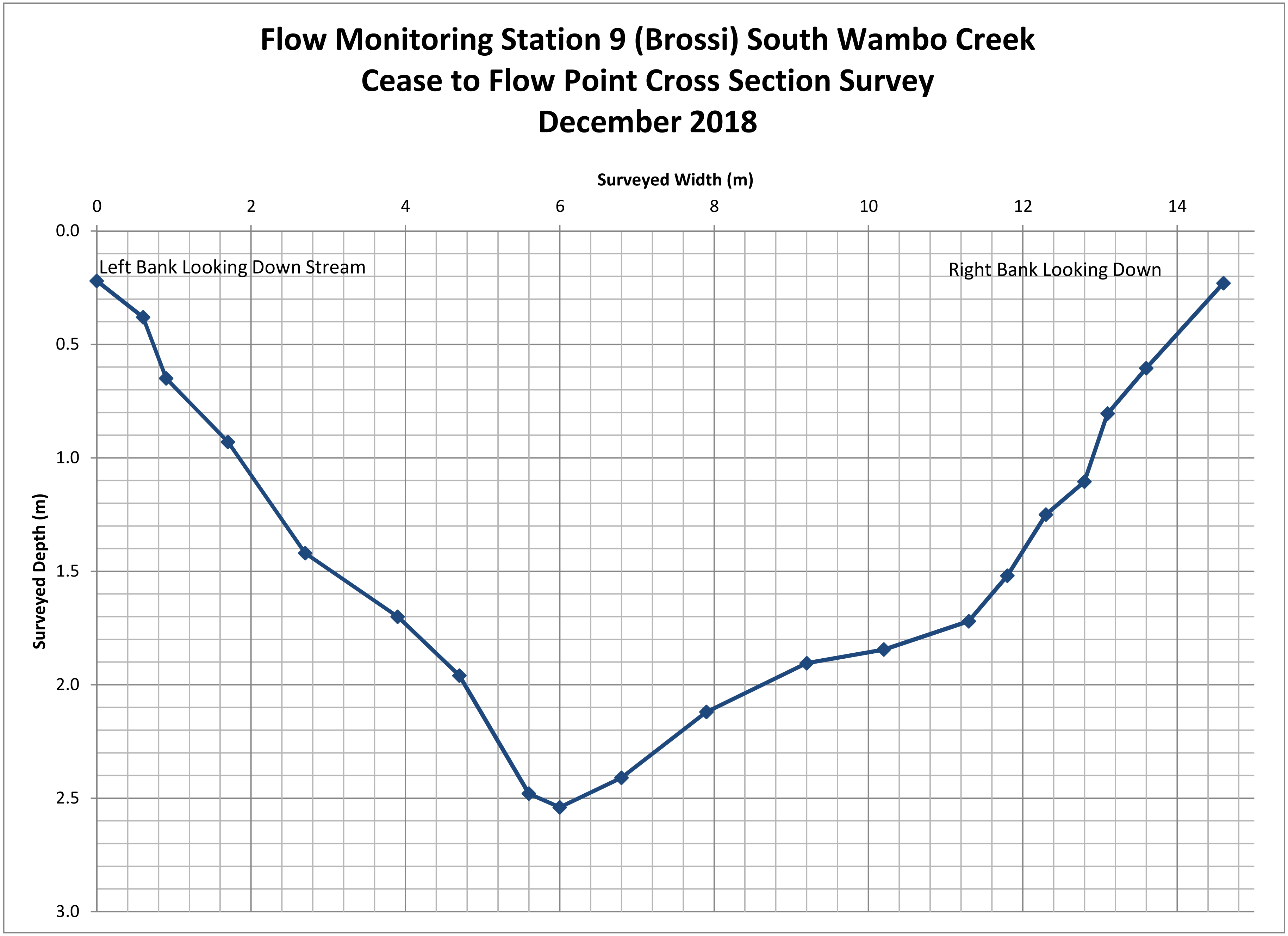


Flow Monitoring Station 4 North Wambo Creek Theoretical Flow
Rating Curve, January 2018
Stream Height Above Cease to Flow Point (m)
Theoretical Flow (Q) m³/s
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
y = 0.6389x² - 4.831x + 9.7026
R² = 1
y = -0.0036x⁶ + 0.044x⁵ - 0.2083x⁴ + 0.4816x³ - 0.579x² + 0.4972x
R² = 0.9994
Flow Q v Height (m) Section 1 (0.0 to 0.57m)
Flow Q v Height (m) Section 2 (0.57 to 0.9m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.57m))
Poly. (Flow Q v Height (m) Section 2 (0.57 to 0.9m))


Flow Monitoring Station 4 North Wambo Creek Two Culverts Cross Section Profiles, May 2013
Left Culvert Looking Down Stream
Right Culvert Looking Down Stream
Culvert Depth (m)
Culver Width (m)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Stream Profile, Depth v Width

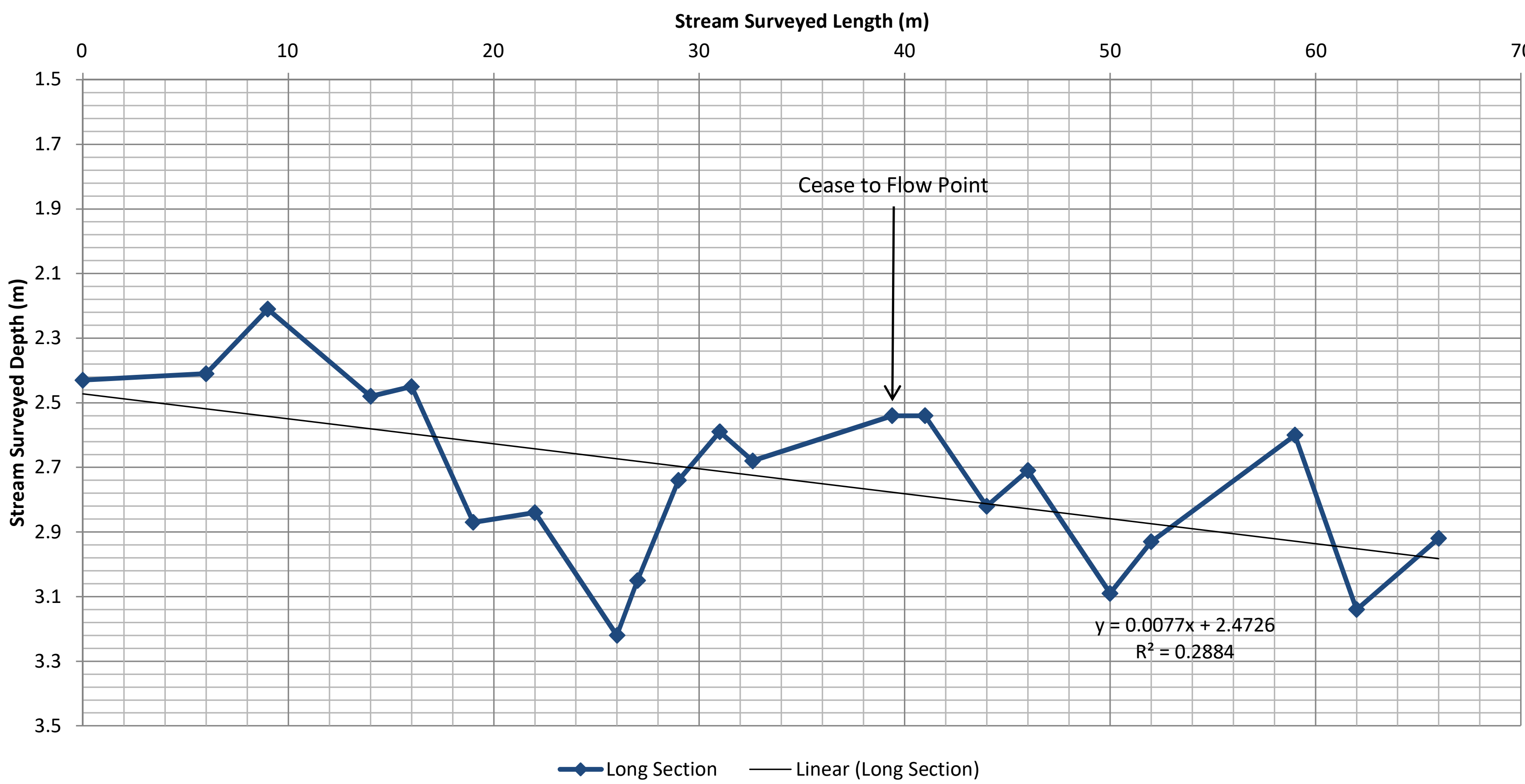


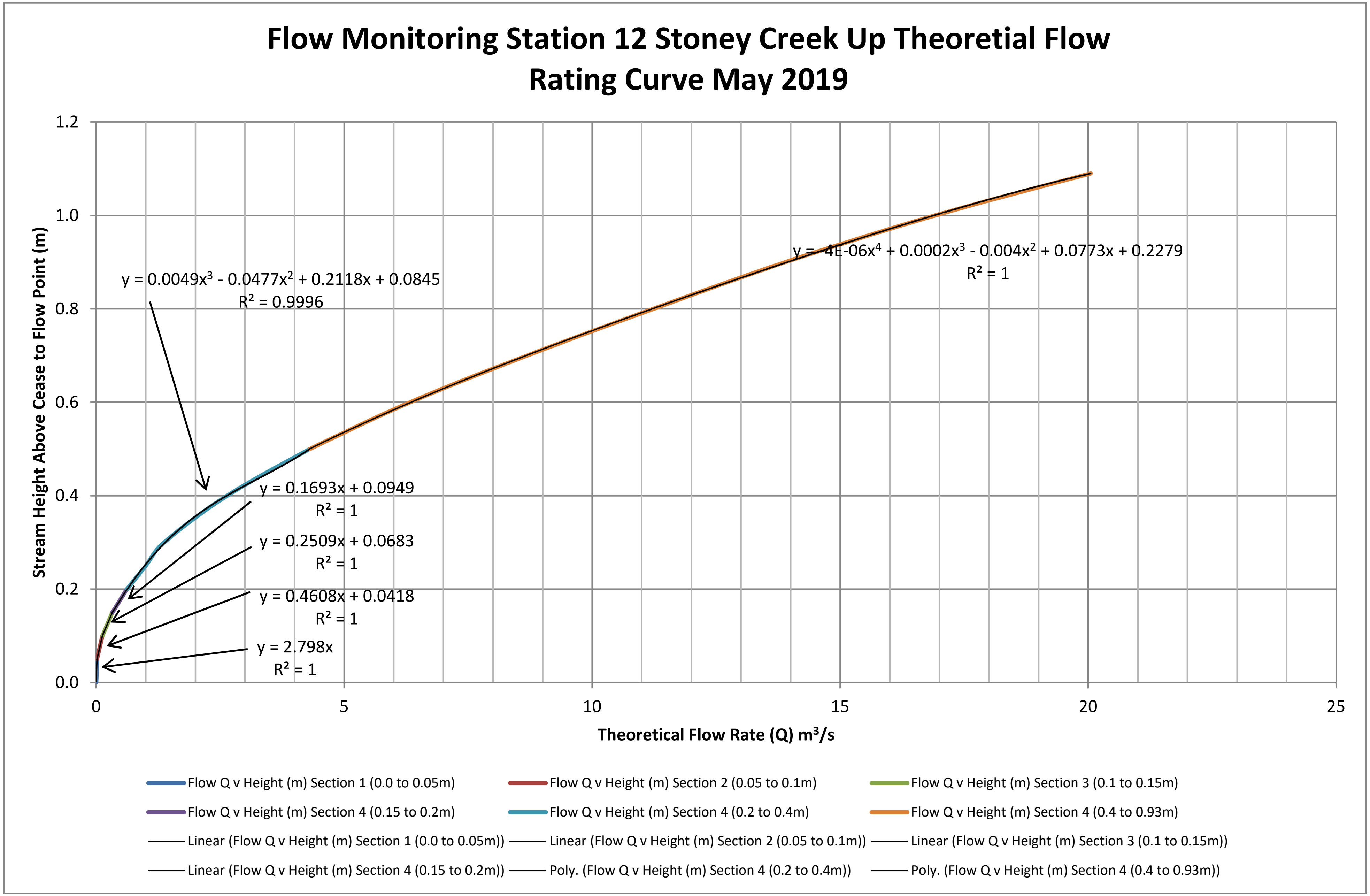
Flow Monitoring Station 9 (Brossi) South Wambo Creek Theoretical
Flow Rating Curve, May 2019
Stream Height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m³/s
0.0
0.5
1.0
1.5
2.0
2.5
0
10
20
30
40
50
60
y = -2E-08x⁵ + 4E-06x⁴ - 0.0003x³ + 0.011x² - 0.1598x + 2.2275
R² = 1
y = -9848x⁴ + 1424.2x³ - 89.15x² + 4.1339x + 0.0416
R² = 1
y = -1E-07x⁶ + 1E-05x⁵ - 0.0003x⁴ + 0.0056x³ - 0.0488x² + 0.2728x + 0.2984
R² = 0.9998
y = -0.179x² + 0.5079x + 0.1668
R² = 0.9999
y = -0.0248x⁴ + 0.1571x³ - 0.403x² + 0.6523x + 0.1285
R² = 1
y = -223.53x⁶ + 307.86x⁵ - 175.98x⁴ + 55.006x³ - 10.809x² + 1.8654x + 0.07
R² = 1
y = -97.718x² + 4.7843x + 0.0373
R² = 1
y = 17.857x + 0.015
R² = 1
y = 41.667x + 0.0083
R² = 1
y = 6.6815x + 0.0244
R² = 1
y = 250x
R² = 1
Flow Q v Height (m) Section 1 (0.0 to 0.01m)
Flow Q v Height (m) Section 2 (0.01 to 0.02m)
Flow Q v Height (m) Section 3 (0.02 to 0.03m)
Flow Q v Height (m) Section 4 (0.03 to 0.06m)
Flow Q v Height (m) Section 4 (0.06 to 0.08m)
Flow Q v Height (m) Section 4 (0.08 to 0.14m)
Flow Q v Height (m) Section 4 (0.14 to 0.32m)
Flow Q v Height (m) Section 4 (0.32 to 0.43m)
Flow Q v Height (m) Section 4 (0.43 to 0.63m)
Flow Q v Height (m) Section 4 (0.63 to 1.61m)
Flow Q v Height (m) Section 4 (1.61 to 1.1m)
Linear (Flow Q v Height (m) Section 1 (0.0 to 0.01m))
Linear (Flow Q v Height (m) Section 2 (0.01 to 0.02m))
Linear (Flow Q v Height (m) Section 3 (0.02 to 0.03m))
Linear (Flow Q v Height (m) Section 4 (0.03 to 0.06m))
Poly. (Flow Q v Height (m) Section 4 (0.06 to 0.08m))
Poly. (Flow Q v Height (m) Section 4 (0.08 to 0.14m))
Poly. (Flow Q v Height (m) Section 4 (0.14 to 0.32m))
Poly. (Flow Q v Height (m) Section 4 (0.32 to 0.43m))
Poly. (Flow Q v Height (m) Section 4 (0.43 to 0.63m))
Poly. (Flow Q v Height (m) Section 4 (0.63 to 1.61m))
Poly. (Flow Q v Height (m) Section 4 (1.61 to 1.1m))

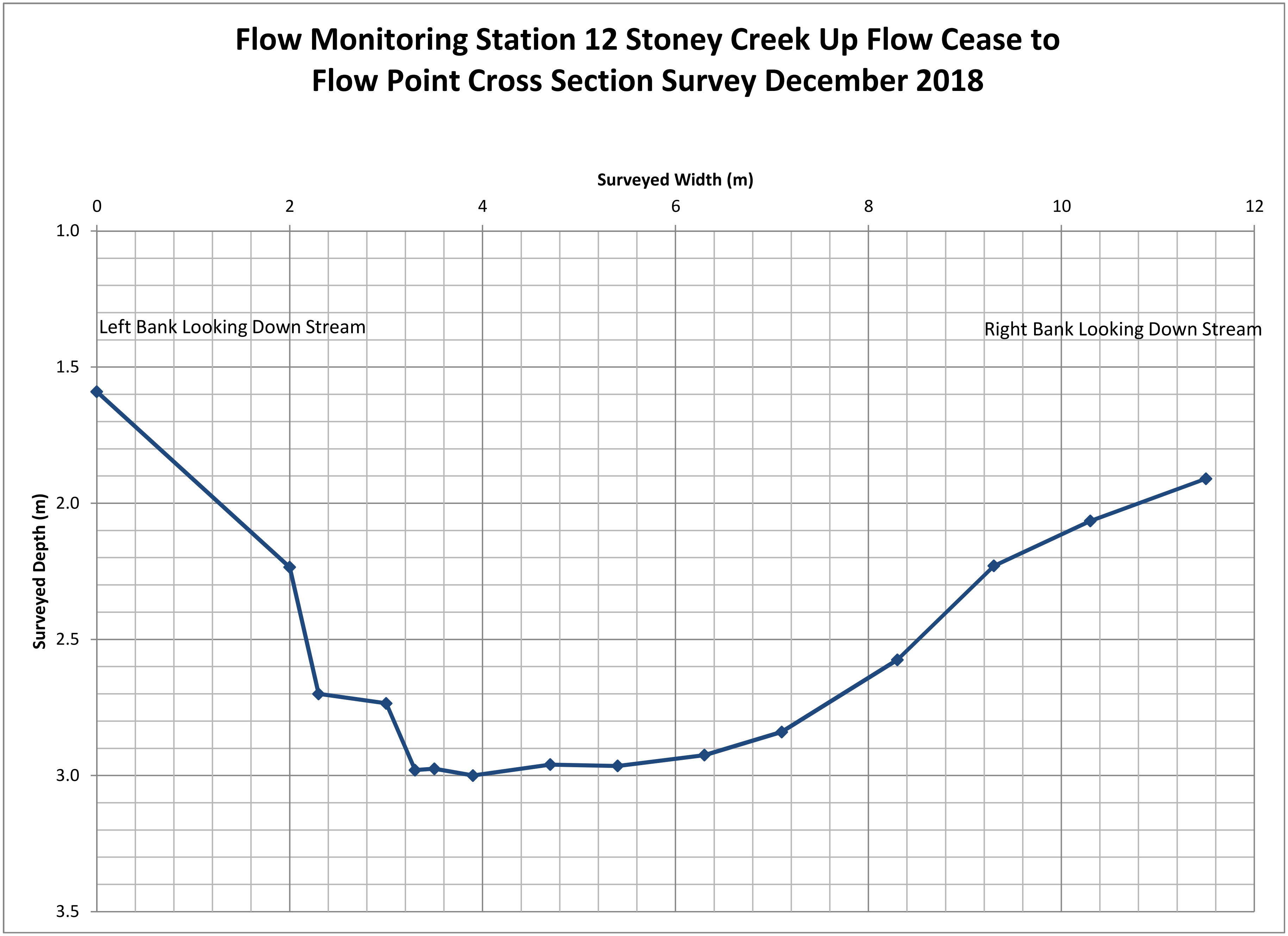


Flow Monitoring Station 9 (Brossi) South Wambo Creek
Cease to Flow Point Cross Section Survey
December 2018
Surveyed Width (m)
0
2
4
6
8
10
12
14
Surveyed Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Left Bank Looking Down Stream
Right Bank Looking Down

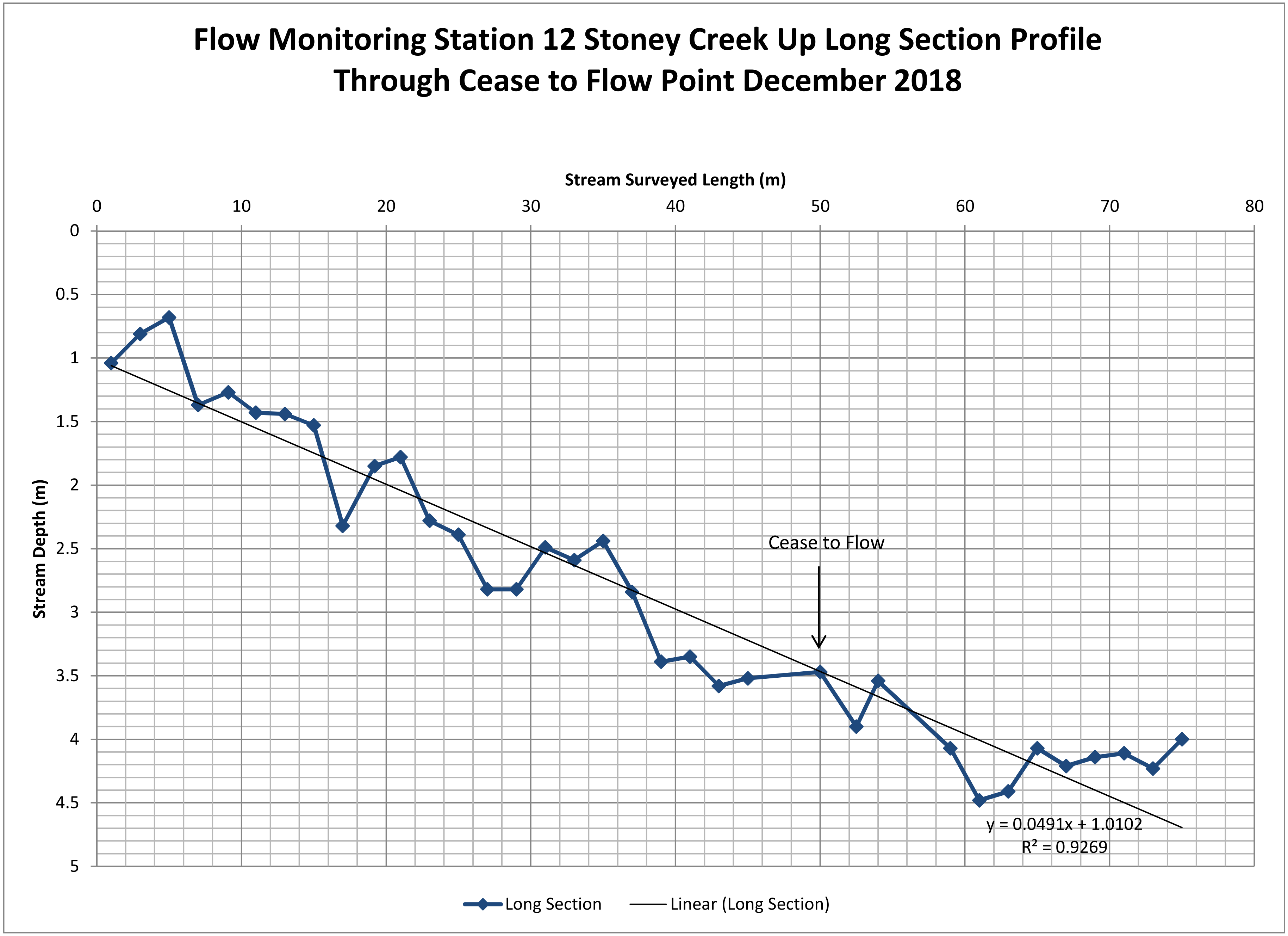
Flow Monitoring Station 9 (Brossi) South Wambo Creek Long Section Profile Through Cease to Flow Point December 2018

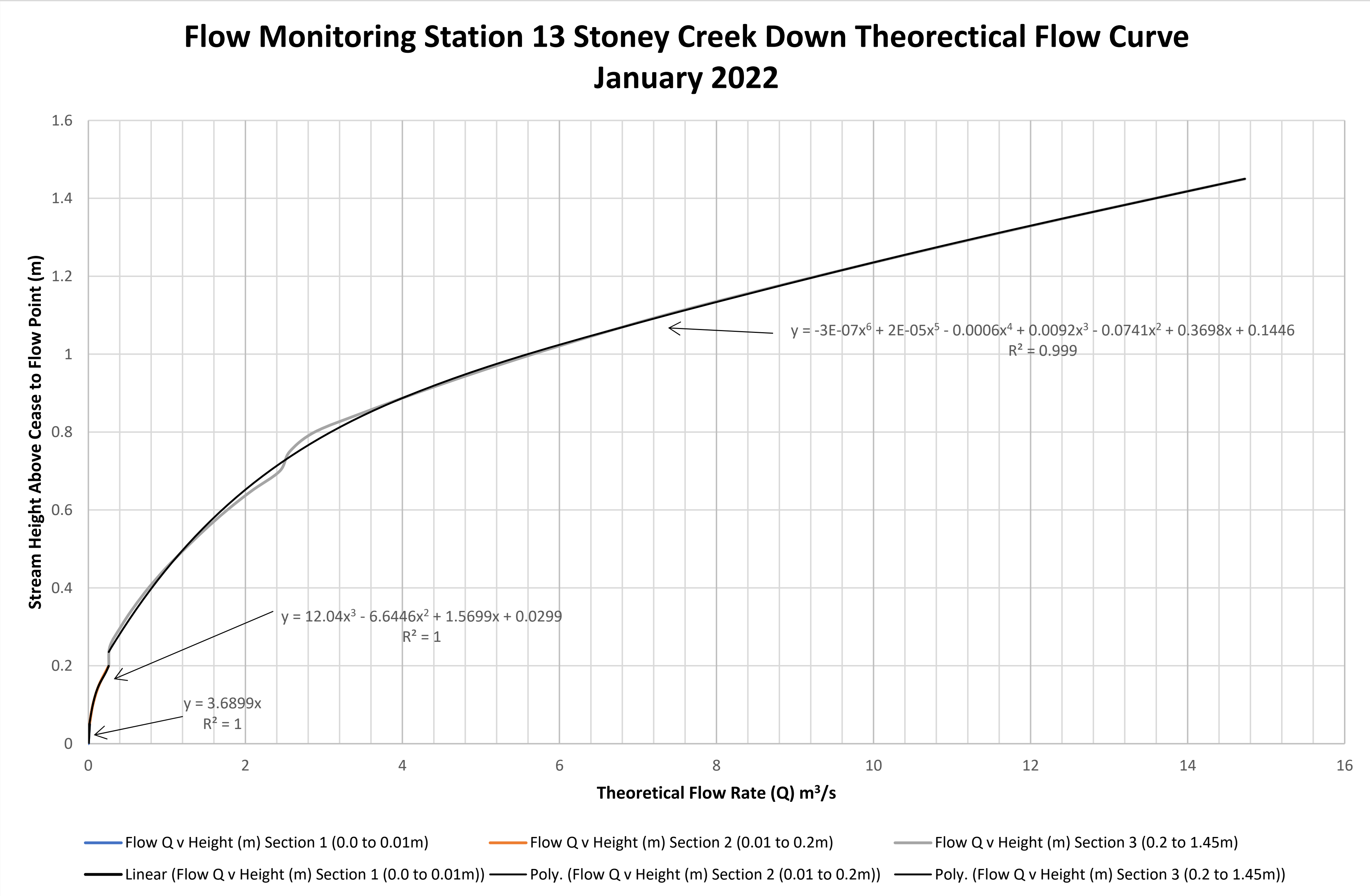



Flow Monitoring Station 12 Stoney Creek Up Theoretial Flow Rating Curve May 2019
Stream Height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m³/s
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
y = -4E-06x⁴ + 0.0002x³ - 0.004x² + 0.0773x + 0.2279
R² = 1
y = 0.0049x³ - 0.0477x² + 0.2118x + 0.0845
R² = 0.9996
y = 0.1693x + 0.0949
R² = 1
y = 0.2509x + 0.0683
R² = 1
y = 0.4608x + 0.0418
R² = 1
y = 2.798x
R² = 1
Flow Q v Height (m) Section 1 (0.0 to 0.05m)
Flow Q v Height (m) Section 2 (0.05 to 0.1m)
Flow Q v Height (m) Section 3 (0.1 to 0.15m)
Flow Q v Height (m) Section 4 (0.15 to 0.2m)
Flow Q v Height (m) Section 4 (0.2 to 0.4m)
Flow Q v Height (m) Section 4 (0.4 to 0.93m)
Linear (Flow Q v Height (m) Section 1 (0.0 to 0.05m))
Linear (Flow Q v Height (m) Section 2 (0.05 to 0.1m))
Linear (Flow Q v Height (m) Section 3 (0.1 to 0.15m))
Linear (Flow Q v Height (m) Section 4 (0.15 to 0.2m))
Poly. (Flow Q v Height (m) Section 4 (0.2 to 0.4m))
Poly. (Flow Q v Height (m) Section 4 (0.4 to 0.93m))



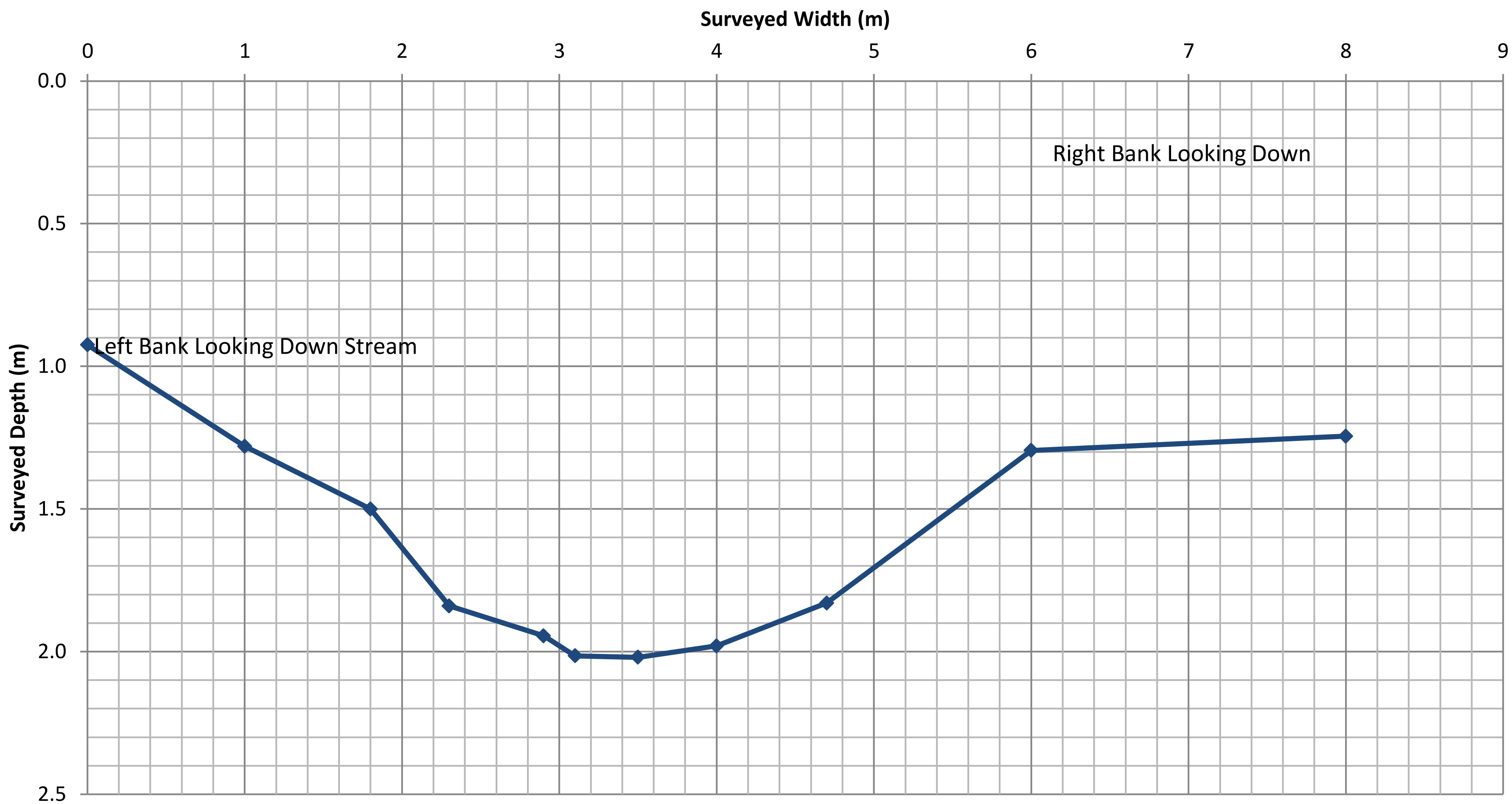
Flow Monitoring Station 12 Stoney Creek Up Flow Cease to
Flow Point Cross Section Survey December 2018
Surveyed Width (m)
0
2
4
6
8
10
12
1.0
1.5
2.0
2.5
3.0
3.5
Surveyed Depth (m)
Left Bank Looking Down Stream
Right Bank Looking Down Stream

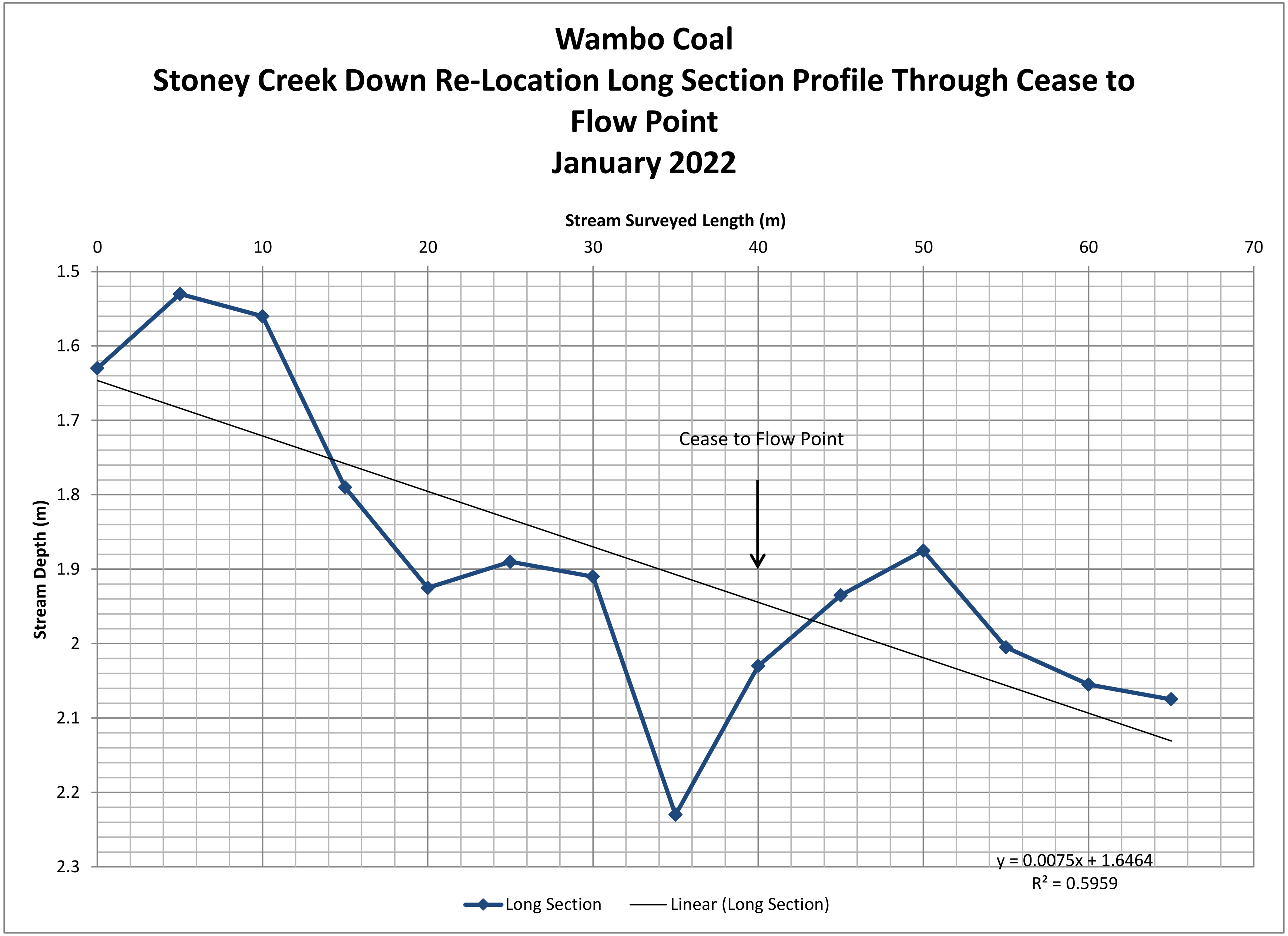

Flow Monitoring Station 12 Stoney Creek Up Long Section Profile
Through Cease to Flow Point December 2018
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
Stream Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Cease to Flow
y = 0.0491x + 1.0102
R² = 0.9269
Long Section
Linear (Long Section)



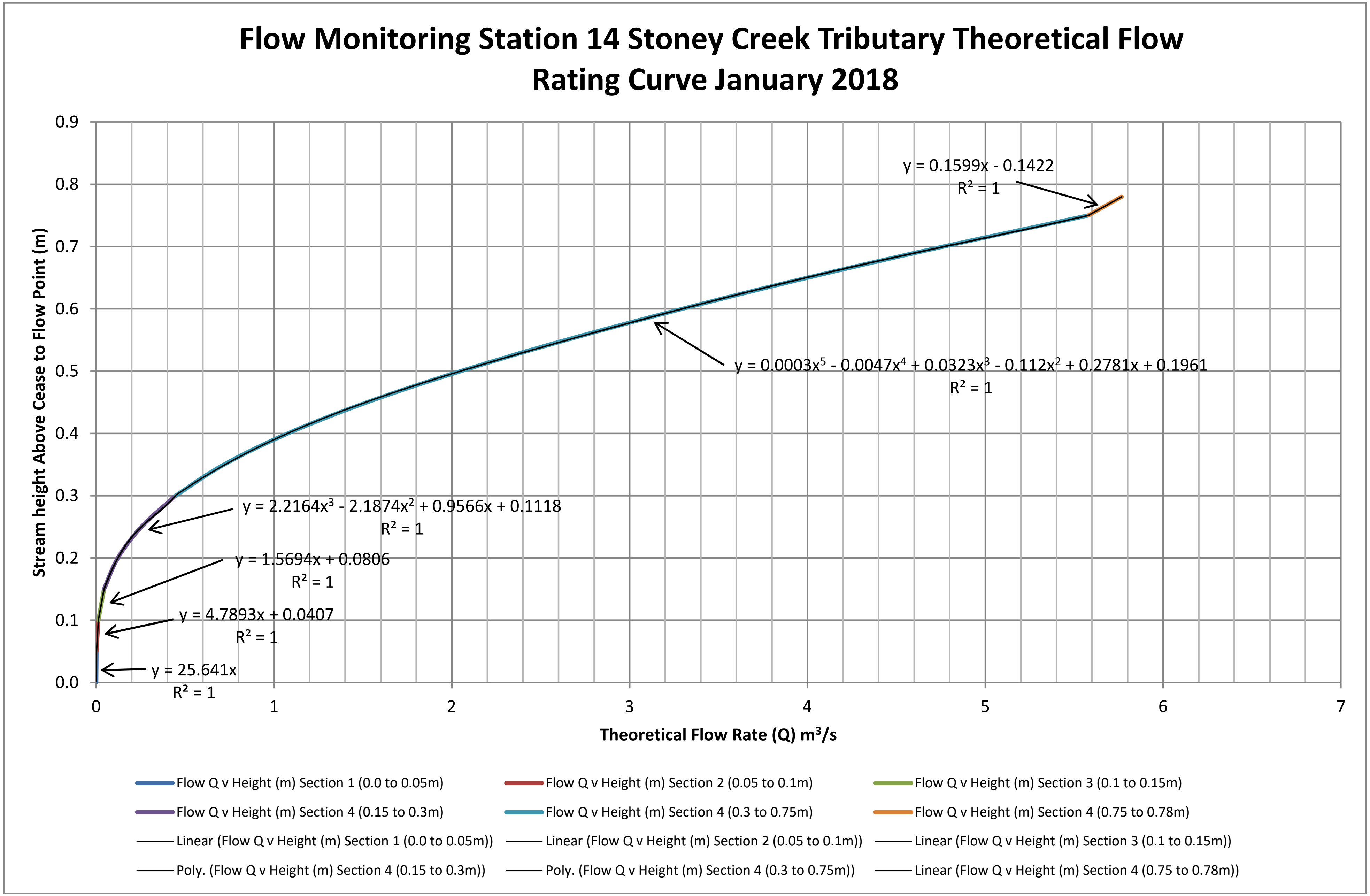
Flow Monitoring Station 13 Stoney Creek Down Theorectical Flow Curve
January 2022
Stream Height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m³/s
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14
16
y = -3E-07x⁶ + 2E-05x⁵ - 0.0006x⁴ + 0.0092x³ - 0.0741x² + 0.3698x + 0.1446
R² = 0.999
y = 12.04x³ - 6.6446x² + 1.5699x + 0.0299
R² = 1
y = 3.6899x
R² = 1
Flow Q v Height (m) Section 1 (0.0 to 0.01m)
Flow Q v Height (m) Section 2 (0.01 to 0.2m)
Flow Q v Height (m) Section 3 (0.2 to 1.45m)
Linear (Flow Q v Height (m) Section 1 (0.0 to 0.01m))
Poly. (Flow Q v Height (m) Section 2 (0.01 to 0.2m))
Poly. (Flow Q v Height (m) Section 3 (0.2 to 1.45m))

Wambo Coal
Stoney Creek Down Flow Station Re-Location Cease to Flow Point Cross Section Survey
January 2022

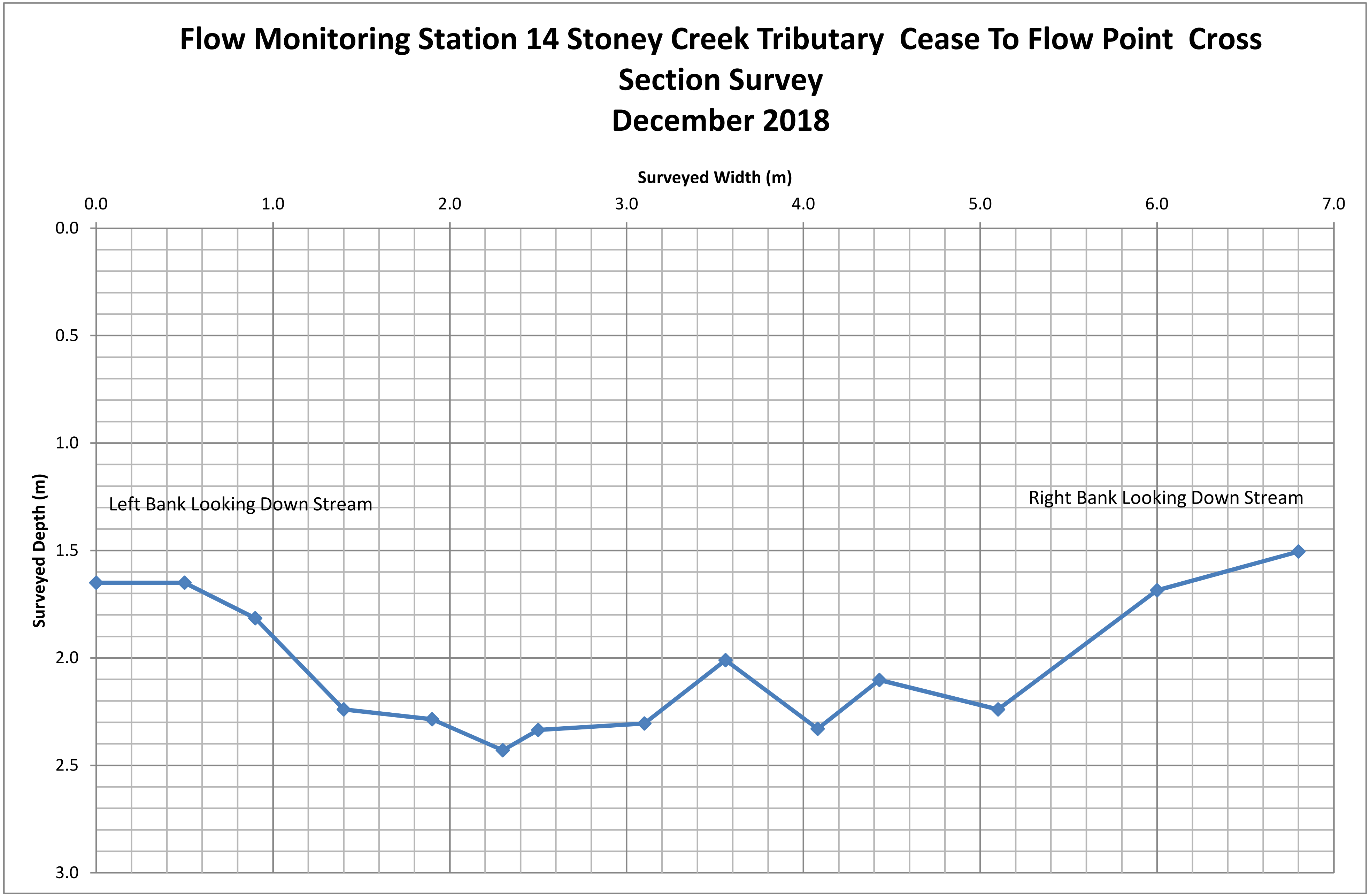




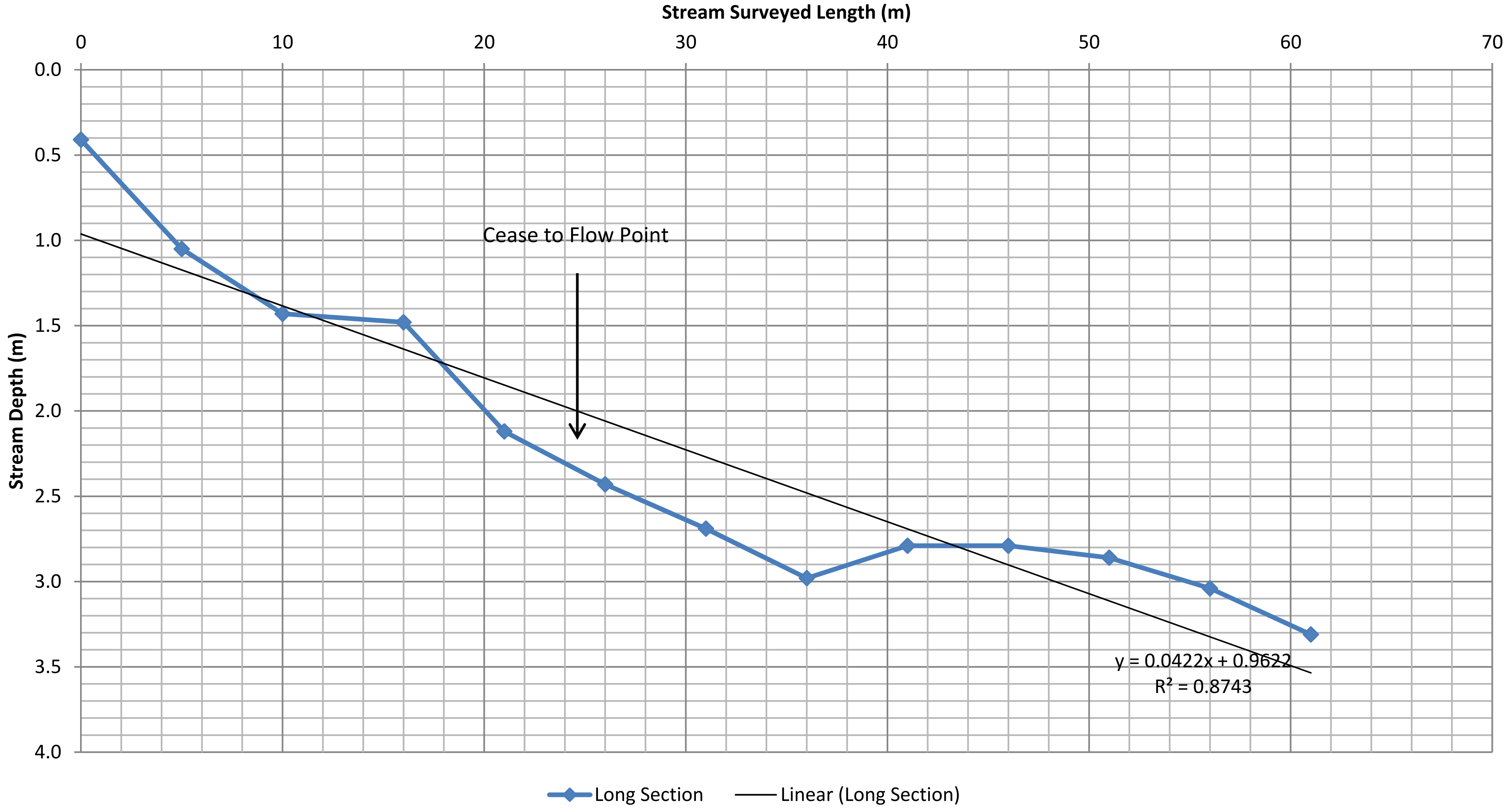
Wambo Coal
Stoney Creek Down Re-Location Long Section Profile Through Cease to Flow Point
January 2022
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
Stream Depth (m)
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
Cease to Flow Point
y = 0.0075x + 1.6464
R² = 0.5959
Long Section
Linear (Long Section)

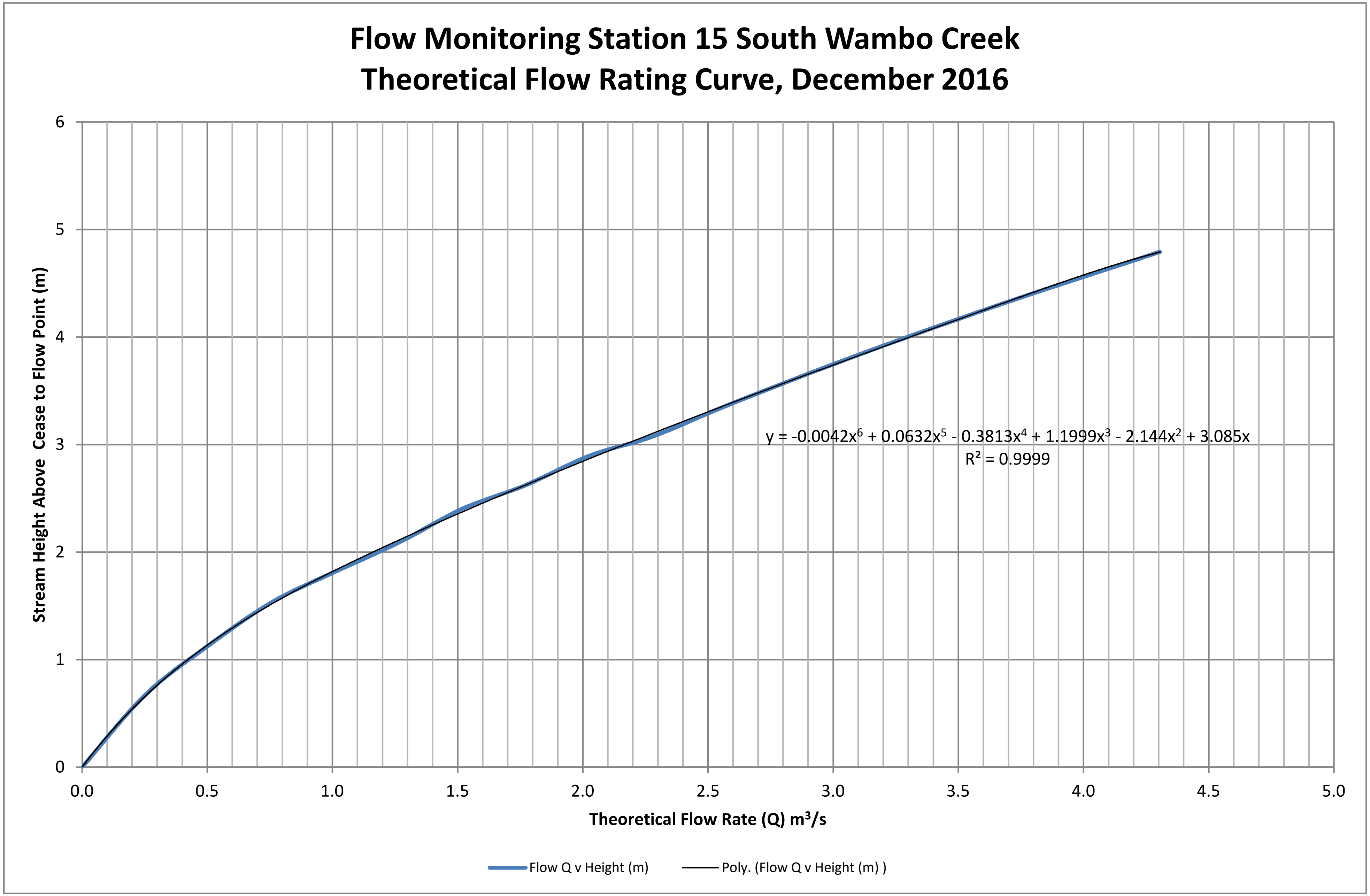


Flow Monitoring Station 14 Stoney Creek Tributary Theoretical Flow Rating Curve January 2018
y = 0.1599x - 0.1422
R² = 1
y = 0.0003x⁵ - 0.0047x⁴ + 0.0323x³ - 0.112x² + 0.2781x + 0.1961
R² = 1
y = 2.2164x³ - 2.1874x² + 0.9566x + 0.1118
R² = 1
y = 1.5694x + 0.0806
R² = 1
y = 4.7893x + 0.0407
R² = 1
y = 25.641x
R² = 1
Stream height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m³/s
Flow Q v Height (m) Section 1 (0.0 to 0.05m)
Flow Q v Height (m) Section 2 (0.05 to 0.1m)
Flow Q v Height (m) Section 3 (0.1 to 0.15m)
Flow Q v Height (m) Section 4 (0.15 to 0.3m)
Flow Q v Height (m) Section 4 (0.3 to 0.75m)
Flow Q v Height (m) Section 4 (0.75 to 0.78m)
Linear (Flow Q v Height (m) Section 1 (0.0 to 0.05m))
Linear (Flow Q v Height (m) Section 2 (0.05 to 0.1m))
Linear (Flow Q v Height (m) Section 3 (0.1 to 0.15m))
Poly. (Flow Q v Height (m) Section 4 (0.15 to 0.3m))
Poly. (Flow Q v Height (m) Section 4 (0.3 to 0.75m))
Linear (Flow Q v Height (m) Section 4 (0.75 to 0.78m))

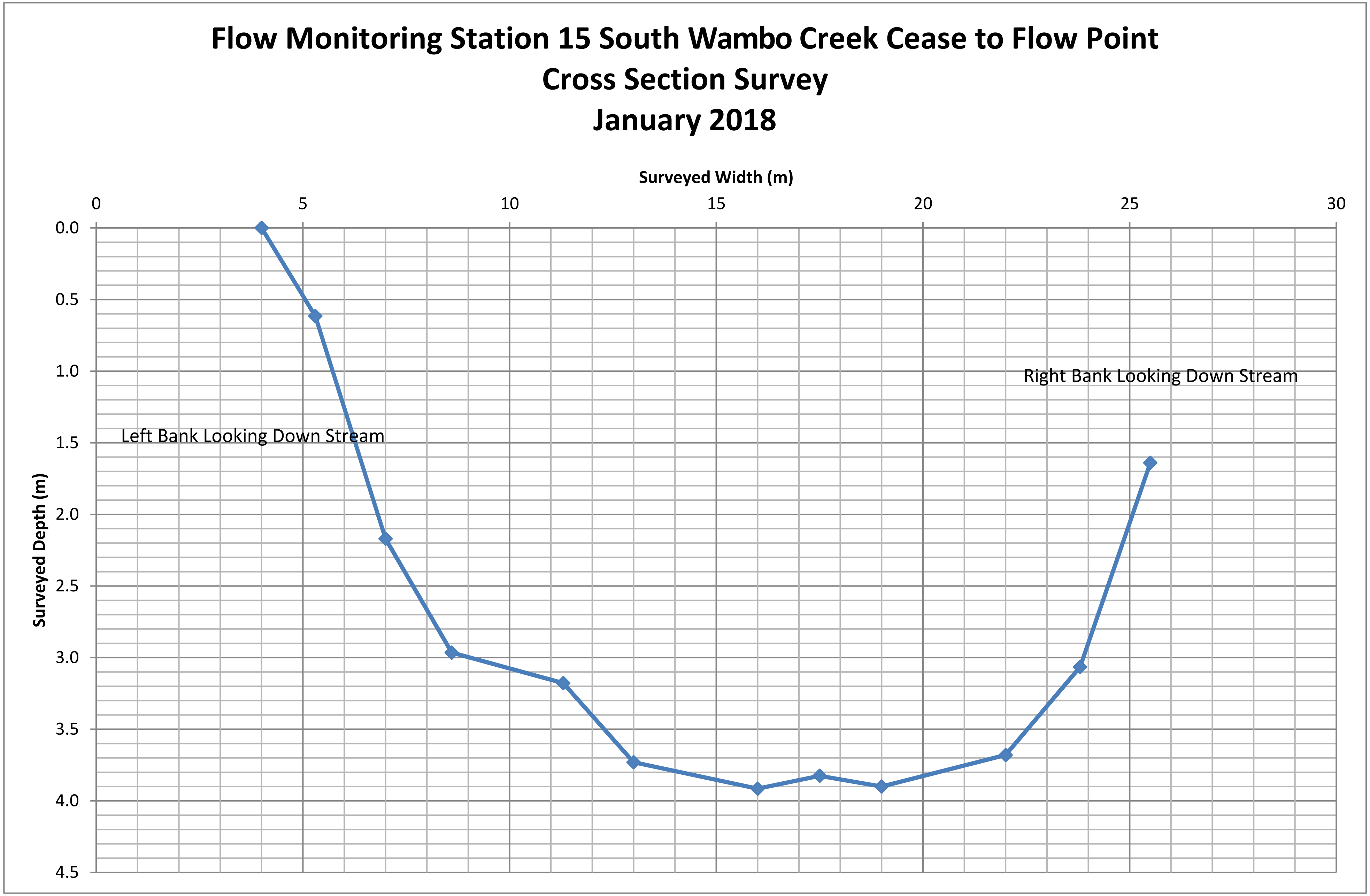

Flow Monitoring Station 14 Stoney Creek Tributary Cease To Flow Point Cross Section Survey
December 2018
Surveyed Width (m)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Surveyed Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Left Bank Looking Down Stream
Right Bank Looking Down Stream

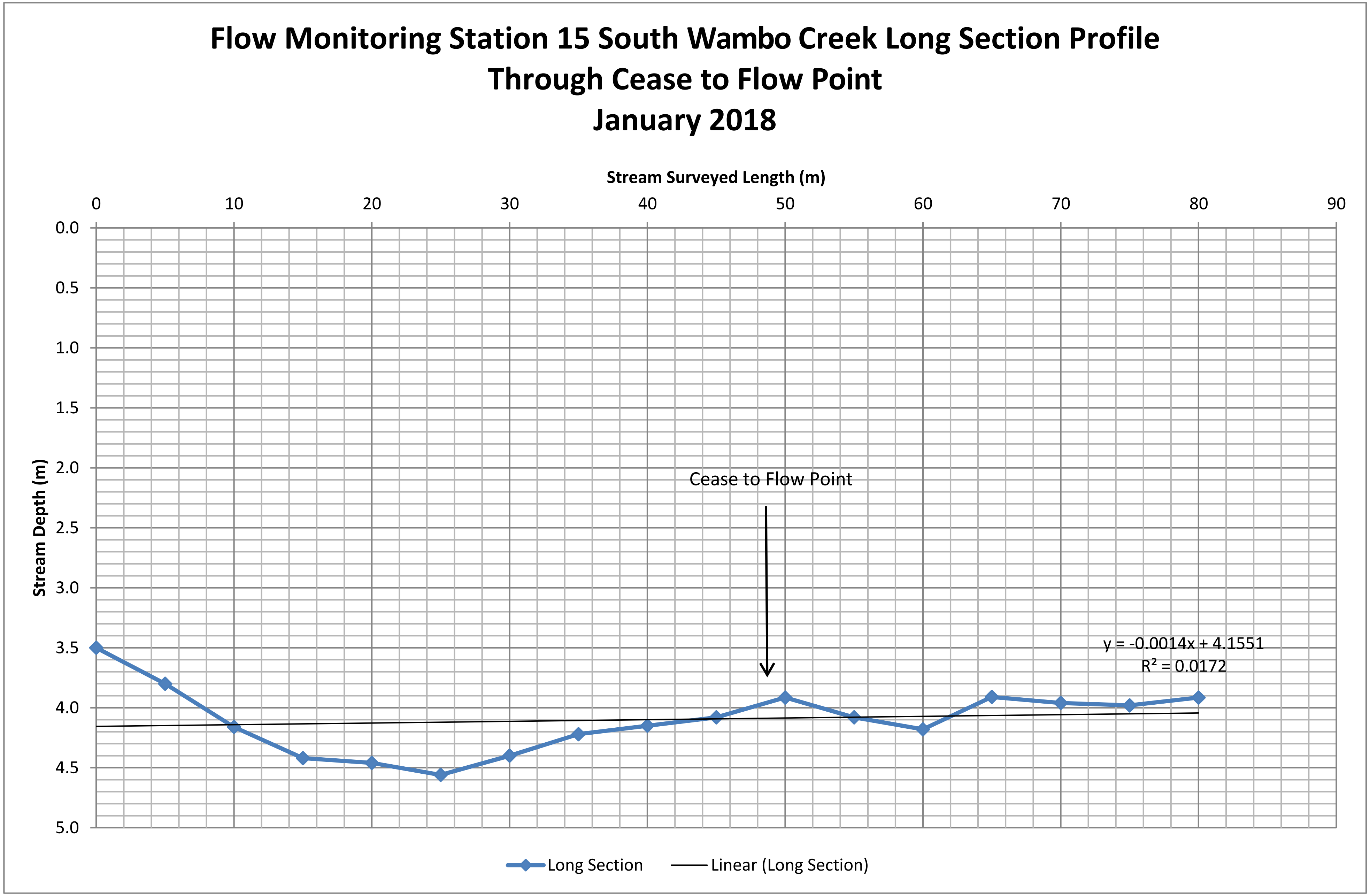
Flow Monitoring Station 14 Stoney Creek Tributary Long Section Profile Through Cease to Flow Point December 2018



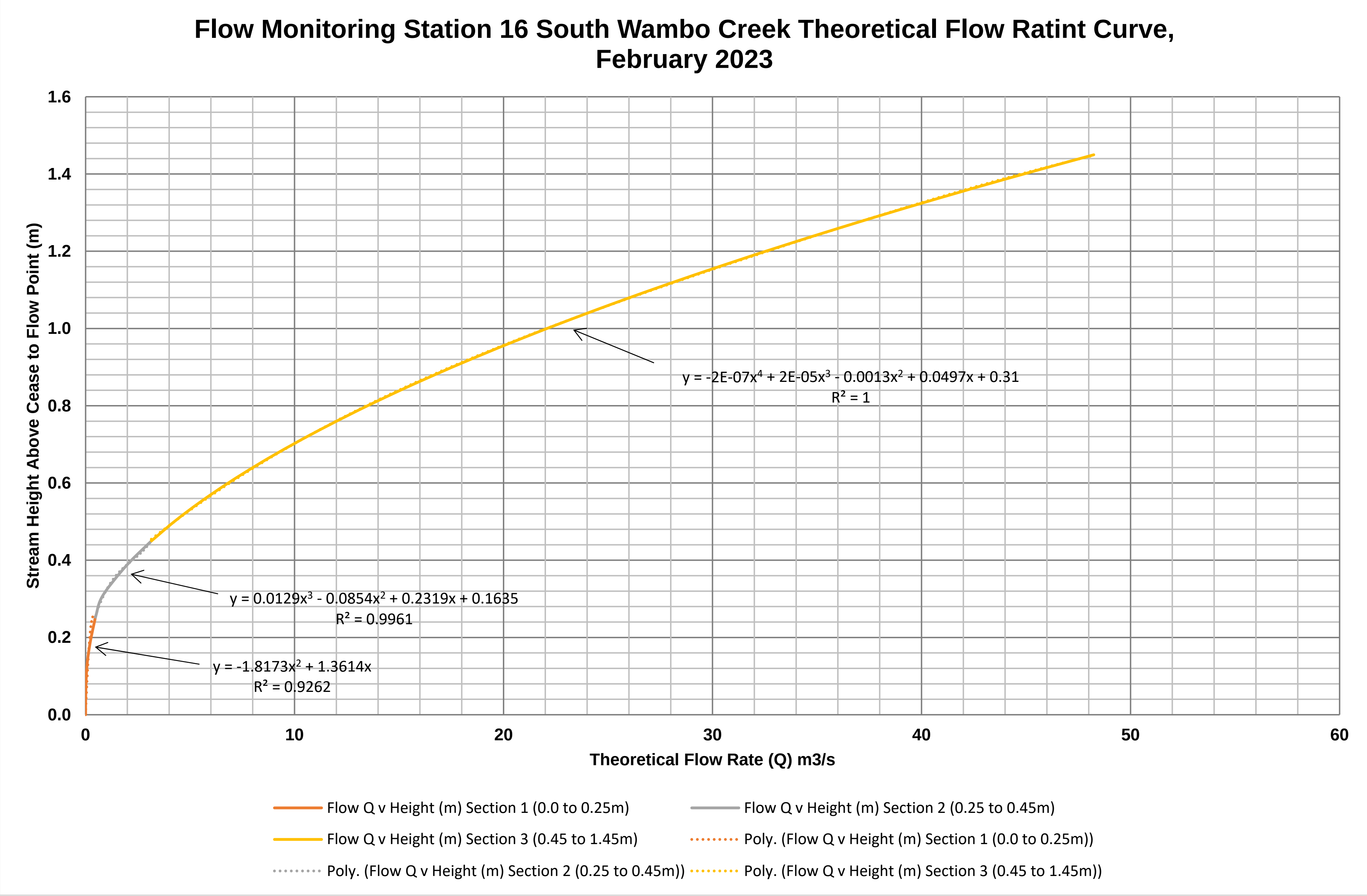


Flow Monitoring Station 15 South Wambo Creek
Theoretical Flow Rating Curve, December 2016
Stream Height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m^3/s
$y = -0.0042x^6 + 0.0632x^5 - 0.3813x^4 + 1.1999x^3 - 2.144x^2 + 3.085x$
$R^2 = 0.9999$
0
1
2
3
4
5
6
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Flow Q v Height (m)
Poly. (Flow Q v Height (m))

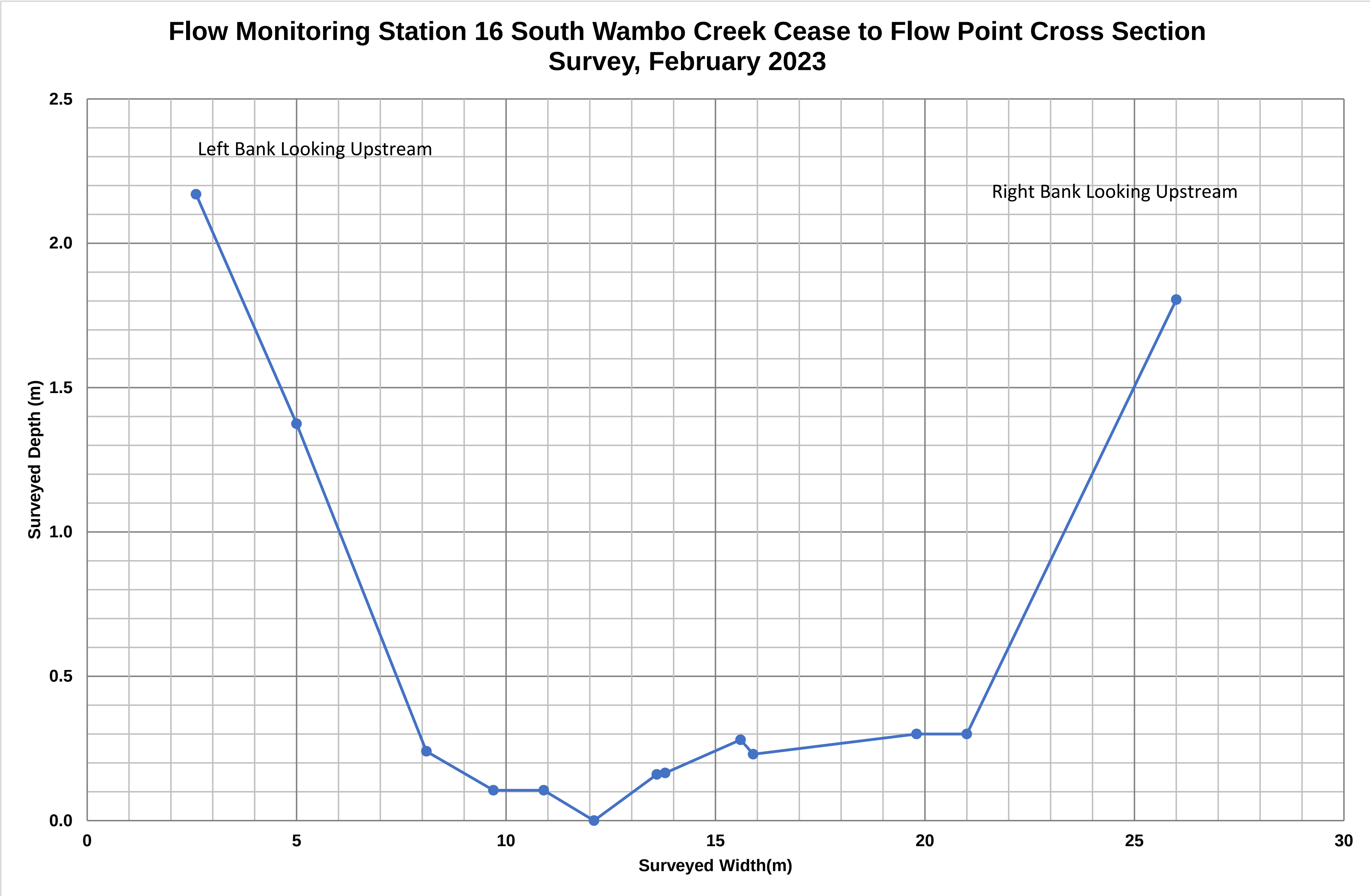

Flow Monitoring Station 15 South Wambo Creek Cease to Flow Point
Cross Section Survey
January 2018
Surveyed Width (m)
0
5
10
15
20
25
30
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Surveyed Depth (m)
Left Bank Looking Down Stream
Right Bank Looking Down Stream

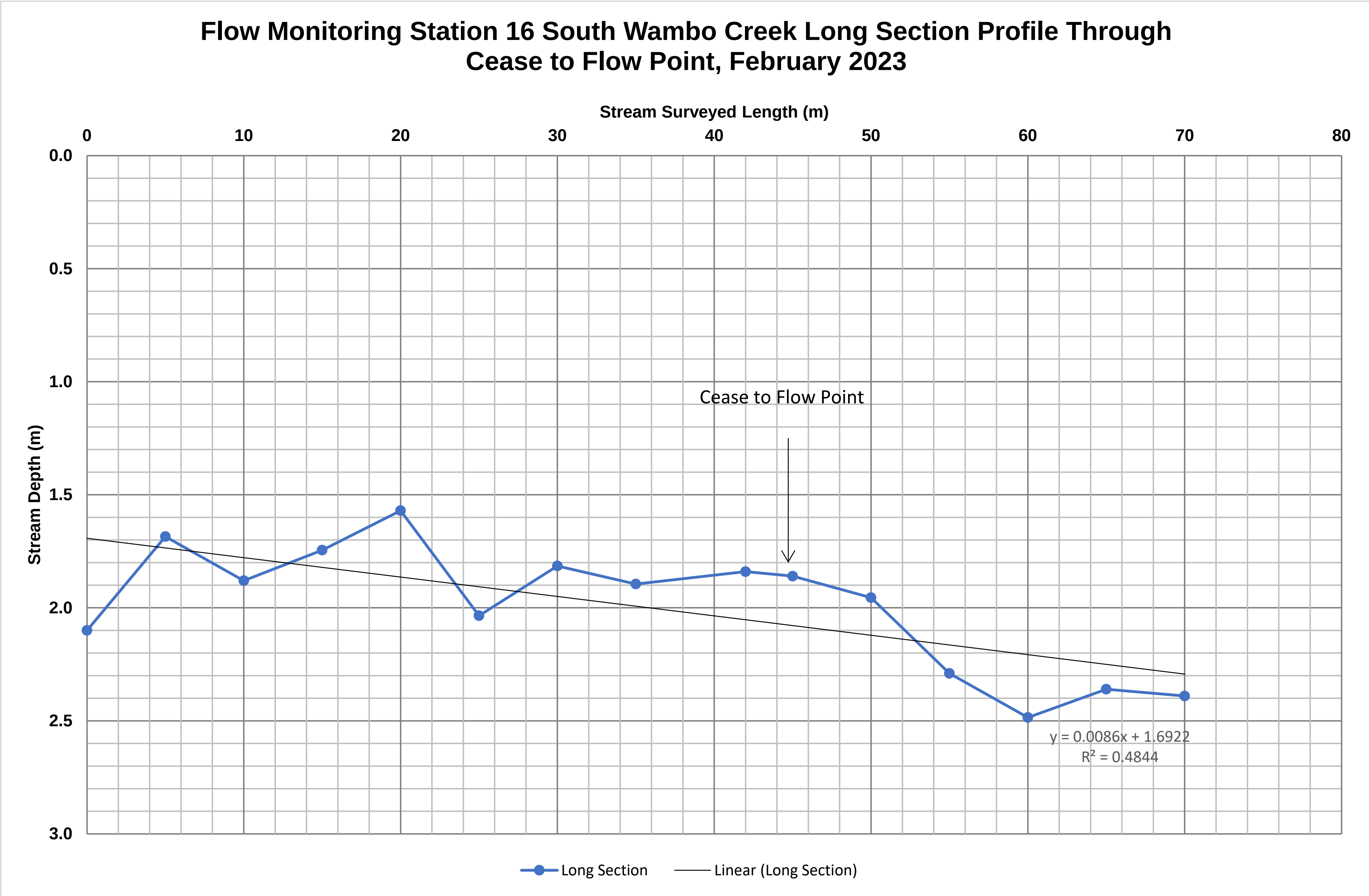


Flow Monitoring Station 15 South Wambo Creek Long Section Profile
Through Cease to Flow Point
January 2018
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
90
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Stream Depth (m)
Cease to Flow Point
y = -0.0014x + 4.1551
R² = 0.0172
Long Section
Linear (Long Section)



Flow Monitoring Station 16 South Wambo Creek Theoretical Flow Ratint Curve, February 2023
Stream Height Above Cease to Flow Point (m)
Theoretical Flow Rate (Q) m3/s
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
10
20
30
40
50
60
y = -2E-07x⁴ + 2E-05x³ - 0.0013x² + 0.0497x + 0.31
R² = 1
y = 0.0129x³ - 0.0854x² + 0.2319x + 0.1635
R² = 0.9961
y = -1.8173x² + 1.3614x
R² = 0.9262
Flow Q v Height (m) Section 1 (0.0 to 0.25m)
Flow Q v Height (m) Section 2 (0.25 to 0.45m)
Flow Q v Height (m) Section 3 (0.45 to 1.45m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.25m))
Poly. (Flow Q v Height (m) Section 2 (0.25 to 0.45m))
Poly. (Flow Q v Height (m) Section 3 (0.45 to 1.45m))


Flow Monitoring Station 16 South Wambo Creek Cease to Flow Point Cross Section Survey, February 2023
Left Bank Looking Upstream
Right Bank Looking Upstream
Surveyed Depth (m)
Surveyed Width(m)
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30



Flow Monitoring Station 16 South Wambo Creek Long Section Profile Through Cease to Flow Point, February 2023
Stream Surveyed Length (m)
0
10
20
30
40
50
60
70
80
Stream Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Cease to Flow Point
y = 0.0086x + 1.6922
R² = 0.4844
Long Section
Linear (Long Section)

Appendix C

Stream Height, Theoretical Flow, Daily and Cumulative Rainfall Charts

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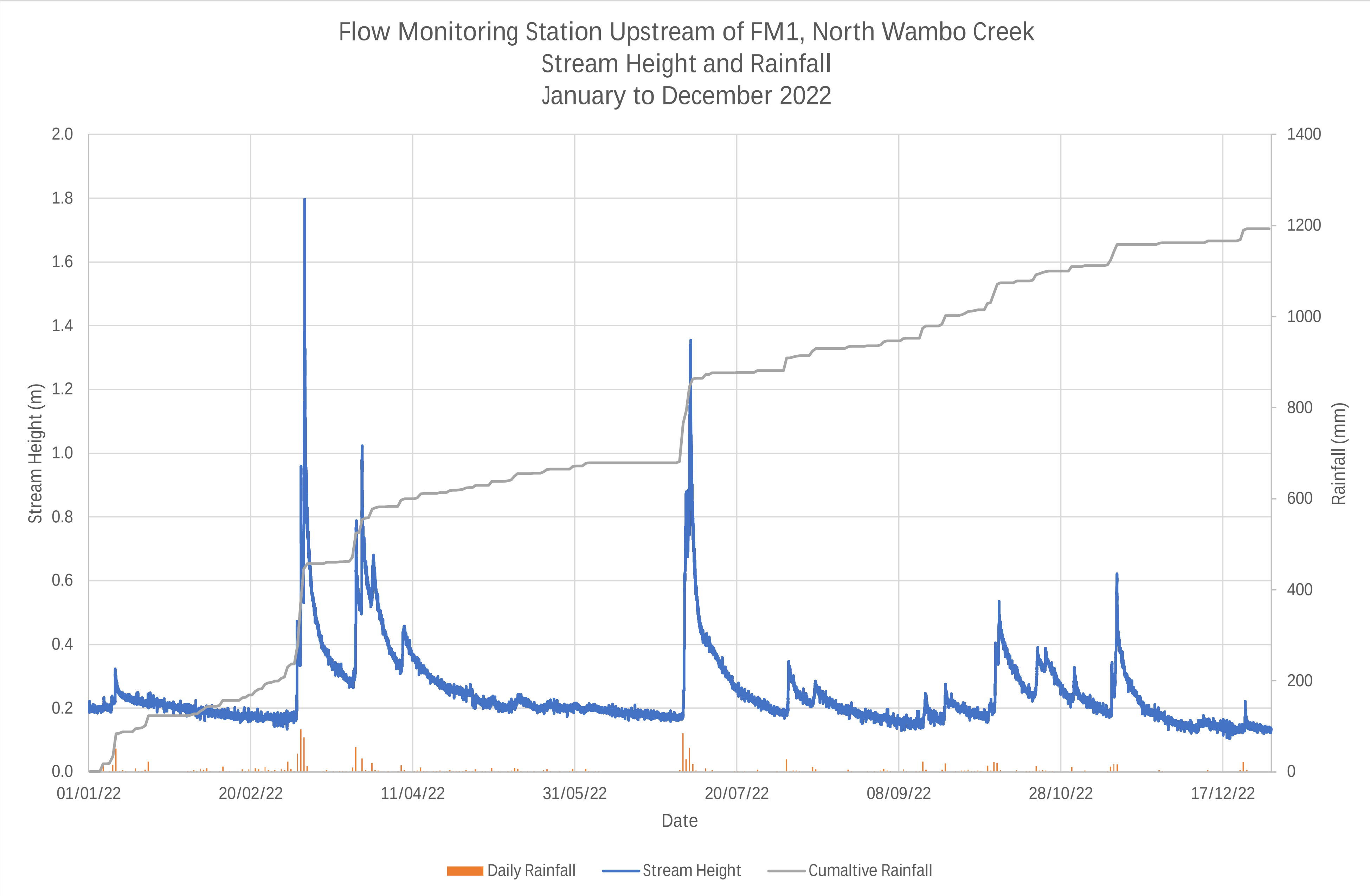
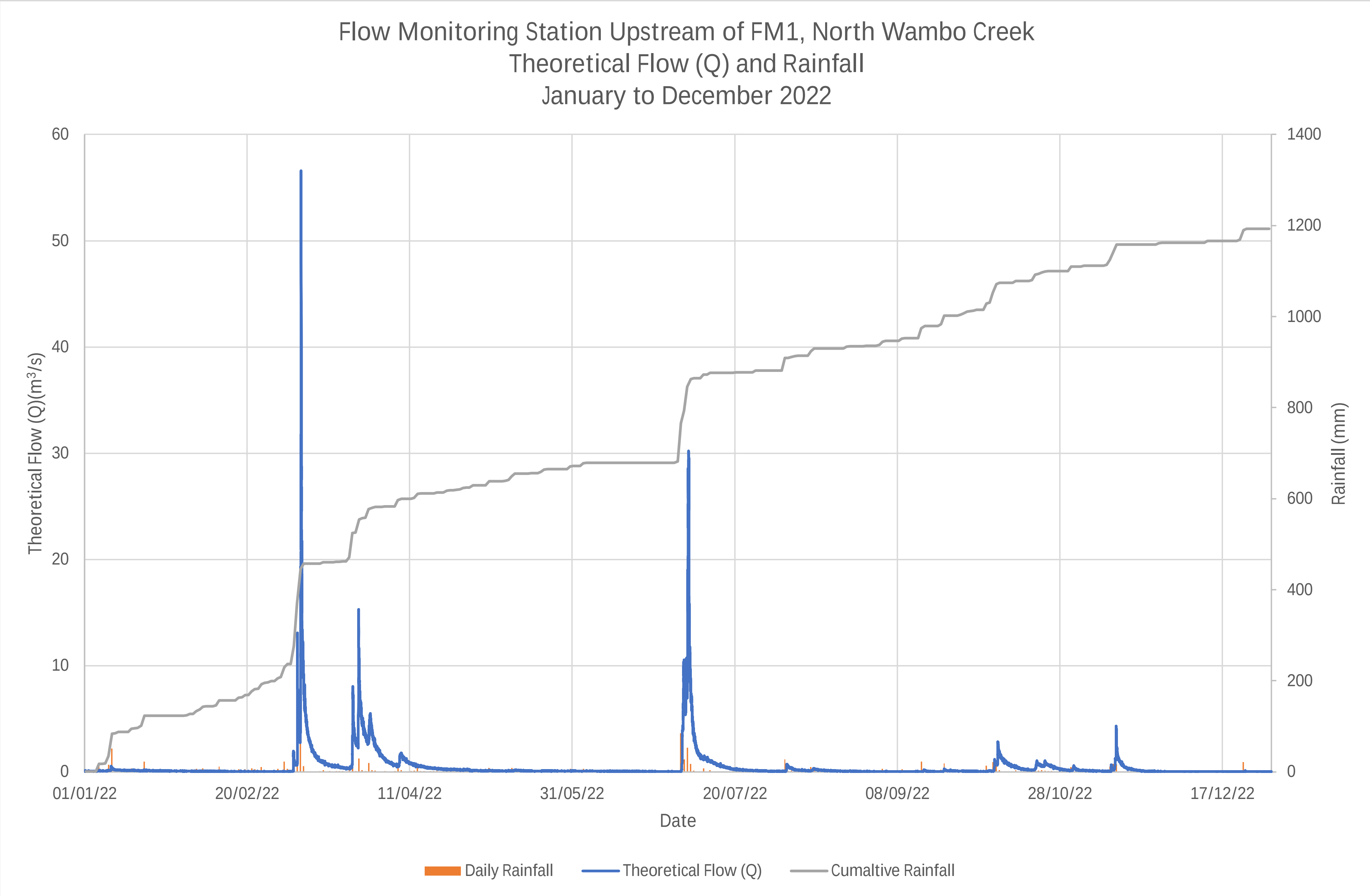
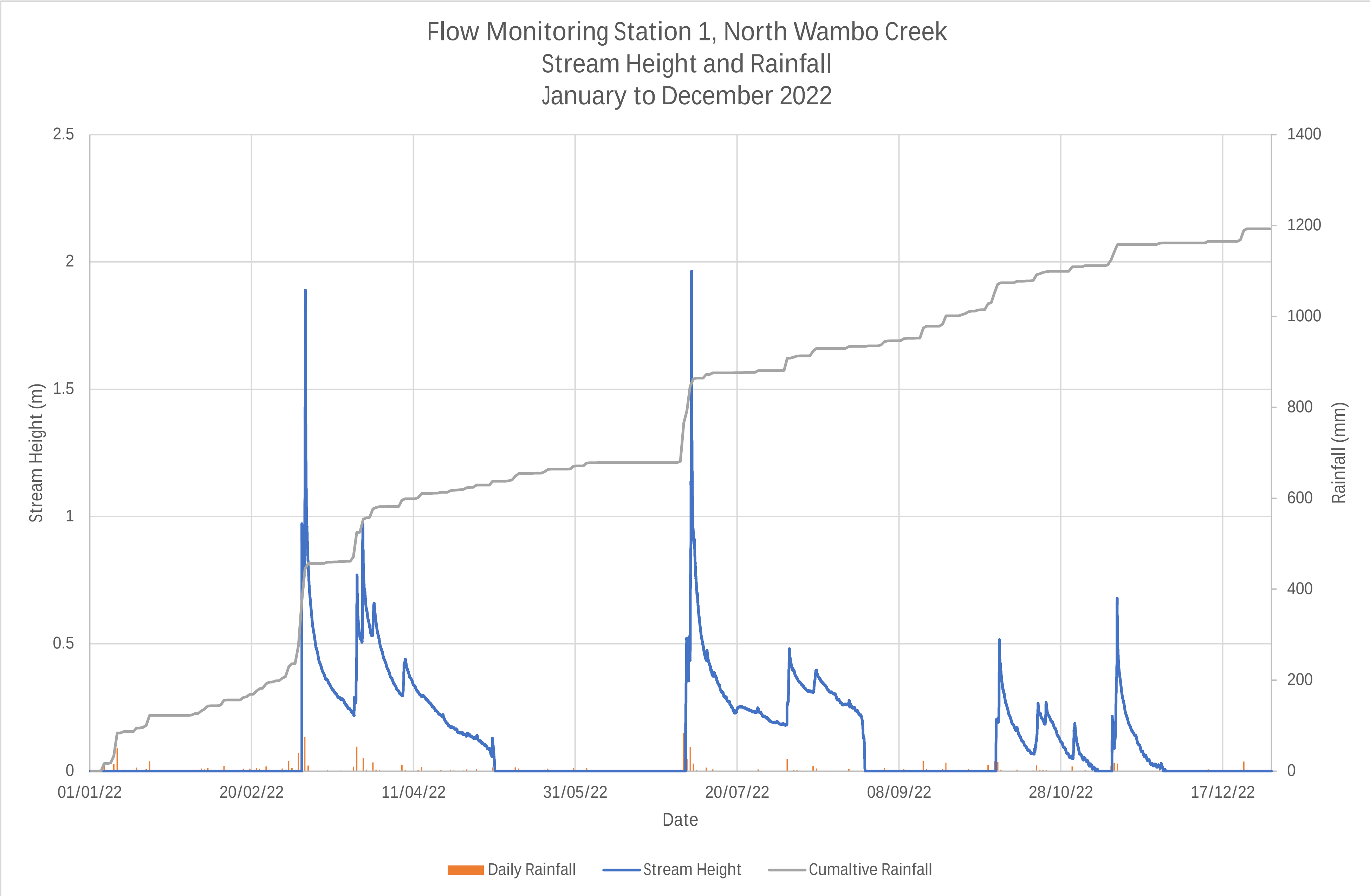
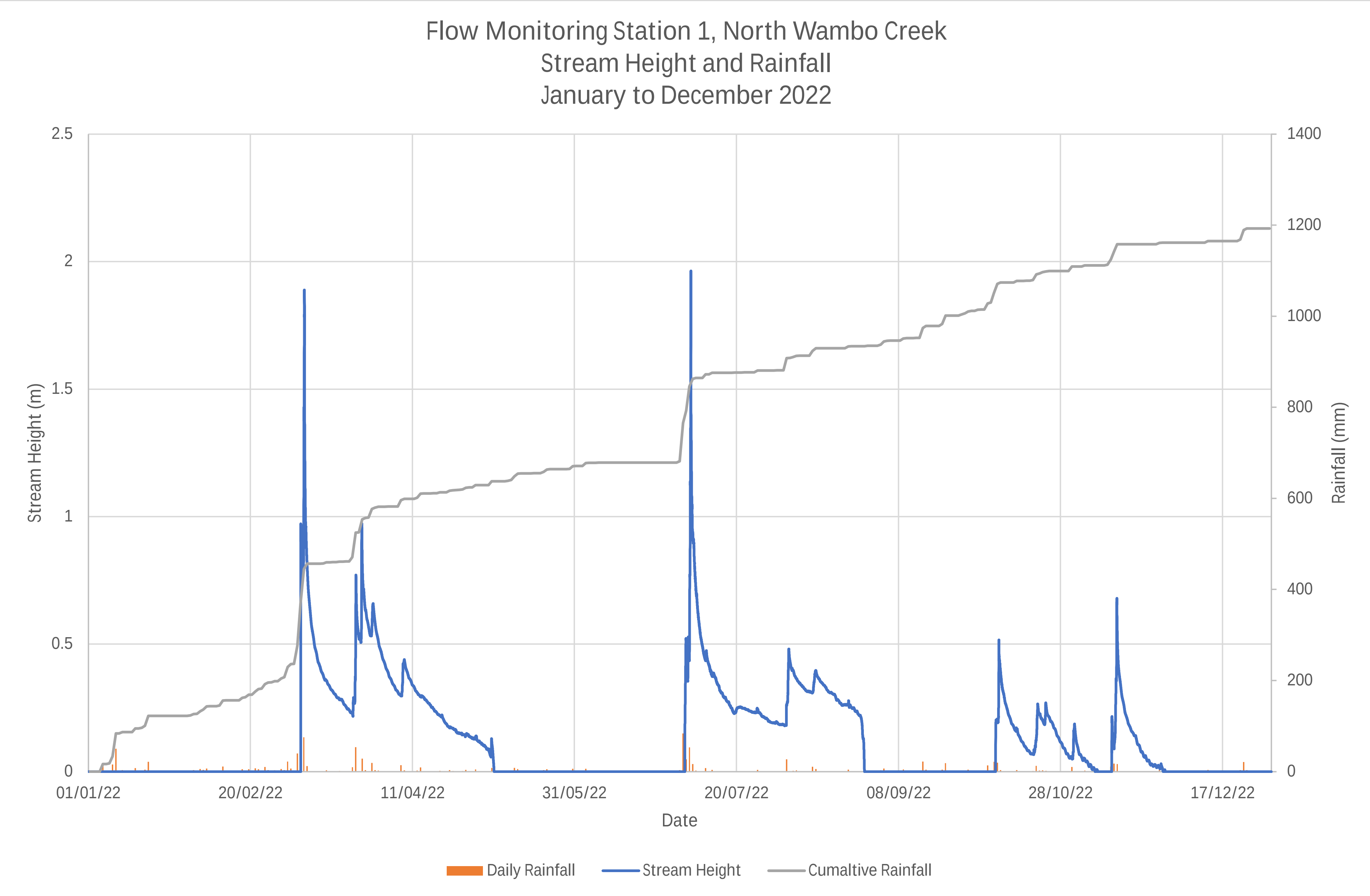


Flow Monitoring Station Upstream of FM1, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

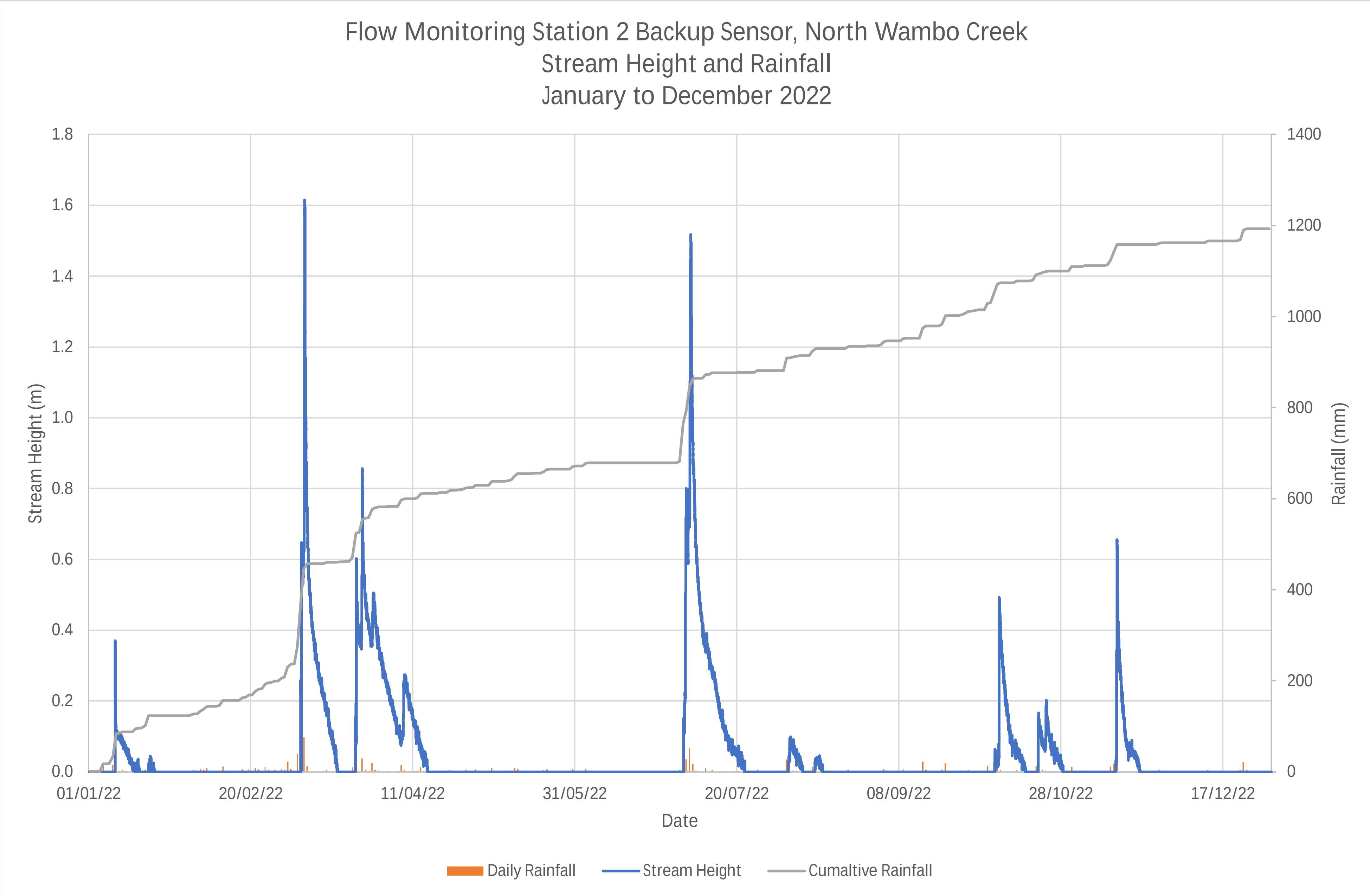


Flow Monitoring Station Upstream of FM1, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q)(m³/s)
Rainfall (mm)
60
50
40
30
20
10
0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

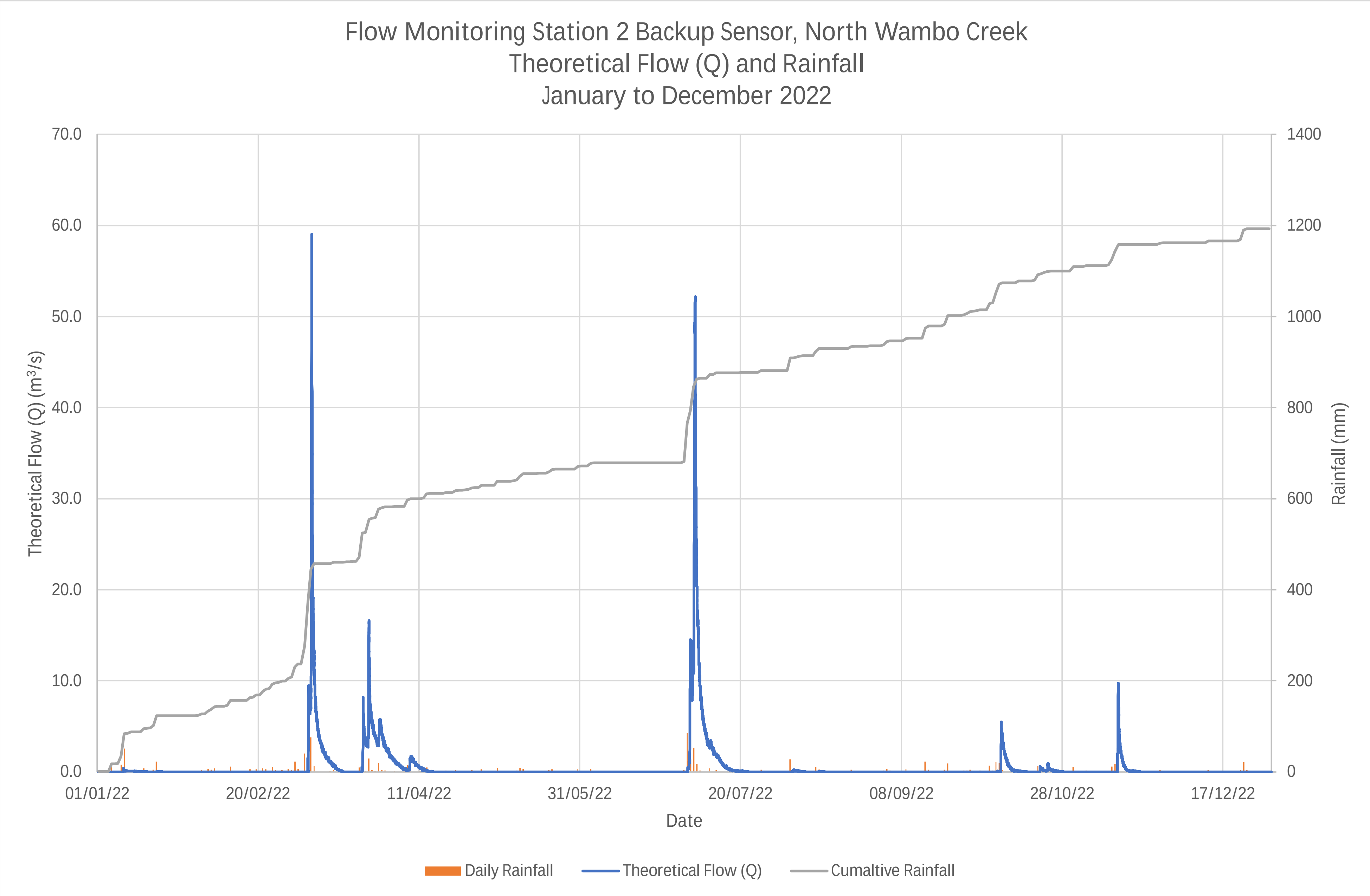

Flow Monitoring Station 1, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
2.5
2
1.5
1
0.5
0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



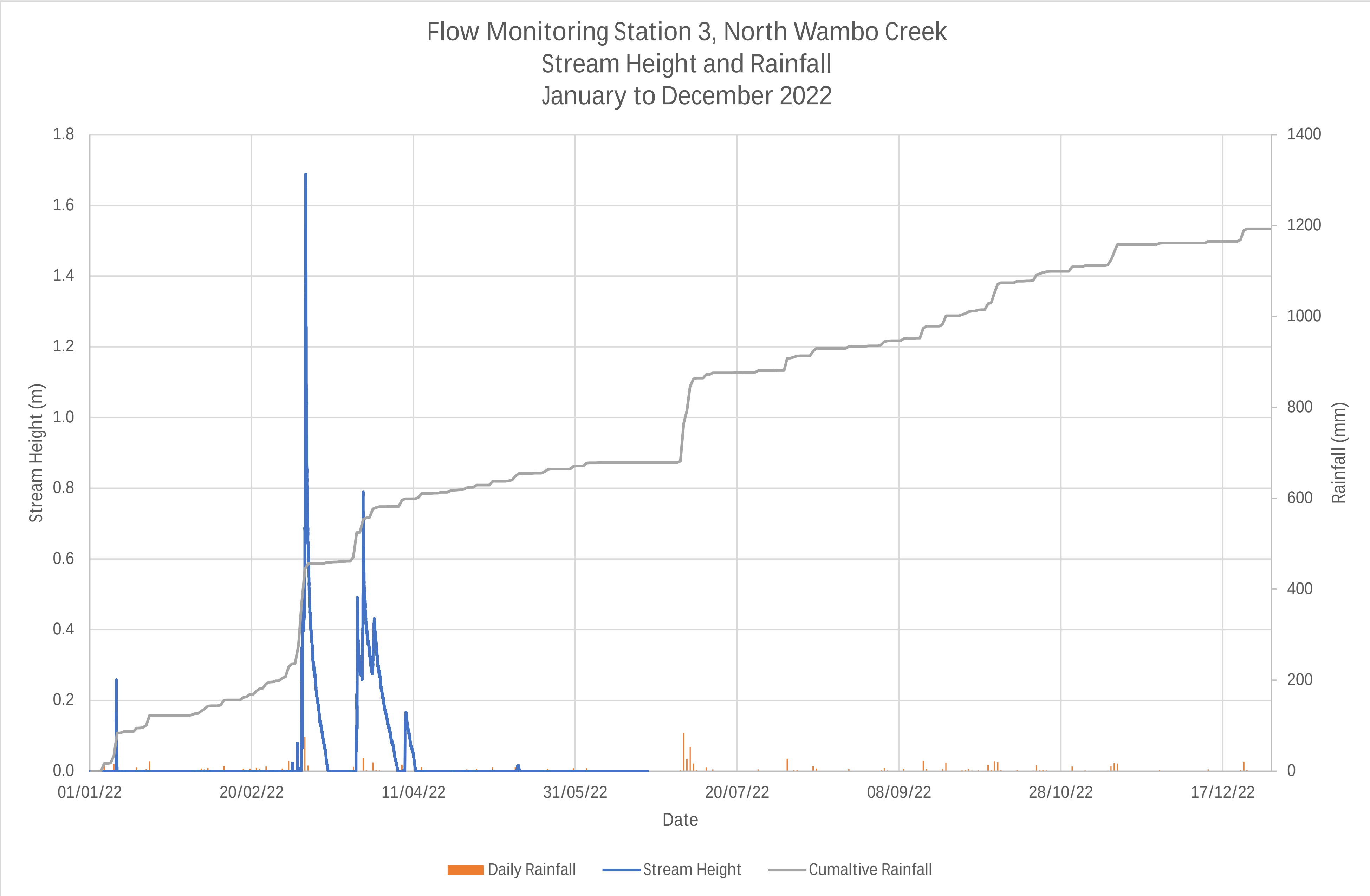
Flow Monitoring Station 1, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
2.5
2
1.5
1
0.5
0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



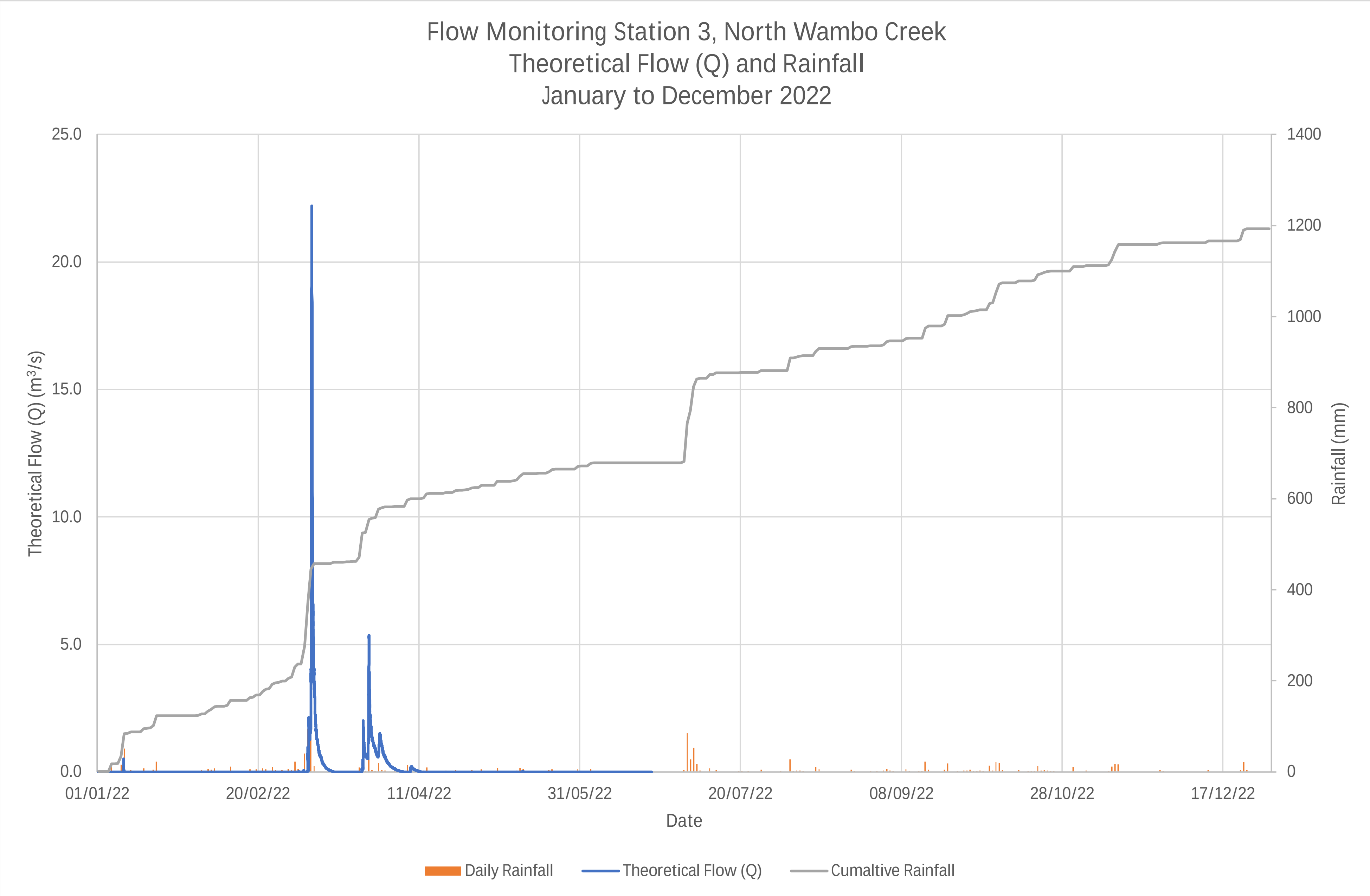
Flow Monitoring Station 2 Backup Sensor, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
Date
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Daily Rainfall
Stream Height
Cumaltive Rainfall



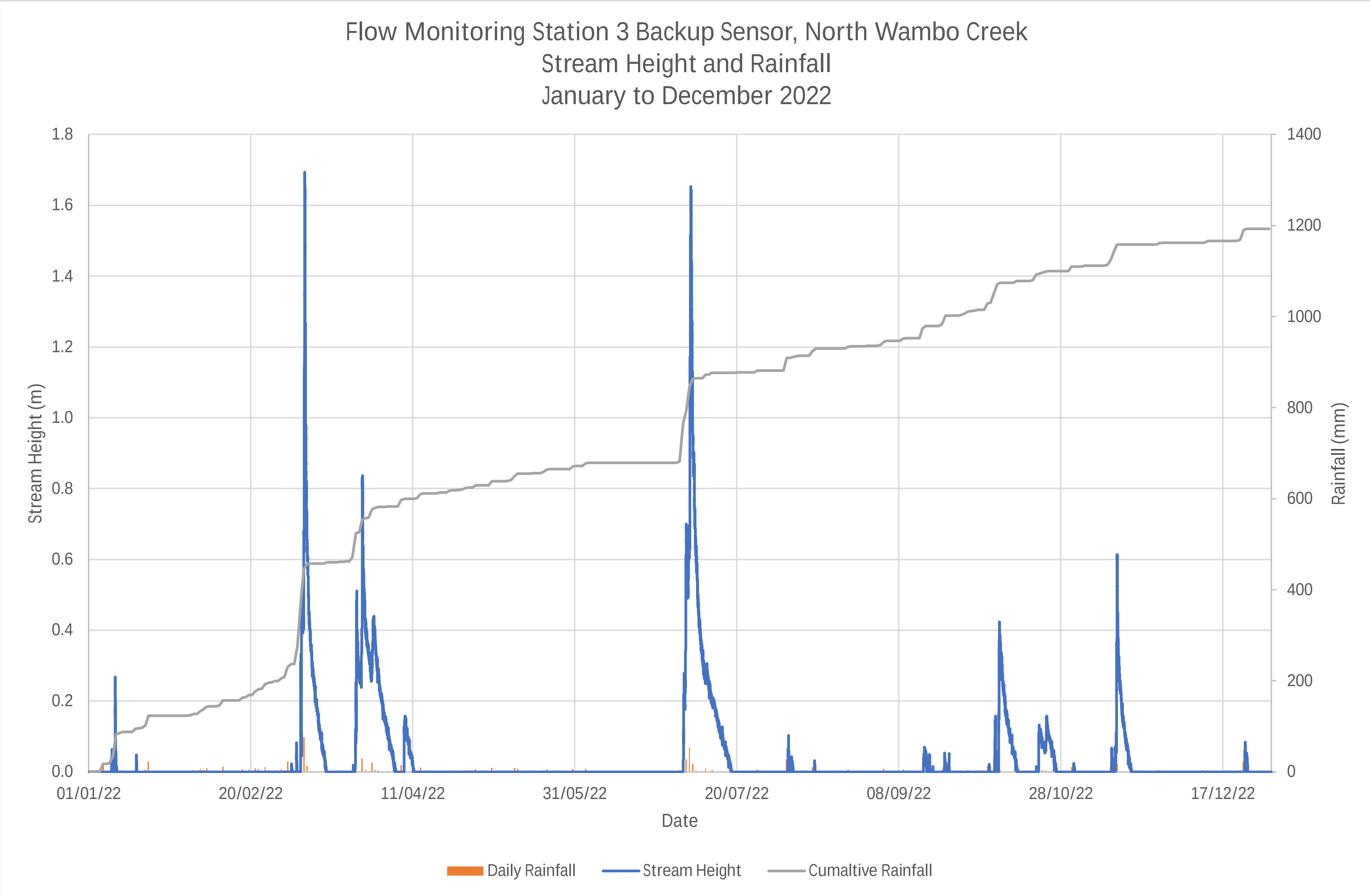
Flow Monitoring Station 2 Backup Sensor, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m^3/s)
Rainfall (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

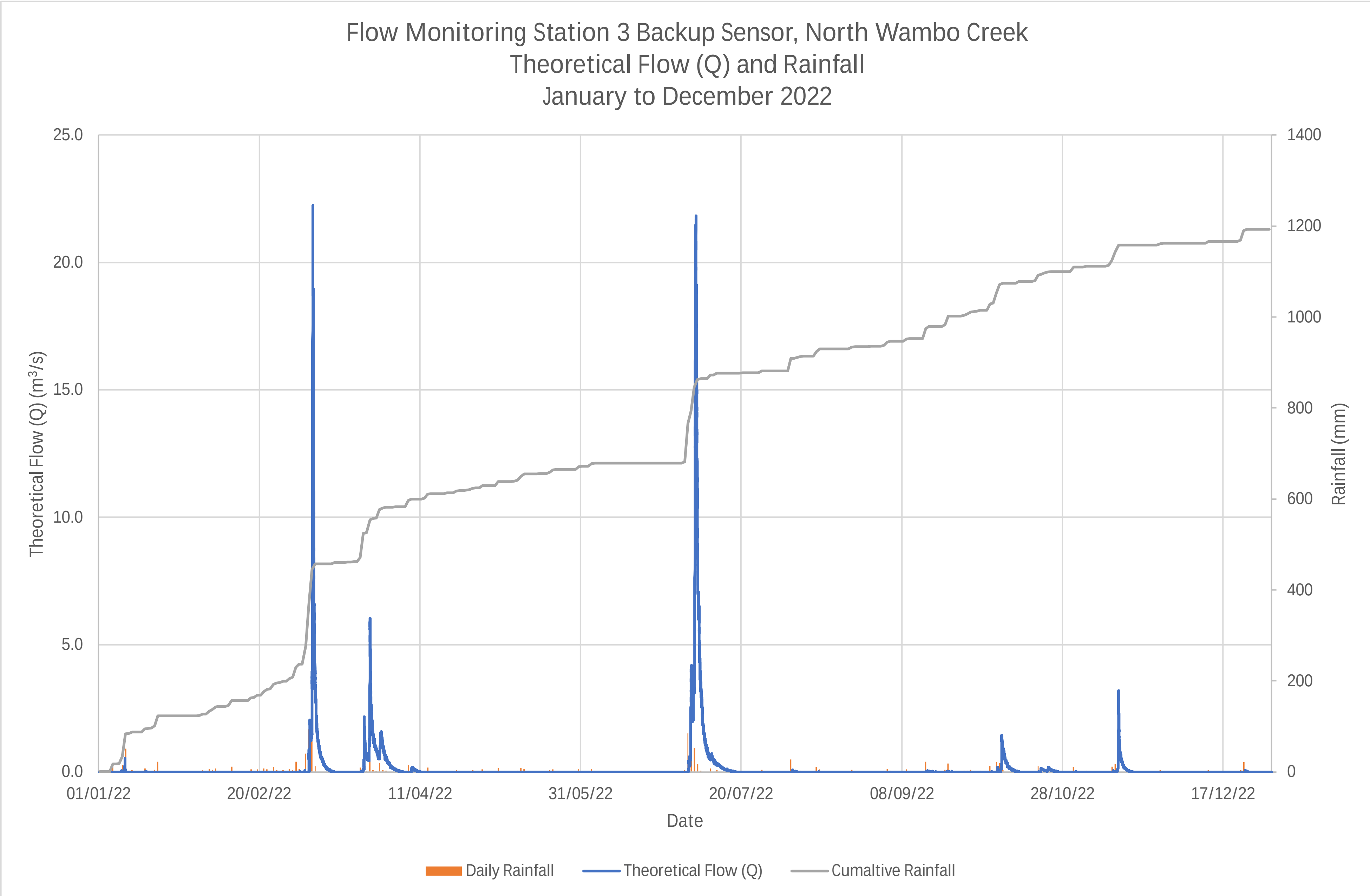


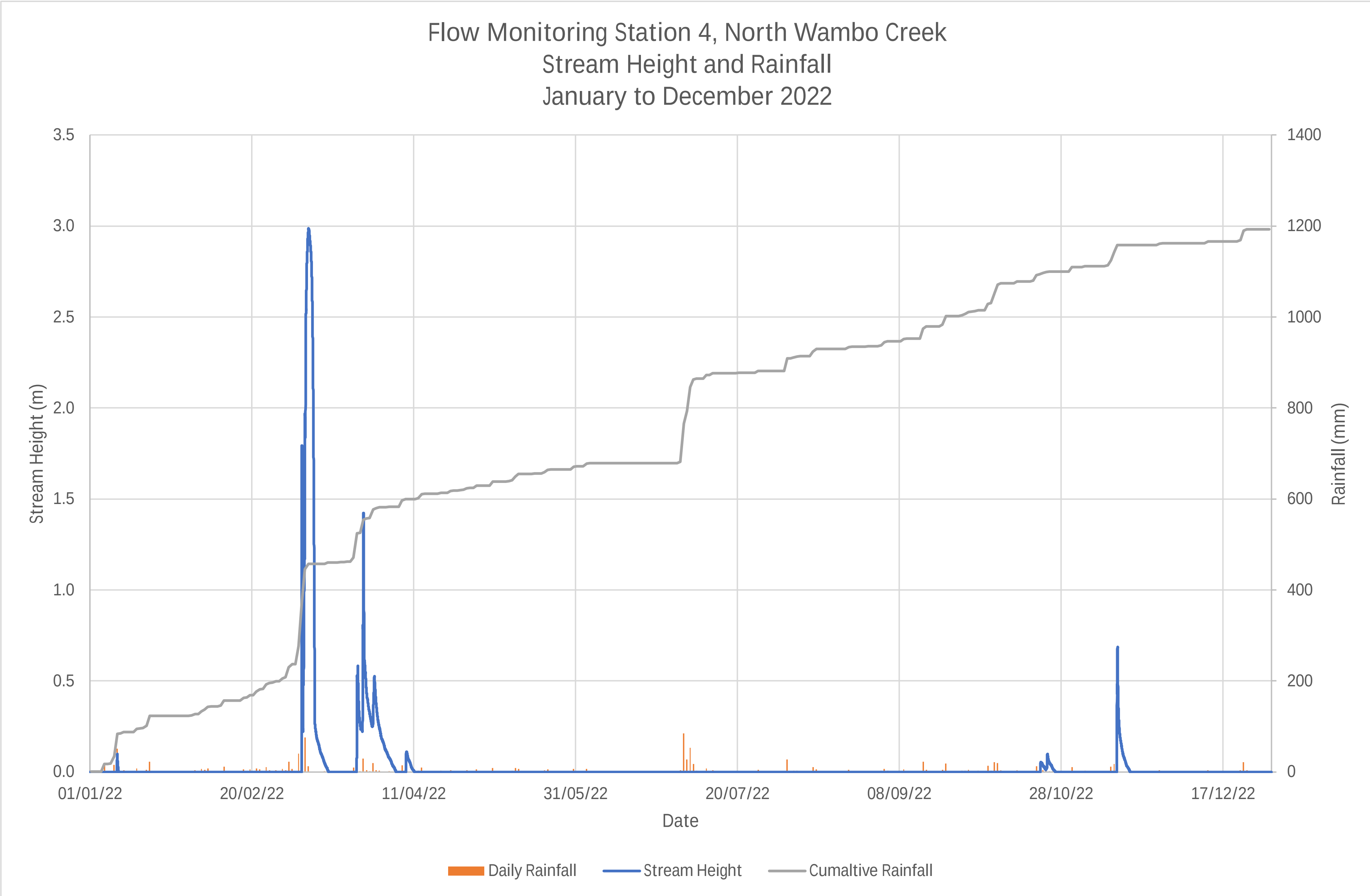
Flow Monitoring Station 3, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



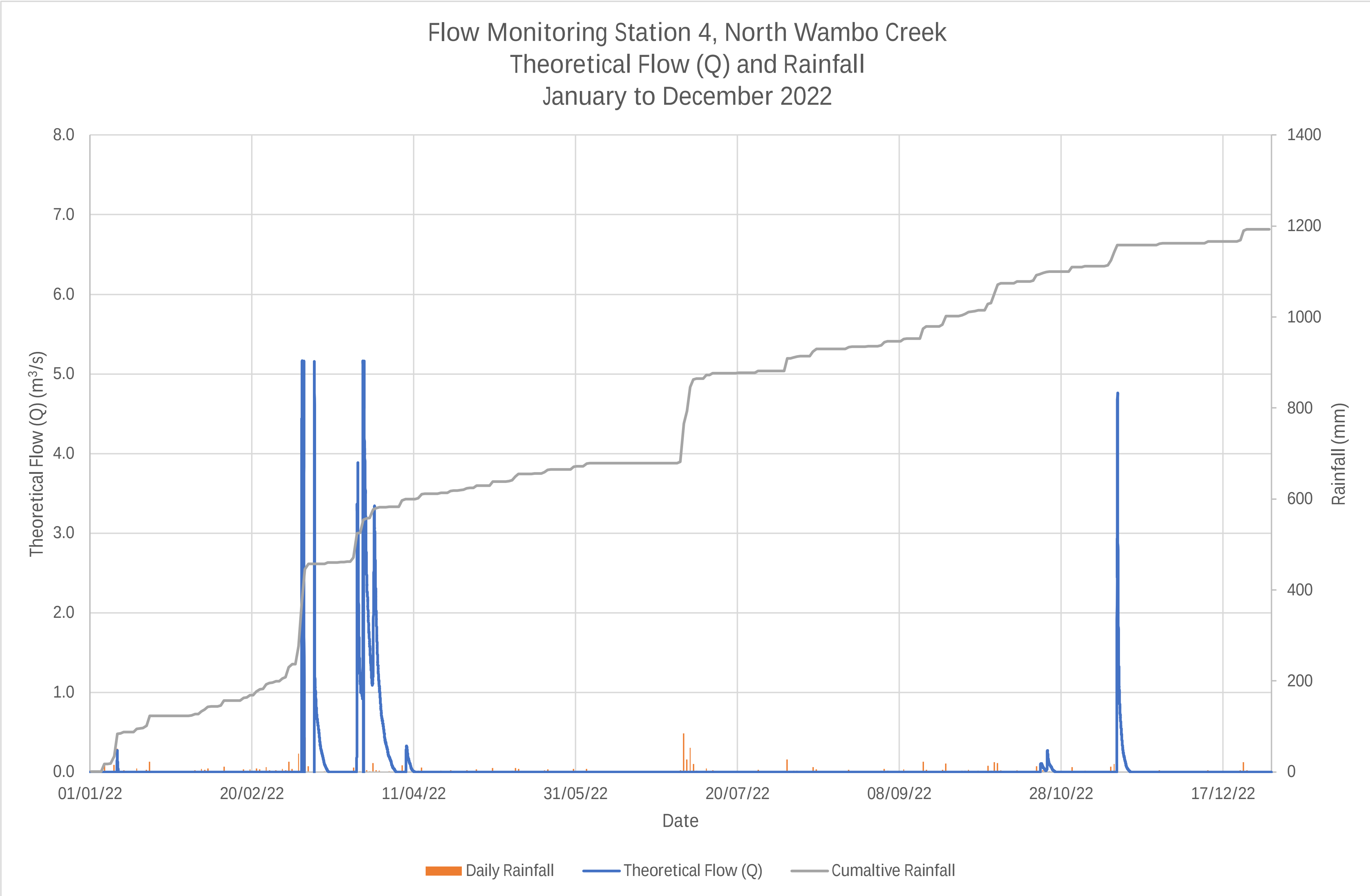
Flow Monitoring Station 3, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m3/s)
Rainfall (mm)
Date
25.0
20.0
15.0
10.0
5.0
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall


Flow Monitoring Station 3 Backup Sensor, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

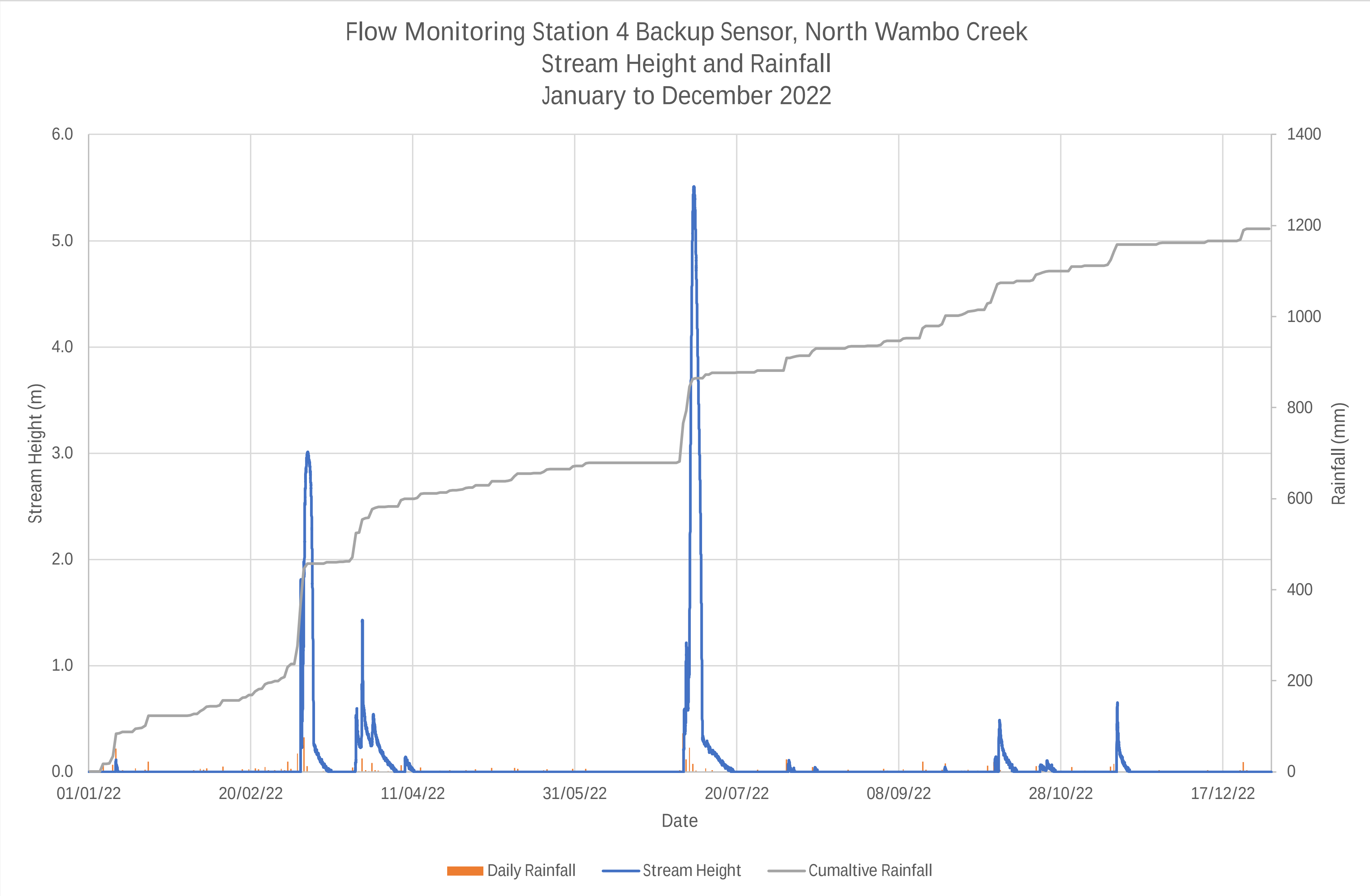

Flow Monitoring Station 3 Backup Sensor, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
25.0
20.0
15.0
10.0
5.0
0.0
Theoretical Flow (Q) (m^3/s)
1400
1200
1000
800
600
400
200
0
Rainfall (mm)
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

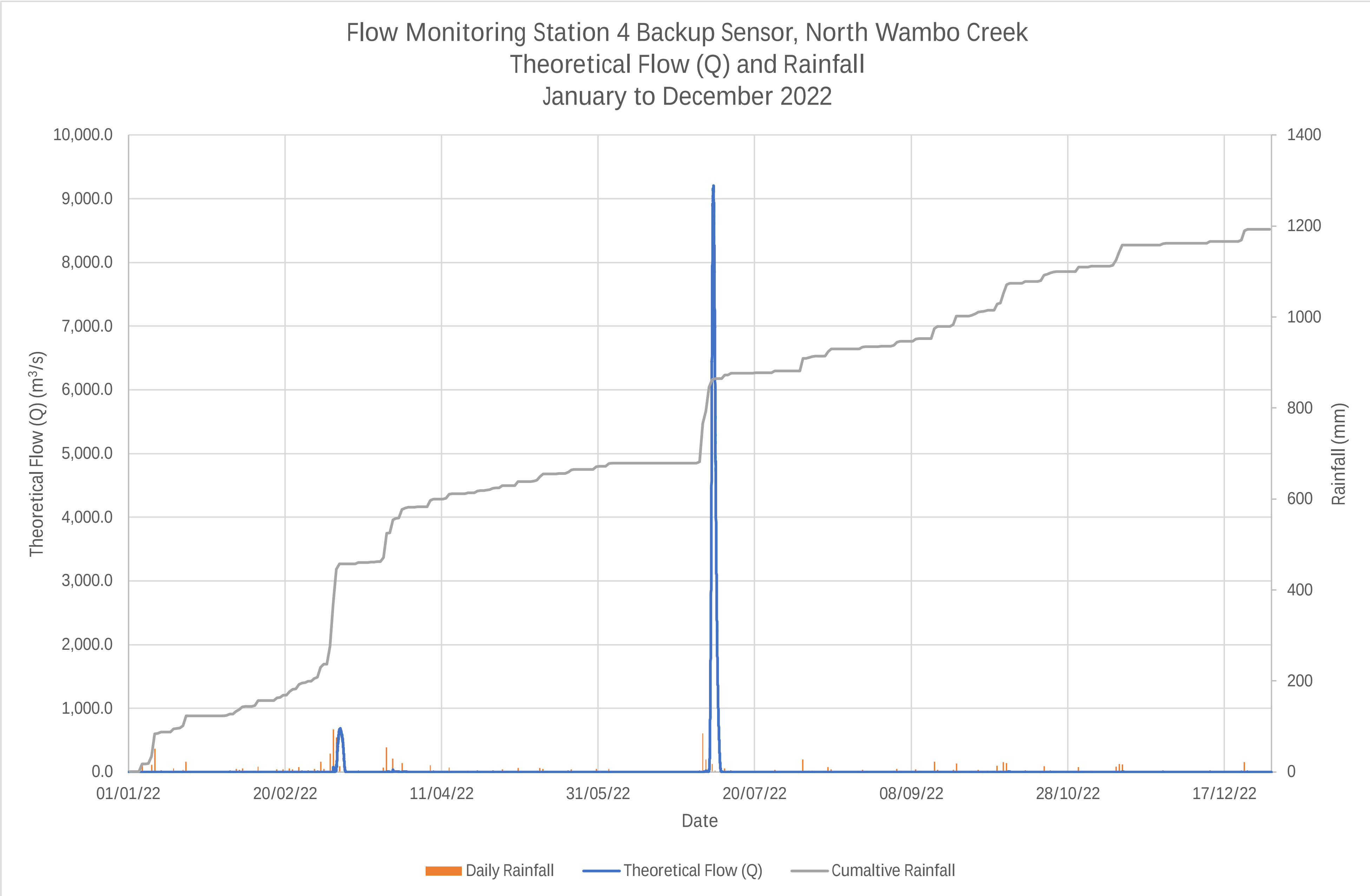


Flow Monitoring Station 4, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

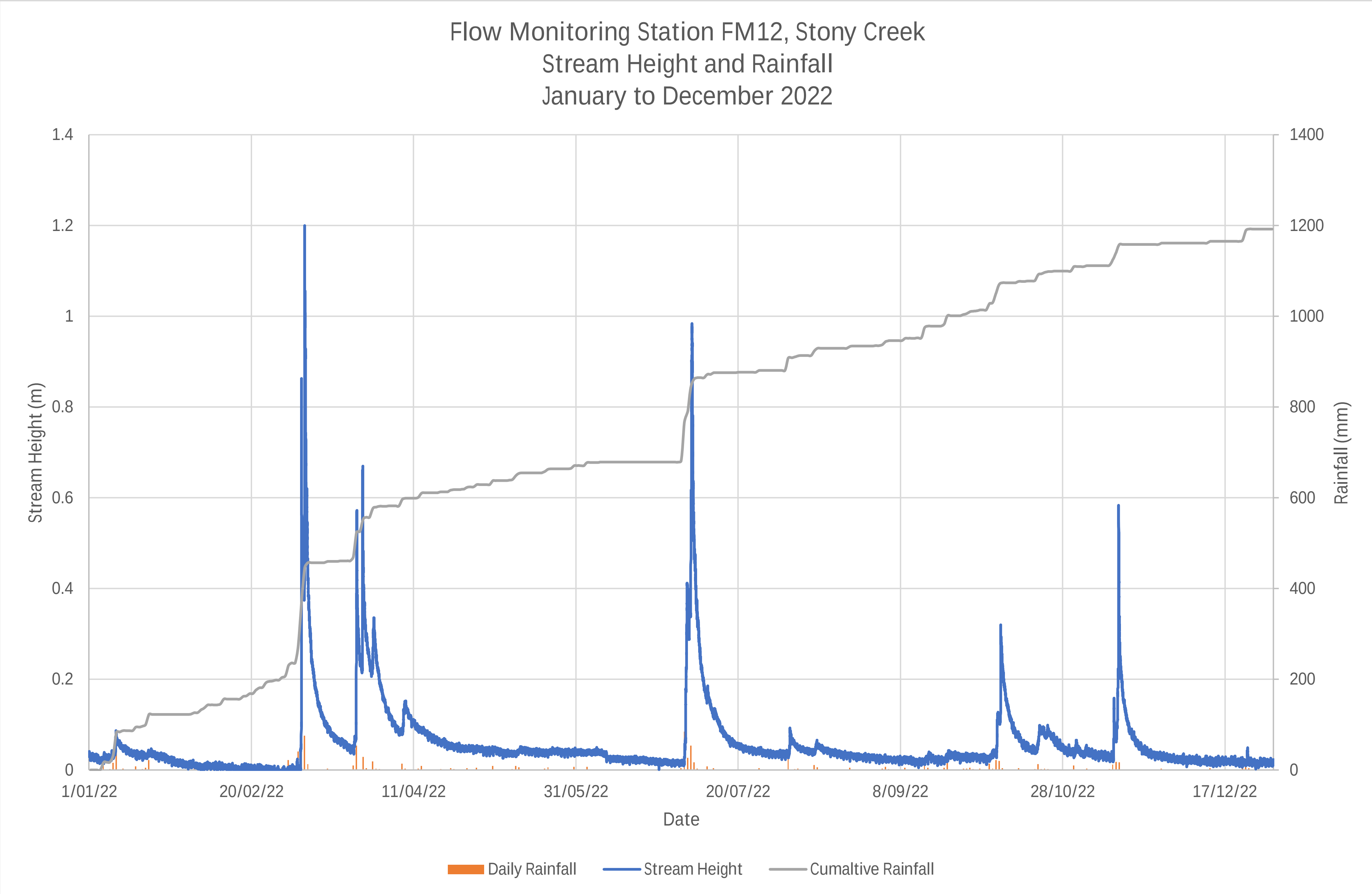


Flow Monitoring Station 4, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m3/s)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

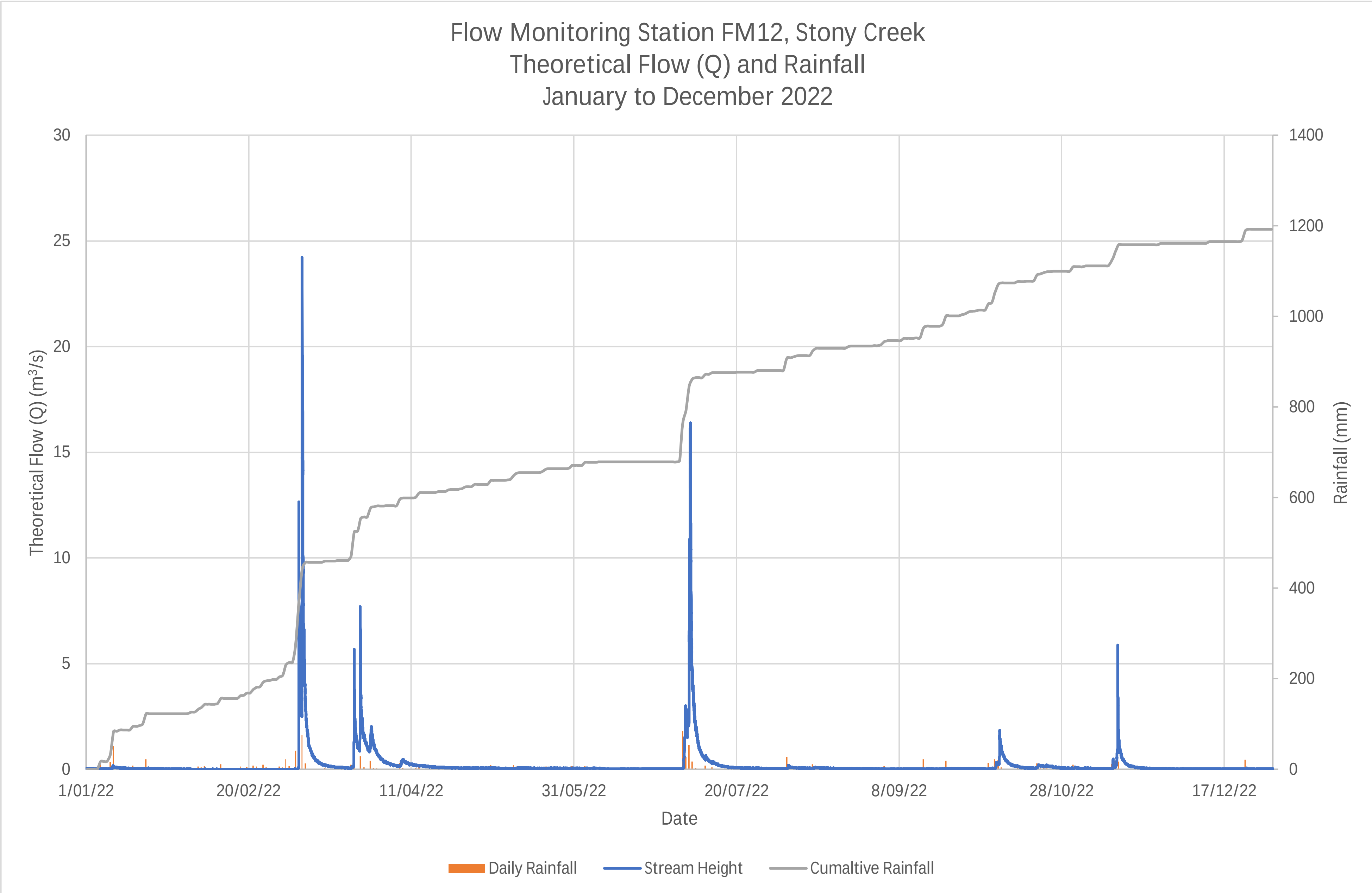

Flow Monitoring Station 4 Backup Sensor, North Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



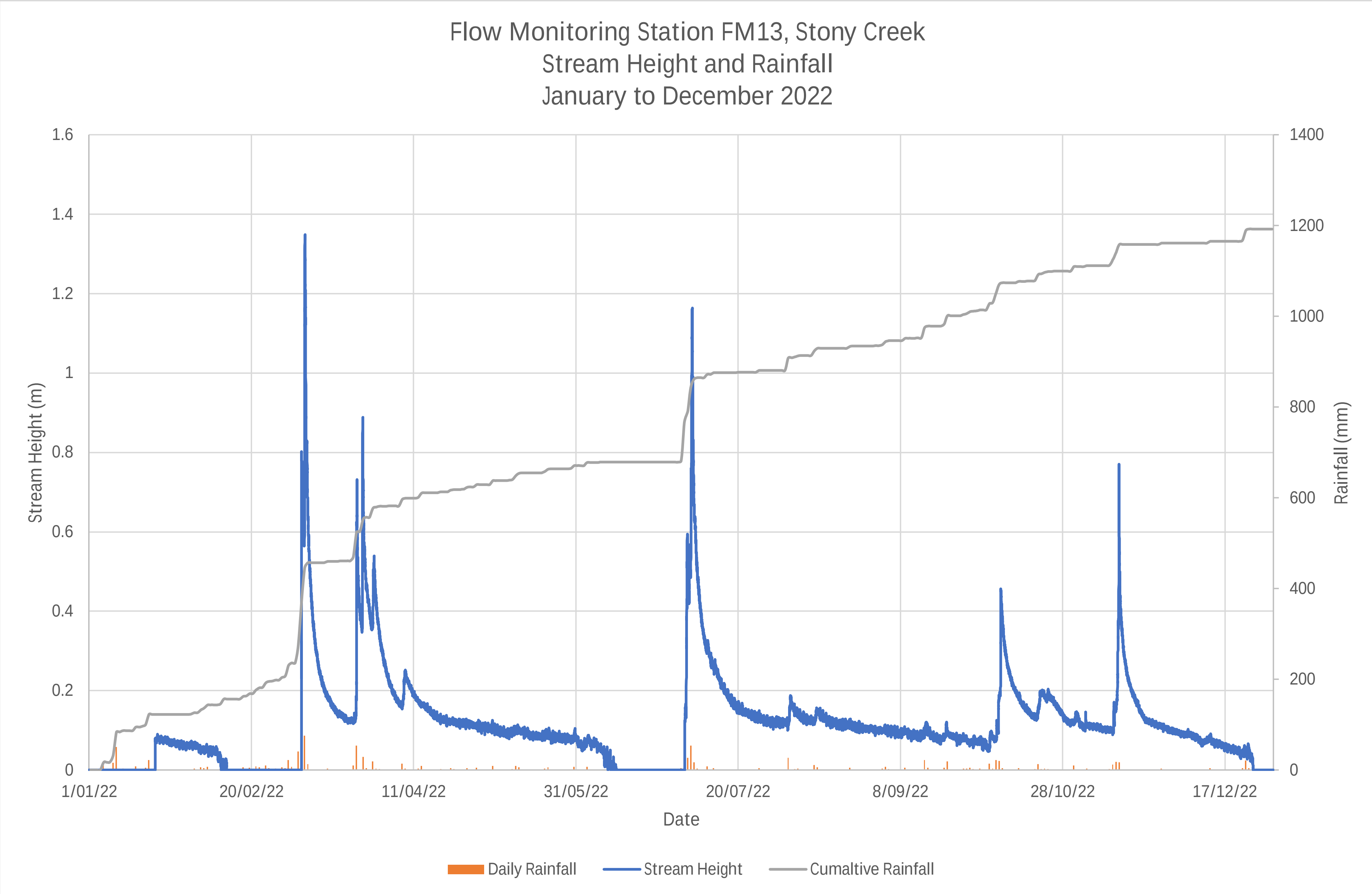
Flow Monitoring Station 4 Backup Sensor, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m3/s)
10,000.0
9,000.0
8,000.0
7,000.0
6,000.0
5,000.0
4,000.0
3,000.0
2,000.0
1,000.0
0.0
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
01/01/22
20/02/22
11/04/22
31/05/22
20/07/22
08/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall



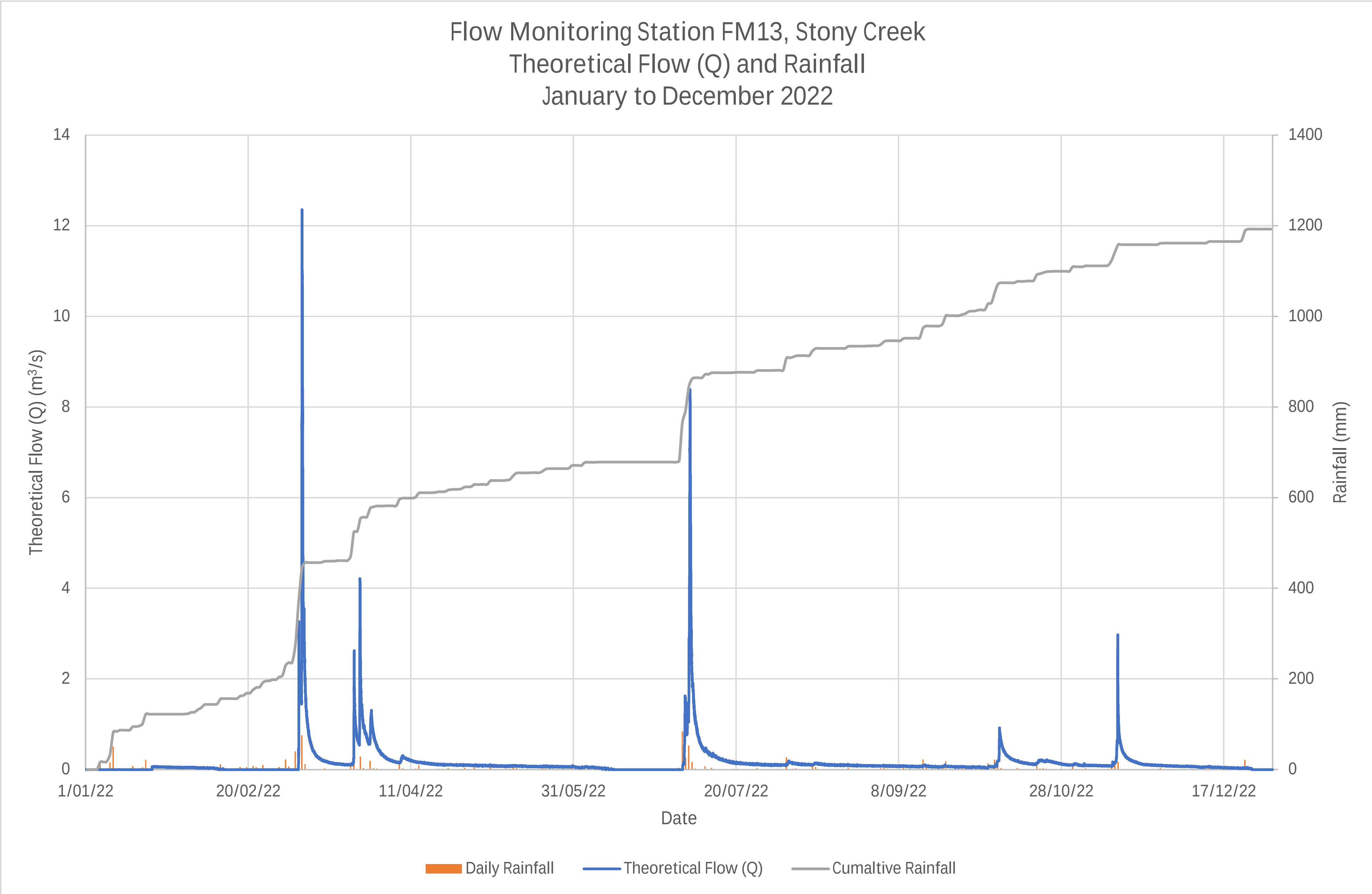
Flow Monitoring Station FM12, Stony Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



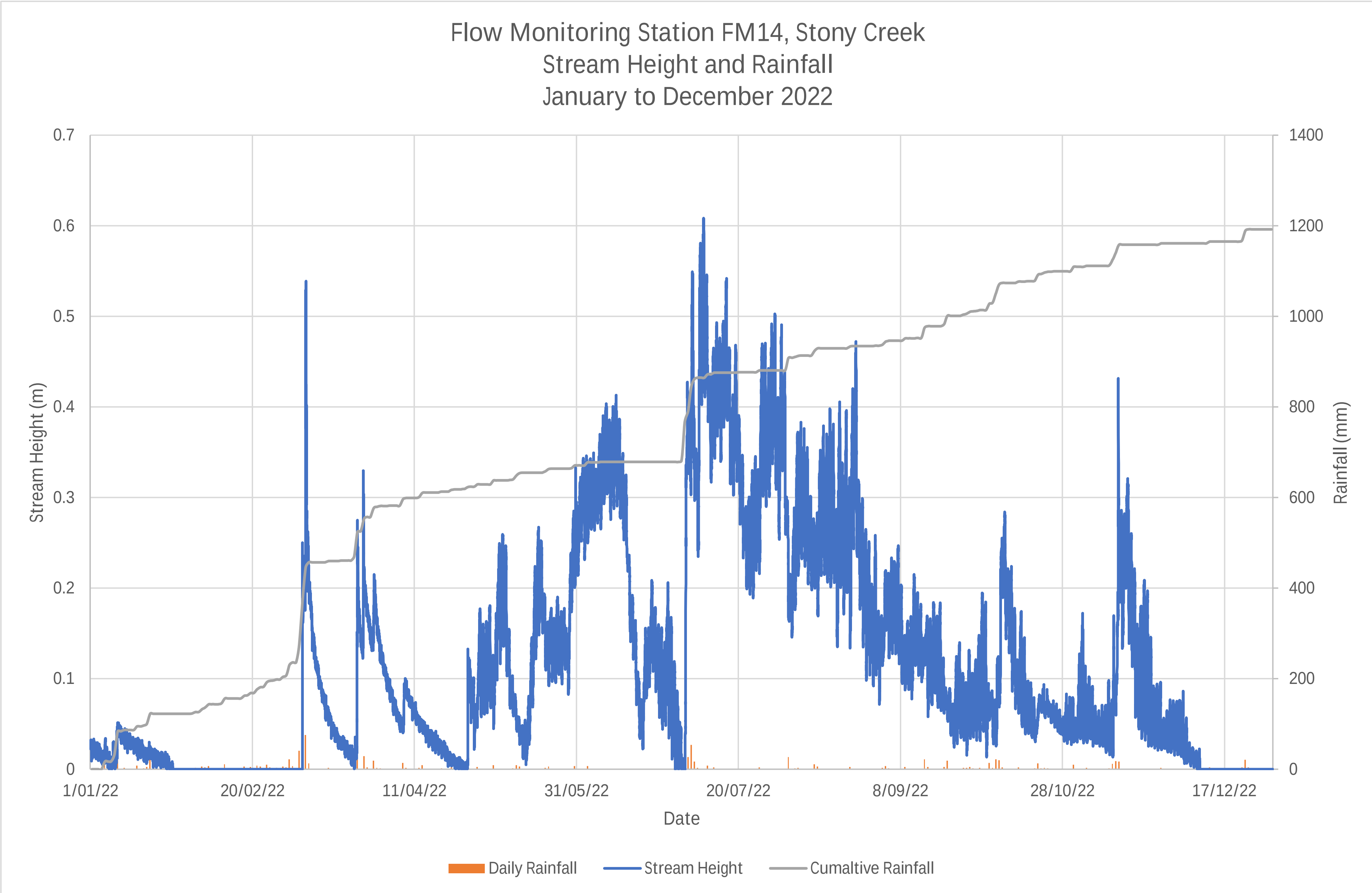
Flow Monitoring Station FM12, Stony Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m^3/s)
Rainfall (mm)
30
25
20
15
10
5
0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

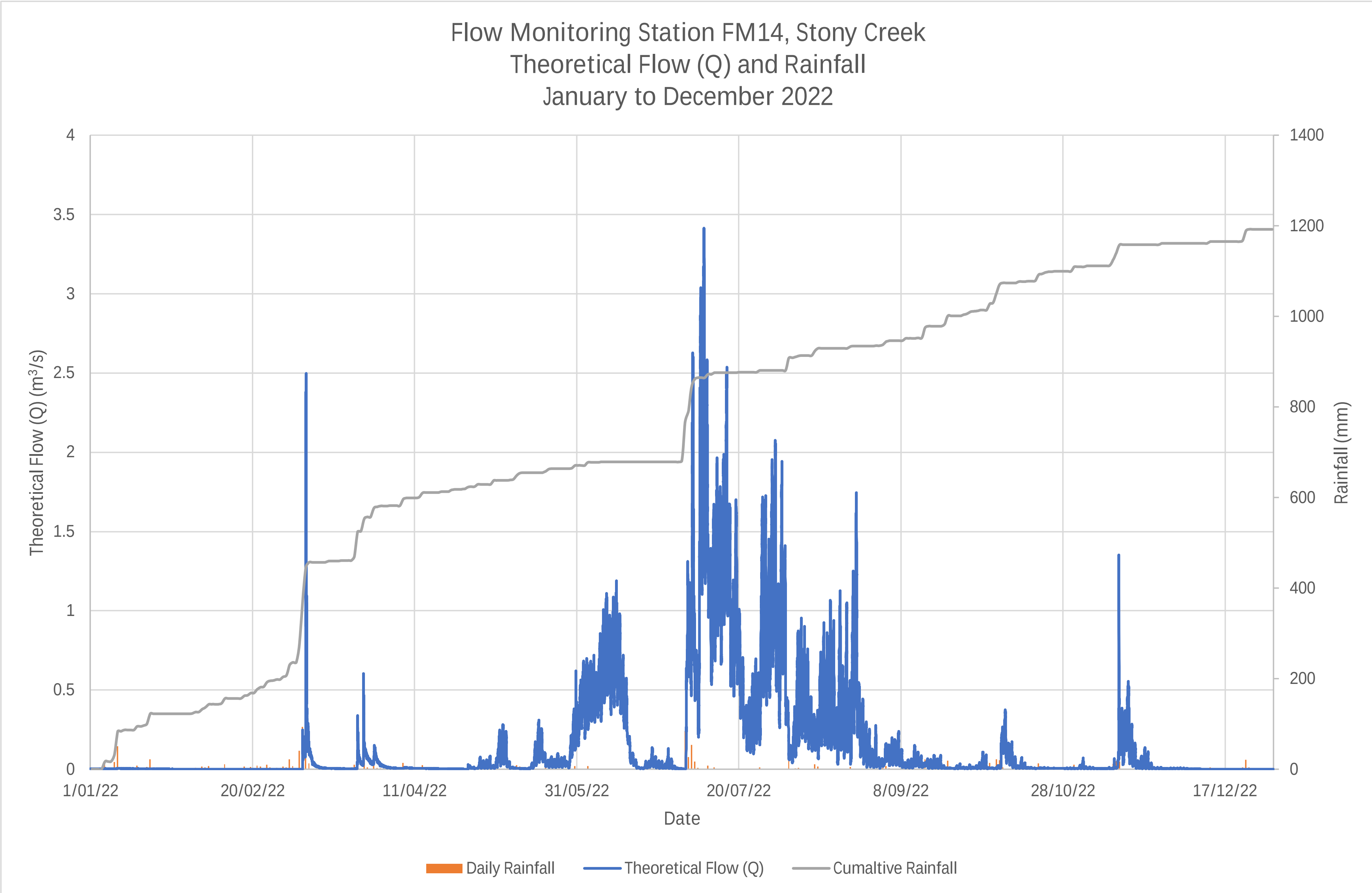


Flow Monitoring Station FM13, Stony Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

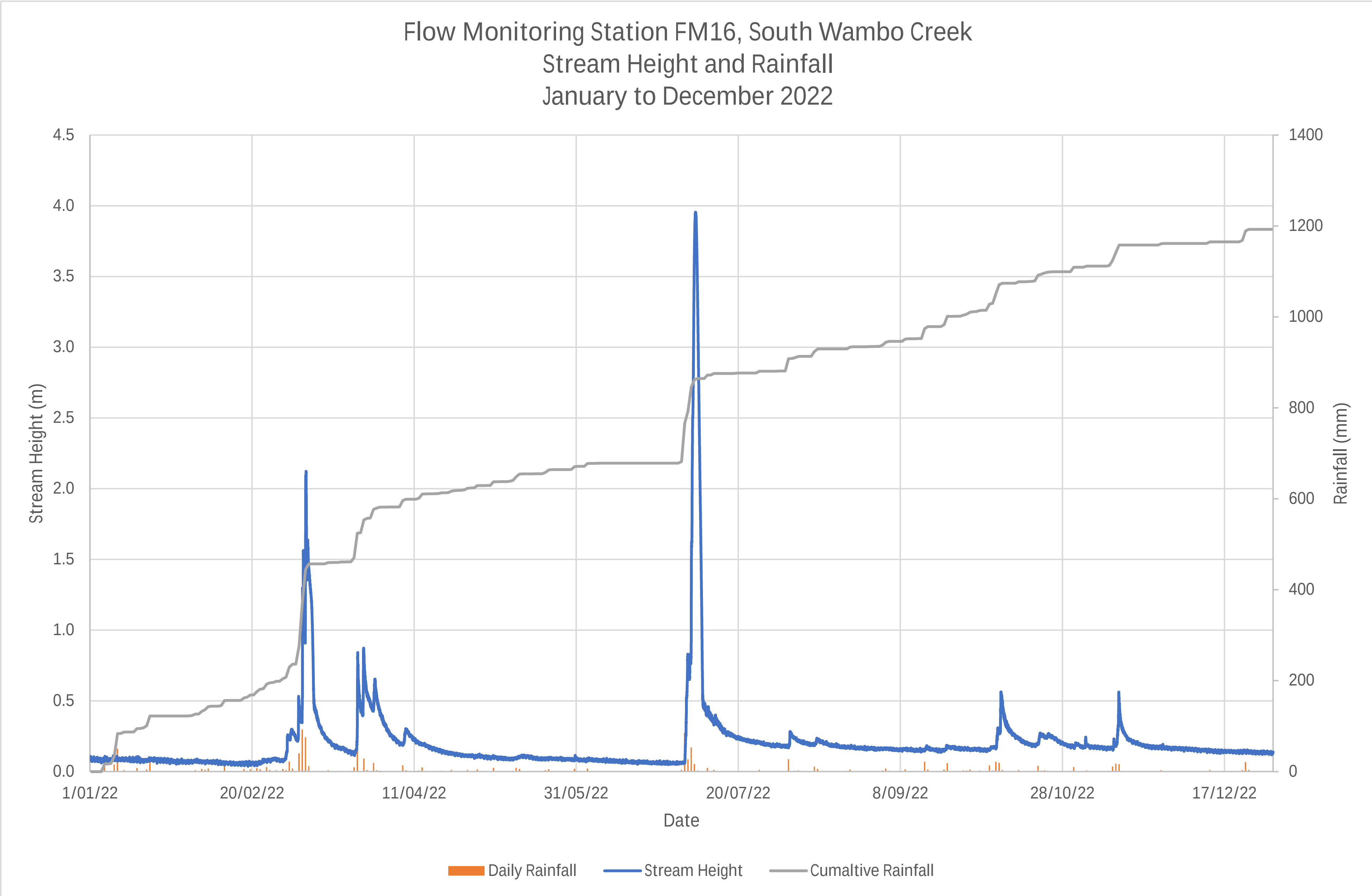


Flow Monitoring Station FM13, Stony Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m³/s)
Rainfall (mm)
14
12
10
8
6
4
2
0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

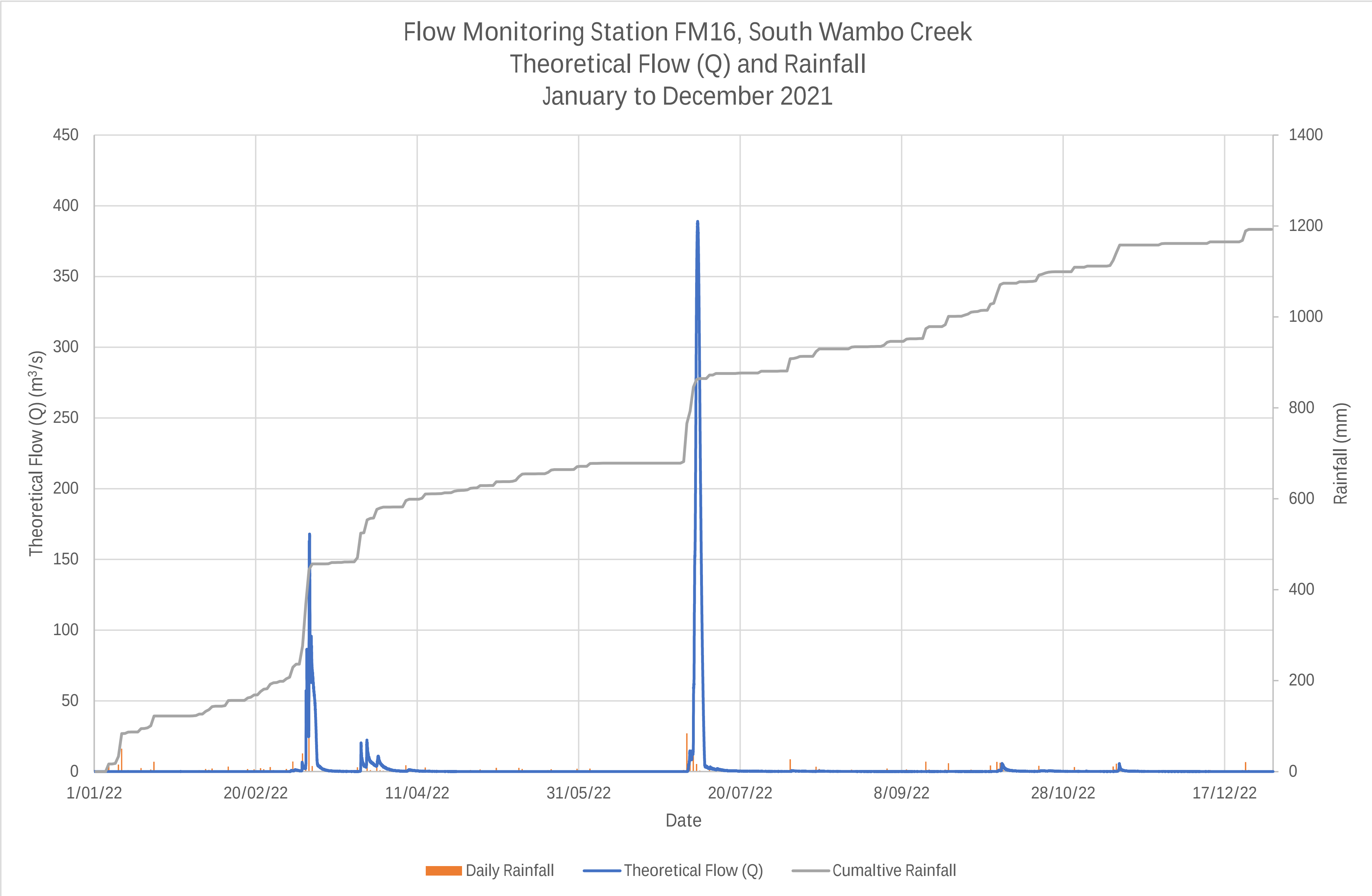

Flow Monitoring Station FM14, Stony Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall



Flow Monitoring Station FM14, Stony Creek
Theoretical Flow (Q) and Rainfall
January to December 2022
Theoretical Flow (Q) (m³/s)
Rainfall (mm)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
200
400
600
800
1000
1200
1400
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall



Flow Monitoring Station FM16, South Wambo Creek
Stream Height and Rainfall
January to December 2022
Stream Height (m)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1400
1200
1000
800
600
400
200
0
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall


Flow Monitoring Station FM16, South Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2021
Theoretical Flow (Q) (m³/s)
Rainfall (mm)
Date
0
50
100
150
200
250
300
350
400
450
0
200
400
600
800
1000
1200
1400
1/01/22
20/02/22
11/04/22
31/05/22
20/07/22
8/09/22
28/10/22
17/12/22
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

APPENDIX H

ANNUAL GROUNDWATER MONITORING REPORT

WAMBO - 2022 ANNUAL REVIEW

Groundwater

Prepared for:

Wambo Coal Pty Ltd
Peabody Energy Australia
PMB 1, Singleton NSW, 2330

SLR Ref: 665.10008.01815-R01
Version No: -v3.0
March 2023

PREPARED BY

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BASIS OF REPORT

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

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

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

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
665.10008.01815-R01-v2.0-20230329	29 March 2023	John Barlow and Gabrielle Killalea	Adam Skorulis	John Barlow
665.10008.01815-R01-v1.0-20230318	18 March 2023	John Barlow and Gabrielle Killalea	Adam Skorulis	John Barlow

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DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

1.1 Overview

The Wambo Coal Pty Ltd (WCPL) mining complex is located approximately 20 kilometres (km) north-west of Singleton, New South Wales (NSW). As part of compliance with mine approval conditions, routine groundwater monitoring is conducted across WCPL, and the data reviewed and analysed on an annual basis. This report presents the annual groundwater review for WCPL for the calendar year 2022, developed in accordance with the approval conditions and requirements outlined within the GWMP (Peabody, 2021). The annual groundwater review is required to:

1. Compare groundwater levels and quality to trigger levels. Groundwater levels are also compared to long term rainfall trends. Modelled groundwater levels are also compared to observed levels (Sections 4.1 and 4.2 of the WCPL Groundwater Management Plan (GWMP) (Peabody, 2021)).
2. Assess the volume and quality of groundwater inflow to Open Cut Pits and Underground Workings (Section 6.1.2 GWMP). Estimated inflow volumes to underground workings are also compared to model predictions.
3. Report against specific performance indicators developed for assessing groundwater impacts at North Wambo Underground (NWU), South Wambo Underground (SWU), and South Bates Extension (SBX) mine areas (Sections 4.3 and 4.4 GWMP).

1.2 Scope

This report addresses the following components of the Annual Environmental Management Review (AEMR) for WCPL for the 2022 calendar year:

1. Review hydrographs for relevant groundwater monitoring bores and VWPs and assess whether trends are due to climate variations, mining, or other influences. (**Sections 5.1 to 5.3**)
2. Assess Vibrating Wire Piezometer (VWP) data quality to assist with optimization of the monitoring network. (**Section 5.6**)
3. Assess shallow monitoring bores for compliance against the groundwater level and quality performance indicators (Tables 11 and 13 of the GWMP (Peabody, 2021)). (**Section 5.4**)
4. Assess bores against relevant groundwater performance indicators defined for MOD16, and South Bates Extension (SBX) (Tables 14, and 16 of the GWMP (Peabody, 2021)). **(Section 5.5)**
5. Assess compliance with groundwater inflow assessment criteria.
6. Address comments and recommendations from previous Annual Reviews and compliance reporting.
7. Provision of recommendations (as required).

2 Wambo Complex

The following section provides a description of the WCPL Complex relevant to this annual groundwater review. The general site layout is presented in **Figure 1**.

2.1 Mine operations

WCPL was granted development consent in February 2004 (DA 305-7-2003). The approved development described in the Project EIS and eighteen subsequent modifications extend the underground mine life until 31 August 2042. Under the most recent modification (Modification 19, determined 25 January 2023) current operations at the Wambo Mine include underground mining and coal processing and handling activities. Open cut mining activities are managed by the United Wambo Joint Venture.

Table 1 presents a summary of mine areas across WCPL, approved mining timeframes and activities conducted during 2022. Mining was only active at South Bates Extension Underground during 2022.

Table 1 Summary of WCPL Activities

Mine Area	Seam Mined To	Approved Life of Mining	2022 Activities
North Wambo Underground (NWU)	Wambo Seam	2007 to 2015	Mining complete
South Bates Underground (SBU)	Wambo Seam and Whybrow Seam	2016 to 2018	Mining complete
South Bates Extension (SBX)	Whybrow Seam	2018 to 2024[1]	Mining of SBX longwalls: LW21 through to February 2022 LW22 April 2022 through to end 2022
South Wambo Underground	Arrowfield and Bowfield Seam	To 2042	Not yet active

[1] based on current Extraction Plan approvals.

2.2 Groundwater Impacts

Groundwater impacts associated with the approved operations at WCPL have been progressively assessed for each mining area, including:

- Wambo Development Project Groundwater Impact Assessment (AGE, 2003);
- North Wambo Underground Mine Modification Groundwater Assessment (Heritage Computing, 2012);
- North Wambo Underground – Longwall 10A – Modification Assessment (HydroSimulations, 2014a);
- Wambo Coal Mine Open Cut Modification Groundwater Assessment (HydroSimulations, 2014b);
- South Bates Underground Mine Modification – Groundwater Assessment (HydroSimulations, 2015);
- South Wambo Underground Mine Modification Groundwater Assessment (HydroSimulations, 2016a):
- South Wambo Box Cut – Groundwater Assessment (HydroSimulations, 2016b);
- South Bates Extension Modification Groundwater Assessment (HydroSimulations, 2017); and
- Wambo Knowledge to inform NWC GDE Study (HydroSimulations, 2019).
- Groundwater Assessment in Support of South Bates Extension LW21-24 Extraction Plan for SBX LW21-24 EP (SLR, 2020), including an updated version of the HydroSimulations (2017a and 2019b) numerical groundwater model simulating approved mine activities.
- South Bates Extension LW24-26 Modification Groundwater Assessment (SLR, 2022b)

2.3 Groundwater Licensing

Under the *Water Act 1912* and *Water Management Act 2000*, adequate water licences are required for approval of the mine developments. Groundwater licenses held for WCPL are detailed in **Table 2**.

Table 2 WCPL Groundwater Entitlement and Licenses

Licence Number	Description	WAL Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Work Approval Expiry date
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 23897[1,2]	Well No. 2	Perpetuity	70 unit shares	Aquifer	20AL211371	20WA211372	31/07/2032
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source)							
WAL42373[1,3]	Dewatering	Perpetuity	1549 unit shares	Aquifer	20AL219997	20MW065010	-
WAL41532 [1,2]	Dewatering	Perpetuity	98 unit shares	Aquifer	20AL218994	20MW065010	-

1. WAL = water access licence, ML/year = megalitres per year.
2. Former licence number: For WAL 23897 = 20BL167737, WAL41532 = 20BL172156
3. 6 x WALs consolidated on 20/12/18

2.4 Groundwater Conditions

In accordance with the development consent approval requirements of DA305-7-2003 (as modified) and various groundwater licences, WCPL are required to prepare and implement a Groundwater Management Plan (GWMP). **Table 3** presents a summary of the relevant groundwater conditions from the development consent and Version 2 of the GWMP (Peabody, 2021) approved on December 2021.

Table 3 DA305-7-2003 Requirements for the GWMP

Condition	Condition Details	GWMP Section
B66	(v) Groundwater Management Plan, which is consistent with Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities (DPI Water, 2014) and includes:	Entire Document
	detailed baseline data of groundwater levels, yield quality for groundwater resources and groundwater dependent ecosystems potentially impacted by the development, including groundwater supply for other water users;	Section 3.4
	a detailed description of the groundwater management system;	Section 5.1
	groundwater performance criteria including trigger levels for identifying and investigating any potentially adverse groundwater impacts associated with the development, on: • Regional and local aquifers (alluvial and hard rock); • Groundwater supply for other water users such as privately-owned licensed groundwater bores; and • Groundwater dependent ecosystems	Section 4.0
	program to monitor and evaluate: • compliance with the relevant performance measures listed in Table 8, and the performance criteria established above, including monitoring of regional groundwater levels and quality during the life of the development and at least 10 years post-mining; • water loss/seepage from water storages into the groundwater system (particularly from South Wambo Dam and Montrose East Dam); • groundwater inflows, outflows, and storage volumes to inform the Site Water Balance; • any hydraulic connectivity between the alluvial and hard-rock aquifers; • impacts on groundwater dependent ecosystems; • impacts on groundwater supply for other water users; and • the effectiveness of the groundwater management systems;	Sections 6.0 and 9.2
	reporting procedures for the results of the monitoring program;	Section 9.2
	a plan to respond to any exceedances of the groundwater performance criteria, and repair, mitigate, compensate and/or offset any adverse groundwater impacts of the development; and	Section 7.0
	a program to periodically validate the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and	Sections 5.3 and 9.1.2
D5	**Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include where relevant: Section 2.1	Section 2.1
	(a) summary of relevant background or baseline data;	Section 2.4
	(b) details of:	Section 2.0 / Section 4.0

Condition	Condition Details	GWMP Section
	• the relevant statutory requirements (including any relevant approval, licence, or lease conditions); • any relevant limits or performance measures and criteria; • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Section 2.0
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Sections 5.0 and 6.0
	(e) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures set out pursuant to paragraph (d)	Monitoring – Section 6.0 Reporting - Section 9.0
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 7.0
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 9.0
	(h) a protocol for managing and reporting any: • incident, non-compliance or exceedance of any impact assessment criterion and performance criterion; • complaint; or • failure to comply with other statutory requirements; and	Managing – Section 7.0 Reporting – Section 9.0 / Section 8.0 / Section 7.4
	(i) a protocol for periodic review of the plan.	Section 9.1.3

Groundwater monitoring is conducted in accordance with the United Wambo and Wambo Water Monitoring Program (WMonProg), a component of the WCPL Water Management Plan. The program outlines groundwater monitoring frequency, parameters to be tested, as well as groundwater triggers for electrical conductivity (EC) and pH. The WMonProg and GWMP were approved in December 2021, including updates and upgrades to the monitoring network, and development of performance indicators for alluvial aquifers and GDE's. This annual review is based upon the monitoring and reporting requirements documented within the December 2021 version of the GWMP. Further discussion on the groundwater monitoring program and triggers is included in **Section 4**.

3 Hydrogeological Setting

This section presents a brief summary of the hydrogeological setting for WCPL. This includes discussion on climate, terrain, drainage, geology, and groundwater bearing units.

3.1 Climate, Terrain, and Drainage

3.1.1 Climate

The climate of the Wambo region is temperate and characterised by hot summers and mild dry winters. Rainfall data is available from the Bureau of Meteorology (BoM), Bulga-South Wambo Station (Station: 0611191), and the Scientific Information for Landowners (SILO) database. The SILO database provides the most complete long-term dataset and is therefore useful for assessing long term rainfall trends. **Table 4** provides the long term historical monthly average rainfall for WCPL and the 2022 monthly rainfall data. From the SILO dataset, the long-term average annual rainfall is 640.7 mm. In 2022, the total rainfall was 1108.3 mm indicating that the year was very wet compared to average, with the substantial majority of the excess rainfall falling in March and July. The Wambo weather station recorded 1163.5 mm of rain in 2022, approximately 5% more than the SILO dataset for the site in 2022.

Table 4 Long Term Average and 2022 Climate Data

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Historical[1]	76.6	75.0	64.7	46.3	37.8	46.6	39.0	34.2	39.9	50.2	60.5	69.9	**640.7**
2022 Rainfall	64.4	69.8	305.7	33.5	54.4	8.5	192.3	67.3	69.5	110.3	113.1	19.5	**1108.3**
Excess/deficit	-12.2	-5.2	241	-12.8	16.6	-38.1	153.3	33.1	29.6	60.1	52.6	-50.4	**467.6**

[1] Based on SILO dataset January 1900 to December 2022

The cumulative rainfall departure (CRD) (**Figure 1**) graphically shows the rainfall trend relative to the long-term average. A positive (upward) slope in the CRD indicates periods of above average rainfall, while a negative (downward) slope indicates periods of below average rainfall. The CRD shows that since the start of 2020 rainfall has been significantly above average. The wet conditions recorded in 2022 continued the widespread recovery from the 2017-2020 drought event. The CRD also shows a prolonged period of above average rainfall from late 2007 to the end of 2016.

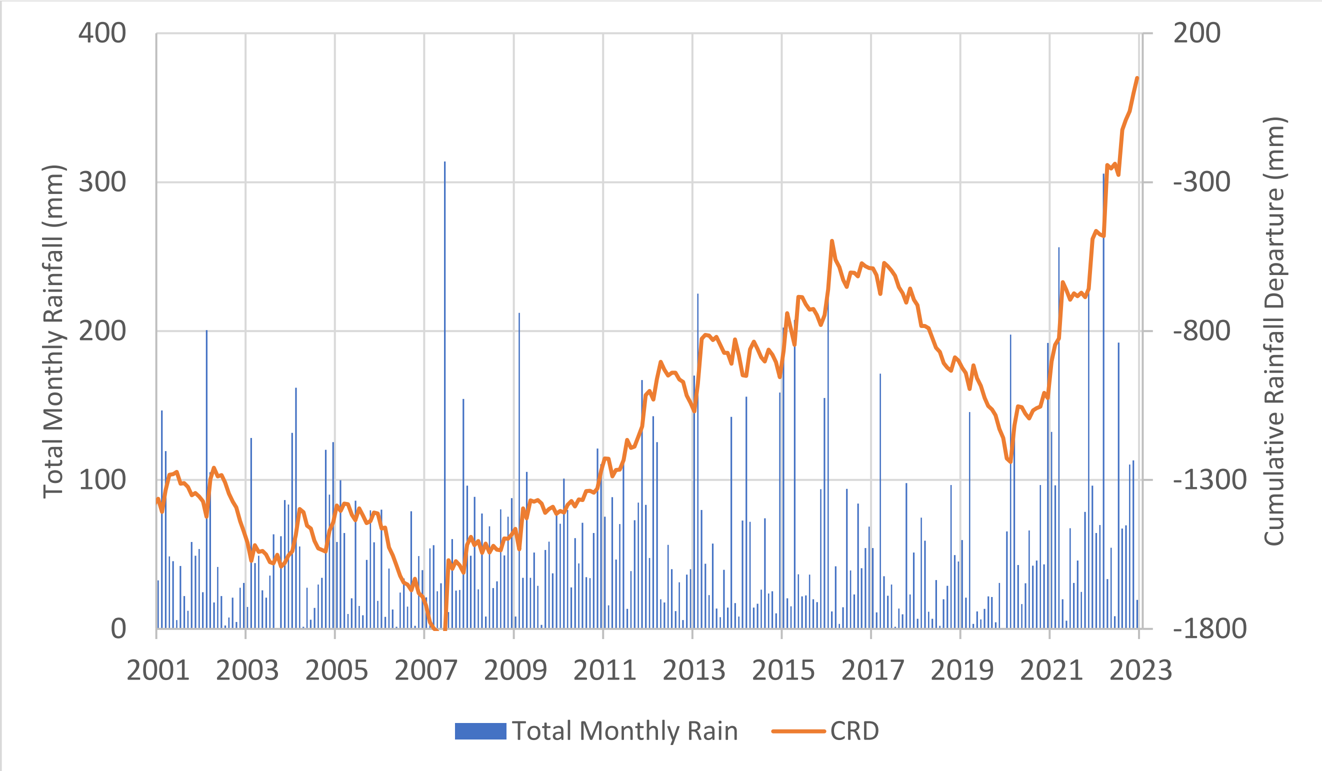


Figure 1 Monthly Rainfall and CRD

3.1.2 Terrain and Drainage

WCPL is located in the Upper Hunter Valley region where landforms are characterised by gently sloping floodplains associated with the Hunter River and the undulating foothills, ridges and escarpments of the Mount Royal Range and Great Dividing Range. Elevations in the vicinity of WCPL range from approximately 60 metres Australian Height Datum (mAHD) at Wollombi Brook to approximately 400 mAHD on the nearest ridges of the hills immediately to the south west of WCPL.

Wollombi Brook, situated immediately south-west of WCPL, flows north-east to its confluence with the Hunter River (**Figure 1**). Wollombi Brook drains an area of approximately 1,950 square kilometres (km^2) and joins the Hunter River some 4 km east of Wambo. The Wollombi Brook sub-catchment is bound by the Myall Range to the south-east, Doyles Range to the west, the Hunter Range to the south-west and Broken Back Range to the north-east (Hunter Catchment Management Trust, 2002).

The majority of lands within WCPL mining tenements drain via Wambo, Stony, North Wambo and Redbank Creeks to Wollombi Brook, while Waterfall Creek drains to the north-east directly to the Hunter River. These watercourses are generally characterised by ephemeral and semi-perennial flow regimes (Gilbert and Associates, 2003).

3.2 Geology

WCPL is situated within the Hunter Coalfield subdivision of the Sydney Basin, which forms the southern part of the Sydney-Gunnedah-Bowen Basin. The stratigraphy in the Wambo area comprises the Triassic Narrabeen Group, Permian coal measures, and more recent (Quaternary) alluvial deposits associated with major drainage pathways. Folding, faulting and igneous intrusions have affected the Permian sediments after deposition. The target Seams for WCPL underground mining lie within the Jerrys Plains Subgroup of the Wittingham Coal Measures.

Along the Wollombi Brook, Wambo Creek, North Wambo Creek (NWC), and Stony Creek thin Quaternary alluvial deposits unconformably overlie the Permian strata. The alluvial deposits comprise surficial fine-grained sediments (i.e. sands, silts, and clays). Along major watercourses (i.e. Wollombi Brook) the surficial sediments overly basal sands and gravels that are between 7 m to 20 m thick. **Table 5** presents a summary of site geology.

Table 5 Wambo Generalised Stratigraphy

Age	Stratigraphic Unit		Description
Cainozoic	Quaternary sediments - alluvium (Qa)	Surficial alluvium (Qhb)	Shallow sequences of clay, silty sand, and sand.
		Productive basal sands/gravel (Qha)	Basal sands and gravels along major watercourses (i.e. Hunter River).
	Silicified weathering profile (Czas)		Silcrete
	Alluvial terraces (Cza)		Silt, sand, and gravel
Jurassic	Volcanics (Jv)		Flows, sills, and dykes
Permian	Whittingham Coal Measures	Jerrys Plains Sub-group (Pswj)	Coal bearing sequences interbedded with sandstone and siltstone. Coal seams (youngest to oldest) include Whybrow Seam, Redbank Creek Seam, Wambo Seam, Whynot Seam, Blakefield Seam, Glen Munro Seam, Woodlands Hill Seam, Arrowfield Seam, Bowfield Seam, Warkworth Seam, Mt Arthur Seam, Piercefield Seam, Vaux Seam, Broonie Seam and Bayswater Seam.

3.2.1 Groundwater Units

The hydrogeological regime of the Wambo area and surrounds comprises two main systems:

- Quaternary alluvial aquifers associated with Wollombi Brook, NWC, Wambo Creek, and Stony Creek; and
- Underlying Permian strata of generally low permeability and very low yielding sandstone and lesser siltstone, with low to moderately permeable coal seams which are the prime water-bearing strata within the Permian coal measures. Triassic strata, namely the Narrabeen Group, are present to the south-west of the North Wambo Underground Mine and underlie some areas of alluvium.

3.2.2 Alluvium

Groundwater flow within the shallow alluvial aquifers reflects local topography and the containment of alluvium within the low-lying drainage pathways. Evidence from temporal groundwater monitoring hydrographs (**Appendix B**) within the alluvium indicates that the shallow aquifer is responsive to rainfall recharge, and it is likely that the alluvium plays an important role in supplying recharge to the underlying Permian strata as well as, in places, contributing to baseflow of the perennial surface water features. In some areas upward or lateral flow may occur from the Permian and Triassic rock, but downward leakage seems to be the more common behaviour.

3.2.3 Permian Coal Measures

Prior to the commencement of mining operations in the region, the piezometric surface across the Wambo area most probably reflected the topography, with elevated water levels/pressures in areas distant from the major drainages and reduced levels in areas adjacent to the alluvial lands. Historical and ongoing open cut and underground mining within the Wambo area and adjoining mining operations have significantly altered the natural regime with a regional zone of depressurisation within the Permian coal measures.

The inter/overburden sediments have low permeability which is primarily is related to secondary porosity i.e. fracture / joint spacing and aperture. Permeability of the rock units generally decreases with depth of burial as the joints tighten and become less frequent.

The permeability of the coal measures is generally low, with rock mass permeabilities typically more than two orders of magnitude lower than the unconsolidated alluvial aquifers. The most permeable horizons are the coal seams, which commonly have hydraulic conductivity one to three orders of magnitude higher than the interburden comprising mudstones, siltstones, shales, and sandstone units.

The coal seams are generally more brittle and therefore more densely fractured than the overburden and interburden strata, which causes the higher permeability. Within the coal seams, groundwater flows predominantly through cleat fractures, although there is some evidence of structure-related fracturing, and this may play an important role in groundwater flow paths.

The impact of fault structures such as the Redmanvale Fault is not known with certainty. However, it is likely that groundwater flow dynamics are complex in the vicinity of these structures.

4 Groundwater Monitoring

4.1 Groundwater Monitoring Program

Groundwater monitoring is conducted at WCPL in accordance with the GWMP (Peabody, 2021). The purpose of the GWMP is to monitor and manage groundwater quality and levels to detect potential impacts on surrounding groundwater users, assess the performance of the mine against the performance indicators, and to ensure that relevant legislative and policy requirements are met.

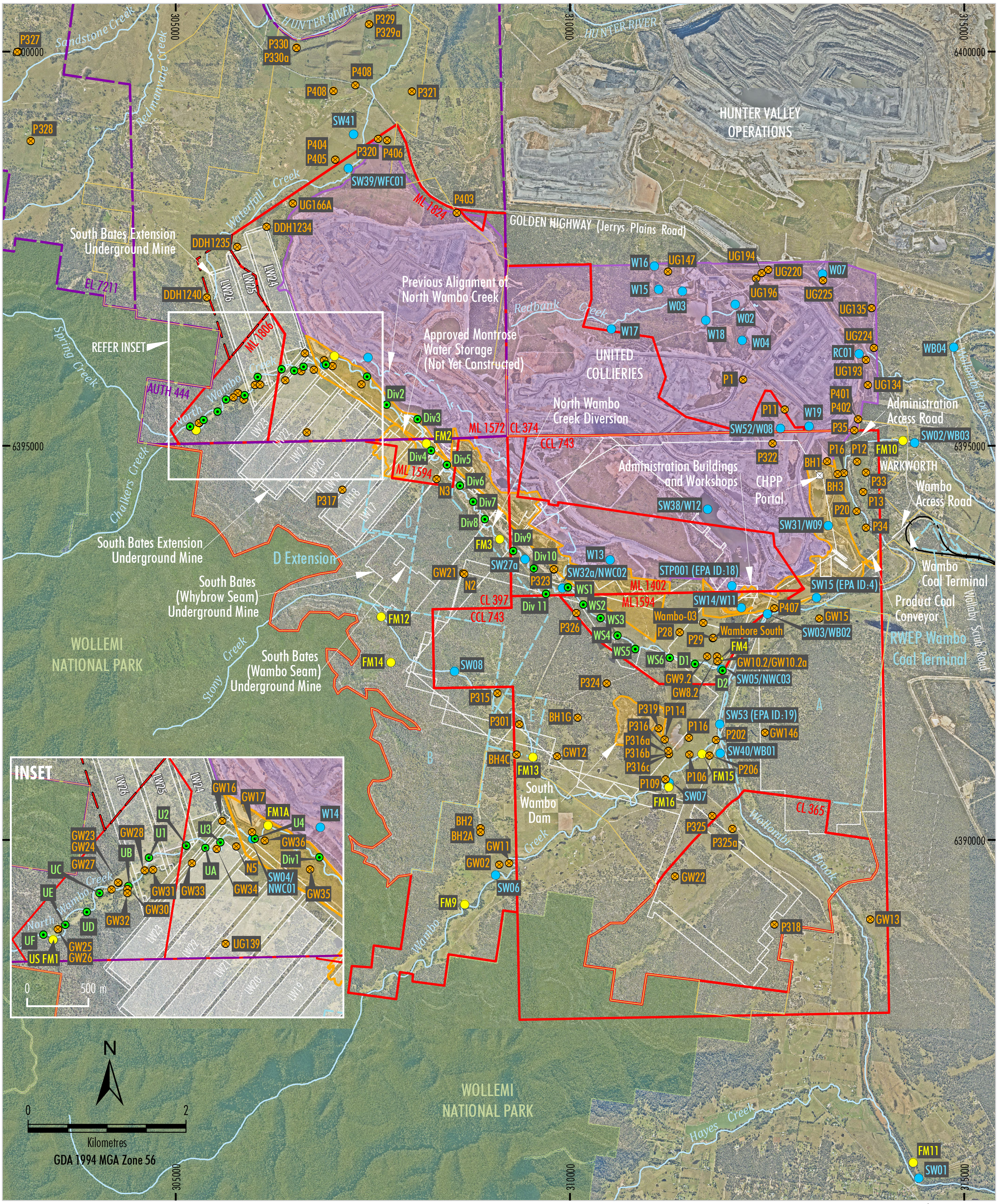
The overall objective of the GWMP is to establish a program of data collection that can be utilised to assess potential impacts of mining activities on local groundwater resources. Groundwater levels are compared to background data, EIS predictions, and historical trends as a means of assessing any WCPL related drawdown impacts to local aquifers.

Ongoing groundwater monitoring requirements at WCPL are as follows:

- Groundwater monitoring above and in close proximity to mine workings;
- Monitoring of potential groundwater leakage from alluvial aquifers;
- Monitoring of groundwater inflows to underground and open cut mining operations; and

The monitoring programme at WCPL also assesses the quality of groundwater against background data and historical trends. Bi-monthly monitoring of groundwater levels, pH, and EC is undertaken at all standpipe bores included in the groundwater monitoring program. Comprehensive analysis of major ions is conducted at each standpipe bore annually.

Standpipe and vibrating wire piezometers within the current WCPL monitoring network are tabulated in **Appendix D** and shown on **Figure 2**.



Source: WCPL (2022); NSW Spatial Services (2022)
Orthophoto Mosaic: WCPL (May, Nov 2022)

LEGEND

National Park
SSD 7142 Operational Area #
WCPL Owned Land

Wambo Coal Mine
Exploration Licence Boundary (AUTH, EL)
Mining and Coal Lease Boundary (ML, CL, CCL)
Proposed Mining Lease Application Area
Remnant Woodland Enhancement Program (RWEP) Area
Existing/Approved Wambo Coal Mine Surface Development Area
Approved Underground Mining Area

Monitoring Sites
Groundwater Monitoring Site
Surface Water Flow Monitoring Site
Surface Water Quality Monitoring Site
Diversion and Subsidence Monitoring Site

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Colleries Pty Ltd under the United Wambo Joint Venture Project.

Peabody

WAMBO COAL MINE

Location of Surface Water and Groundwater Monitoring Sites

FIGURE 2

4.2 Groundwater Monitoring Compliance Criteria

The annual groundwater monitoring data review is undertaken with reference to specific compliance criteria (trigger levels - **Table 6**), and an assessment of the data against specific performance criteria set out in groundwater (**Table 7** and **Table 8**).

4.2.1 Groundwater Trigger Levels

Trigger levels are used to initiate investigations into shallow (primarily alluvium) groundwater levels or groundwater quality at WCPL when they stray beyond anticipated bounds. The trigger levels specified in the WCPL Groundwater Monitoring Program (Peabody 2020), are based on statistical analysis of pre-mining (i.e. baseline) monitoring data.

Trigger levels for groundwater level, EC and pH are presented in **Table 6**. The trigger for groundwater levels and pH occurs when two consecutive bi-monthly observations exceed or fall below the maximum / minimum trigger levels. Triggers for EC occur when three consecutive bi-monthly observations (a 6-month period) exceed the specified trigger value.

As per the GWMP, several the bores (presented in Table 12 of the GWMP) are no longer assessed against groundwater trigger levels, namely: P106, P114, P116, P202, P206, P301, GW02, GW11, GW12, and GW13. Detailed justification for this is provided in Table 12 of the GWMP (Peabody, 2021).

Trigger exceedances and analysis for the 2022 monitoring period are presented in **Section 5.4.**

Table 6 Groundwater Level and Groundwater Quality Trigger Levels (Peabody, 2021)

Bore	Monitoring Area	Lithology	Groundwater Level (mAHD)		Groundwater Quality		
			Maximum (10th %ile level)	Minimum (90th %ile level)	EC (µS/cm)	pH Min	pH Max
P301	Stony Creek	Alluvium	N/A	N/A	9200	6.1	7.2
P315[1]	Stony Creek	Shallow Permian	N/A	N/A	552	6.0	7.4
GW08.2[2]	NWC (downstream)	Alluvium	ND	ND	ND	ND	ND
GW09.2[2]	NWC (downstream)	Alluvium	ND	ND	ND	ND	ND
GW10.2[2]	NWC (downstream)	Alluvium	ND	ND	ND	ND	ND
P109[3]	South Wambo Creek	Alluvium	57.8	55.7	695	6.5	7.6
GW15	Wollombi Brook	Shallow Permian	52.0	51.3	730	6.7	7.2
P16	Wollombi Brook	Alluvium	50.4	49.7	10832	7.0	7.7
P20	Wollombi Brook	Alluvium	50.3	49.2	10625	7.0	7.6

N/A = Not applicable
ND = Not defined, due to Insufficient data at present
[1]P315 was dry prior to NWU mining activity. Therefore, a specific depth to water trigger is not appropriate to indicate Wambo mining impacts. Data will be reviewed as part of the Annual Review to determine whether there are changes in groundwater level that can be attributed to Wambo mining activity.
[2]GW08.2, GW09.2 and GW10.2 have been installed as replacement bores to GW08 and GW09. Establishing trigger levels for these bores will be considered following the collection of baseline data and also informed by model predictions.
[3] Monitoring has ceased at this location and has not been assessed against trigger levels in 2022. Monitoring will recommence once replacement bores are constructed in 2023.

4.2.2 Groundwater Performance Criteria

The current GWMP, published in December 2021 (Peabody, 2021) includes three sets of performance indicators relevant to groundwater (**Table 7** and **Table 8**), the first set are performance indicators relevant to general water management performance (GWMP – Table 14). The second and third sets are specific performance indicators to monitor the subsidence impact for North Wambo Underground (GWMP – Table 15) and South Bates Underground and Extension longwalls (GWMP – Table 16) respectively.

It is noted that North Wambo Underground Mine completed operations with the extraction of Longwall 8b on 30 January 2016, with underground infrastructure removed and entries sealed in 2017. As a result, the NWU extraction plan is no longer current and has been superseded by the South Bates Underground Extraction Plan. Table 15 has been updated from the previous GWMP (Peabody, 2020) to indicate where the relevant performance indicators are now assessed, and which are no longer relevant and only performance indicators relevant to this annual review are considered.

An assessment of compliance with performance indicators relevant to groundwater (**Table 7** and **Table 8**) is presented in **Section 5.5**.

Table 7 Performance Indicators

Feature	Performance Indicator
Groundwater Management Performance Indicators	
Alluvial aquifers (including Wollombi Brook alluvium and excluding the NWC alluvium)	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: A greater than negligible change in groundwater levels; A greater than negligible change in groundwater quality; and A greater than negligible impact to other groundwater users.
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c); and Channel stability is not maintained or improved

Table 8 Subsidence Performance Indicators for Groundwater

North Wambo Underground Performance Indicators
- The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergences away from the modelled groundwater.
South Bates Underground and South Bates Extension Underground Performance Indicators
- The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (Table 11 of the GWMP). - The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (Table 13 of the GWMP). - The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.

5 Monitoring Results

A summary of the groundwater level data for each of the main water bearing units is provided below together with a review of electrical conductivity (EC) and pH (see **Appendix B** for plots). Performance against trigger levels prescribed in the GWMP (Peabody, 2021), is presented in Section 5.4.

Data from monitoring bores at key sites has been reviewed to identify potential impact:

- Alluvium (**Section 5.1**);
- Regolith – Weathered Shallow Strata (**Section 5.2**);
- Permian Coal Measures (**Section 5.3**).

5.1 Alluvium

Table 9 summarises groundwater level and quality trends for Wambo alluvial monitoring locations.

Table 9 2022 alluvial groundwater trends

Alluvial Aquifer	Reach/ Area	Monitoring bores	2022 Groundwater Trends	Comment
Wambo Creek Alluvium	Upstream	GW02, GW11	Above average rainfall in 2022 has led to recovery and increasing groundwater levels within the Wambo Creek Alluvium bores. Reduced EC and pH has been widely observed as a response to this increased rainfall/recharge.	Limited access to bores due to flooding during monitoring period.
	Downstream	P106, P316a		P106 has an obstruction. P109 is screened across multiple aquifers. A single, paired replacement site for both bores scheduled for install in 2023 as previously recommended.
North Wambo Creek Alluvium	Upstream	GW23, GW25, GW27	Above average rainfall in 2022 has led to recovery and increasing groundwater levels within the North Wambo Creek Alluvium bores. Reduced EC and pH has been widely observed as a response to this increased rainfall/recharge.	GW27 destroyed in flooding between Feb-April 2022 monitoring rounds
	Central Upper	GW28, GW30, GW32, GW33, GW35, GW36a,		GW28 destroyed in flooding between Feb-April 2022 monitoring rounds
	Downstream	GW08.2, GW09.2, GW10.2		GW10.2 flagged as damaged in Dec 2022 – bore should be inspected.

Alluvial Aquifer	Reach/ Area	Monitoring bores	2022 Groundwater Trends	Comment
Wollombi Brook Alluvium		P16, P20, GW15 and P325a	Above average rainfall in 2022 has led to recovery and increased groundwater levels within a number of the Wollombi Brook Alluvium bores. Observations were above min depth to water trigger levels at GW15, P16 and P20. GW15 exceeded the min depth to water trigger level with further detail in **Section 5.4**.	Flooding has led to limited access and missed monitoring periods in 2022.
Stony Creek Alluvium/ Colluvium		P315 and P301	A clear relationship between groundwater levels and rainfall exists at Stony Creek due to the steep and narrow catchment area. Above average rainfall in 2022 saw significant recovery/increasing groundwater levels. Reduced EC and pH has been observed in P301 as a response to this increased rainfall/recharge. Fluctuations in P315 groundwater levels suggest that it may be impacted by nearby mining activities. EC has steadily increased since early 2021 with all monitoring events during 2022 exceeding the trigger value, with further detail in **Section 5.4**..	

5.2 Regolith – Shallow Weathered

Table 10 summarises groundwater level and quality trends for Wambo monitoring locations within regolith and shallow weathered strata.

Table 10 2022 groundwater trends in regolith/ shallow weathered strata

Regolith Aquifer	Monitoring bores	2022 Groundwater Trends	Comment
Wambo Creek	P316b	P316b fluctuates in response to high rainfall events. EC shows an inverse trend to rainfall events, consistent with vertical infiltration by rainfall. fluctuates	P316b was installed in 2020 as a supplementary bore and is screened only in regolith.

Regolith Aquifer	Monitoring bores	2022 Groundwater Trends	Comment
North Wambo Creek	GW24, GW26, GW36b, GW16, GW17, SBX-GW02 and GW10.2a	Similar to alluvial sites, increased rainfall in 2022 has led to recovery and increasing groundwater levels within North Wambo Creek regolith bores. Reduced EC (becoming significantly fresher) and pH has been widely observed as a response to this increased rainfall/recharge. Water levels started to decrease in a majority of the upstream bores towards the end of 2022, reflecting drier conditions in December. For these bores, a positive correlation for EC exists – EC increasing with lower water levels. pH has remained stable with generally neutral conditions (6.5-7.5).	
Wollombi Brook	GW13		Flooding throughout 2022 damaged the access track which has restricted access to this site No data was recollected for GW13 during this monitoring period.

5.3 Permian Coal Measures

Table 10 summarises groundwater level and quality trends for Wambo monitoring locations within Permian coal measures.

Table 11 2022 groundwater trends in Permian coal measures

Regolith Aquifer	Monitoring bores	2022 Groundwater Trends	Comment
Wambo Creek Catchment	P202, P206, P316c	P206 declined in 2022 in spite of above average rainfall and P202 reported an anomalously low reading in August. EC decreased at P202 and P206 in this monitoring period. pH remained stable around near-neutral. Groundwater levels increased in P316c throughout 2022 in response to above average rainfall. EC is brackish (2,500-4,000 µS/cm) and initially high pH observations have started to stabilise at pH 8.5.	Several historical bores exist near P202 and P206 and the wrong bore may have been sampled. Location and bore details should be confirmed in 2023.

Regolith Aquifer	Monitoring bores	2022 Groundwater Trends	Comment
North Wambo Creek Catchment	N2, N3 and N5 VWPs	The shallowest sensor for N5 (4) shows correlation to the rainfall trend and has steadily increased in 2022. Similar trends are observed in the lower 3 sensors until mid-2022 where levels stabilise or start to decline. This may reflect and SBX mining impact as longwalls approach. Upper 3 sensors are dry in N2, while the lower 3 show some SBX mining impact while maintaining some saturation. Lower 5 sensors at N3 failed since 2019. Upper sensor dry since 2017.	Inspect N3 and consider removal from network.
Wollombi Brook Catchment	GW22	A sharp rise in groundwater level (3m) was observed in GW22 in response to significantly above average rainfall. Fluctuations in EC appear to coincide with spikes in CRD - a reflection of significant rainfall events. GW22 returns more basic pH levels, with values consistently near pH 8.3.	

5.4 Trigger Level Exceedances

Triggers for EC occur when three consecutive bi-monthly observations (a 6-month period) exceed the specified trigger level. Triggers for pH occur when two consecutive bi-monthly observations (a 4-month period) exceed or fall below the specified trigger level (Peabody, 2021). The trigger level exceedances for groundwater level and groundwater quality in 2021 are shown in **Table 12**.

Note that due to conditions on site through 2022, some bores could not be reached for some scheduled sampling events. The trigger levels are still deemed to have been breached if the required number of consecutive exceedances includes an intervening missed event.

Table 12 2022 Trigger Level Exceedances

Bore (Aquifer#)	Trigger Exceedances				
	Min Depth to Water 2 Consecutive (10th percentile) *	Max Depth to Water 2 Consecutive (90th percentile) **	EC 3 Consecutive	pH min 2 Consecutive	pH max 2 Consecutive
GW02 (WCA)	N/A	N/A	No	No	No
P315 (SCA)	N/A	N/A	Yes (6, Feb to Dec)	No	No
P301 (SP)	N/A	N/A	No	No	No (1 exceedance)
GW15 (WBA)	Yes (July to Dec)	No	No	No	No
P16 (WBA)	No (2 exceedance Apr, Aug)	No	No	No	No
P20 (WBA)	No (2 exceedance Apr, Aug)	No	No	No	No
GW08.2 (NWCA)	ND				
GW09.2 (NWCA)	ND				
GW10.2 (NWCA)	ND				

Aquifer: WCA = Wambo Ck alluvium; SCA = Stony Ck alluvium; WBA = Wollombi Brook alluvium; NWCA = North Wambo Ck alluvium; SP = shallow Permian;

ND = Not Defined – currently there is insufficient baseline data to develop appropriate trigger levels

*Minimum depth-to-water is equivalent to maximum groundwater level (mAHD)

**Maximum depth-to-water is equivalent to minimum groundwater level (mAHD)

During 2022, groundwater levels in bore GW15 exceeded the trigger level the minimum depth to water due to responses to the high rainfall through 2022. Bore P315 also exceeded the EC trigger. No bores exceeded the pH trigger guidelines in 2022.

5.4.1 P315 – Stony Creek Alluvium - EC

EC increased above the trigger level of 552 µS/cm in February with a value of 699 µS/cm and reached a maximum of 1424 µS/cm in October before falling back to 1016 µS/cm in December 2022. This is considered an ongoing exceedance that was identified in 2021 and reported on by SLR (2022). The investigation concluded that high rainfall may have resulted in sufficient recharge to the shallow groundwater system. This recharge is believed to have enabled "flushing" of shallow groundwater through fractures in bedrock caused by NWU undermining in the Newcastle Coal Measures; leading to an increase in EC. As EC has continued to increase and exceed trigger limit values in 2022 following rainfall events similar to those experienced in 2021, it is possible the same process may be occurring and expected to continue if above average rainfall conditions persist into the future.

The following work was undertaken in 2022 to further assess the drivers of water quality change within Stony Creek and its alluvium:

- Initial analysis and assessment of surface and groundwater conditions (SLR, 2022a) delivered and presented to DPE and the EPA in mid-2022.
- Additional locations established which monitor real-time level and quality of groundwater and surface water.
- Additional rounds of sampling for dissolved metals and major ions.
- Site inspections by WCPL staff, hydrogeological consultants, and a subsidence expert.

Updated reporting considering new data sources will be provided to DPE and the EPA at the end of March 2023.

5.4.2 GW15 – Wollombi Brook Alluvium - Minimum Groundwater Level

GW15 is located 275m east of the channel of Wollombi Brook and 1.5km west of the advancing Warkworth Open Cut. Historical observations show a consistent, correlation between CRD and groundwater level at GW15. Groundwater level went above the minimum trigger level of 51.96 mAHD in June with a value of 54.56 mAHD increasing to a maximum of 55.64 mAHD in December 2022. These exceedances coincide with above average rainfall in 2022 and not with WCPL or other nearby mining activity.

5.5 Compliance with Groundwater Performance Criteria

The 2022 groundwater monitoring has been evaluated against the performance criteria, defined within the GWMP (Peabody, 2021). **Table 13**.

Table 13 Performance Indicators

Feature	Performance Indicator	2022 Performance Indicator Observations	Overall Compliance
Groundwater Management Performance Indicators			
Alluvial aquifers (including Wollombi Brook alluvium and excluding the NWC alluvium)	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: A greater than negligible change in groundwater levels;	Exceedances of the upper groundwater level trigger at GW15 is related to above average rainfall conditions and not a WCPL mining effect. No further investigation is required. See **Section 5.4**. The modelling undertaken for the MOD19 groundwater assessment (SLR, 2022) involved model rebuild, recalibration and peer review. The history-match of observed groundwater levels and trends have broadly improved in the updated model compared to previous assessments. Drawdown impacts at some alluvial sites are better captured in the SLR (2022) modelling than previous versions (e.g. HydroSimulations, 2019b) and should better quantify licencing obligations for WCPL. See **Section 6**.	**Compliant**
	A greater than negligible change in groundwater quality	EC trigger exceedances continued to be observed at P315 in 2022 (up to 1,424 µS/cm vs a trigger level of 552 µS/cm). This trend was first observed in 2021. Groundwater and surface water quality in Stony Creek is subject to additional ongoing monitoring and investigation (including SLR, 2022a) to establish the cause of the exceedance. .See **Section 5.4.1 and Section 5.4.3** for more details on this trigger level breach and the recommendations set out in **Section 10**.	**Not Compliant (subject to further investigations)**
	A greater than negligible impact to other groundwater users.	Previous groundwater assessments for Wambo Coal predicted that some privately-owned bores may experience more than 2 m cumulative drawdown as a result of the approved operations (HydroSimulations, 2017a, 2019b and SLR, 2020). No complaints have been made to Wambo Coal during the 2022 AR period in respect to groundwater or water (WCPL, 2022).	**Compliant**

Feature	Performance Indicator	2022 Performance Indicator Observations	Overall Compliance
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c)	GW36a and GW36b were drilled in 2020 to monitor impacts at the River Oak GDE on North Wambo Creek. To date observed depths to groundwater are <3 mbgl and therefore accessible by the River Oak GDE, and groundwater is fresh (EC is in the range 300-550 µS/cm); and pH of 6.25-8.4. There is no evidence of a mining impact associated with approaching SBX underground mine. Continued monitoring will allow trends / ranges to be established for these bores and determine whether SBX mining is impacting groundwater close to this GDE.	**Compliant**

Table 14, and **Table 15** below provide an assessment of compliance with the performance criteria defined for general water management performance, and subsidence impacts for North Wambo Underground and South Bates Underground and Extension longwalls.

Table 14 North Wambo Underground Performance Indicators

North Wambo Underground Performance Indicators		Overall Compliance
The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergence from modelling predictions.	The modelling undertaken for the MOD19 groundwater assessment (SLR, 2022) involved model rebuild, recalibration and peer review. The history-match of observed groundwater levels and trends have broadly improved in the updated model compared to previous assessments. Drawdown impacts at some alluvial sites are better captured in the SLR (2022) modelling than previous versions (e.g. HydroSimulations, 2019b) and should better quantify licencing obligations for WCPL. See **Section 6**.	**Compliant** (further reviewed in MOD19 numerical modelling - See recommendations set out in **Section 9**)

Table 15 South Bates Underground and South Bates Extension Underground Performance Indicators

South Bates Underground and South Bates Extension Underground Performance Indicators		
The performance indicators will be considered to have been exceeded if groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (Table 11 of the GWMP).	Exceedances of the upper groundwater level trigger at GW15 is related to above average rainfall conditions and not a WCPL mining effect. No further investigation is required. See **Section 5.4**.	**Compliant**

South Bates Underground and South Bates Extension Underground Performance Indicators		
The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (Table 13 of the GWMP).	EC trigger exceedances continued to be observed at P315 in 2022 (up to 1,424 µS/cm vs a trigger level of 552 µS/cm). This trend was first observed in 2021. Groundwater and surface water quality in Stony Creek is subject to additional ongoing monitoring and investigation to establish the cause of the exceedance. See **Section 5.4.1**. for more details on this trigger level breach and the recommendations set out in **Section 9**.	**Not Compliant** (see **Table 13**)
The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.	GW36a and GW36b were drilled in 2020 to monitor impacts at the River Oak GDE on North Wambo Creek. To date observed depths to groundwater are <3 mbgl and therefore accessible by the River Oak GDE, and groundwater is fresh (EC is in the range 300-550 µS/cm); and pH of 6.25-8.4. There is no evidence of a mining impact associated with approaching SBX underground mine. Continued monitoring will allow trends / ranges to be established for these bores and determine whether SBX mining is impacting groundwater close to this GDE.	**Compliant**

5.6 Vibrating Wire Piezometer Data Review

SLR has been undertaking periodic reviews of the WCPL VWP monitoring network, both on-site and of the downloaded data. The table included in **Appendix C** provides details on each of the VWP locations, and also provides a preliminary assessment of data quality collected at each of the sites for 2022. Key findings from the data quality assessment include:

- Unreliable data at VWP sites where sensors are within shallow overburden, Whybrow or Wambo seams. Sensors are dry or near-dry, likely associated with WCPL or regional mining activity. It is worth continuing to download these while at least one of the sensors is collecting reliable data, and where recovery / re-saturation is possible.
- As recommended in 2020, older sites and unlabelled sites (MG06, MG08, MG09, GW20, U/Fenwick) which are no longer collecting reliable data should be removed from monitoring network.

Discussion and assessment of VWP data has not been undertaken or presented in this report but could be considered for inclusion in future reporting for sites where the data quality is assessed as reliable. A summary of groundwater level observations from site VWPs are provided below:

- Most shallow VWP sensors (~10 m depth) are dry indicating greater depths to water table.
- Depressurisation associated with Wambo mining activity is observed within the Wambo and Whybrow seams and adjacent Permian Coal Measures in sites close to historical and current mining activity. This observed depressurisation is broadly consistent with current model predictions (SLR, 2022).
- Deeper sensors, installed to monitor impacts of the Approved South Wambo Project, maintain significant pressure head in the absence of South Wambo Project mining activity.

6 Verification of Model Predictions

The most recent groundwater modelling for WCPL was completed as part of the Groundwater Assessment in support of the South Bates Extension LW24-26 Modification (Mod19) (SLR, 2022c). The model utilised in this groundwater assessment was rebuilt from previous Wambo groundwater models (e.g. HydroSimulations, 2019b), the United Wambo Open Cut numerical model (AGE, 2016) and site and regional geological models using current best practice modelling techniques. Key features of the updated model include:

- *Algomesh* software was used to generate the model grid using Voronoi polygons, enabling progressive refinement of the model grid near key mining and environmental features.
- MODFLOW-USG used as model code.
- Update of alluvial geometry, representation of flow in ephemeral watercourses, and use of the Australian Landscape Water Balance Model (AWRA-L) to better capture observed groundwater levels in shallow strata.
- The model is calibrated to observed groundwater levels to the end of December 2020.

The rebuilt model was then recalibrated and underwent peer review (Appendix E of SLR, 2022c – HydroAlgorithmics, 2022) as part of the approvals process for MOD19. The peer review (HydroAlgorithmics, 2022) found the model to be *fit for purpose* where the models purpose was defined by the objectives stated in SLR (2022c):

- "*assess the groundwater inflow to the mine workings as a function of mine position and timing;*
- *simulate and predict the extent of dewatering due to the Project and the level and rate of drawdown at specific locations;*
- *identify areas of potential risk, where groundwater impact mitigation/control measures may be necessary;*
- *estimate direct and indirect water take; and*
- *estimate post-mining recovery conditions*."

Detailed discussion of the revised model's performance (ability to represent groundwater level observations) is included in the Groundwater Modelling Technical Report (Appendix D of SLR, 2022c) completed for the MOD19 Groundwater Assessment.

Hydrographs presenting the modelled groundwater levels versus observed groundwater levels to the end of 2022 at Wambo monitoring sites are presented in **Appendix A**.

A key consideration for assessing modelled and observed groundwater levels during 2022 is that the transient historical period for the SLR (2022) groundwater modelling ended in December 2020, and will not include ongoing above average rainfall conditions experienced in 2021 and 2022. As this wet period is not included in the SLR (2022) model, a response in predicted groundwater levels to recent rainfall and streamflow event is not expected. The WCPL GWMP (Peabody, 2021 – Section 5.3) commits to periodic recalibration and independent peer review of the groundwater model every three years. The peer review referred to above satisfies this requirement for 2022. Future updates of the model will include recent climatic conditions and enable further assessment of model performance during the previous years' of above average rainfall.

7 Inflow to WCPL workings

Annual assessment for mine inflows is to be undertaken as part of the site water balance to allow for calculation of groundwater take from alluvial and rock water sources (**Section 6.1.2** of the GWMP (Peabody, 2021). This section assesses compliance of WCPL against the requirements and measurement criteria in the GWMP (Peabody, 2021).

The assessment of licence compliance regarding the interception of groundwater is undertaken in **Section 6.5** of the main WCPL Annual Review document.

7.1 Inflows to Open-Cut pits

Under the most recent modification (Modification 16, determined 28 August 2019) current operations at the Wambo Mine include underground mining and coal processing and handling activities. Open cut mining activities have been managed by the United Wambo Joint Venture since the commencement of development *Phase 2* on 1 December 2020.

Inflows to open cut pits with respect to groundwater licencing entitlements and water quality will be quantified by the United Wambo Joint Venture.

7.2 Inflows to Underground Workings

SBX workings in the Whybrow Seam is currently being dewatered as part of WCPL underground mining operations. The current GWMP (Peabody, 2021) requires annual assessments for mine inflows against the peak simulated mine inflow from HydroSimulations (2017) of 316 ML/yr. An exceedance of this predicted inflow by greater than 50% (i.e. an annual inflow of > 474 ML/yr) will require WCPL to:

- Investigate if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities;
- Where there is an increased take from the Lower Wollombi Brook Water Source, investigate any influence on low flow cease-to-pump criteria specified in the HUA WSP;
- Define the Mine inflow volume value triggering this response procedure;
- Submit a report summarising the assessment to DPE Water.

Predictions of annual inflows are currently based on the groundwater modelling completed for the South Bates Extension LW24-26 Modification Groundwater Assessment (SLR, 2022c). This modelling predicted up to 405 ML/year inflows to the South Bates Extension and South Bates Underground mine areas over 2022.

While this number is lower than the '*greater than 50% exceedance*' criteria defined in the GWMP (Peabody, 2021) and does not require WCPL to undertake further action, it is recommended that the GWMP be updated to use contemporary mine inflow predictions to guide future assessments.

8 Summary

A summary of key findings from the review and analysis of WCPL groundwater data collected during 2022 is presented below:

- 2022 saw above average rainfall conditions at Wambo and across most of NSW. This resulted in flow events occurring in ephemeral watercourses across site, and broad-scale recharge to shallow groundwater systems (**Section 3.1** and **Section 5**).
    - Bore GW15 breached the minimum groundwater trigger level in 2022, although this exceedances are not related to WCPL mining activity and require no further investigation.
    - Investigation at P315 – Stony Creek Alluvium – exceedance of EC trigger level (**Section 5.4.1**),
- is already ongoing. The data quality assessment undertaken on WCPL VWPs identifies arrays with failed sensors/ poor quality data which can be excluded from the monitoring program (**Appendix C**).
- Groundwater model performance, relating to the model's ability to simulate observed groundwater levels and groundwater level trends, has generally improved compared to previous versions of the Wambo groundwater model (see **Section 6**).
- Predicted inflow volumes for South Bates Underground and South Bates Extension mine areas are 405 ML for 2022, this is within assessment limits.

9 Recommendations

Following the 2022 annual review of groundwater data several recommendations have been made:

- The P106 and P109 replacement bores are scheduled to be constructed in 2023. A paired standpipe monitoring site is scheduled for installation: with one bore in the alluvium, and the other in the in the underlying weathered Permian/ regolith.
- A review of the monitoring network is recommended at the next update of GWMP to consider whether replacement sites are necessary for GW27 and GW28, which have been destroyed following recent flood events.
- VWP locations identified with persistent poor-quality data should be considered for inspection, and removed from the monitoring network if they cannot be repaired (see **Appendix C**). These sites include:
    - P320 – sensors stopped reading between April and July 2022.
    - P322 – no data provided for 2022.
    - N3 – no reliable data in recent years.
    - MG06, MG08-01, MG08-02, MG09-01, and GW20 are all older VWPs at Wambo that have not been providing reliable data for a number of years. These should be inspected and assessed for decommissioning.
- GW10.2 was identified as being damaged (likely from flooding) in the December round of groundwater sampling) and was not able to be sampled. The nature of the damage to the bore is unknown and the site should be investigated and repaired as required.
- Groundwater inflow assessment criteria from **Section 6.1.2** of the GWMP (Peabody, 2021) values (i.e. Inflow greater than 474 ML/yr) should be updated to reflect peak inflow values from contemporary model predictions (SLR, 2022) (**Section 7.2**).

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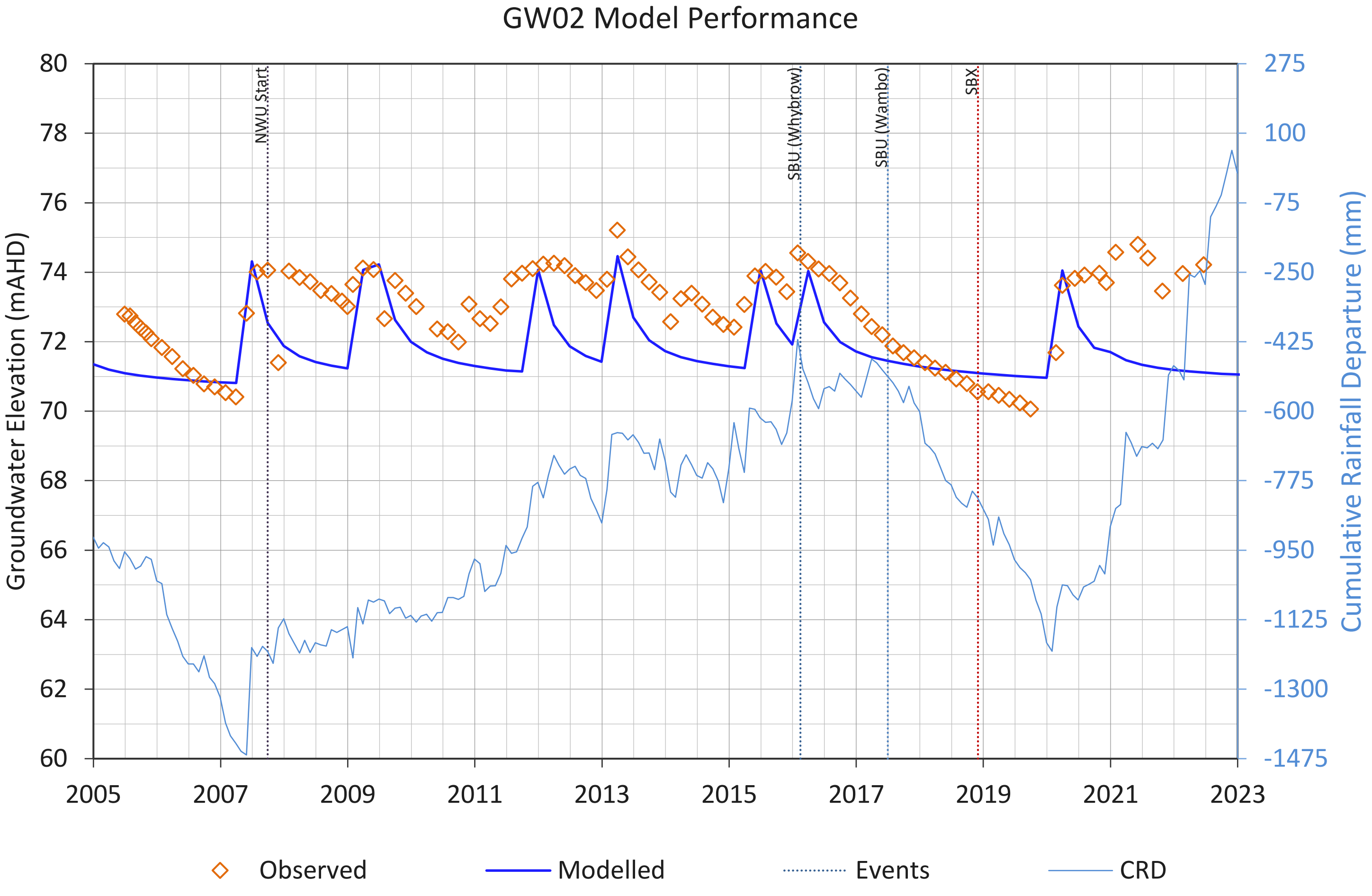
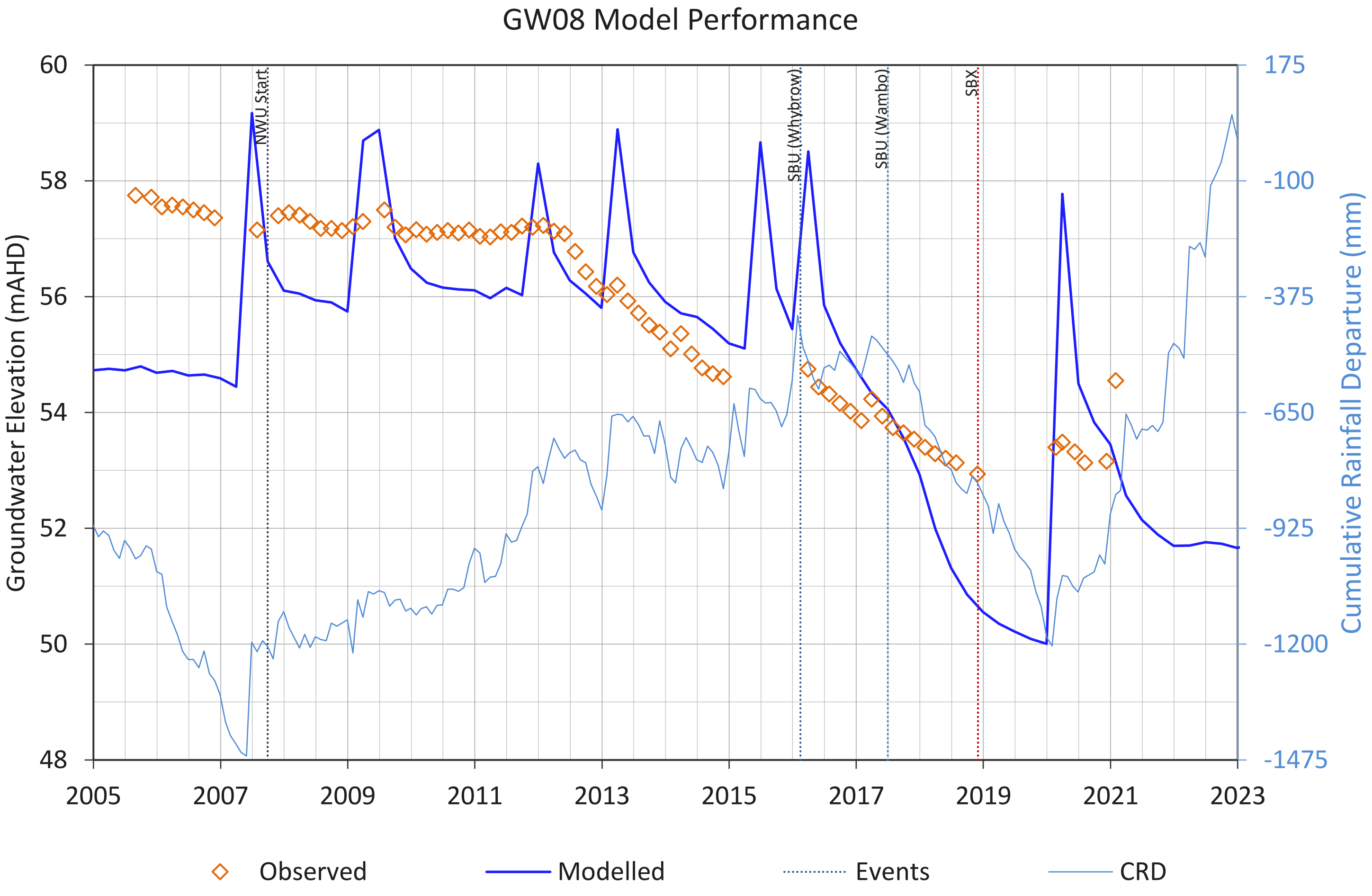
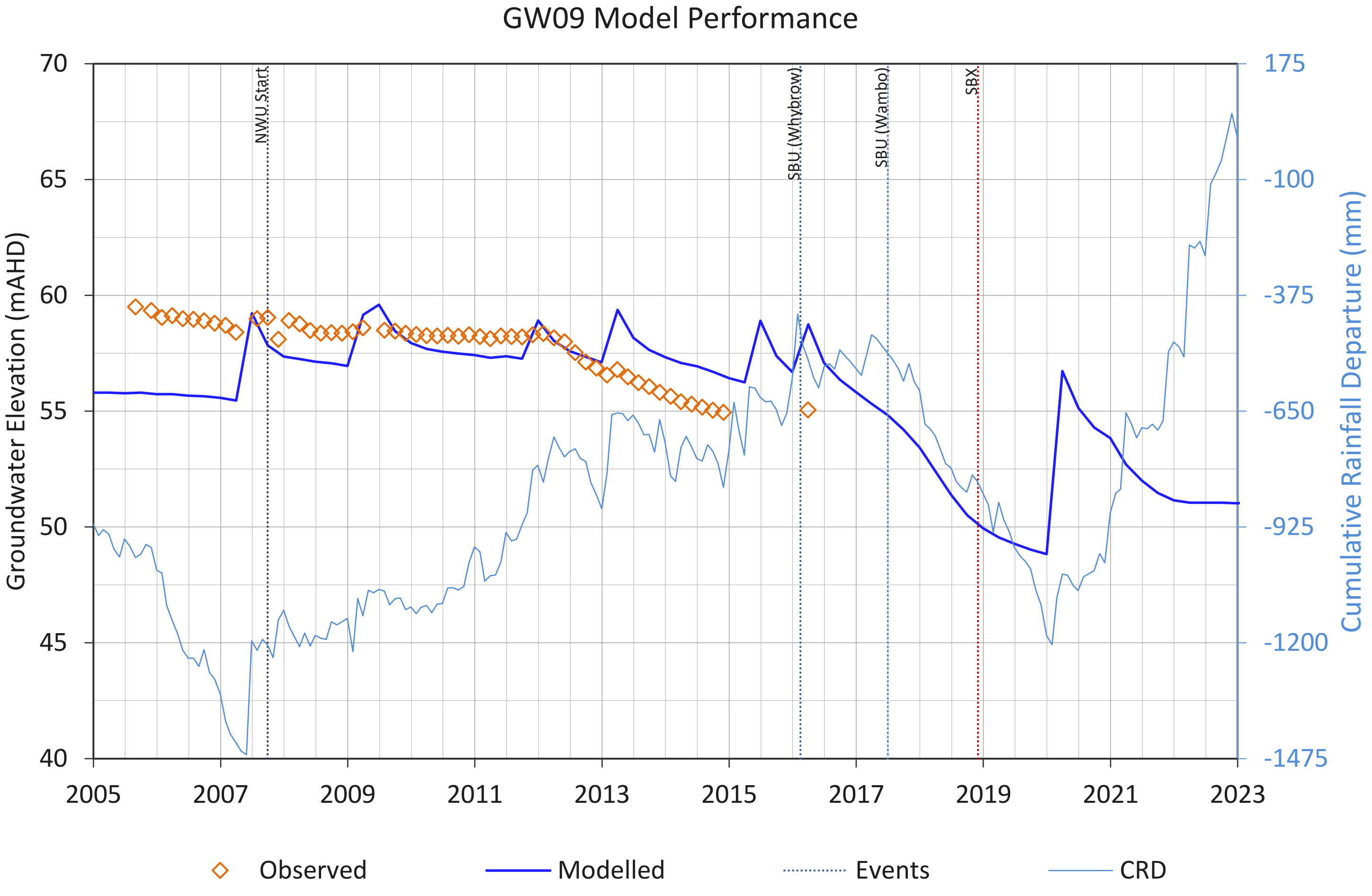
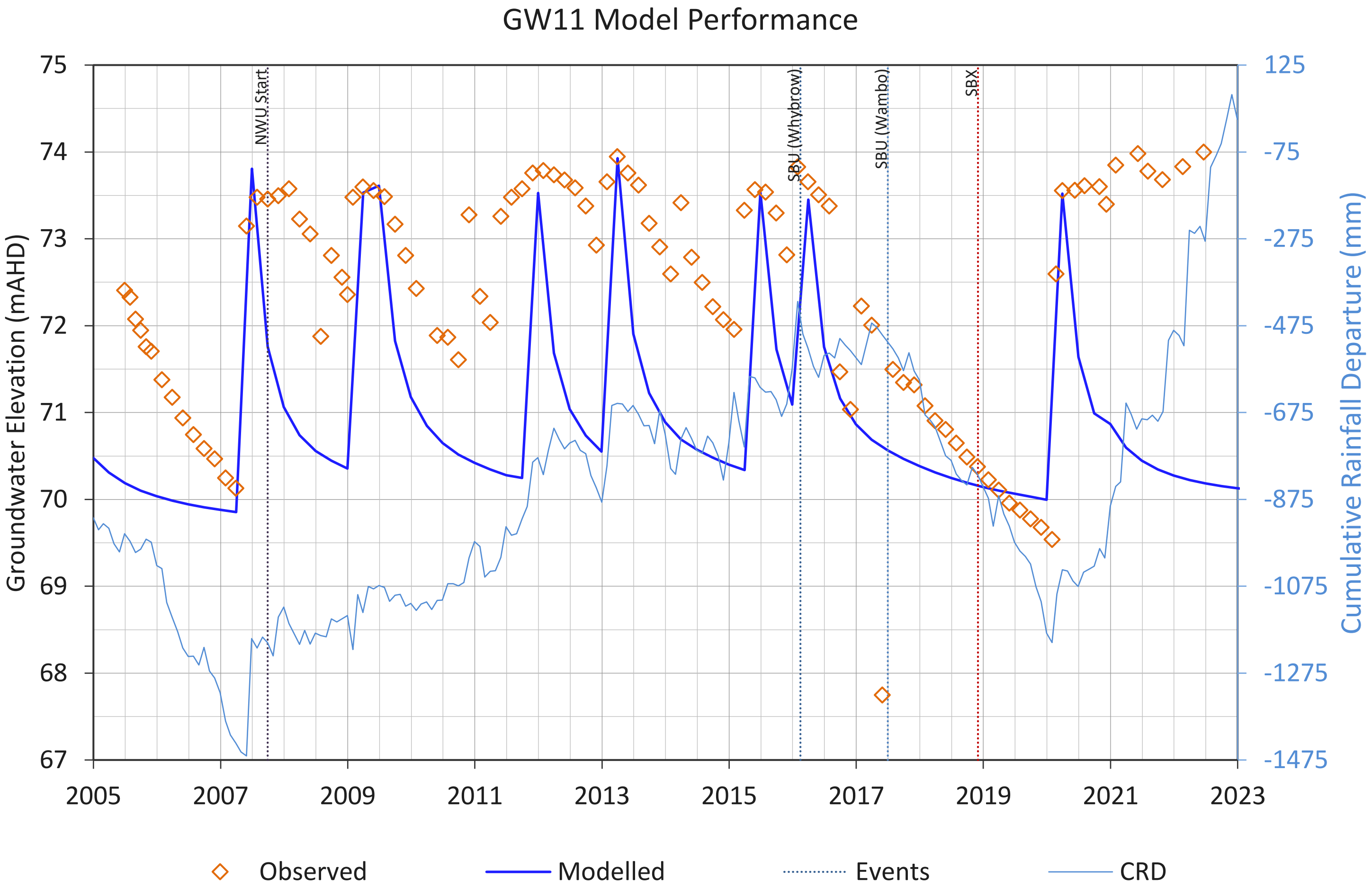
APPENDIX A

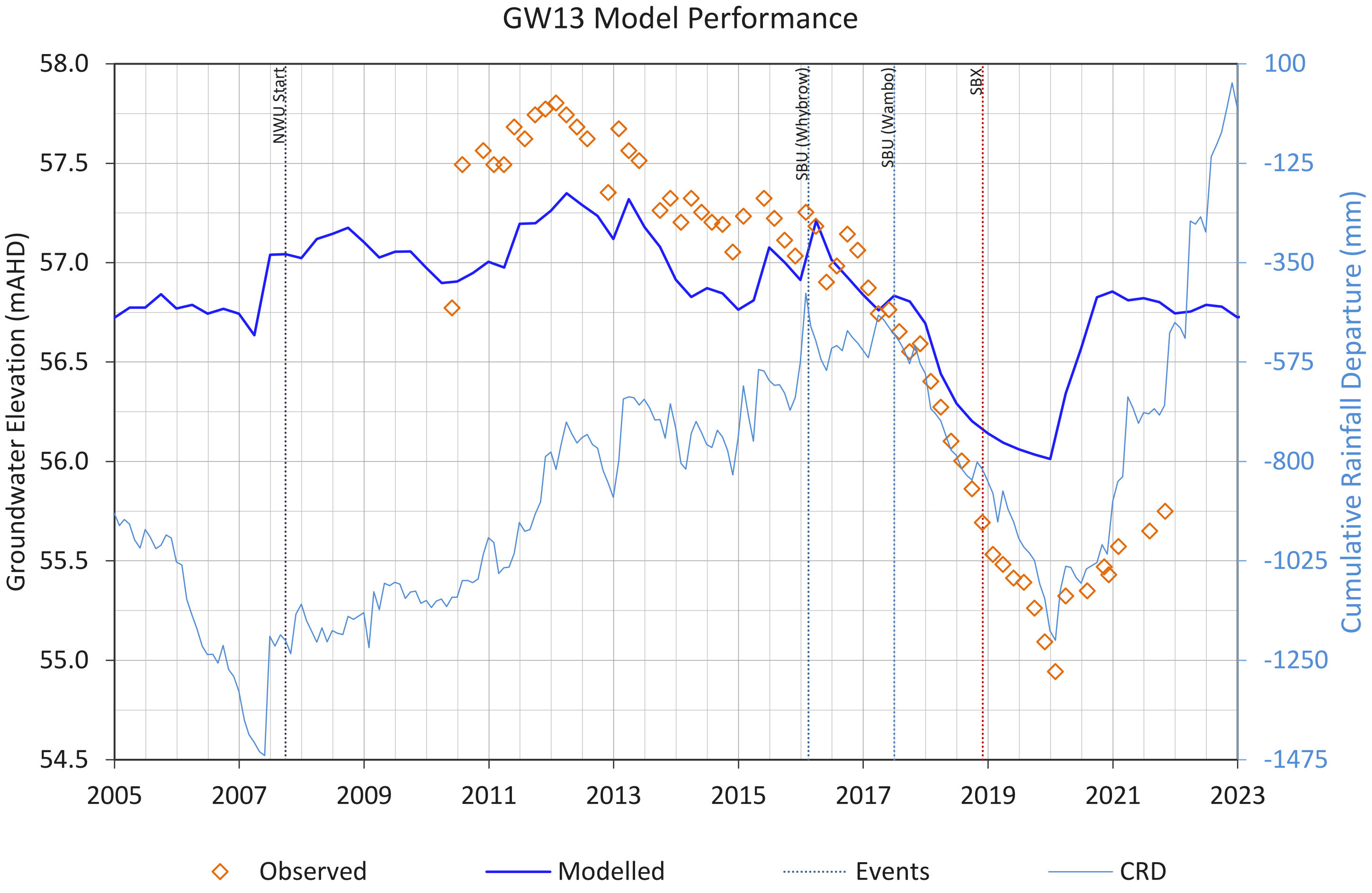
Model Performance (mod vs obs) Hydrographs

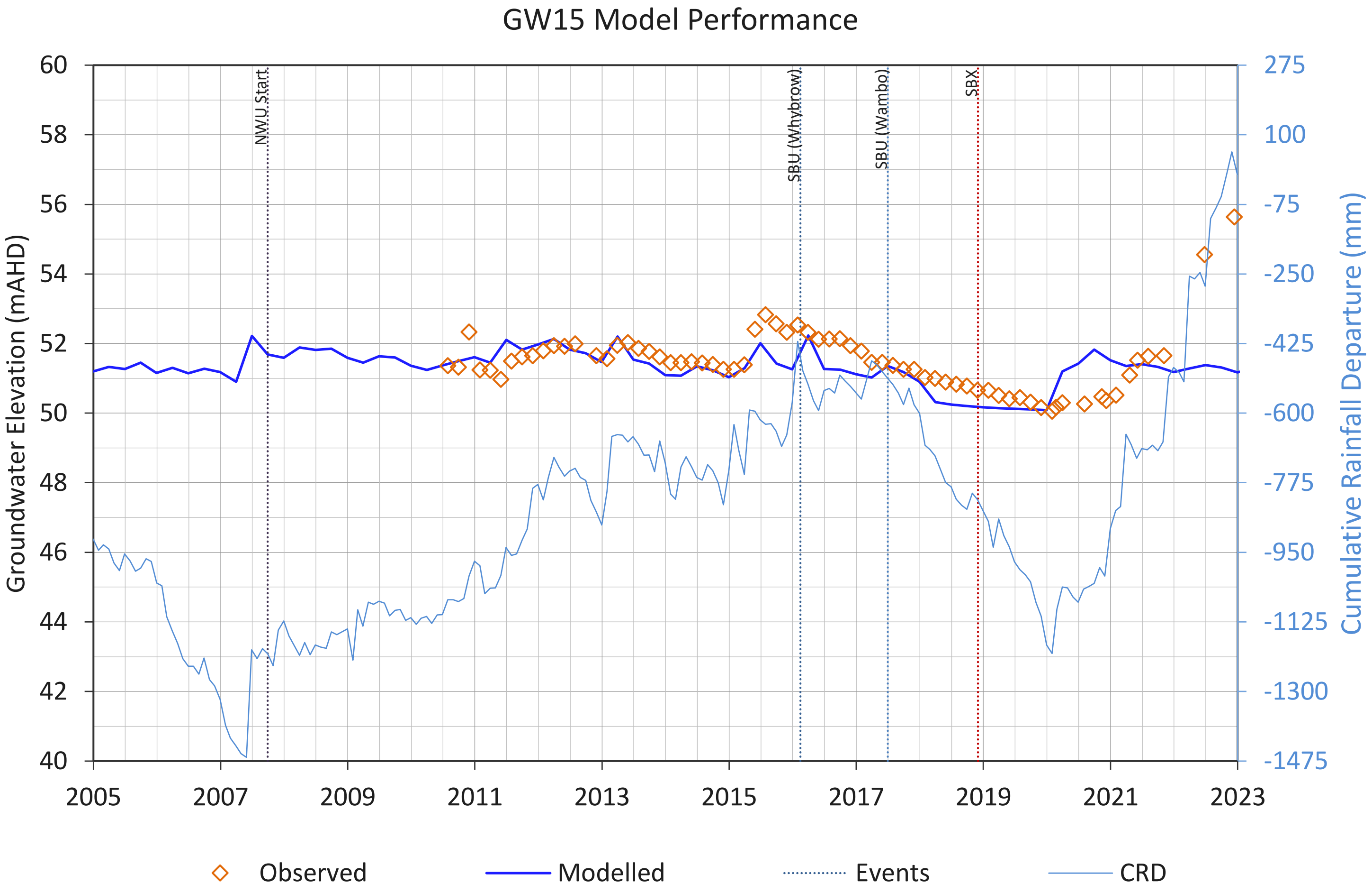

GW02 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
80
78
76
74
72
70
68
66
64
62
60
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

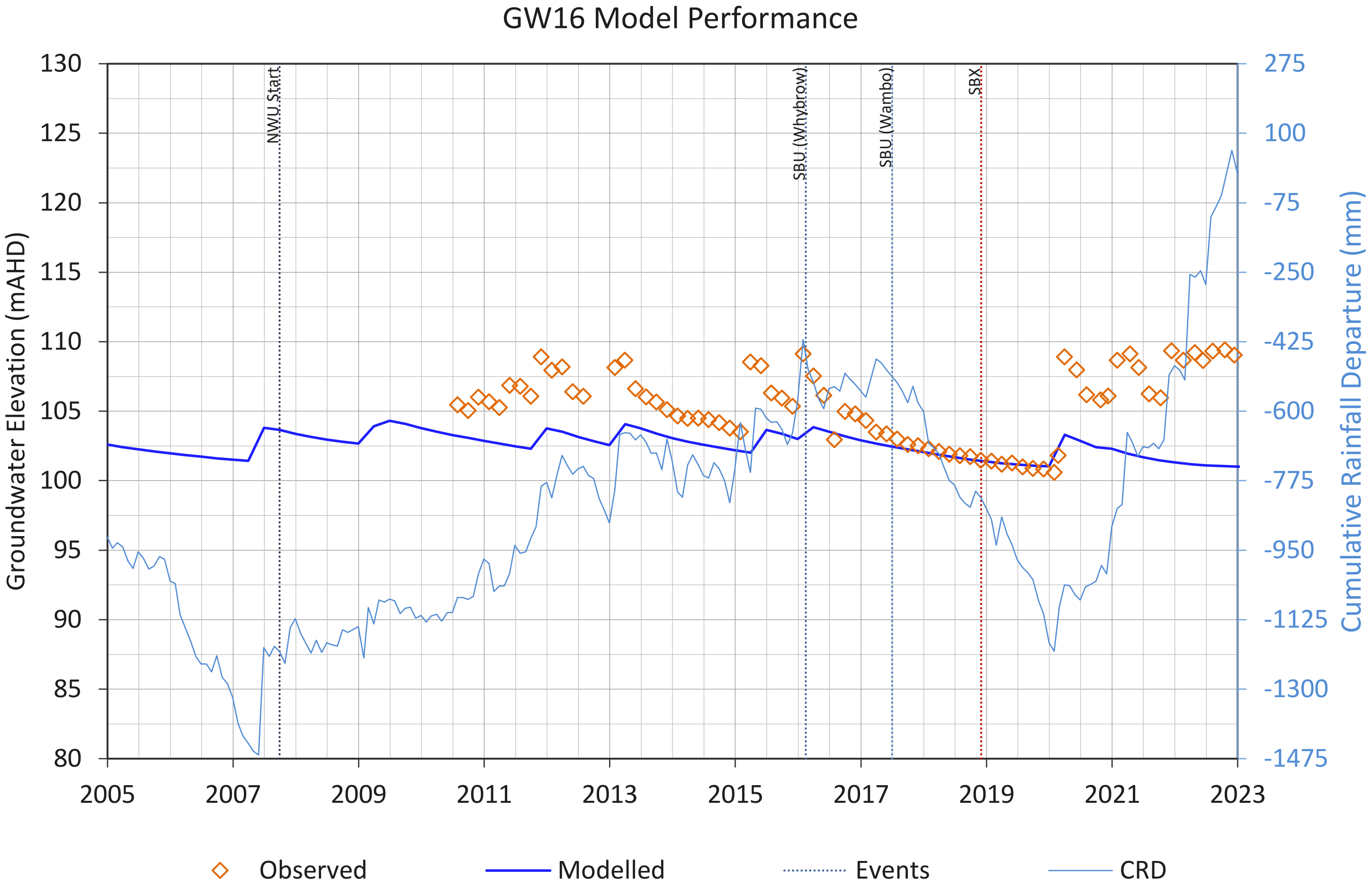

GW08 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
60
58
56
54
52
50
48
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


GW09 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
70
65
60
55
50
45
40
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

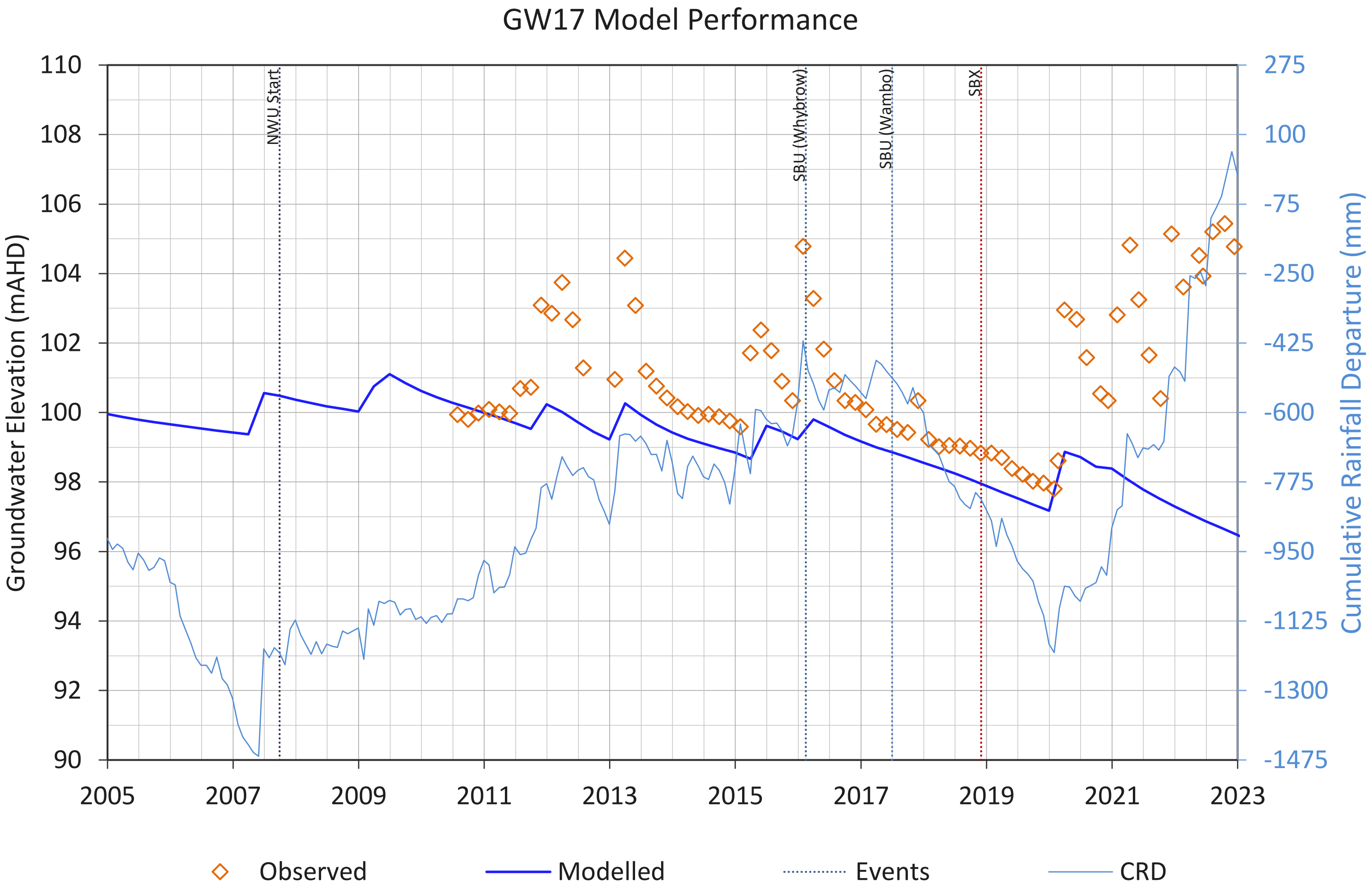

GW11 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
75
74
73
72
71
70
69
68
67
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


GW13 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
58.0
57.5
57.0
56.5
56.0
55.5
55.0
54.5
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


GW15 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
60
58
56
54
52
50
48
46
44
42
40
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

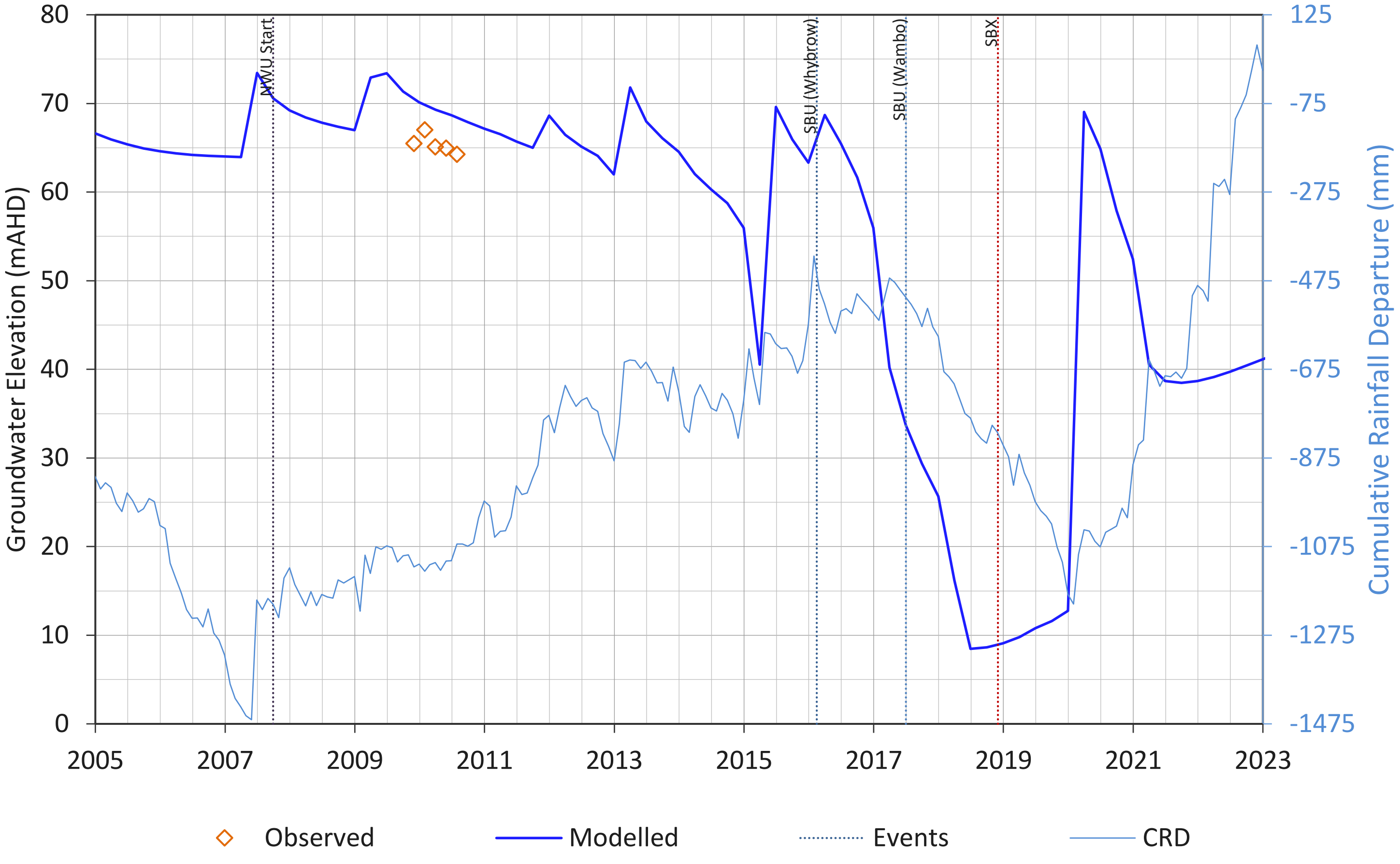


GW16 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
130
125
120
115
110
105
100
95
90
85
80
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

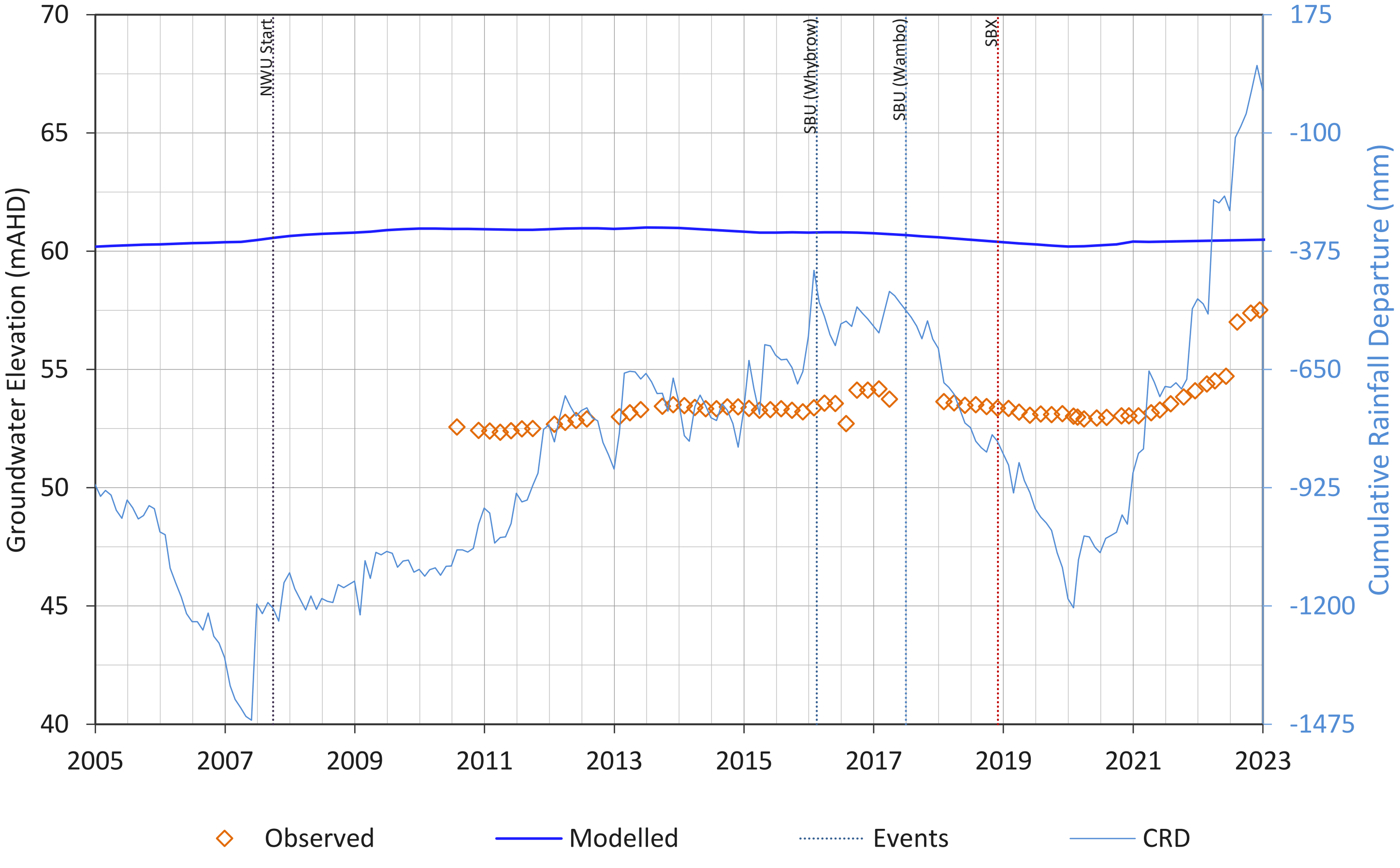


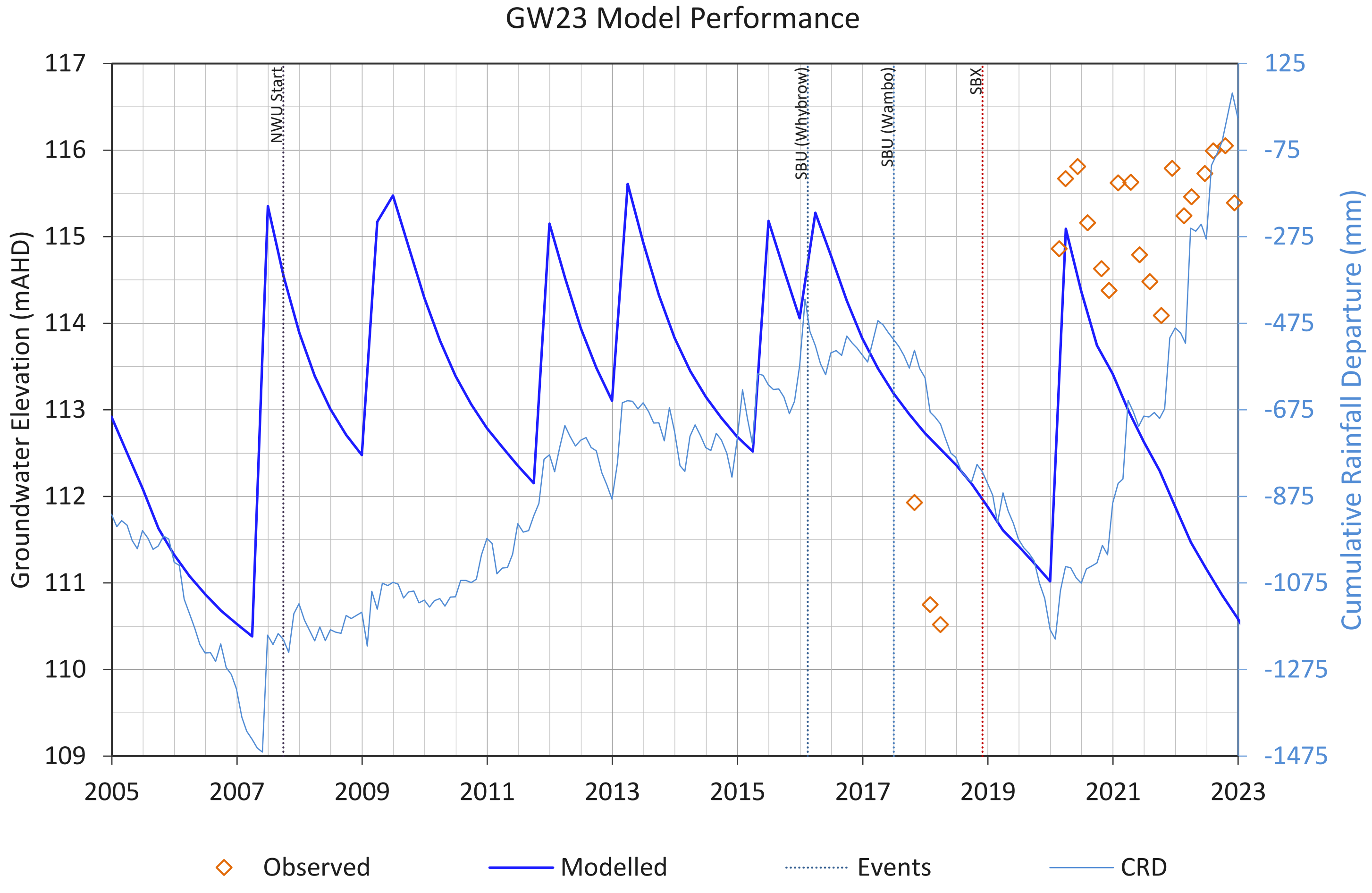
GW17 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
110
108
106
104
102
100
98
96
94
92
90
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

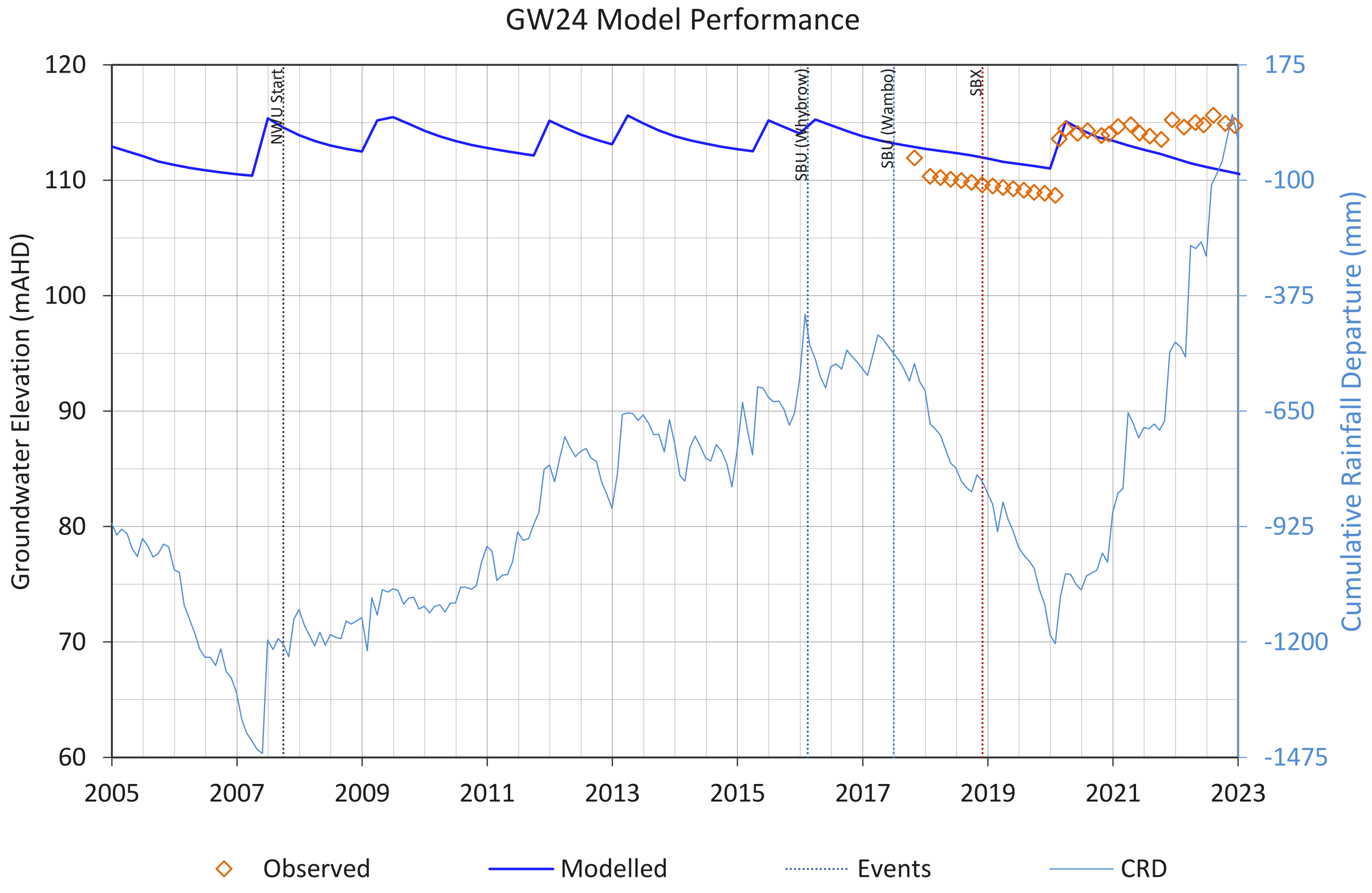
GW18 Model Performance

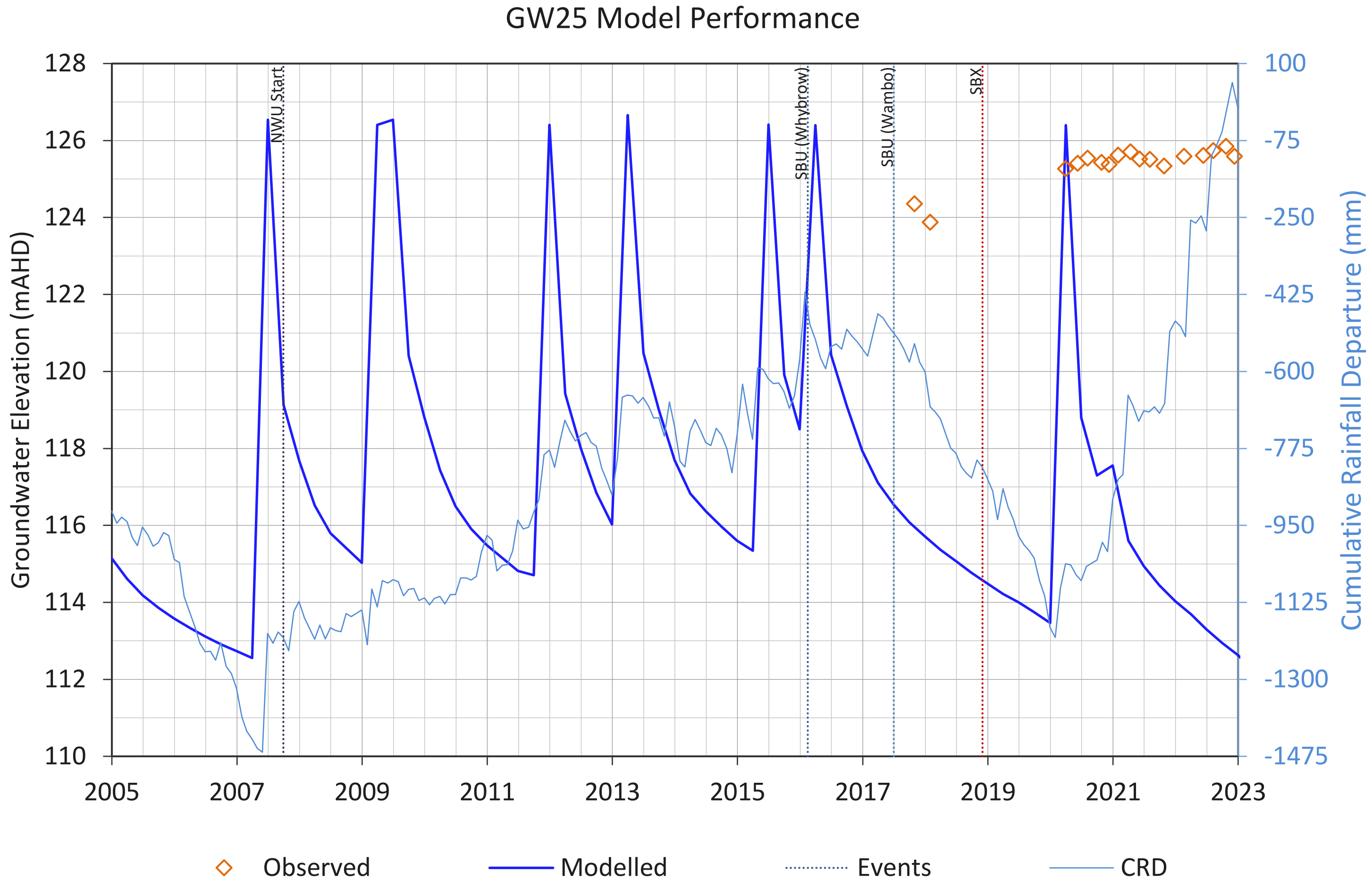


GW22 Model Performance

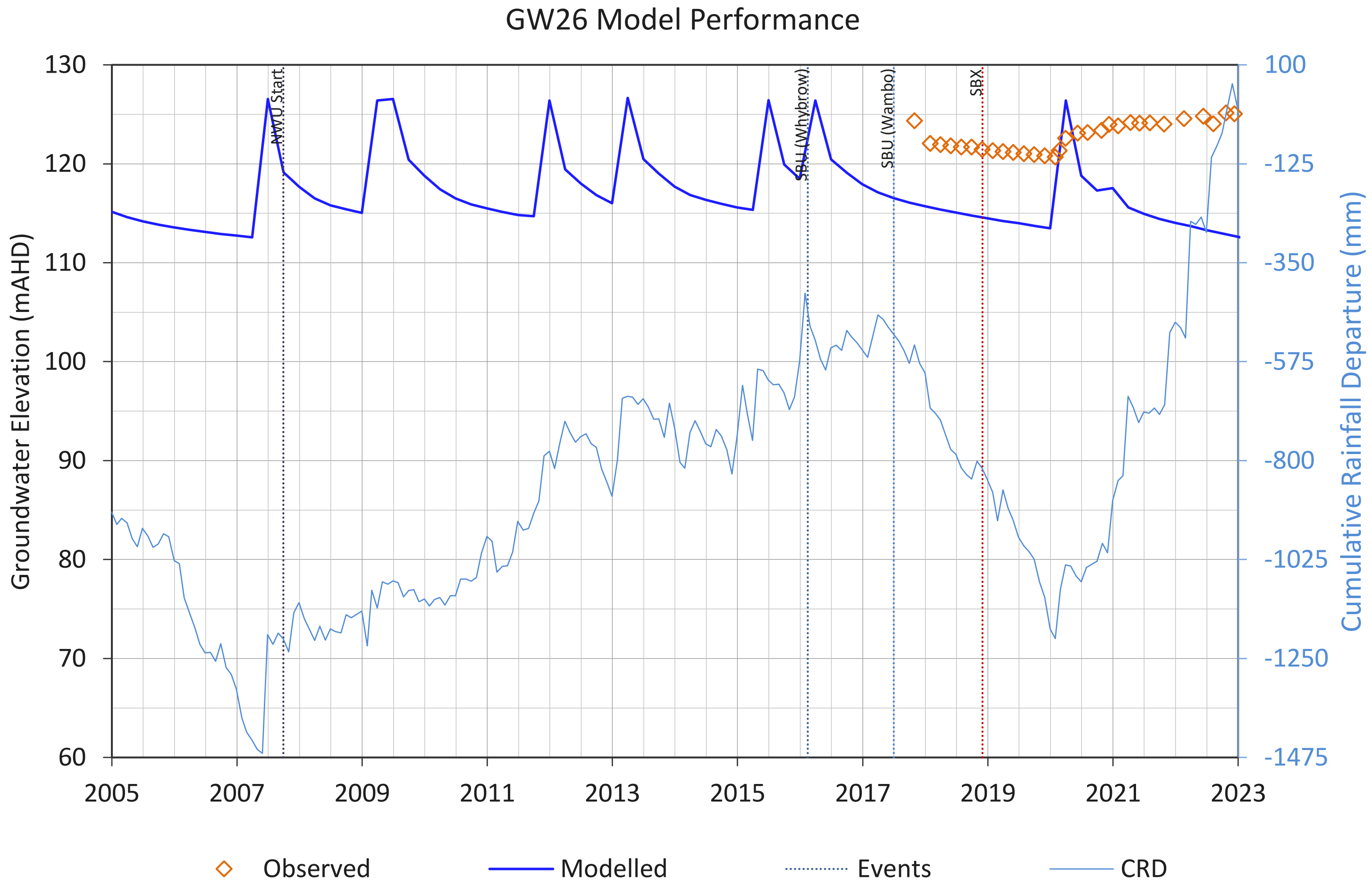



GW23 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
117
116
115
114
113
112
111
110
109
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


GW24 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
120
110
100
90
80
70
60
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

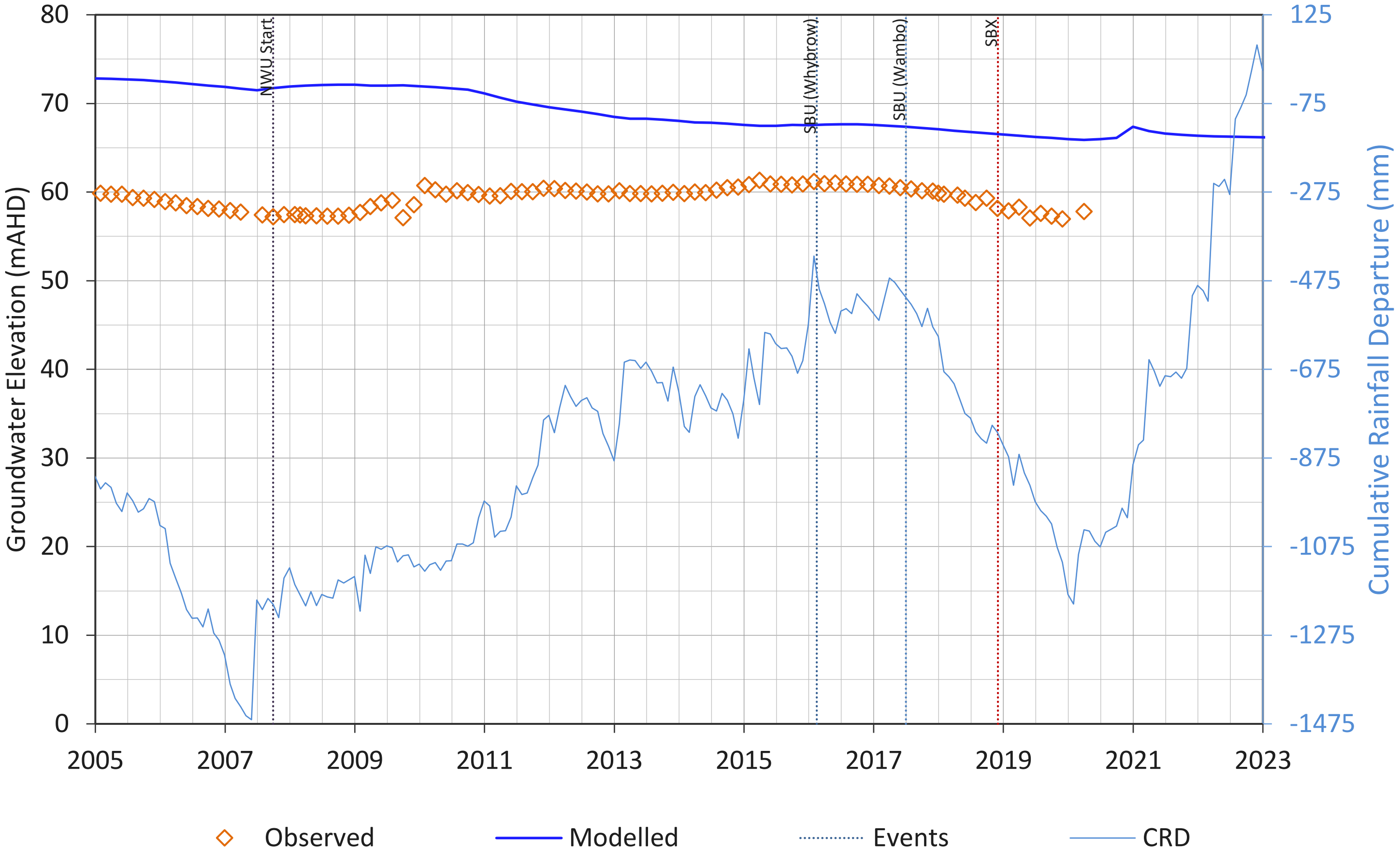


GW25 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
128
126
124
122
120
118
116
114
112
110
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

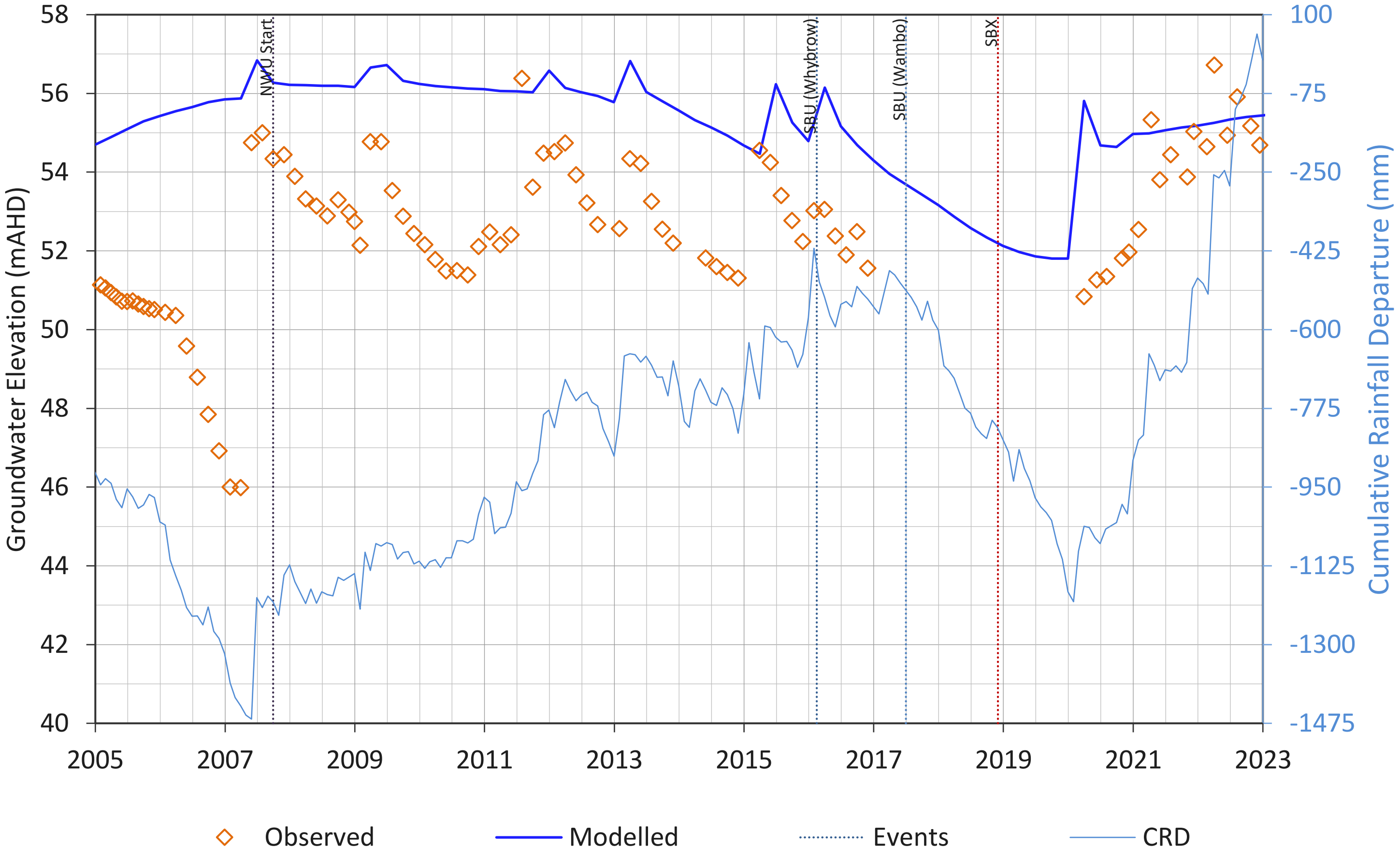


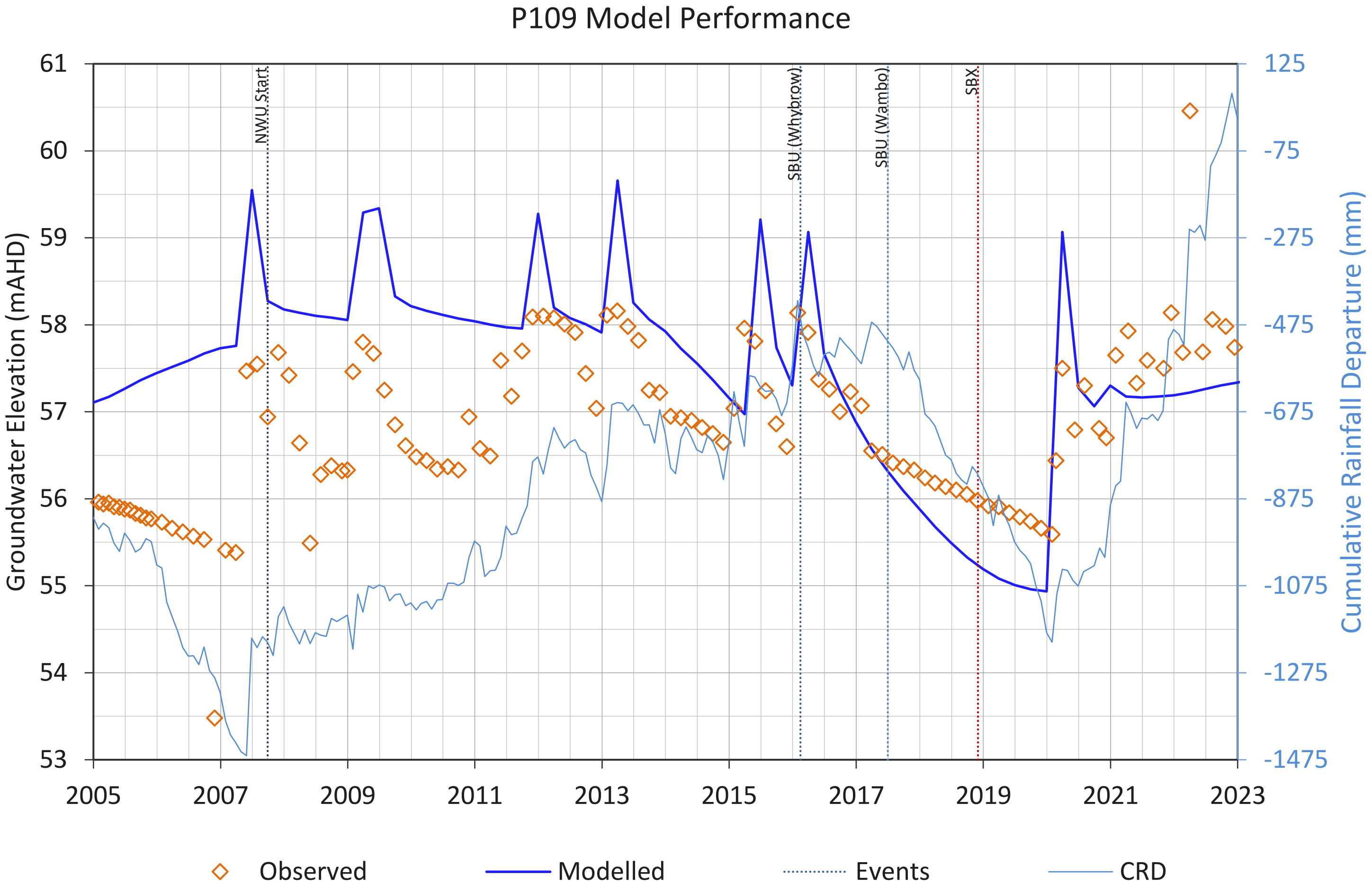
GW26 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
130
120
110
100
90
80
70
60
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

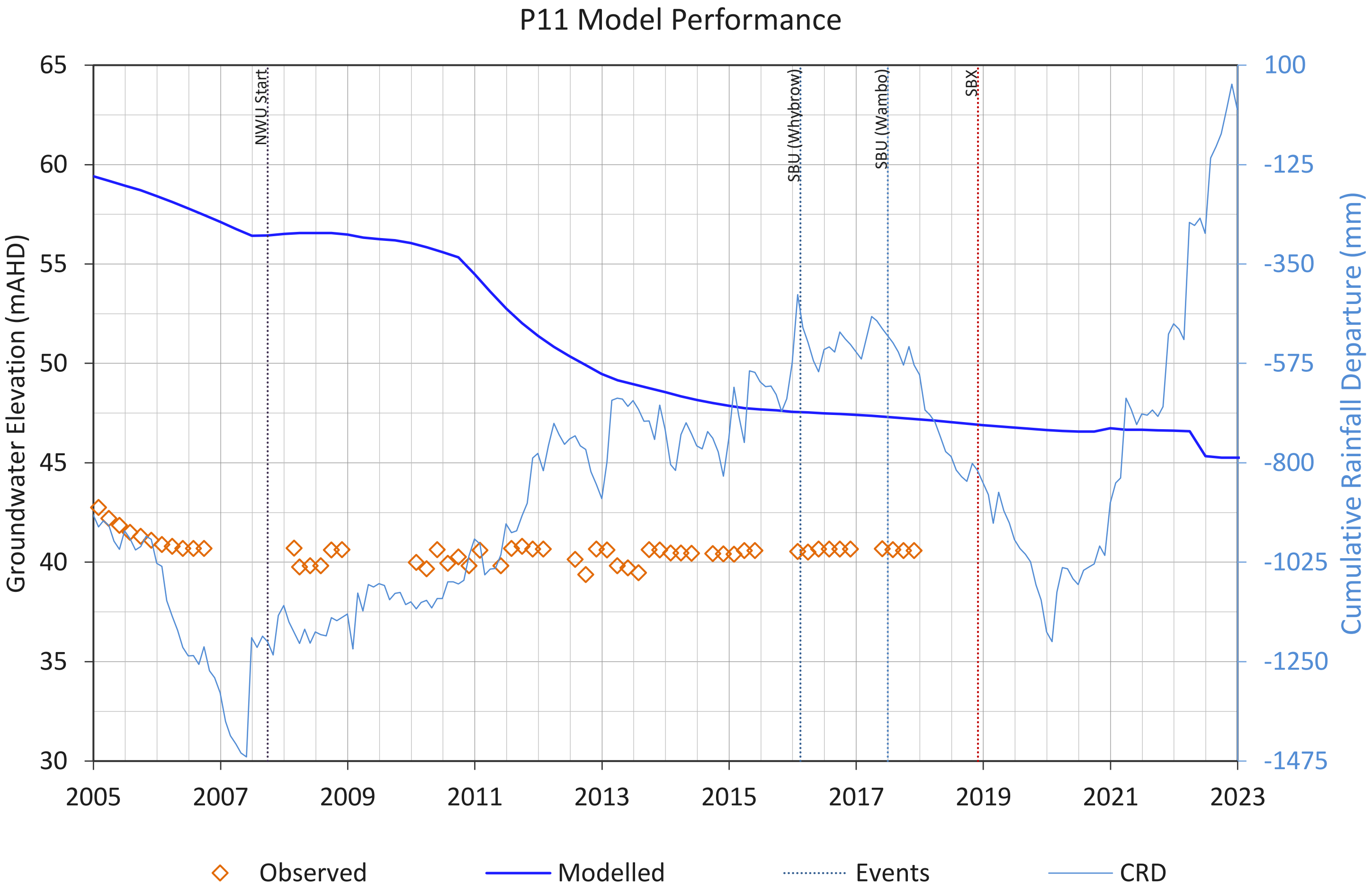
P1 Model Performance

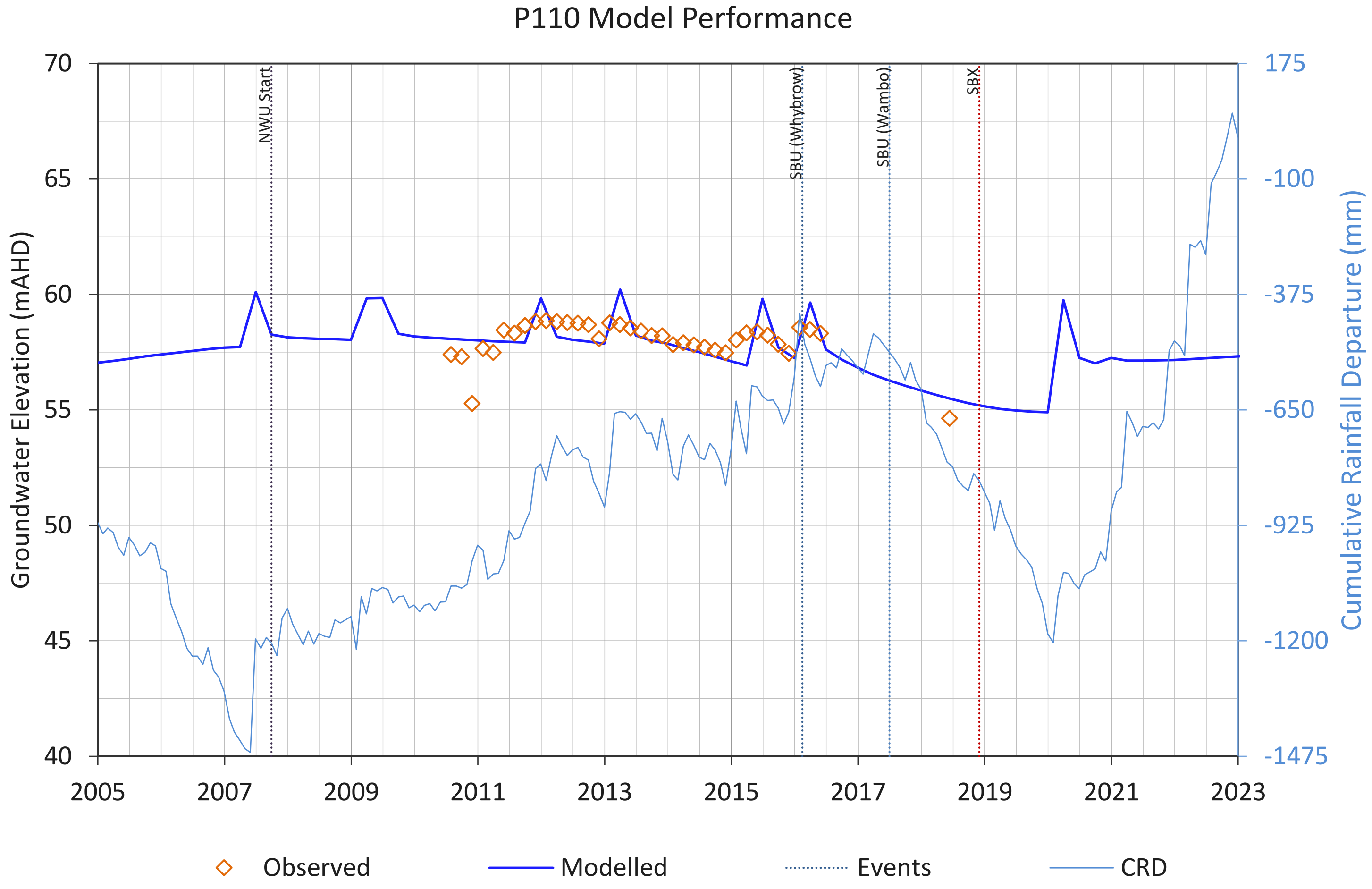


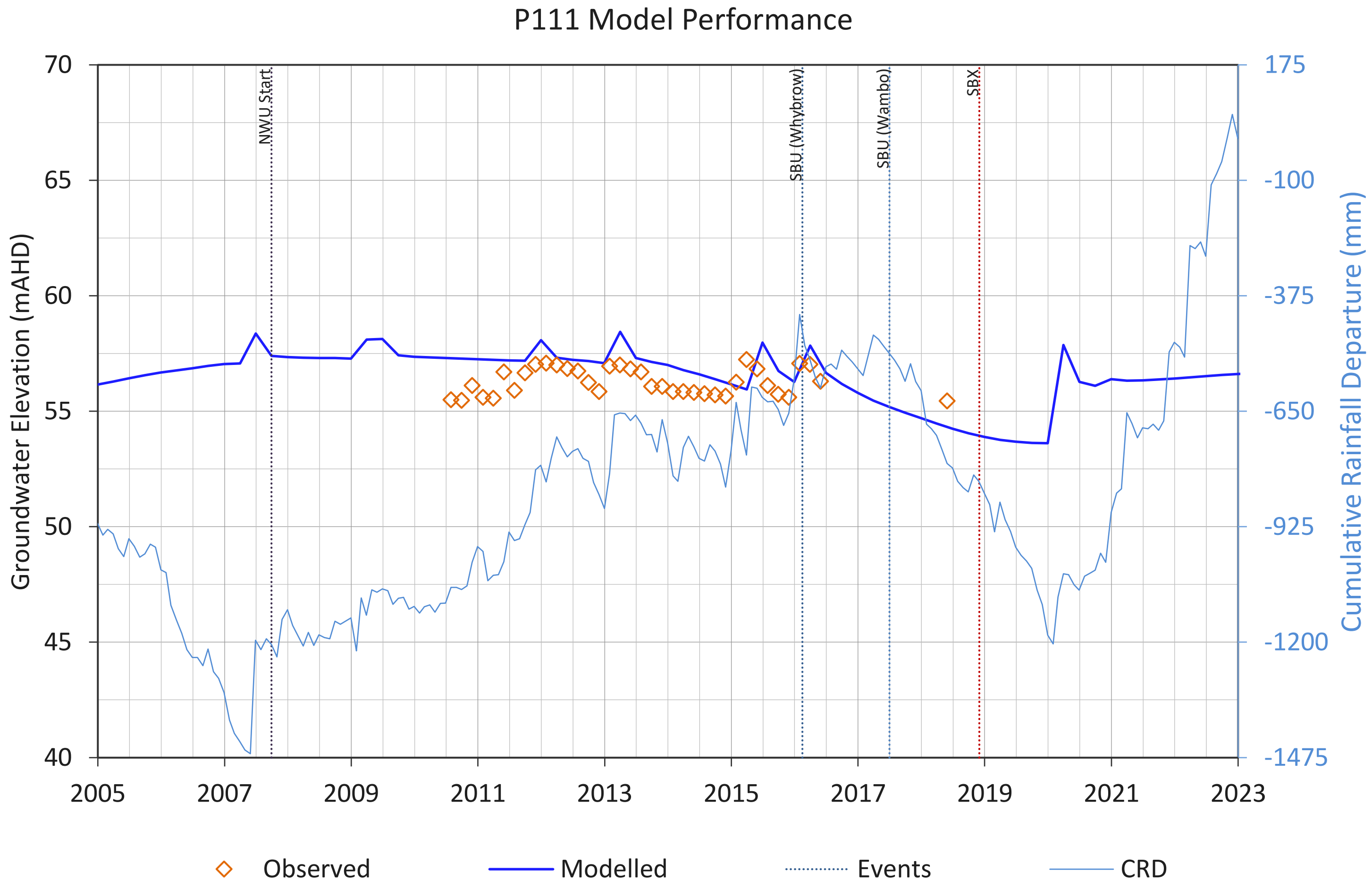
P106 Model Performance

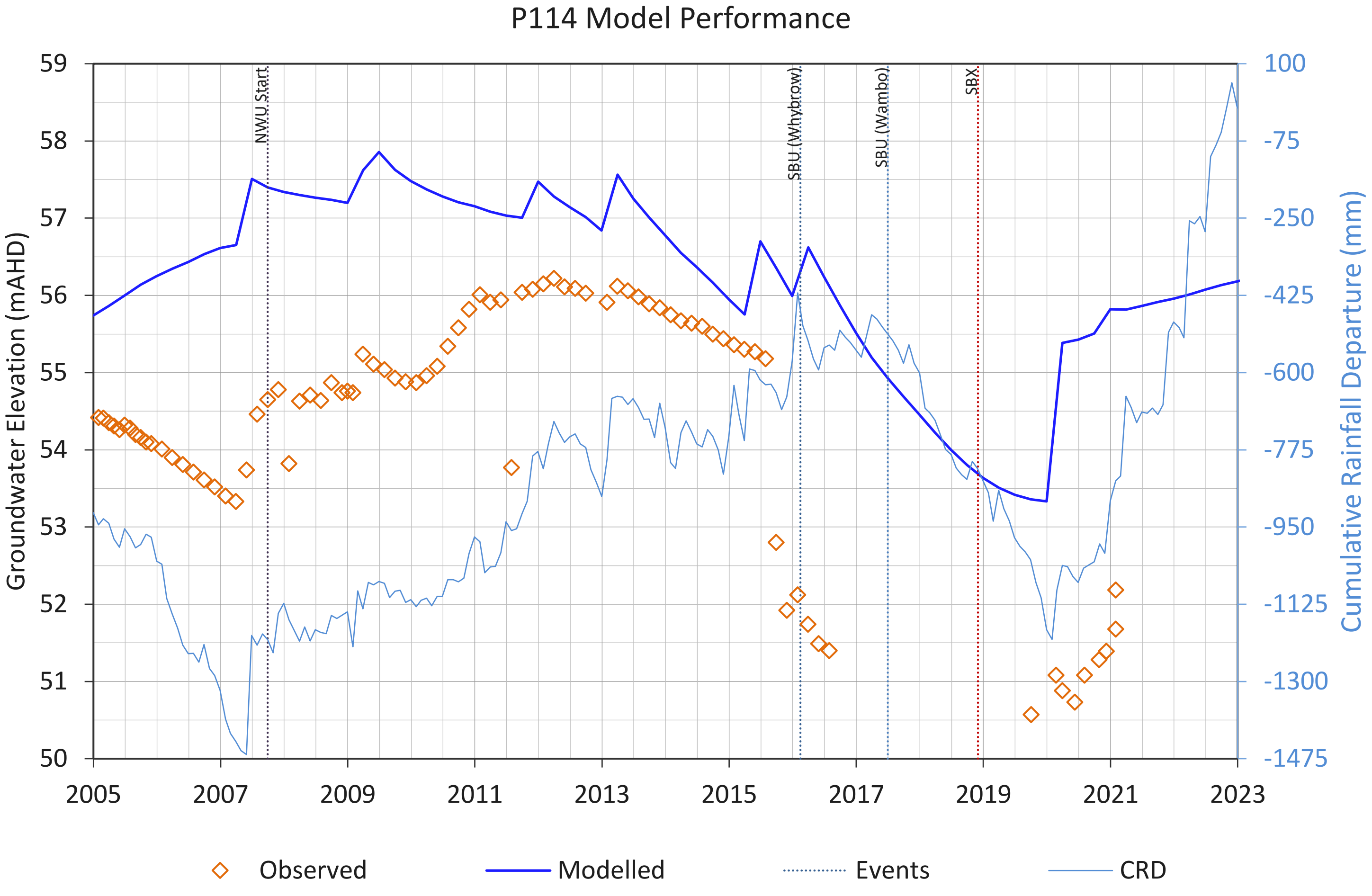


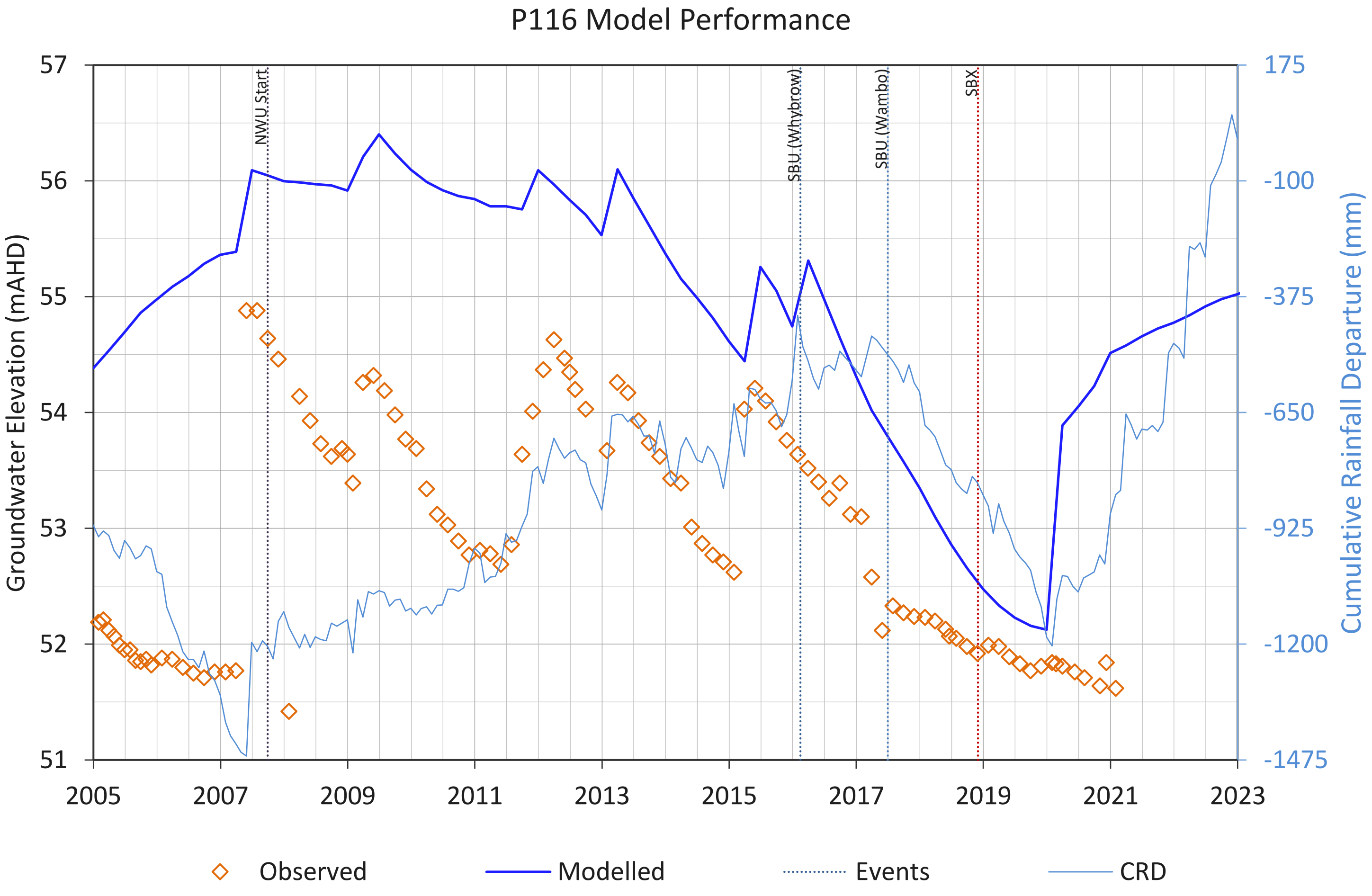

P109 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
61
60
59
58
57
56
55
54
53
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


P11 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
65
60
55
50
45
40
35
30
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

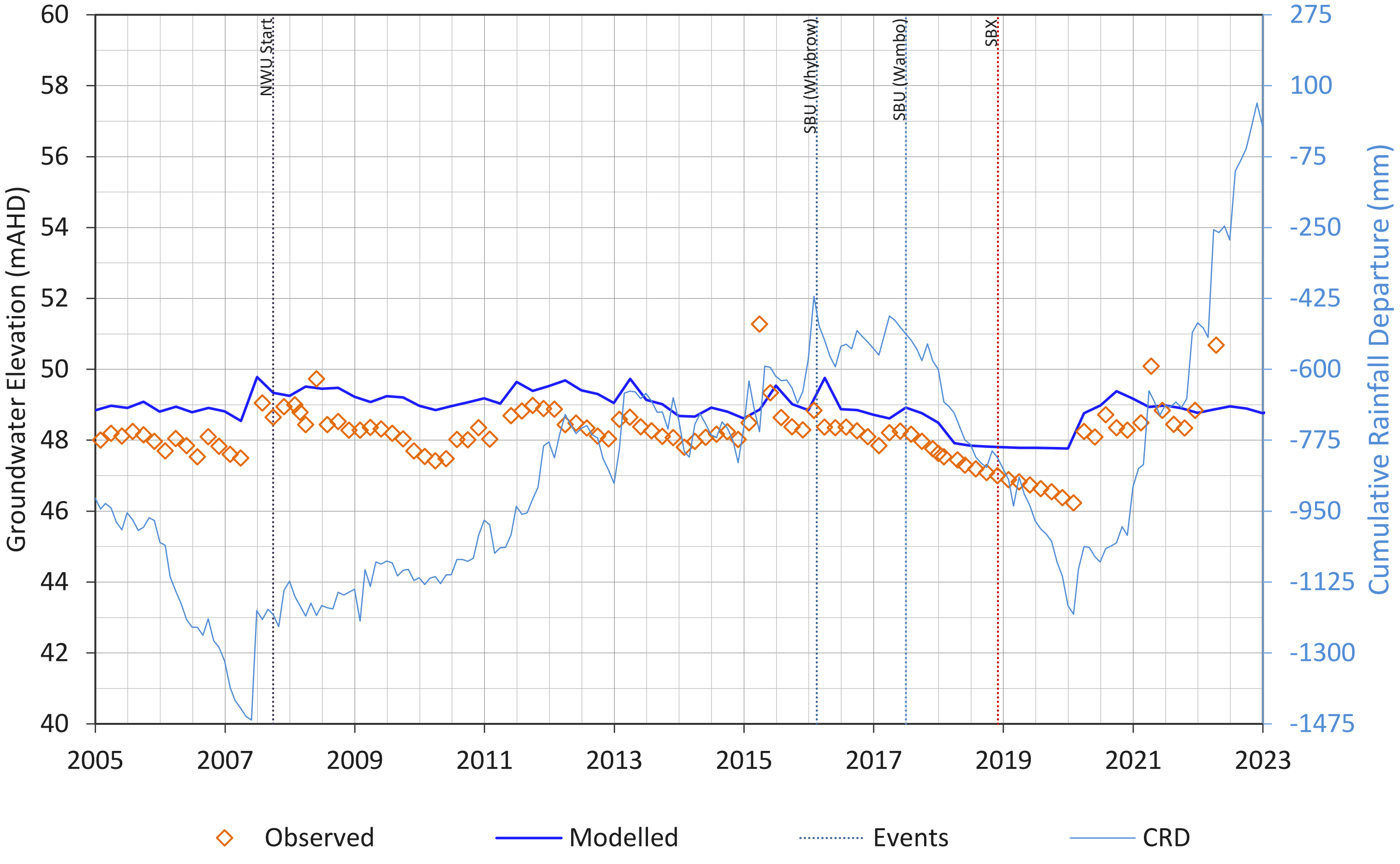

P110 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
70
65
60
55
50
45
40
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


P111 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
70
65
60
55
50
45
40
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

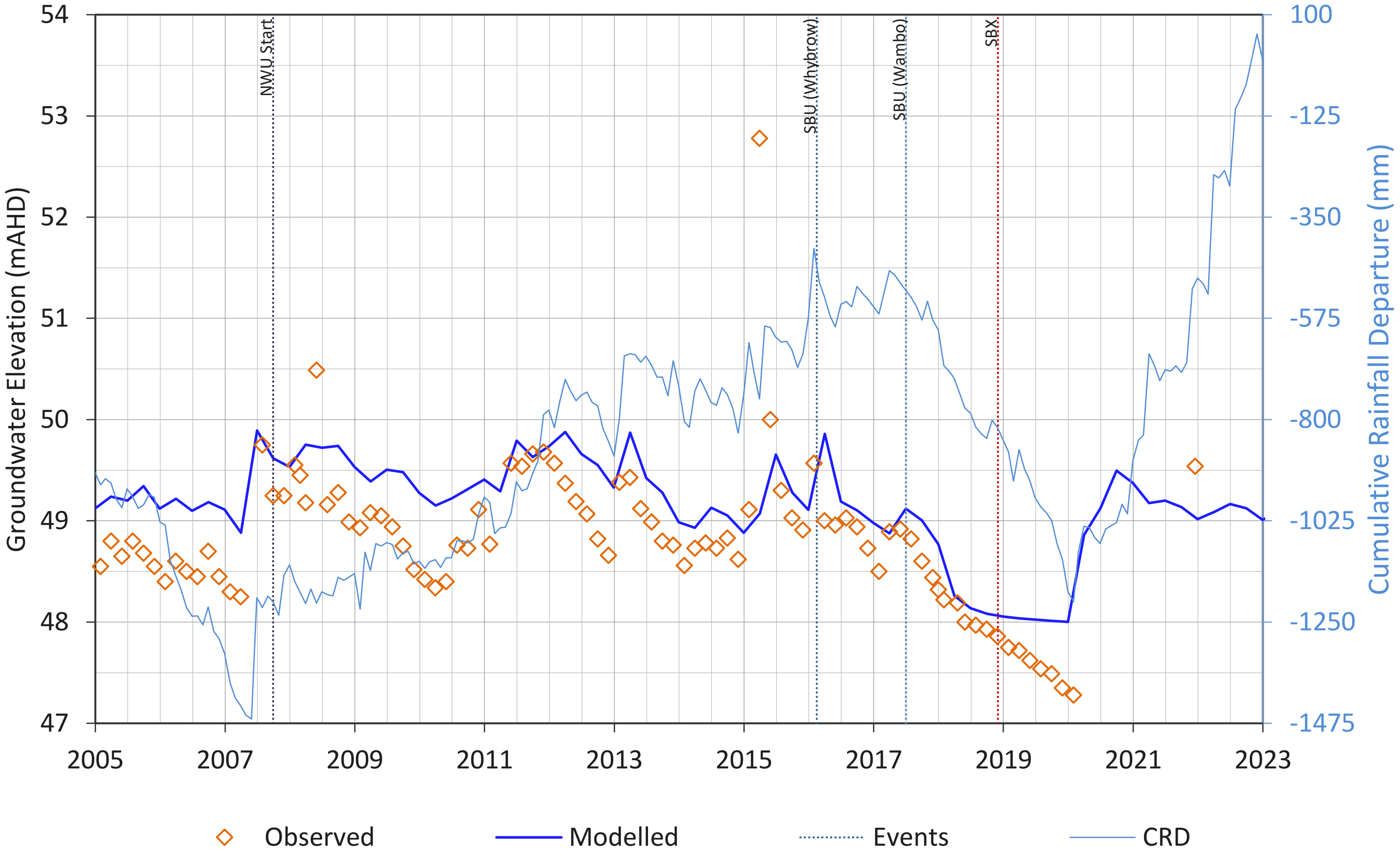

P114 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
59
58
57
56
55
54
53
52
51
50
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
Observed
Modelled
Events
CRD

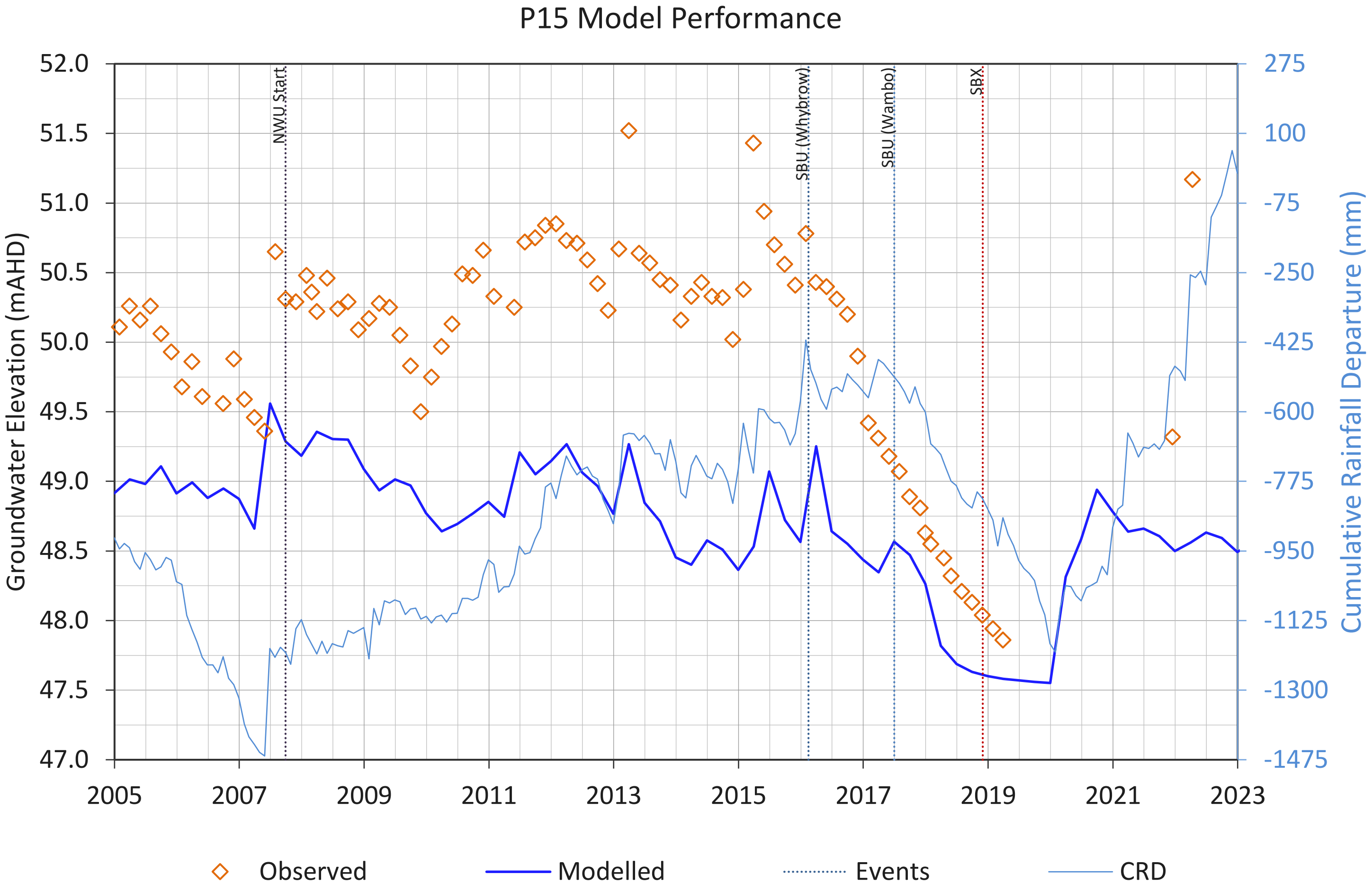

P116 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
57
56
55
54
53
52
51
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
Observed
Modelled
Events
CRD

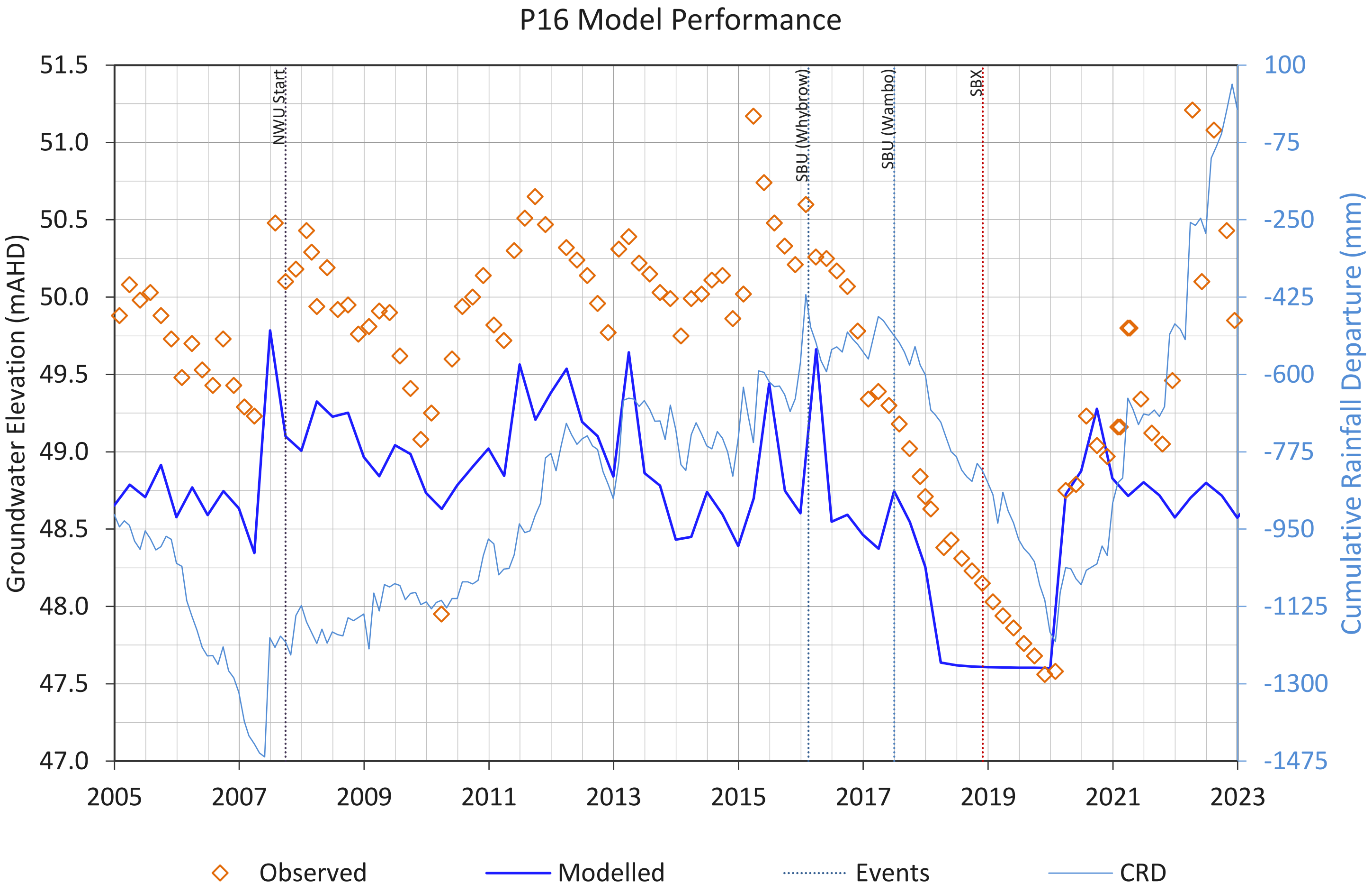
P12 Model Performance

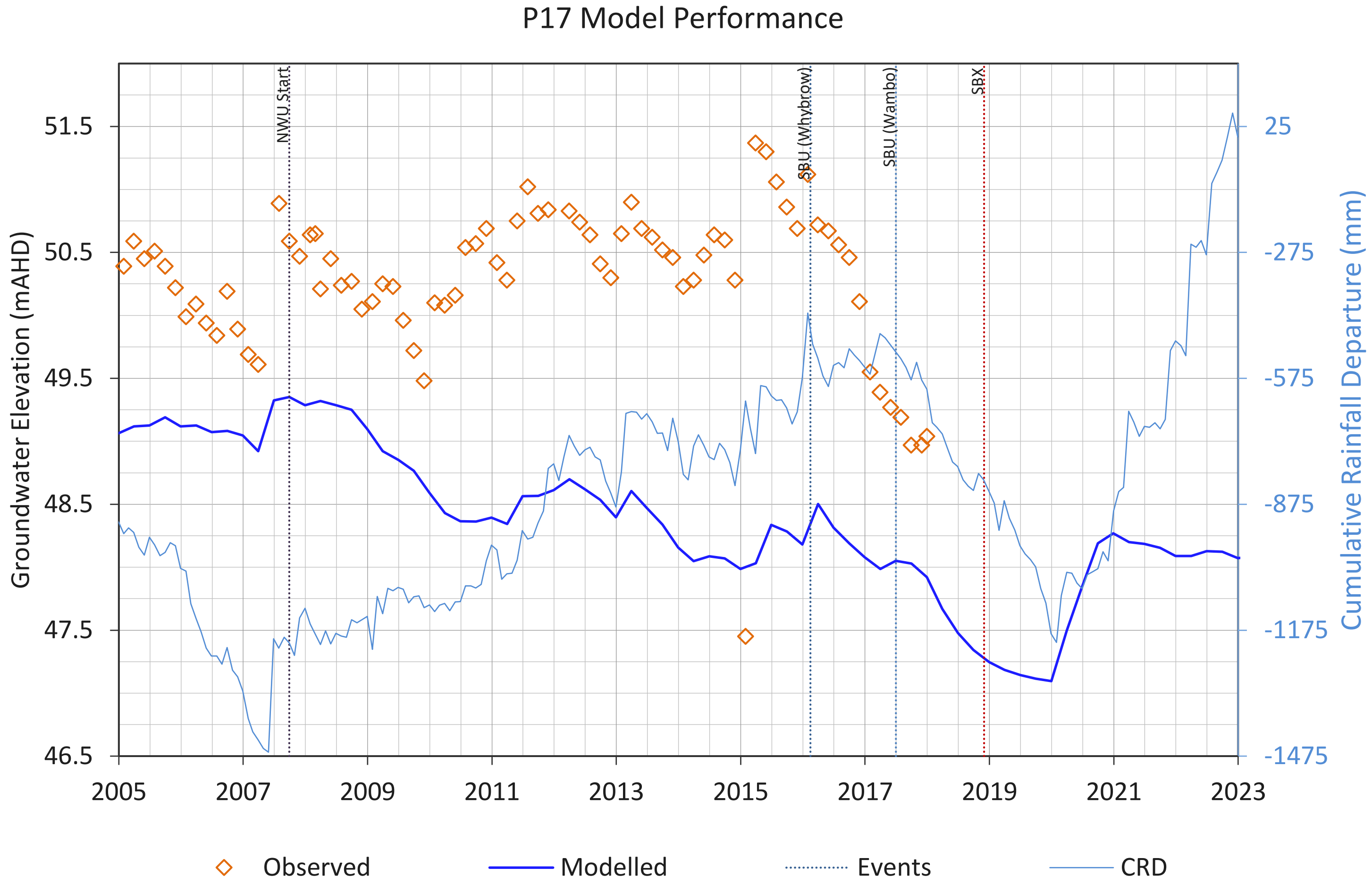


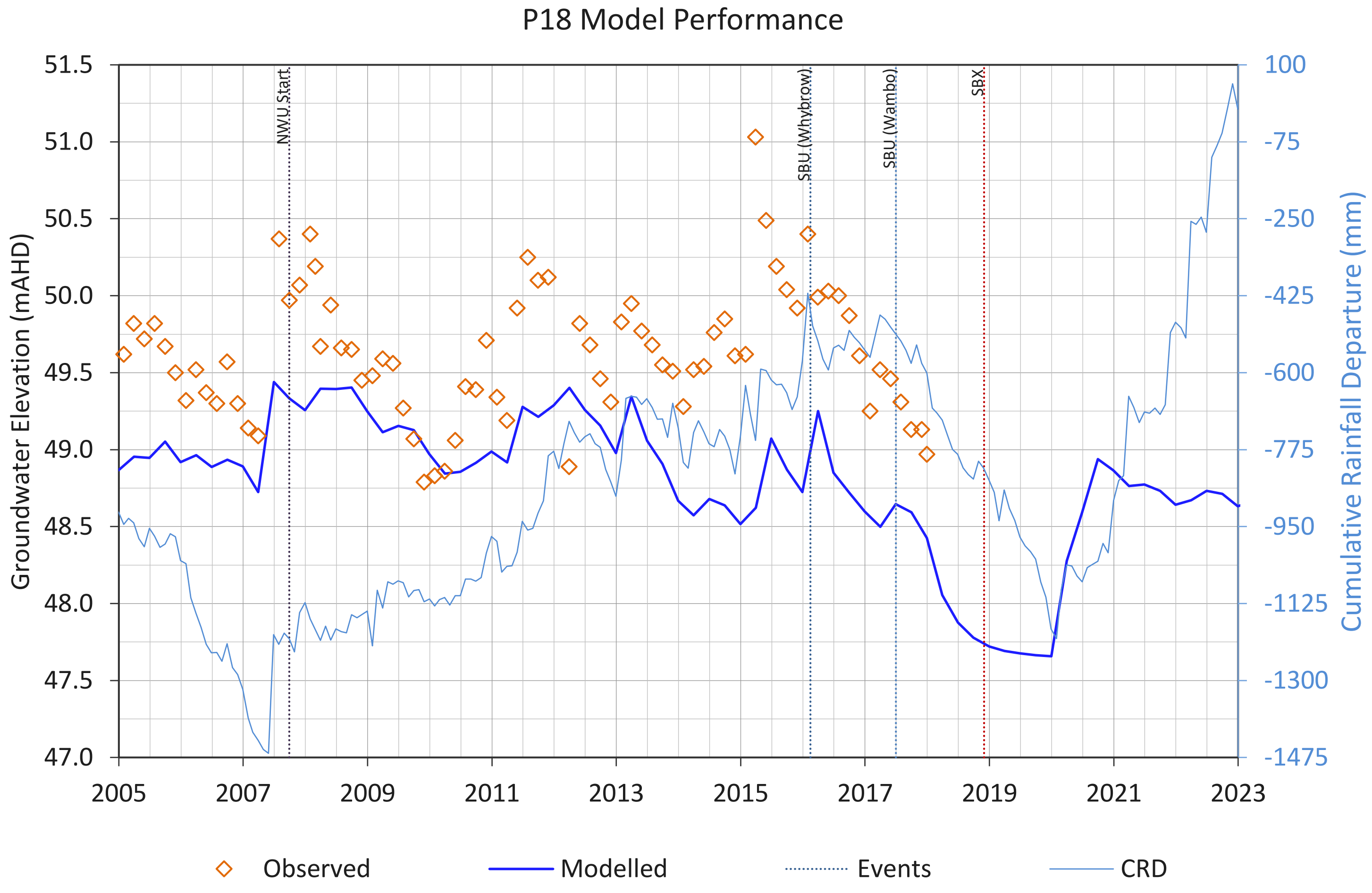
P13 Model Performance

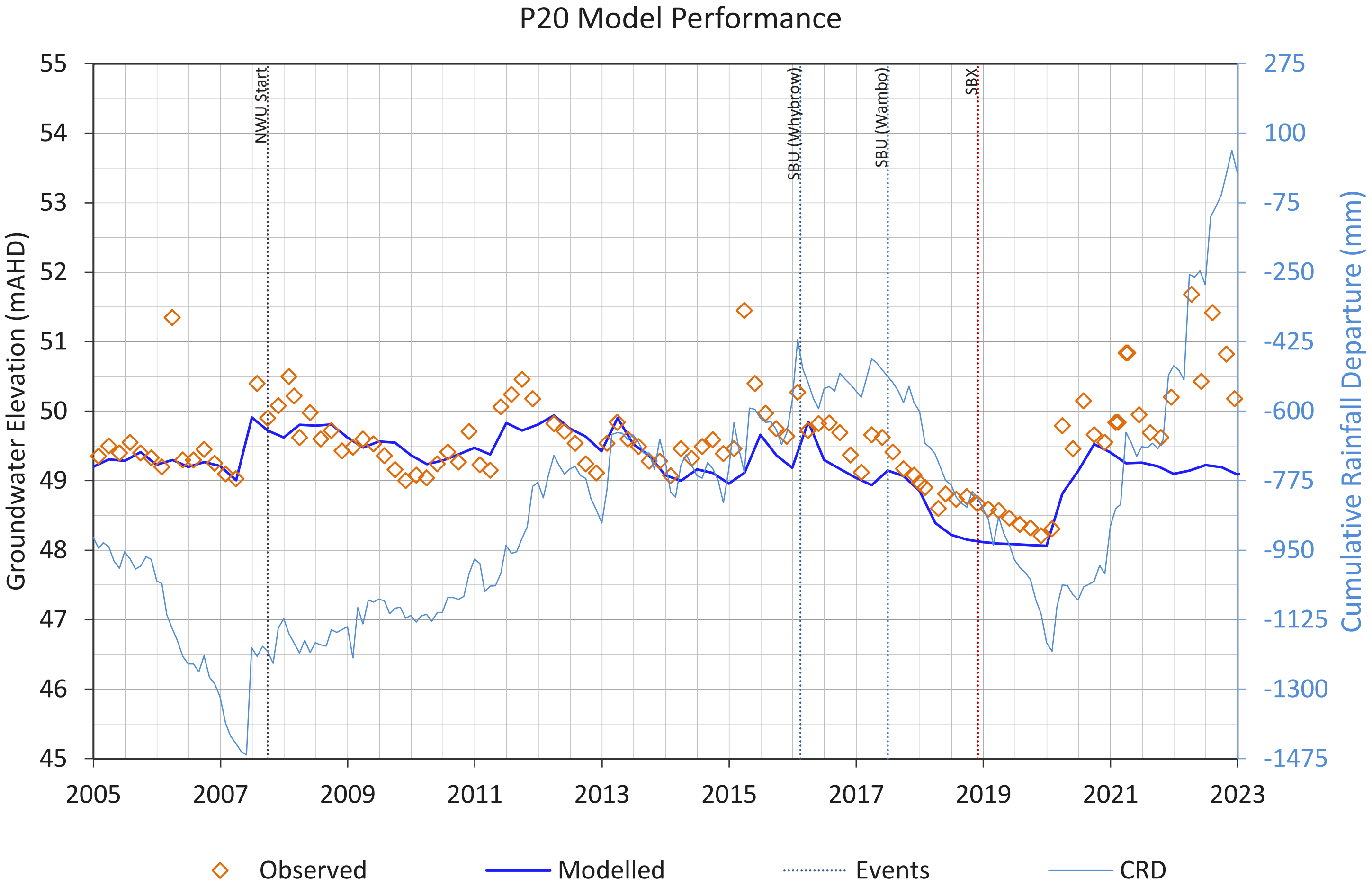


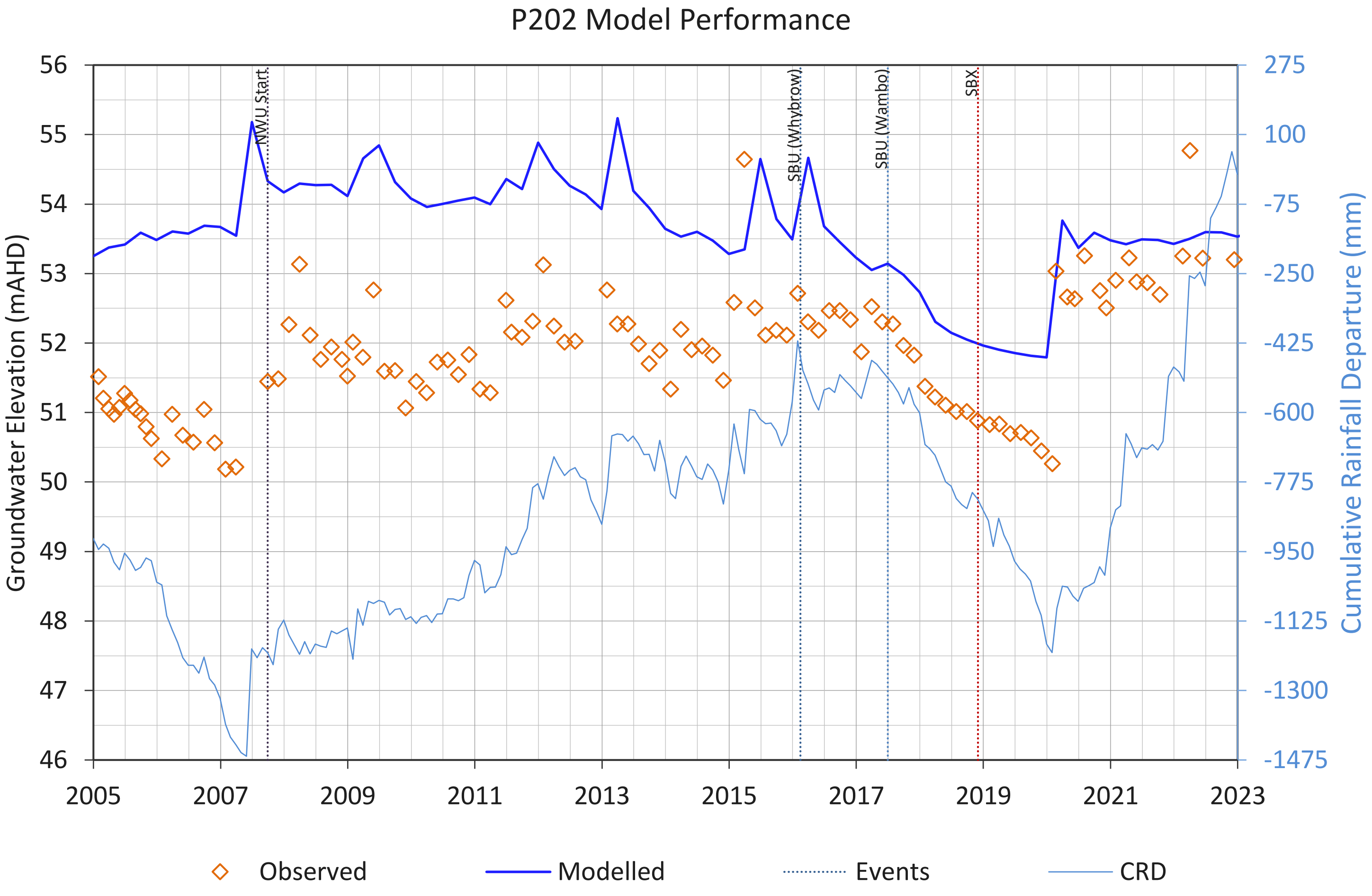

P15 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
52.0
51.5
51.0
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


P16 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
51.5
51.0
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

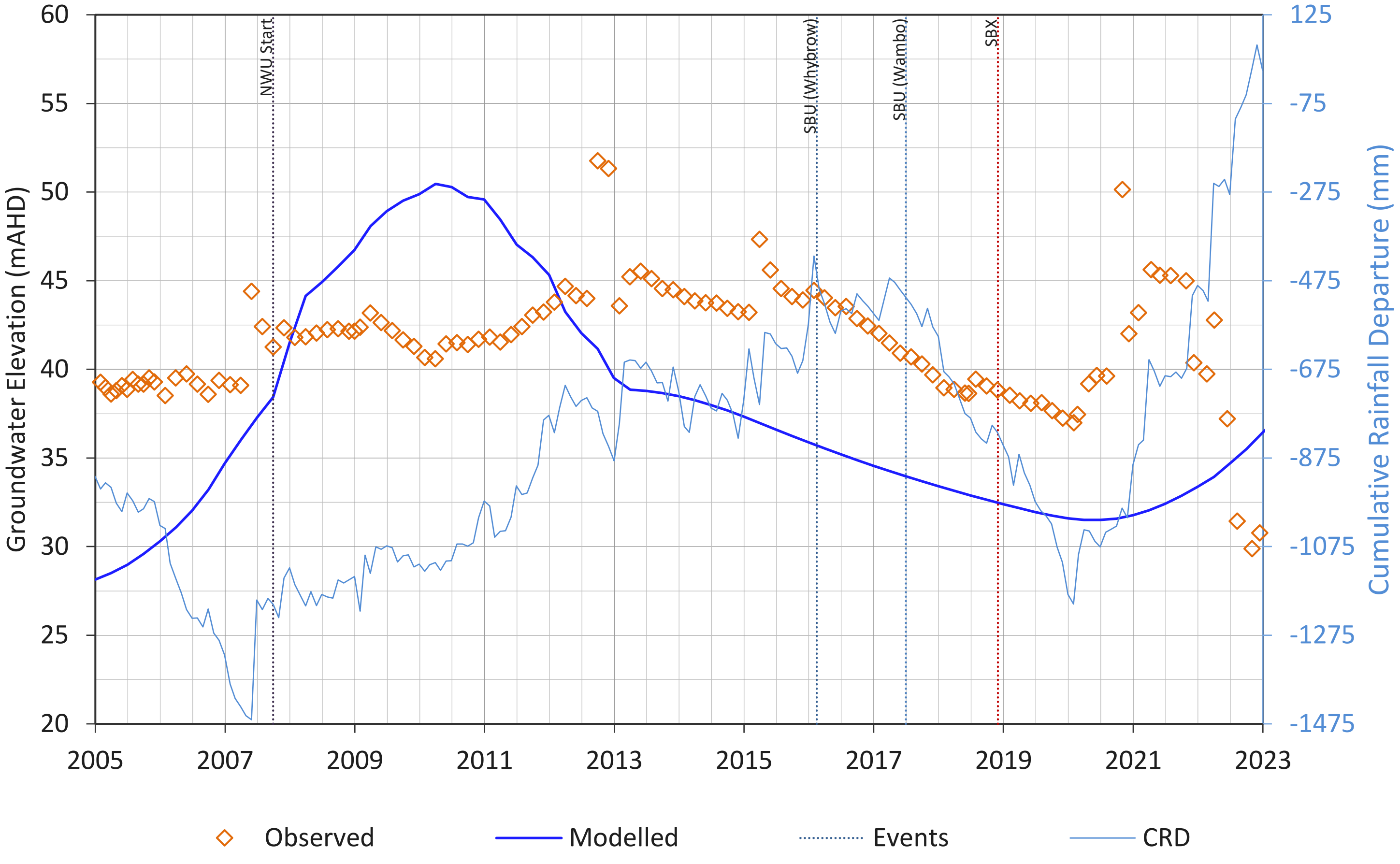

P17 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
51.5
50.5
49.5
48.5
47.5
46.5
25
-275
-575
-875
-1175
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


P18 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
51.5
51.0
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

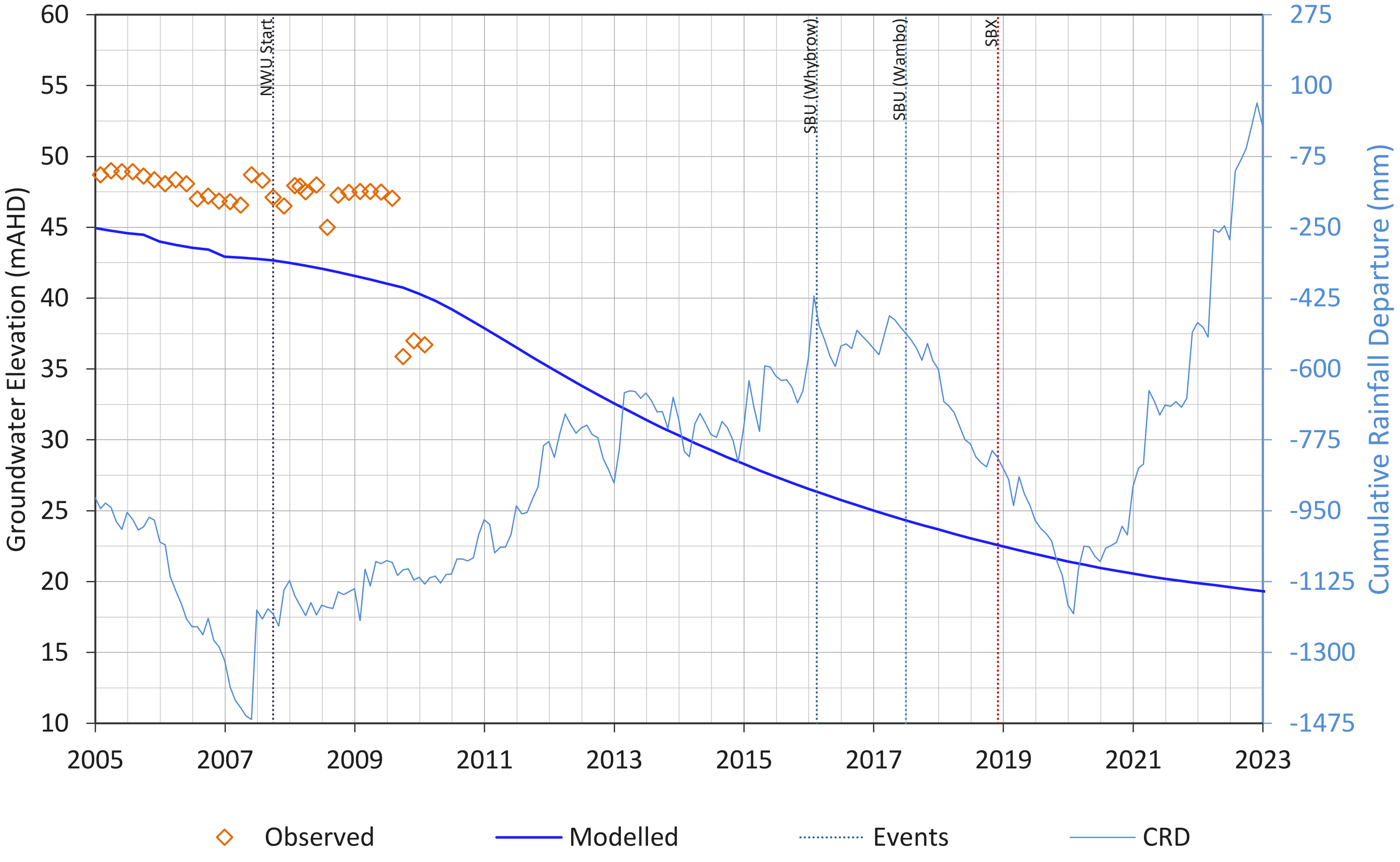

P20 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
55
54
53
52
51
50
49
48
47
46
45
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

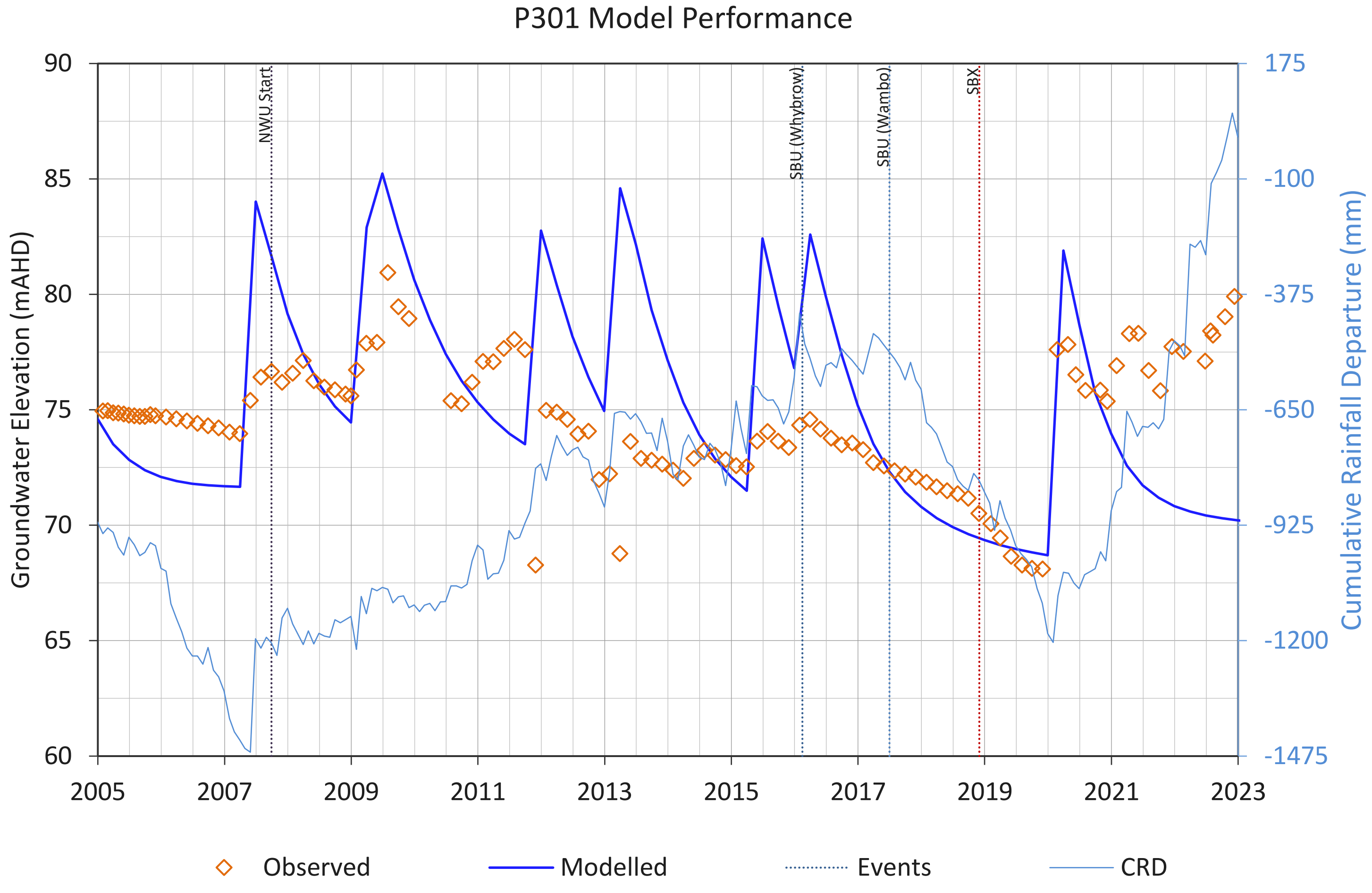

P202 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
56
55
54
53
52
51
50
49
48
47
46
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD

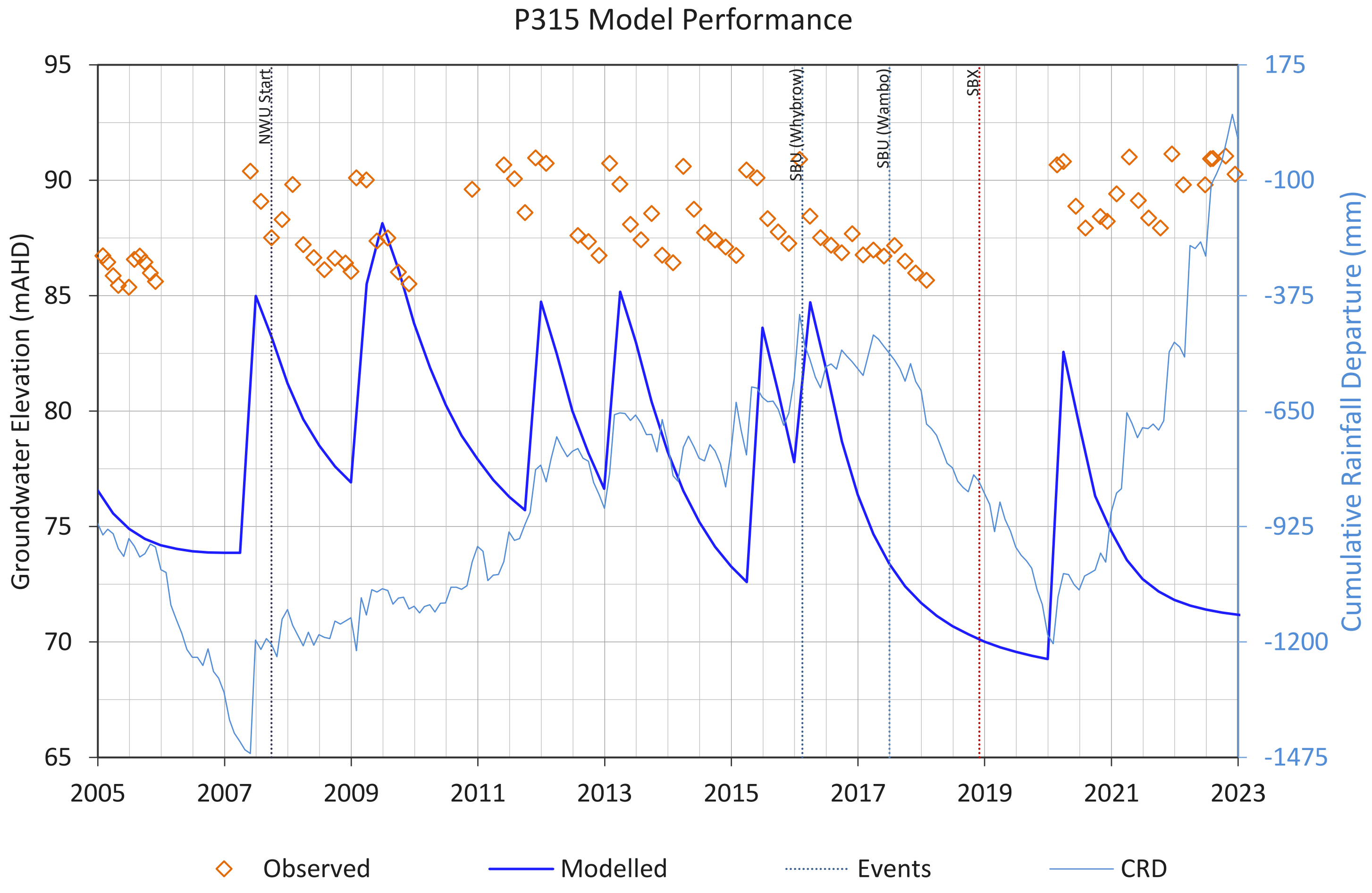
P206 Model Performance

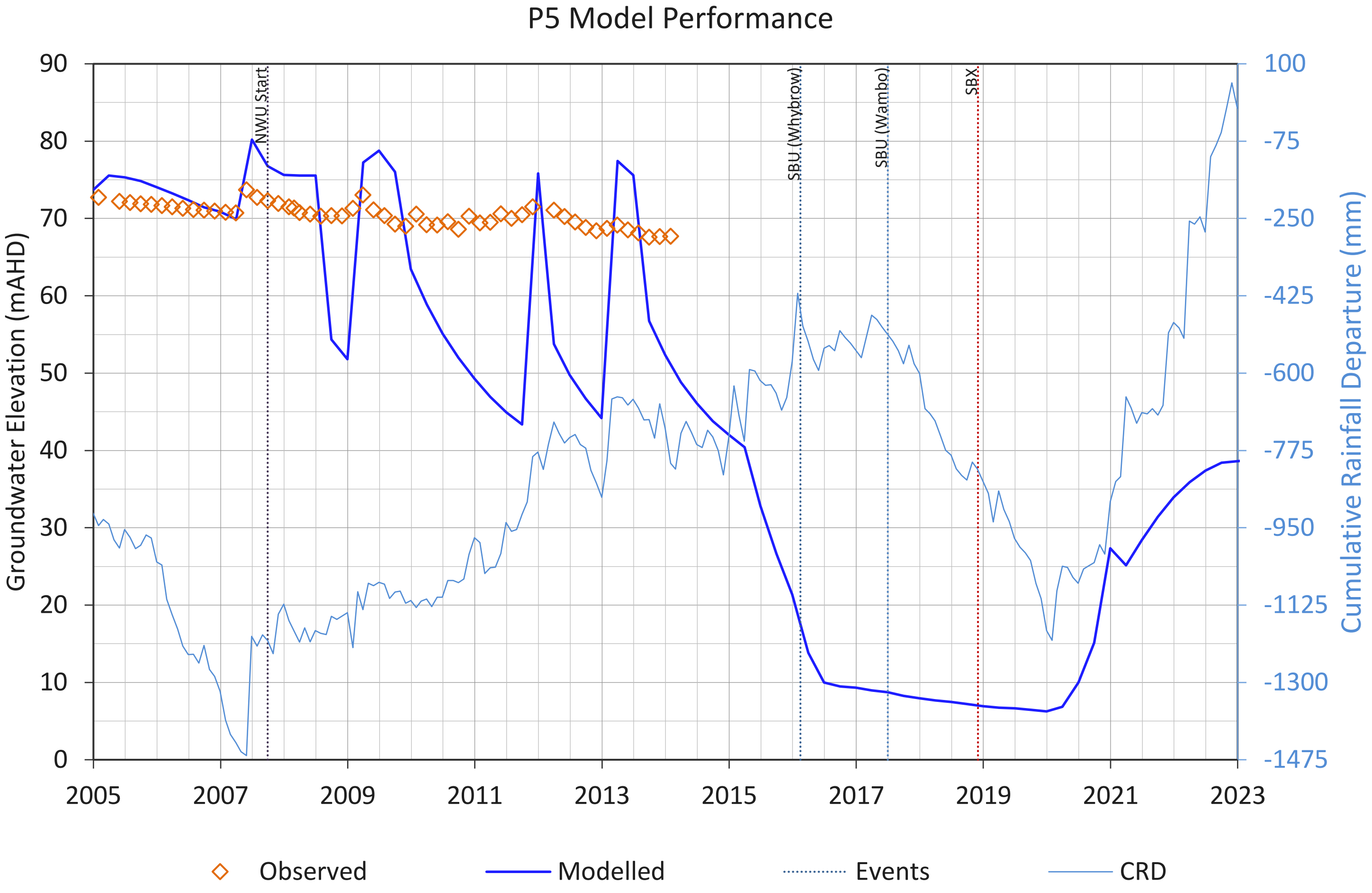


P3 Model Performance

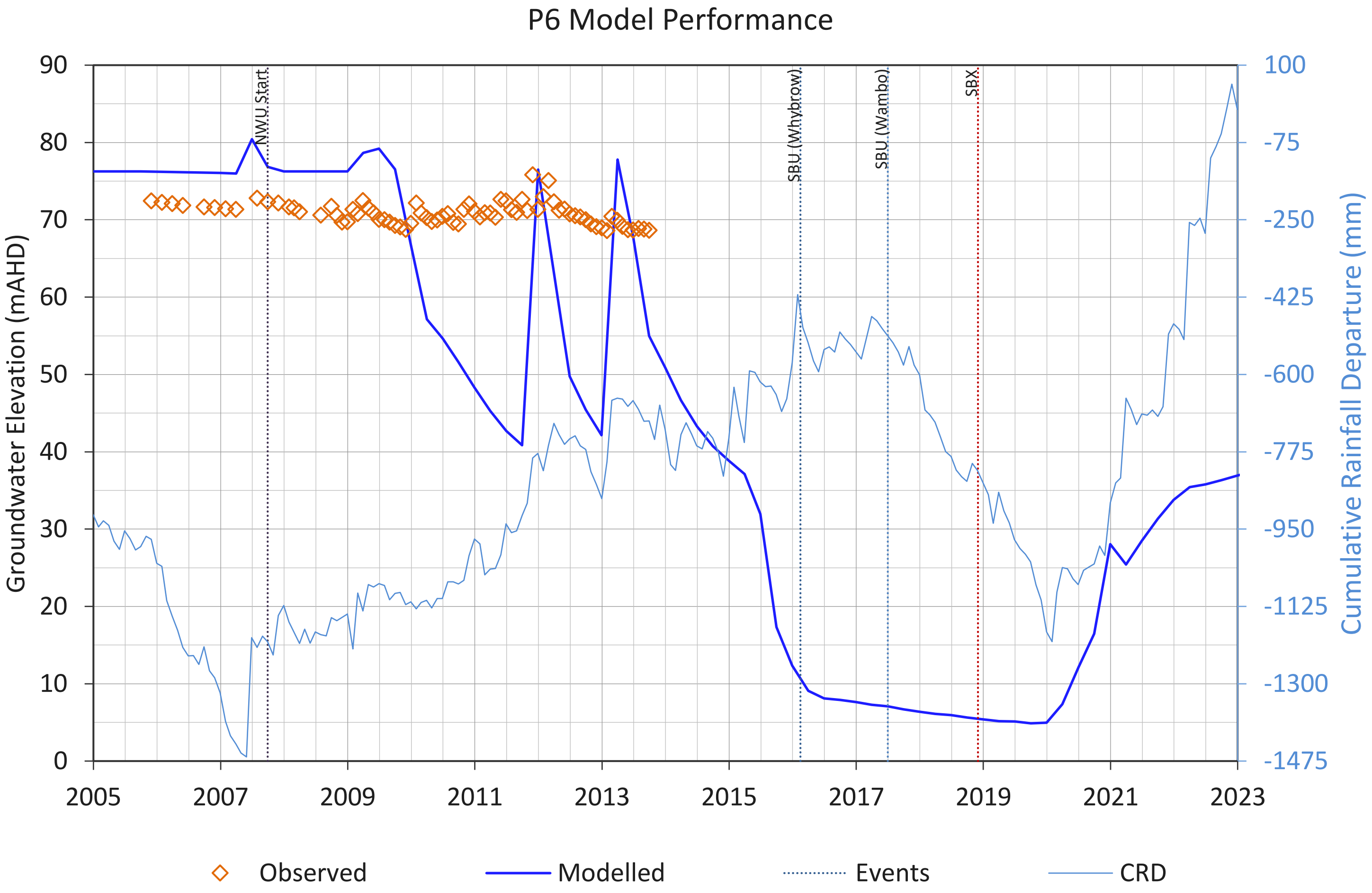



P301 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
90
85
80
75
70
65
60
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD


P315 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
95
90
85
80
75
70
65
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Observed
Modelled
Events
CRD



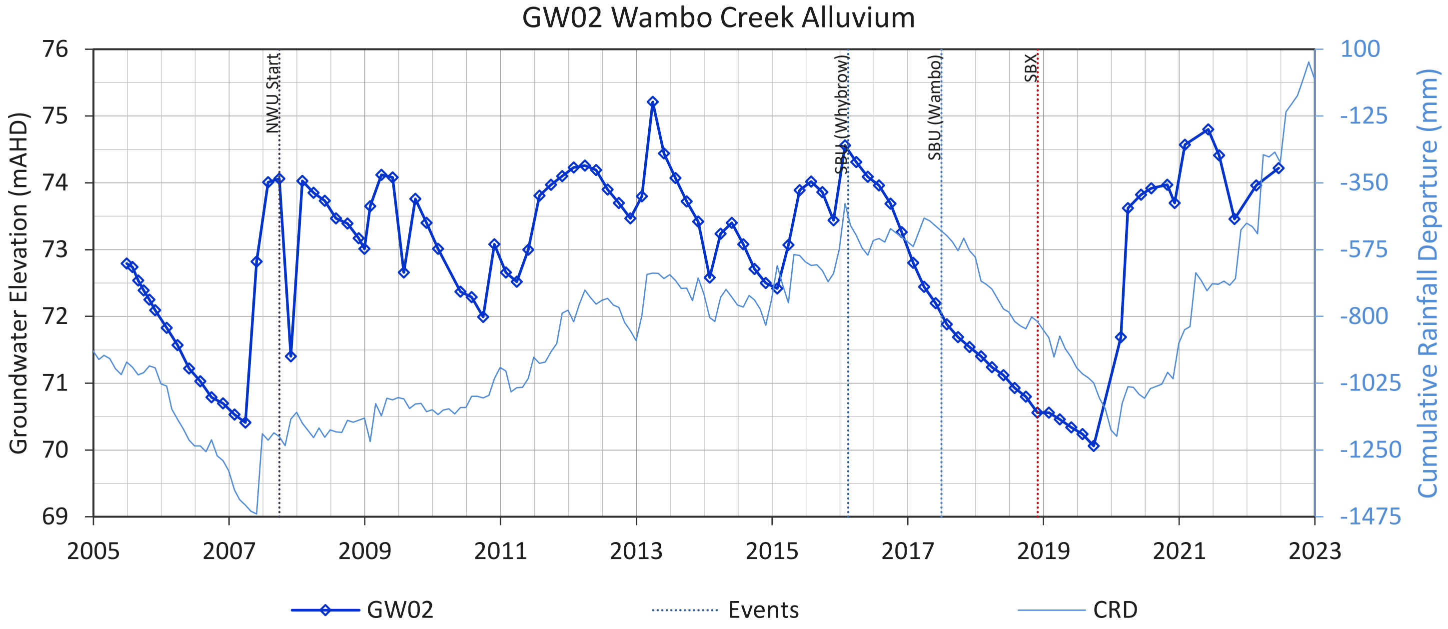
P5 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
0
10
20
30
40
50
60
70
80
90
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
Observed
Modelled
Events
CRD

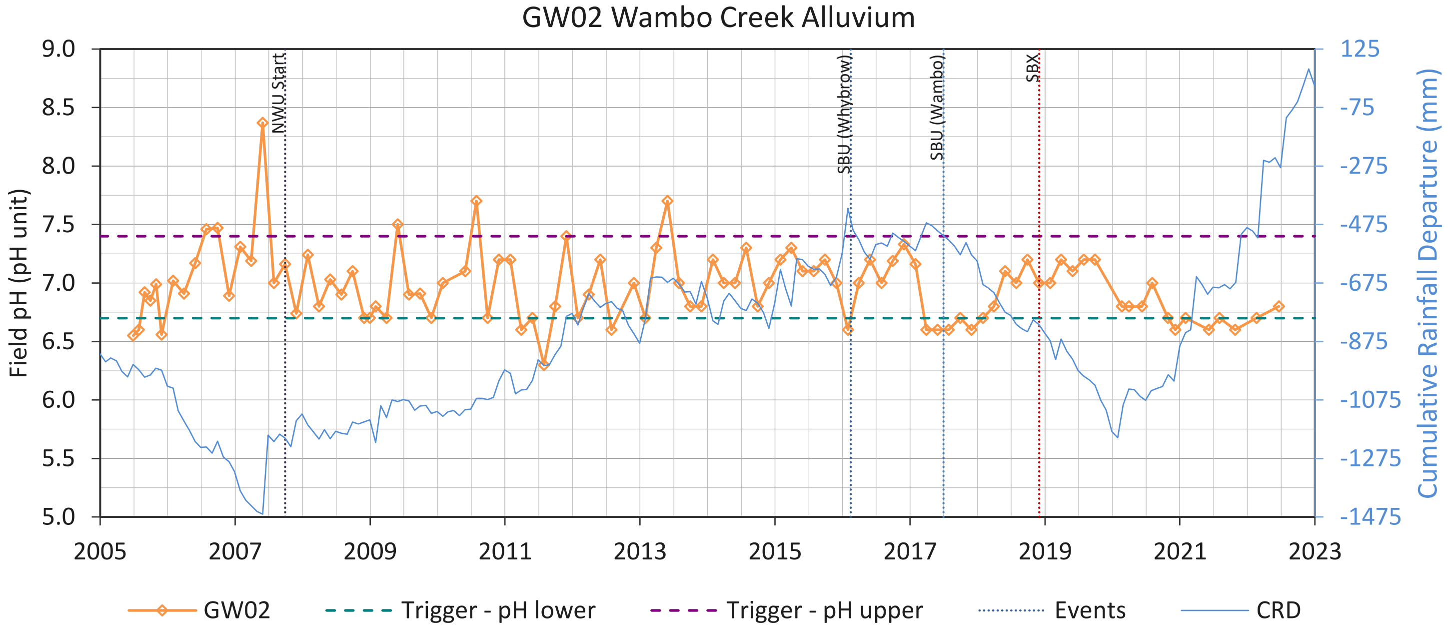


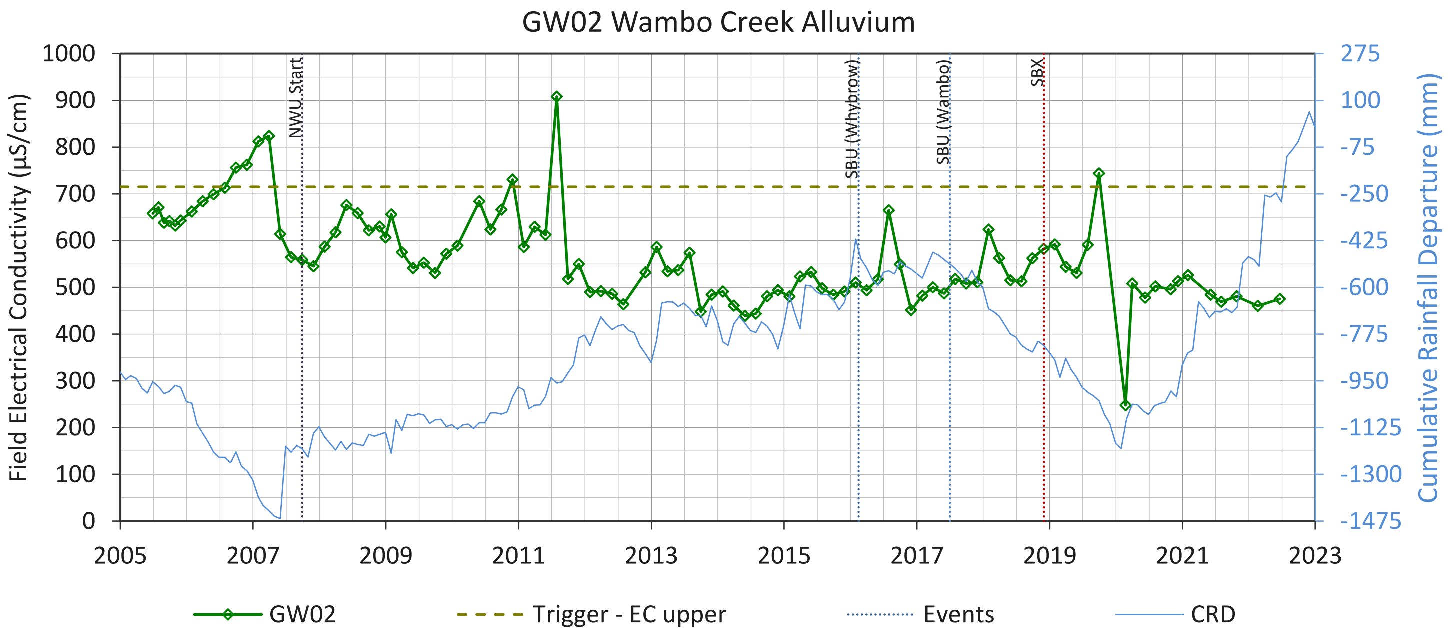
P6 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
0
10
20
30
40
50
60
70
80
90
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
Observed
Modelled
Events
CRD

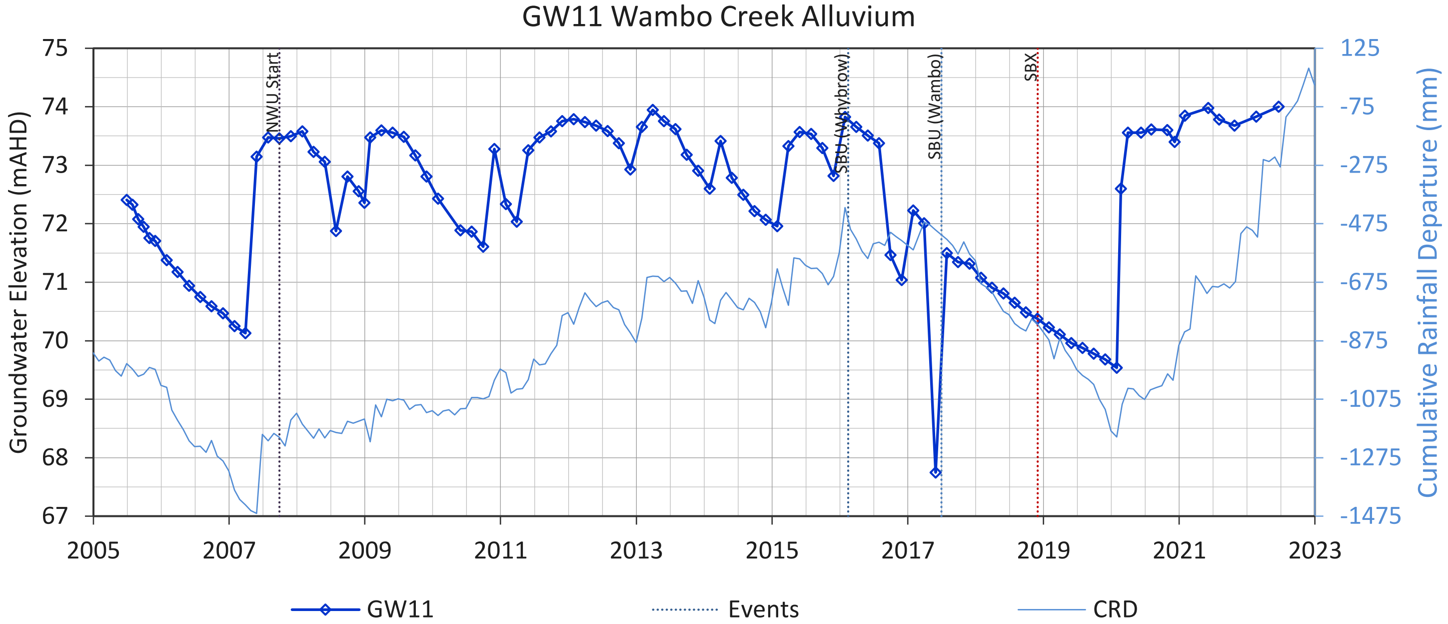
APPENDIX B

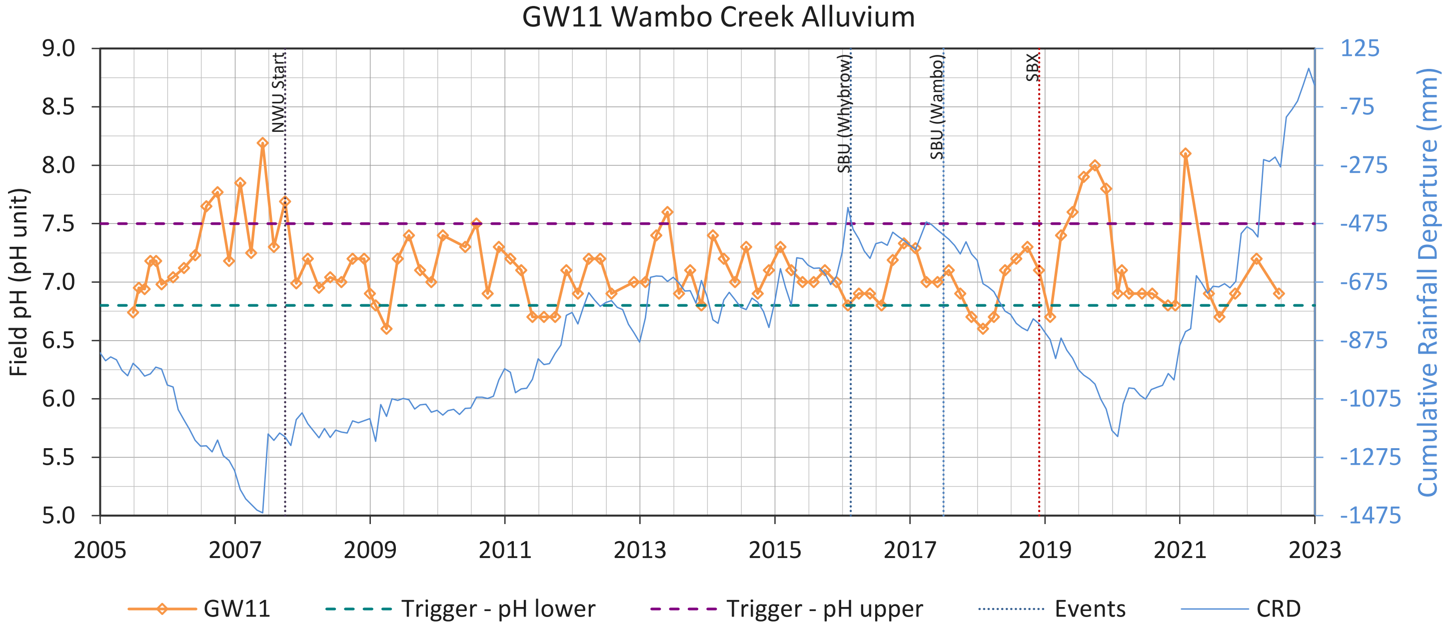
Groundwater Level and Groundwater Quality Graphs

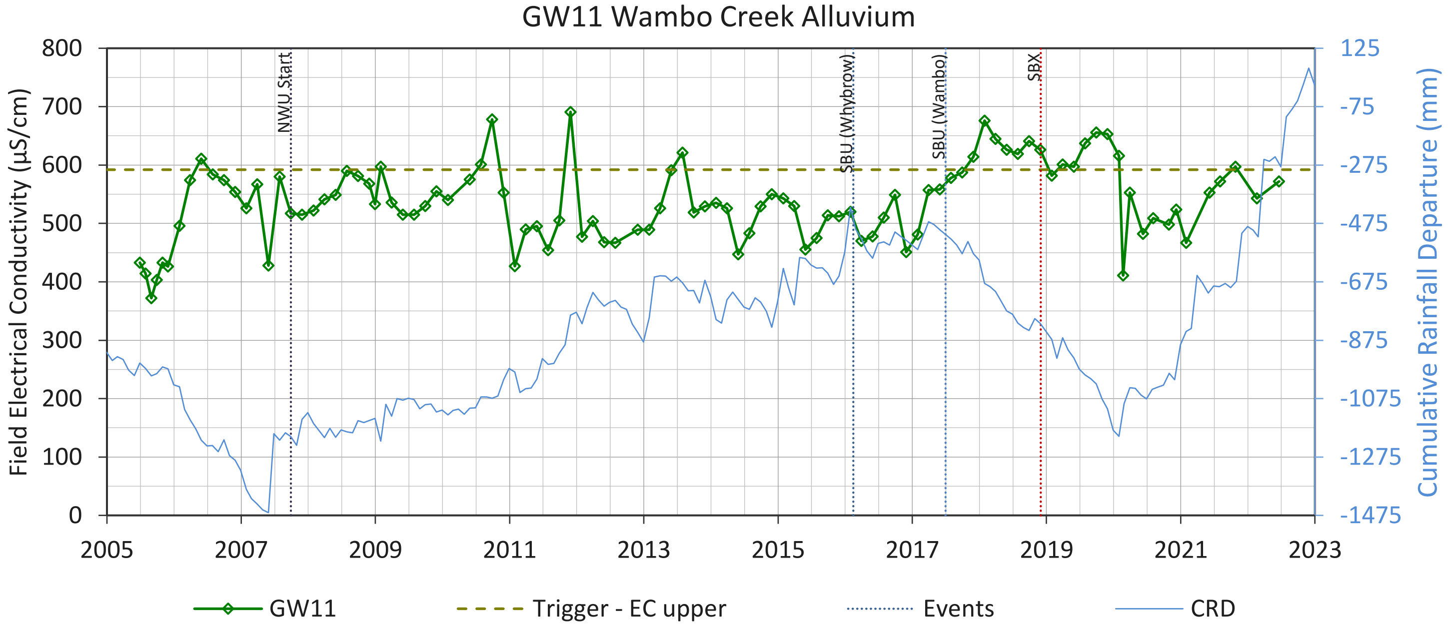

GW02 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW02
Events
CRD

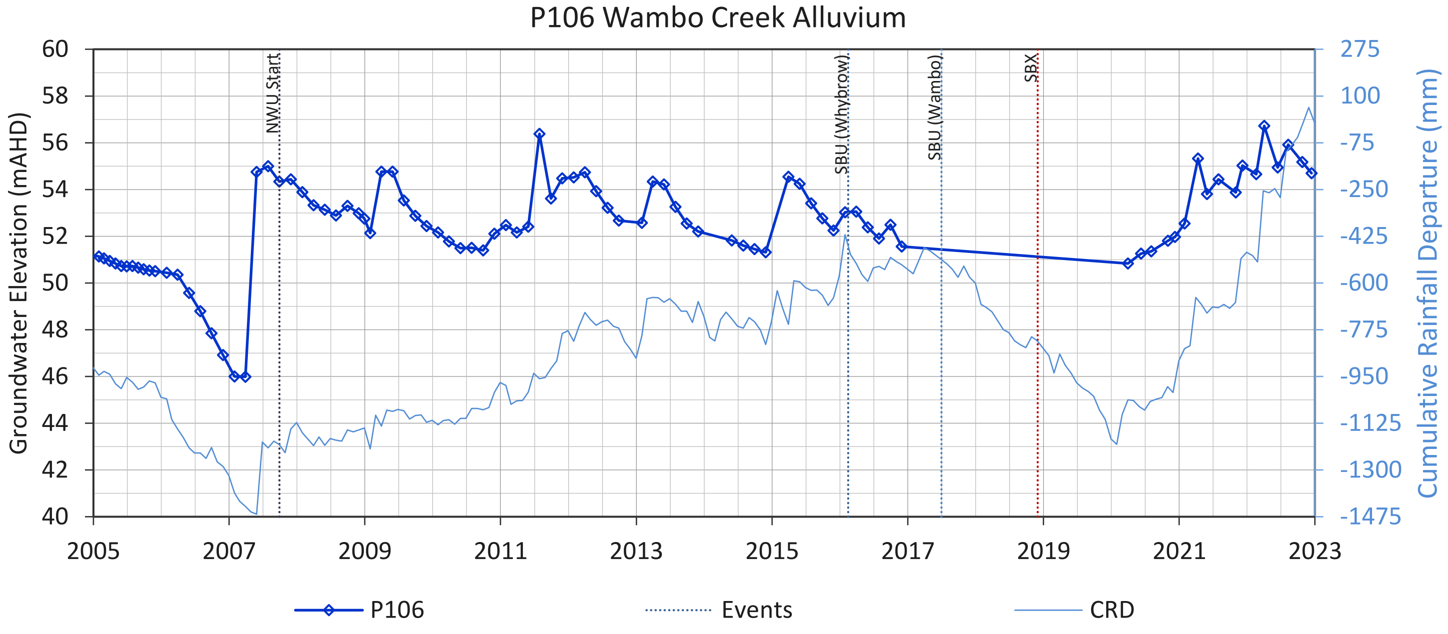

GW02 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW02
Trigger - pH lower
Trigger - pH upper
Events
CRD

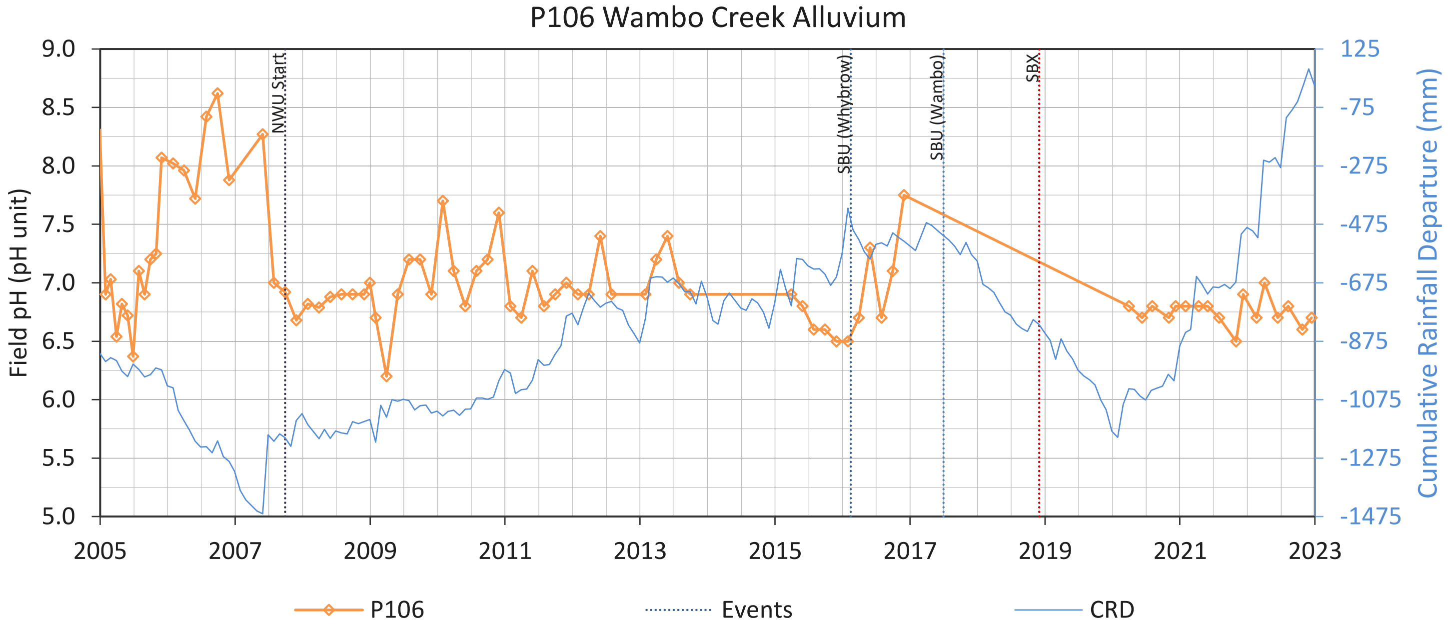

GW02 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW02
Trigger - EC upper
Events
CRD

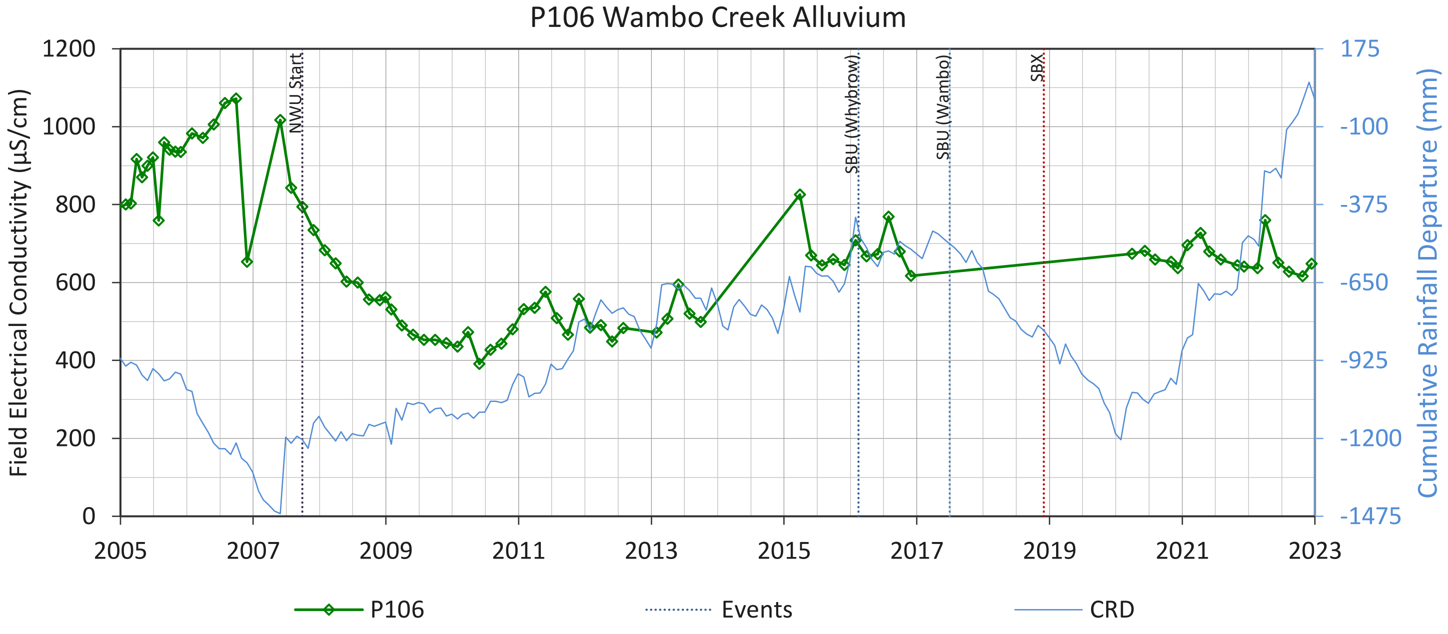

GW11 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW11
Events
CRD

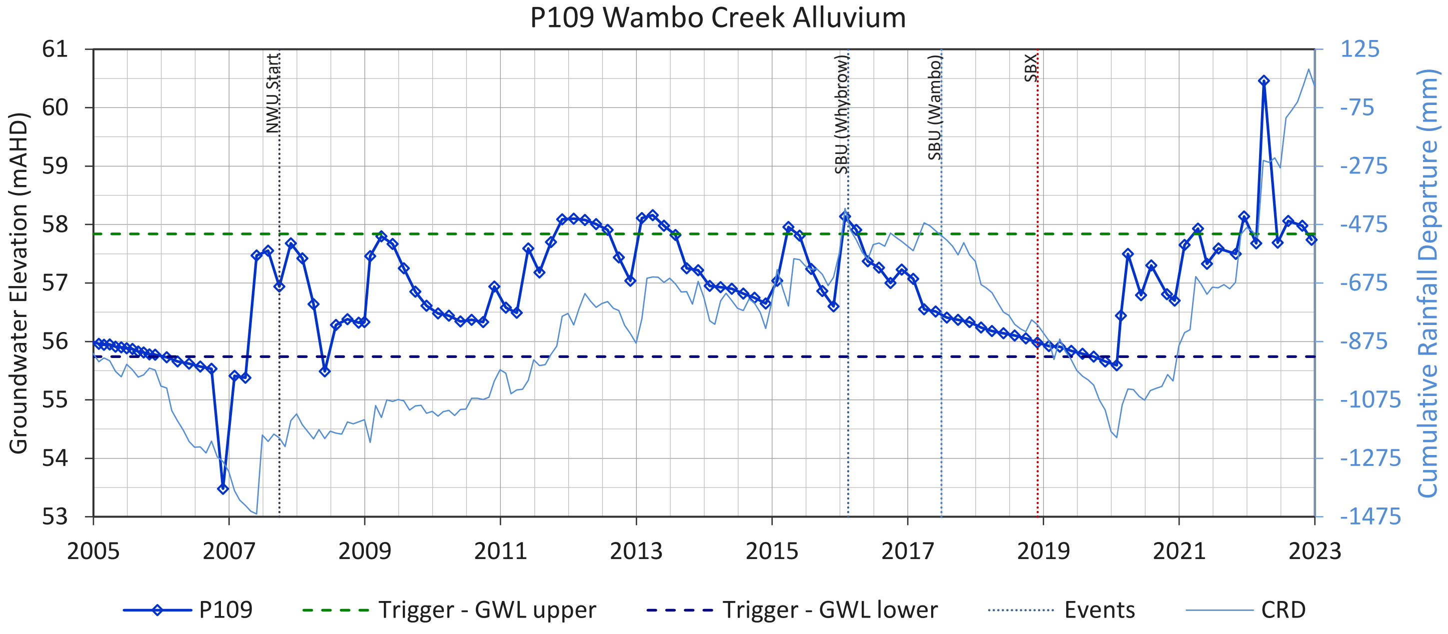

GW11 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW11
Trigger - pH lower
Trigger - pH upper
Events
CRD

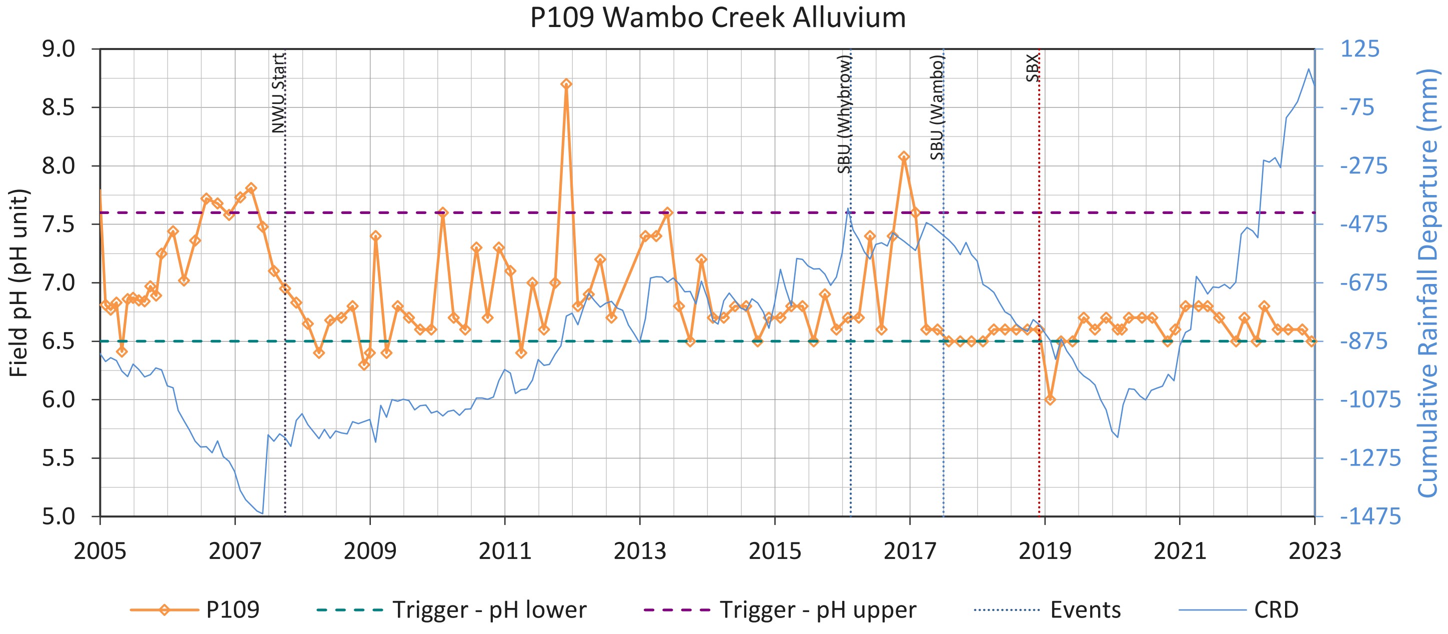

GW11 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW11
Trigger - EC upper
Events
CRD

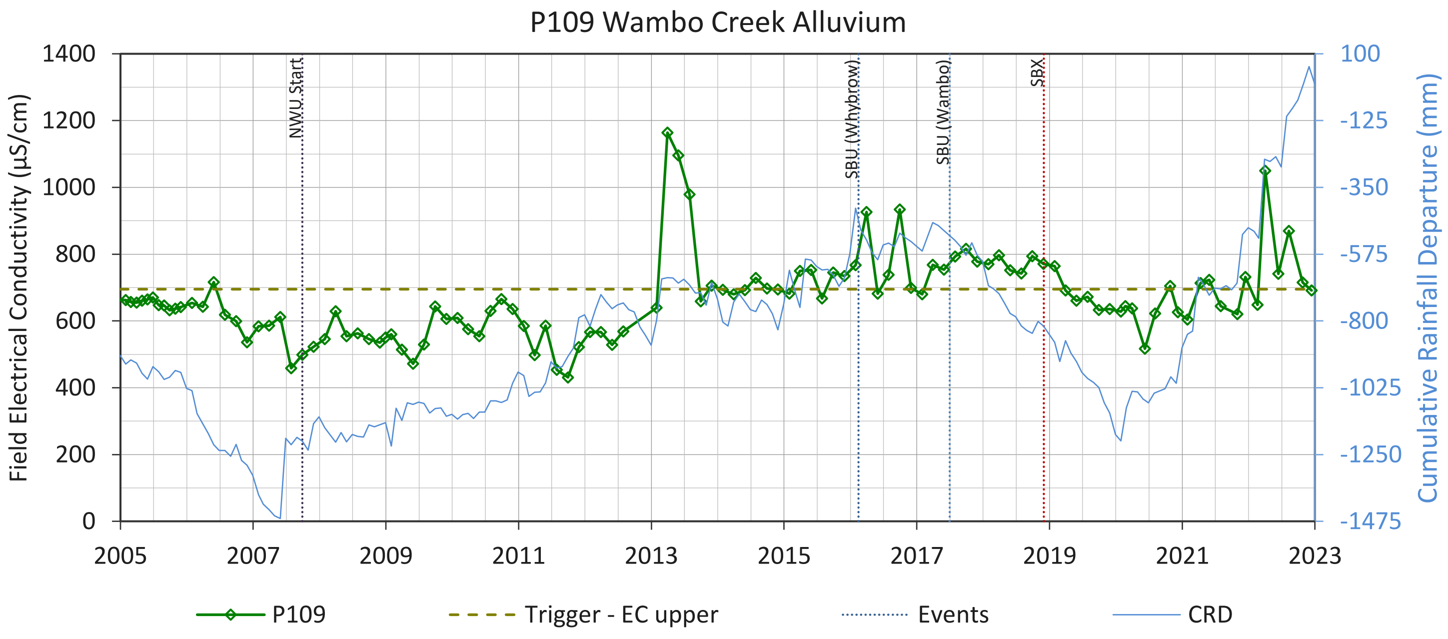

P106 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

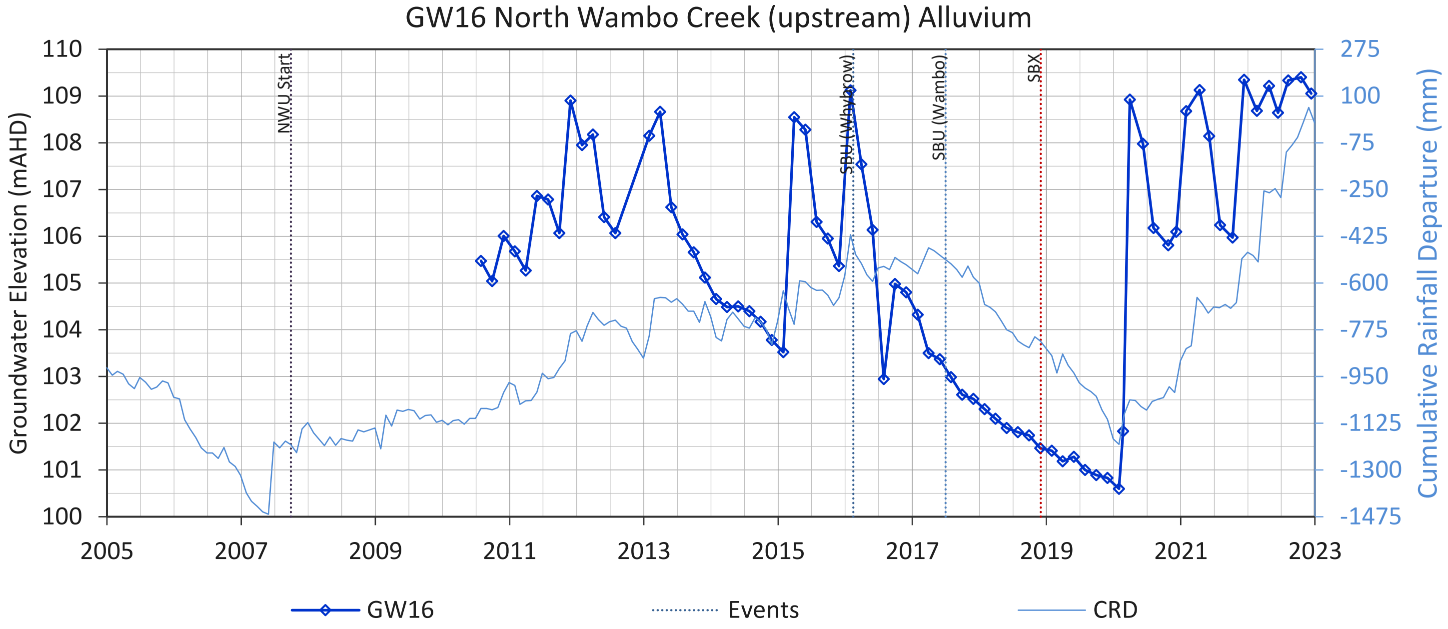

P106 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

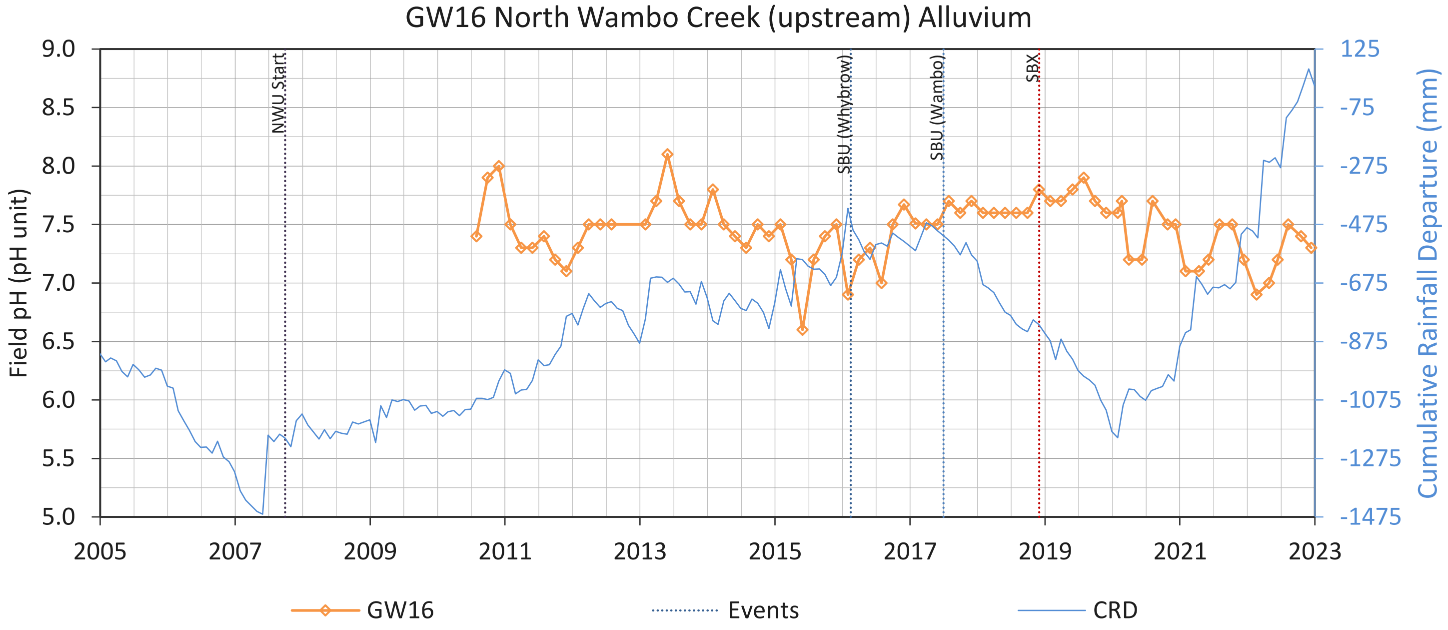

P106 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

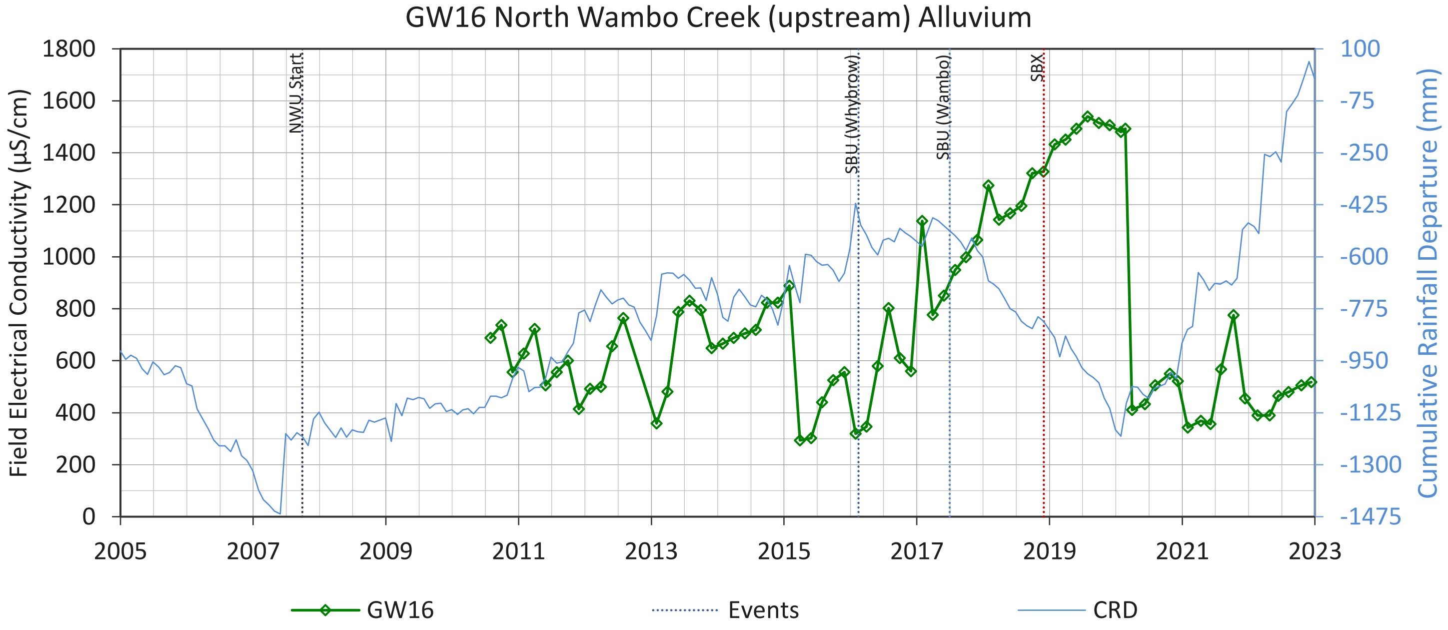

P109 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P109
Trigger - GWL upper
Trigger - GWL lower
Events
CRD

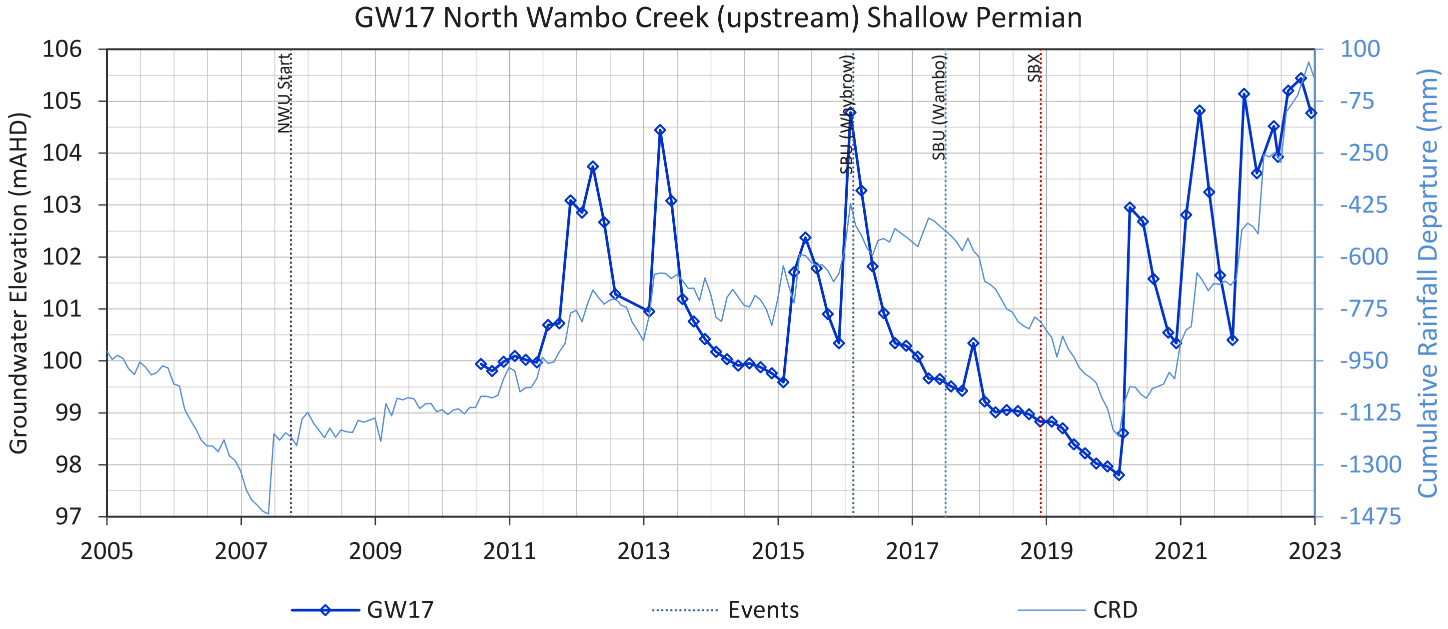

P109 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P109
Trigger - pH lower
Trigger - pH upper
Events
CRD

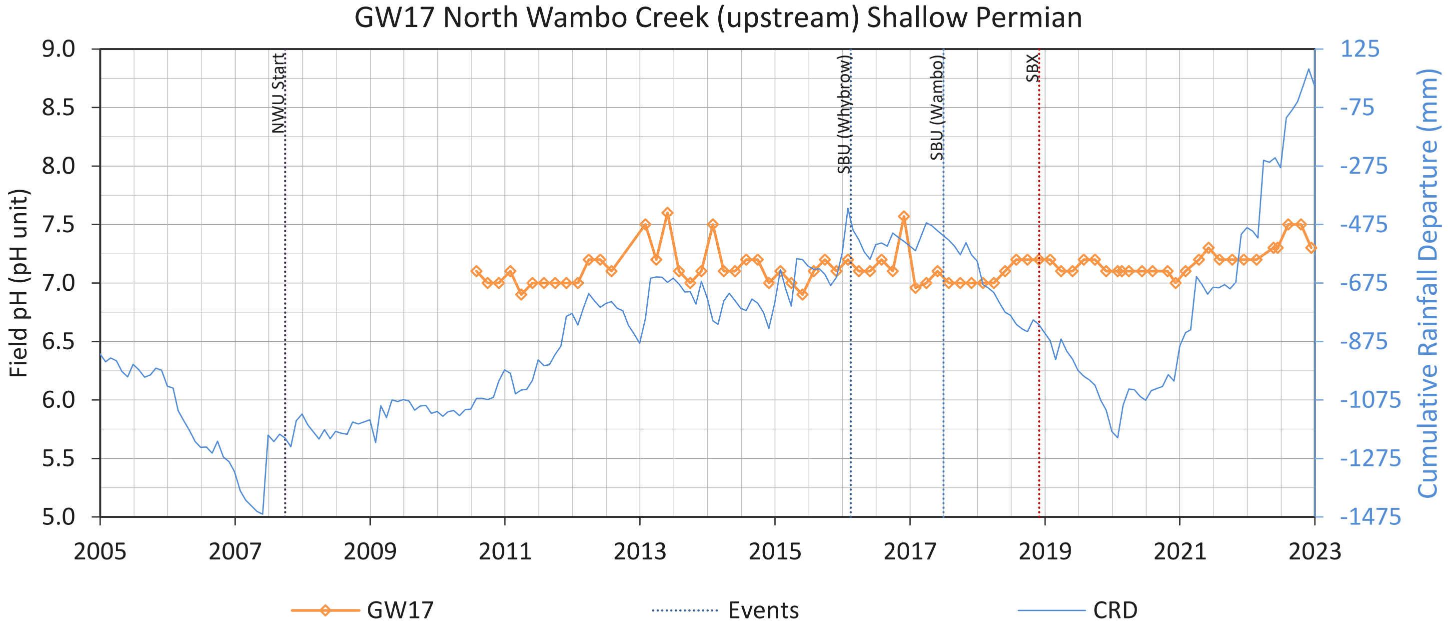

P109 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P109
Trigger - EC upper
Events
CRD

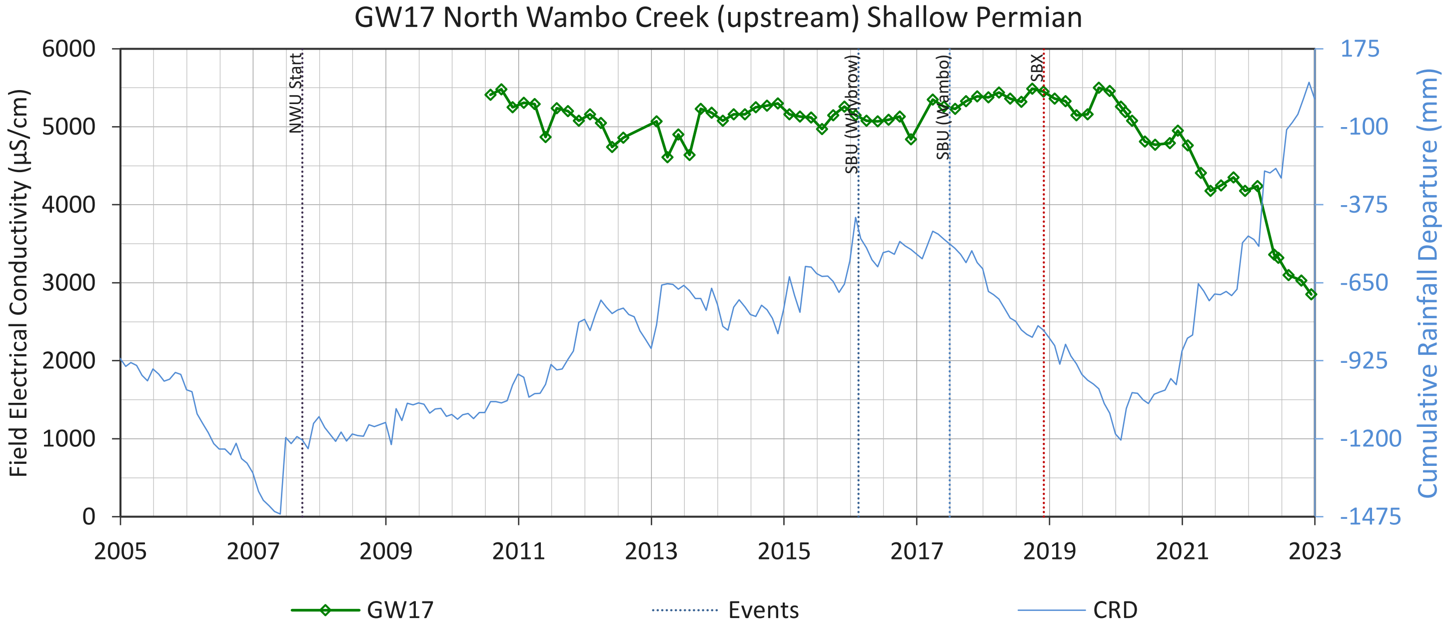

GW16 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

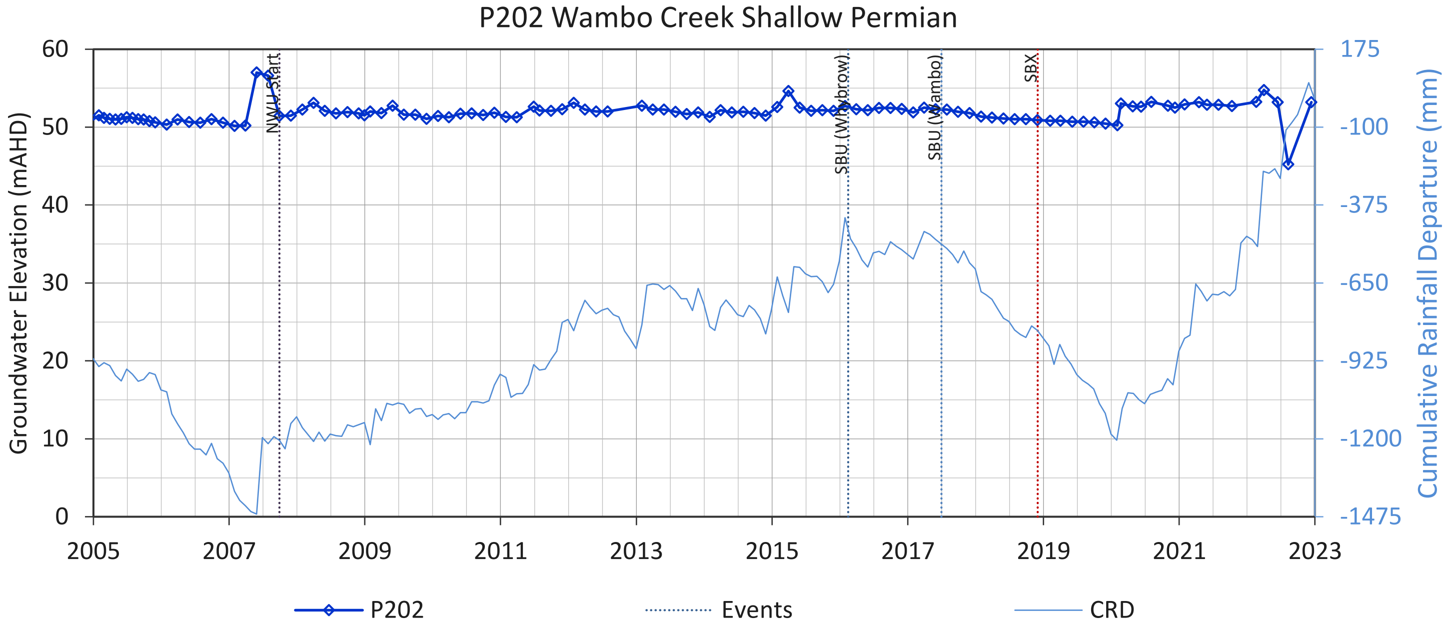

GW16 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

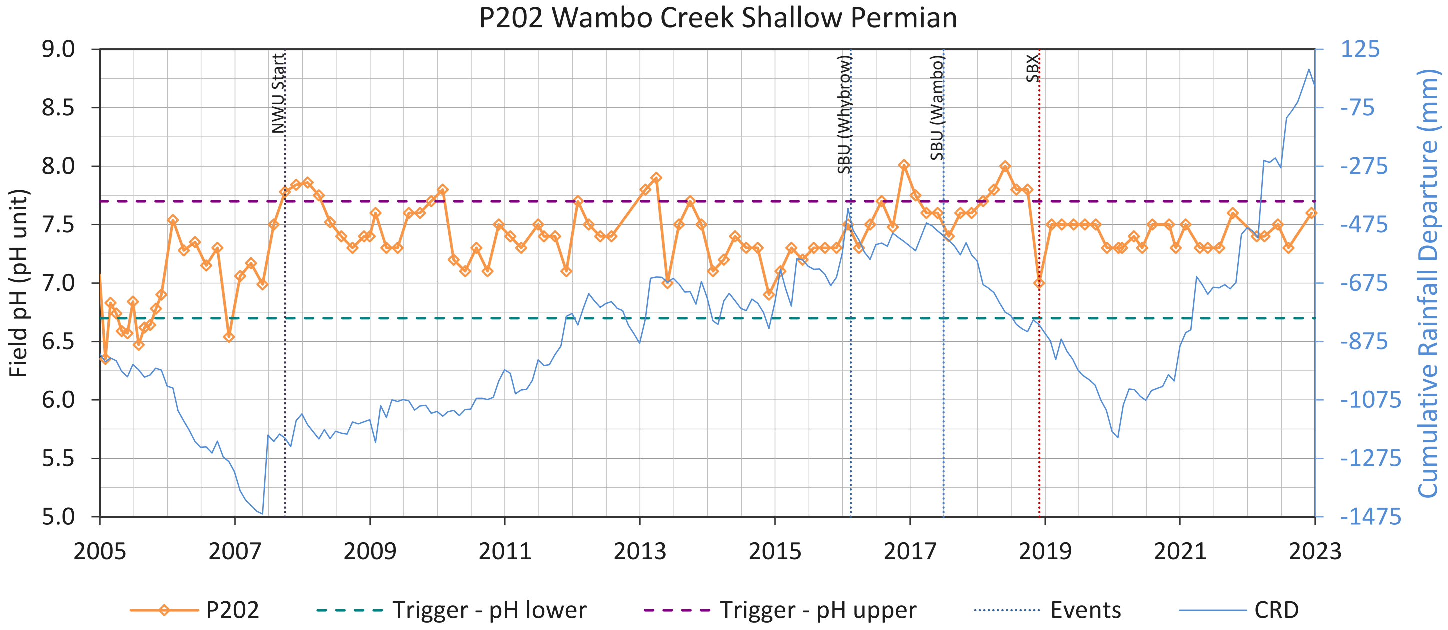

GW16 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

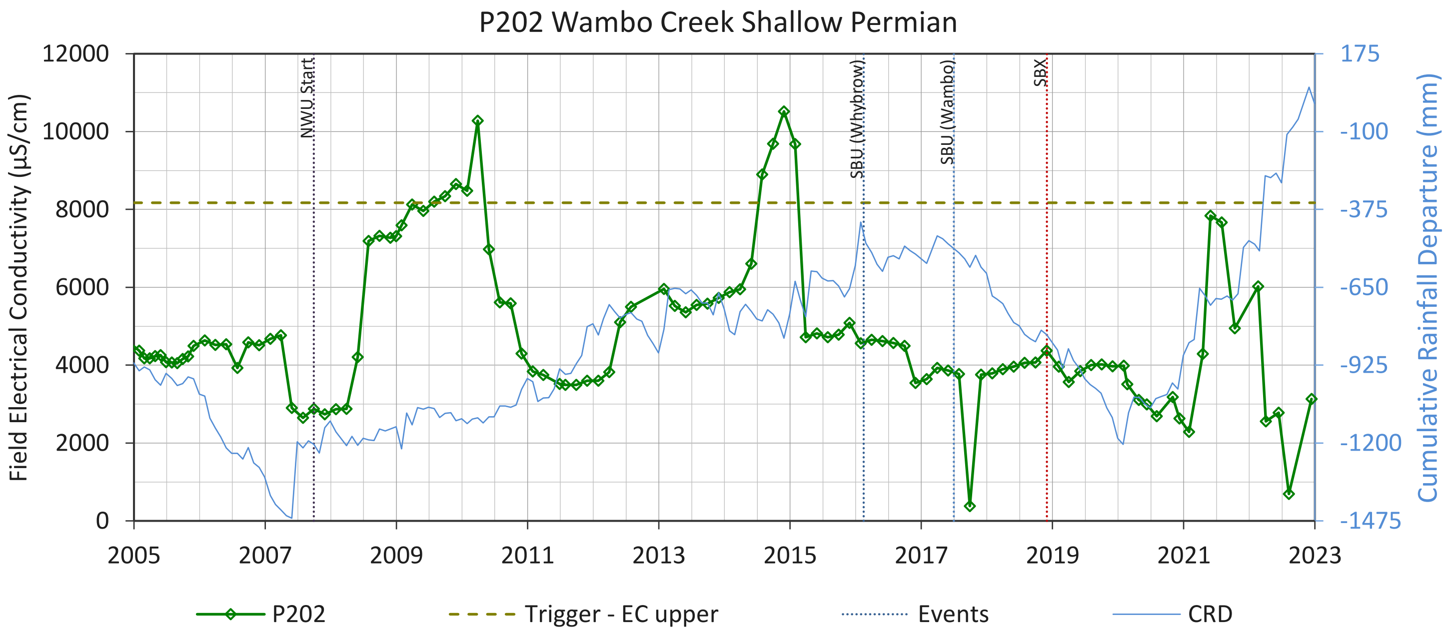

GW17 North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

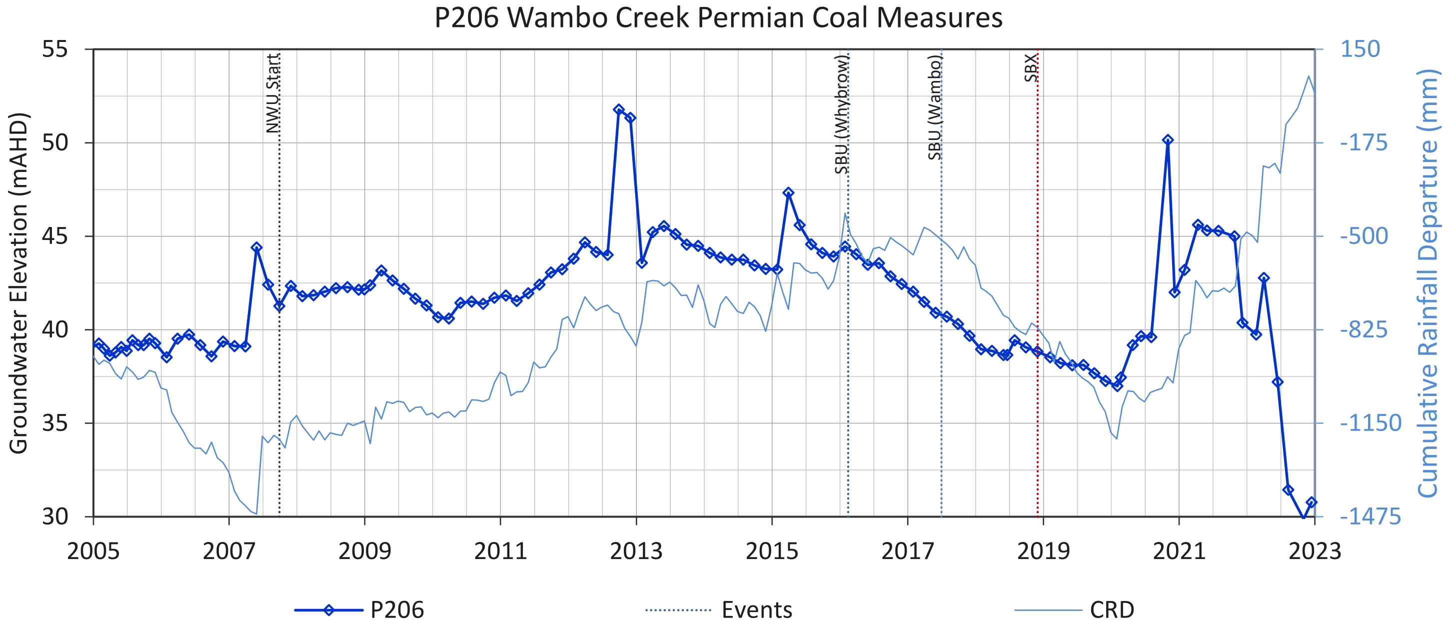

GW17 North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

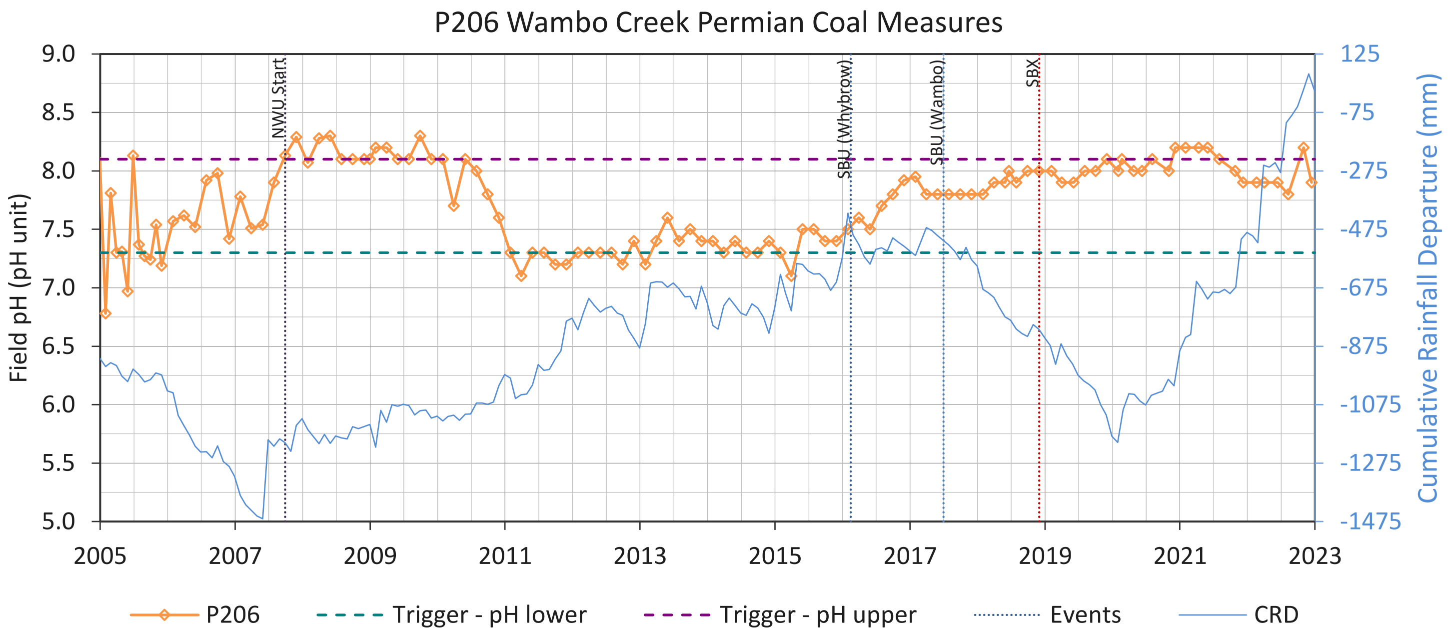

GW17 North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

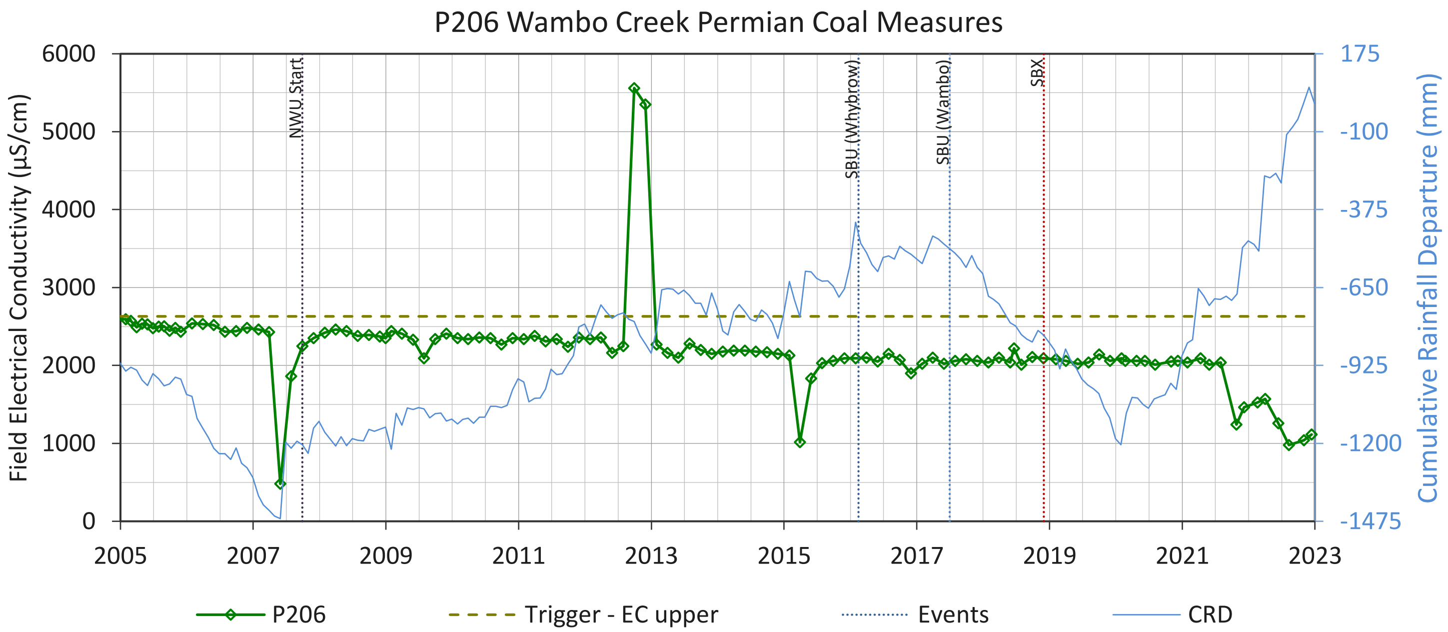

P202 Wambo Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
60
50
40
30
20
10
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P202
Events
CRD

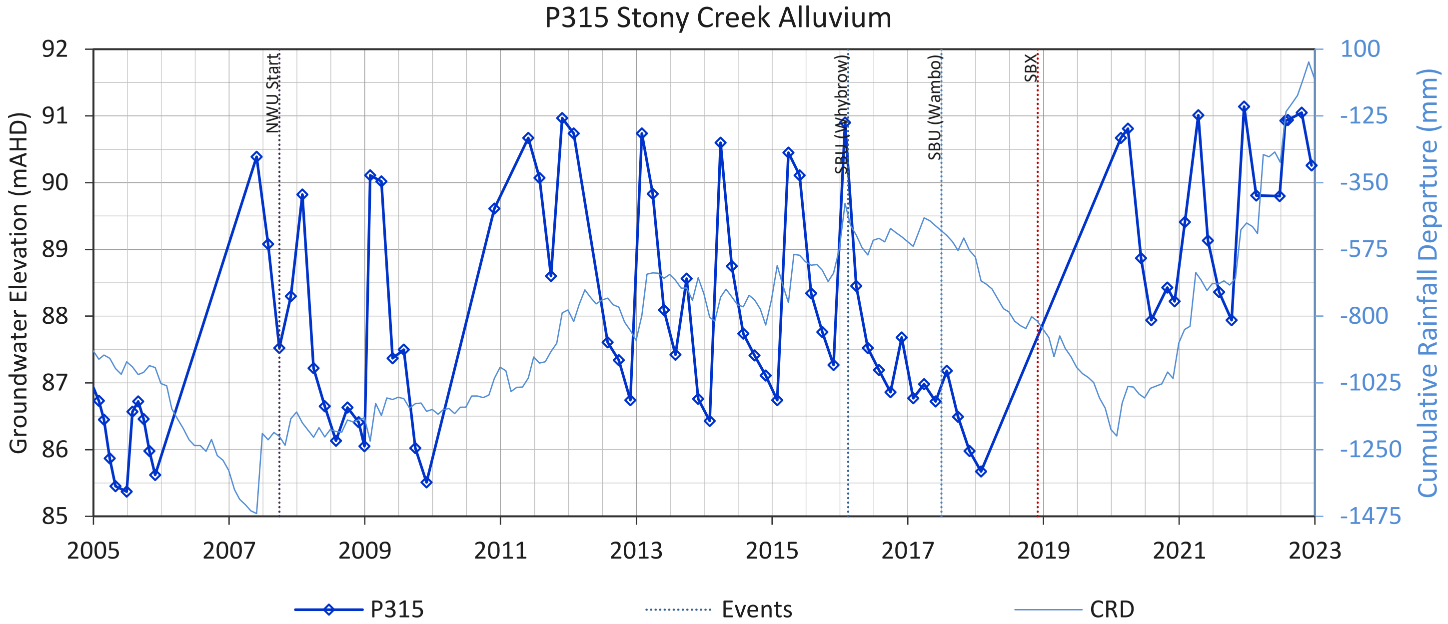

P202 Wambo Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P202
Trigger - pH lower
Trigger - pH upper
Events
CRD

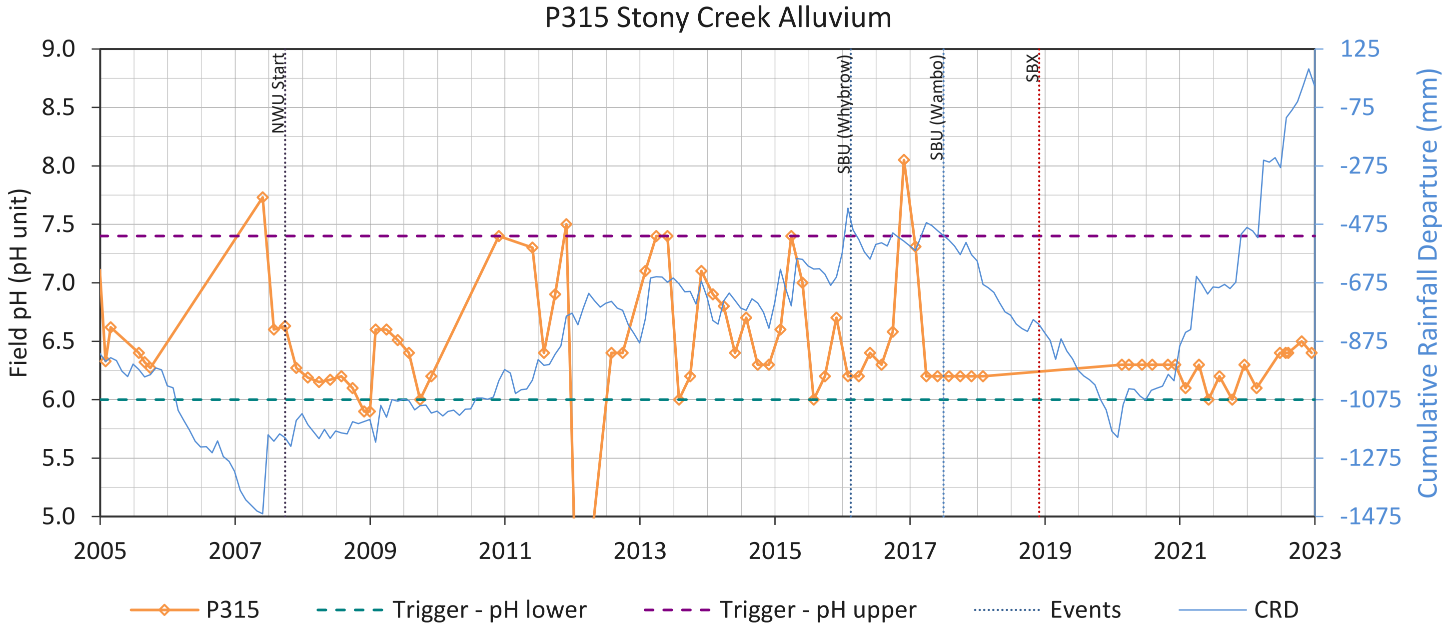

P202 Wambo Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
12000
10000
8000
6000
4000
2000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P202
Trigger - EC upper
Events
CRD

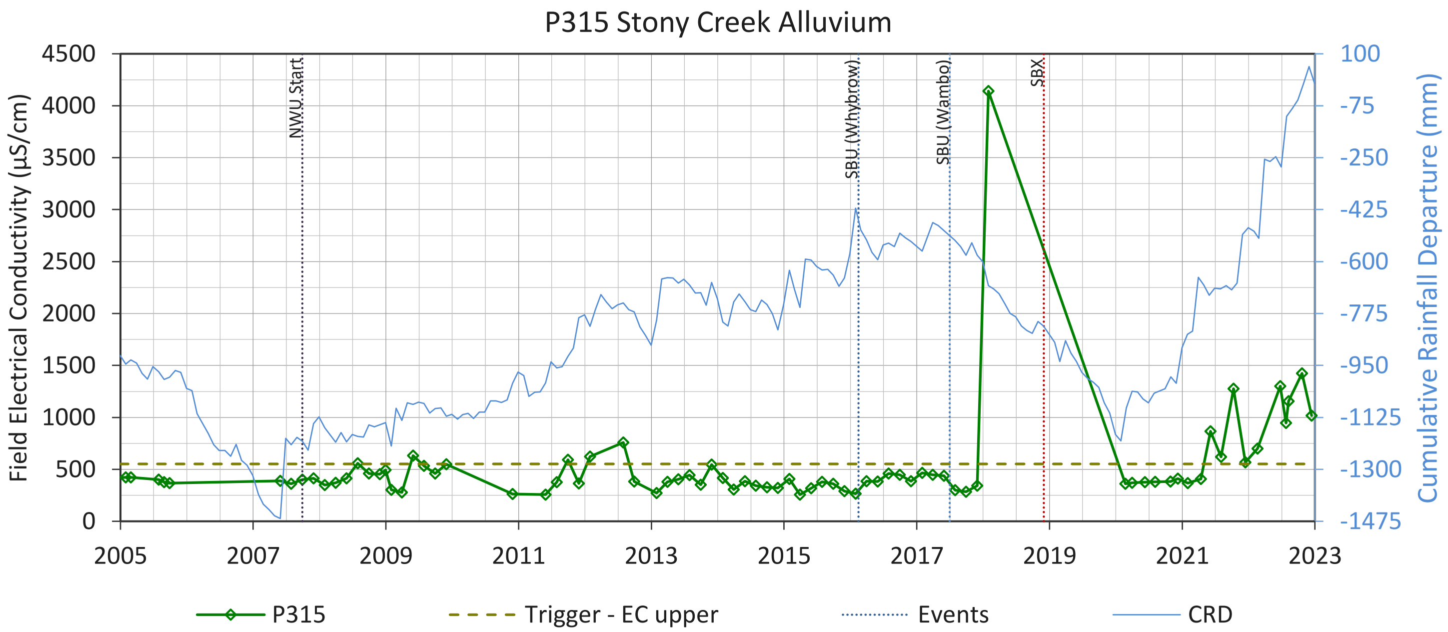

P206 Wambo Creek Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
55
50
45
40
35
30
150
-175
-500
-825
-1150
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P206
Events
CRD

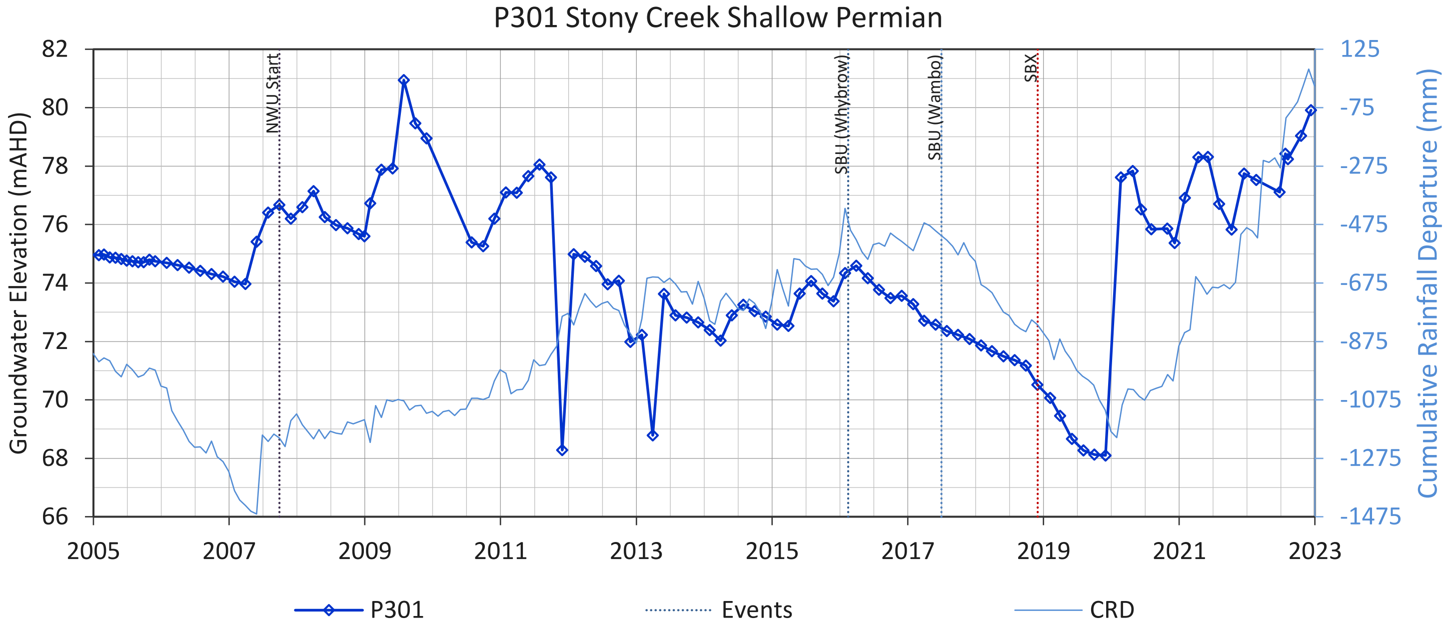

P206 Wambo Creek Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P206
Trigger - pH lower
Trigger - pH upper
Events
CRD

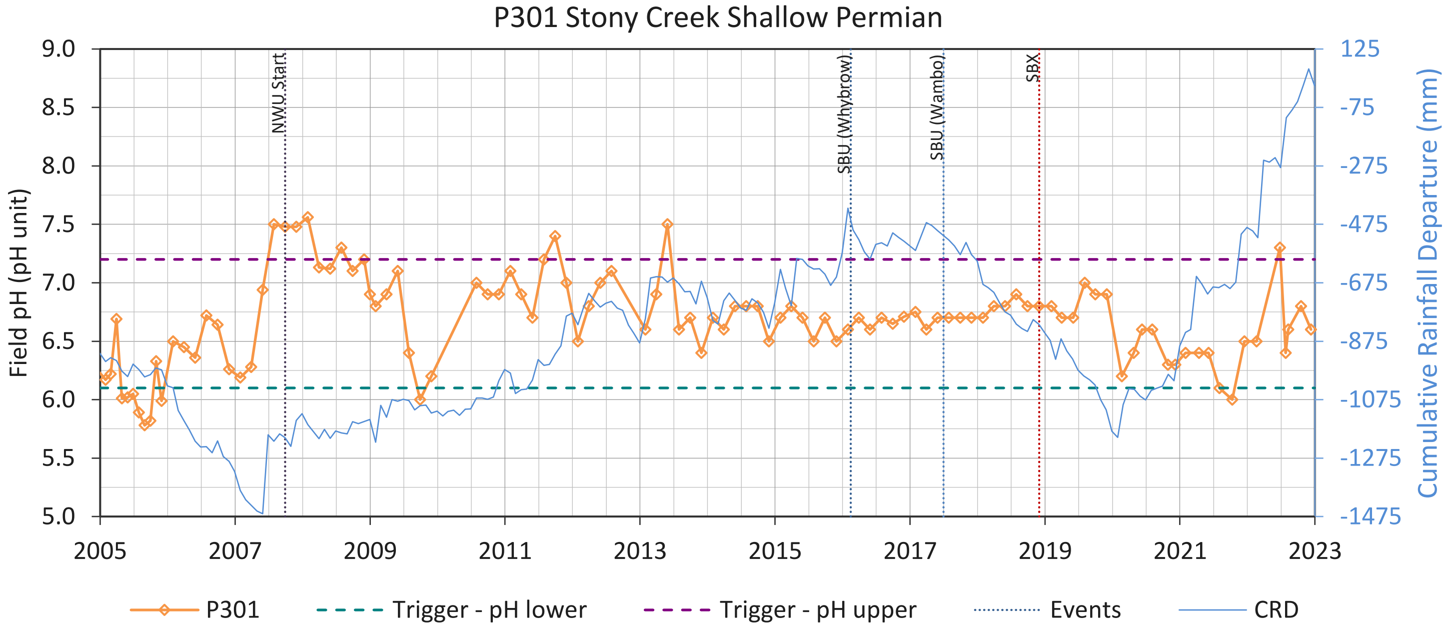

P206 Wambo Creek Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
6000
5000
4000
3000
2000
1000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P206
Trigger - EC upper
Events
CRD

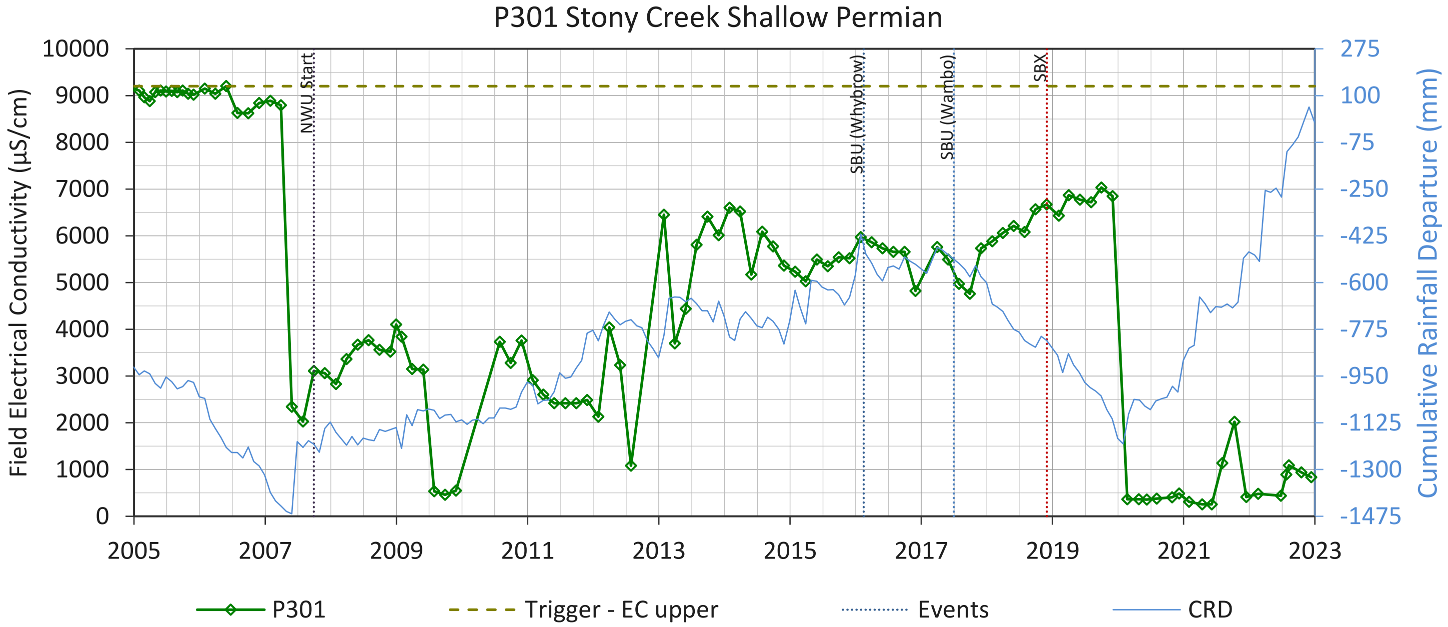

P315 Stony Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P315
Events
CRD

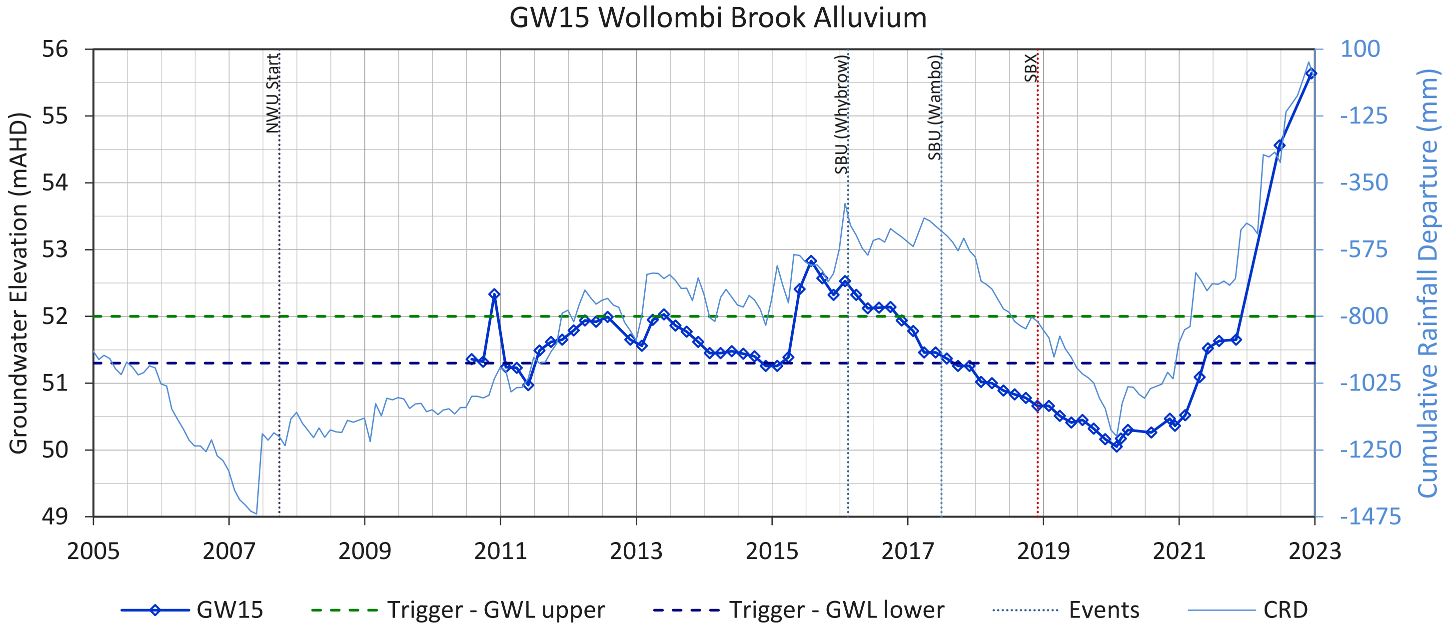

P315 Stony Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P315
Trigger - pH lower
Trigger - pH upper
Events
CRD

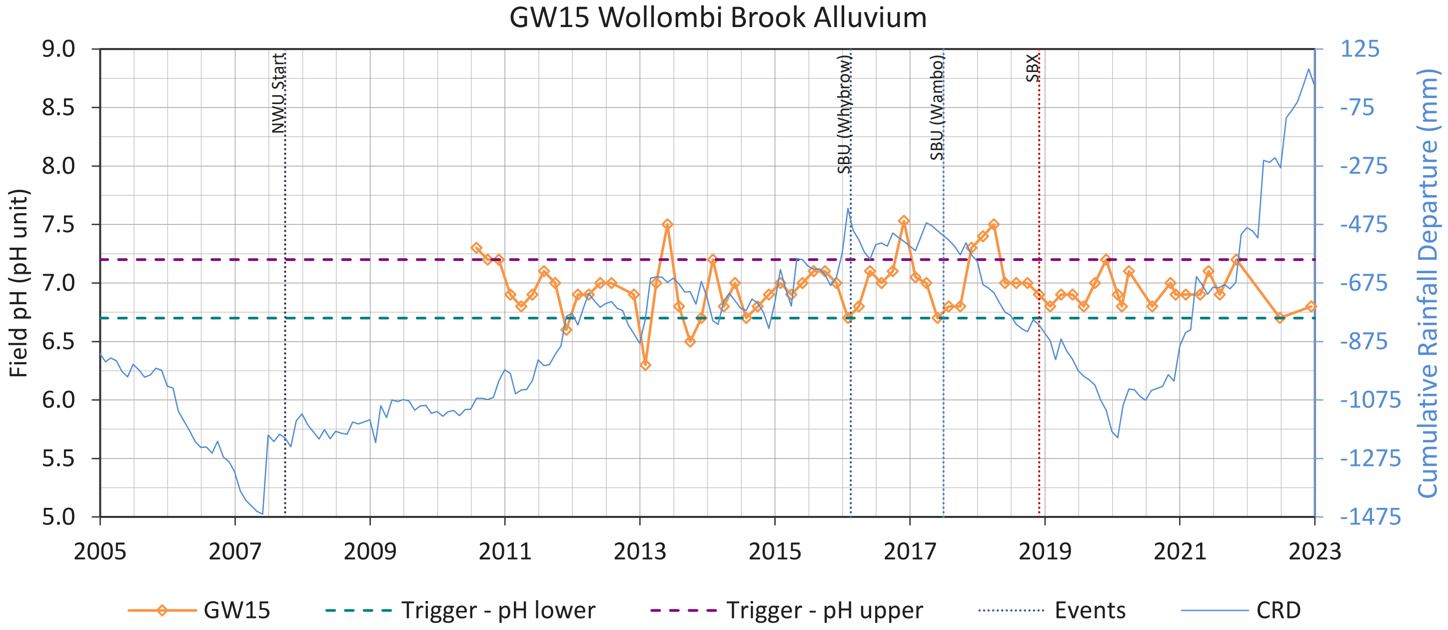

P315 Stony Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P315
Trigger - EC upper
Events
CRD

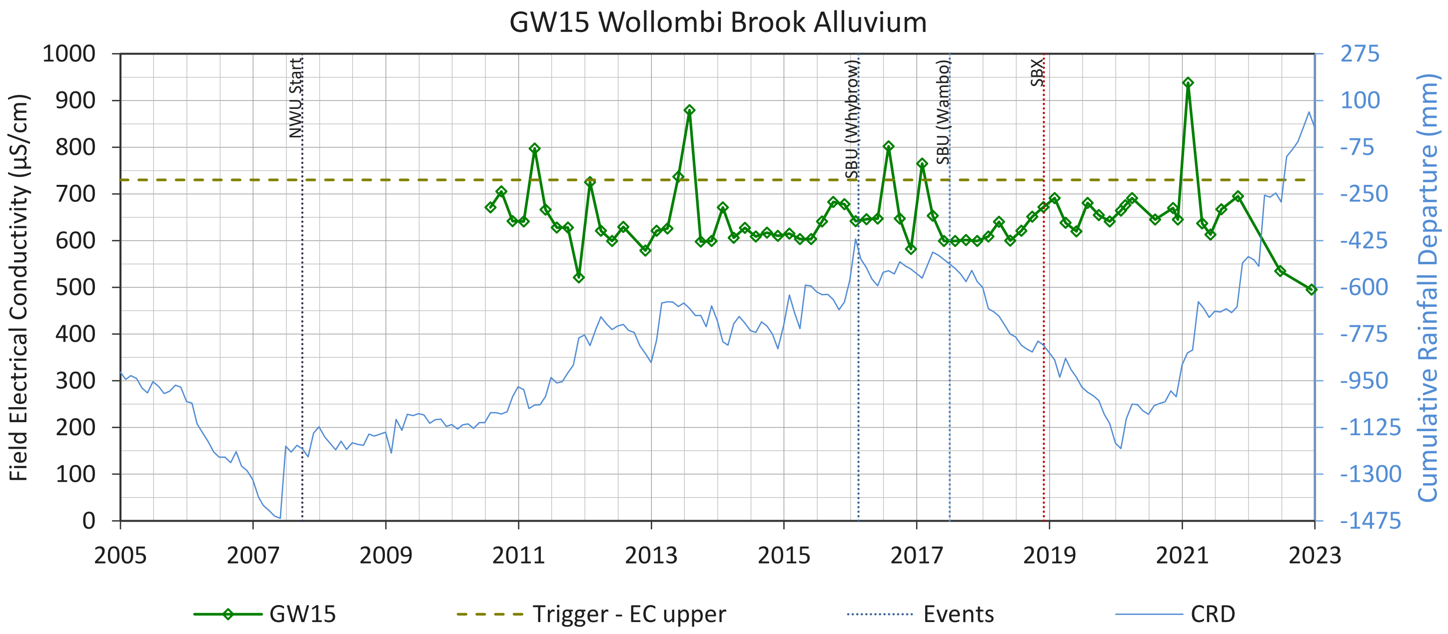

P301 Stony Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P301
Events
CRD

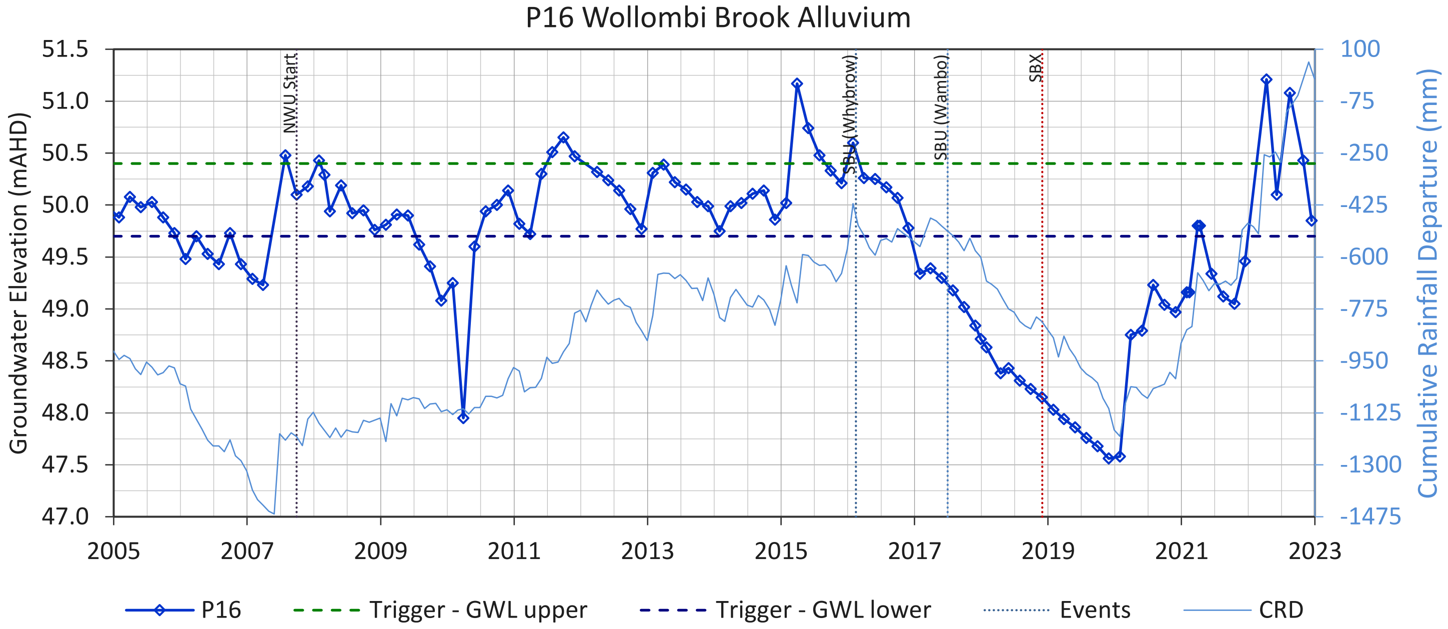

P301 Stony Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P301
Trigger - pH lower
Trigger - pH upper
Events
CRD

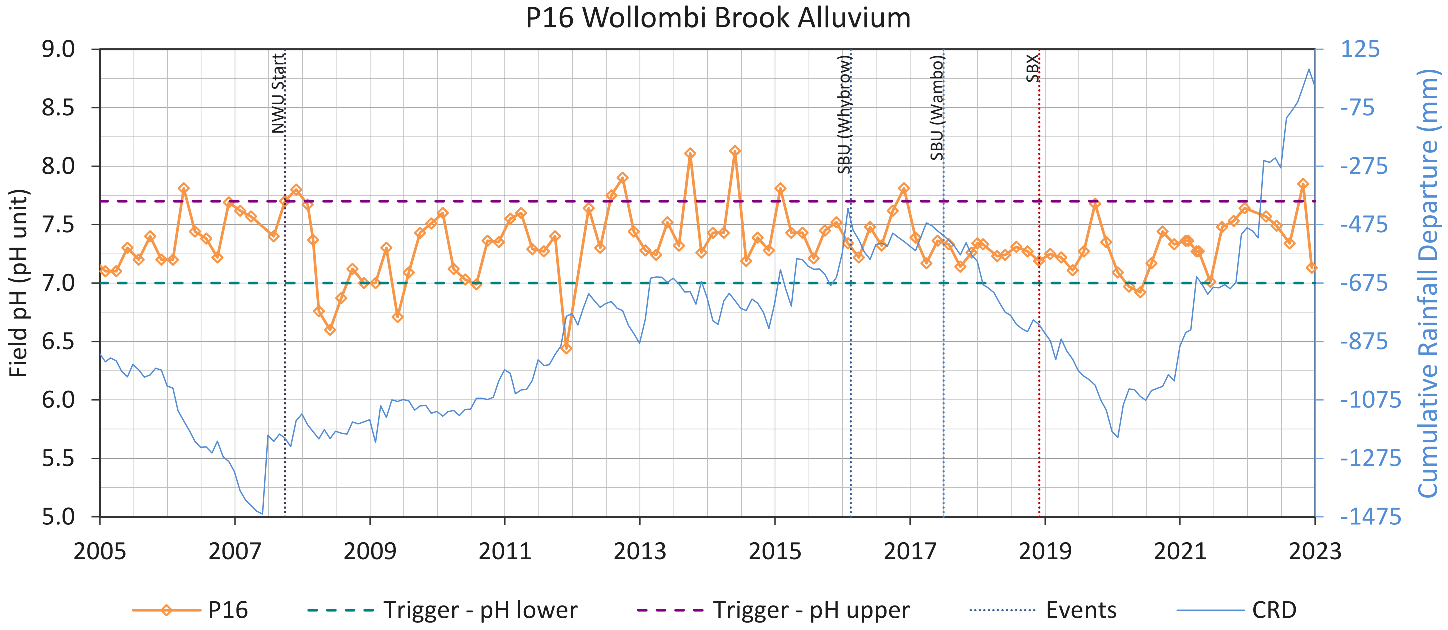

P301 Stony Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P301
Trigger - EC upper
Events
CRD

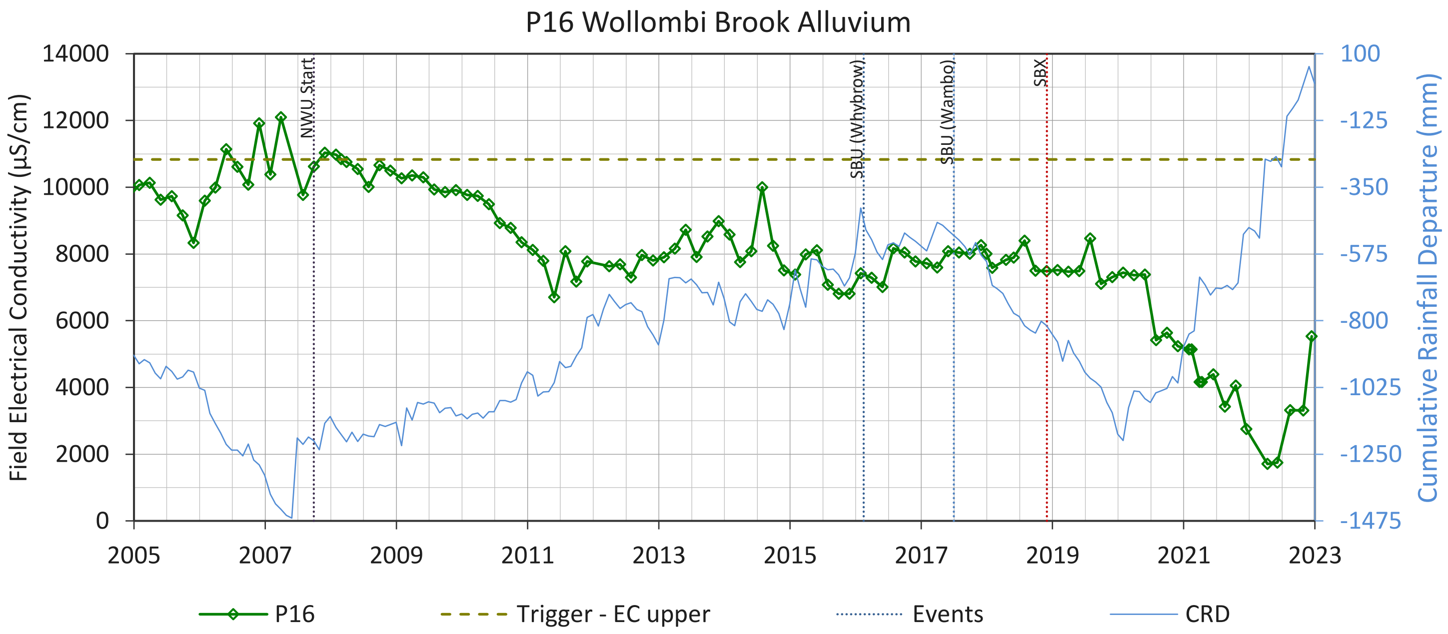

GW15 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
56
55
54
53
52
51
50
49
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW15
Trigger - GWL upper
Trigger - GWL lower
Events
CRD

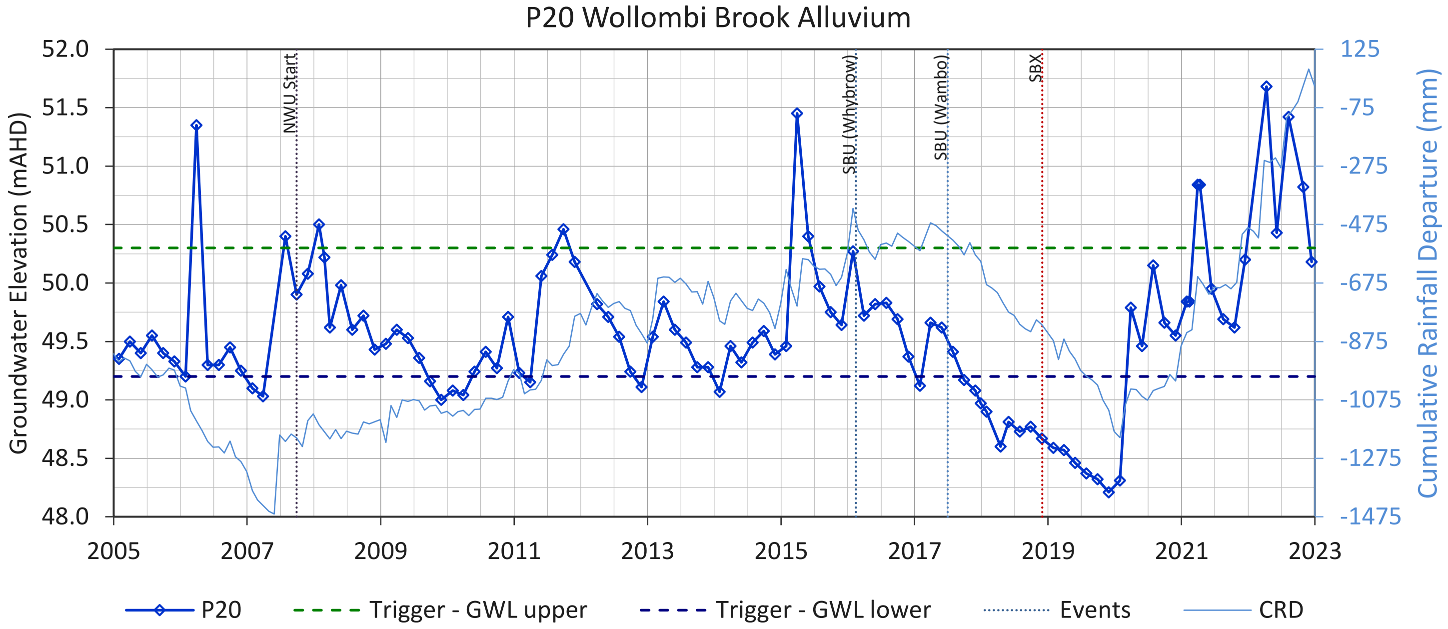

GW15 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW15
Trigger - pH lower
Trigger - pH upper
Events
CRD

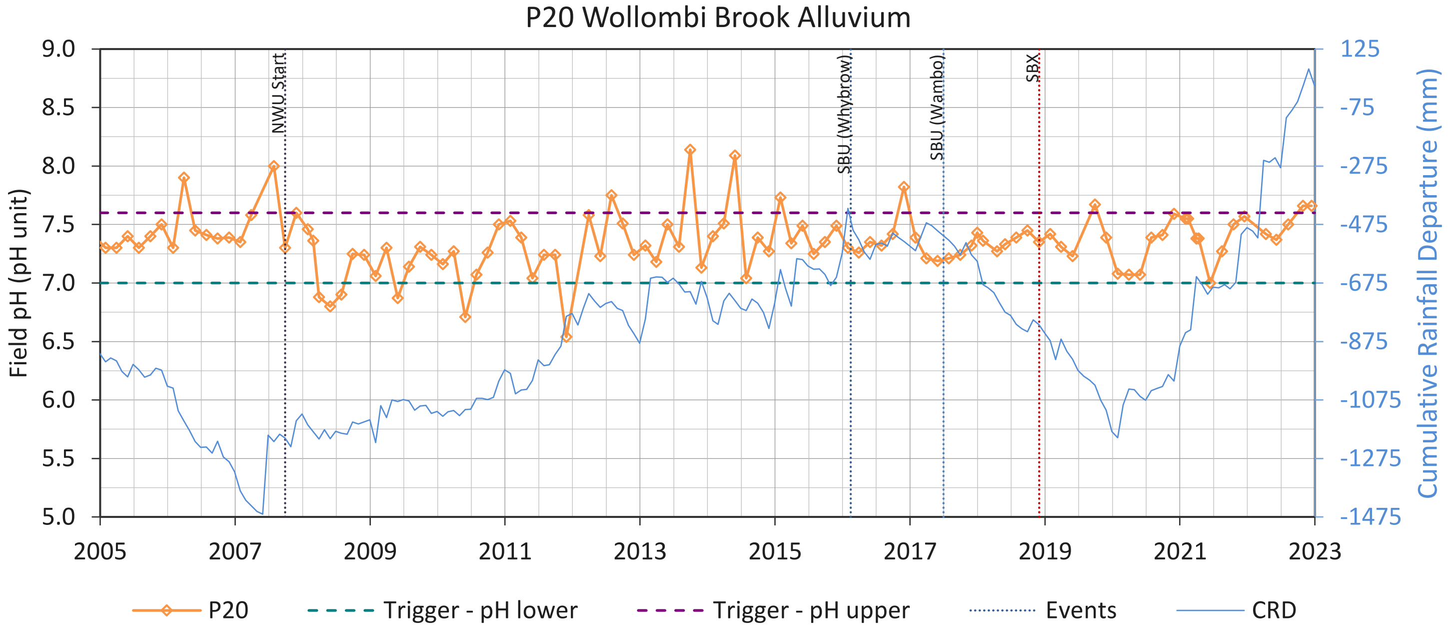

GW15 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW15
Trigger - EC upper
Events
CRD

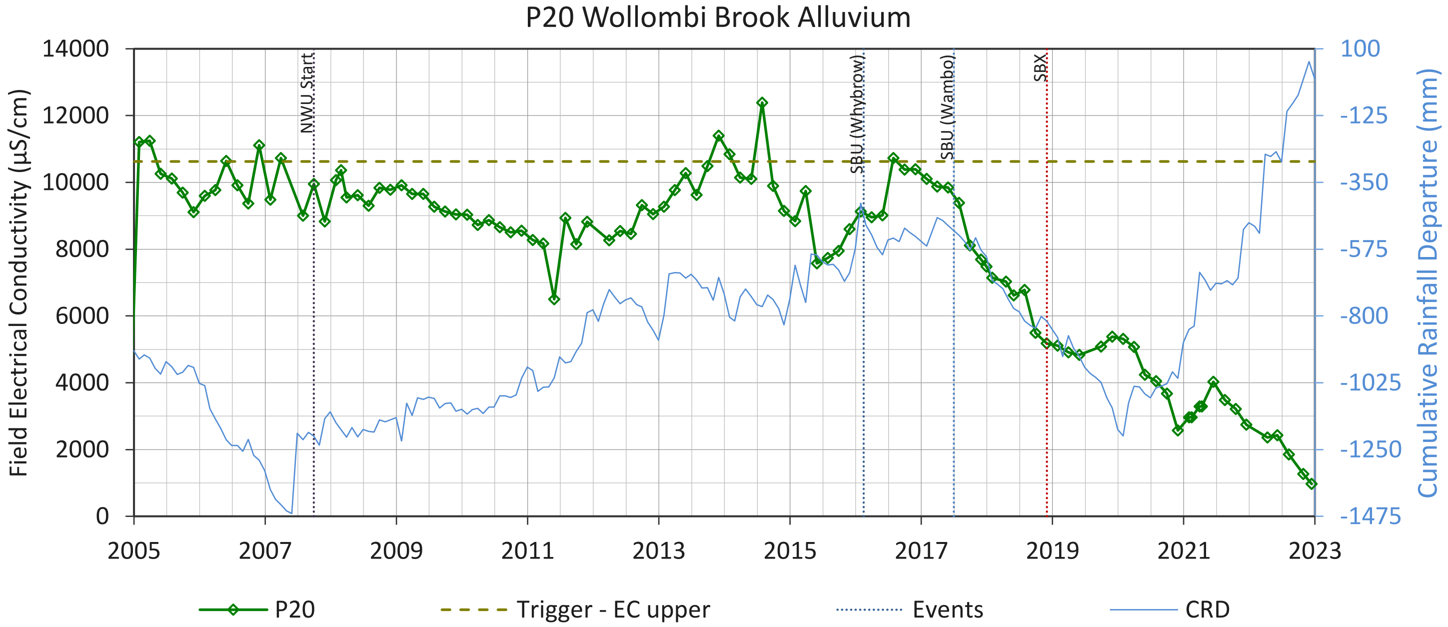

P16 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P16
Trigger - GWL upper
Trigger - GWL lower
Events
CRD

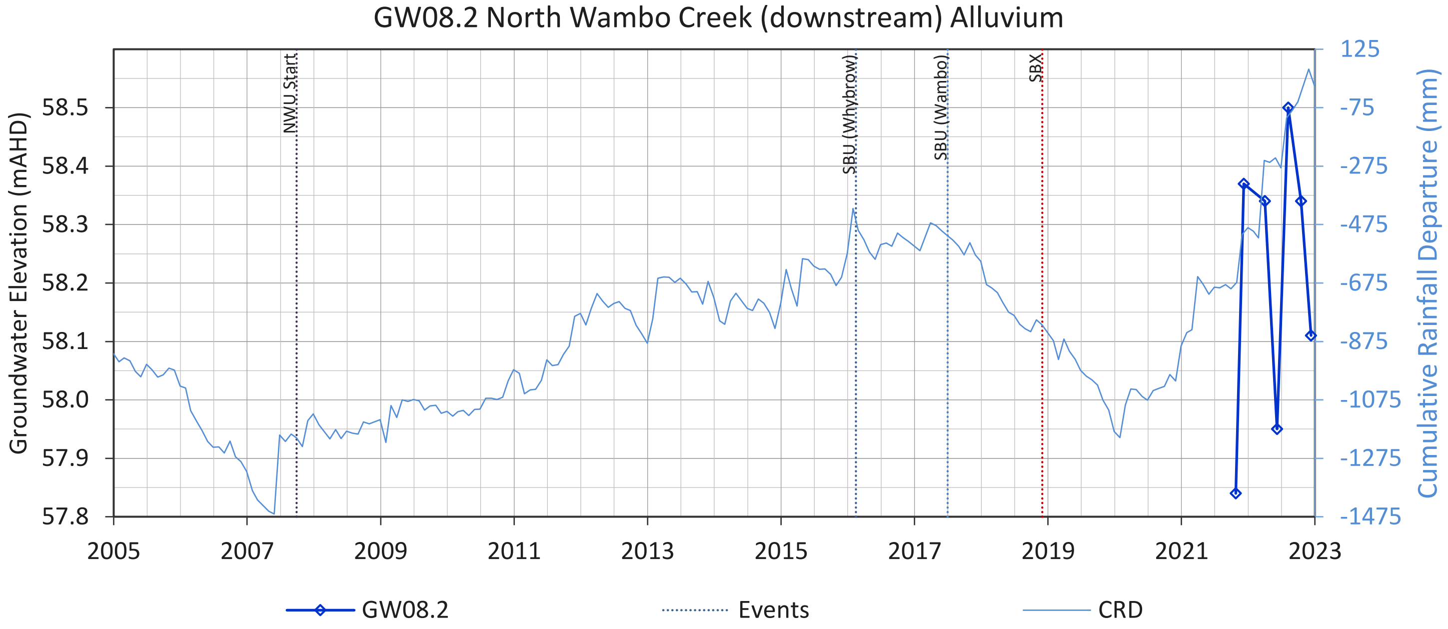

P16 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P16
Trigger - pH lower
Trigger - pH upper
Events
CRD

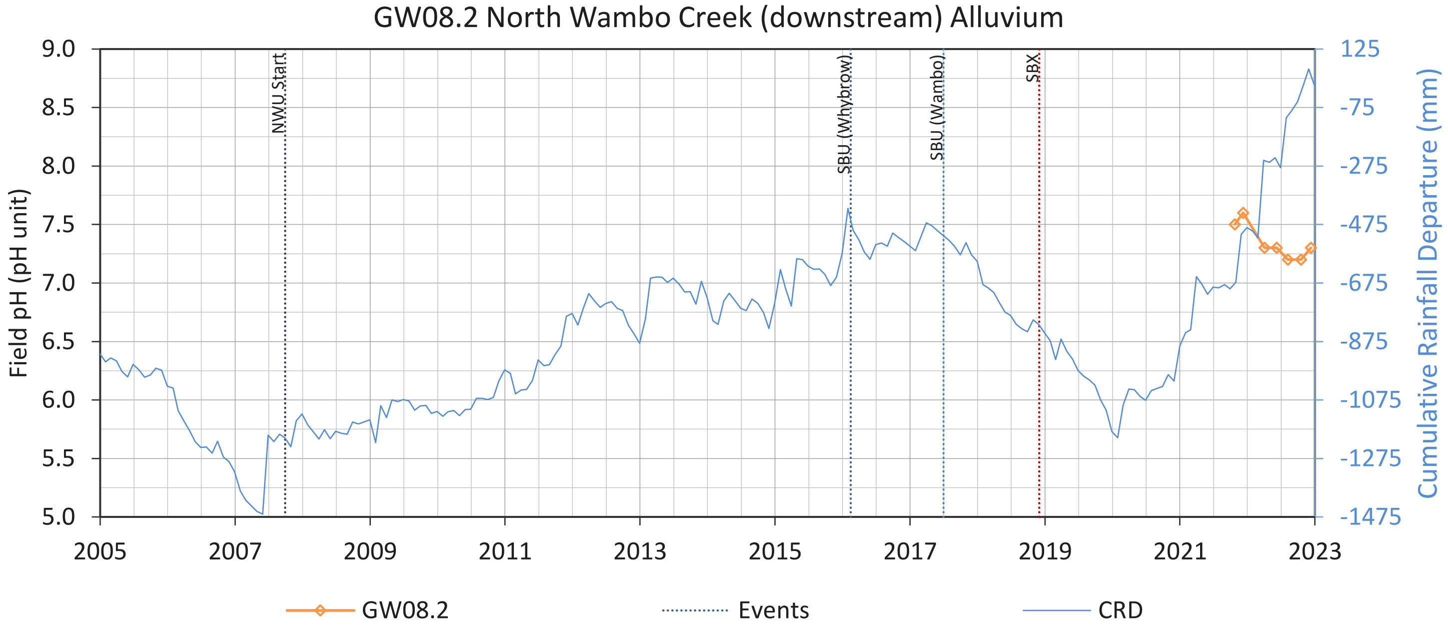

P16 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P16
Trigger - EC upper
Events
CRD

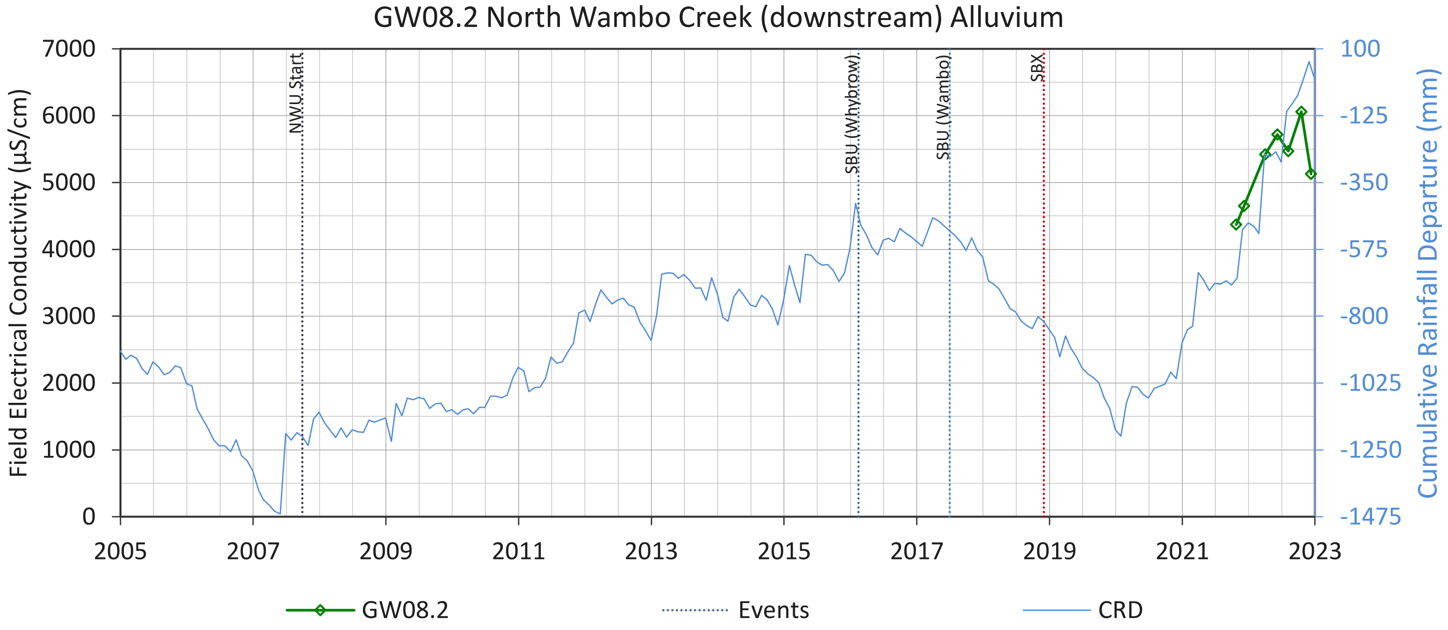

P20 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
52.0
51.5
51.0
50.5
50.0
49.5
49.0
48.5
48.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P20
Trigger - GWL upper
Trigger - GWL lower
Events
CRD

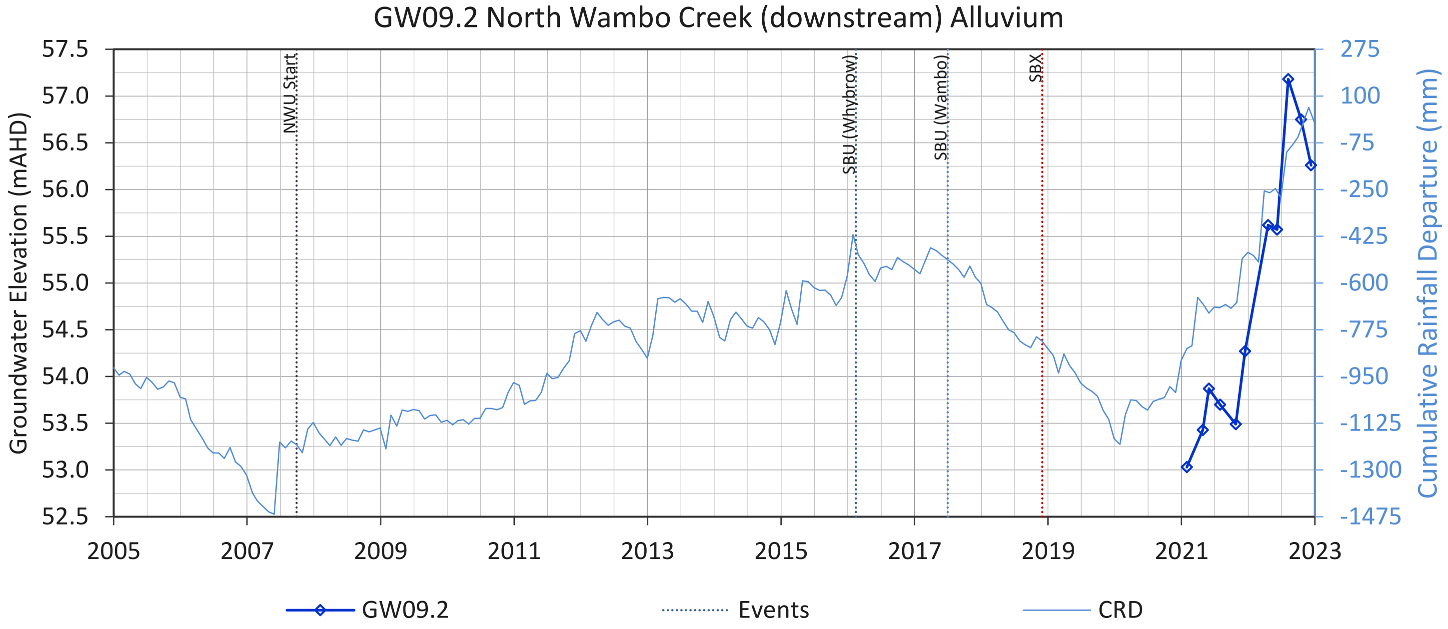

P20 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P20
Trigger - pH lower
Trigger - pH upper
Events
CRD

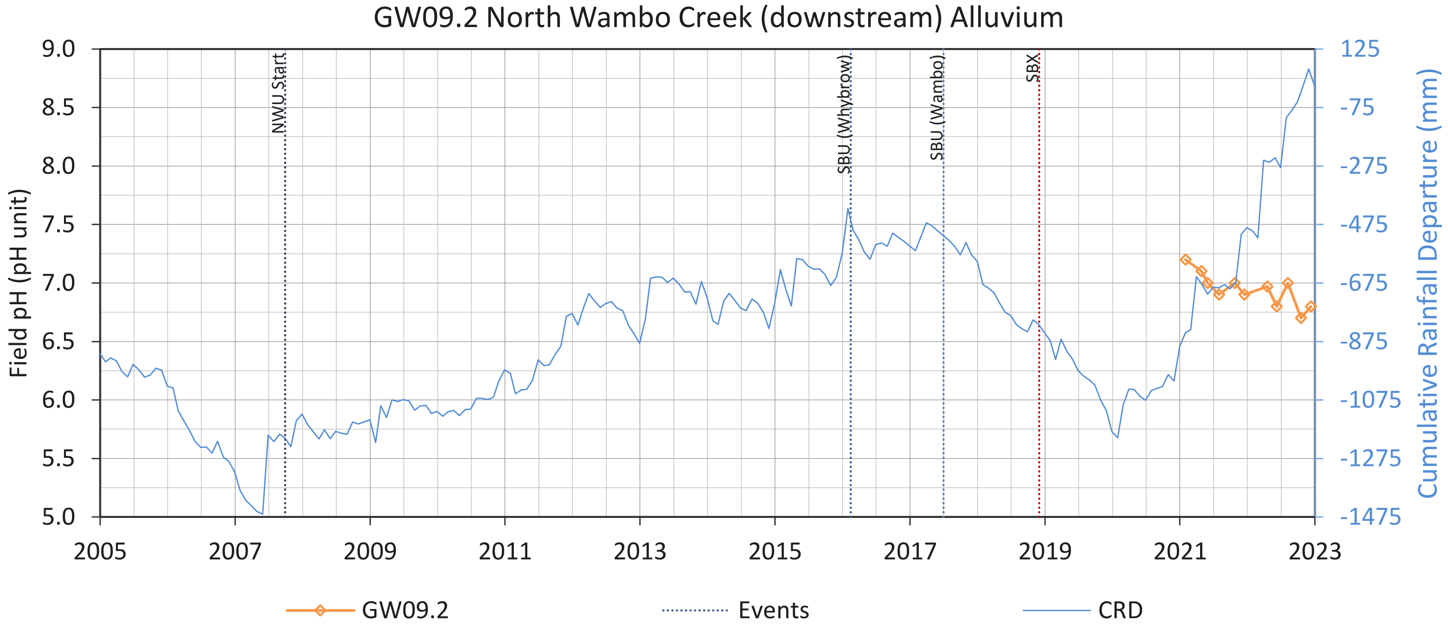

P20 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
14000
12000
10000
8000
6000
4000
2000
0
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P20
Trigger - EC upper
Events
CRD

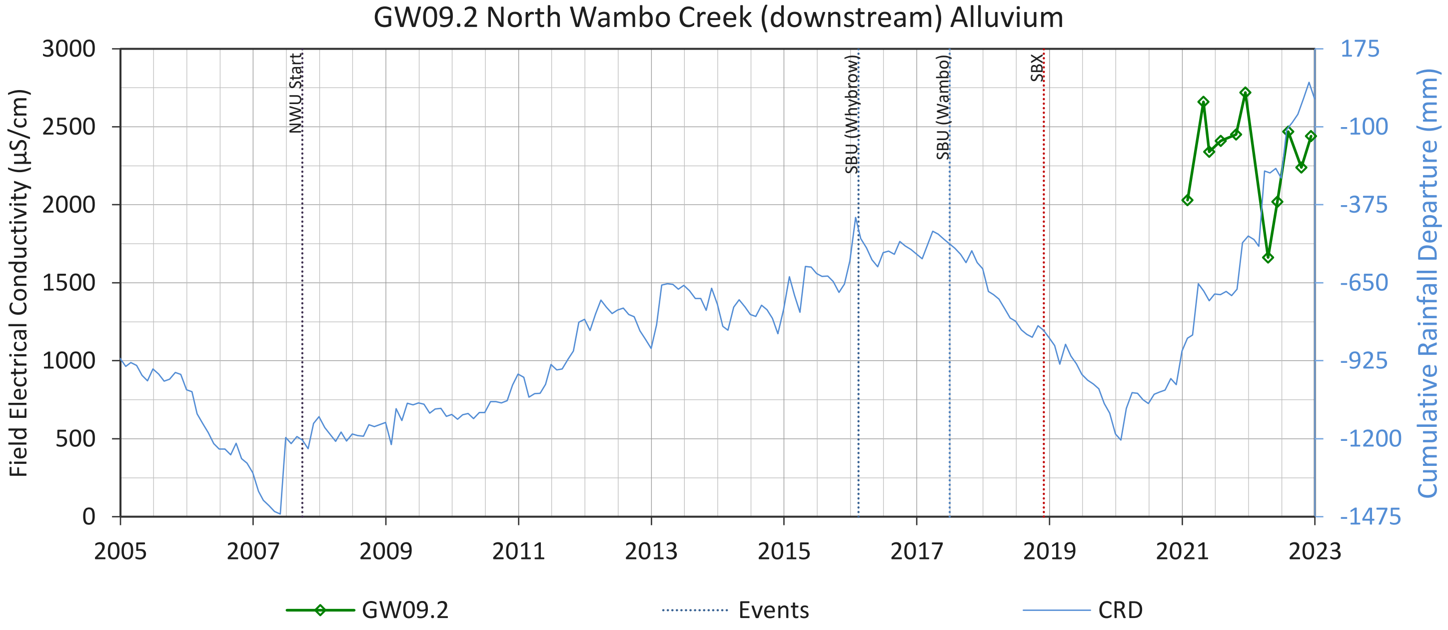

GW08.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
58.5
58.4
58.3
58.2
58.1
58.0
57.9
57.8
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW08.2
Events
CRD

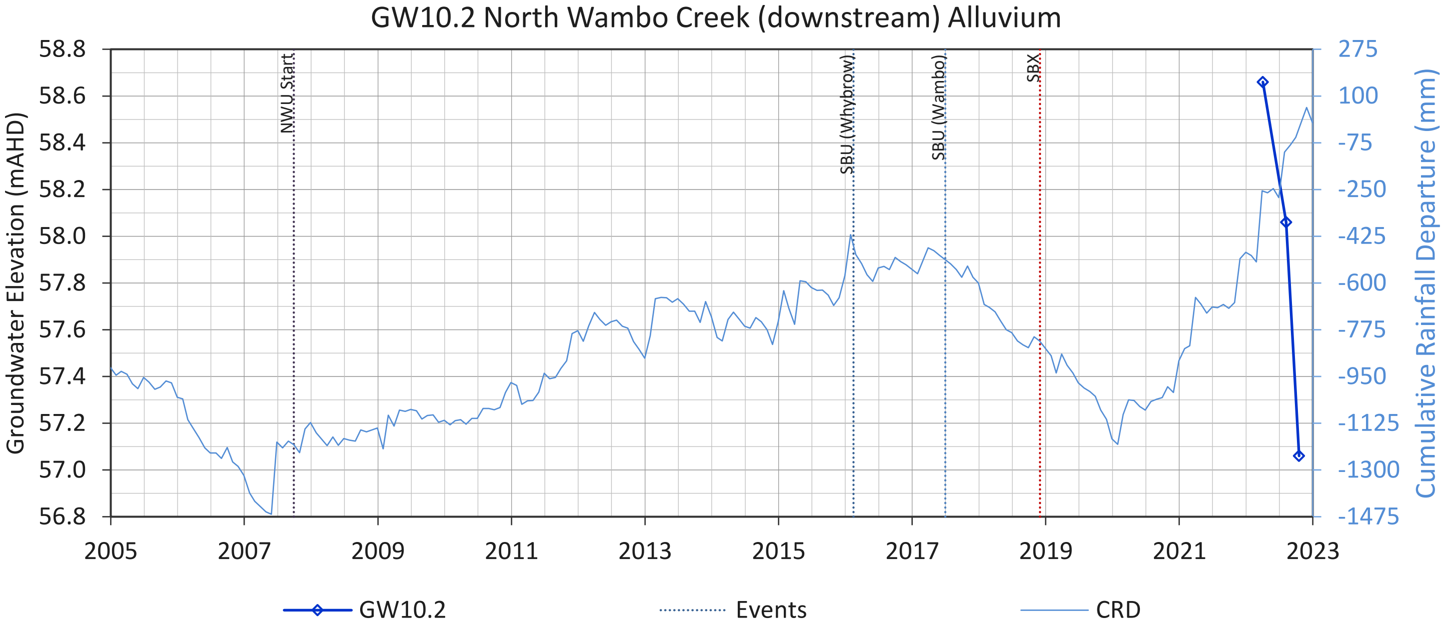

GW08.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW08.2
Events
CRD

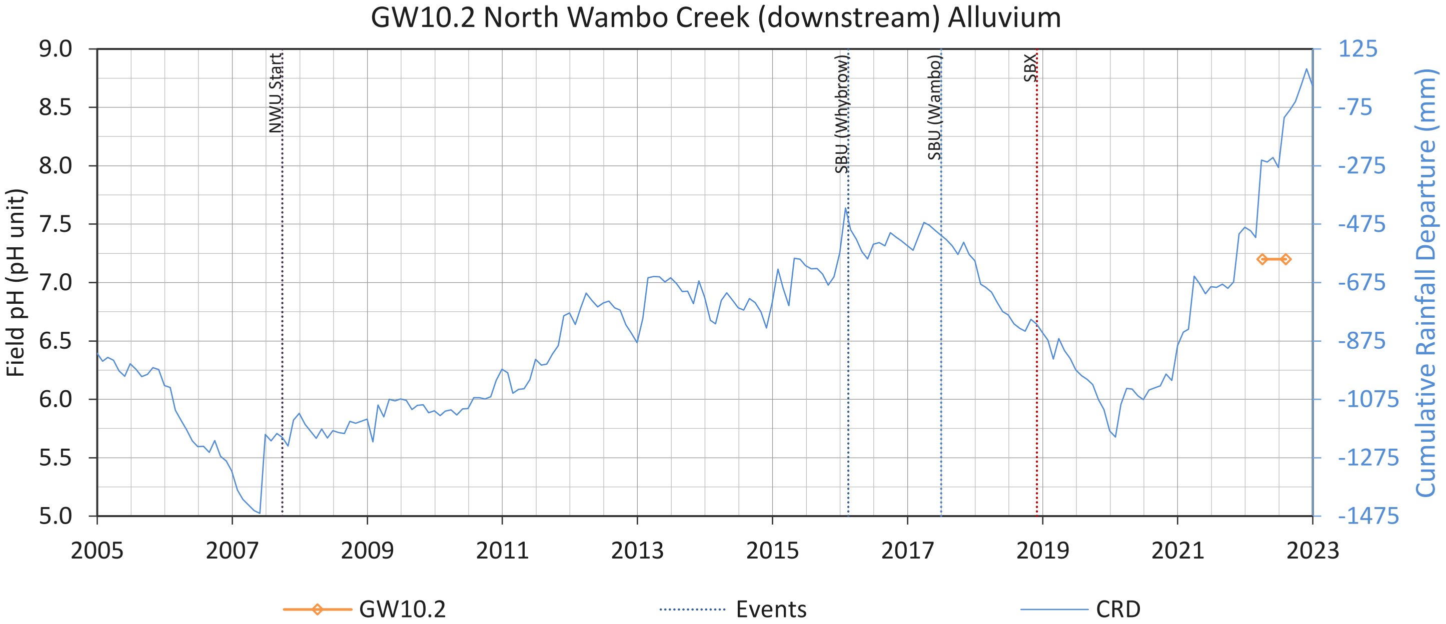

GW08.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
7000
6000
5000
4000
3000
2000
1000
0
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW08.2
Events
CRD

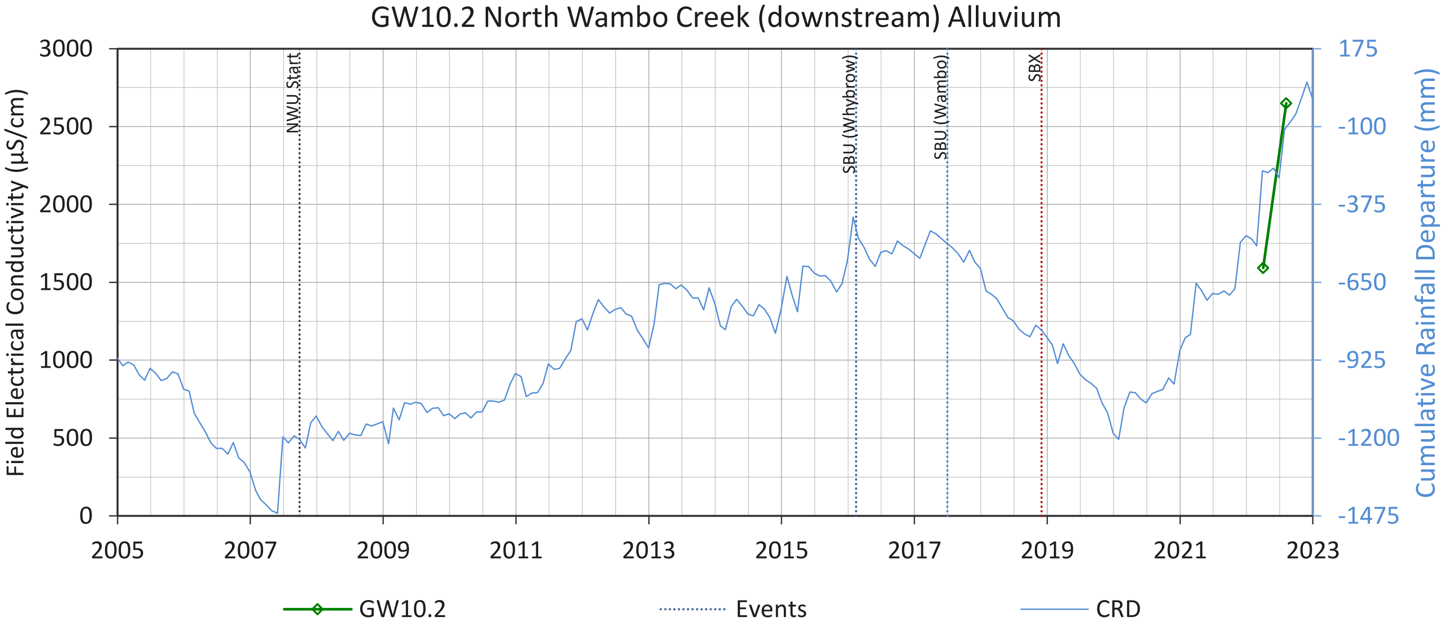

GW09.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD


GW09.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD

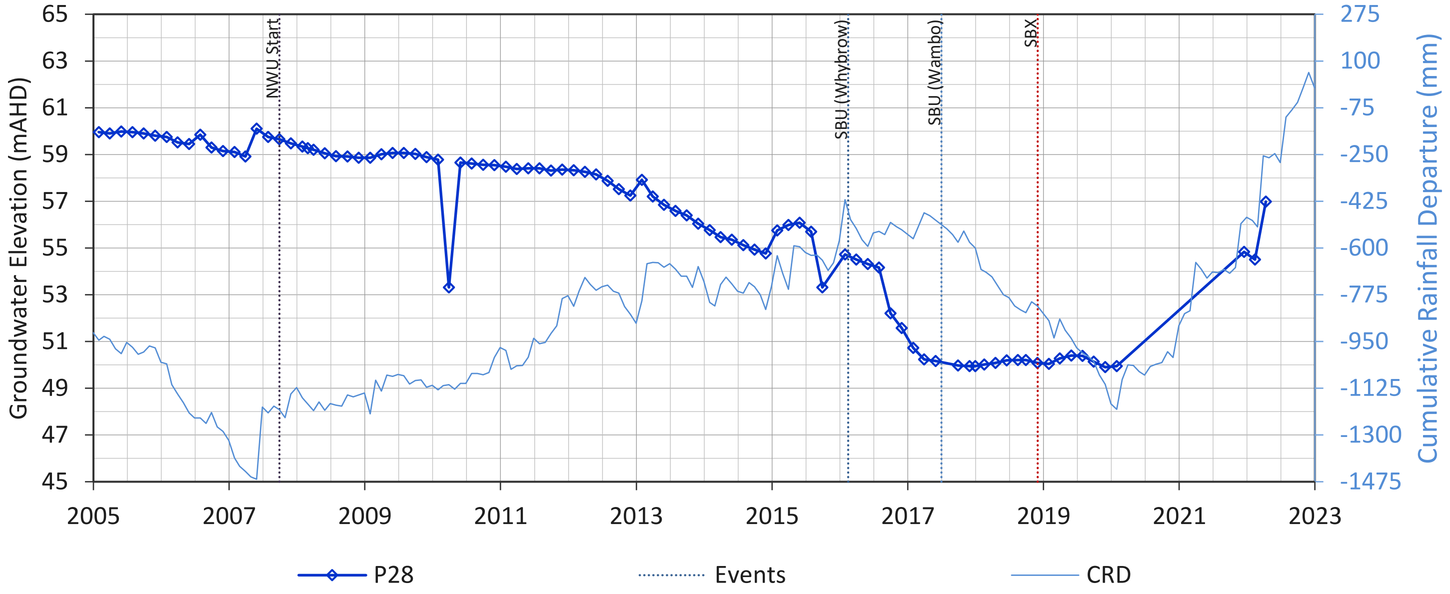

GW09.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD


GW10.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
58.8
58.6
58.4
58.2
58.0
57.8
57.6
57.4
57.2
57.0
56.8
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2
Events
CRD

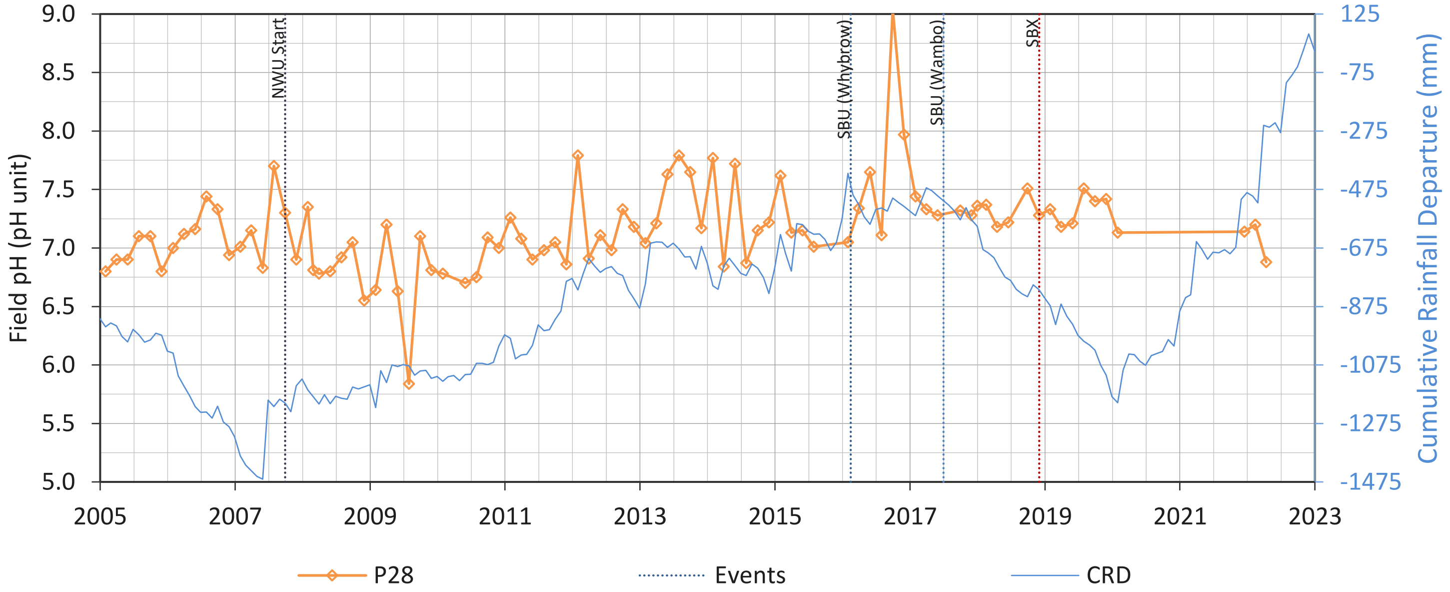

GW10.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2
Events
CRD


GW10.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
3000
2500
2000
1500
1000
500
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2
Events
CRD

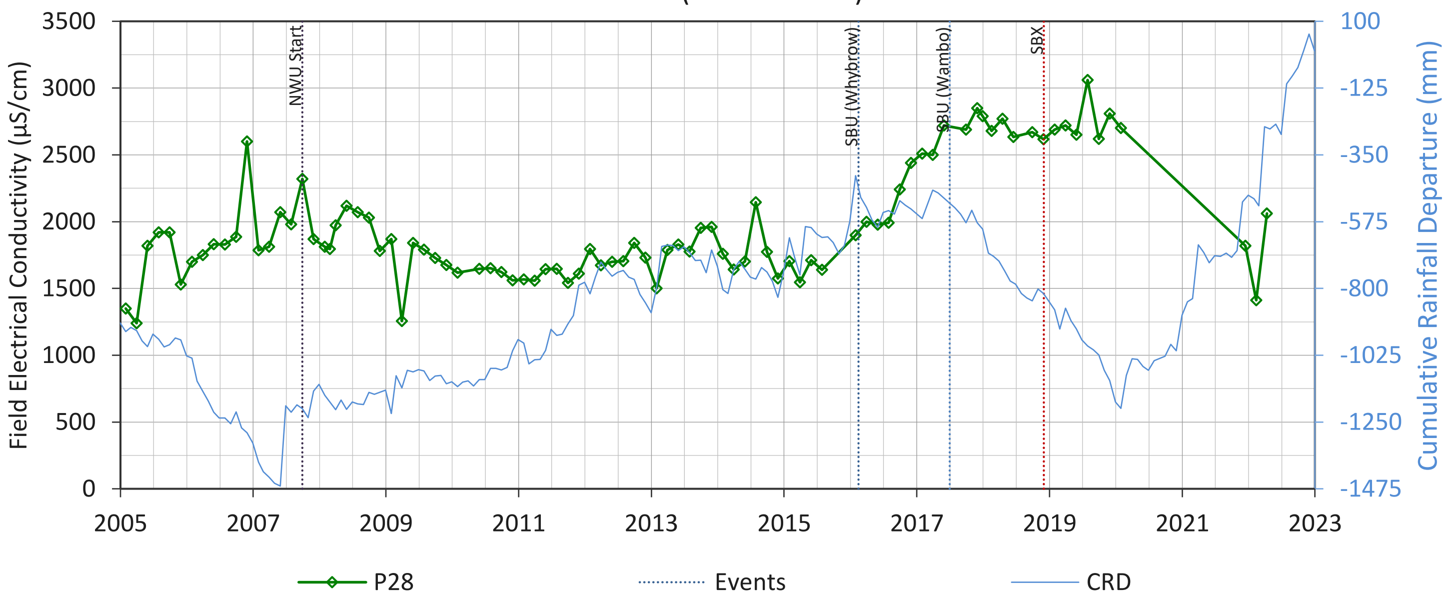
P28 North Wambo Creek (downstream) Shallow Permian

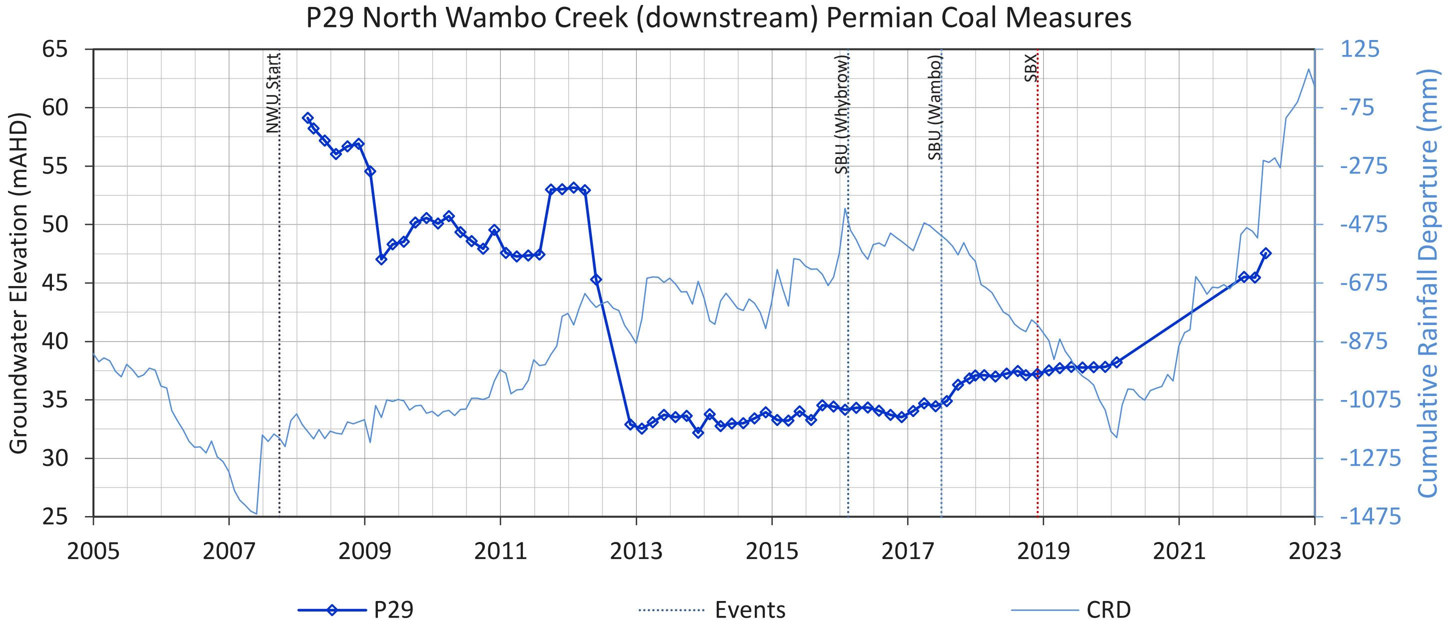


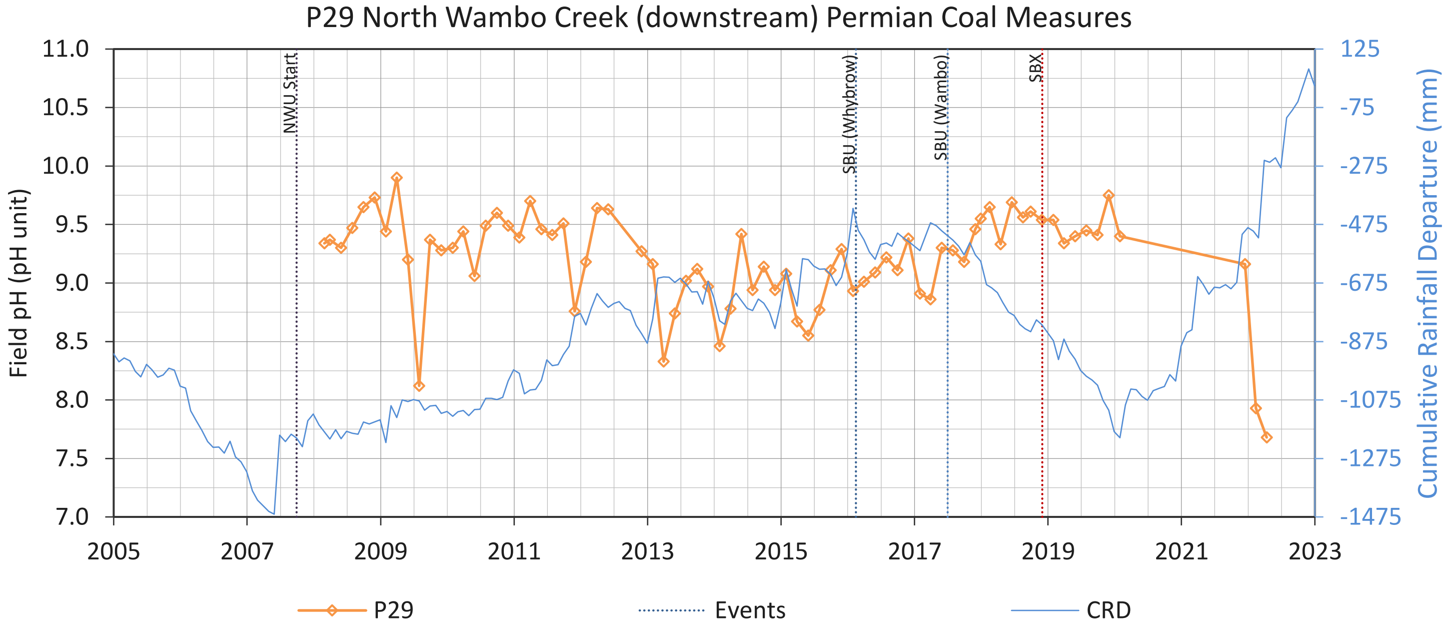
P28 North Wambo Creek (downstream) Shallow Permian

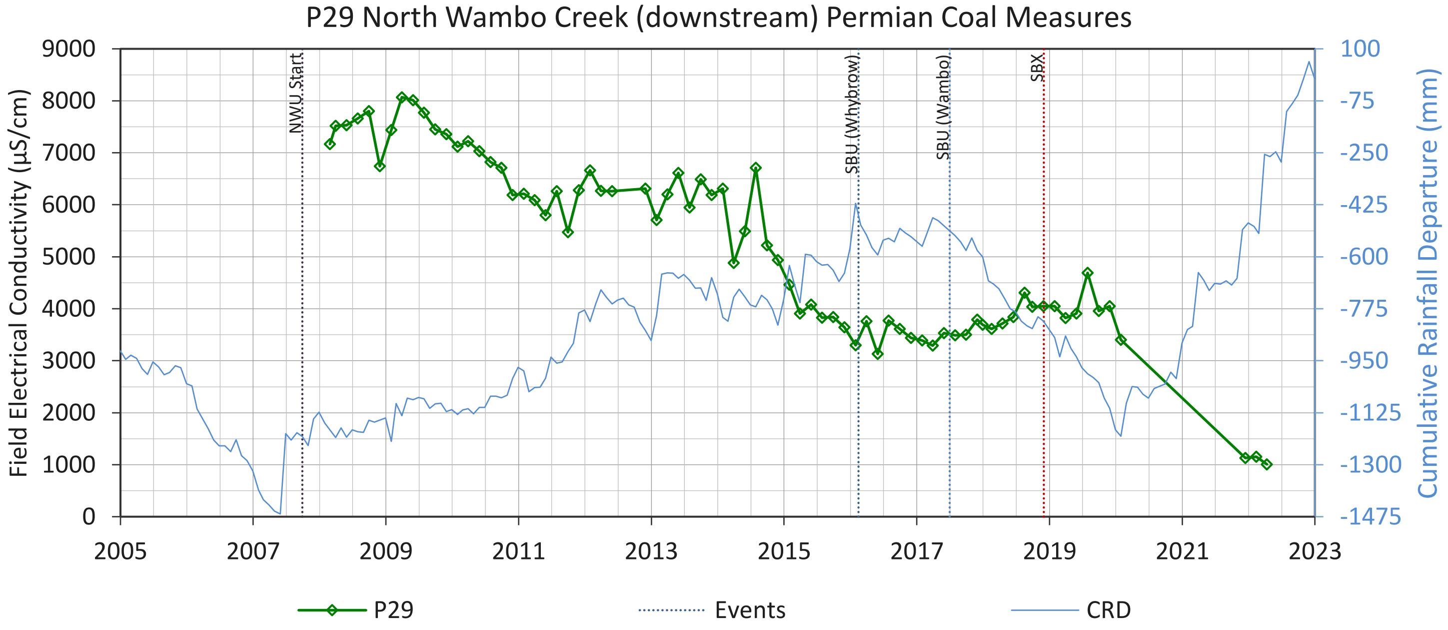


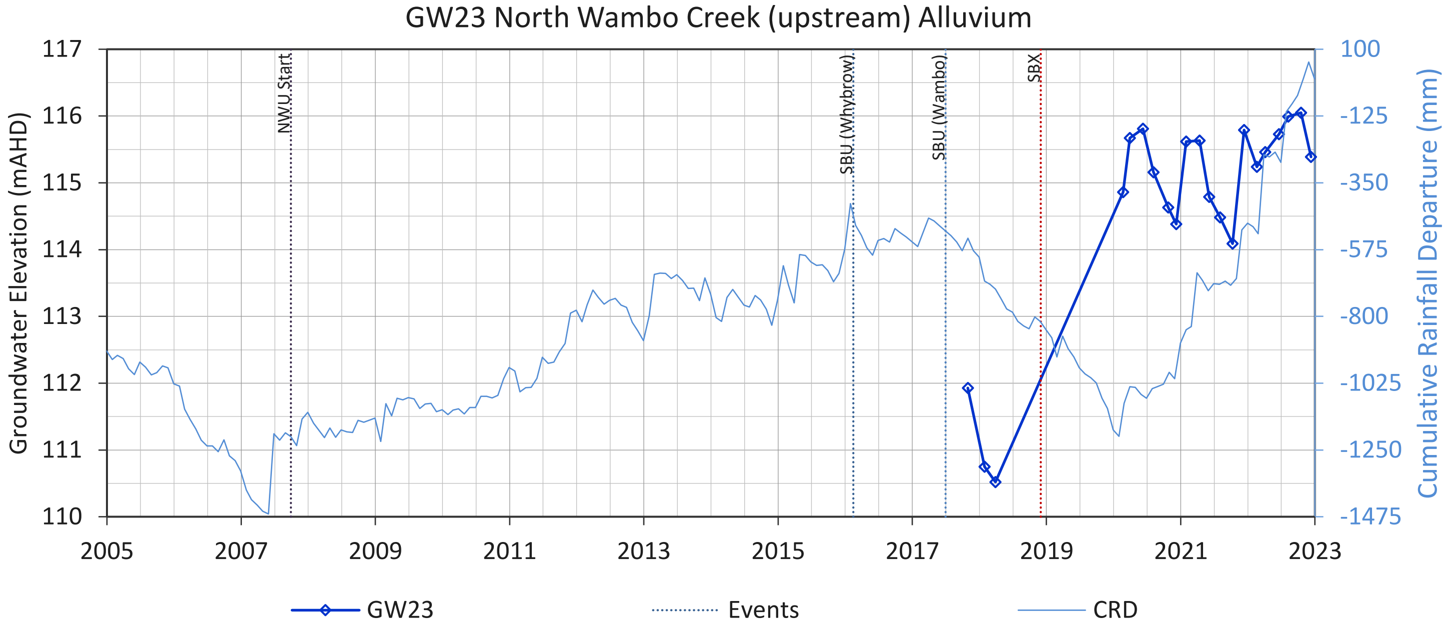
P28 North Wambo Creek (downstream) Shallow Permian

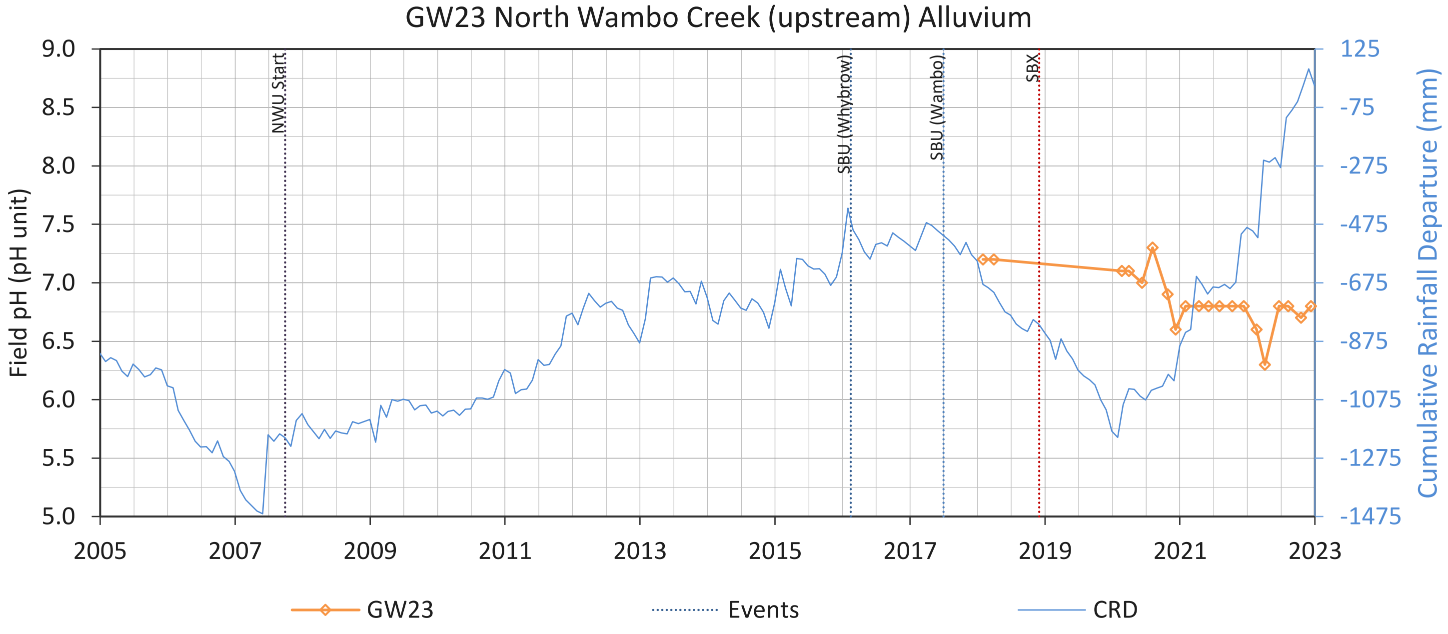


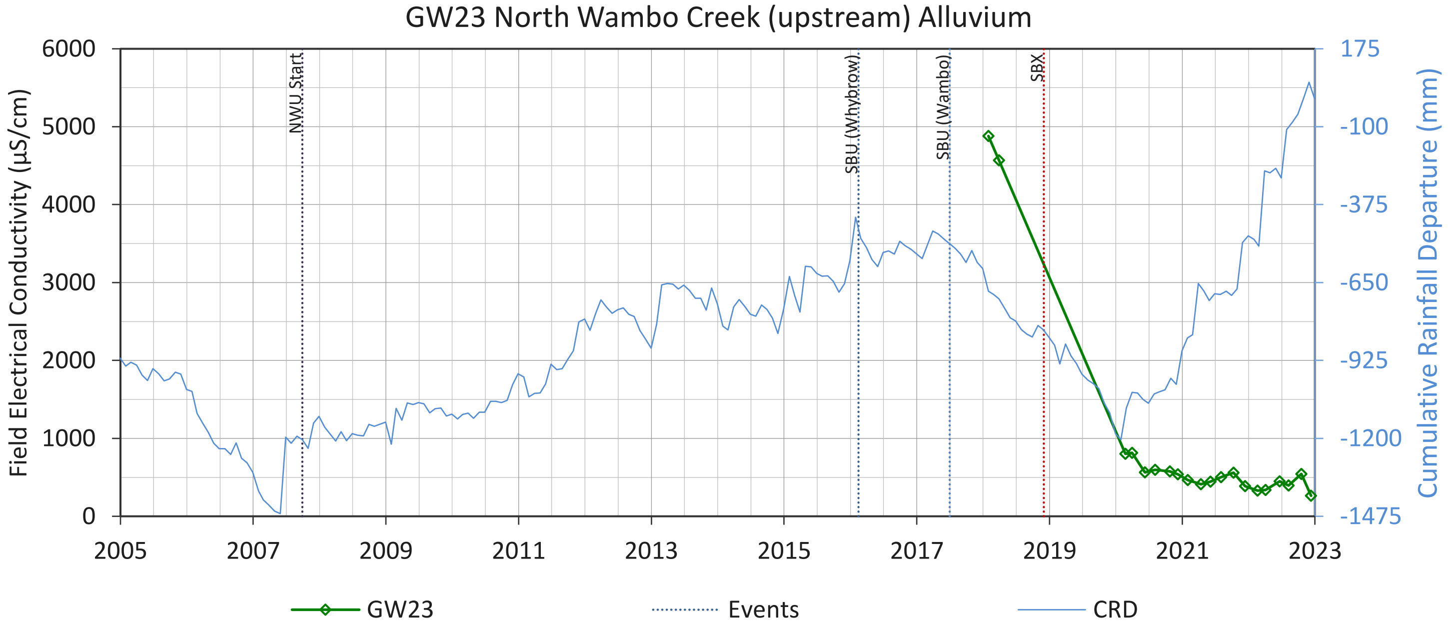

P29 North Wambo Creek (downstream) Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
65
60
55
50
45
40
35
30
25
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P29
Events
CRD

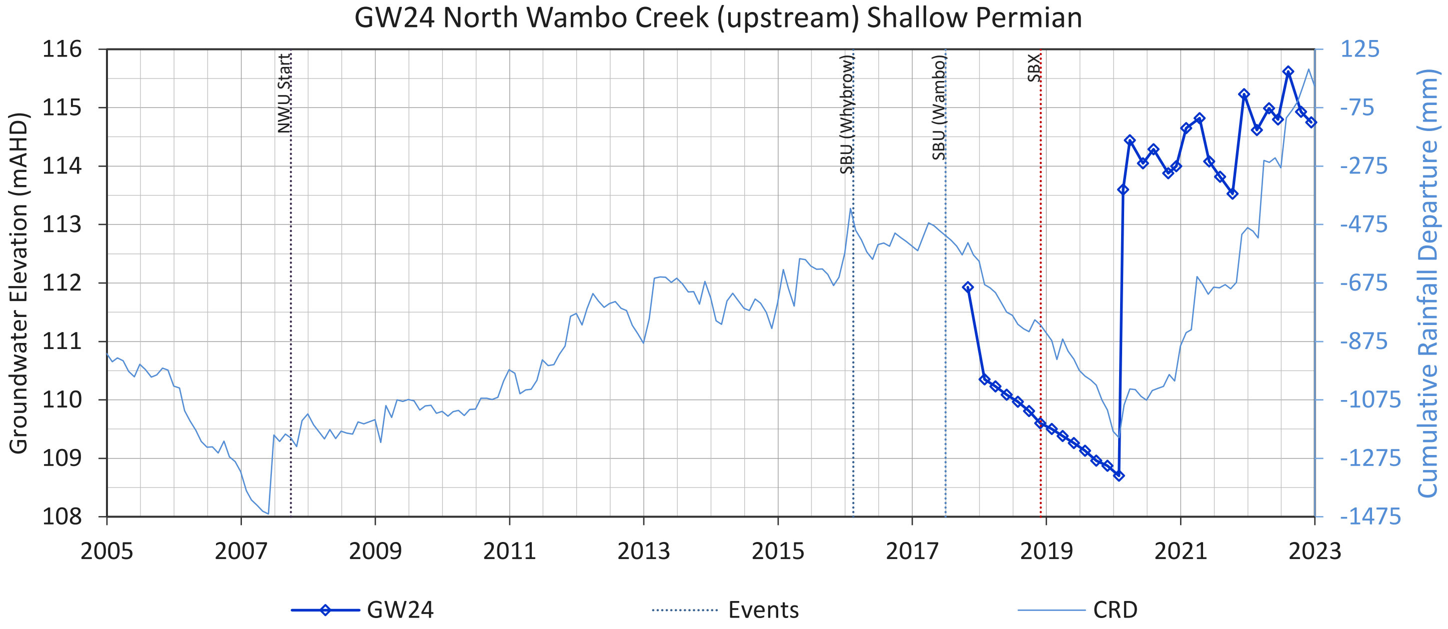

P29 North Wambo Creek (downstream) Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P29
Events
CRD

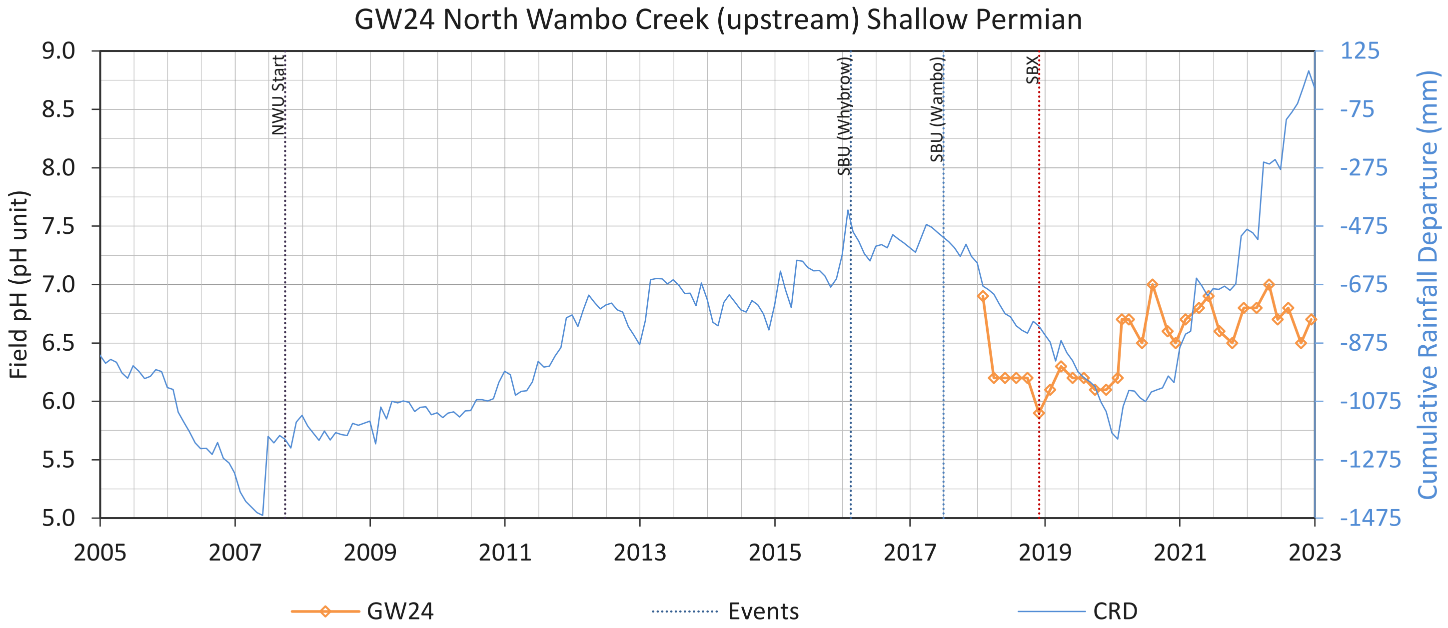

P29 North Wambo Creek (downstream) Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P29
Events
CRD

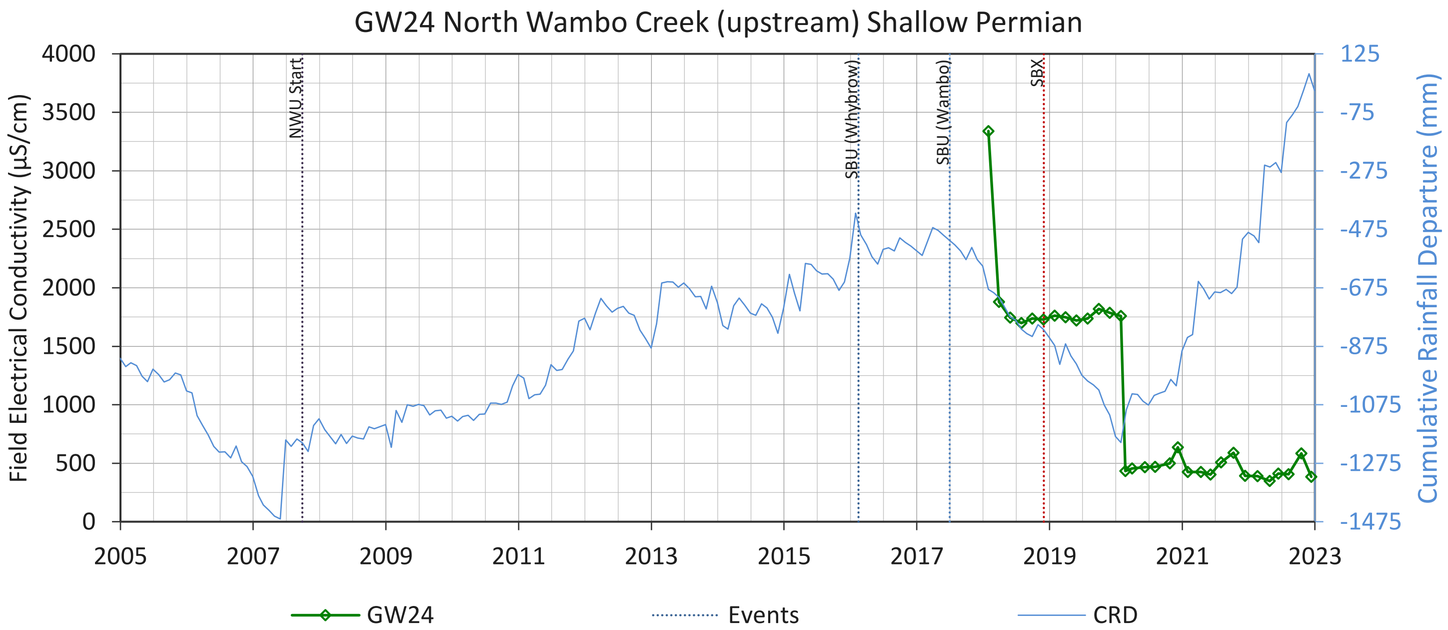

GW23 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
117
116
115
114
113
112
111
110
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW23
Events
CRD

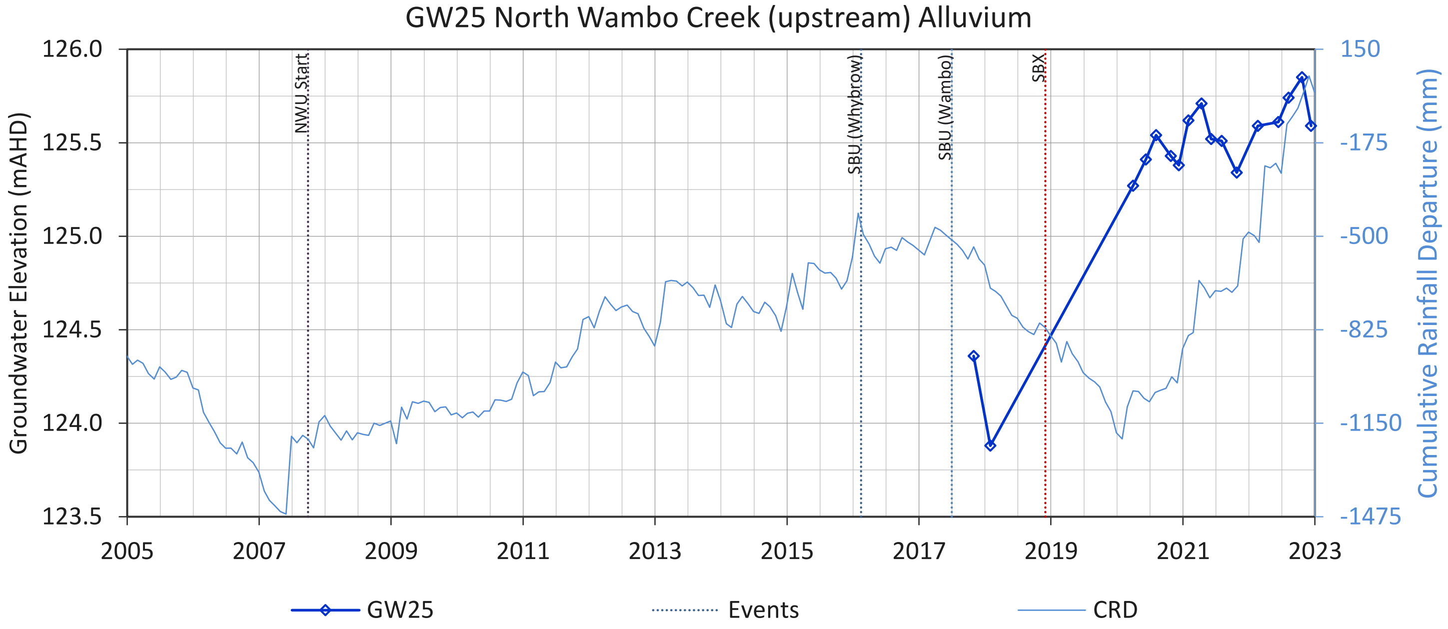

GW23 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW23
Events
CRD

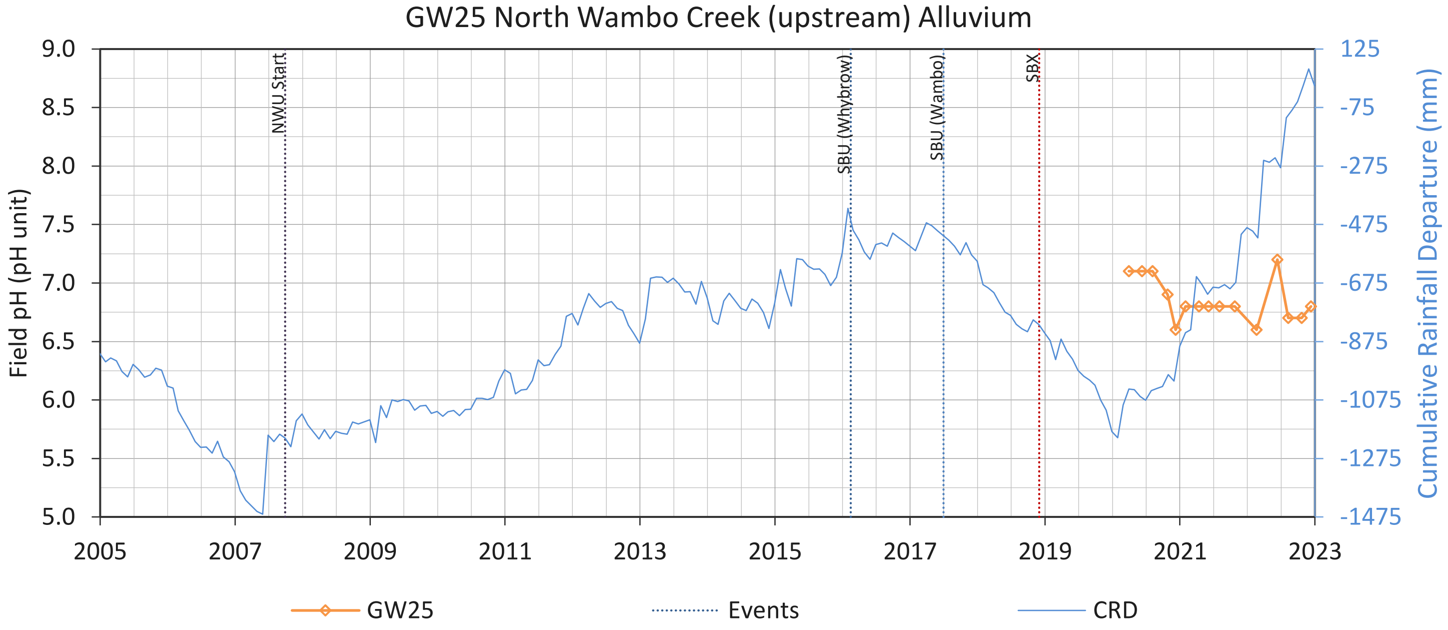

GW23 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
6000
5000
4000
3000
2000
1000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW23
Events
CRD

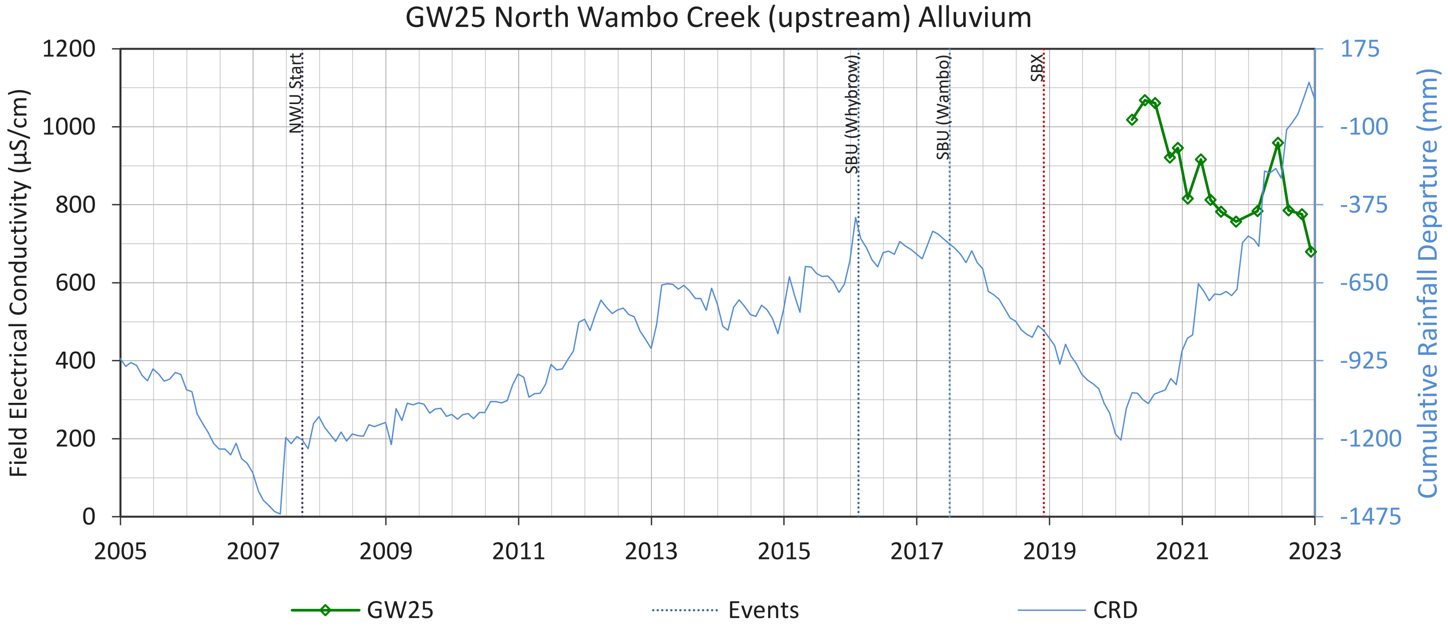

GW24 North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
116
115
114
113
112
111
110
109
108
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW24
Events
CRD

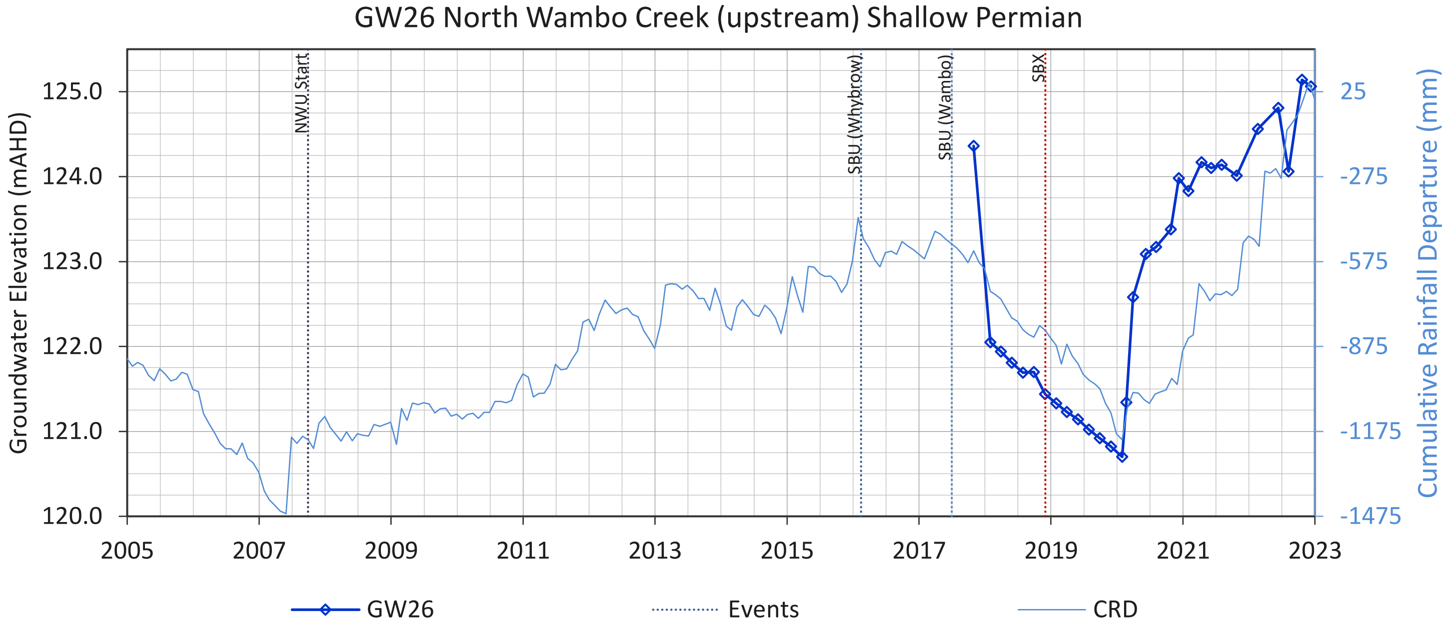

GW24 North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW24
Events
CRD

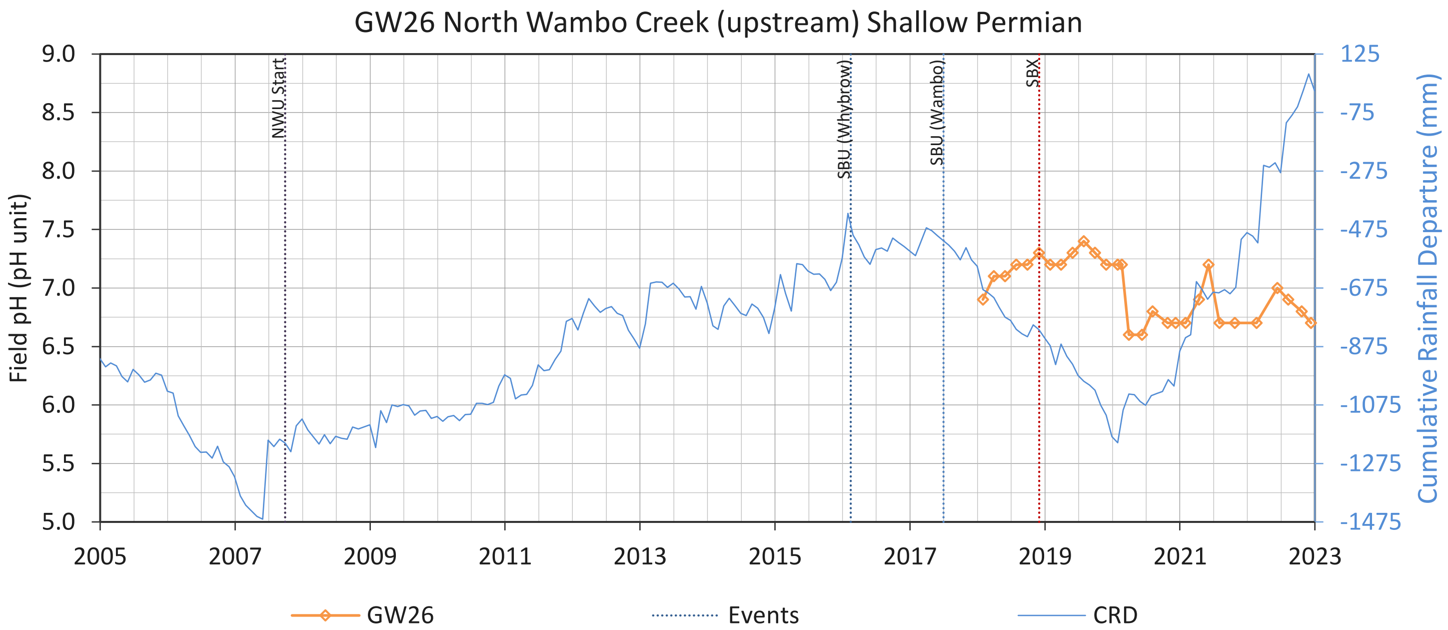

GW24 North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
4000
3500
3000
2500
2000
1500
1000
500
0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW24
Events
CRD

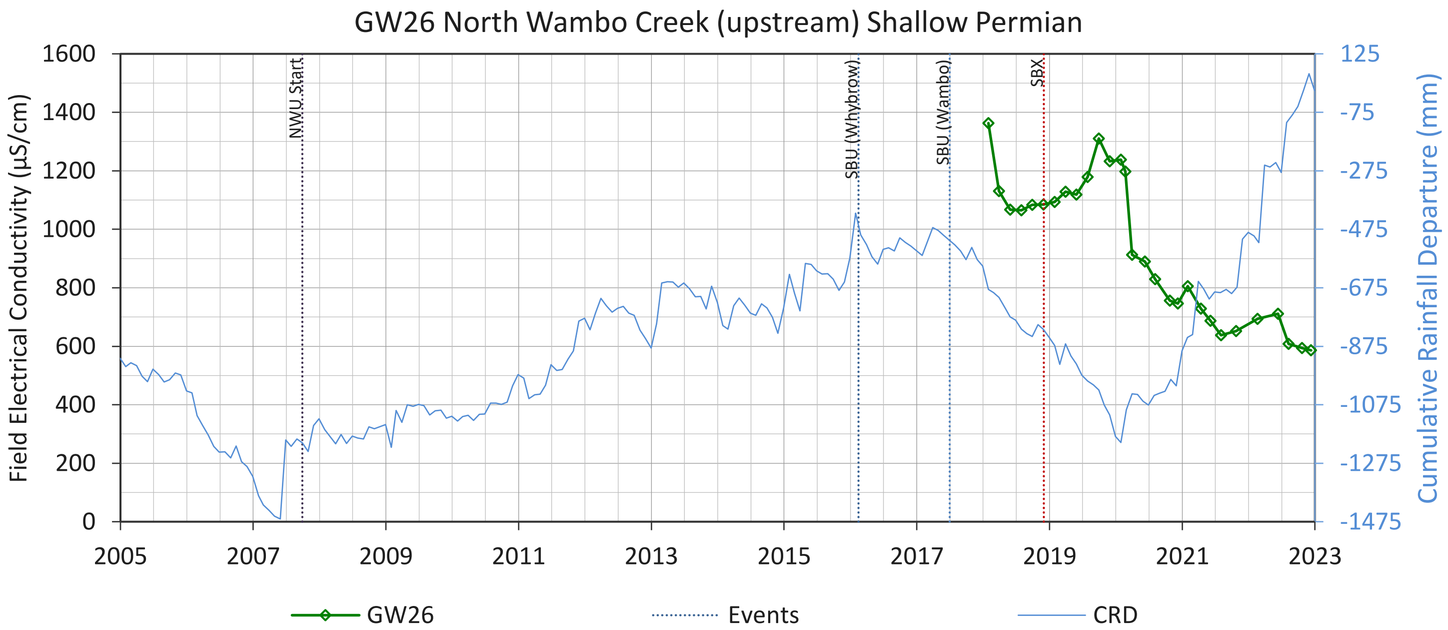

GW25 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
126.0
125.5
125.0
124.5
124.0
123.5
150
-175
-500
-825
-1150
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW25
Events
CRD

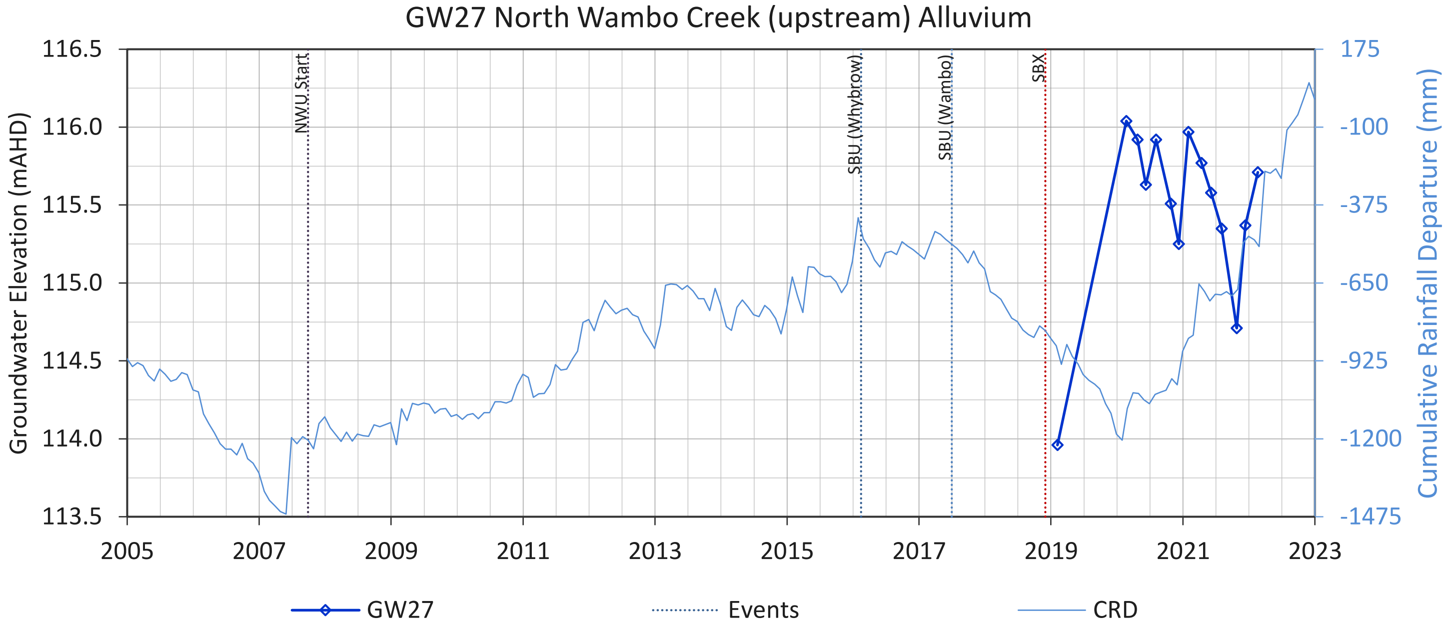

GW25 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW25
Events
CRD

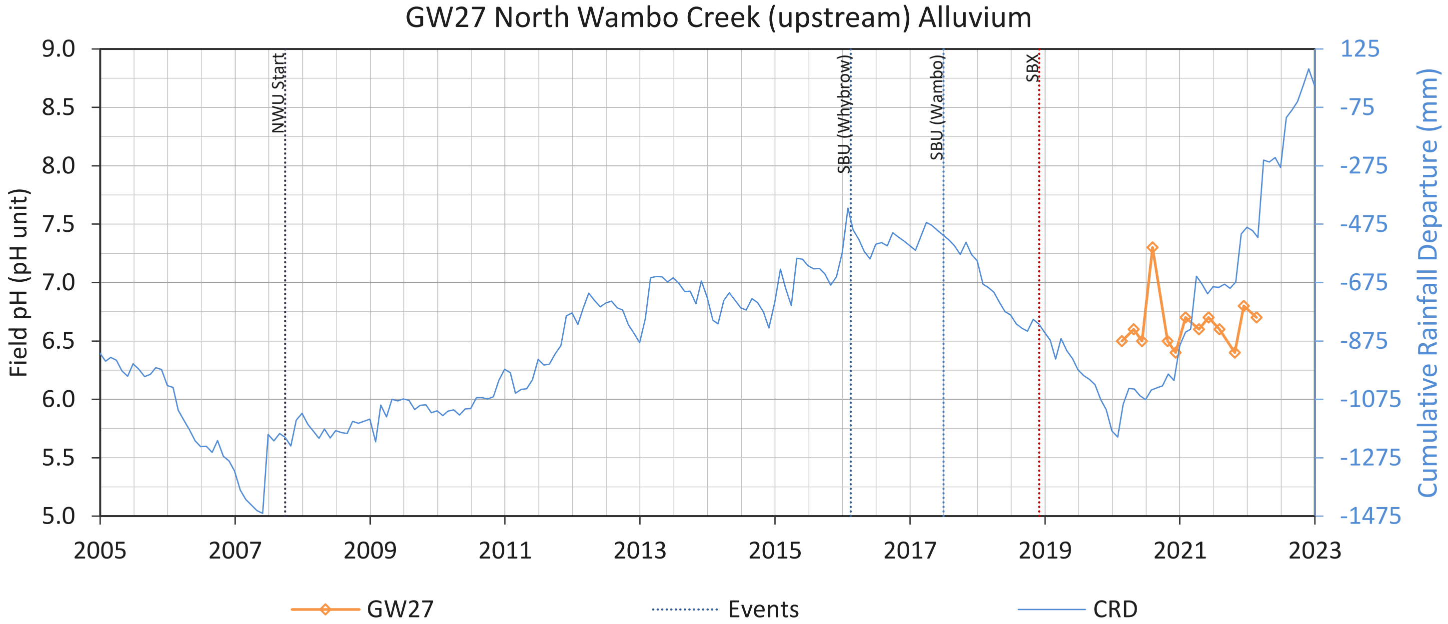

GW25 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1200
1000
800
600
400
200
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW25
Events
CRD

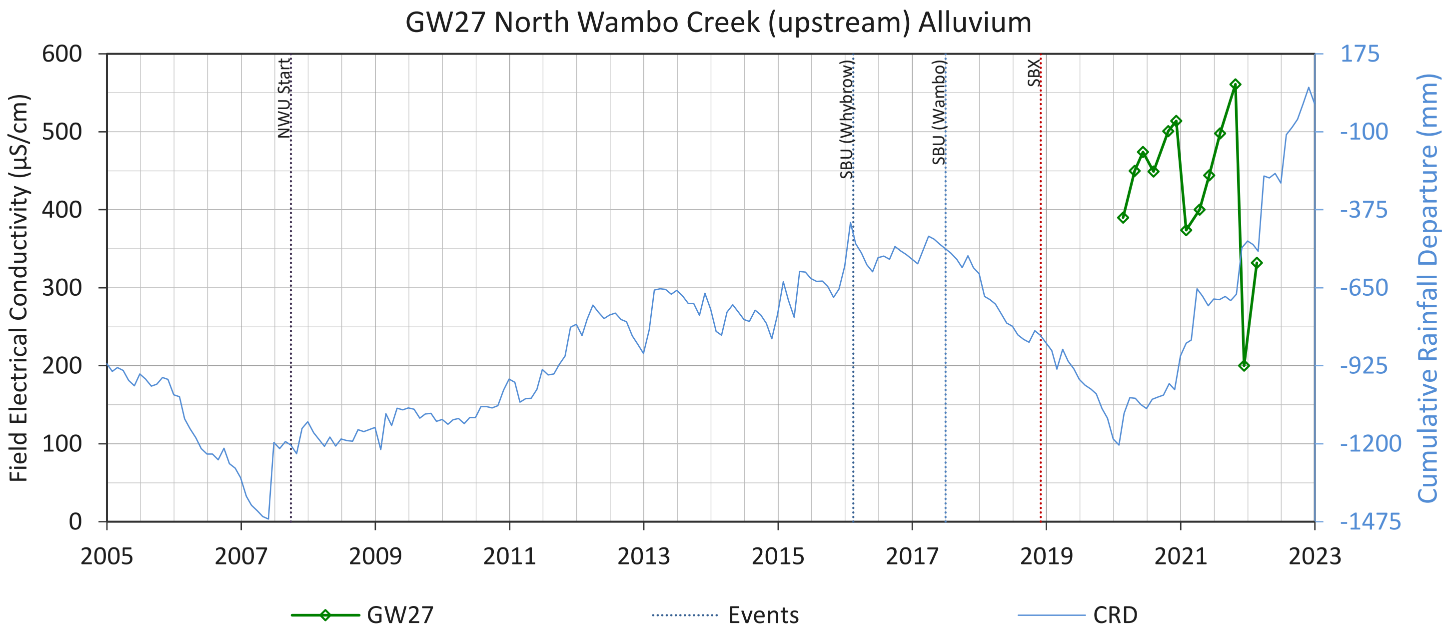

GW26 North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
125.0
124.0
123.0
122.0
121.0
120.0
25
-275
-575
-875
-1175
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW26
Events
CRD

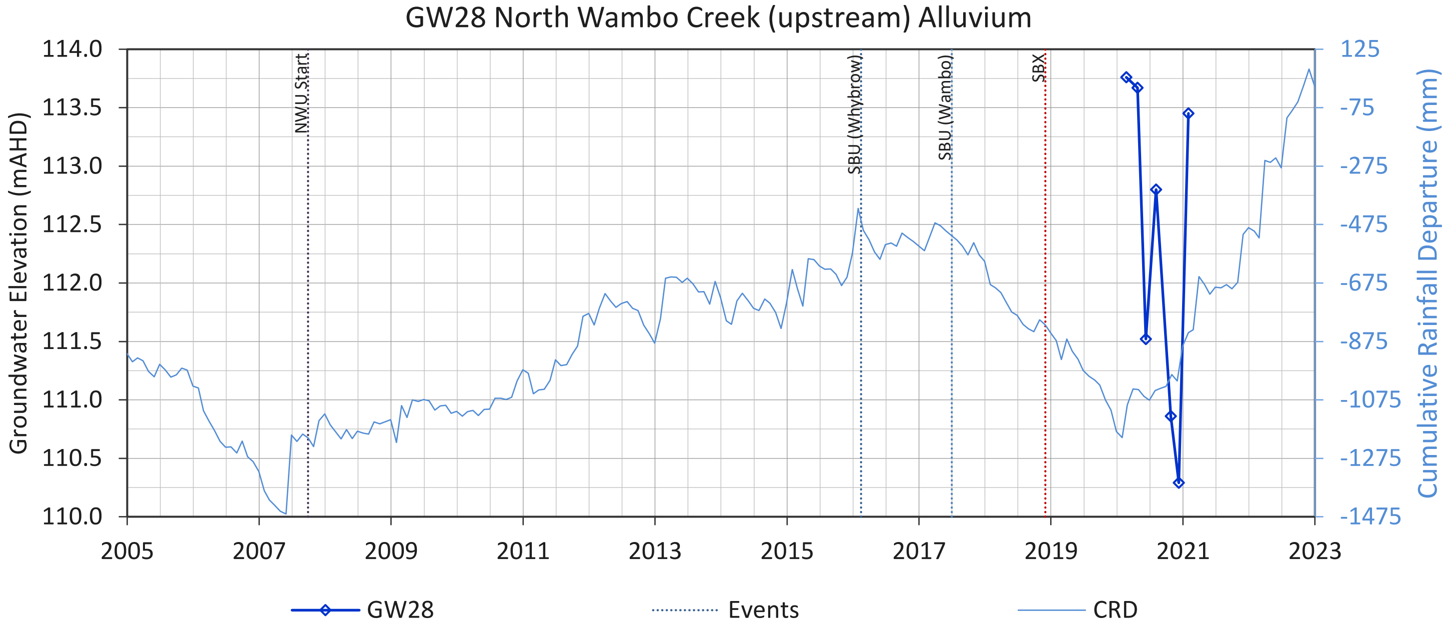

GW26 North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW26
Events
CRD

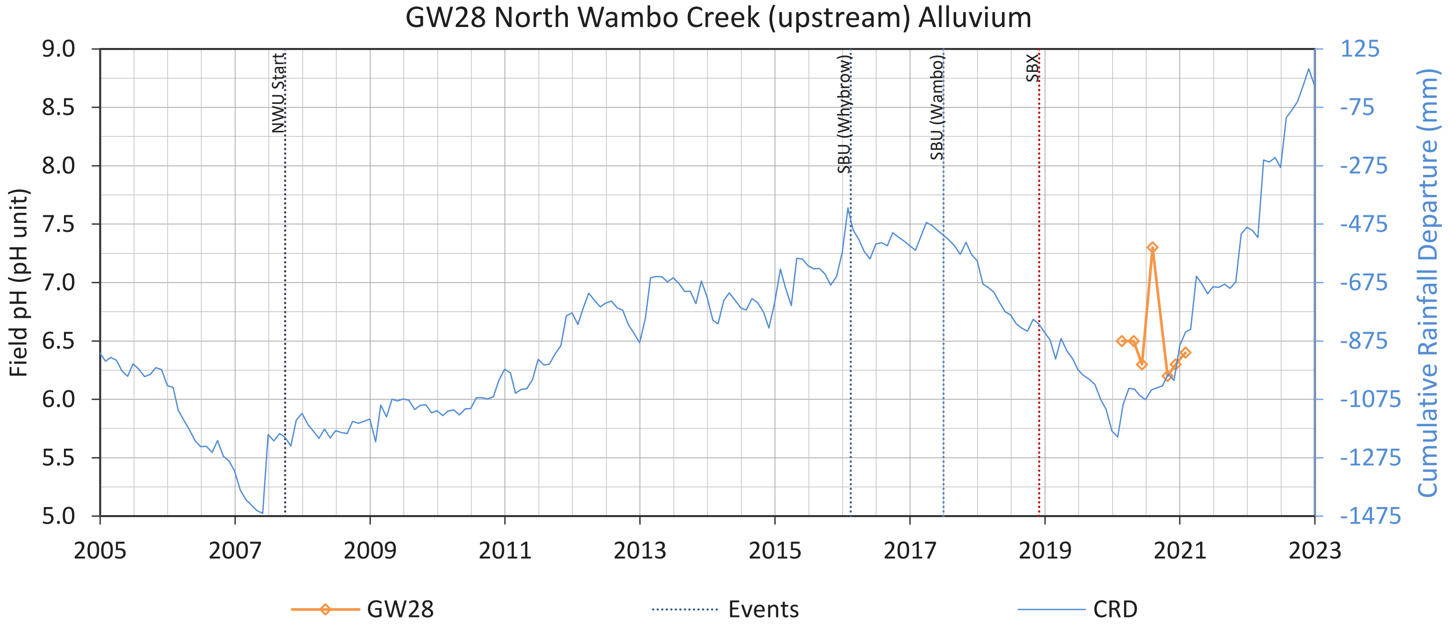

GW26 North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1600
1400
1200
1000
800
600
400
200
0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW26
Events
CRD

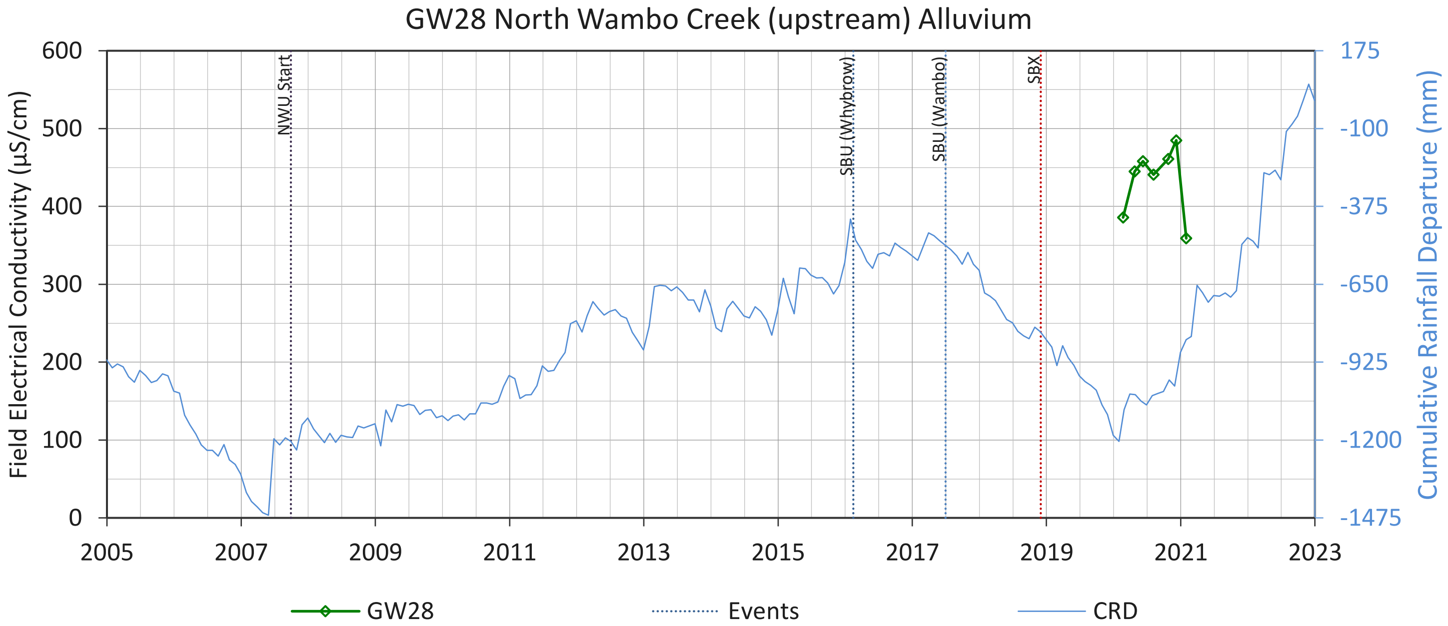

GW27 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
116.5
116.0
115.5
115.0
114.5
114.0
113.5
175
-100
-375
-650
-925
-1200
-1475
NWJU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW27
Events
CRD

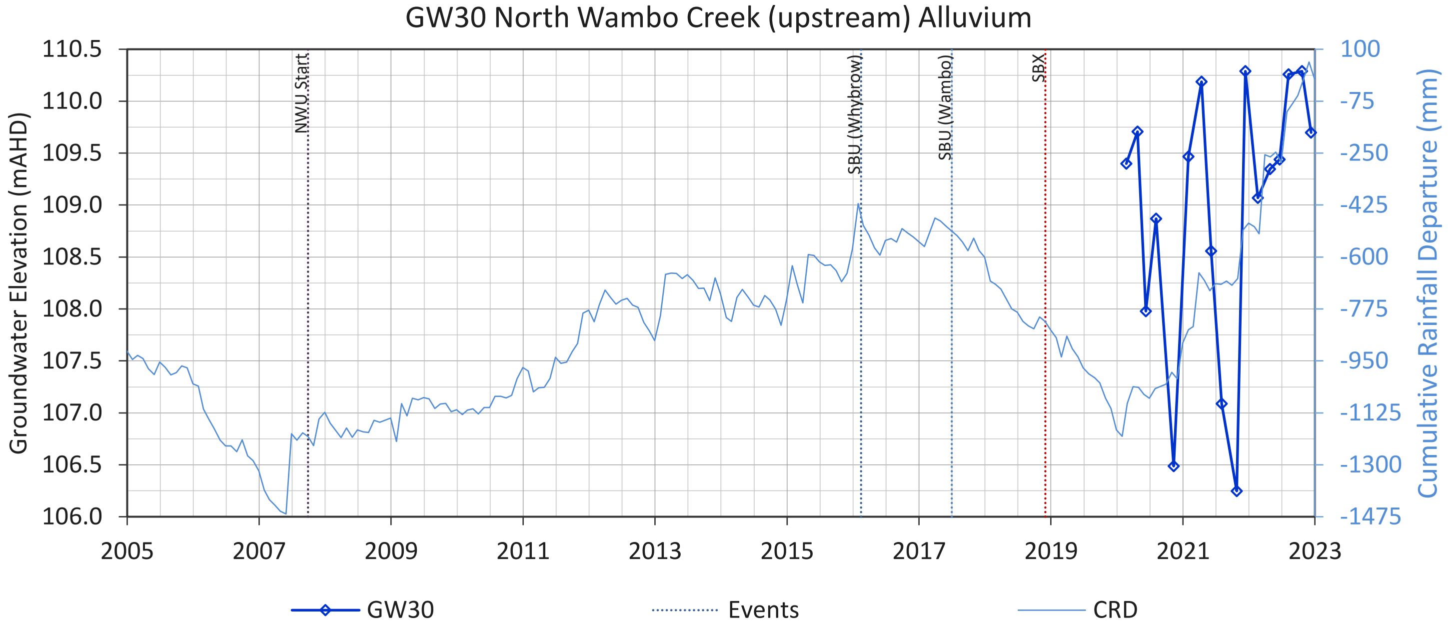

GW27 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
NWJU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW27
Events
CRD

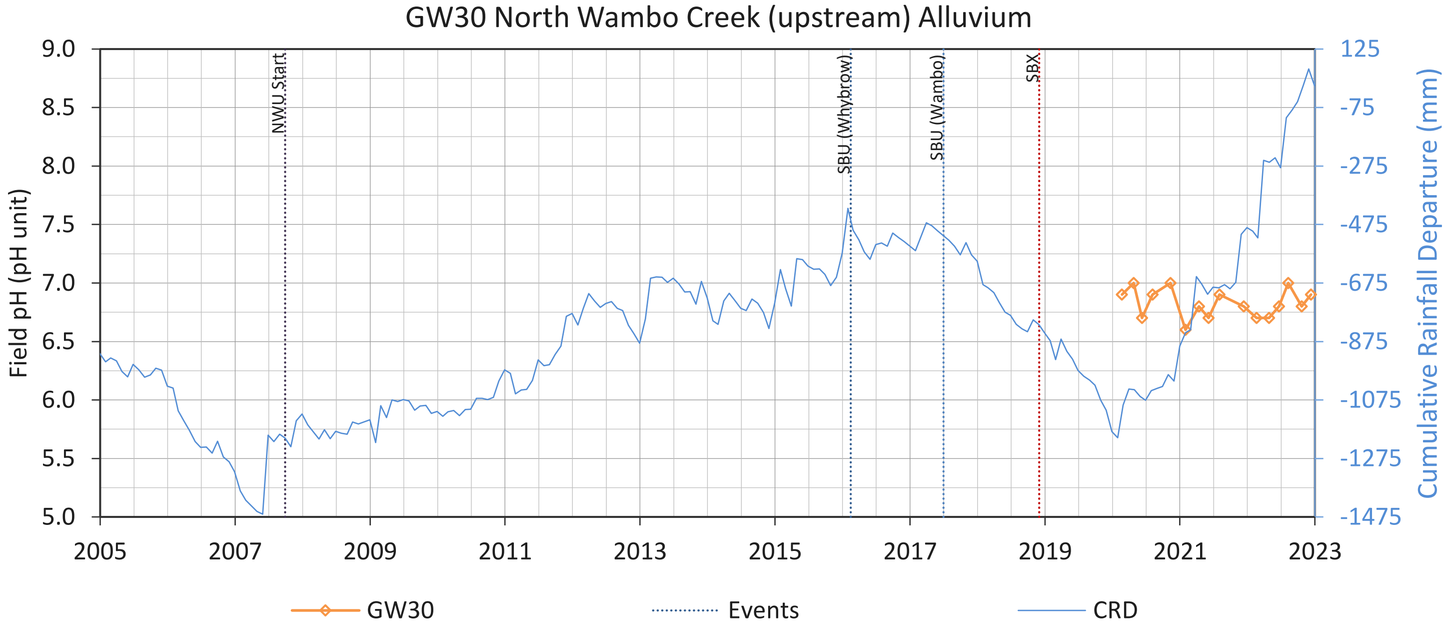

GW27 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
600
500
400
300
200
100
0
175
-100
-375
-650
-925
-1200
-1475
NWJU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW27
Events
CRD

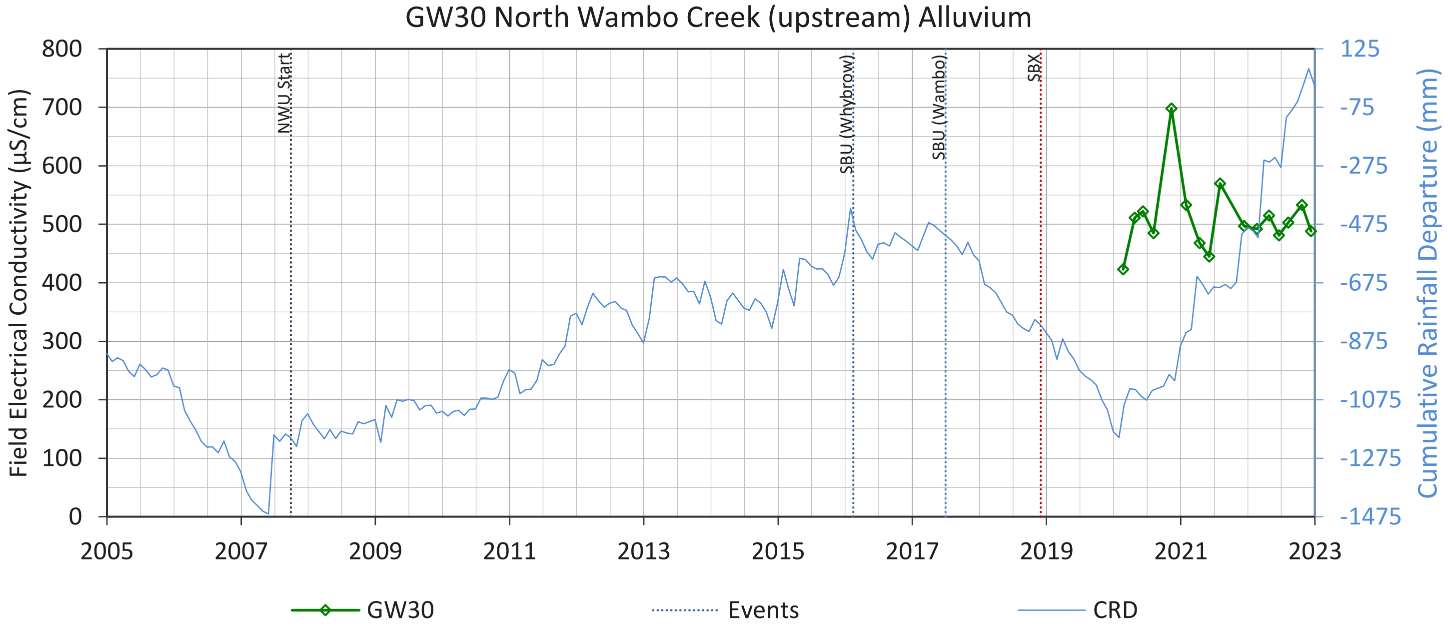

GW28 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWIJ Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

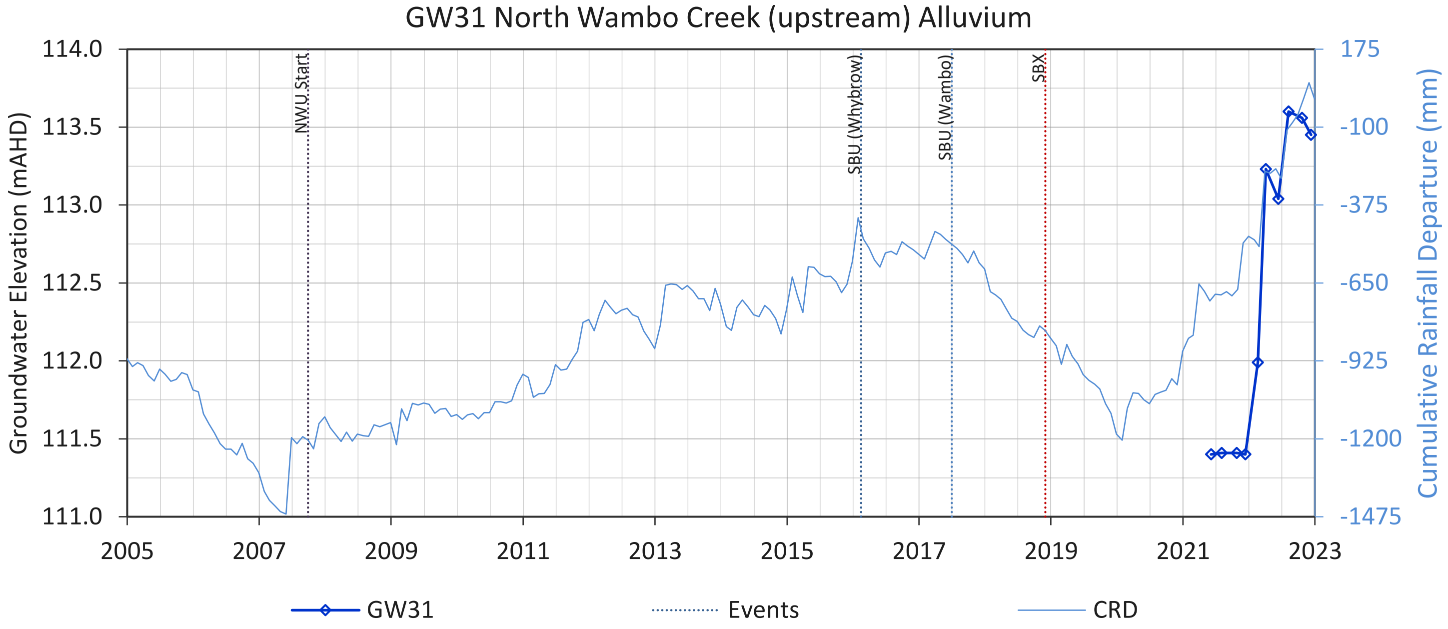

GW28 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWIJ Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

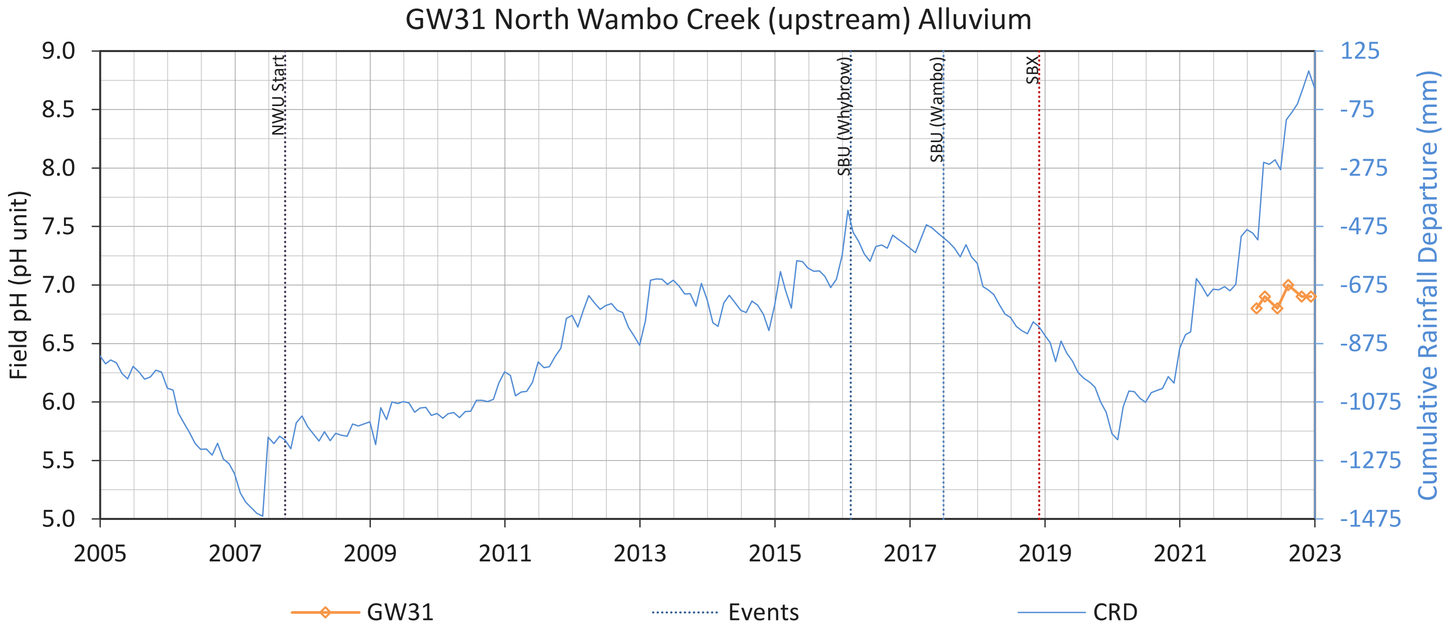

GW28 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWIJ Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

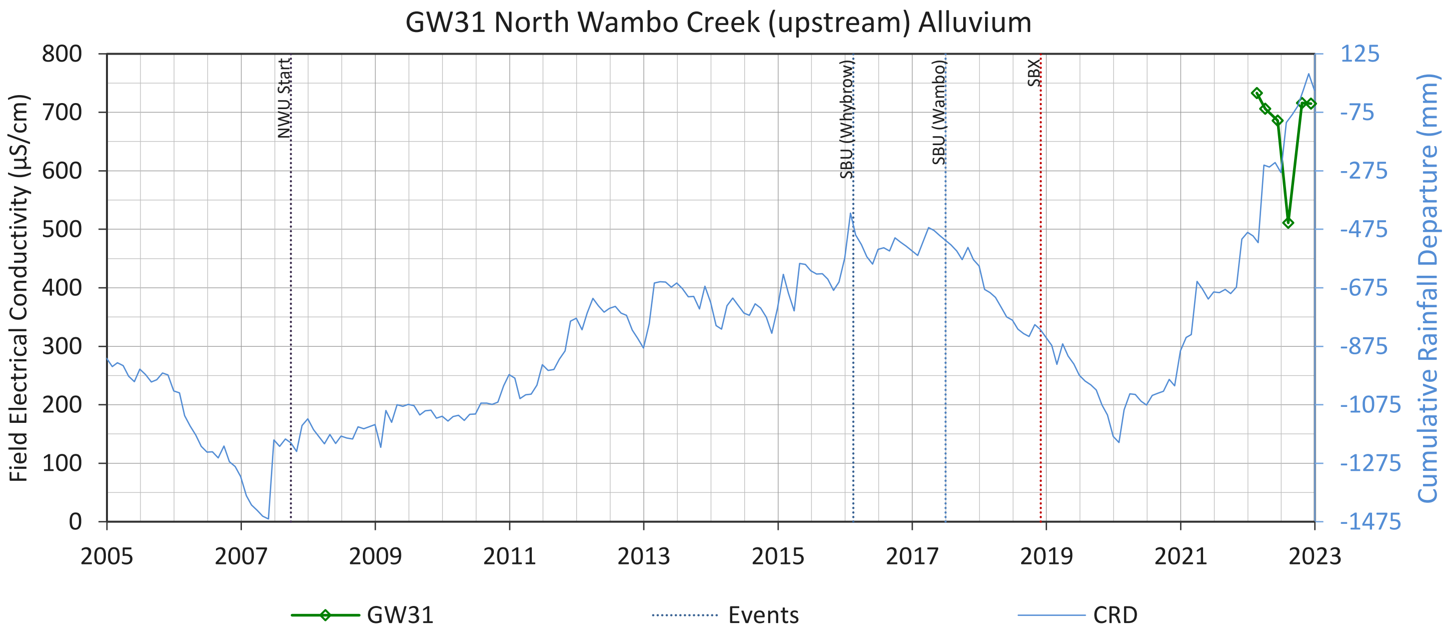

GW30 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW30
Events
CRD

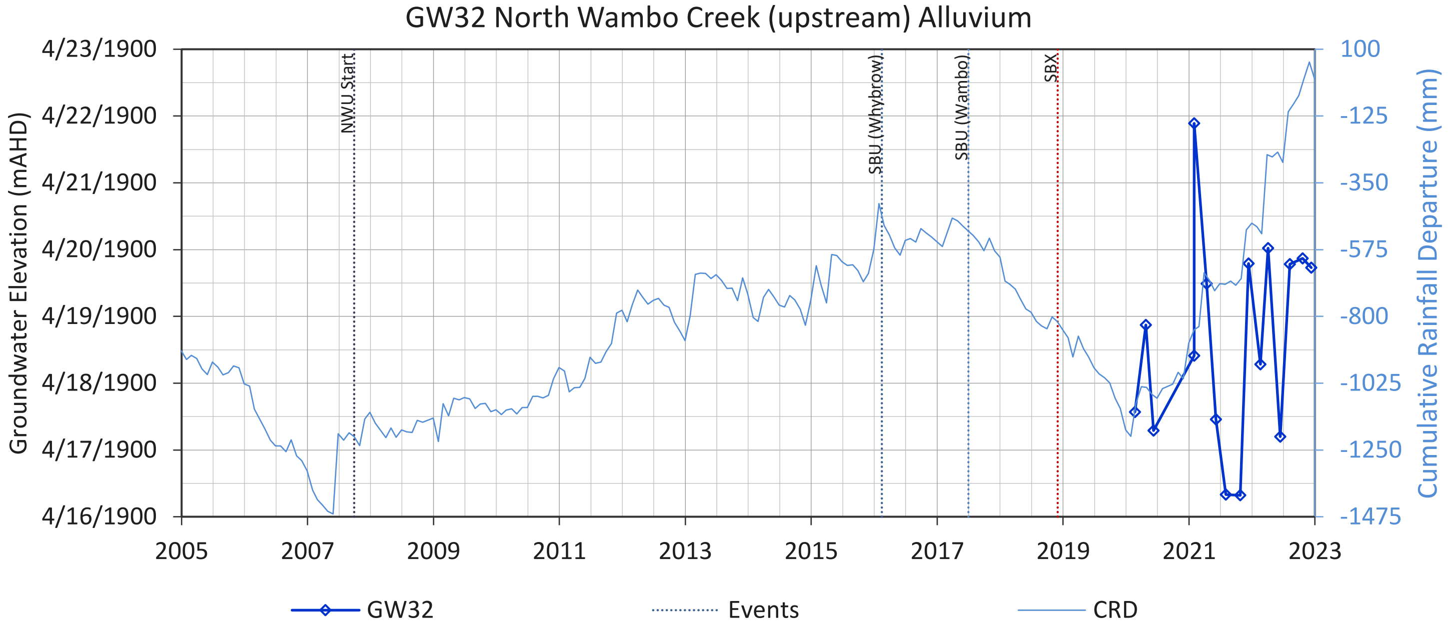

GW30 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW30
Events
CRD

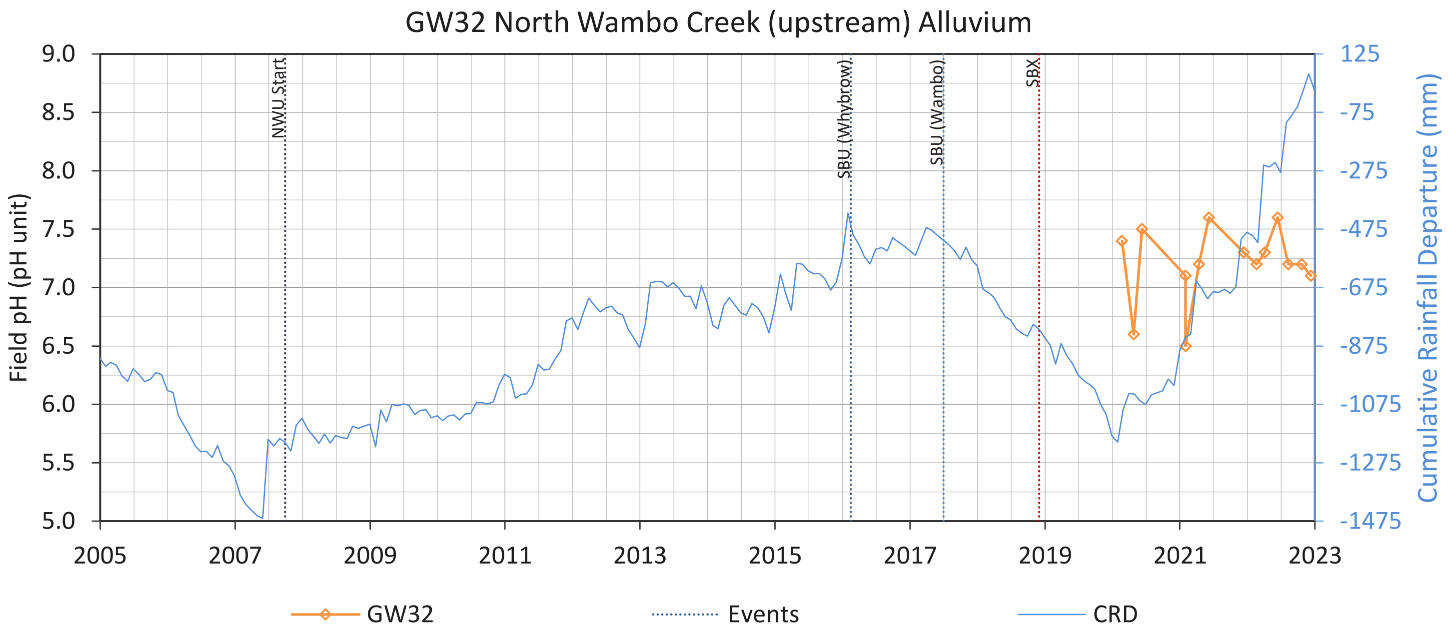

GW30 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW30
Events
CRD

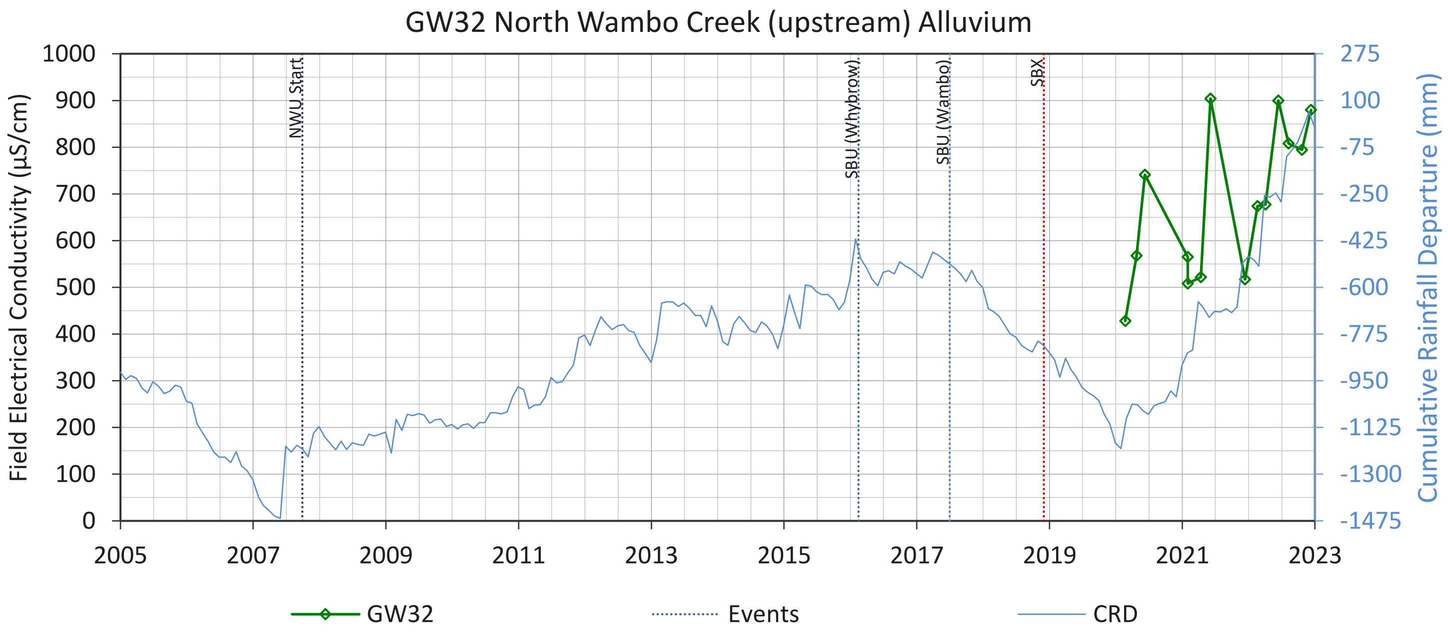

GW31 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
114.0
113.5
113.0
112.5
112.0
111.5
111.0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW31
Events
CRD

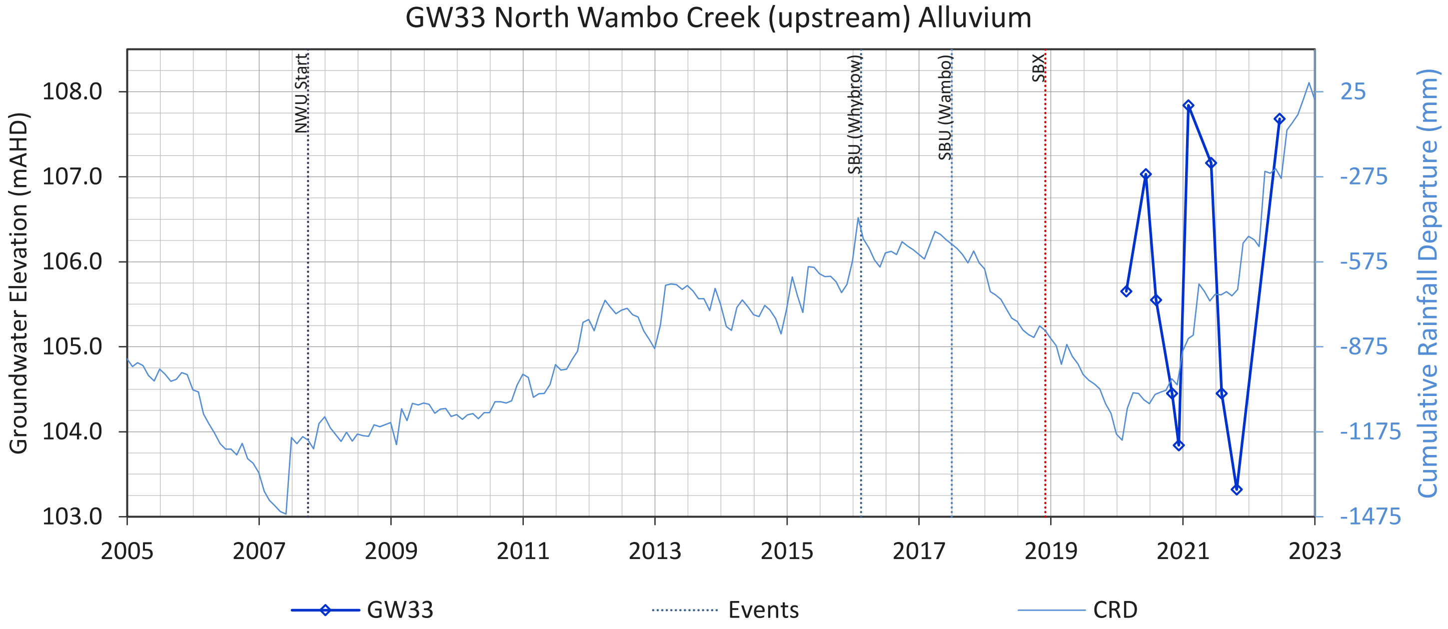

GW31 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW31
Events
CRD

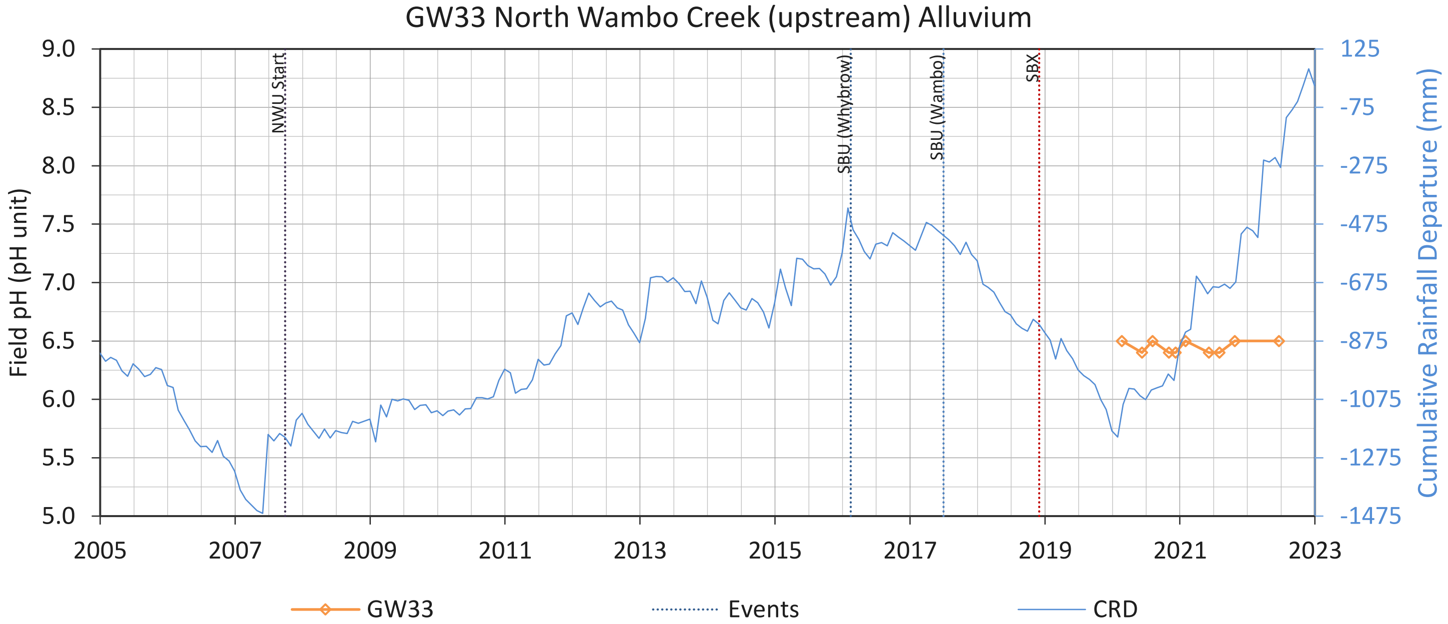

GW31 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
800
700
600
500
400
300
200
100
0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW31
Events
CRD

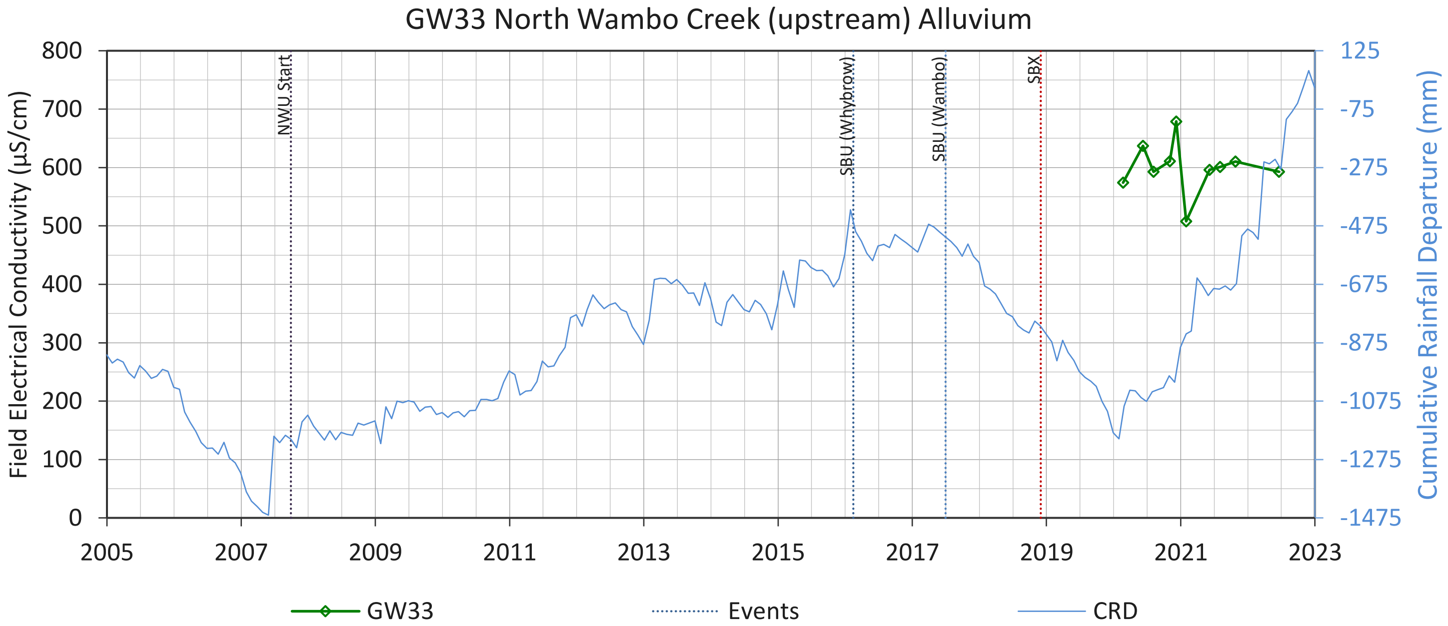

GW32 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
4/23/1900
4/22/1900
4/21/1900
4/20/1900
4/19/1900
4/18/1900
4/17/1900
4/16/1900
100
-125
-350
-575
-800
-1025
-1250
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW32
Events
CRD

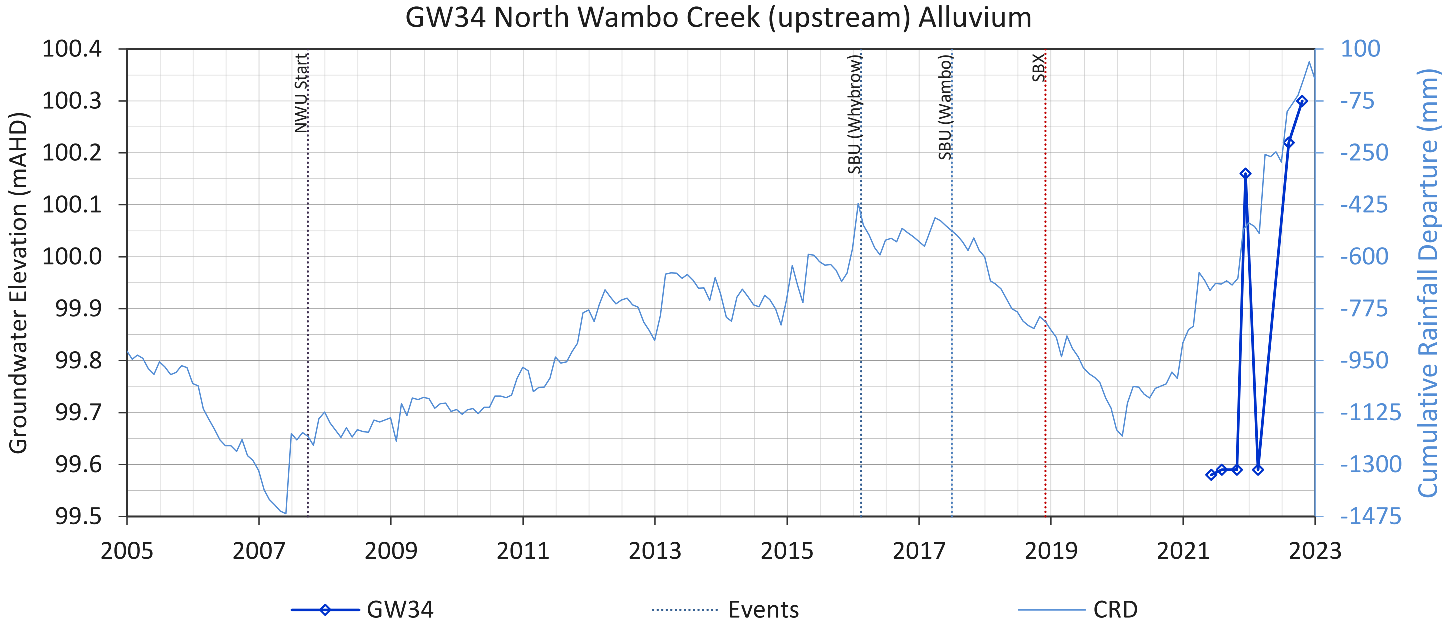

GW32 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW32
Events
CRD

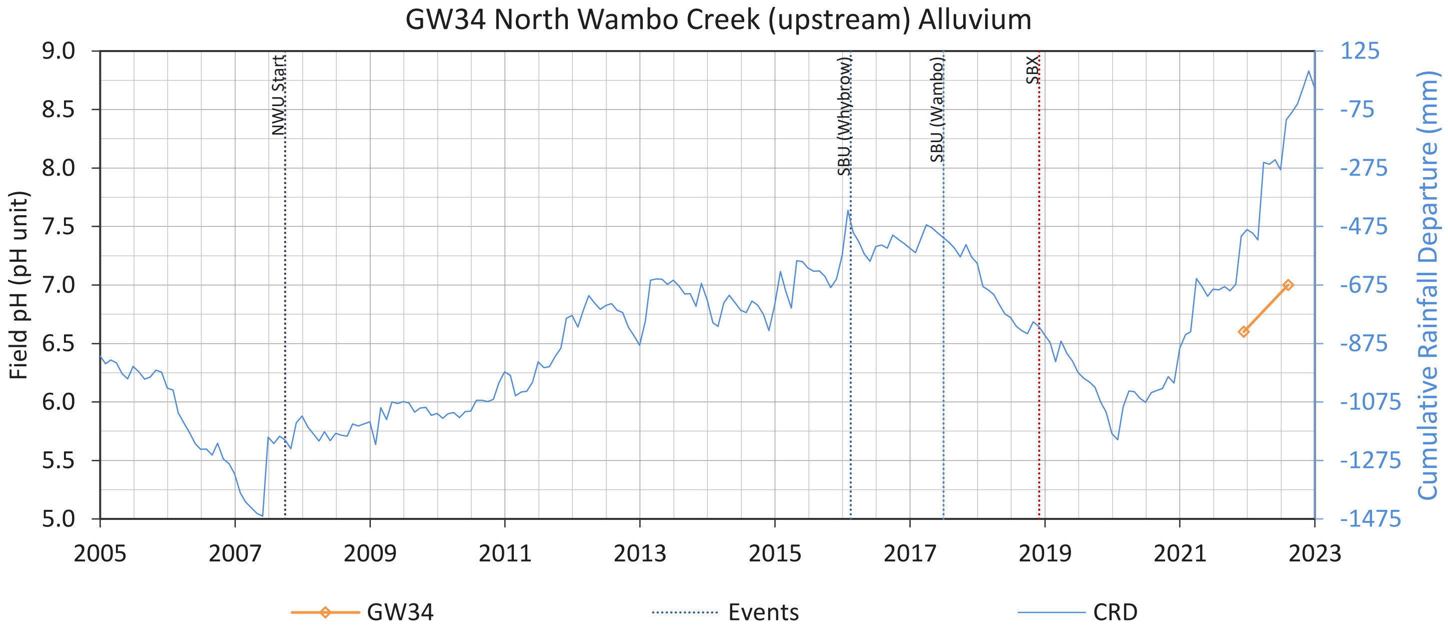

GW32 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW32
Events
CRD

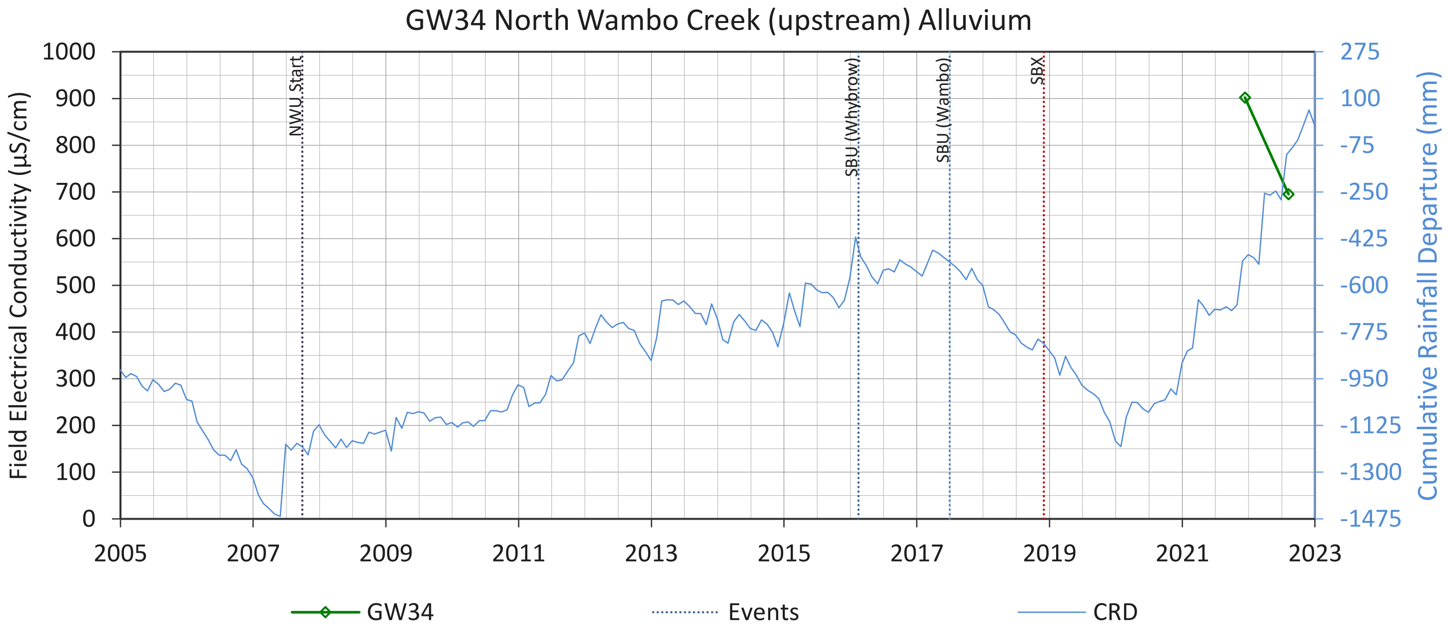

GW33 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

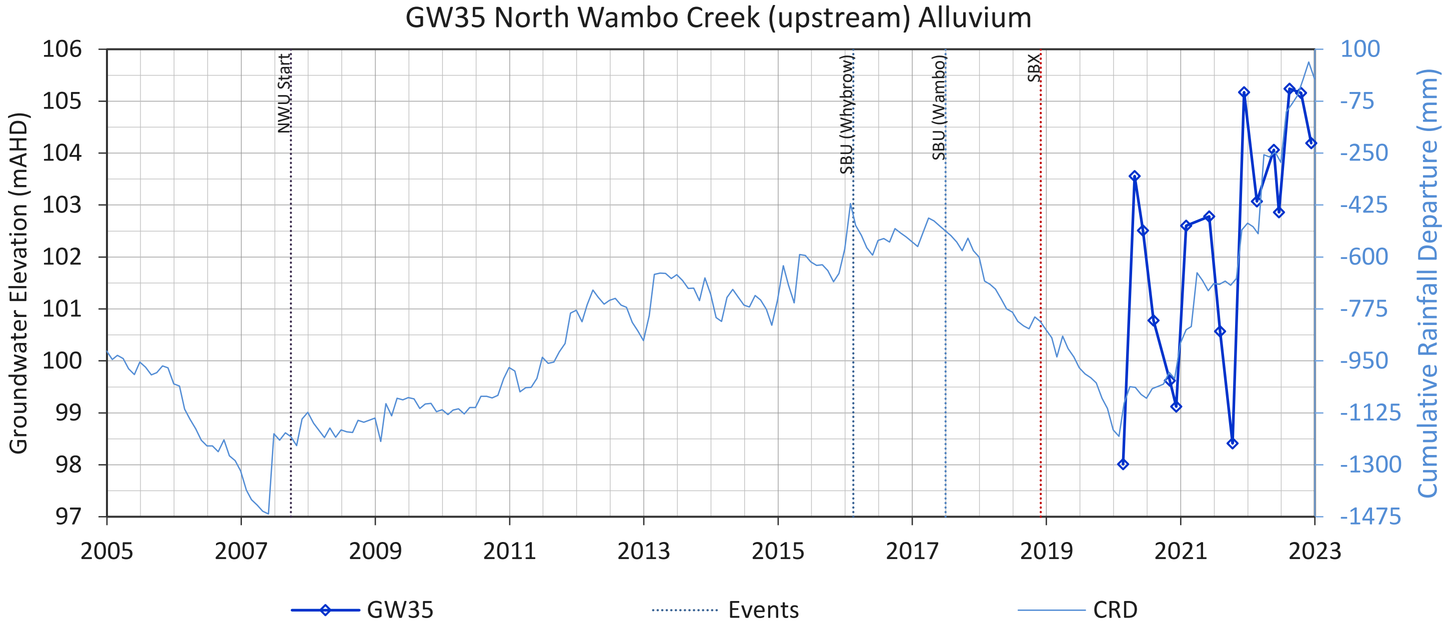

GW33 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

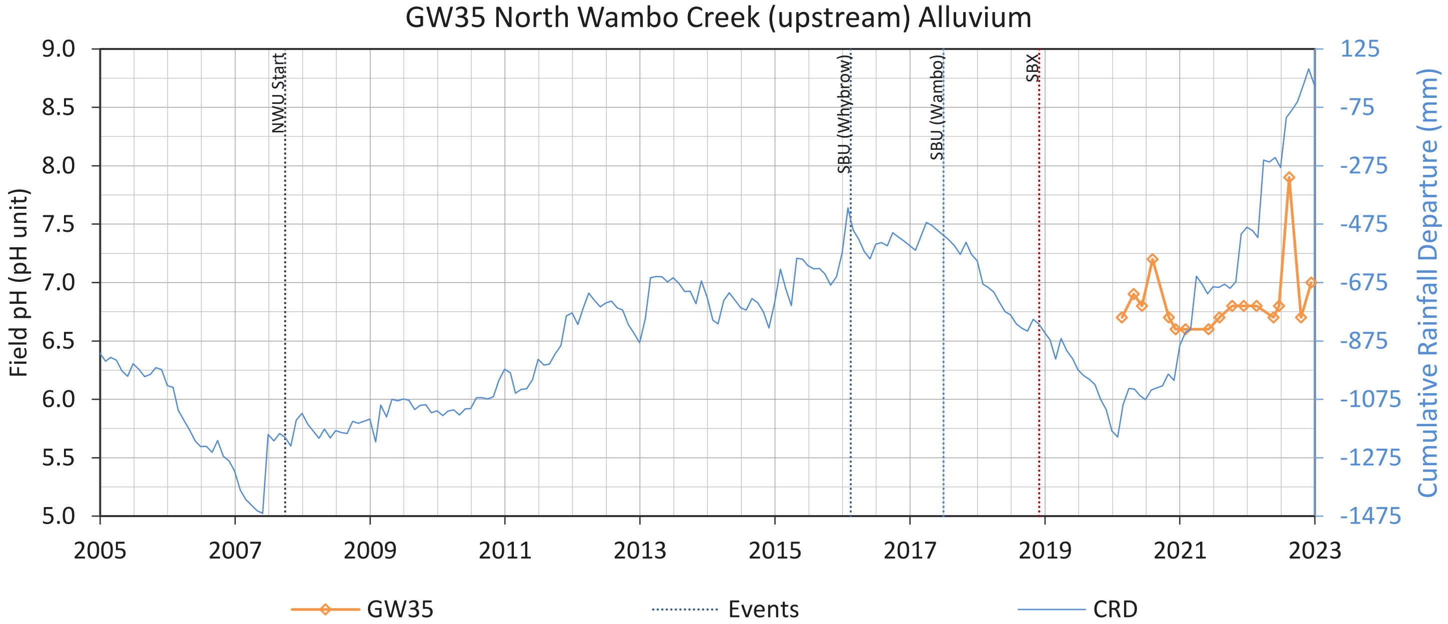

GW33 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

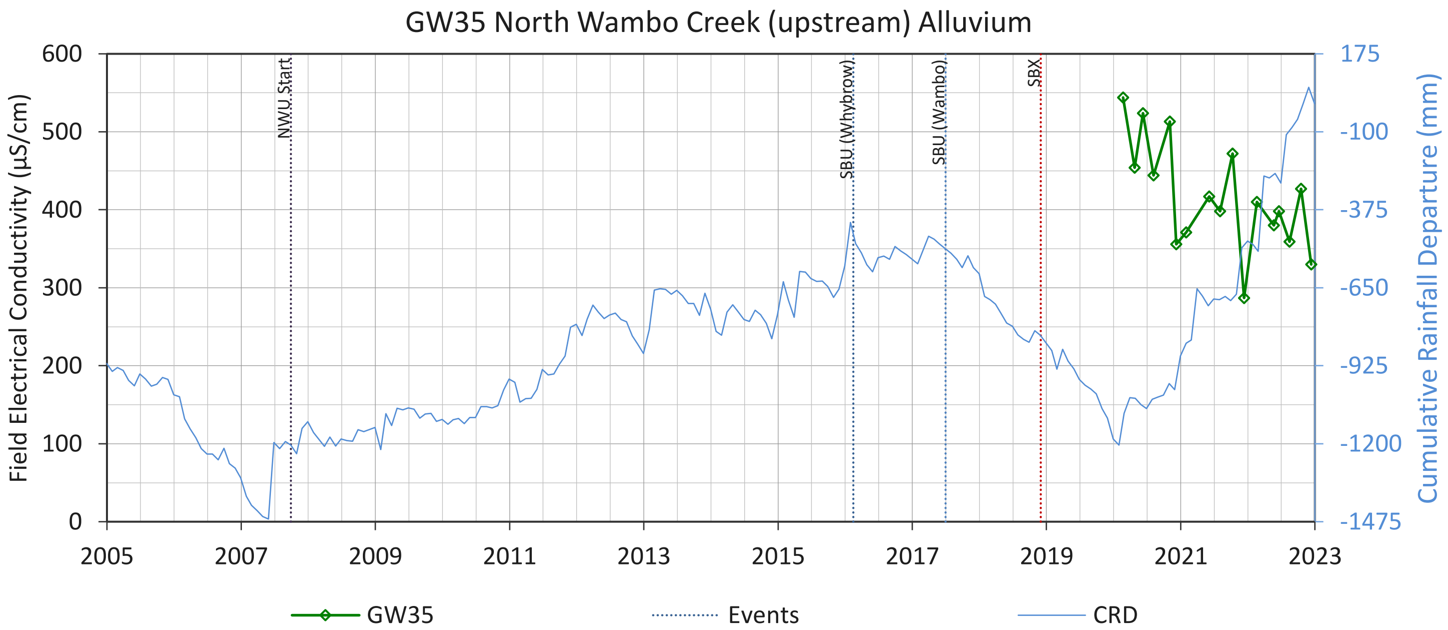

GW34 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
100.4
100.3
100.2
100.1
100.0
99.9
99.8
99.7
99.6
99.5
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

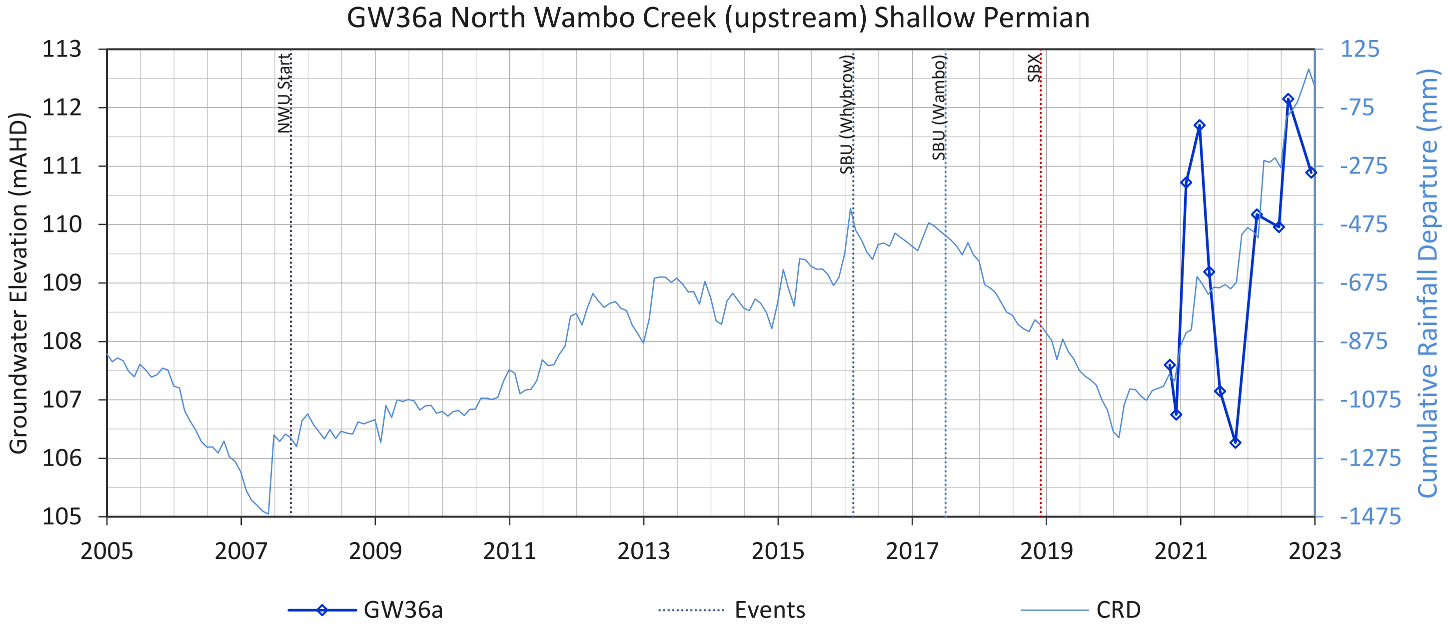

GW34 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

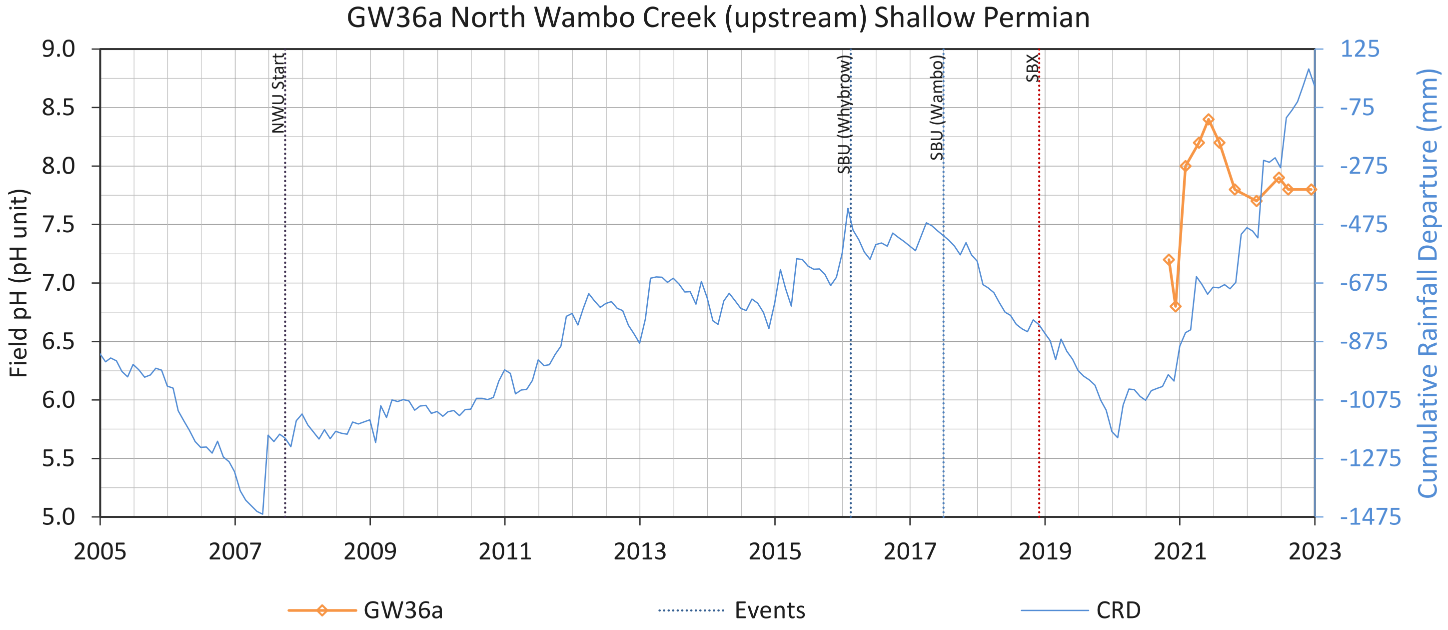

GW34 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

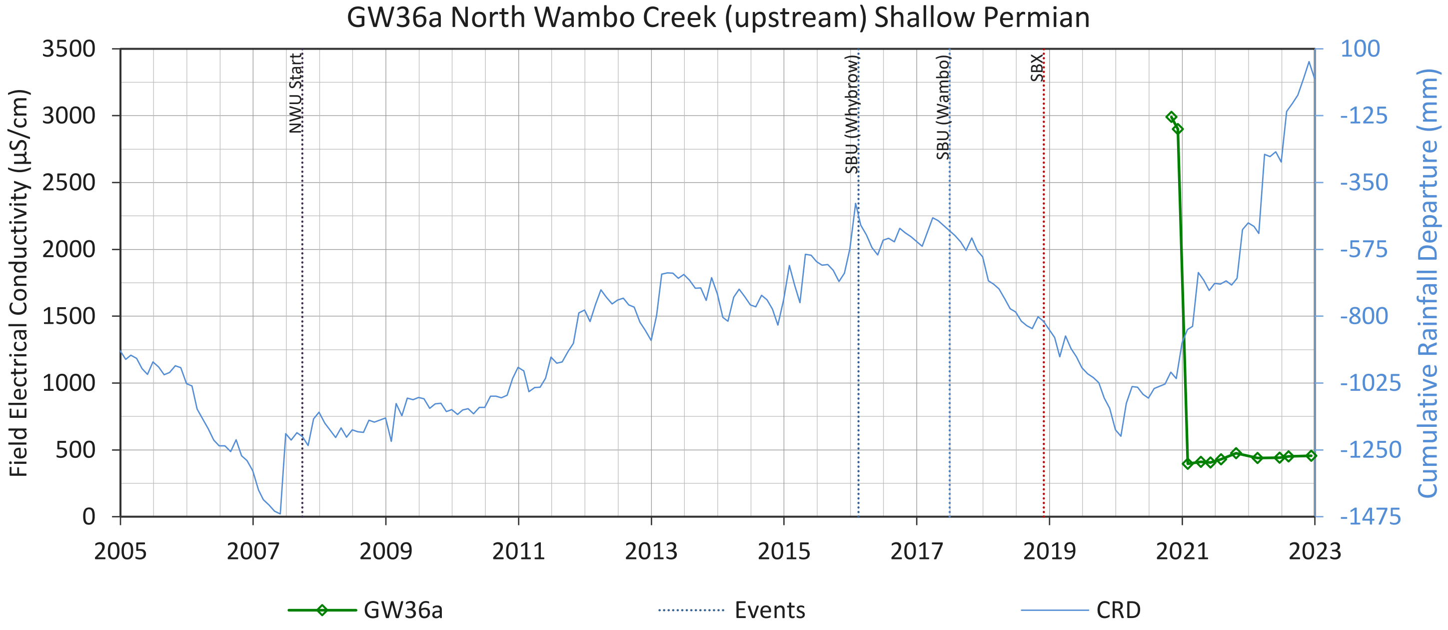

GW35 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW35
Events
CRD

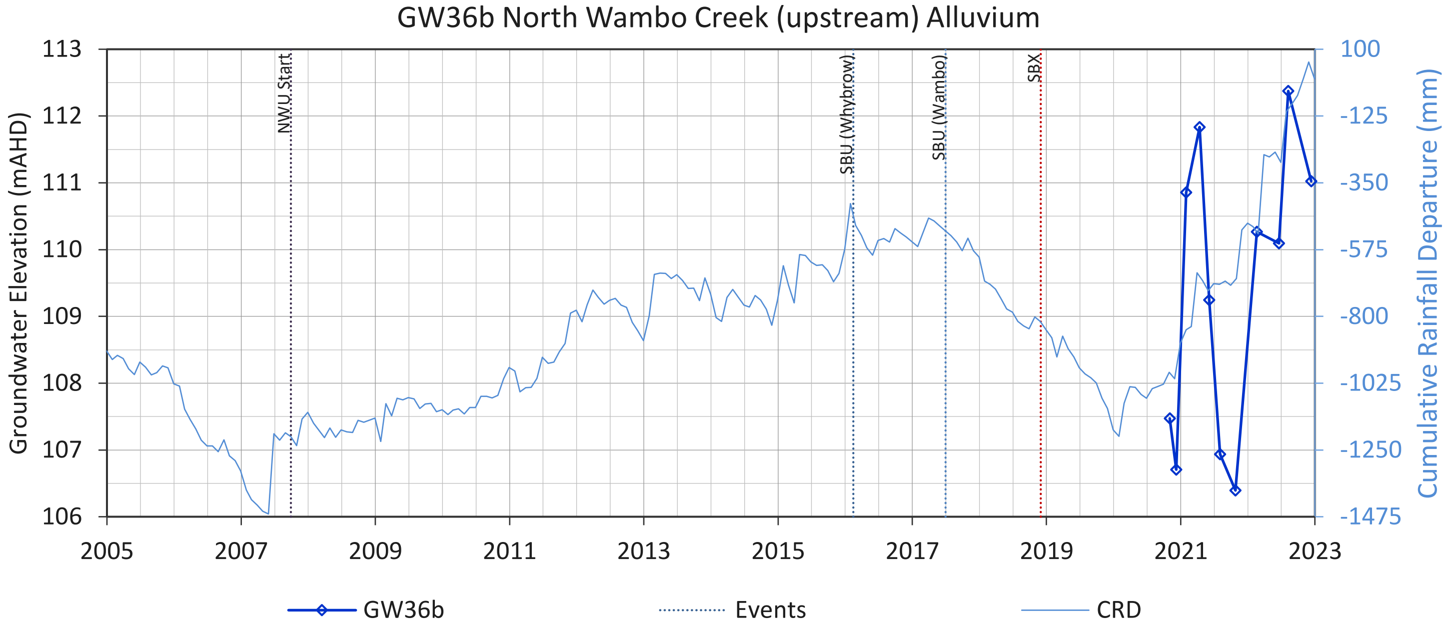

GW35 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW35
Events
CRD

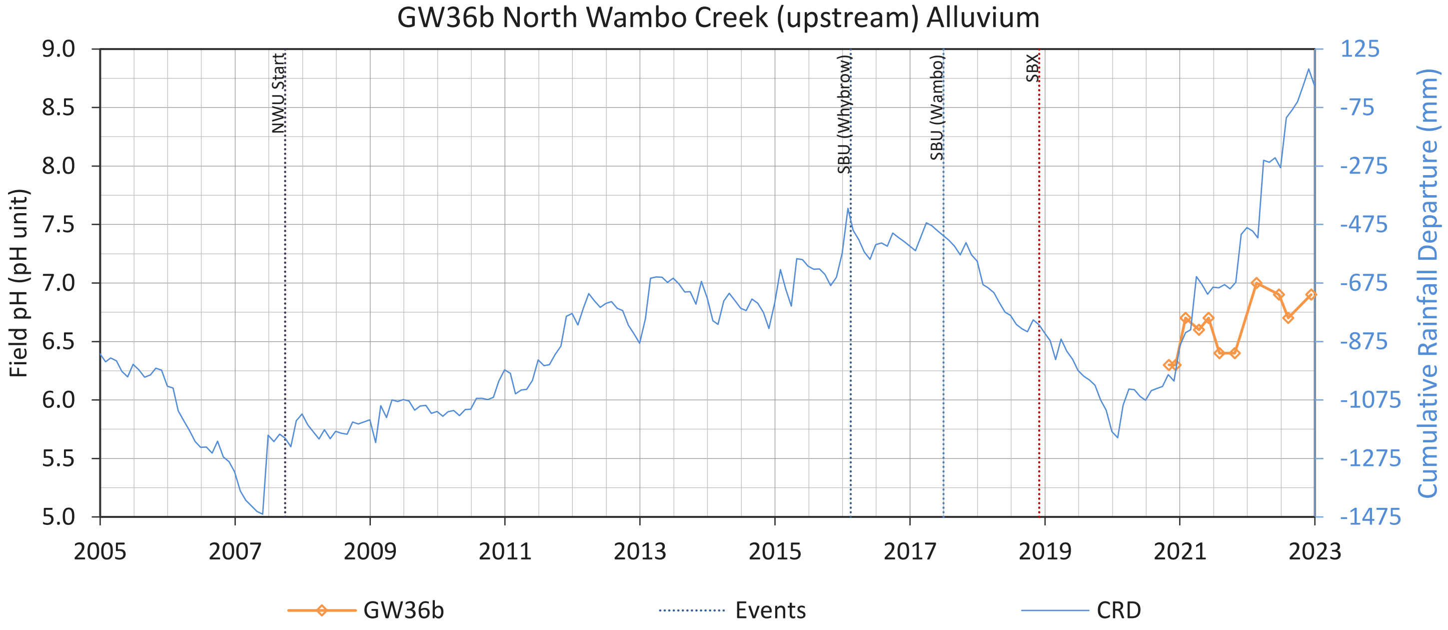

GW35 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
GW35
Events
CRD

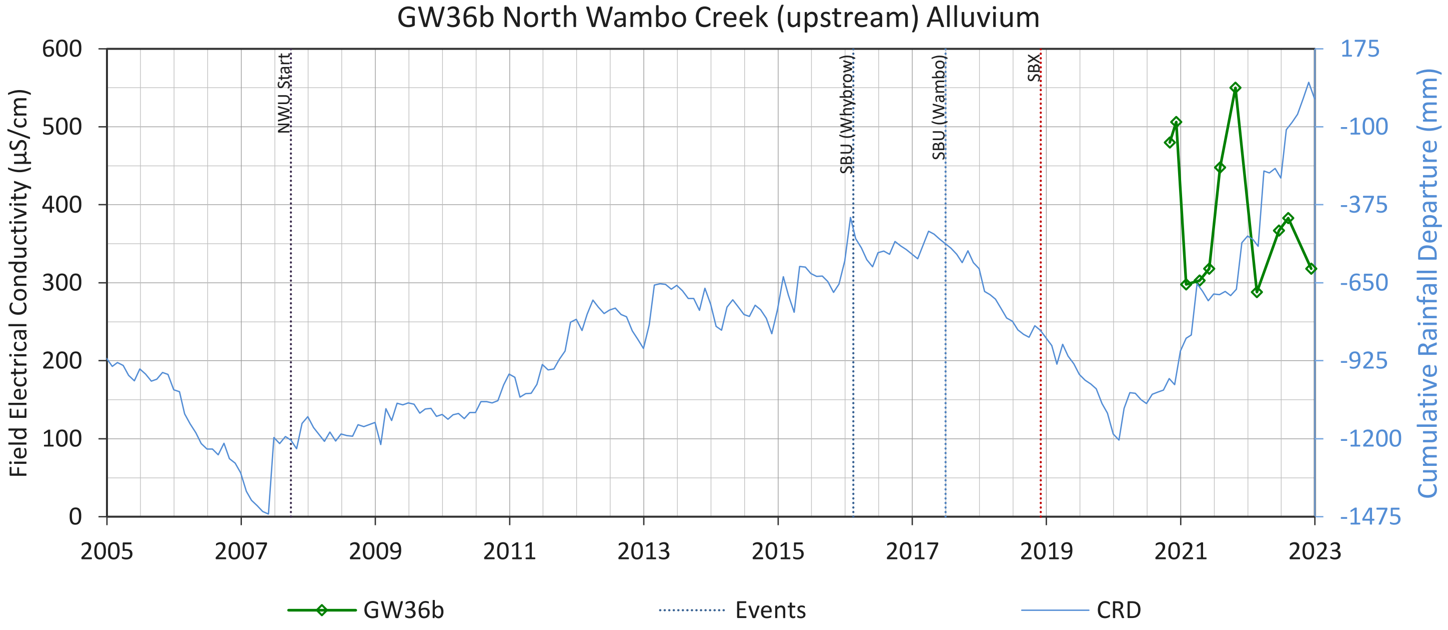

GW36a North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
113
112
111
110
109
108
107
106
105
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW36a
Events
CRD

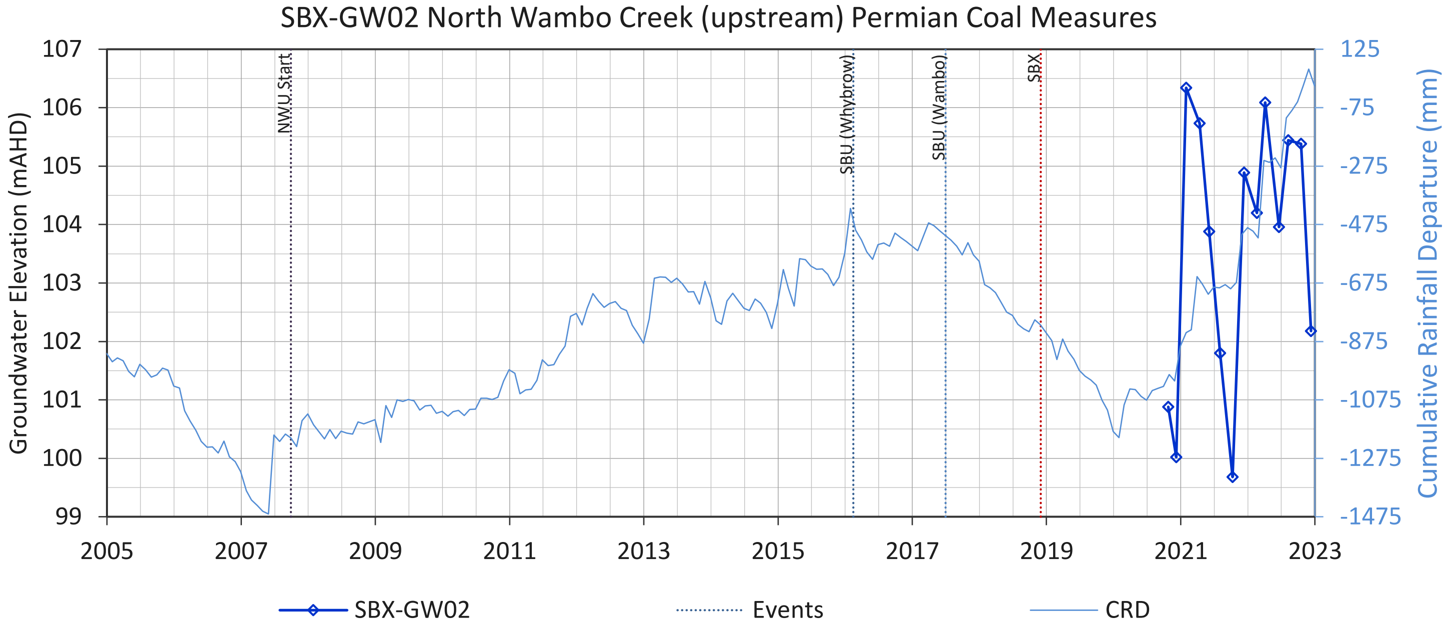

GW36a North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW36a
Events
CRD

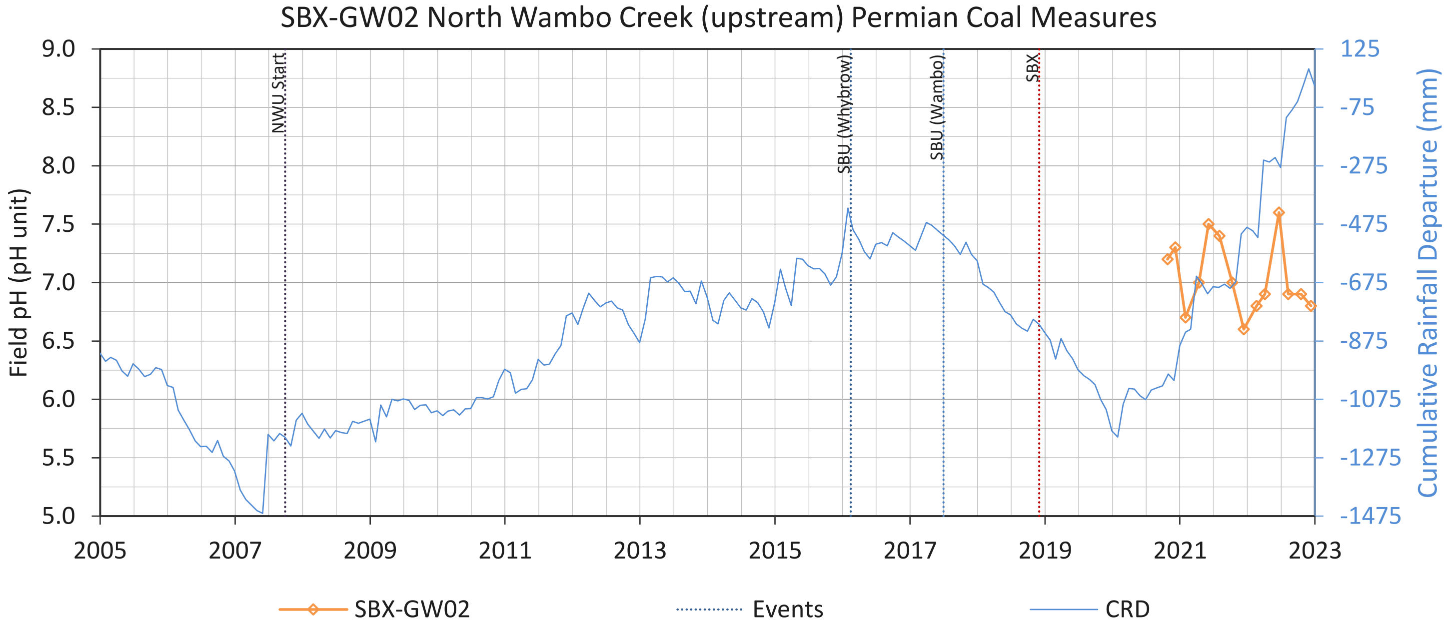

GW36a North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
3500
3000
2500
2000
1500
1000
500
0
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW36a
Events
CRD

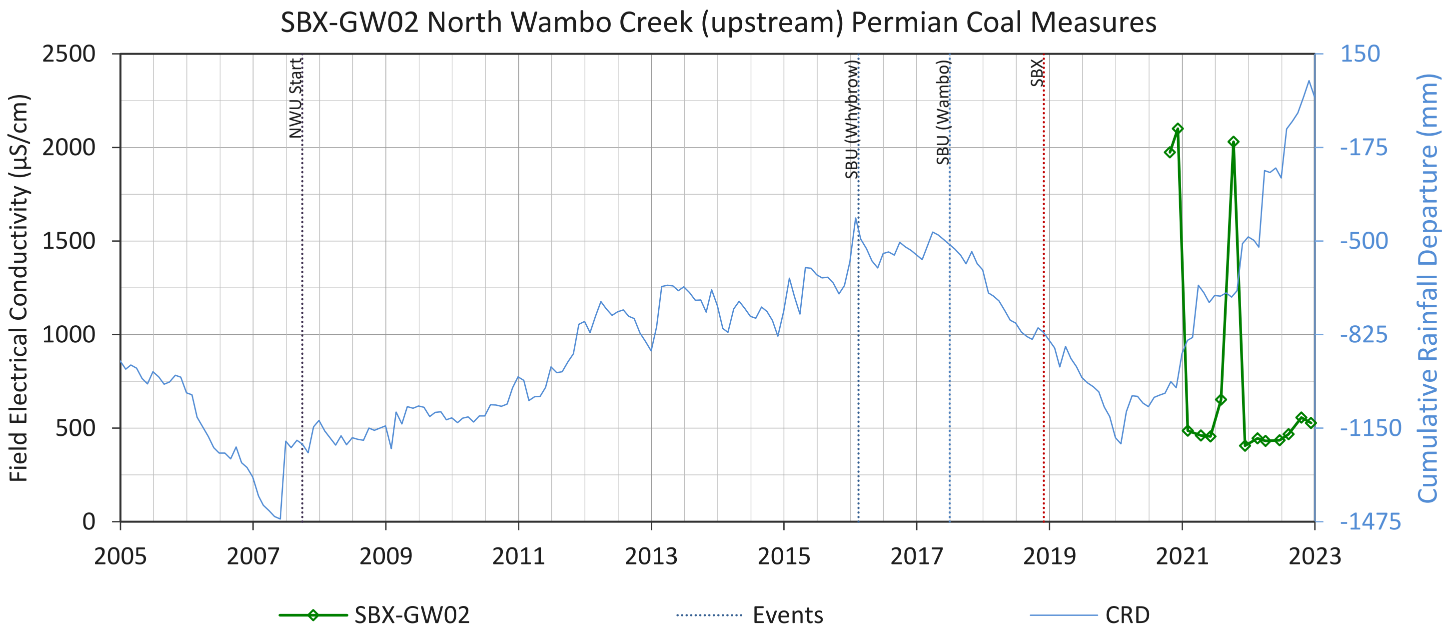

GW36b North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

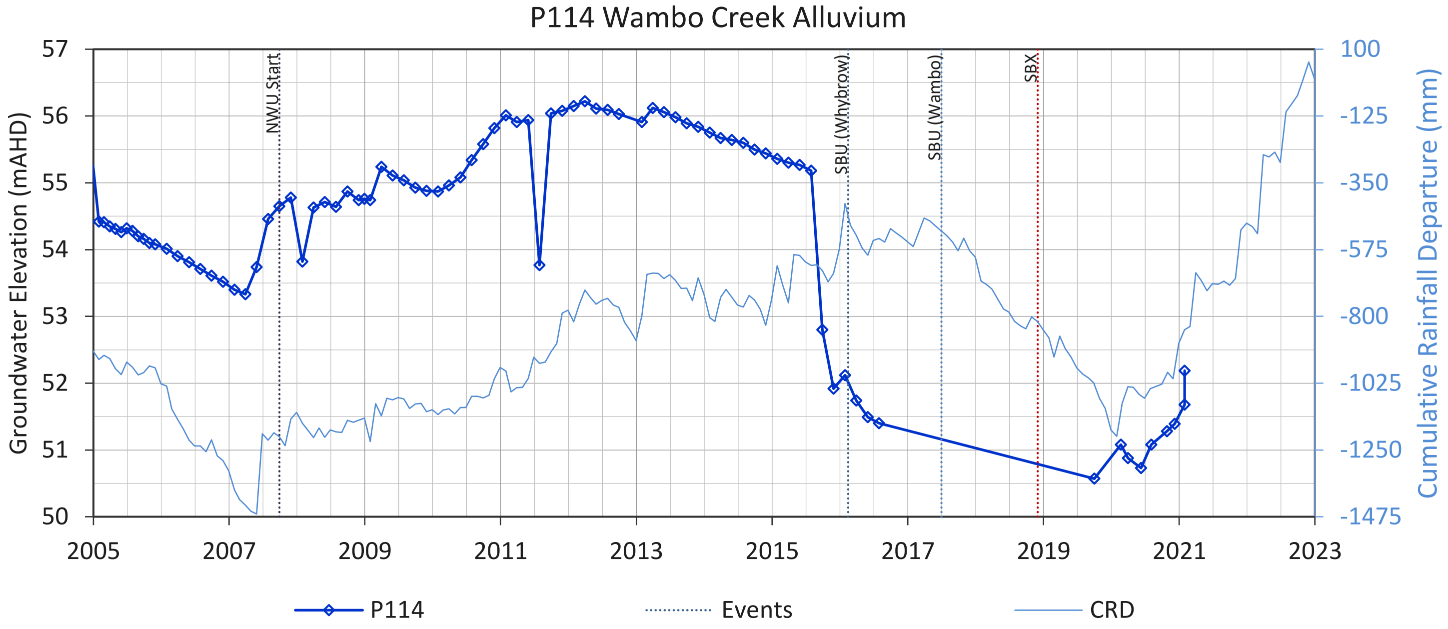

GW36b North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

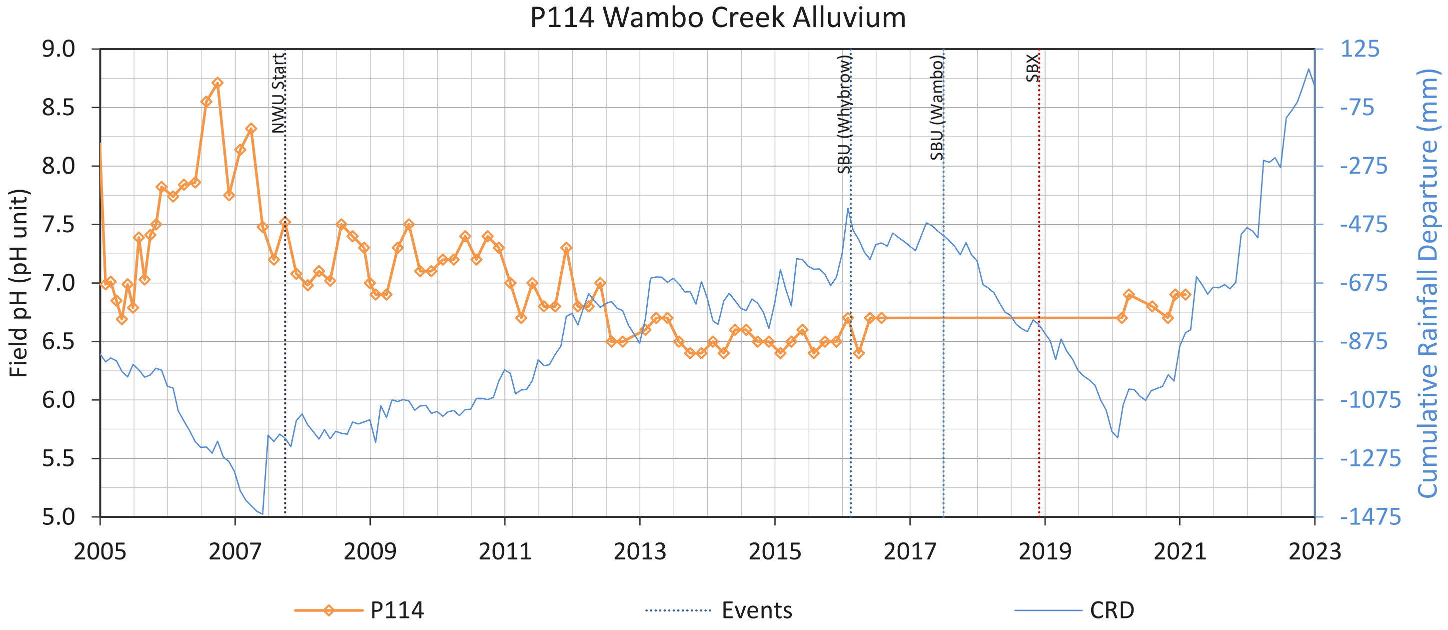

GW36b North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

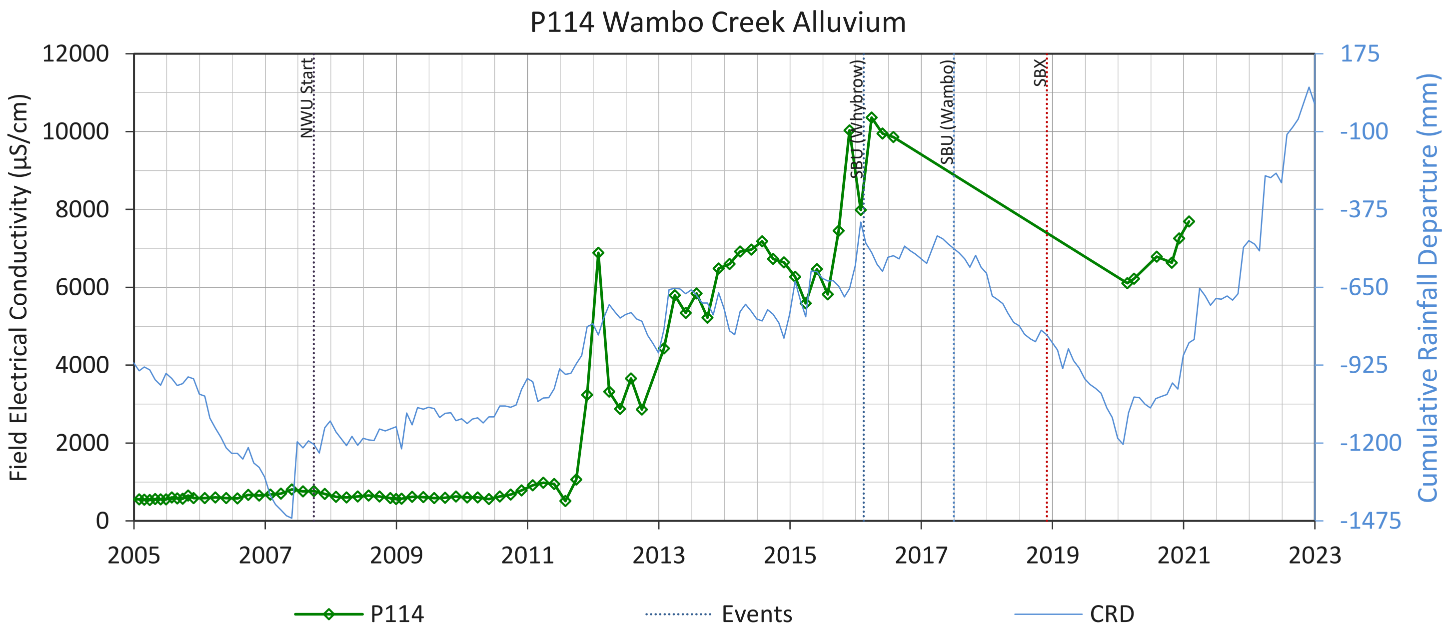

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
107
106
105
104
103
102
101
100
99
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
SBX-GW02
Events
CRD

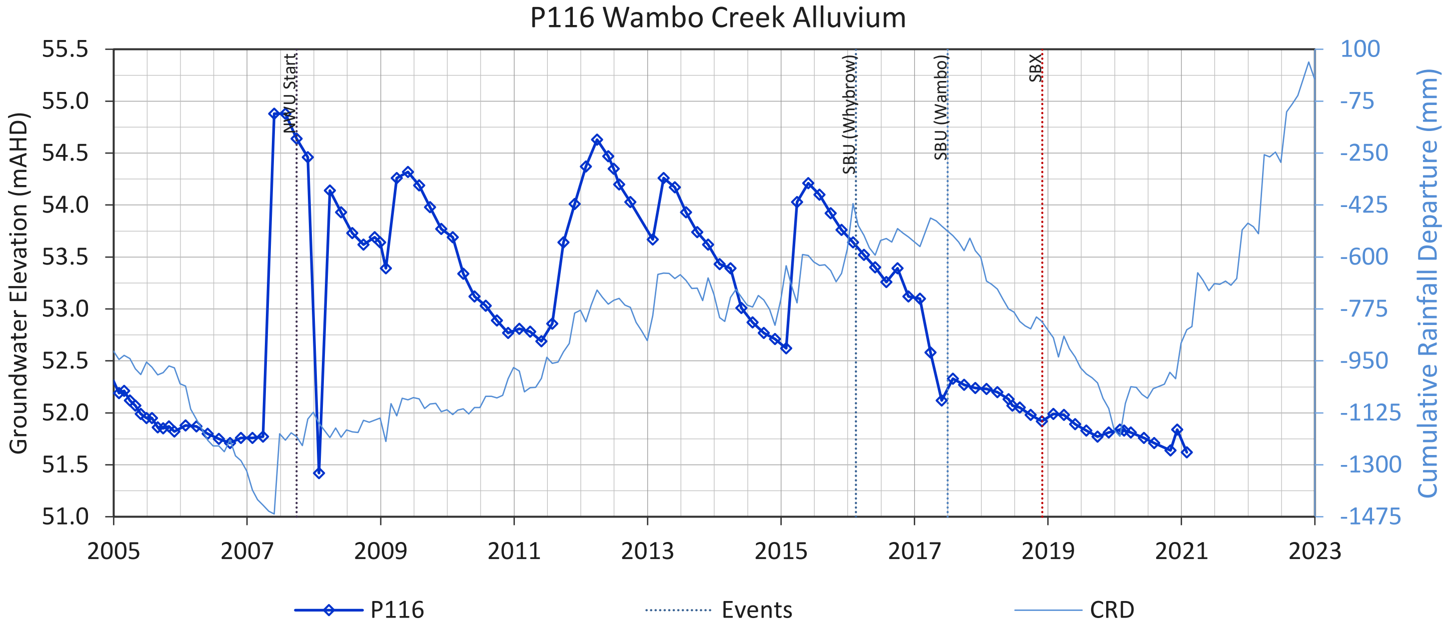

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
SBX-GW02
Events
CRD

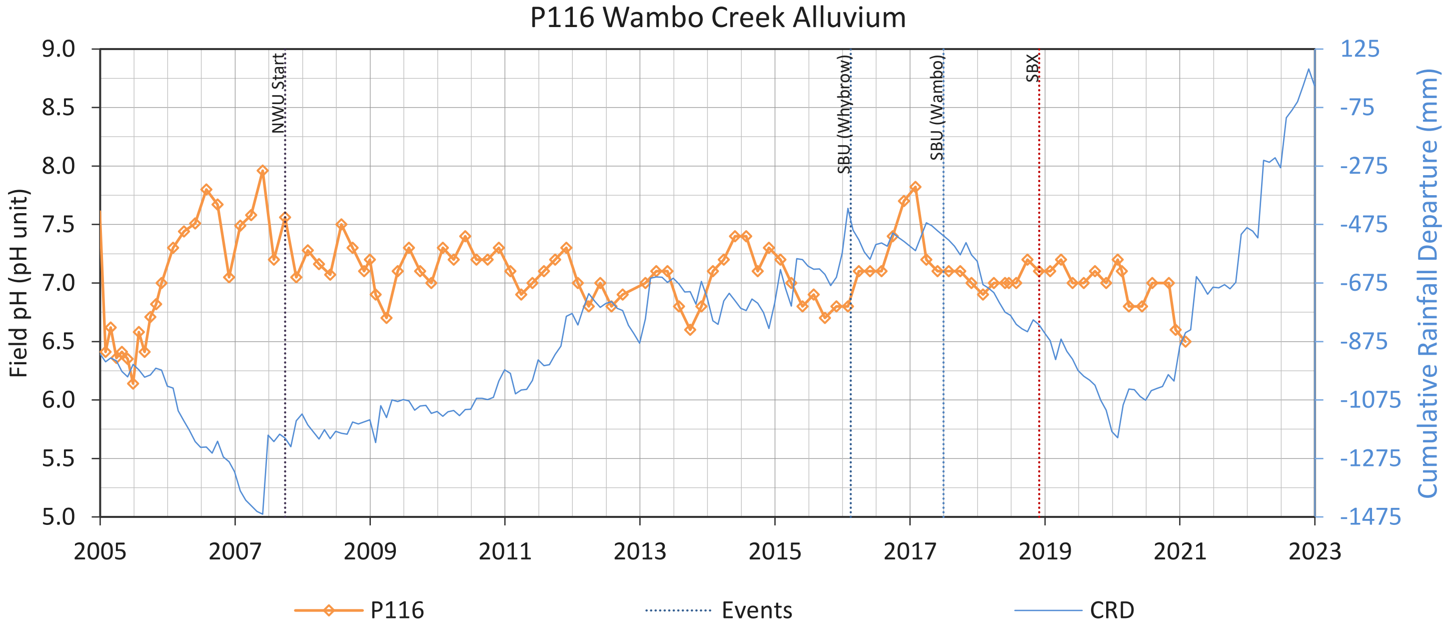

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2500
2000
1500
1000
500
0
150
-175
-500
-825
-1150
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
SBX-GW02
Events
CRD

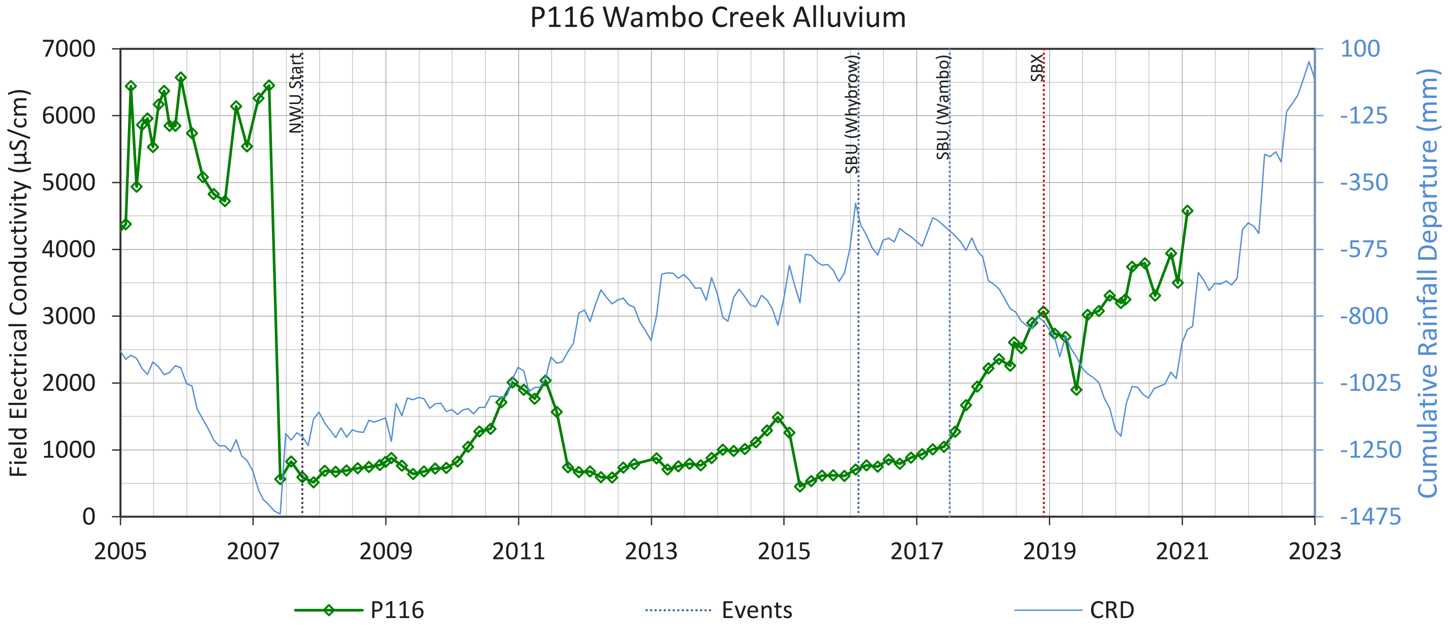

P114 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
57
56
55
54
53
52
51
50
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P114
Events
CRD


P114 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P114
Events
CRD

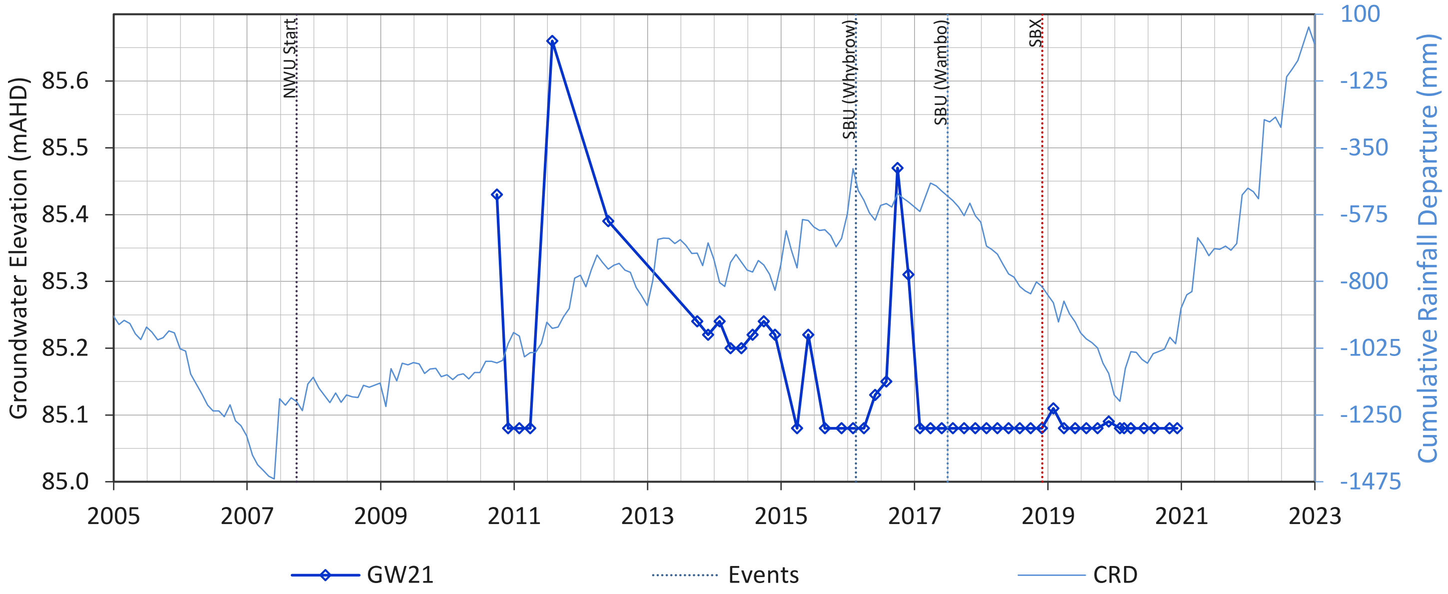

P114 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
12000
10000
8000
6000
4000
2000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P114
Events
CRD


P116 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P116
Events
CRD

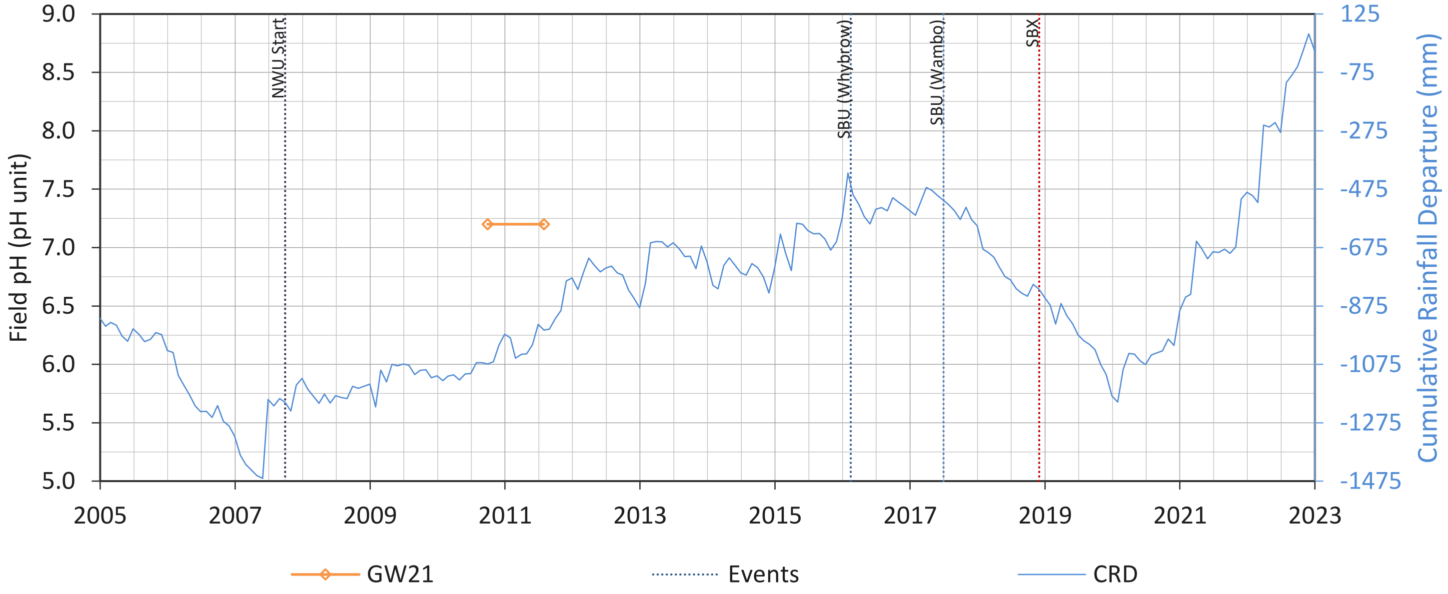

P116 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P116
Events
CRD


P116 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P116
Events
CRD

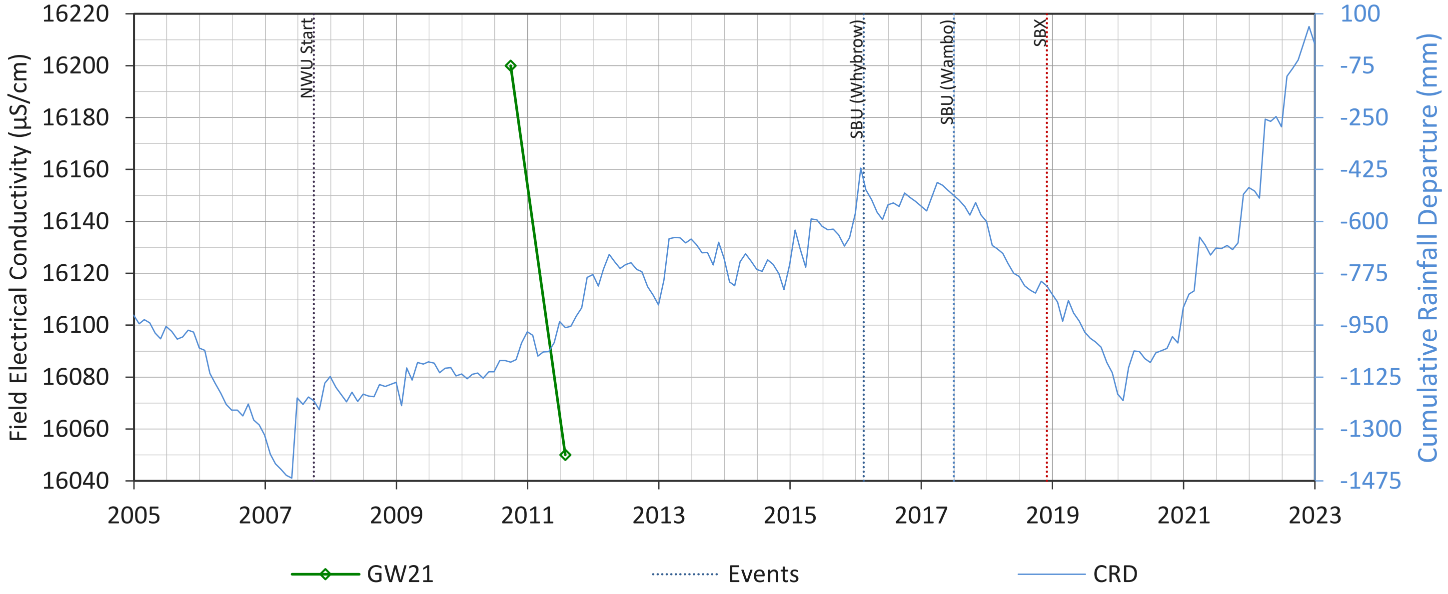
GW21 Wambo Creek Permian Coal Measures

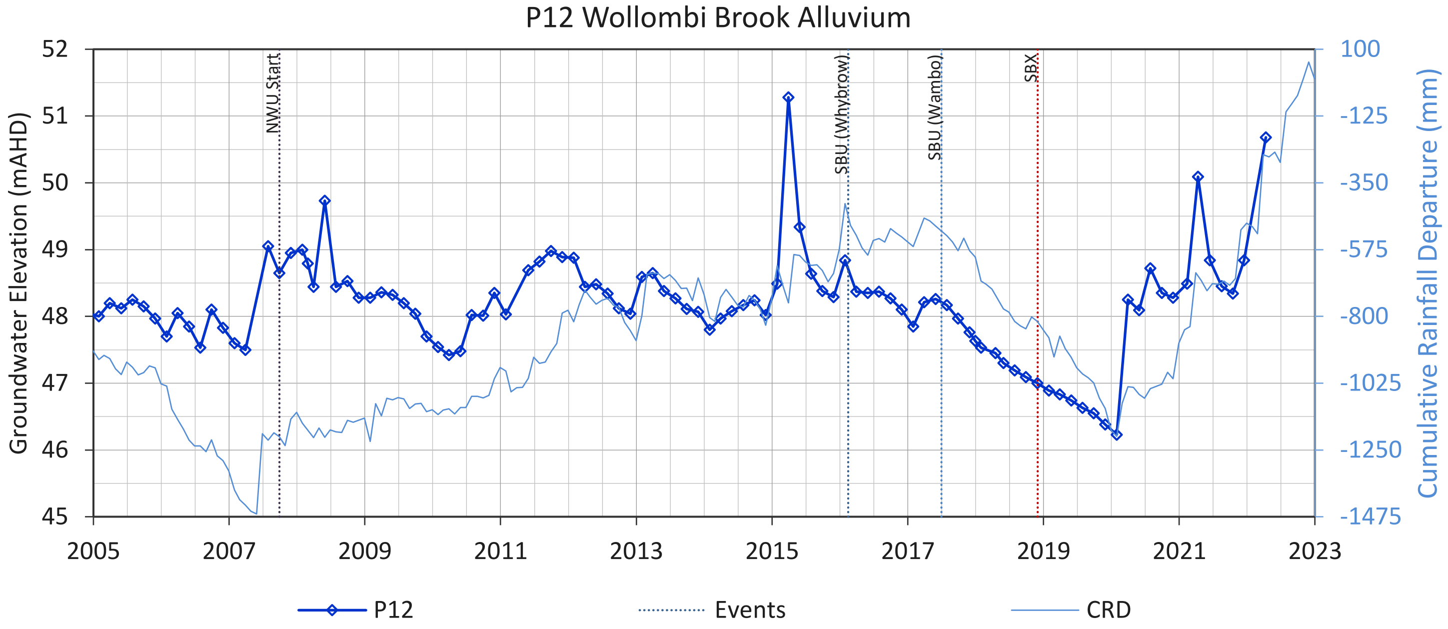


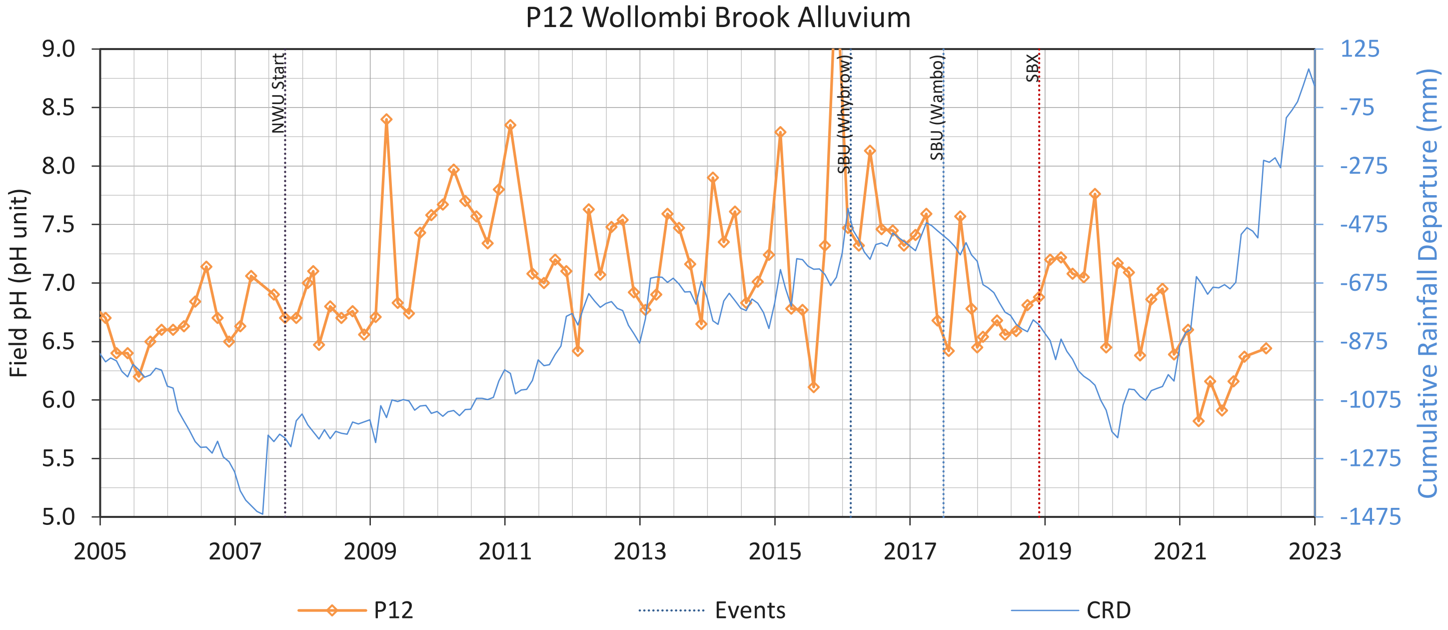
GW21 Wambo Creek Permian Coal Measures

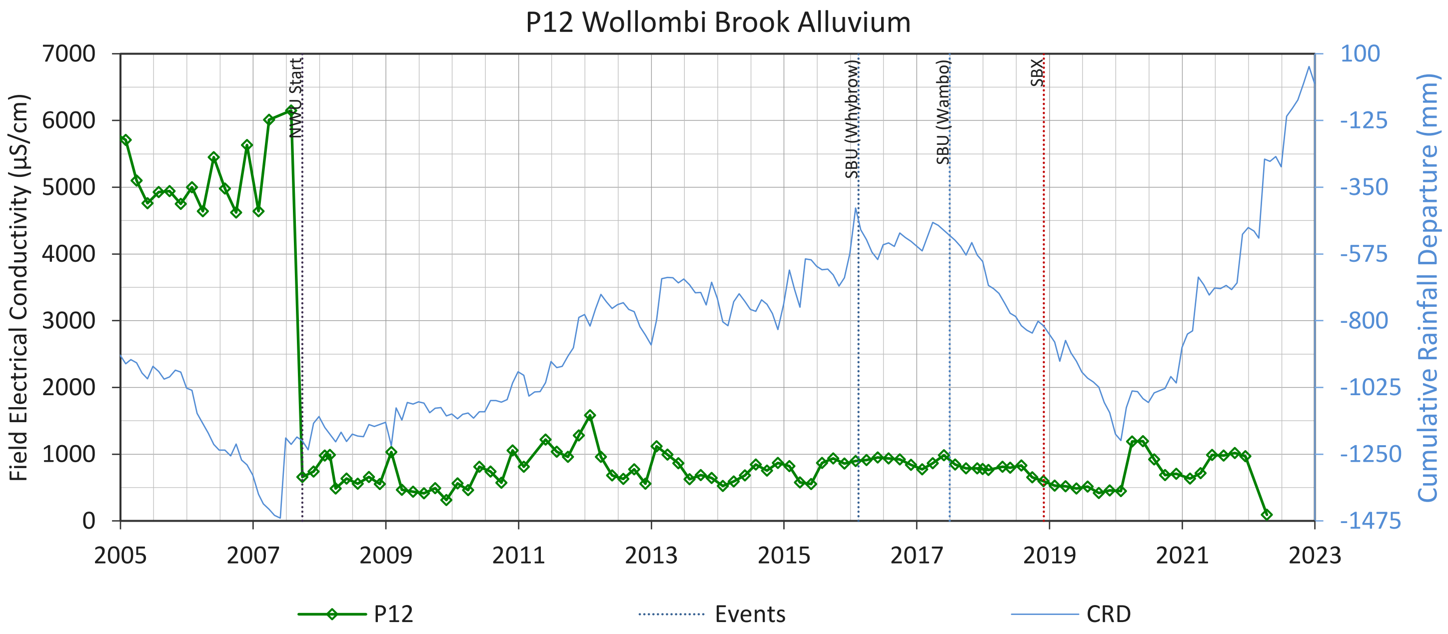


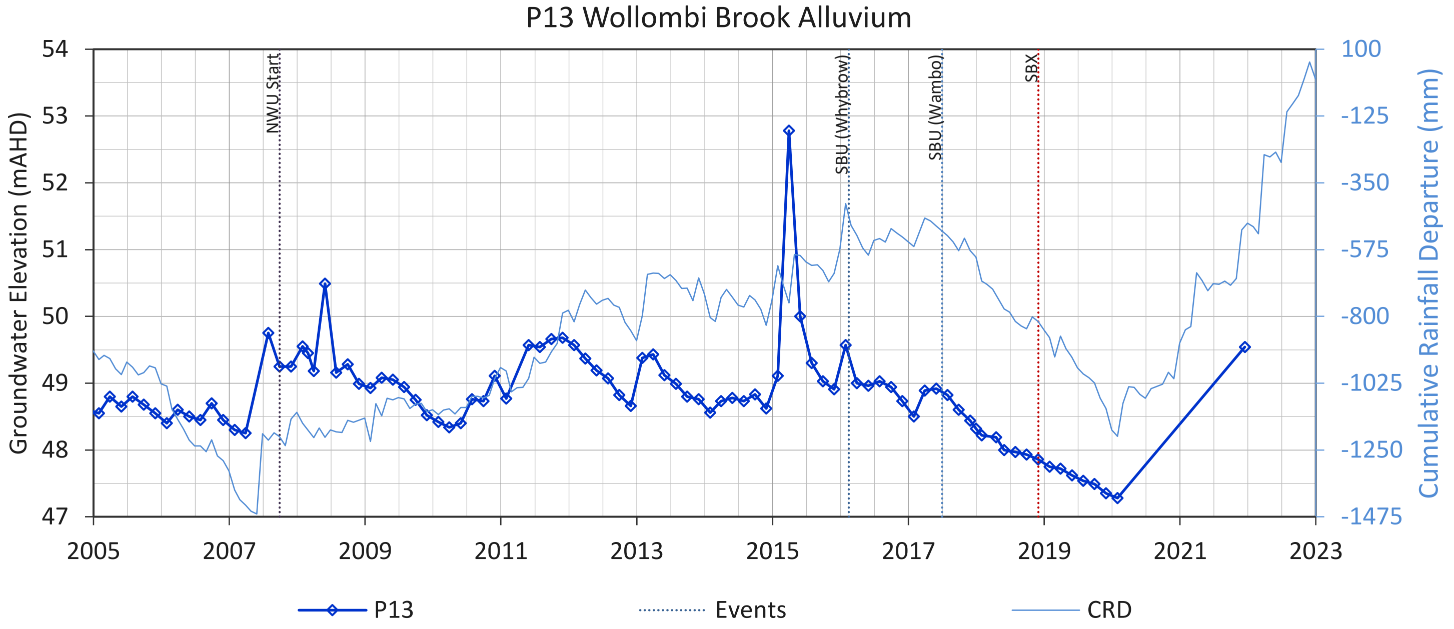
GW21 Wambo Creek Permian Coal Measures

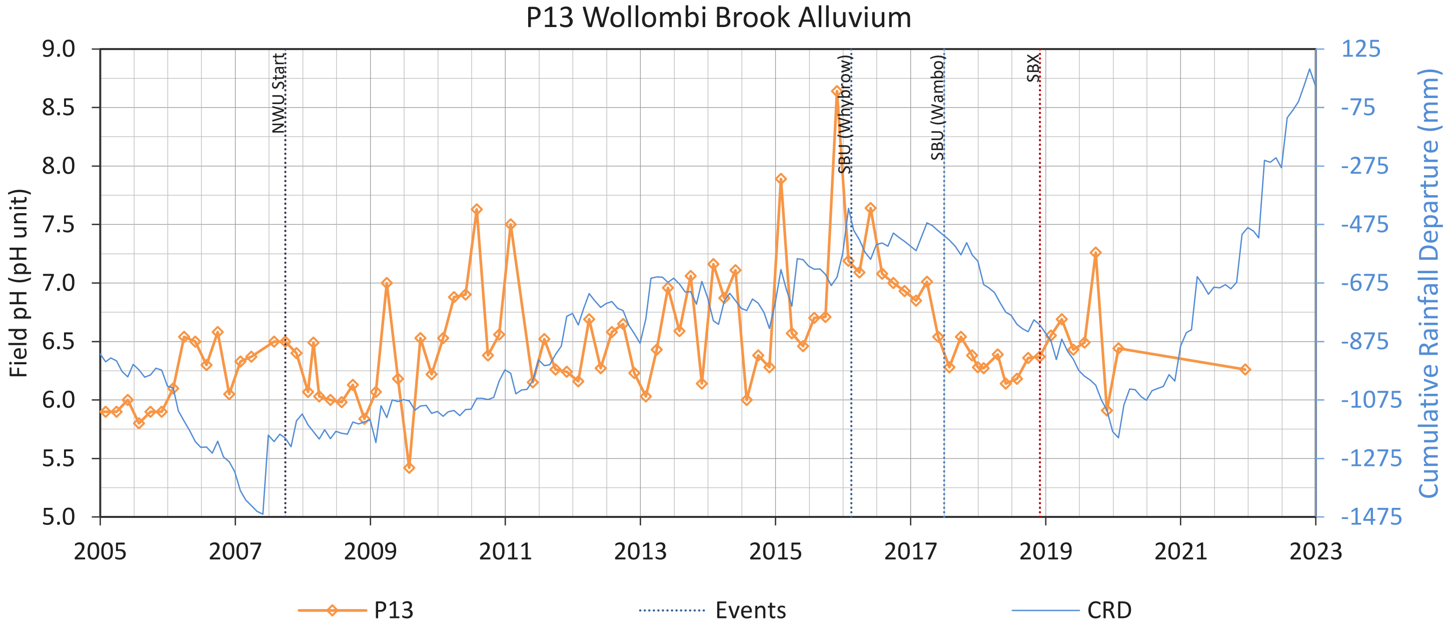


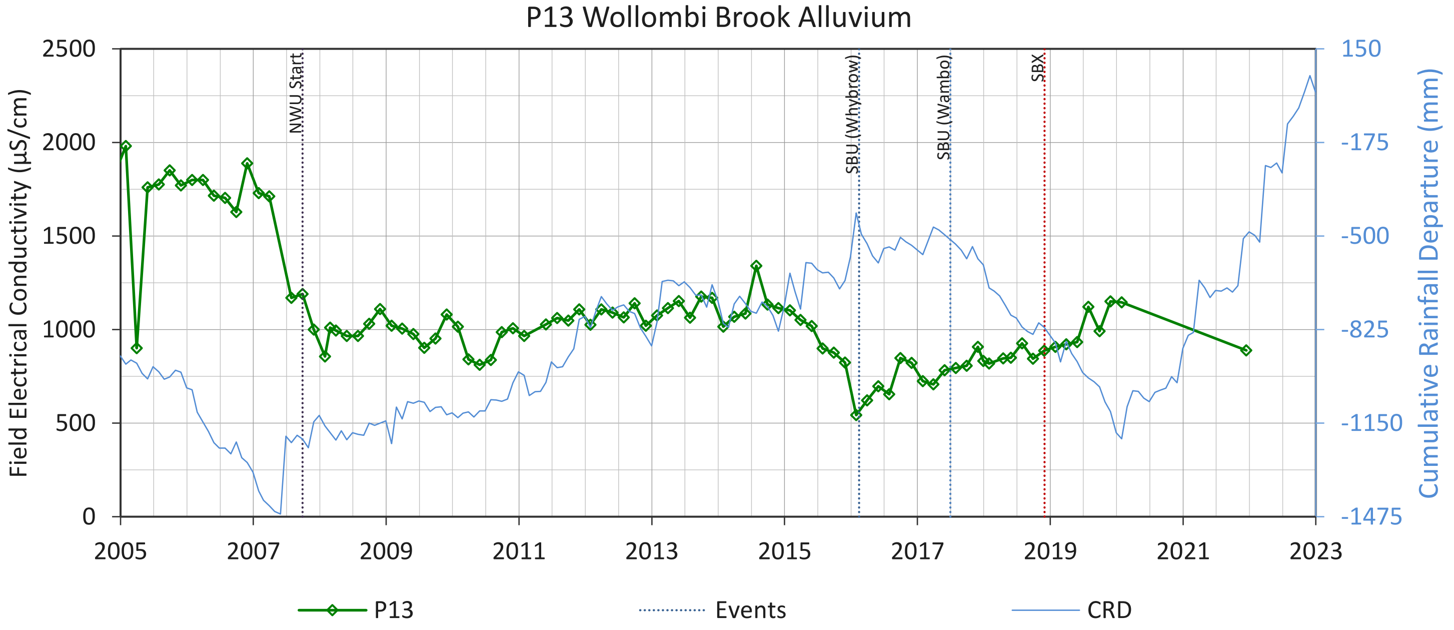

P12 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P12
Events
CRD

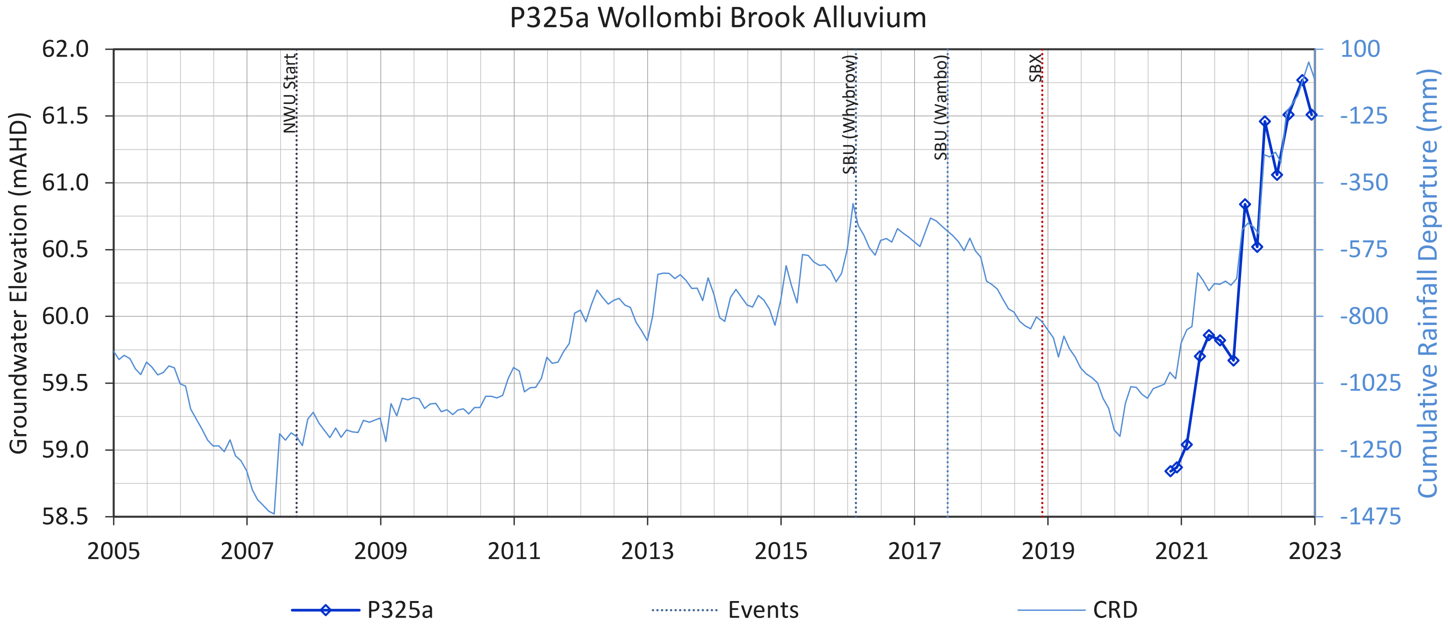

P12 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P12
Events
CRD

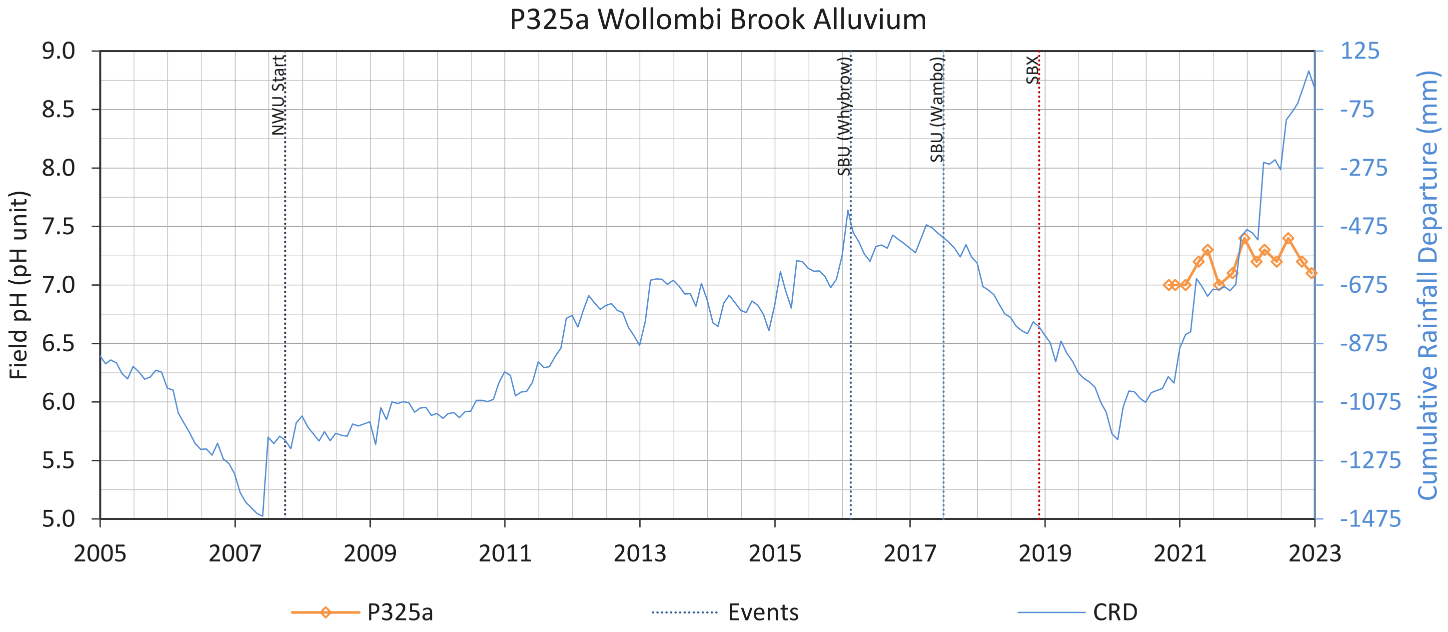

P12 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P12
Events
CRD

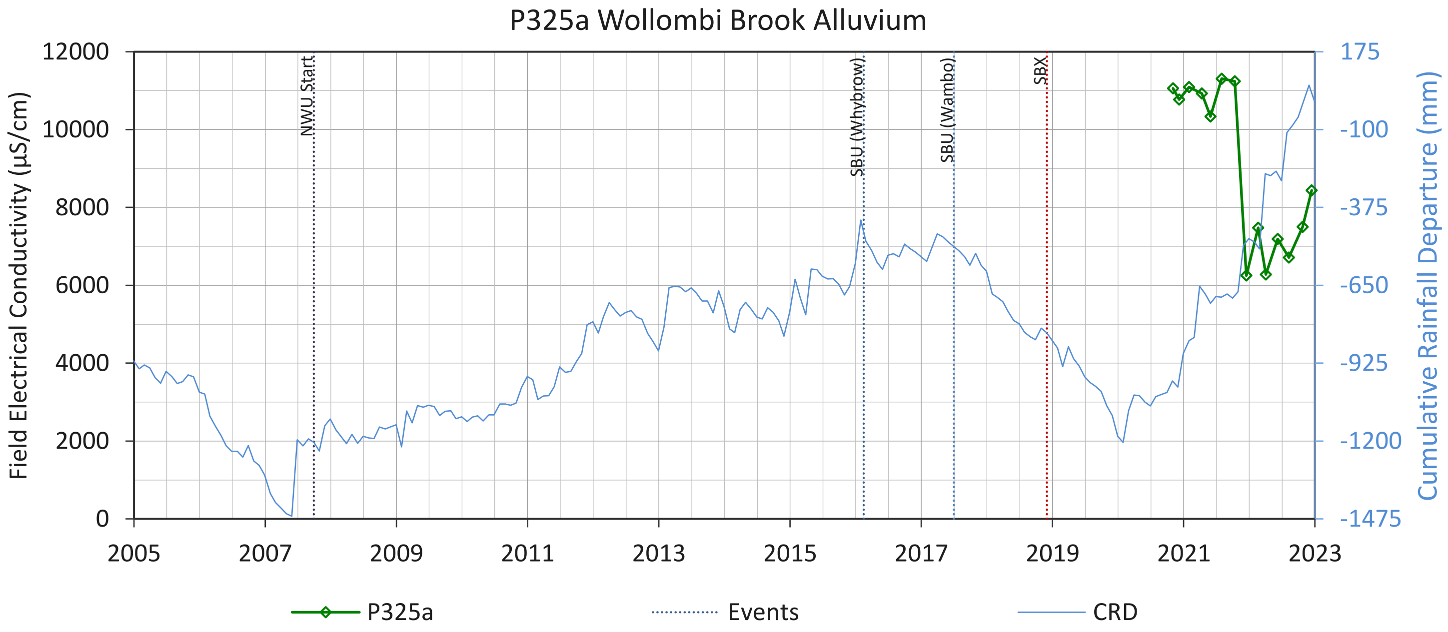

P13 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P13
Events
CRD

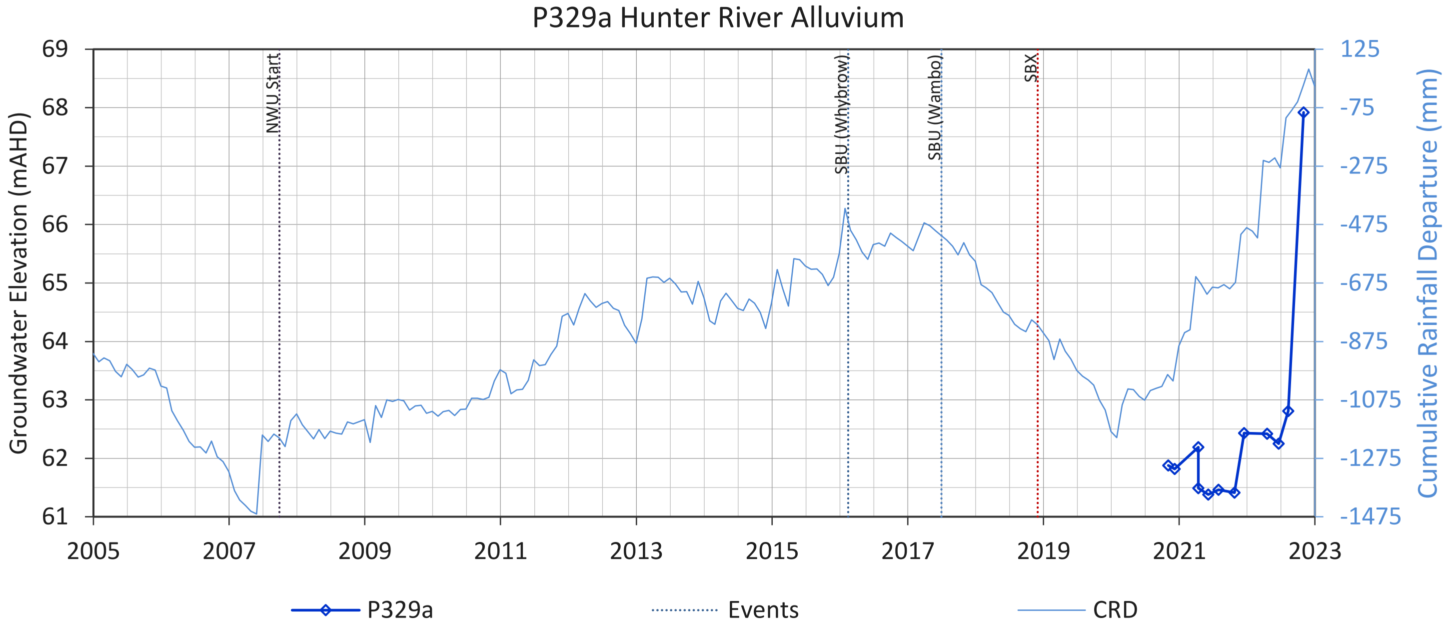

P13 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P13
Events
CRD

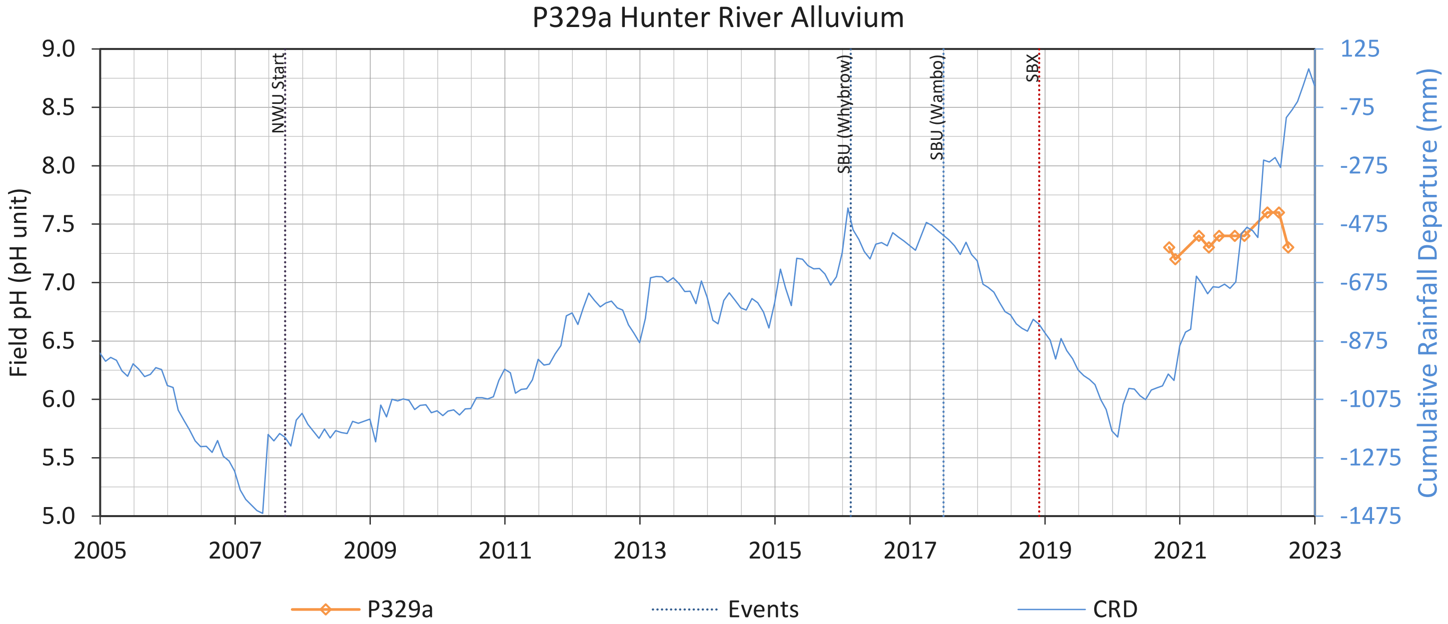

P13 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P13
Events
CRD

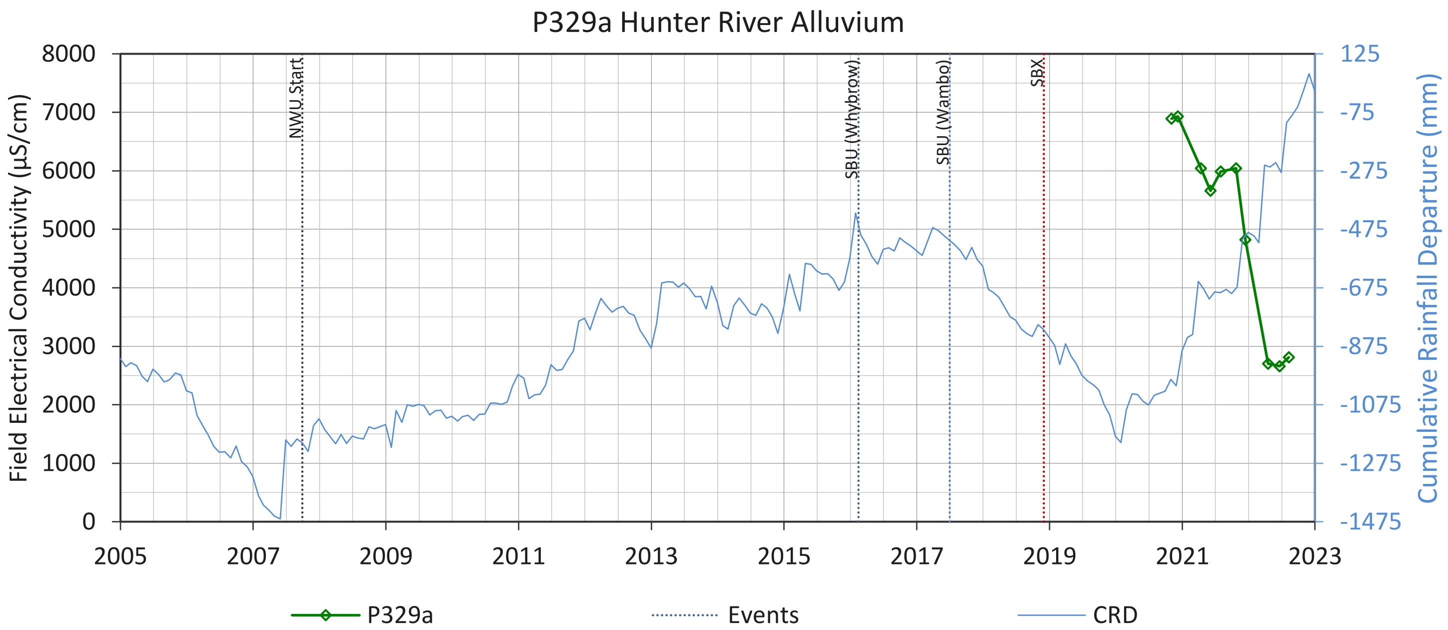

P325a Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
62.0
61.5
61.0
60.5
60.0
59.5
59.0
58.5
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

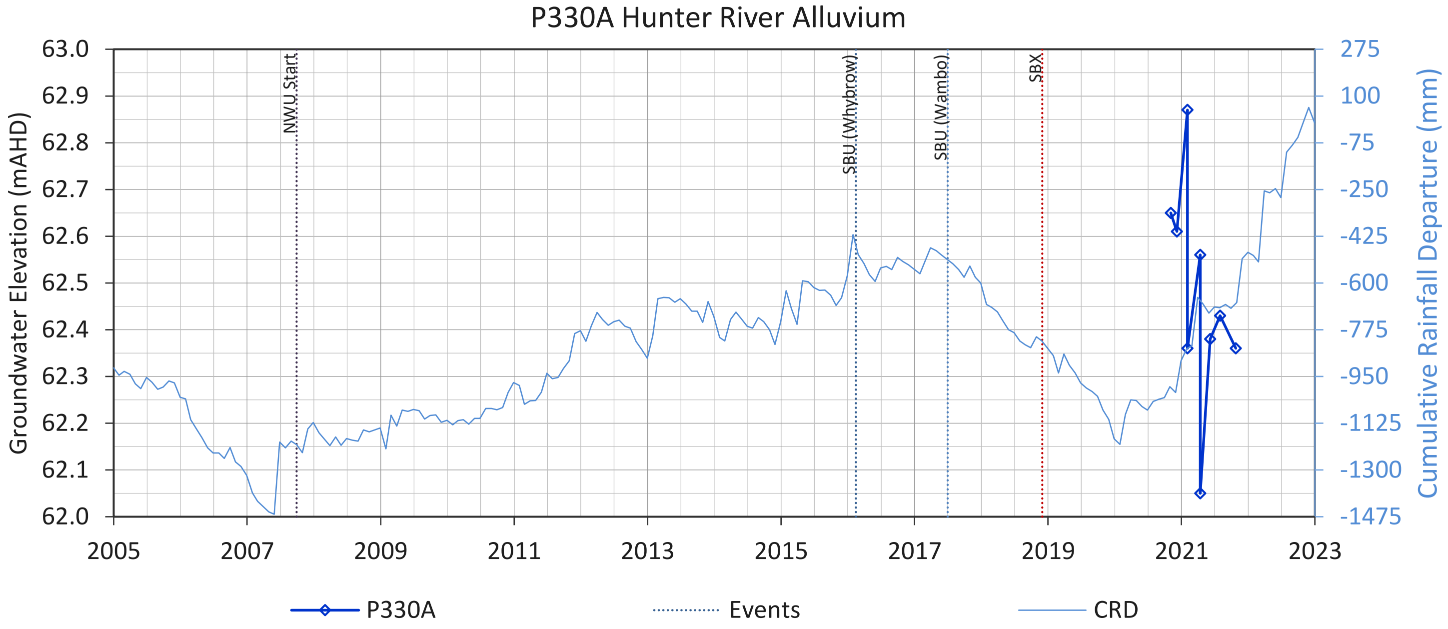

P325a Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

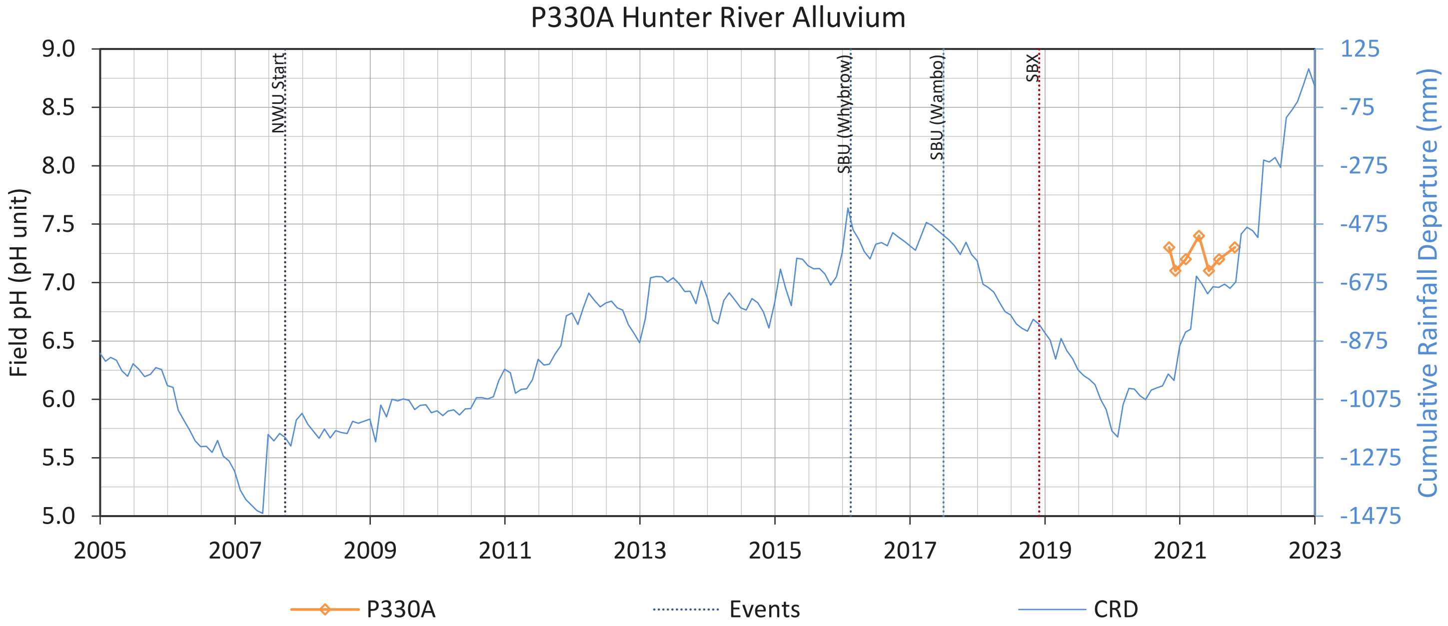

P325a Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
12000
10000
8000
6000
4000
2000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

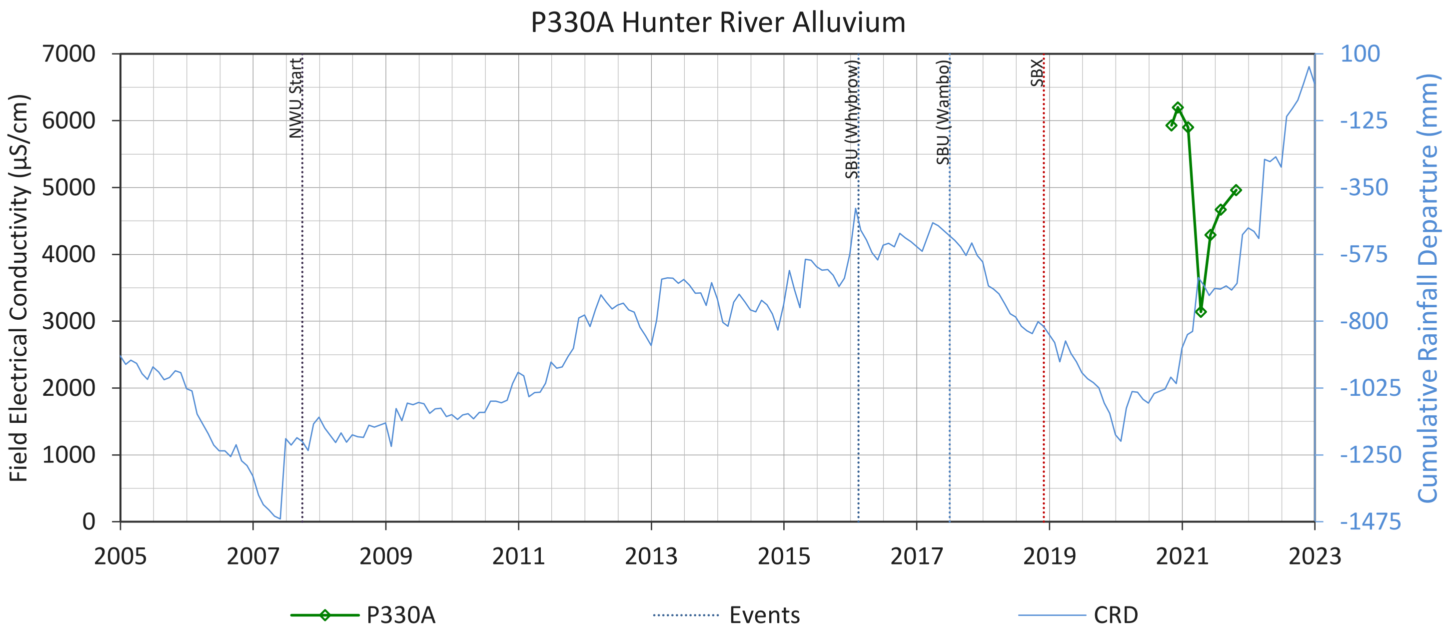

P329a Hunter River Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
69
68
67
66
65
64
63
62
61
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

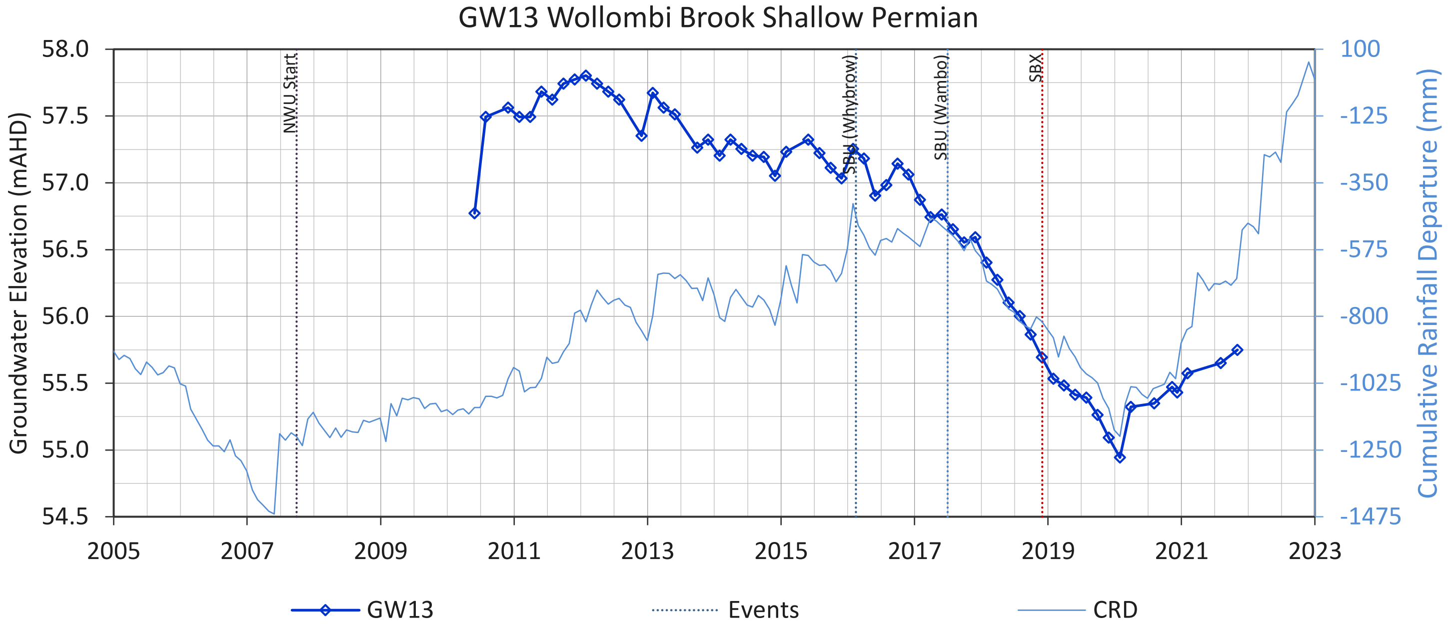

P329a Hunter River Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

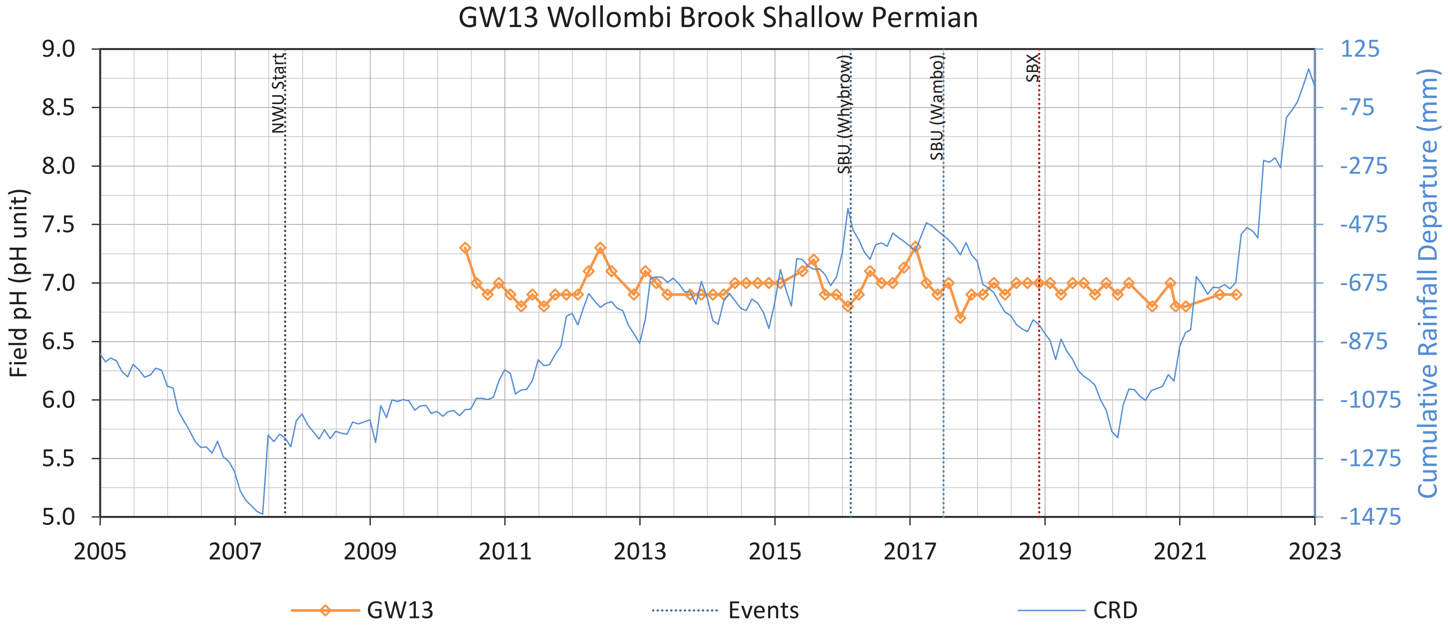

P329a Hunter River Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
8000
7000
6000
5000
4000
3000
2000
1000
0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

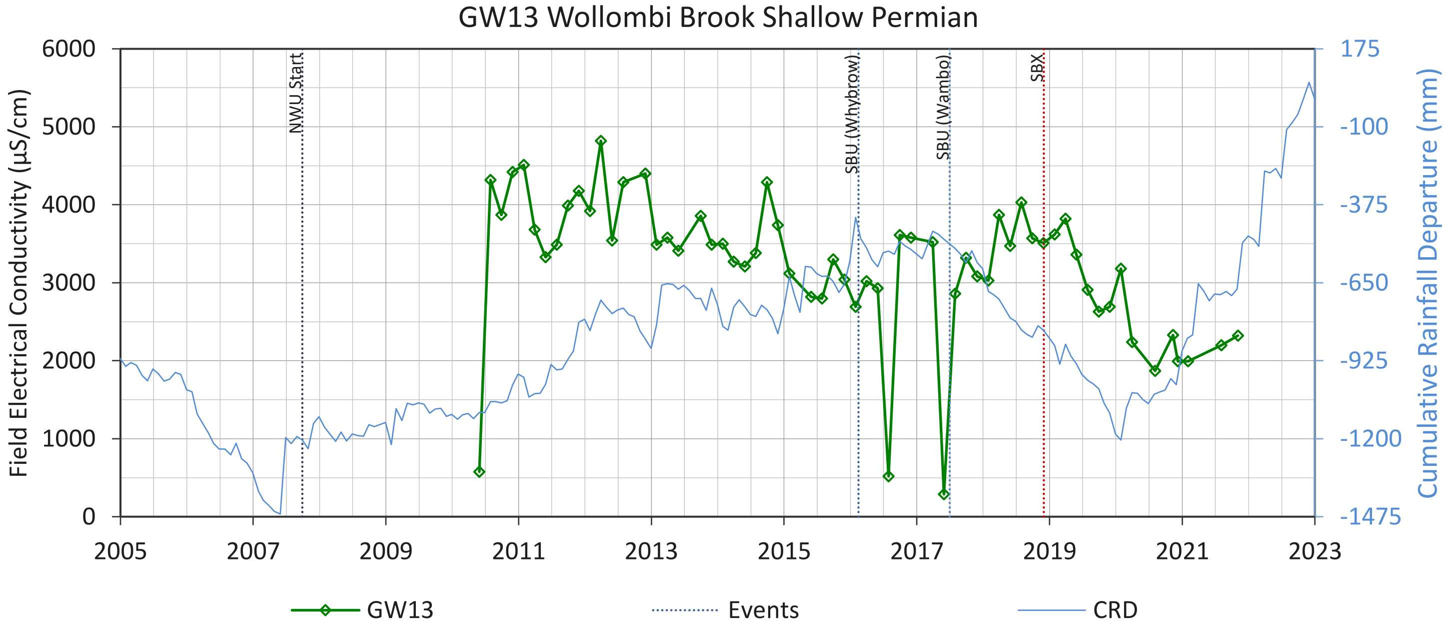

P330A Hunter River Alluvium
Groundwater Elevation (mAHD)
63.0
62.9
62.8
62.7
62.6
62.5
62.4
62.3
62.2
62.1
62.0
Cumulative Rainfall Departure (mm)
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P330A
Events
CRD

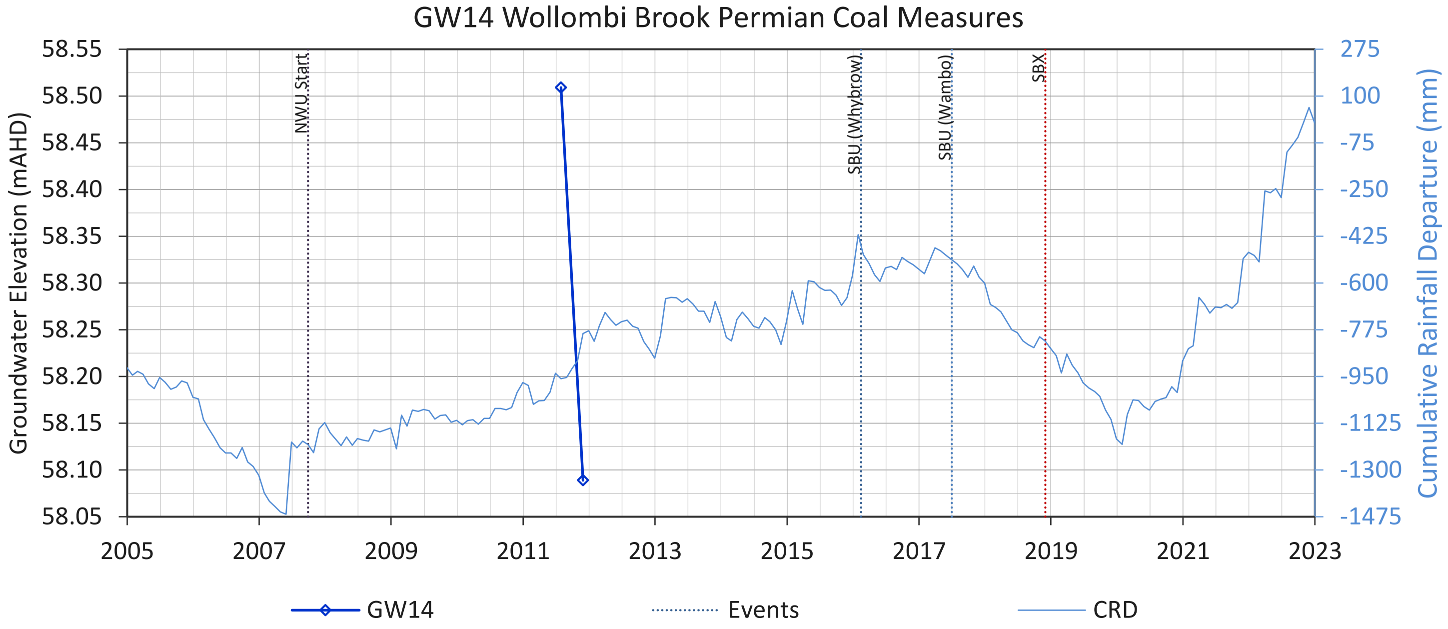

P330A Hunter River Alluvium
Field pH (pH unit)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Cumulative Rainfall Departure (mm)
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P330A
Events
CRD


P330A Hunter River Alluvium
Field Electrical Conductivity (µS/cm)
7000
6000
5000
4000
3000
2000
1000
0
Cumulative Rainfall Departure (mm)
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P330A
Events
CRD


GW13 Wollombi Brook Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
58.0
57.5
57.0
56.5
56.0
55.5
55.0
54.5
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

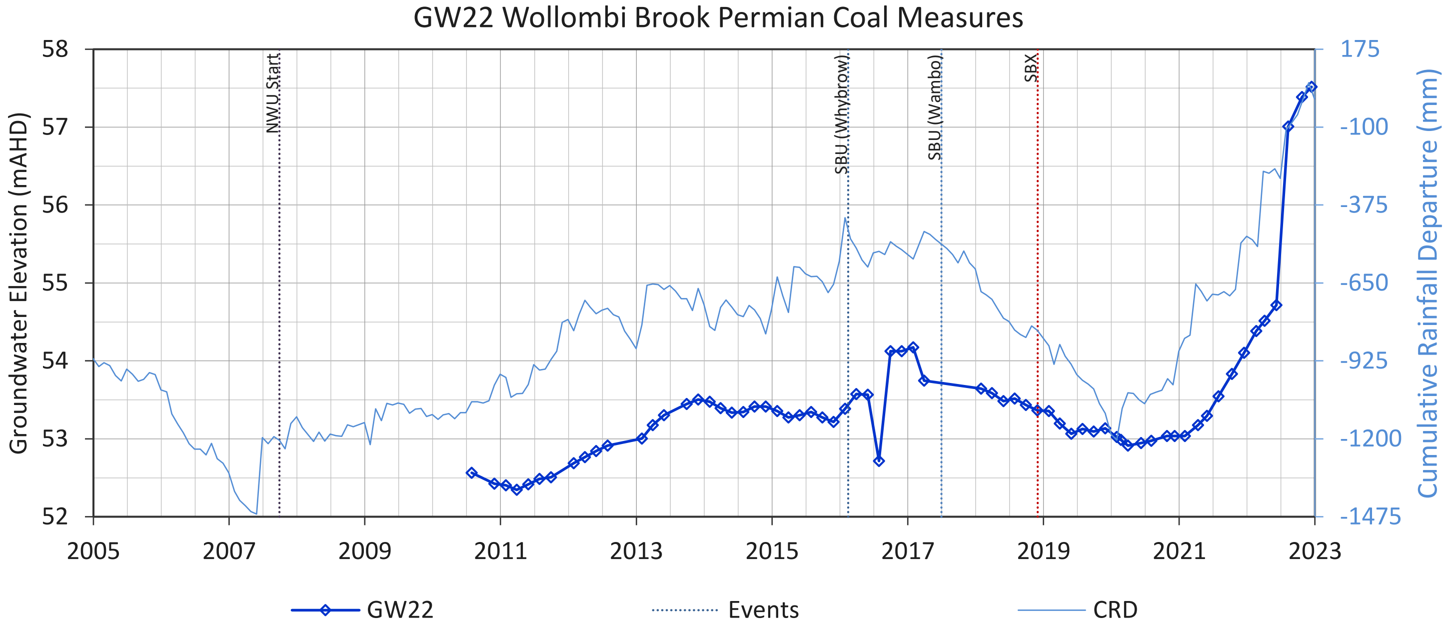

GW13 Wollombi Brook Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

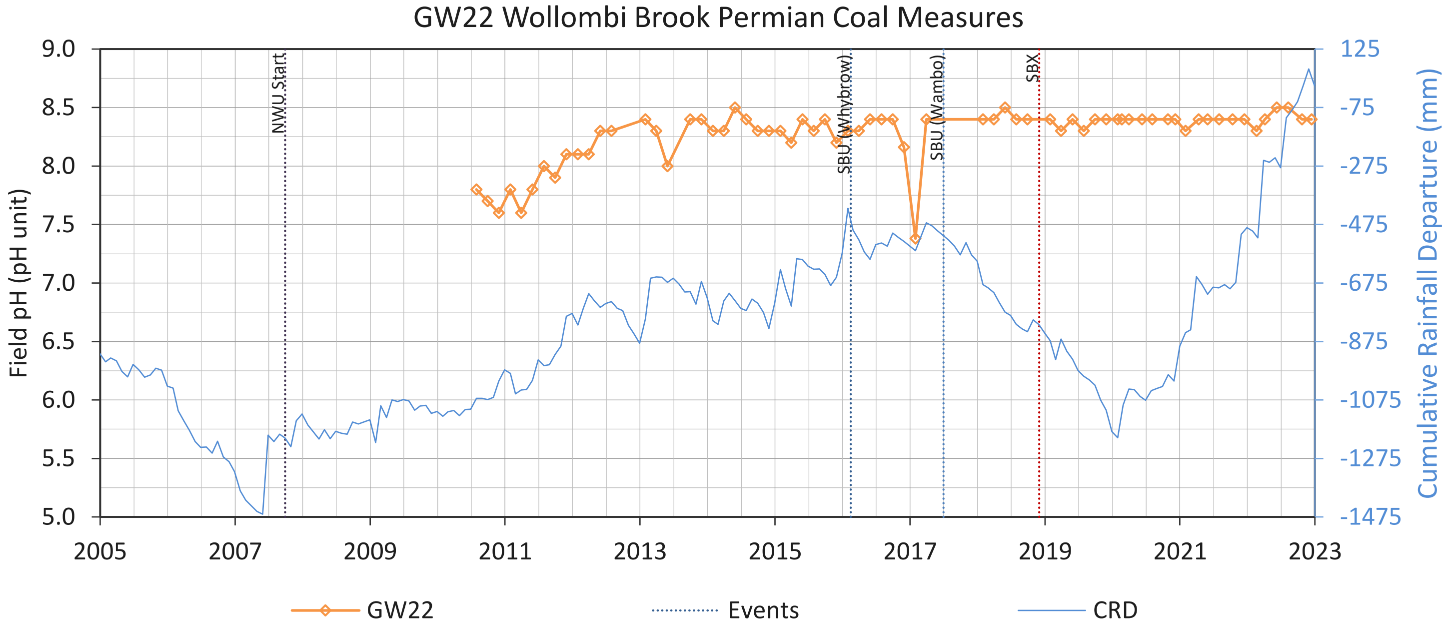

GW13 Wollombi Brook Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
6000
5000
4000
3000
2000
1000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

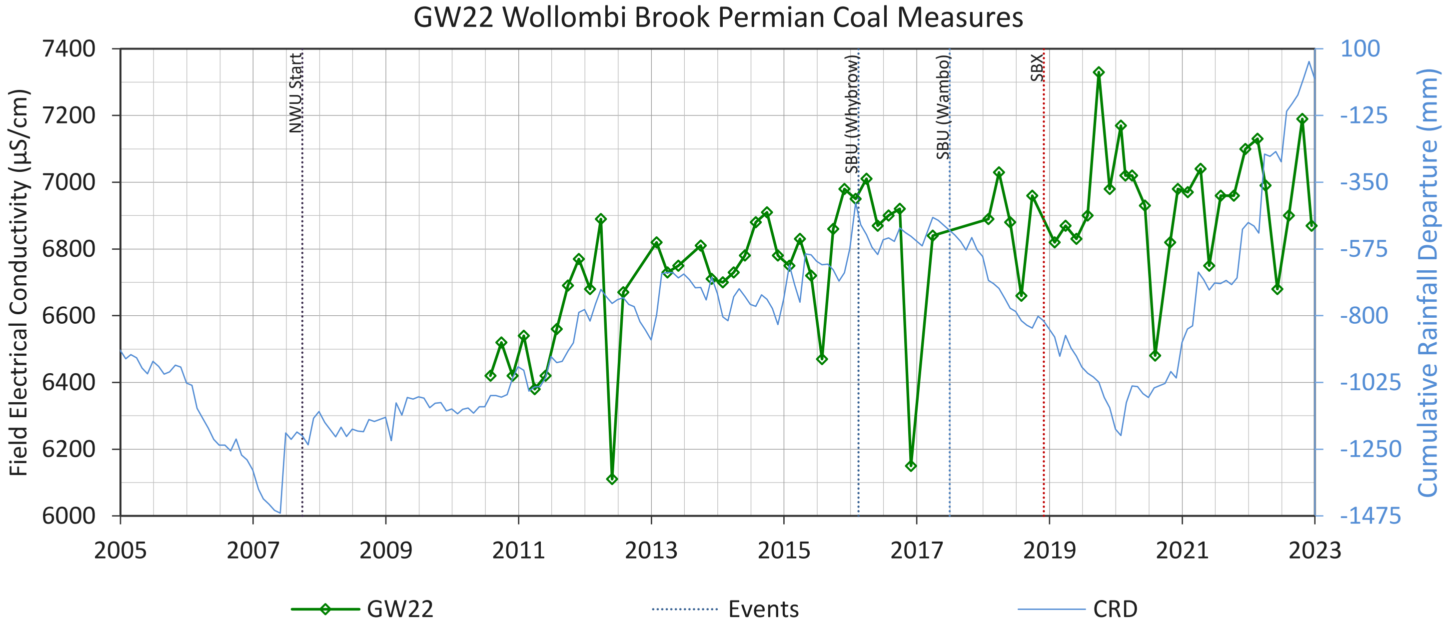


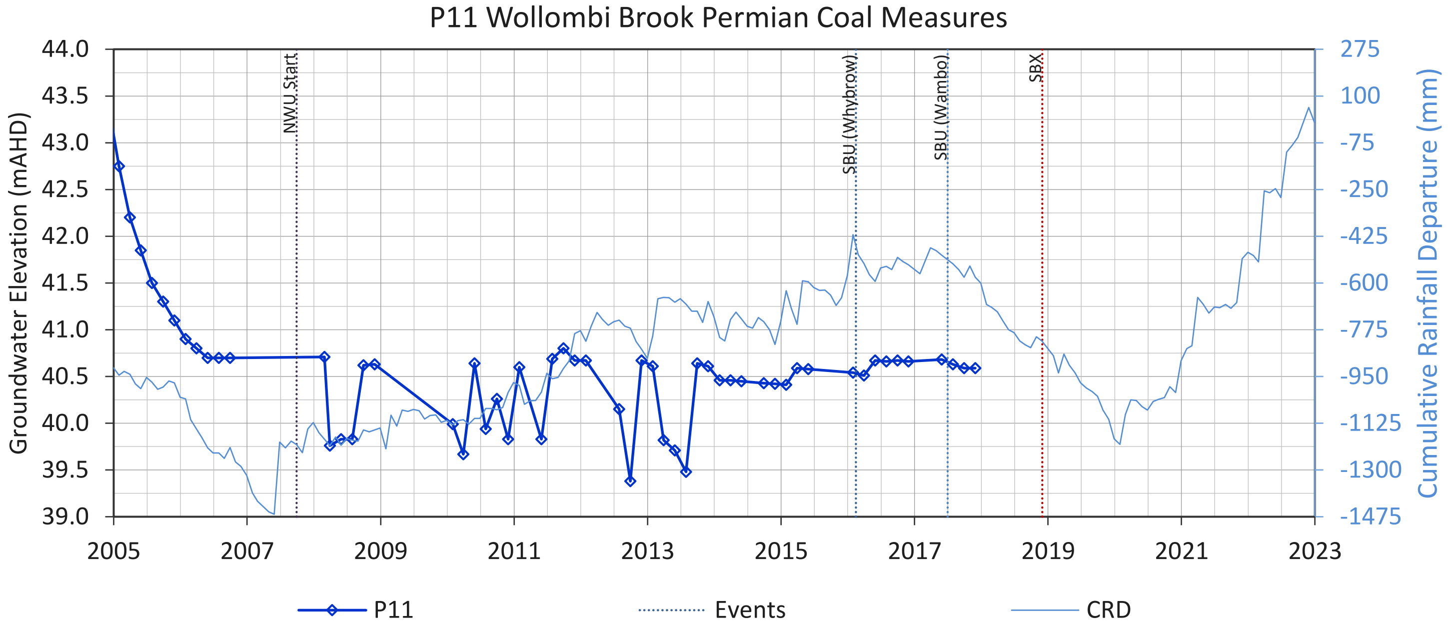
No Data Available for Field pH (pH unit)

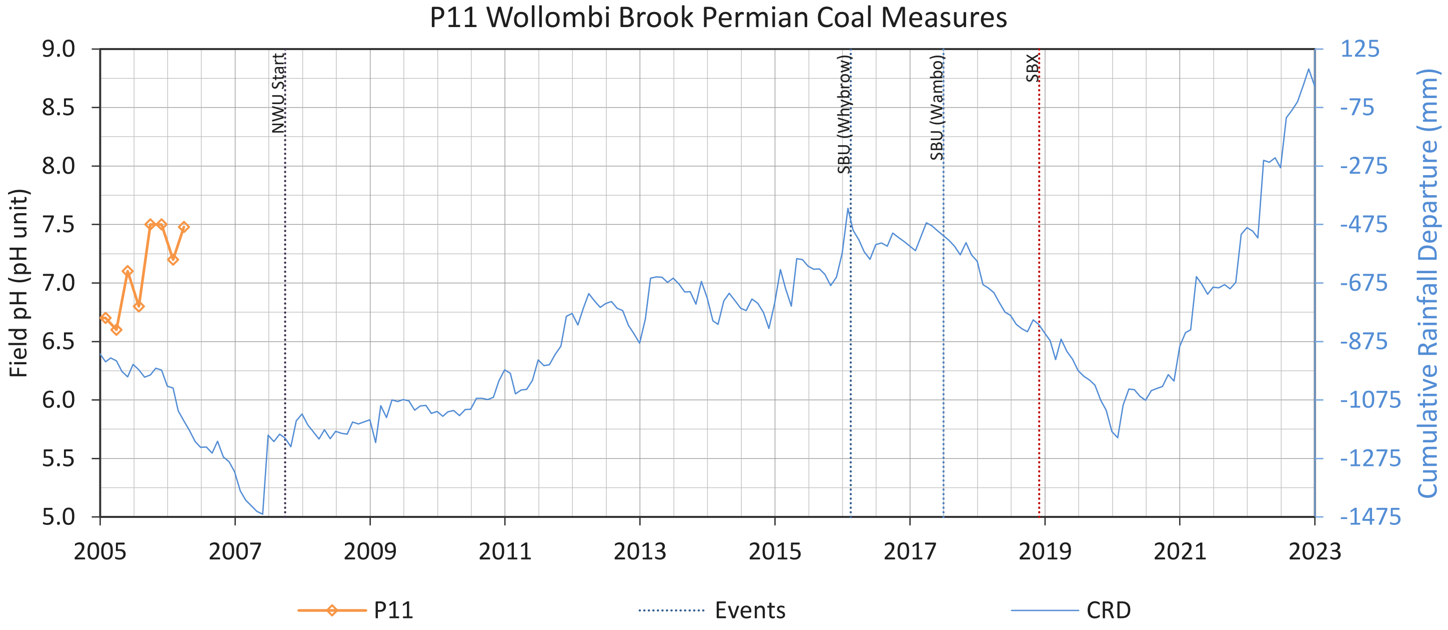
No Data Available for Field Electrical Conductivity (µS/cm)

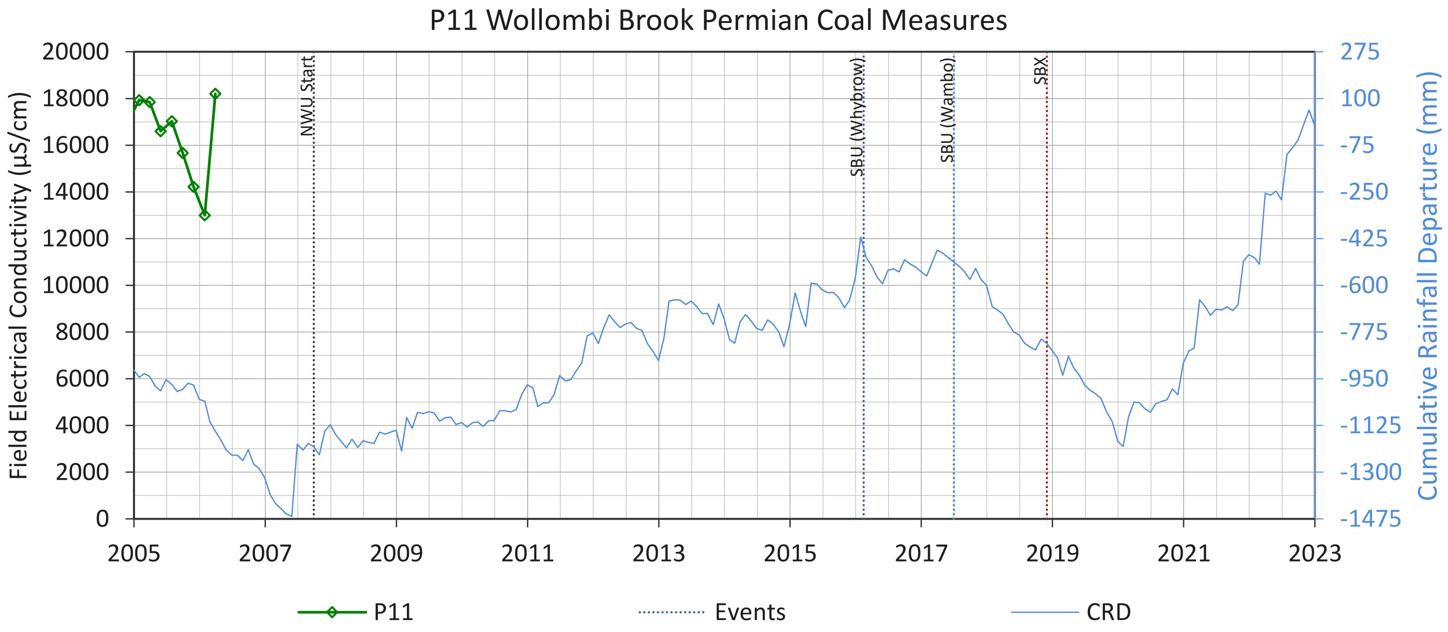

GW22 Wollombi Brook Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

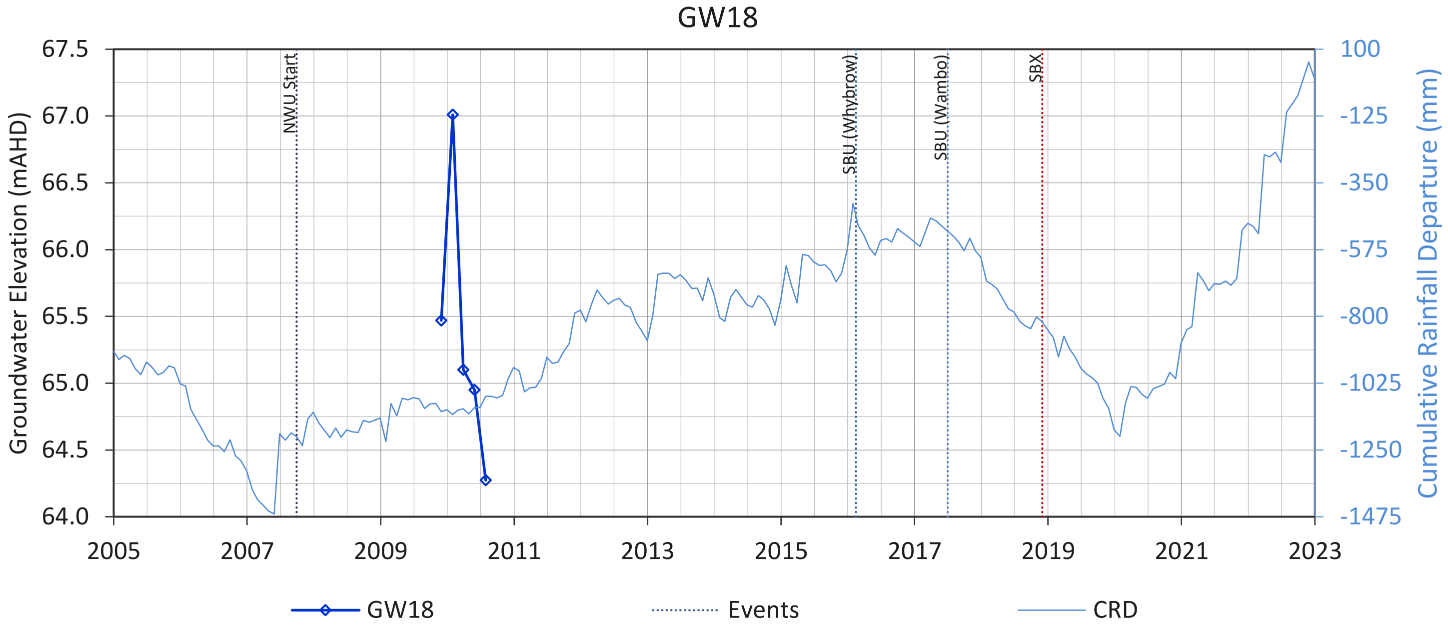

GW22 Wollombi Brook Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

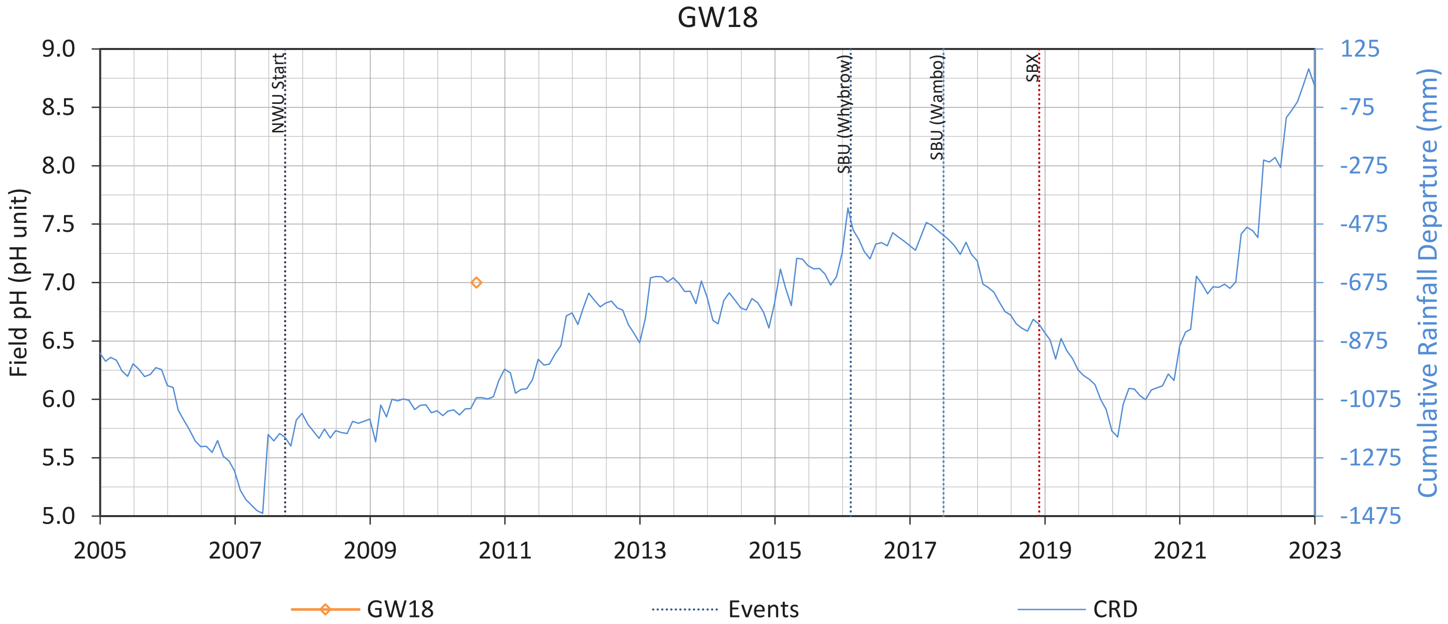

GW22 Wollombi Brook Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

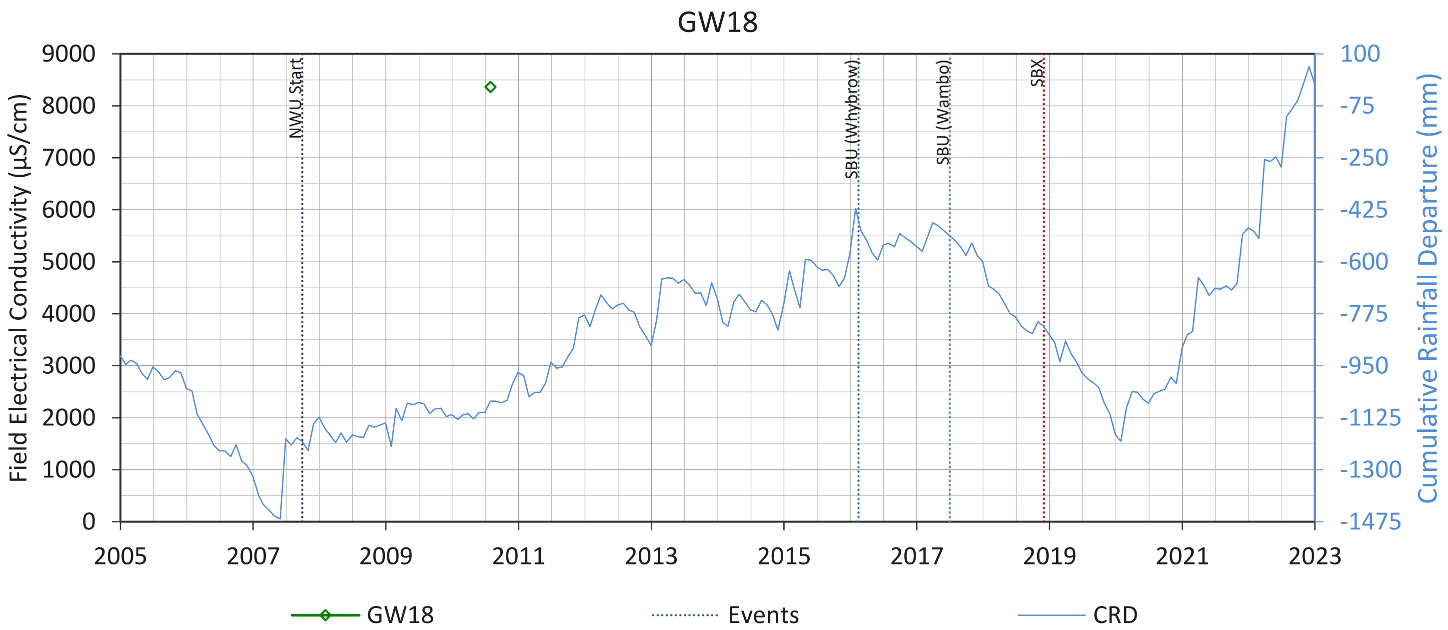

P11 Wollombi Brook Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
44.0
43.5
43.0
42.5
42.0
41.5
41.0
40.5
40.0
39.5
39.0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P11
Events
CRD

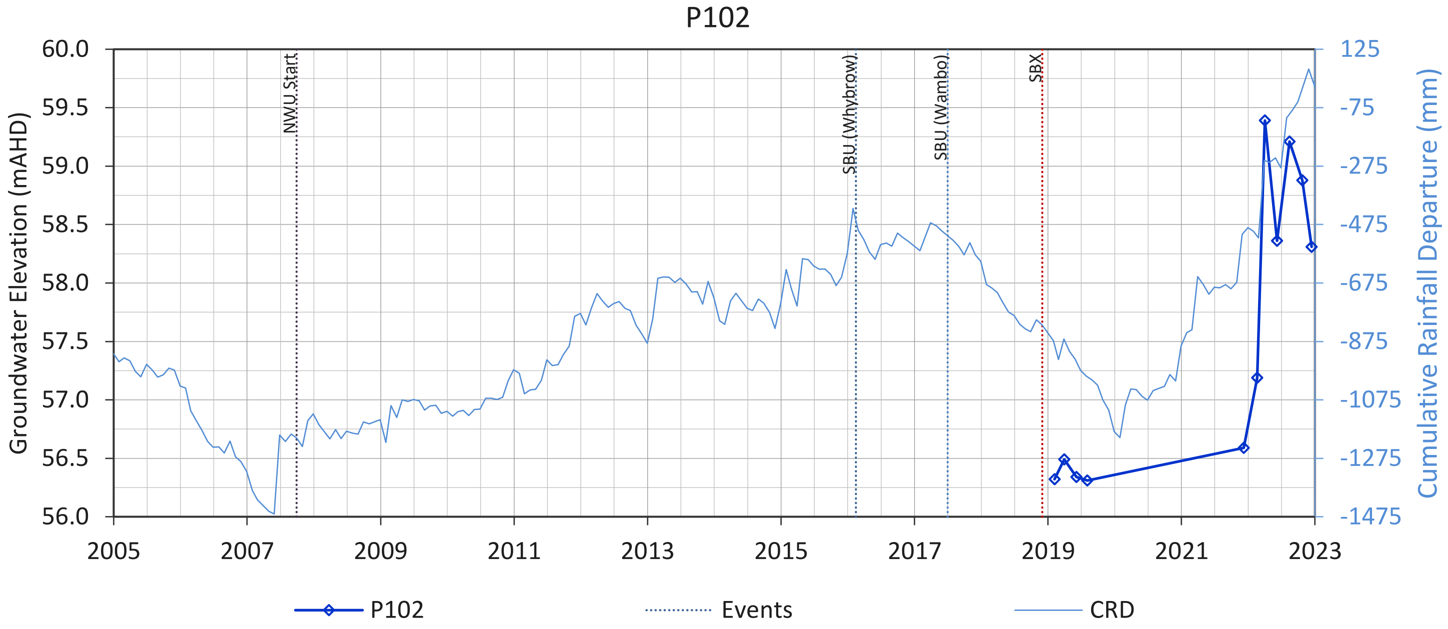

P11 Wollombi Brook Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P11
Events
CRD

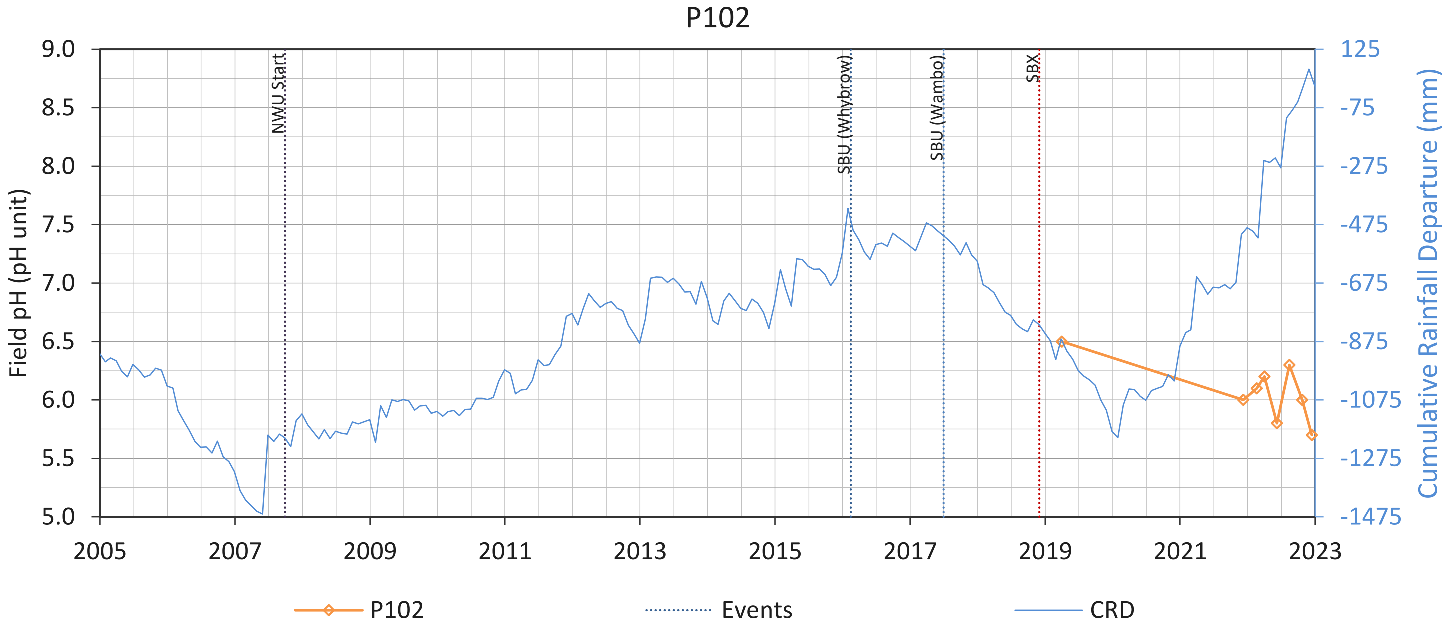

P11 Wollombi Brook Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P11
Events
CRD

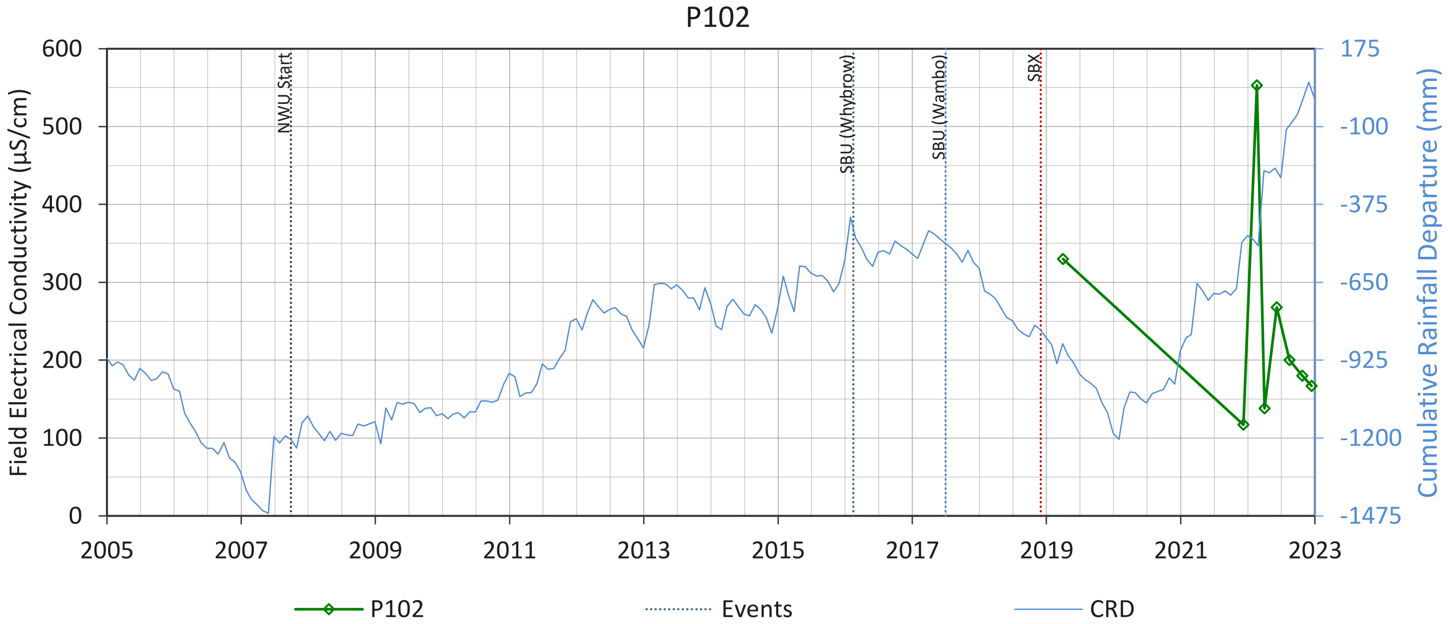

GW18
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
67.5
67.0
66.5
66.0
65.5
65.0
64.5
64.0
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW18
Events
CRD

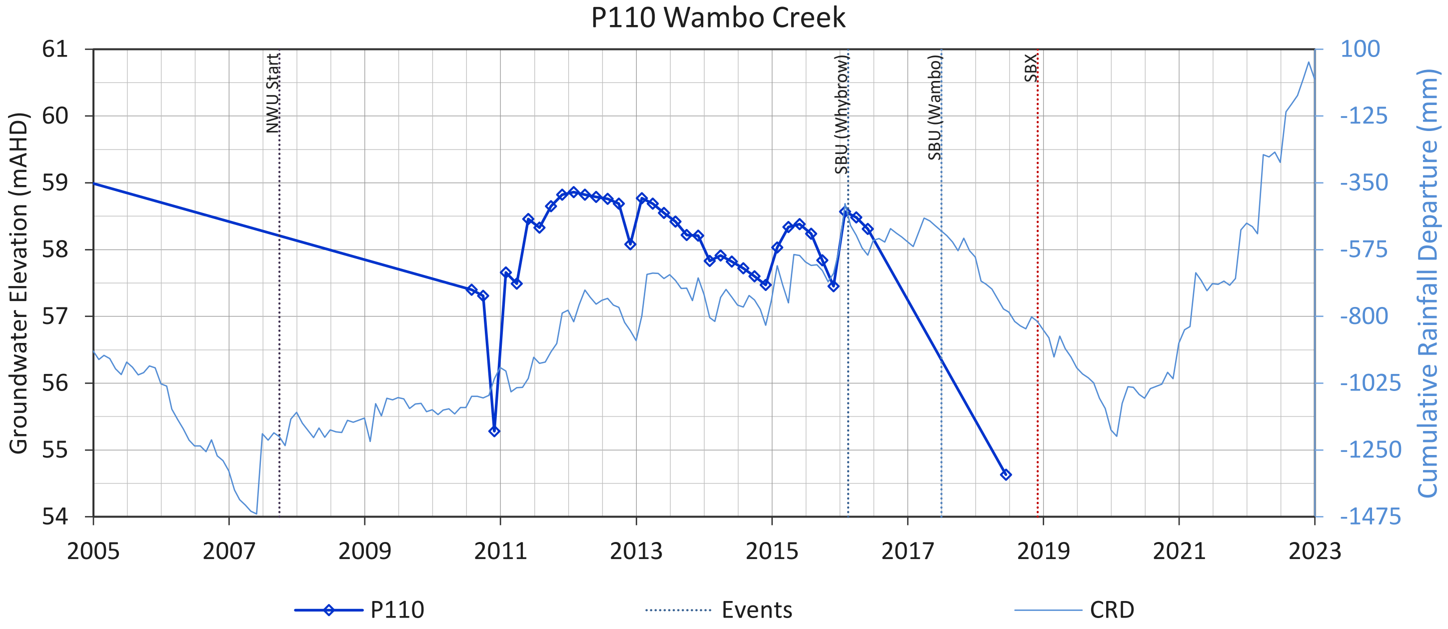

GW18
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW18
Events
CRD

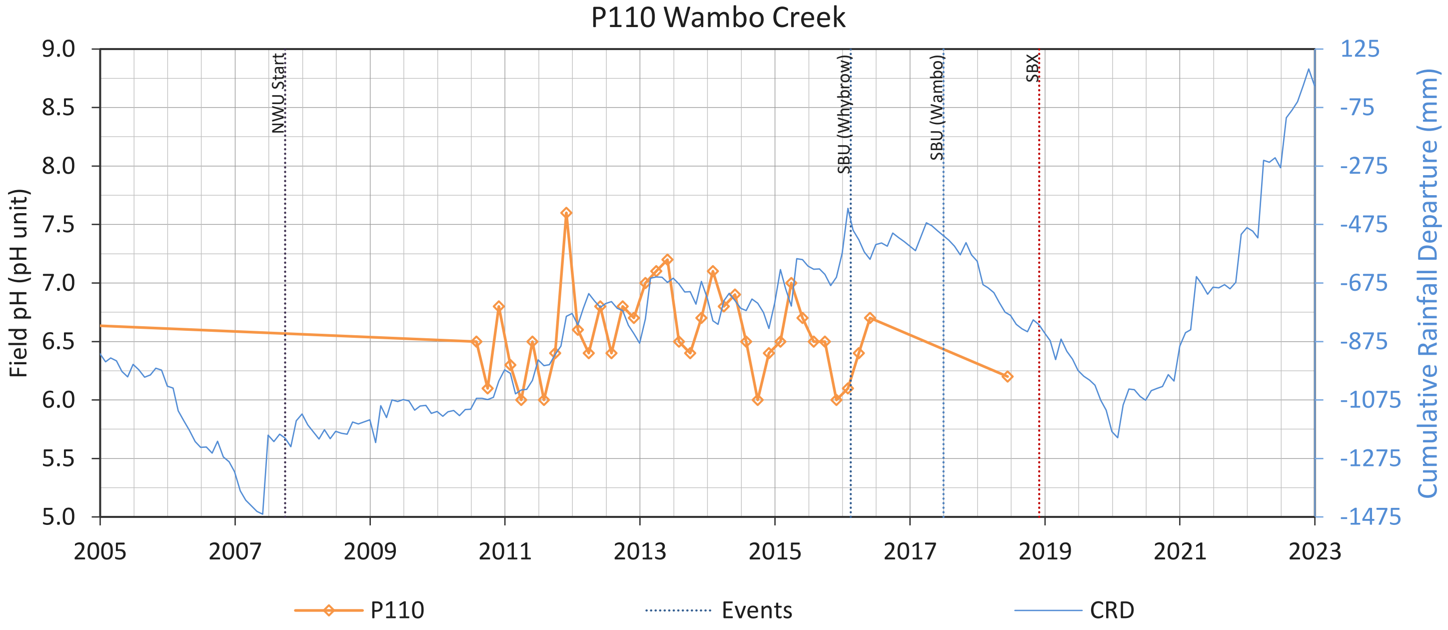

GW18
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW18
Events
CRD

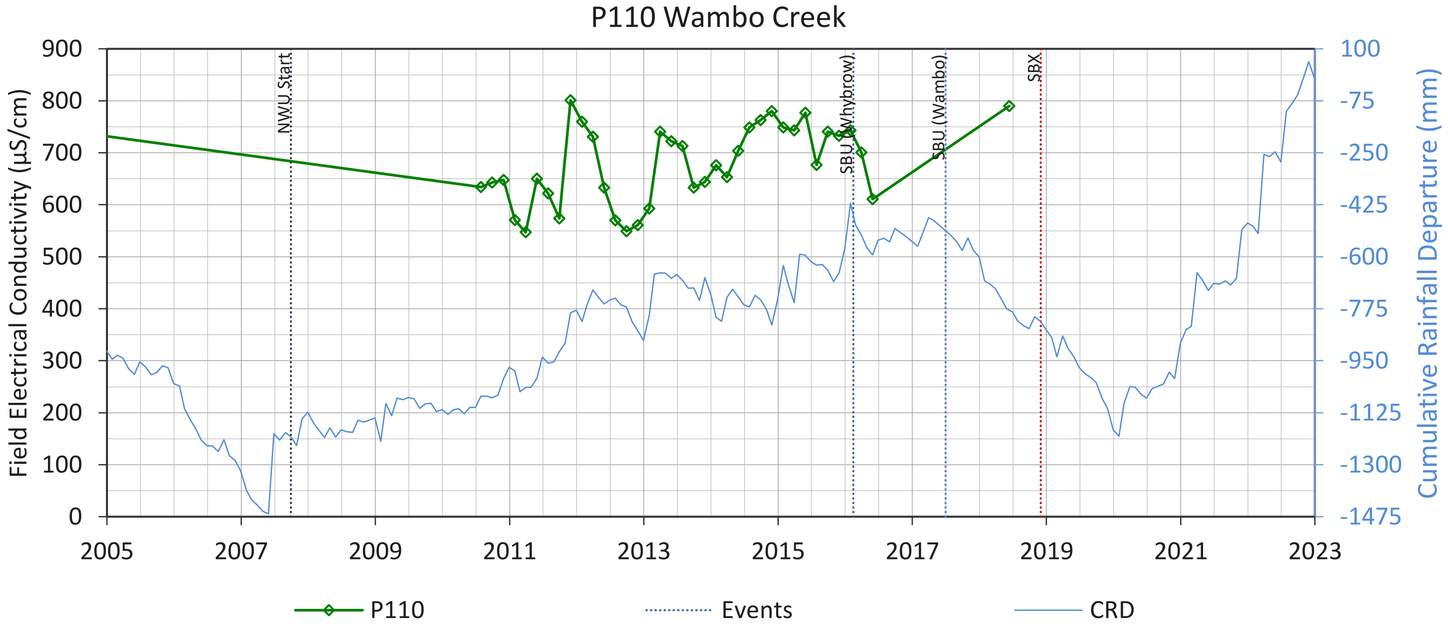

P102
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P102
Events
CRD

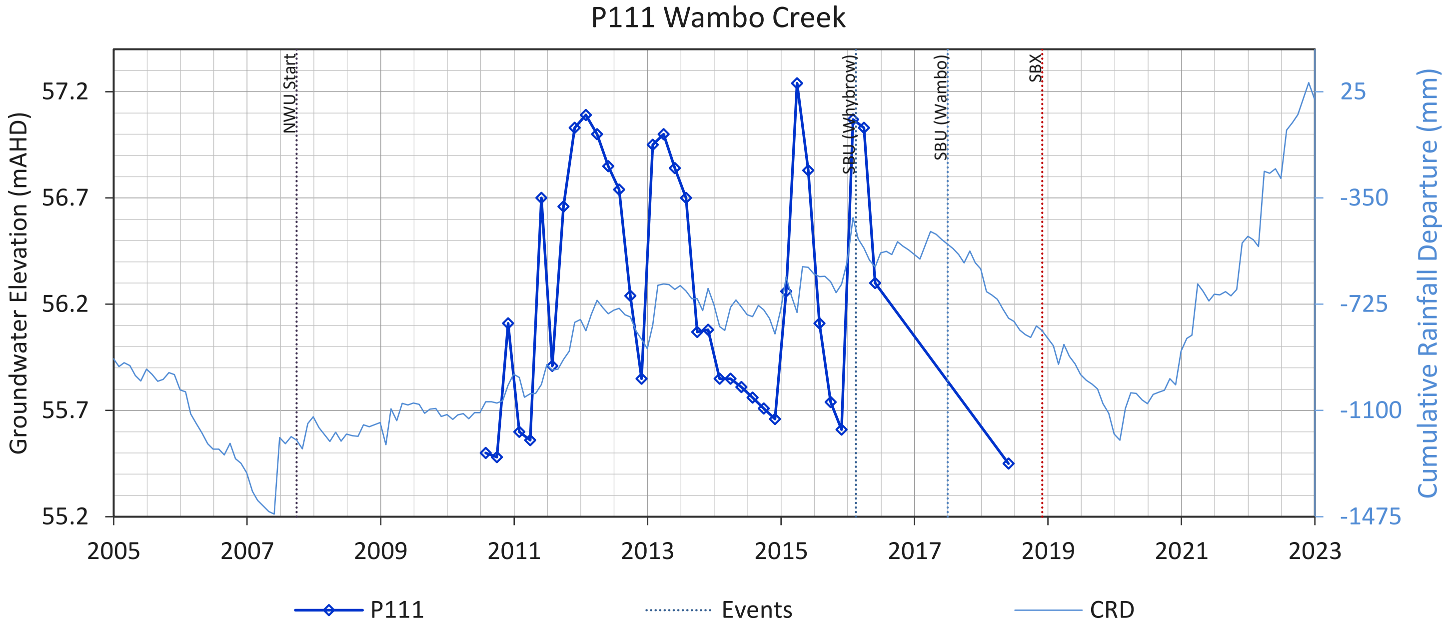

P102
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P102
Events
CRD

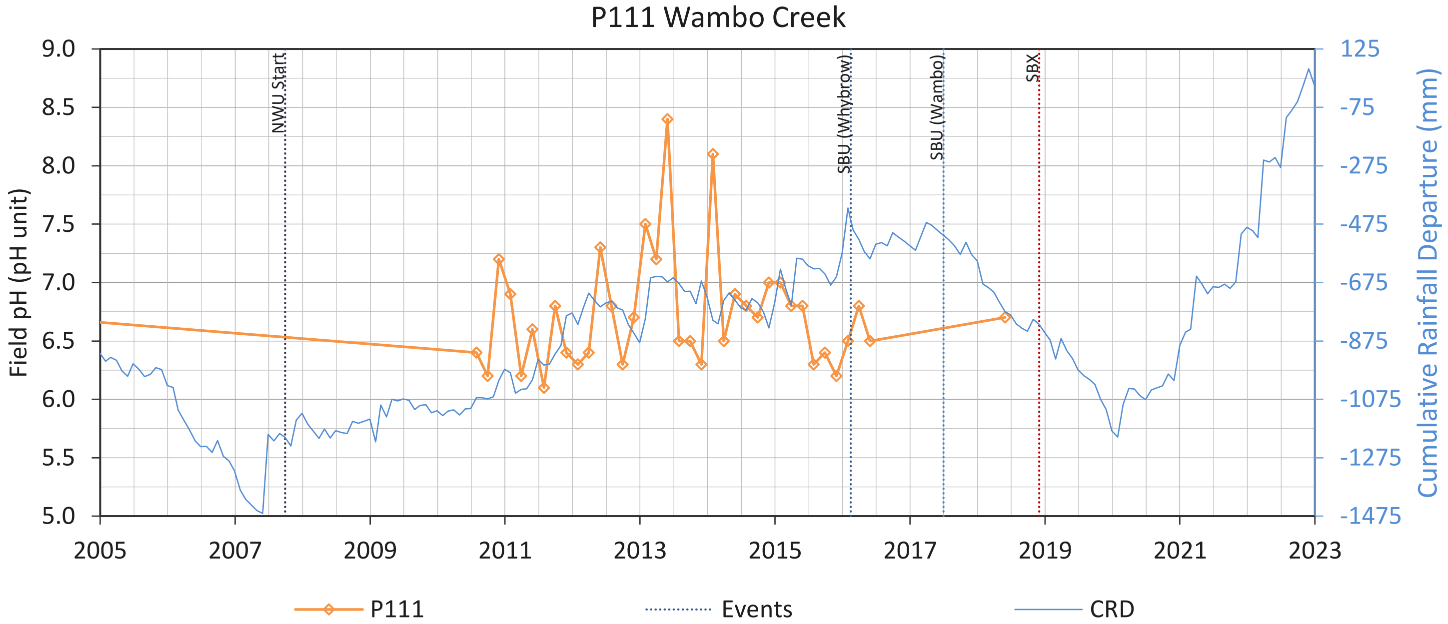

P102
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P102
Events
CRD

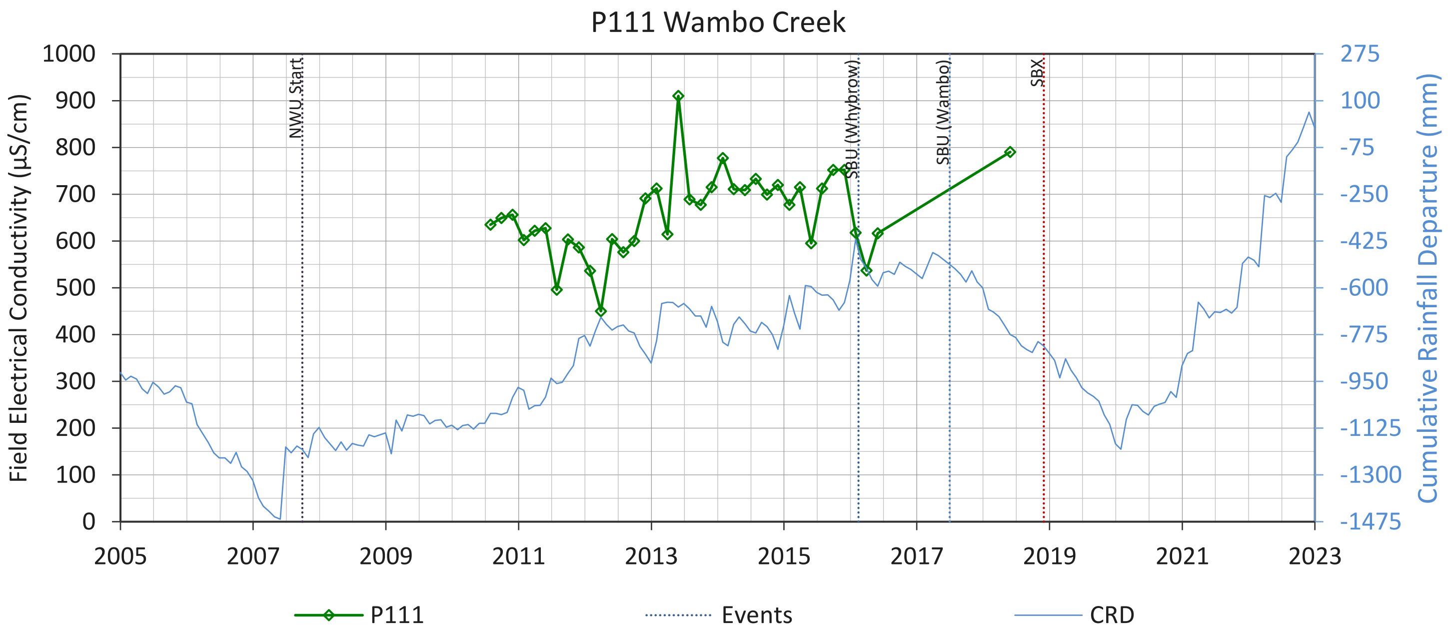

P110 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
61
60
59
58
57
56
55
54
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P110
Events
CRD

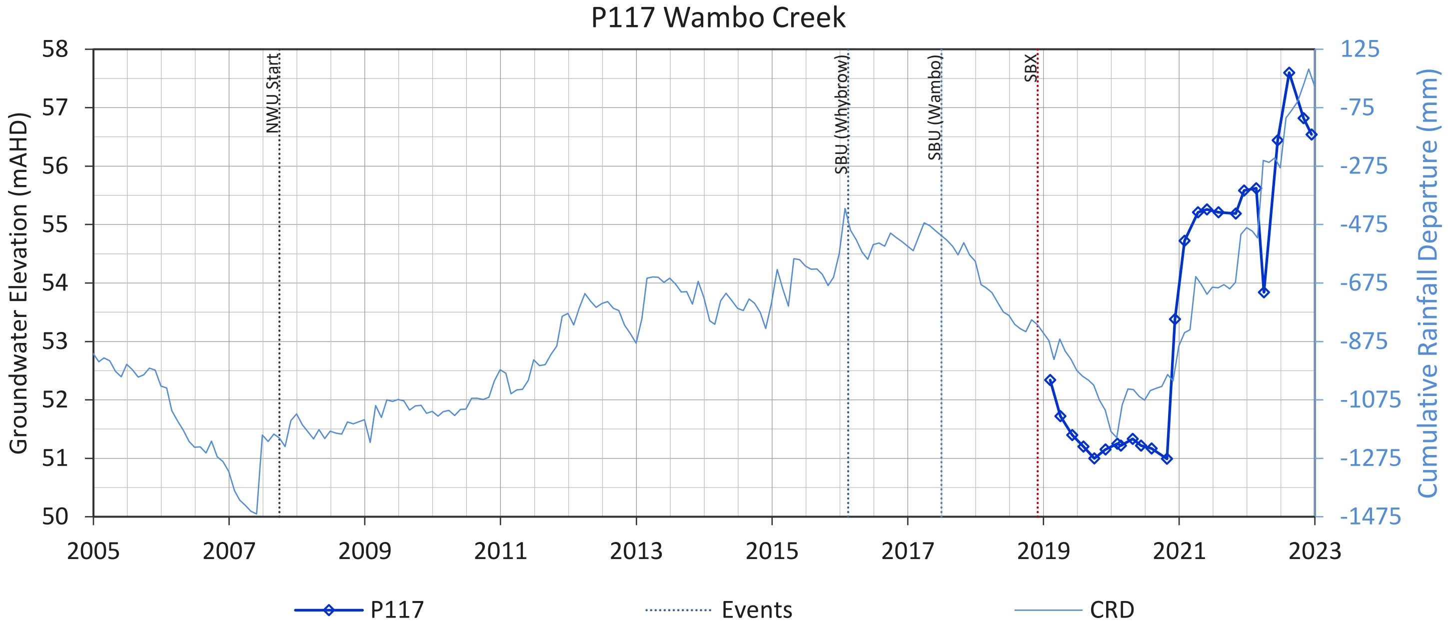

P110 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P110
Events
CRD

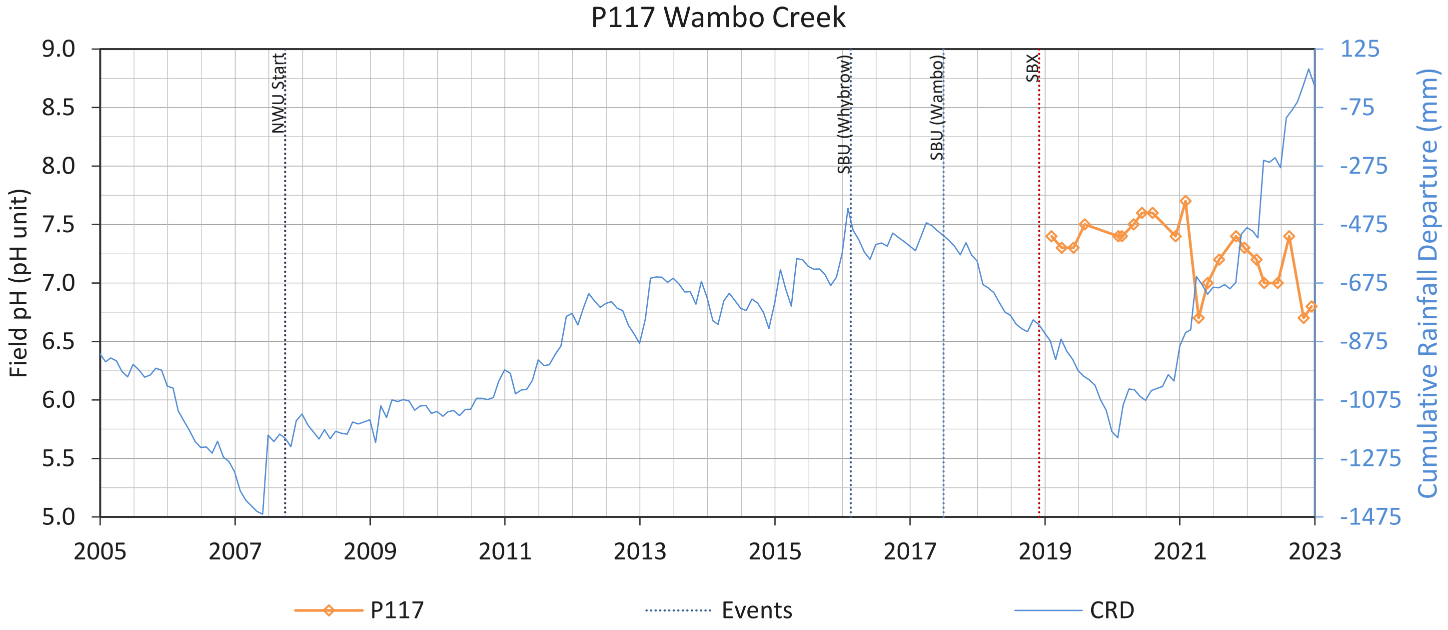

P110 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
900
800
700
600
500
400
300
200
100
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P110
Events
CRD

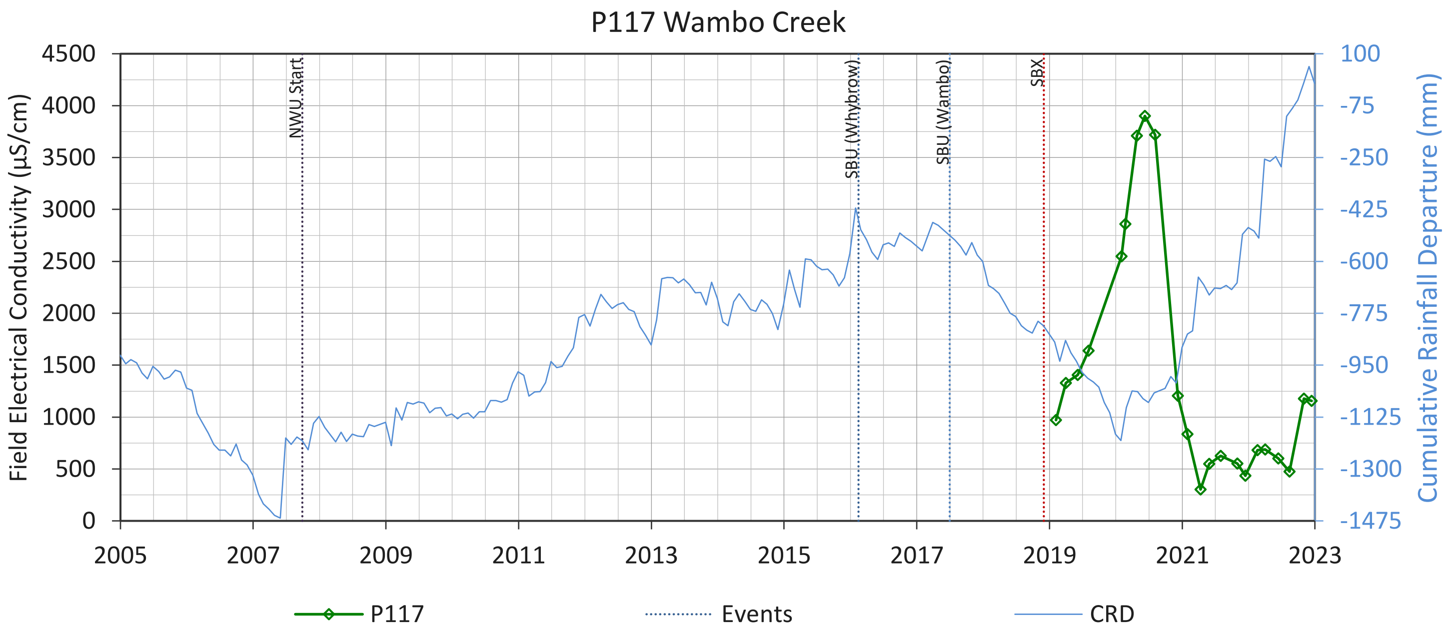

P111 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
57.2
56.7
56.2
55.7
55.2
25
-350
-725
-1100
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P111
Events
CRD

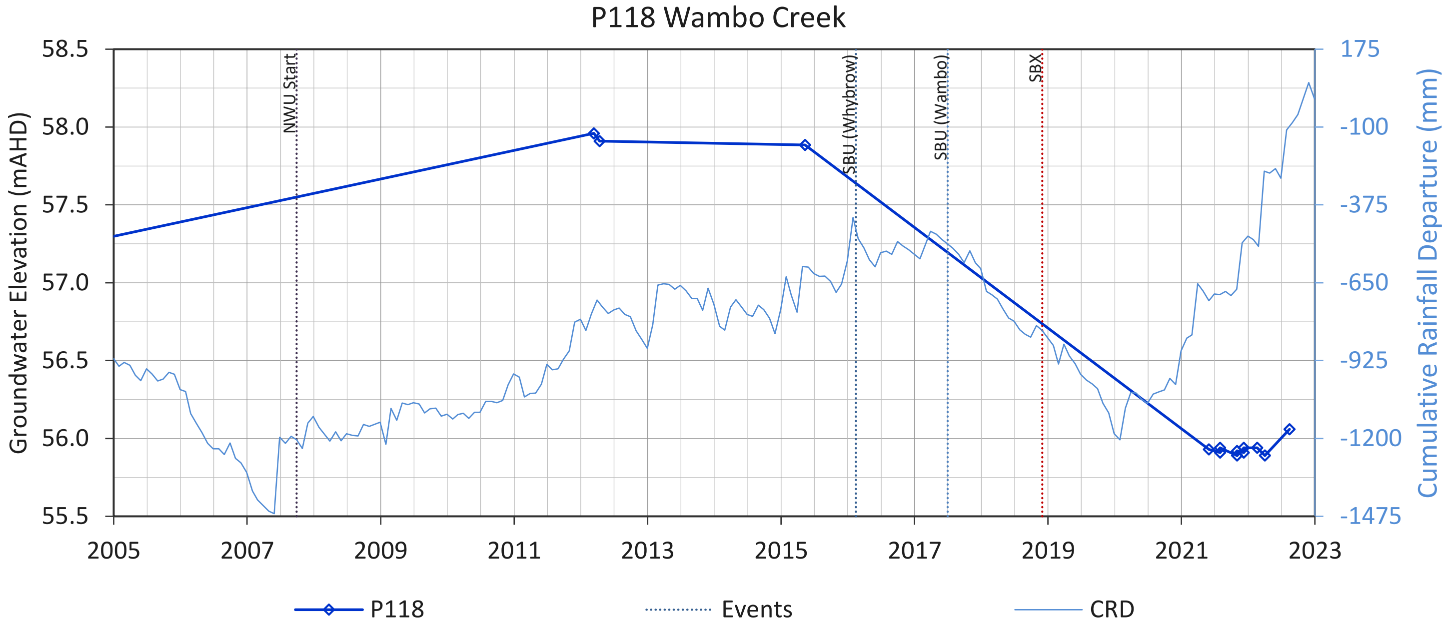

P111 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P111
Events
CRD


P111 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P111
Events
CRD

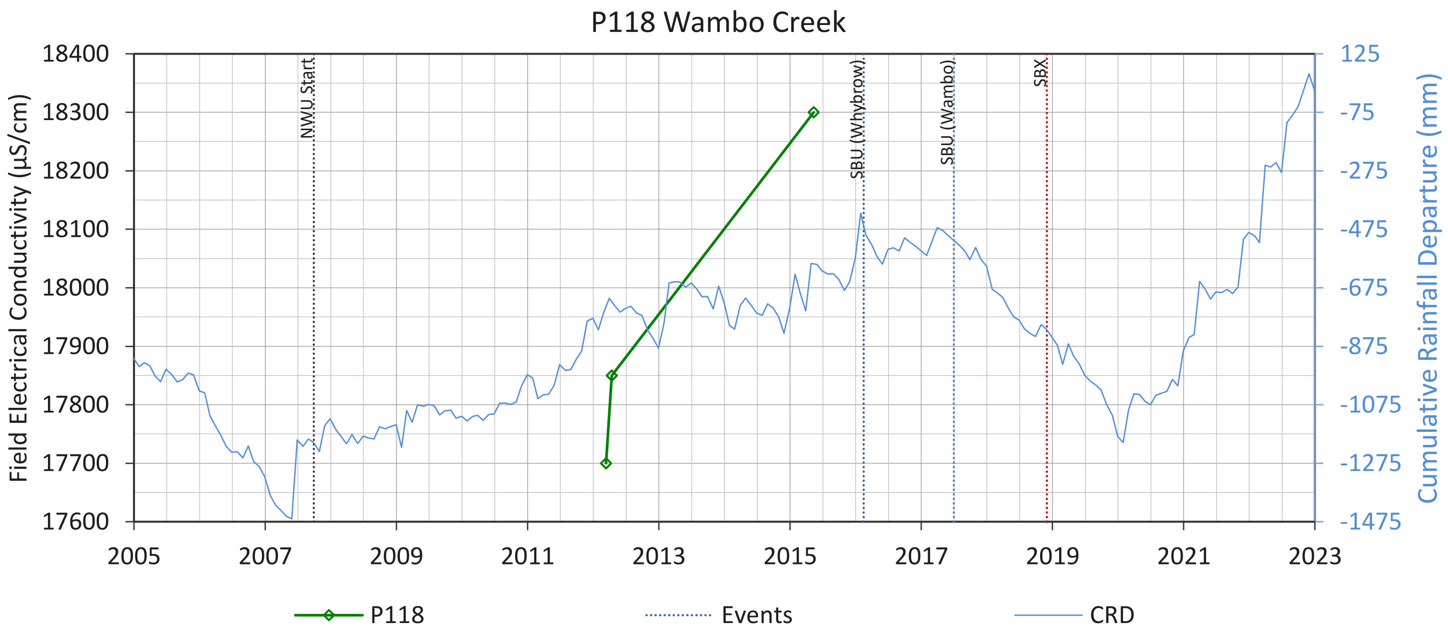

P117 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
58
57
56
55
54
53
52
51
50
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P117
Events
CRD

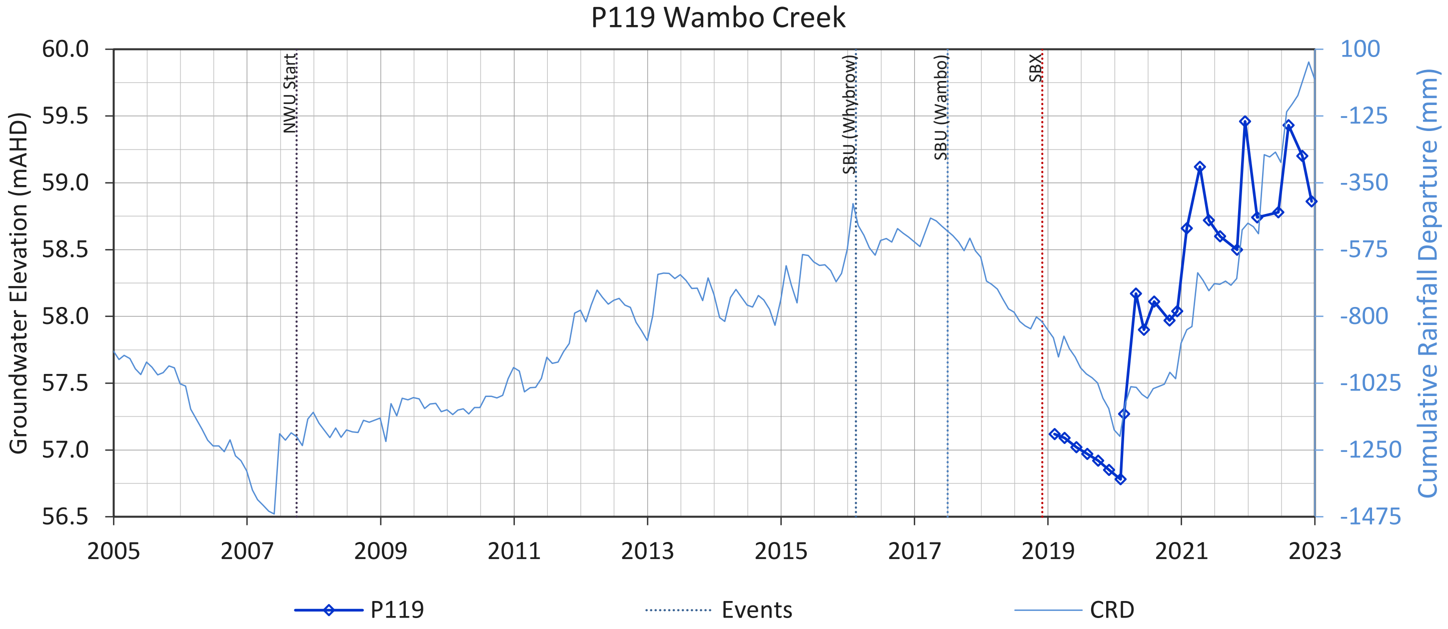

P117 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P117
Events
CRD

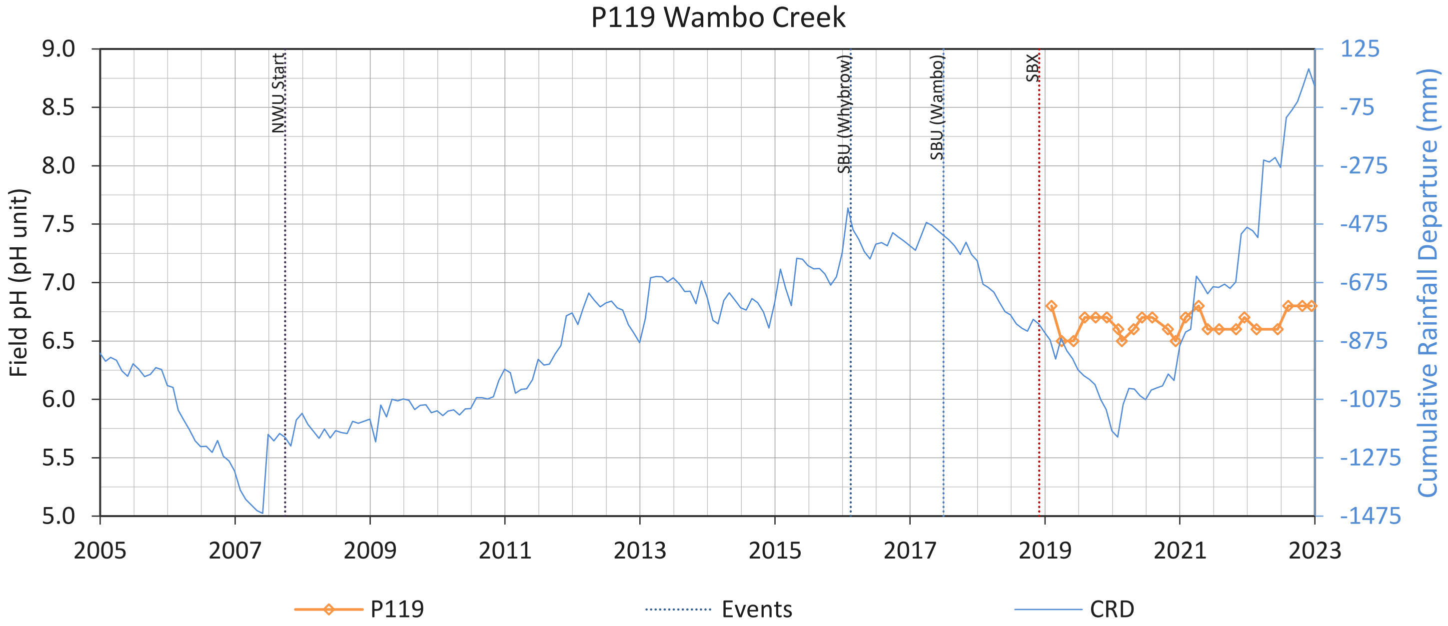

P117 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWIU Start
SBU (Whybrow)
SBU (Wambo)
SBX
4500
4000
3500
3000
2500
2000
1500
1000
500
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P117
Events
CRD

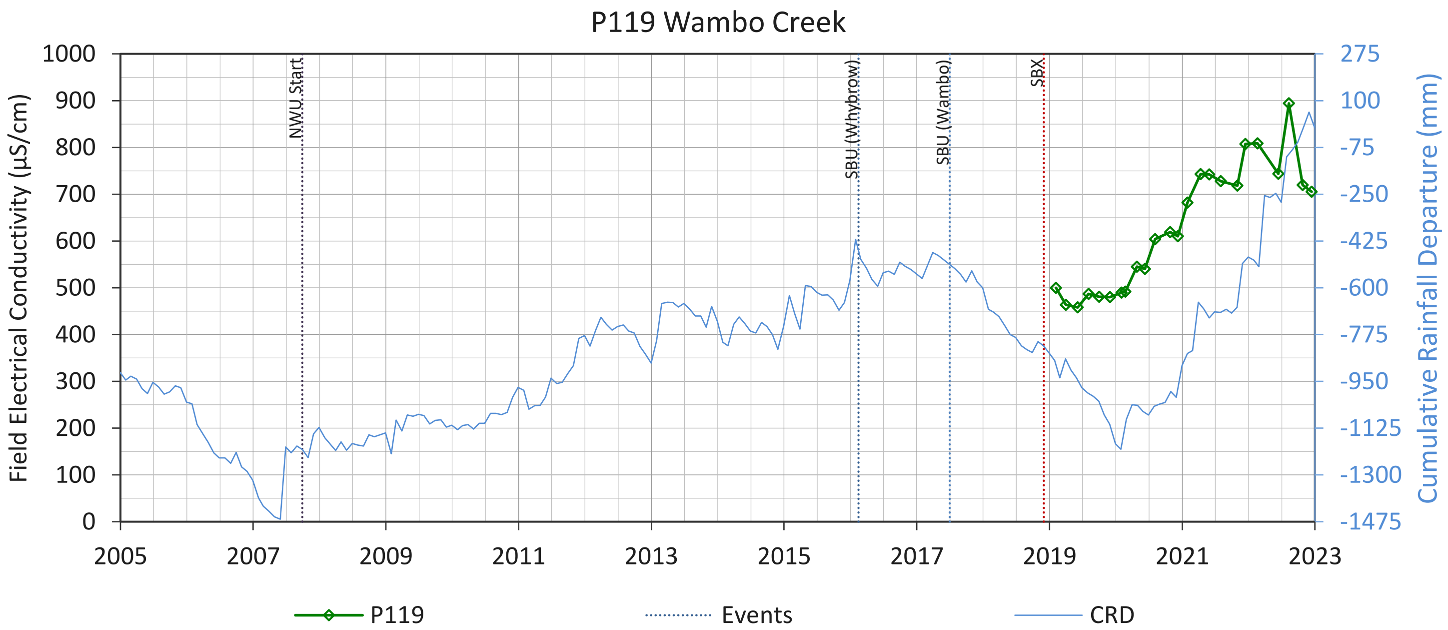


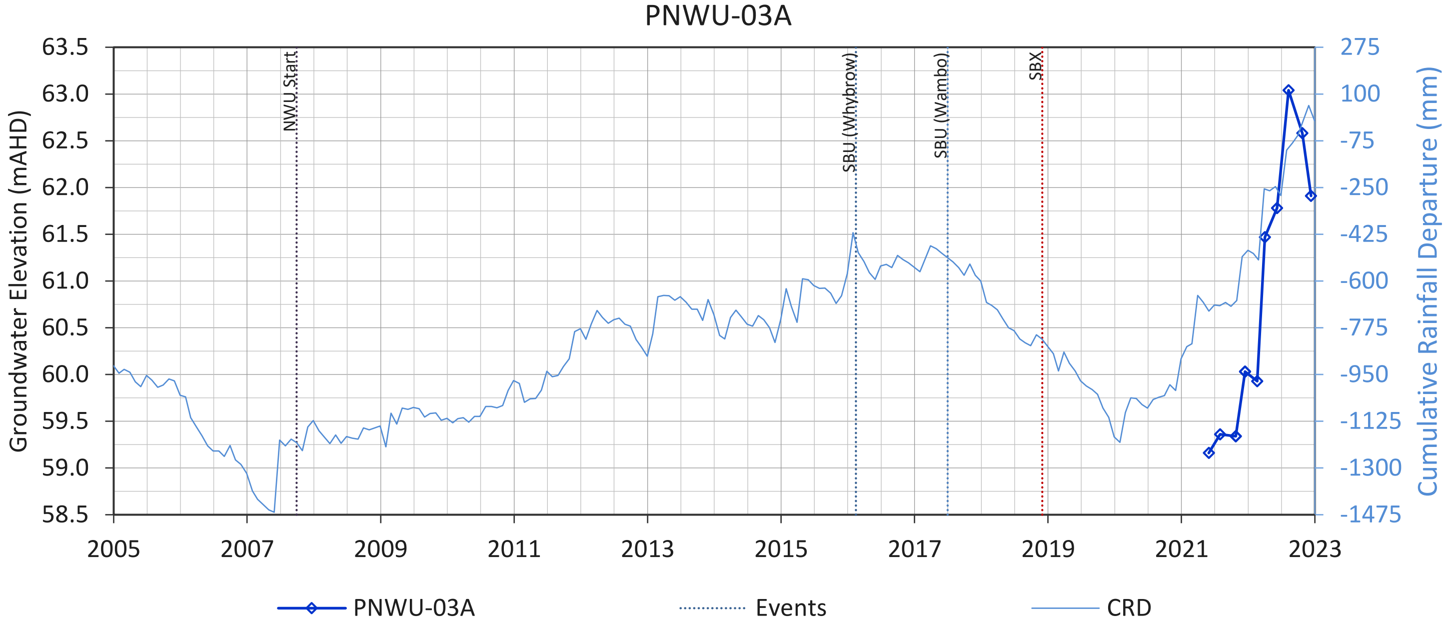
No Data Available for Field pH (pH unit)

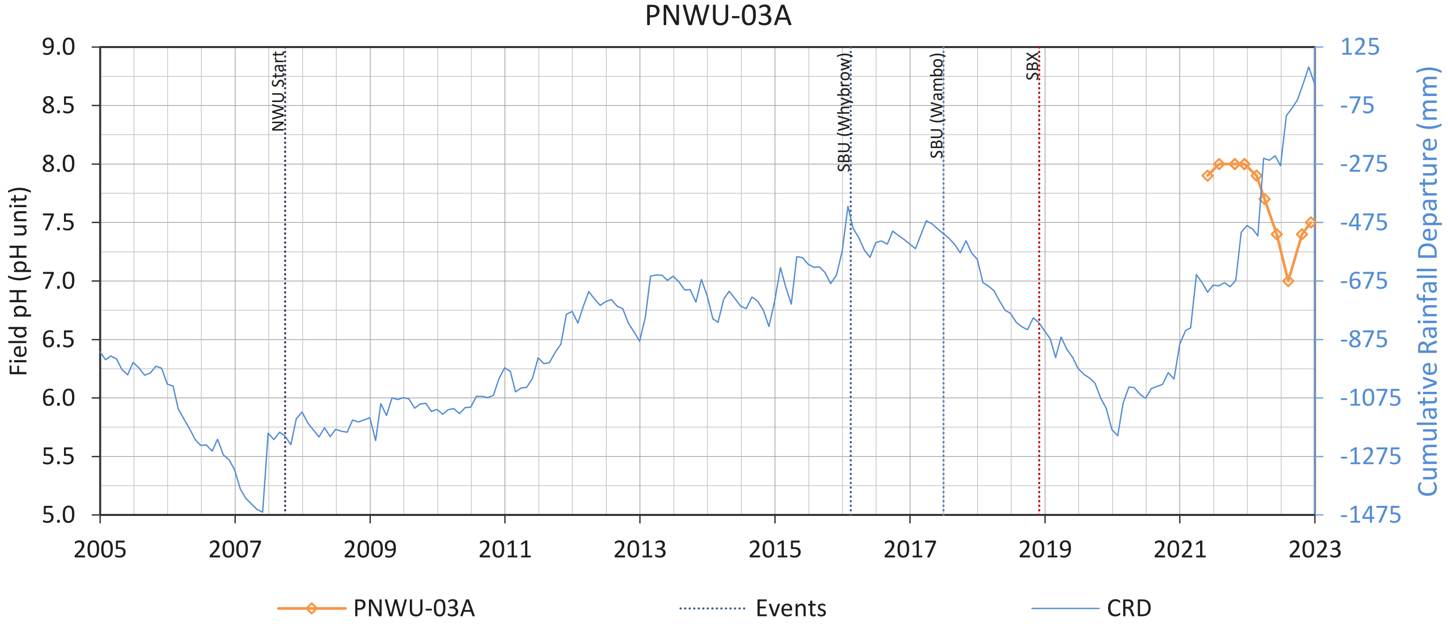


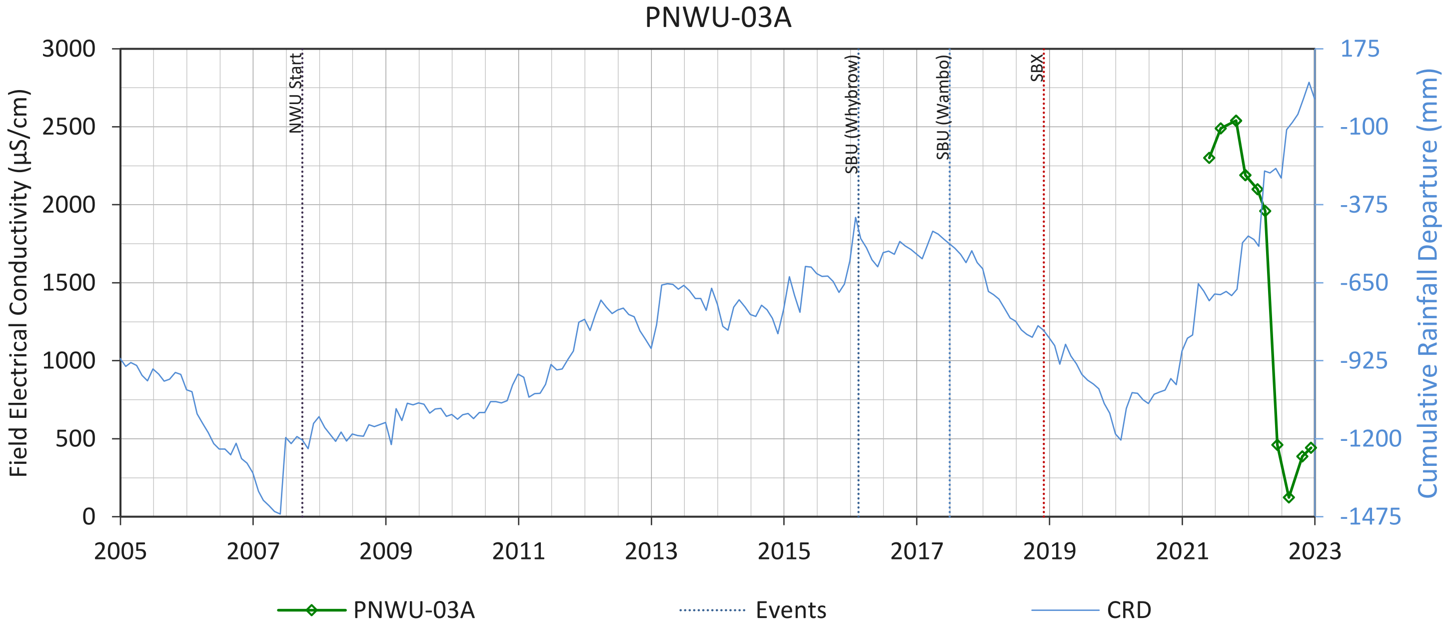

P119 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
100
-125
-350
-575
-800
-1025
-1250
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P119
Events
CRD

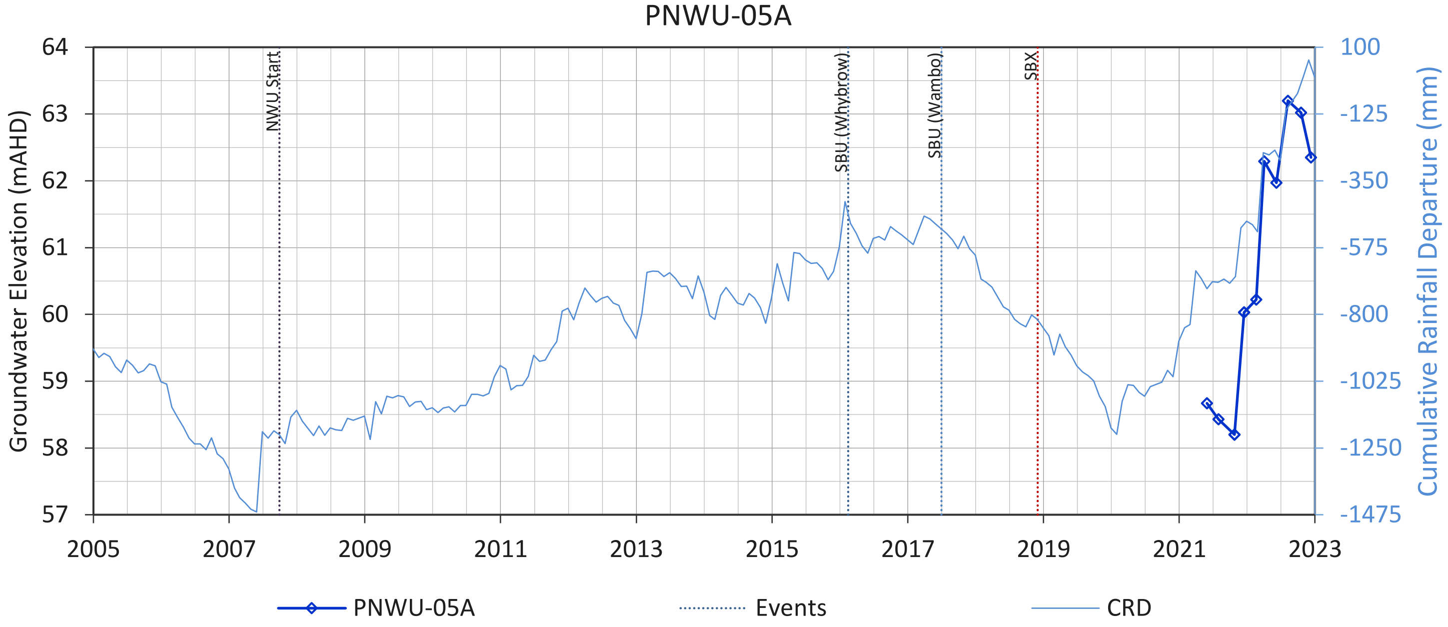

P119 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P119
Events
CRD


P119 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P119
Events
CRD

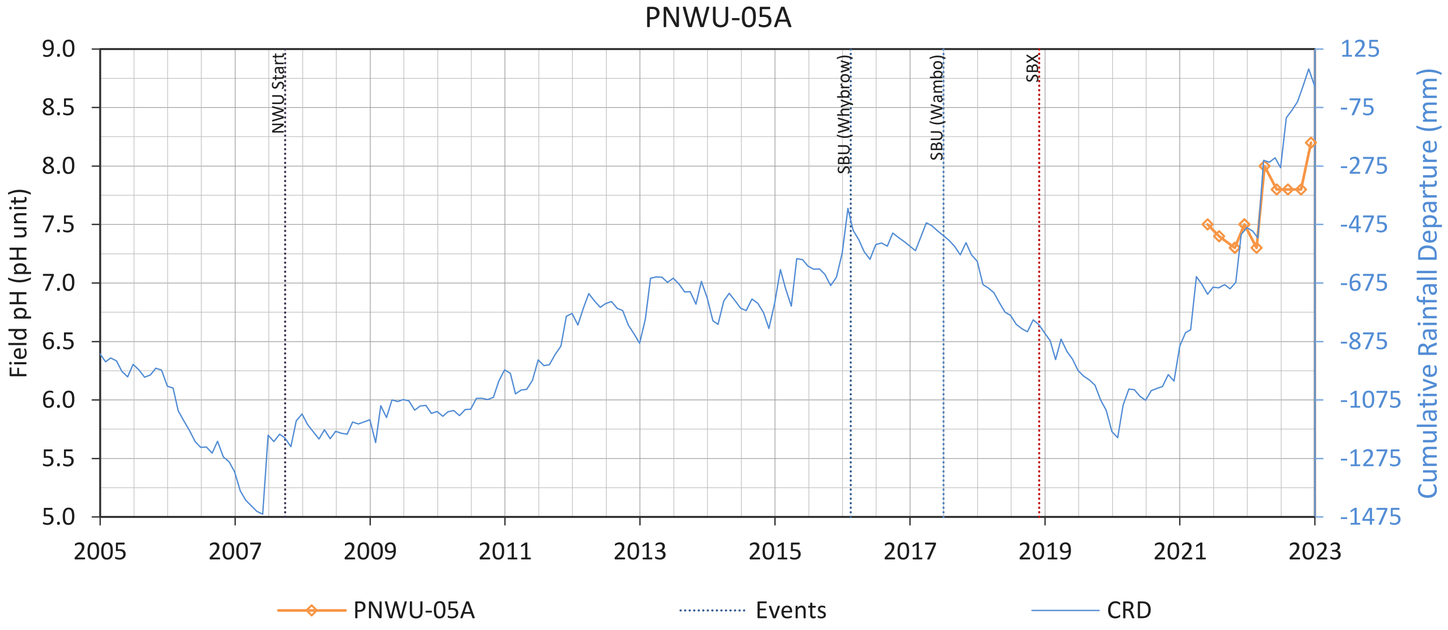

PNWU-03A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
63.5
63.0
62.5
62.0
61.5
61.0
60.5
60.0
59.5
59.0
58.5
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-03A
Events
CRD


PNWU-03A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-03A
Events
CRD

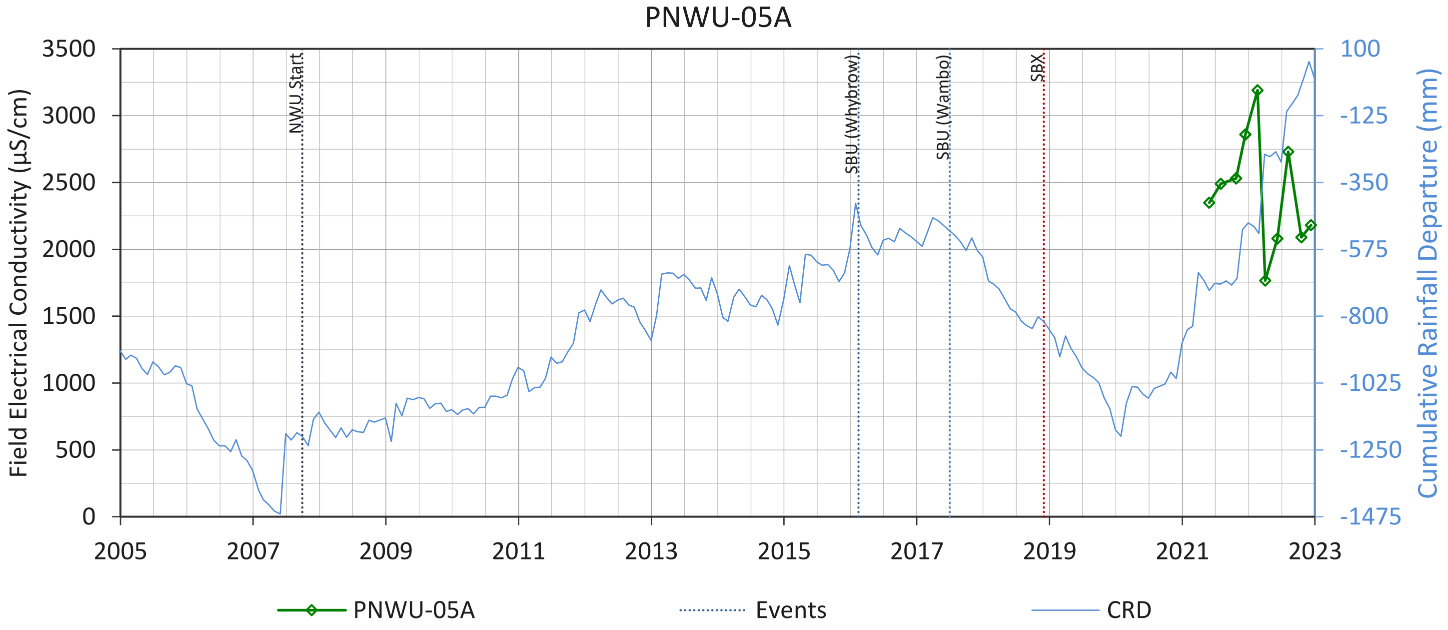

PNWU-03A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
3000
2500
2000
1500
1000
500
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-03A
Events
CRD



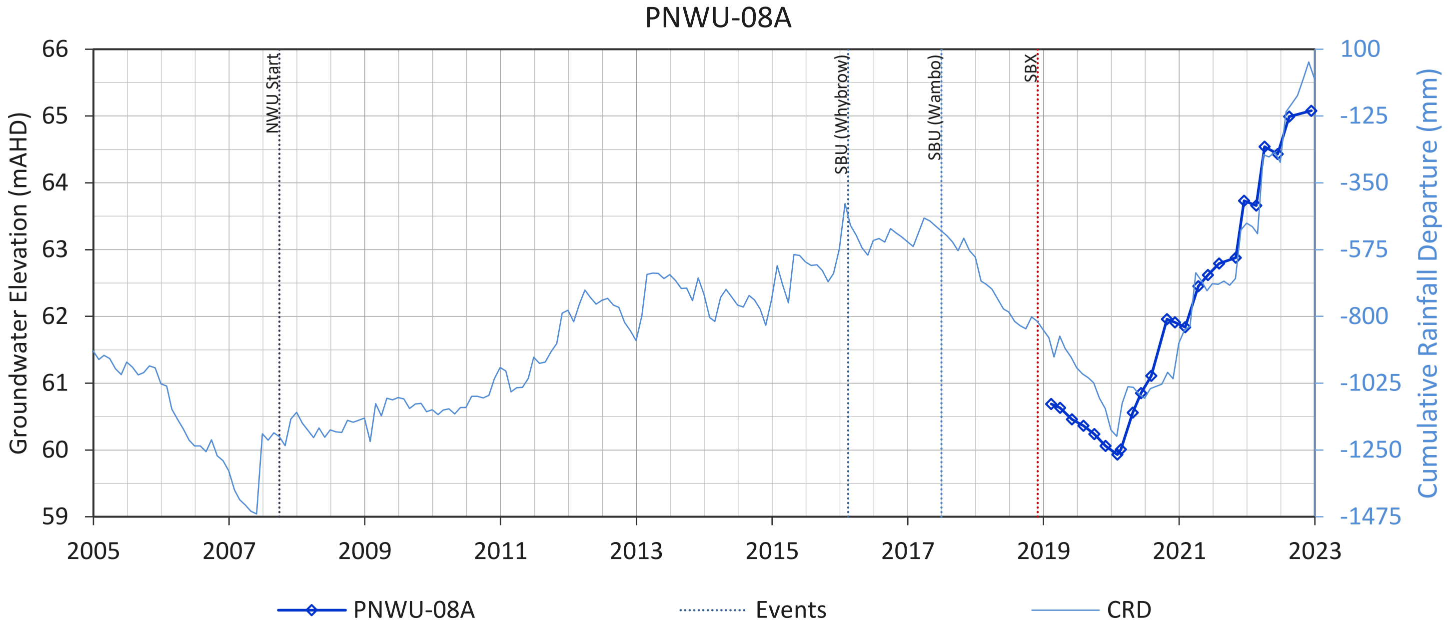
PNWU-05A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

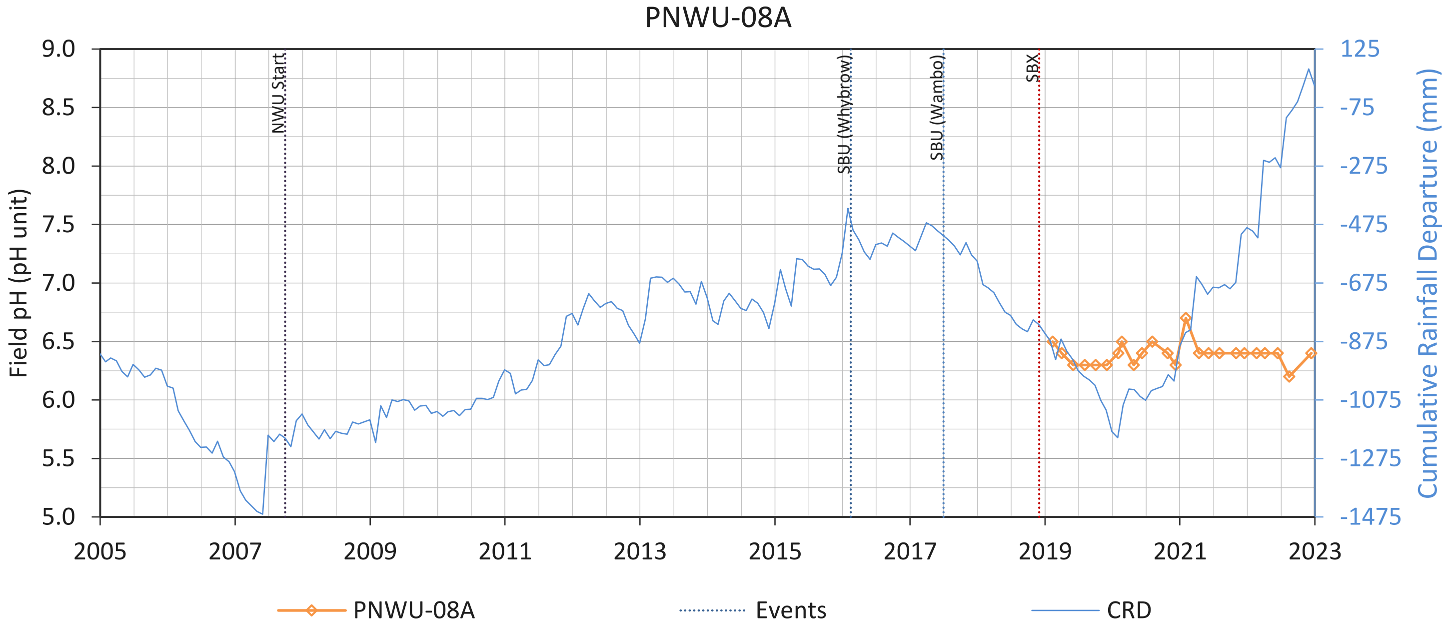


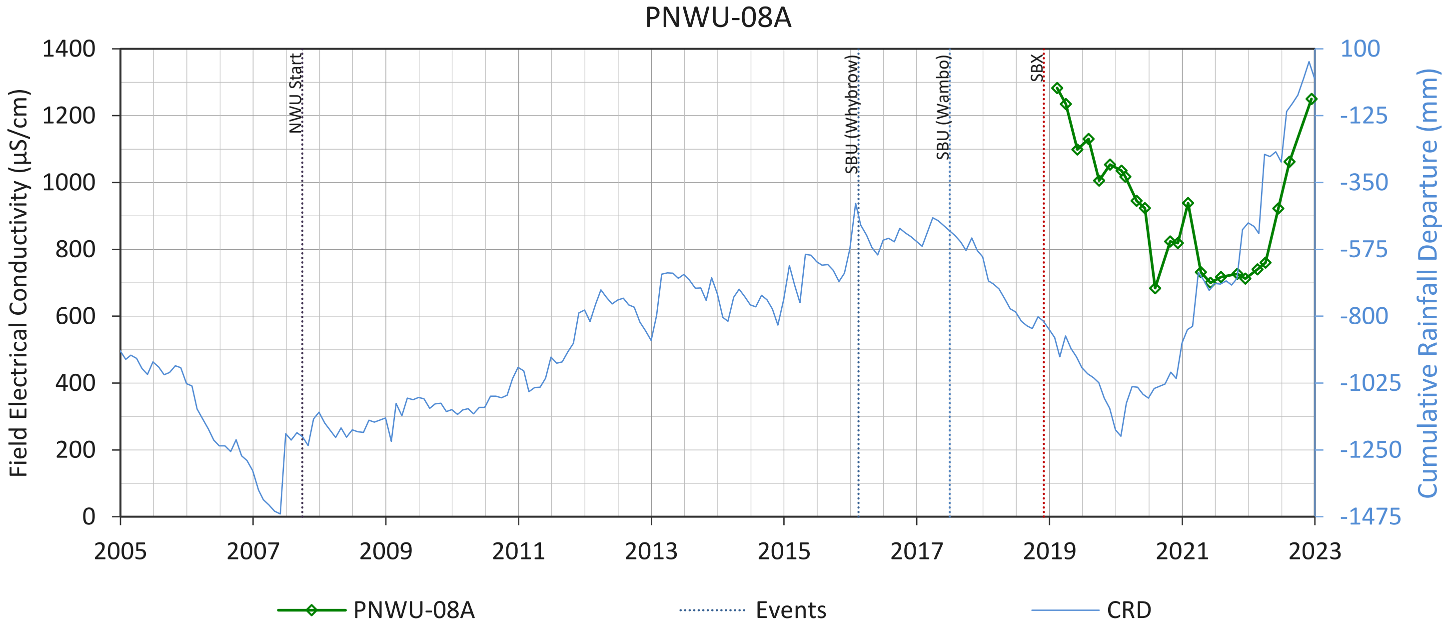
PNWU-05A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

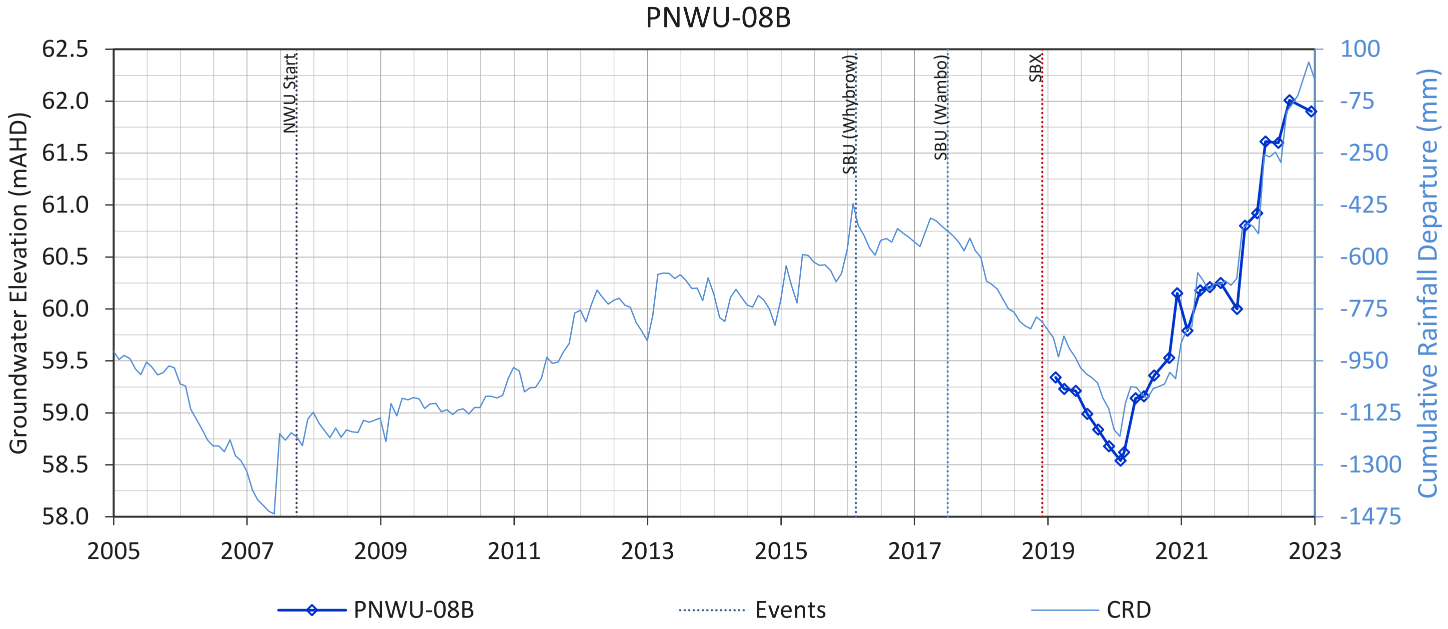


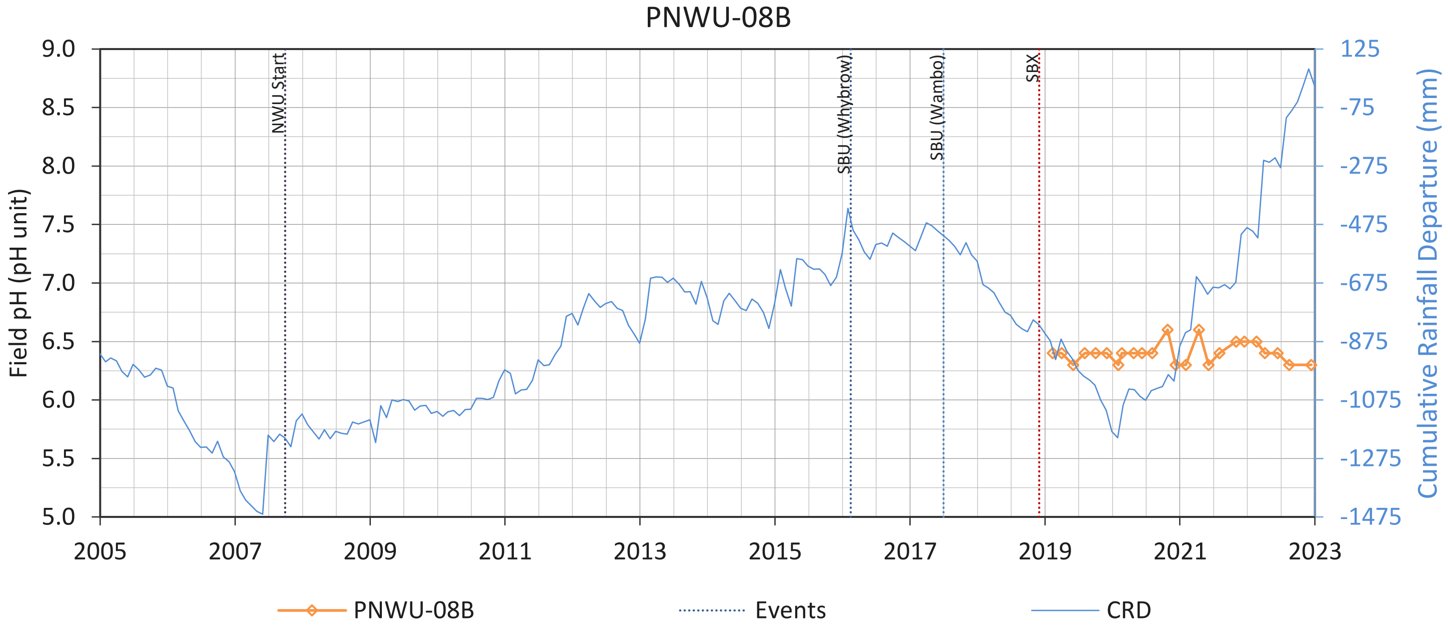
PNWU-05A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

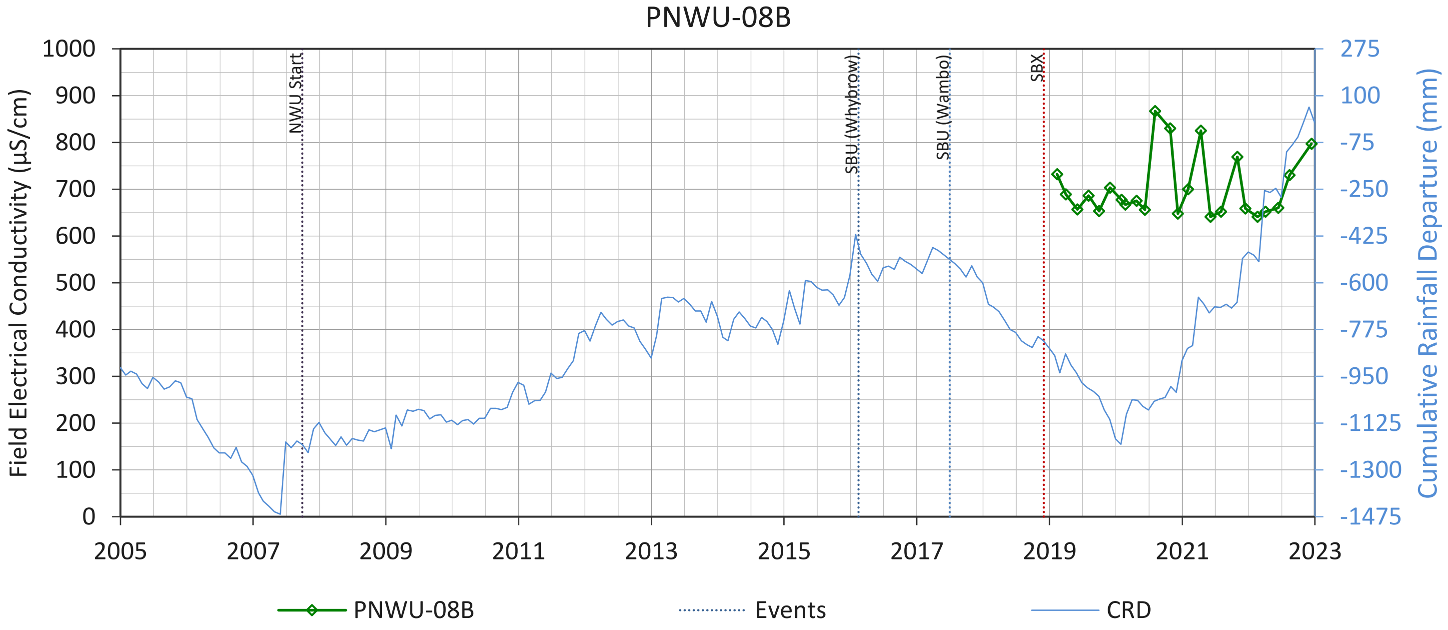

PNWU-08A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
66
65
64
63
62
61
60
59
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08A
Events
CRD

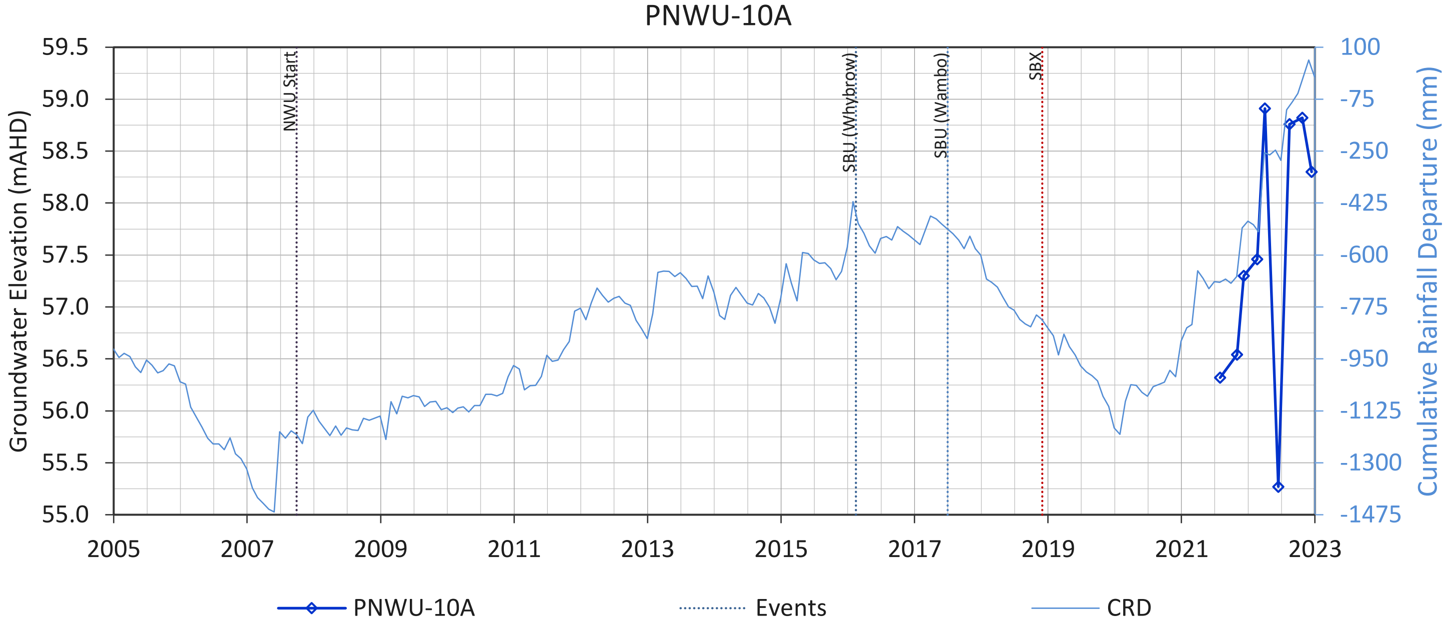

PNWU-08A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08A
Events
CRD

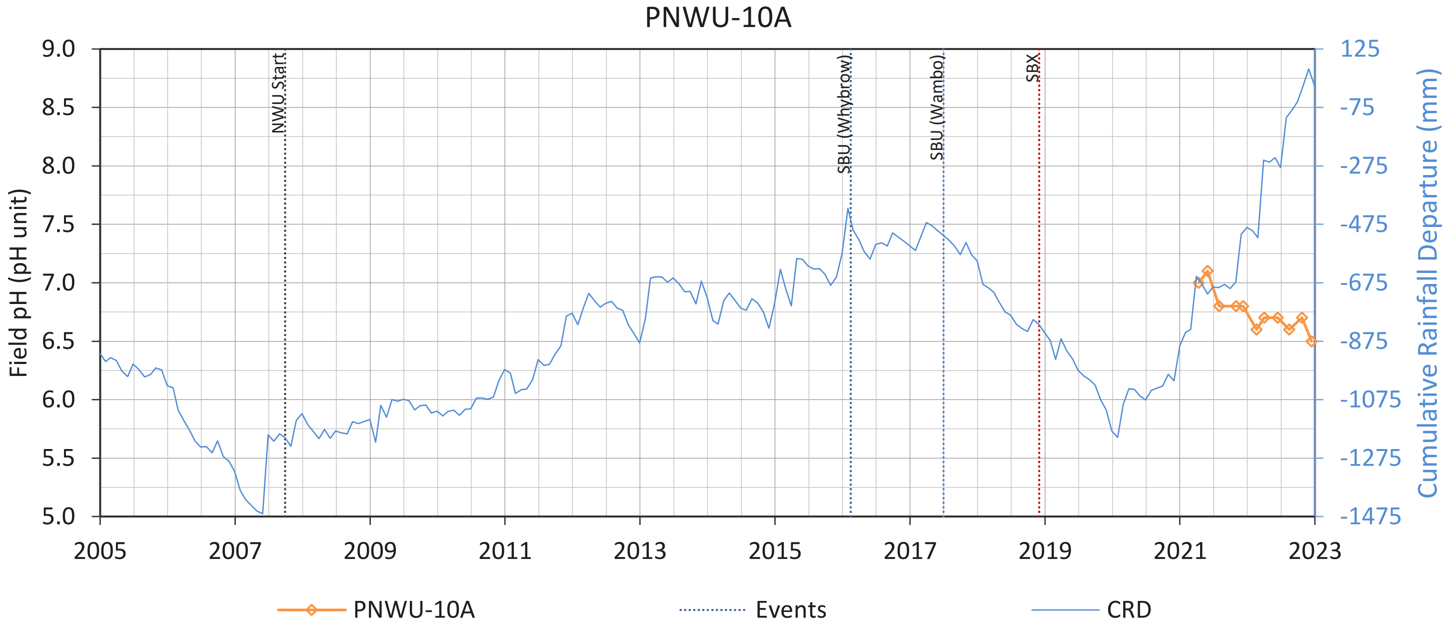

PNWU-08A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1400
1200
1000
800
600
400
200
0
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08A
Events
CRD

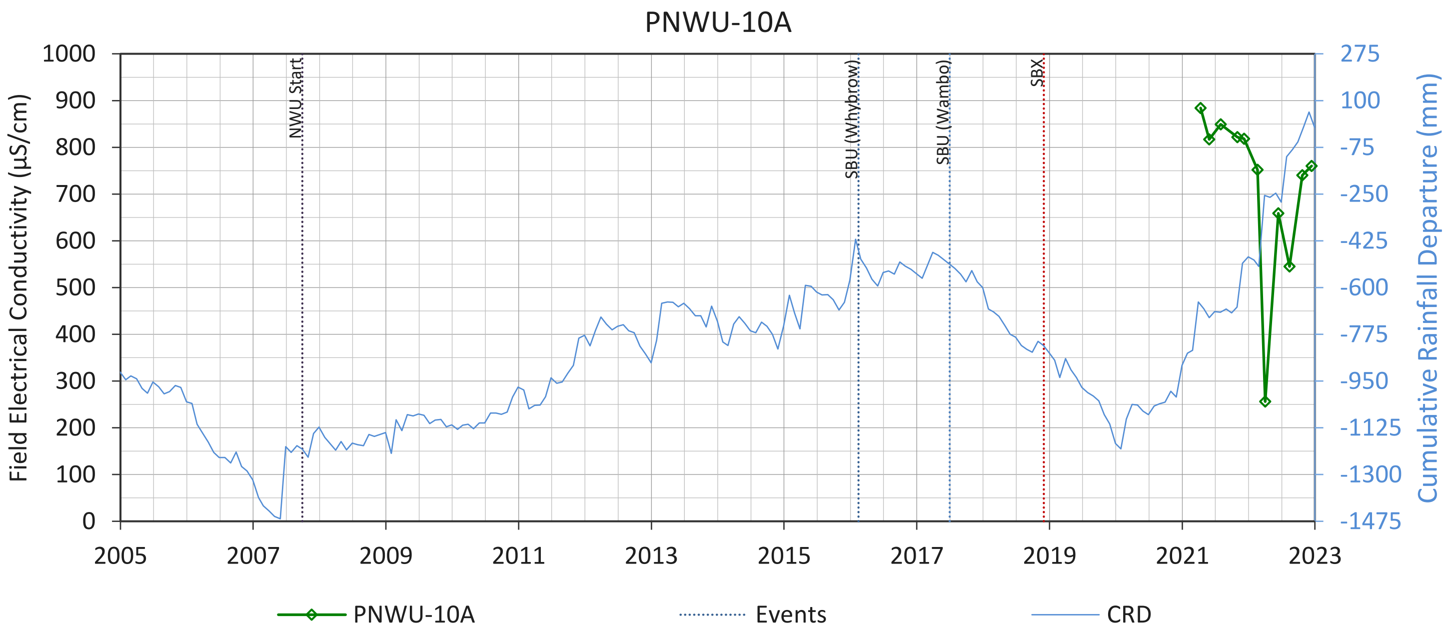

PNWU-08B
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
62.5
62.0
61.5
61.0
60.5
60.0
59.5
59.0
58.5
58.0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08B
Events
CRD

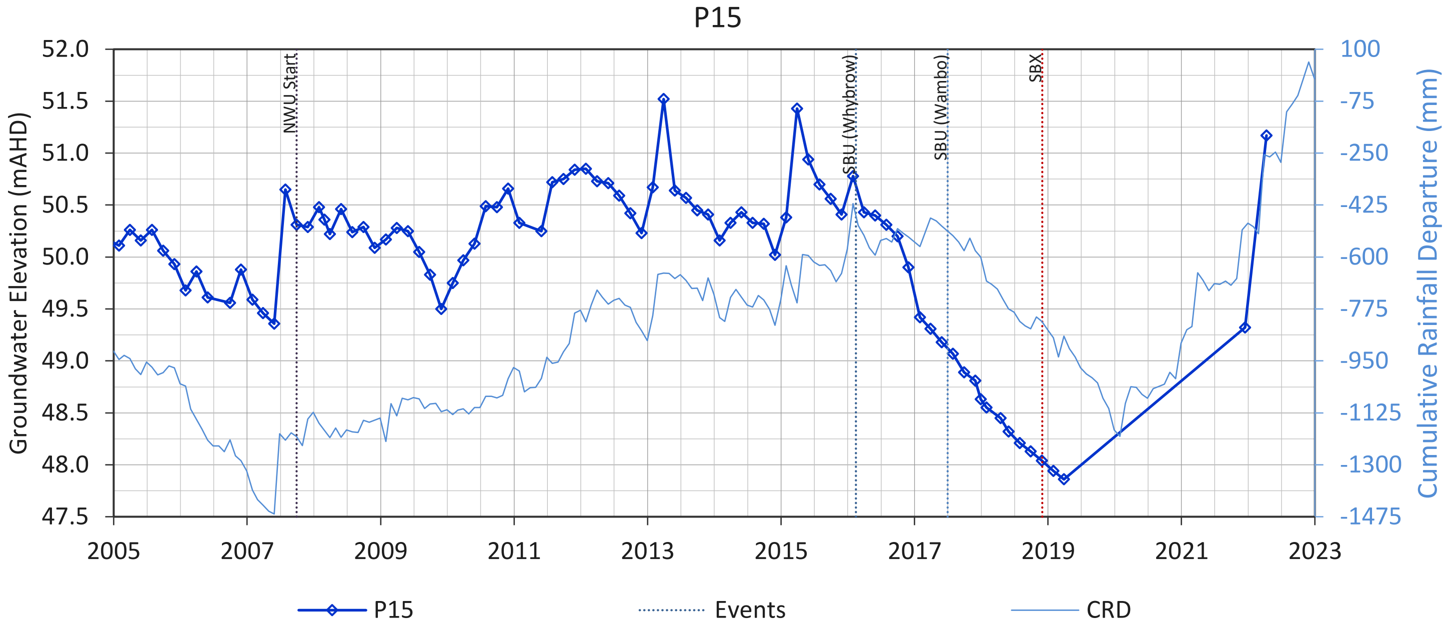

PNWU-08B
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08B
Events
CRD

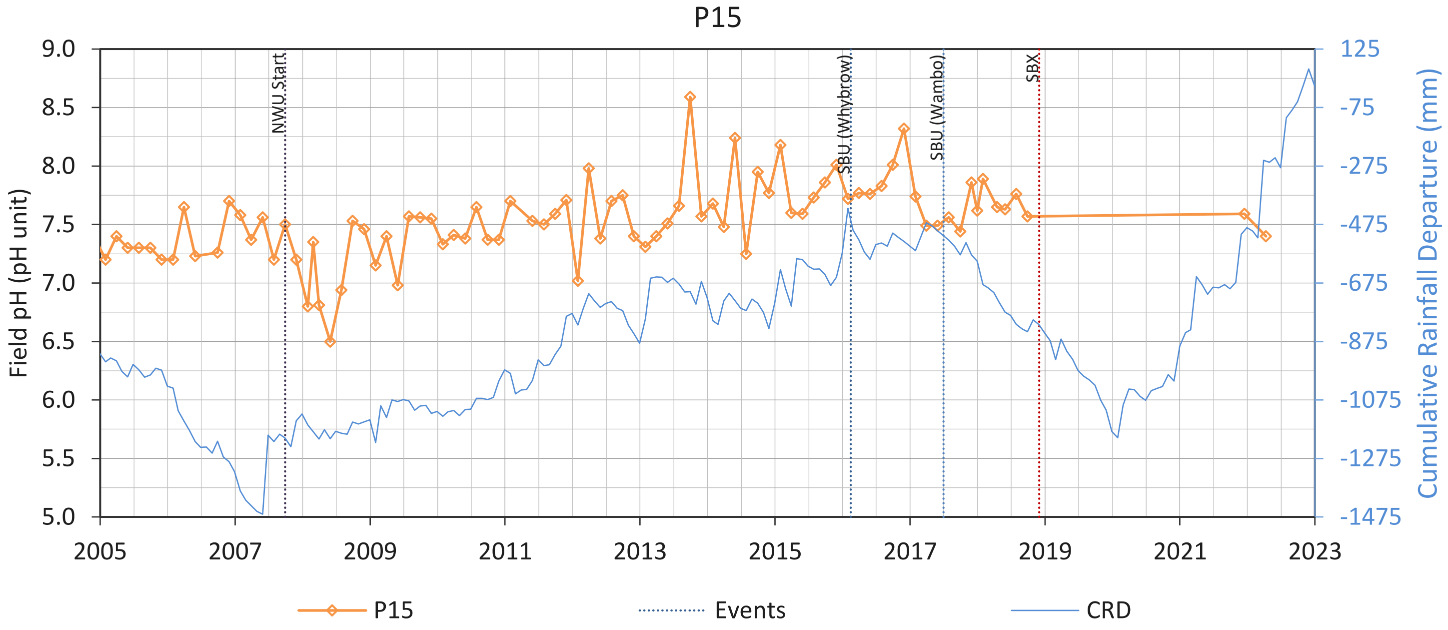

PNWU-08B
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-08B
Events
CRD

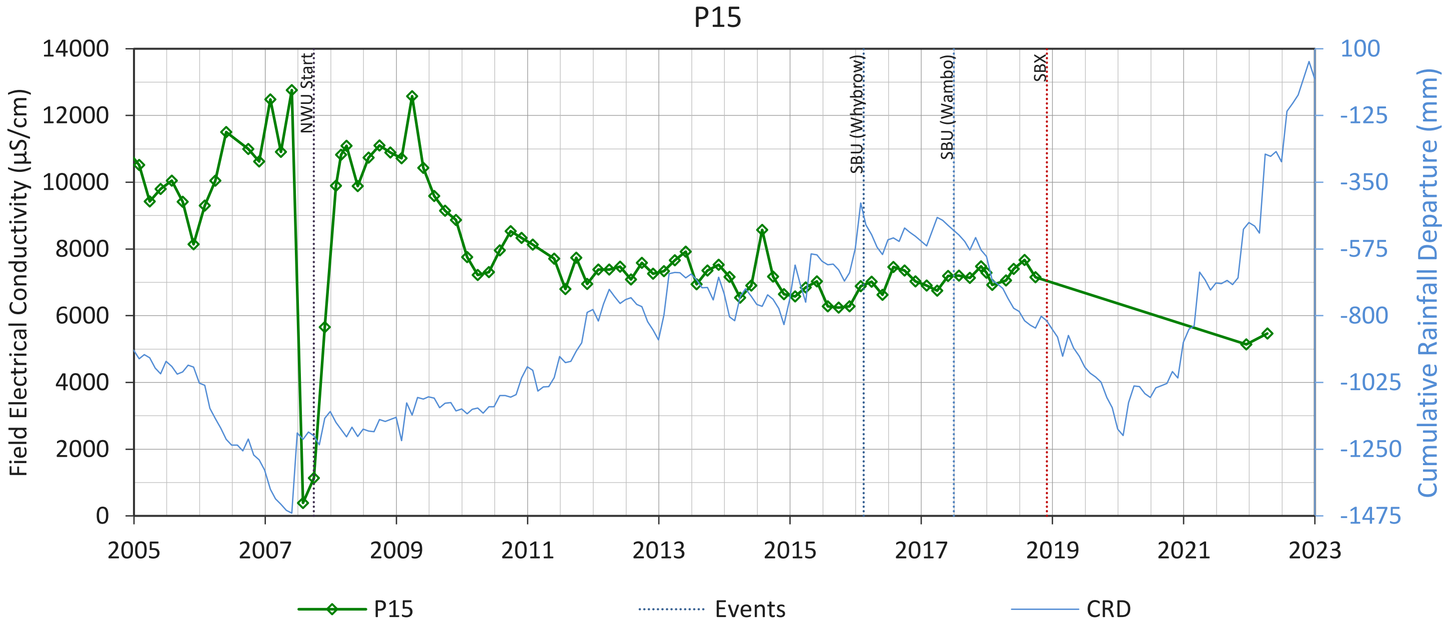

PNWU-10A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
55.5
55.0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-10A
Events
CRD

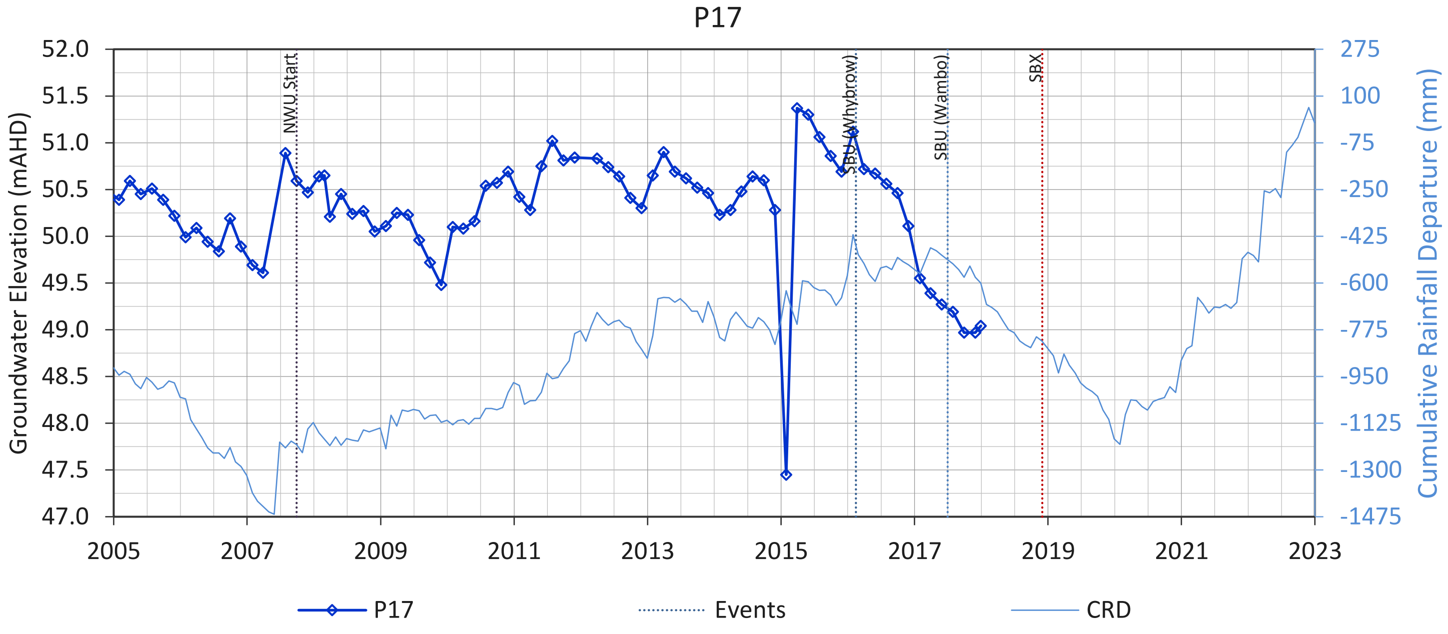

PNWU-10A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-10A
Events
CRD

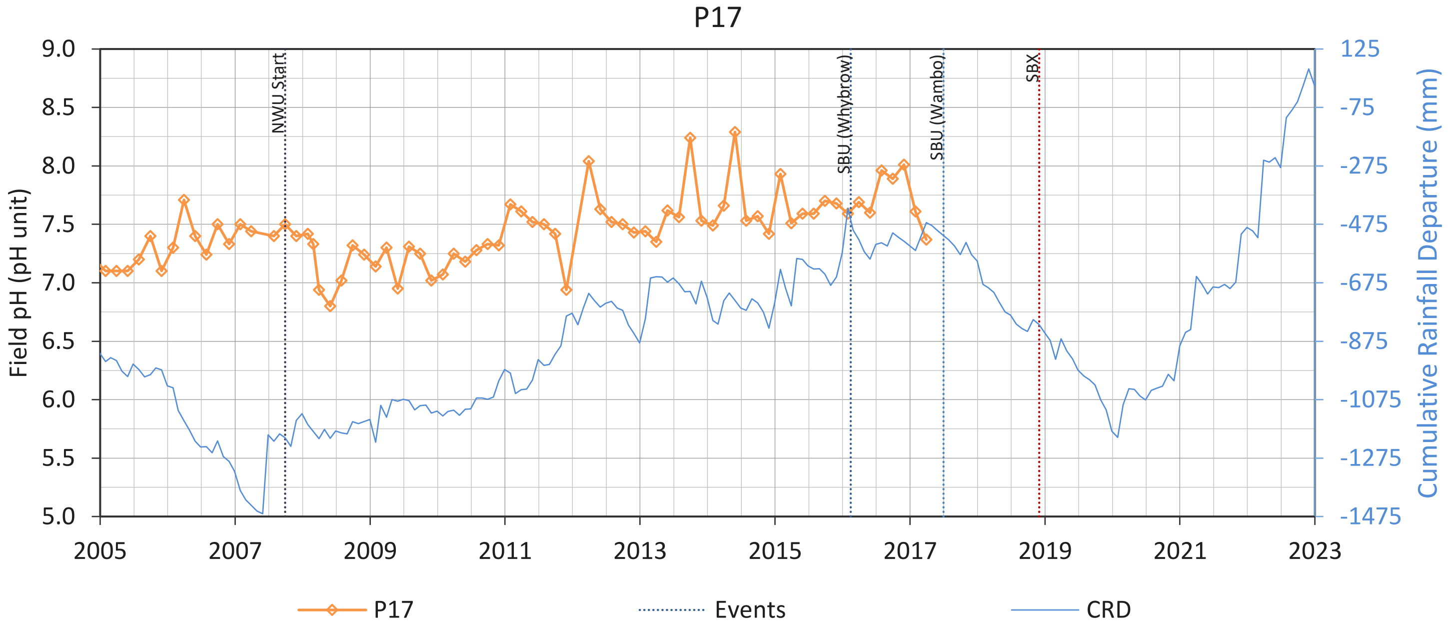

PNWU-10A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1000
900
800
700
600
500
400
300
200
100
0
275
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
PNWU-10A
Events
CRD

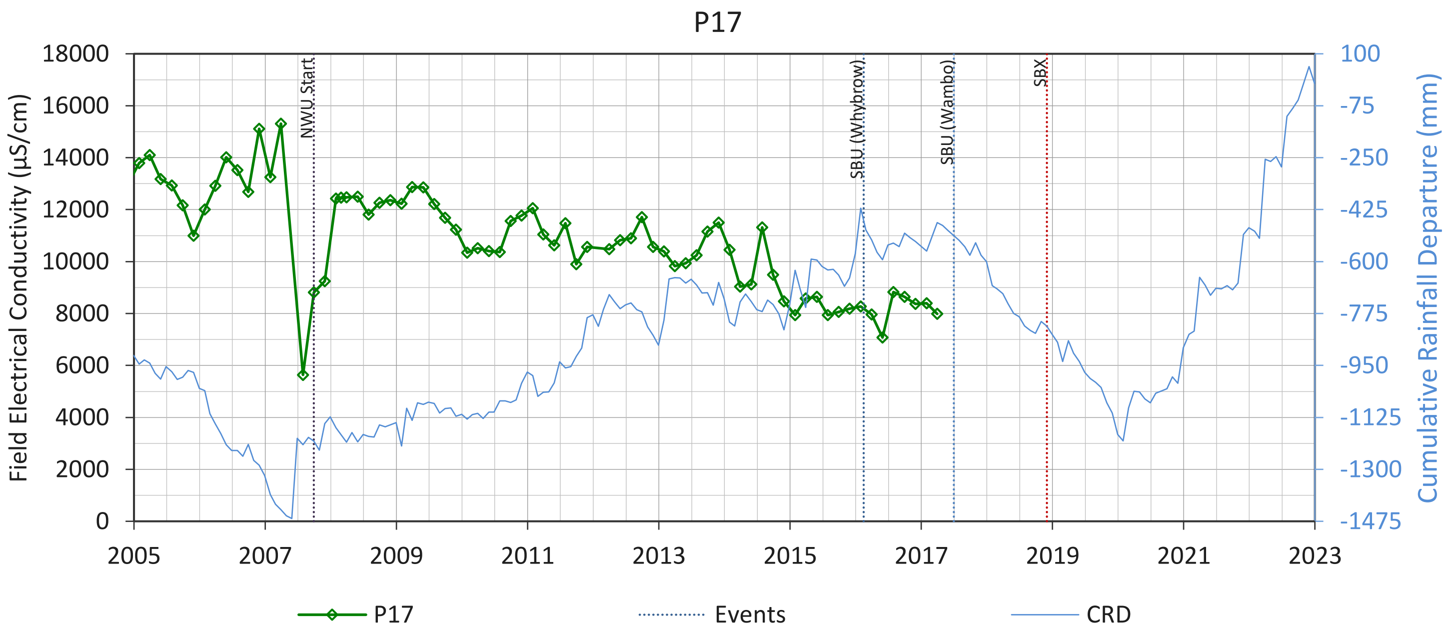

P15
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P15
Events
CRD

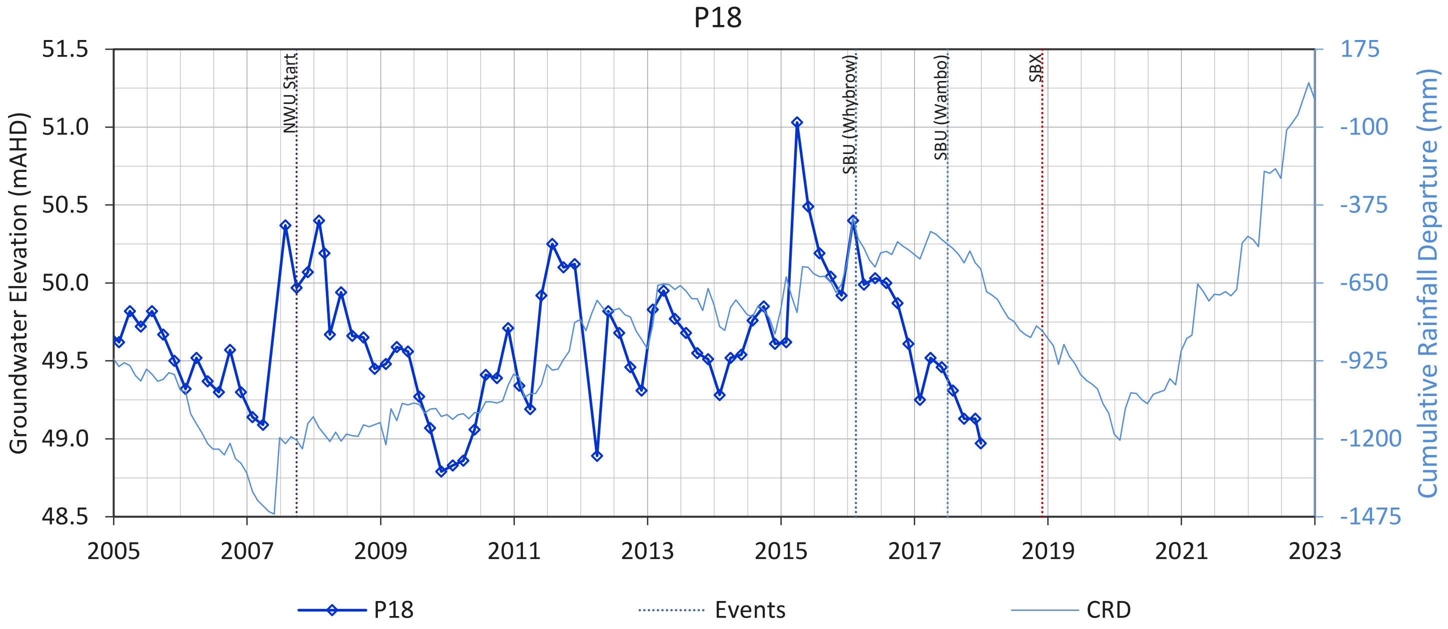

P15
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P15
Events
CRD

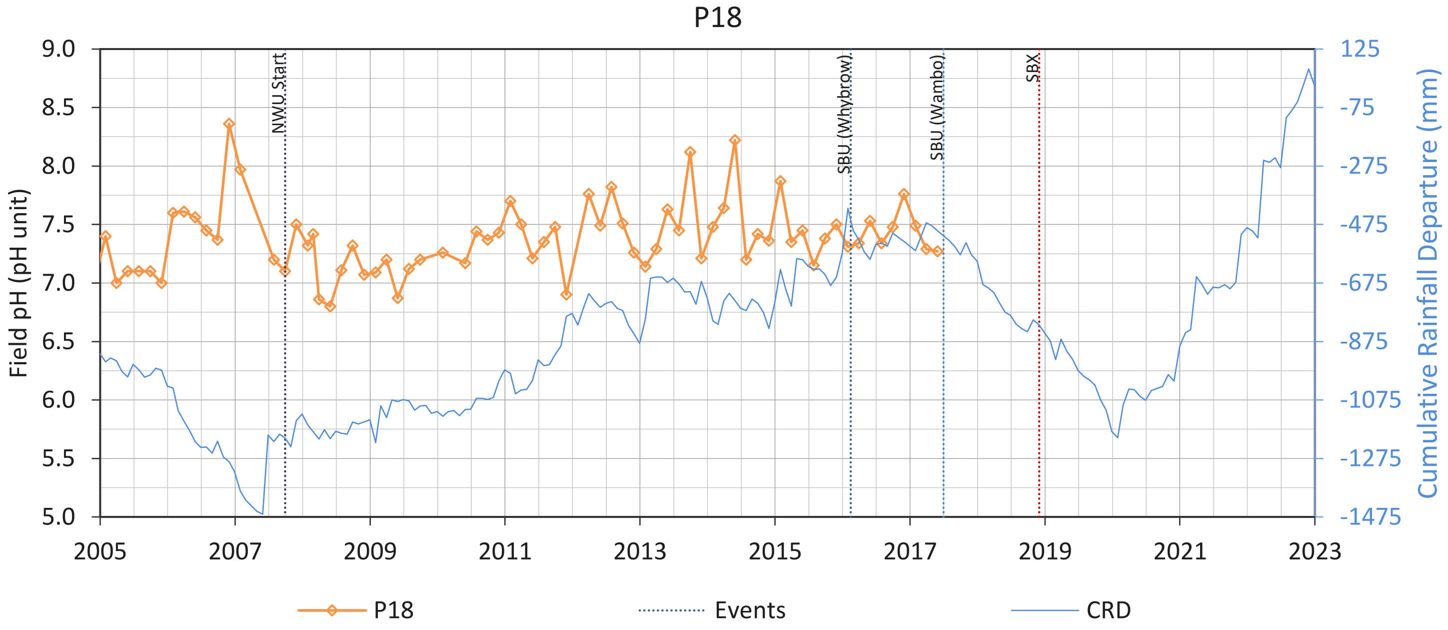

P15
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P15
Events
CRD

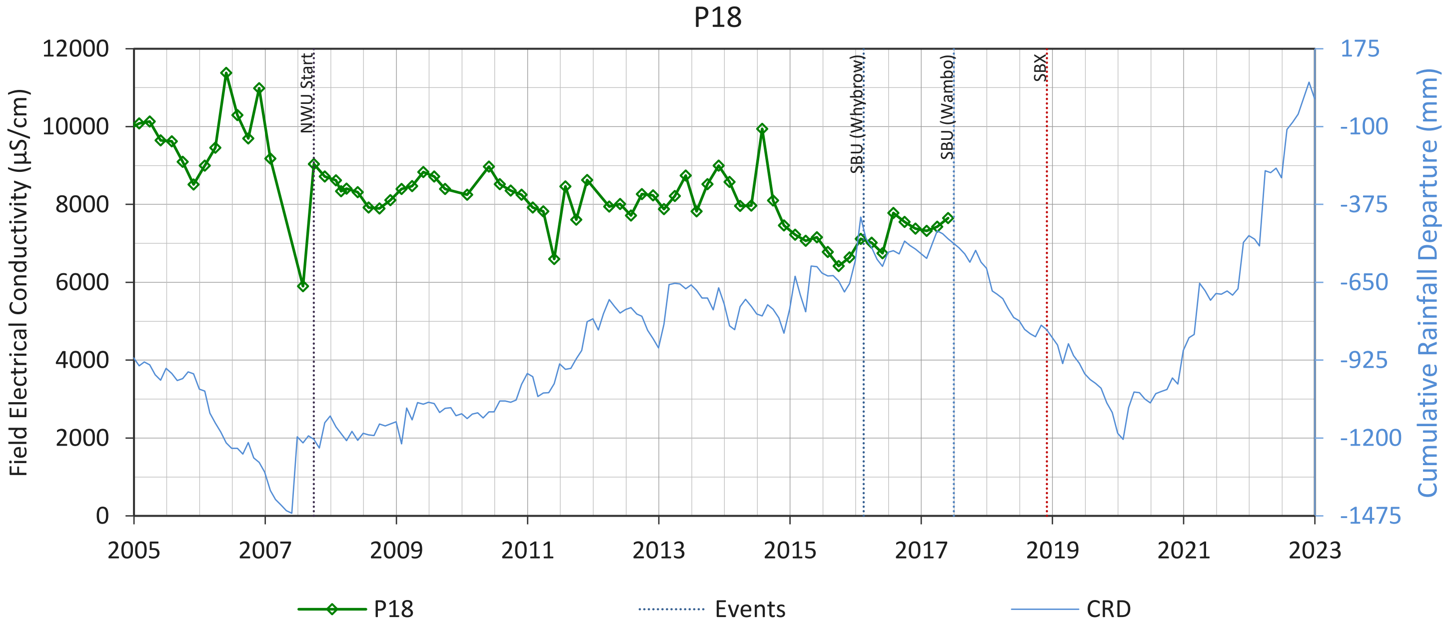

P17
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P17
Events
CRD

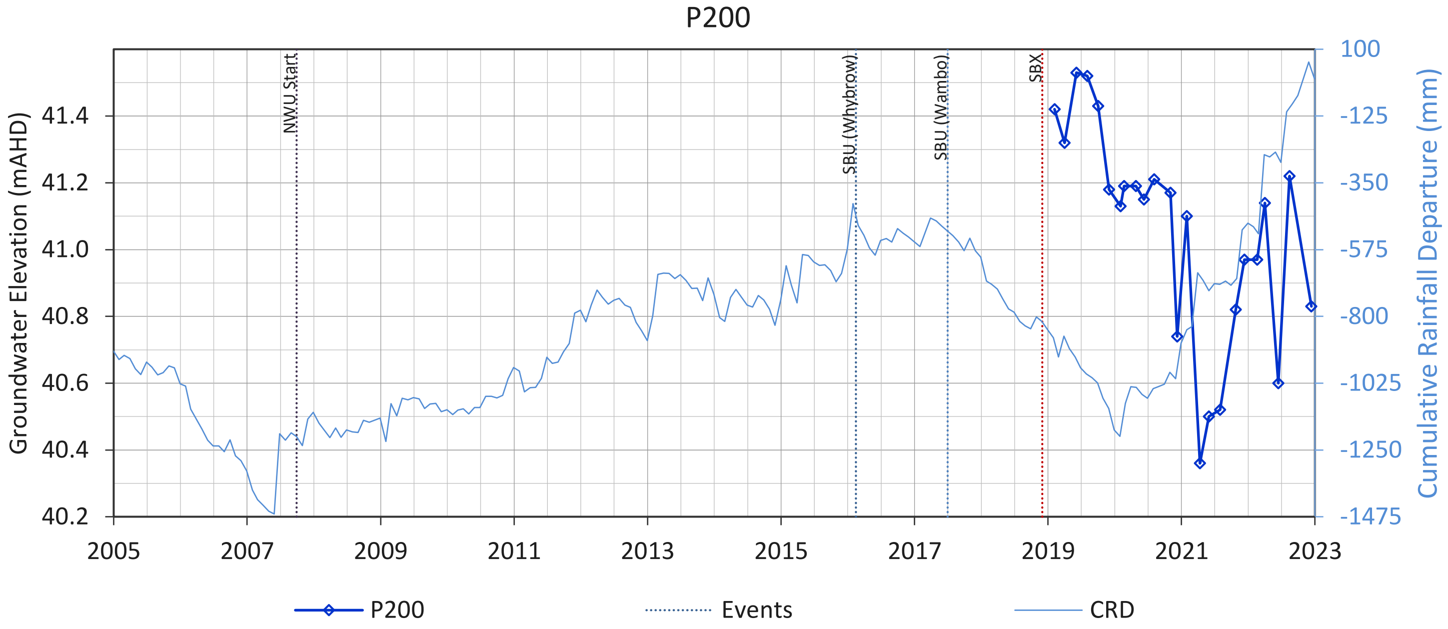

P17
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P17
Events
CRD

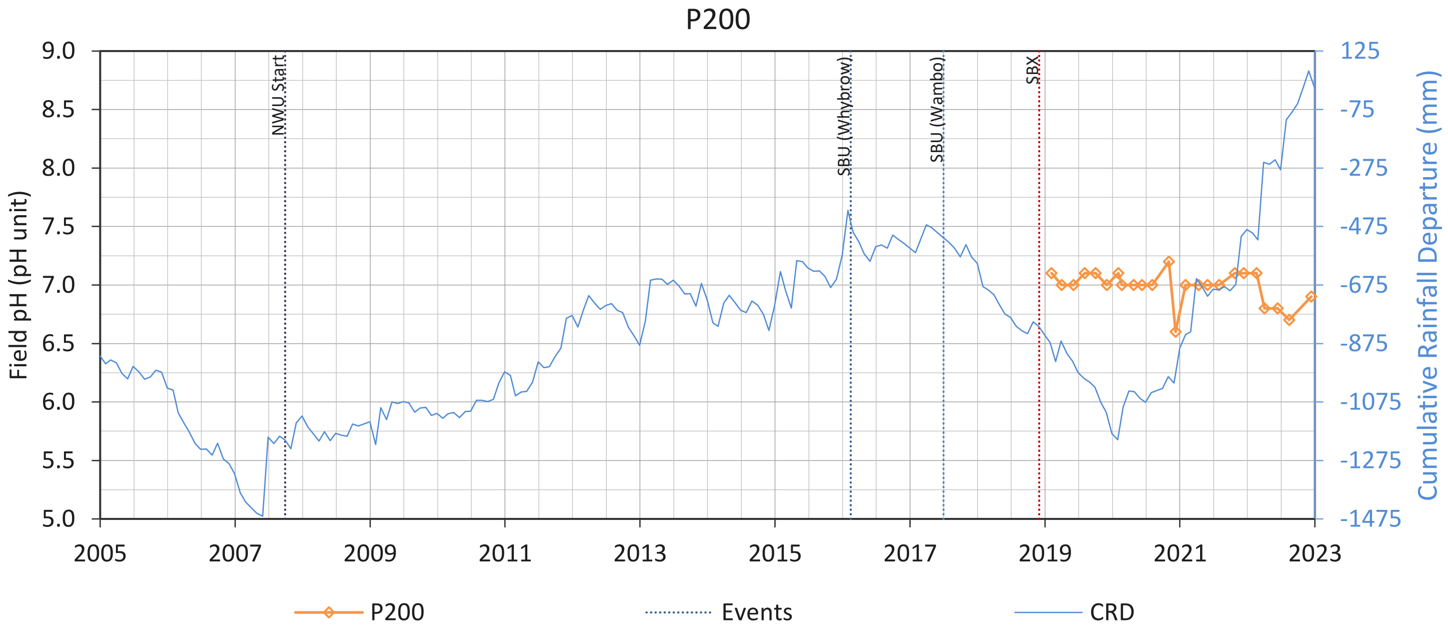

P17
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P17
Events
CRD

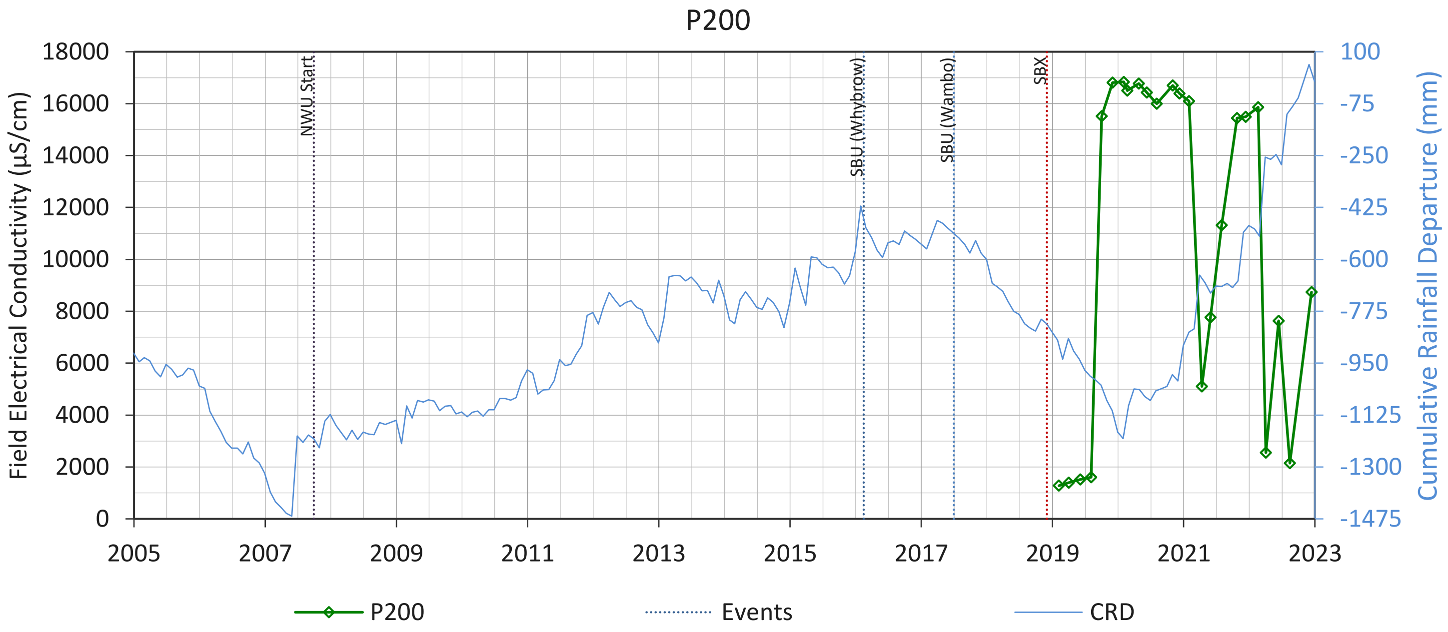

P18
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
51.5
51.0
50.5
50.0
49.5
49.0
48.5
175
-100
-375
-650
-925
-1200
-1475
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
P18
Events
CRD

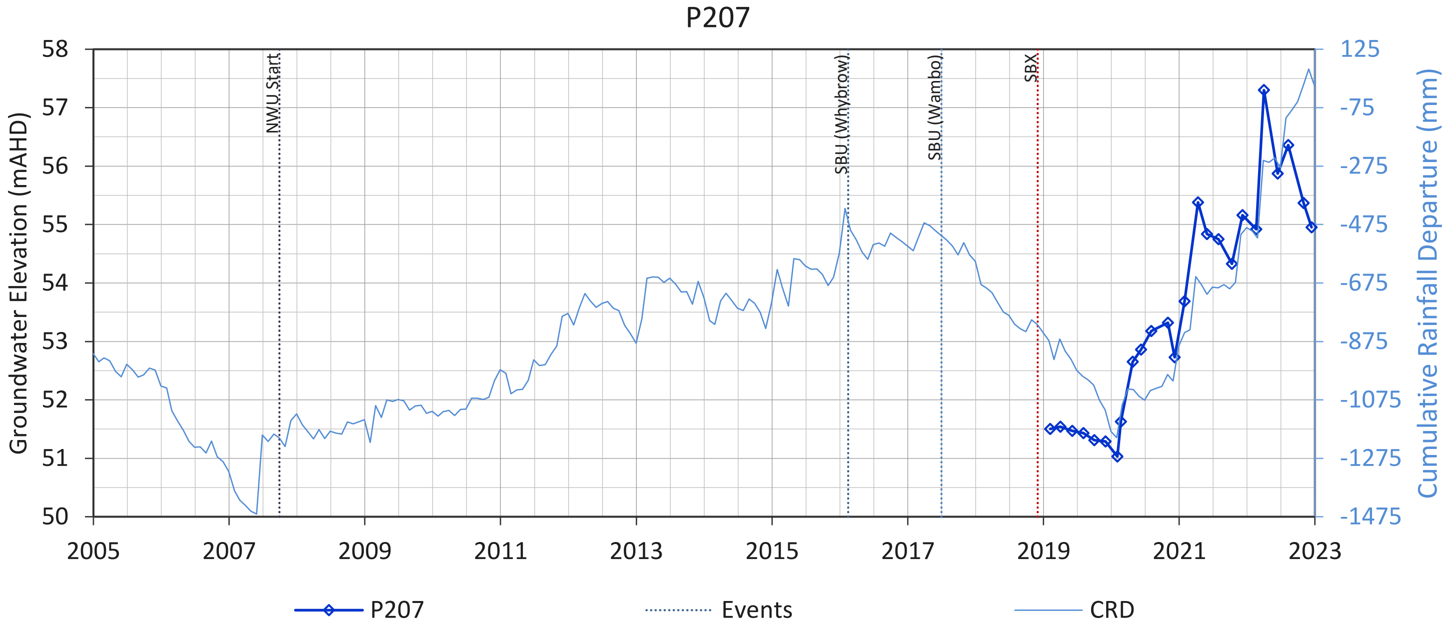

P18
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
P18
Events
CRD

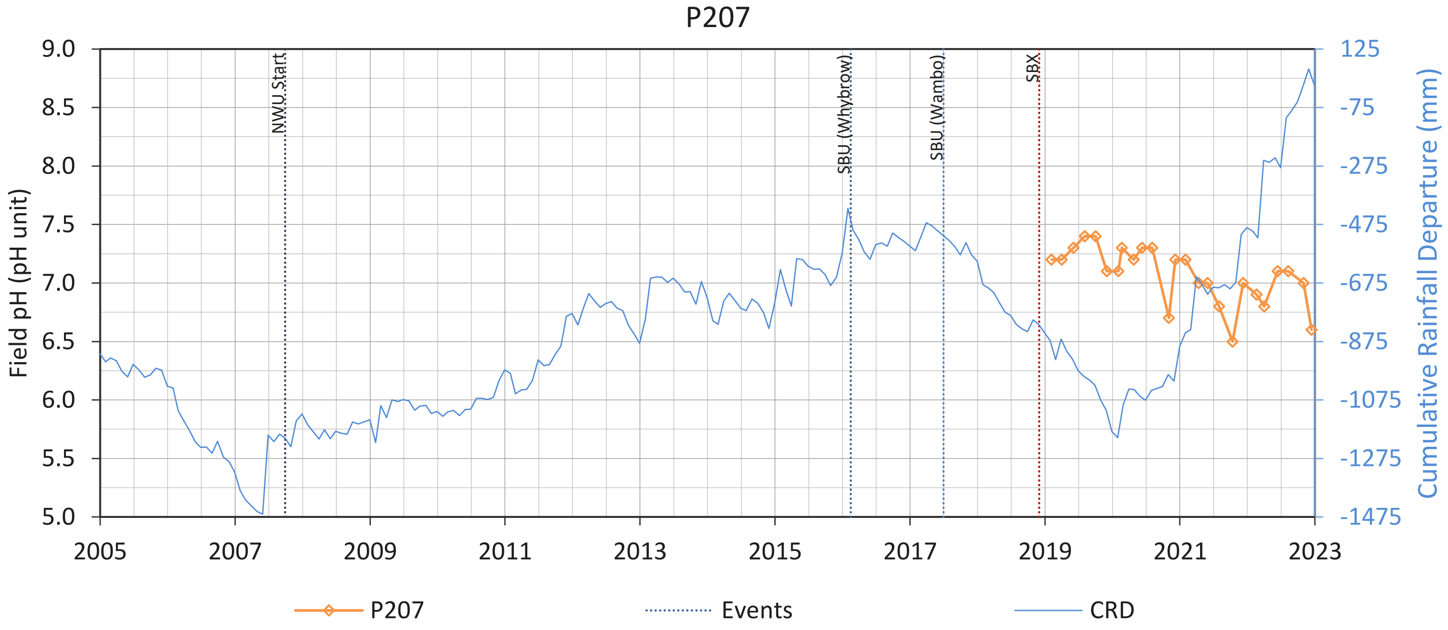

P18
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
12000
10000
8000
6000
4000
2000
0
175
-100
-375
-650
-925
-1200
-1475
2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
P18
Events
CRD

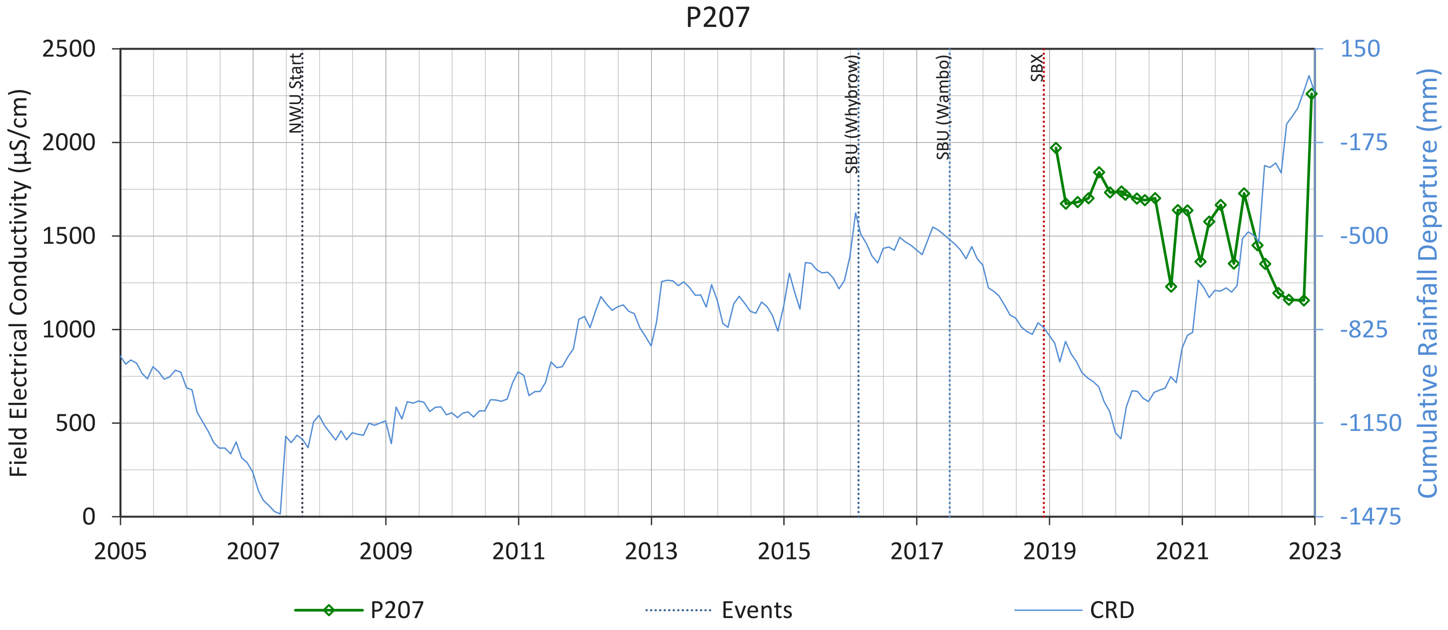

P200
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
41.4
41.2
41.0
40.8
40.6
40.4
40.2
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P200
Events
CRD

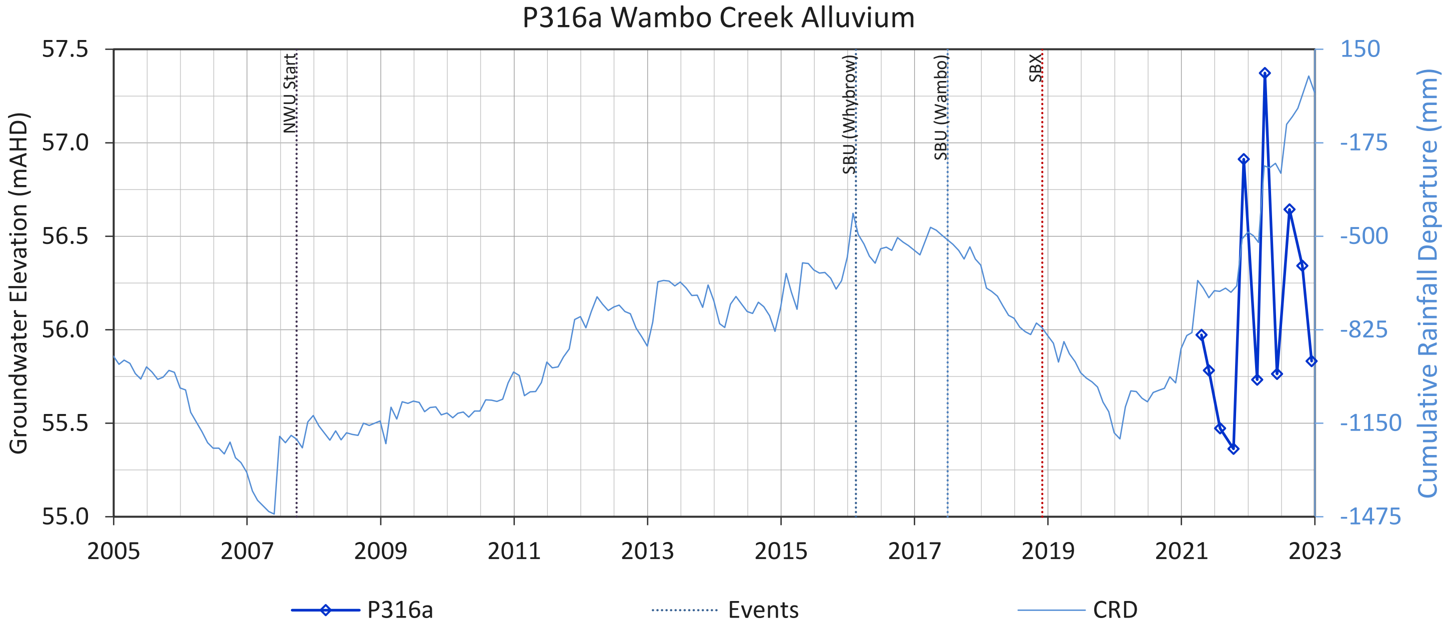

P200
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P200
Events
CRD

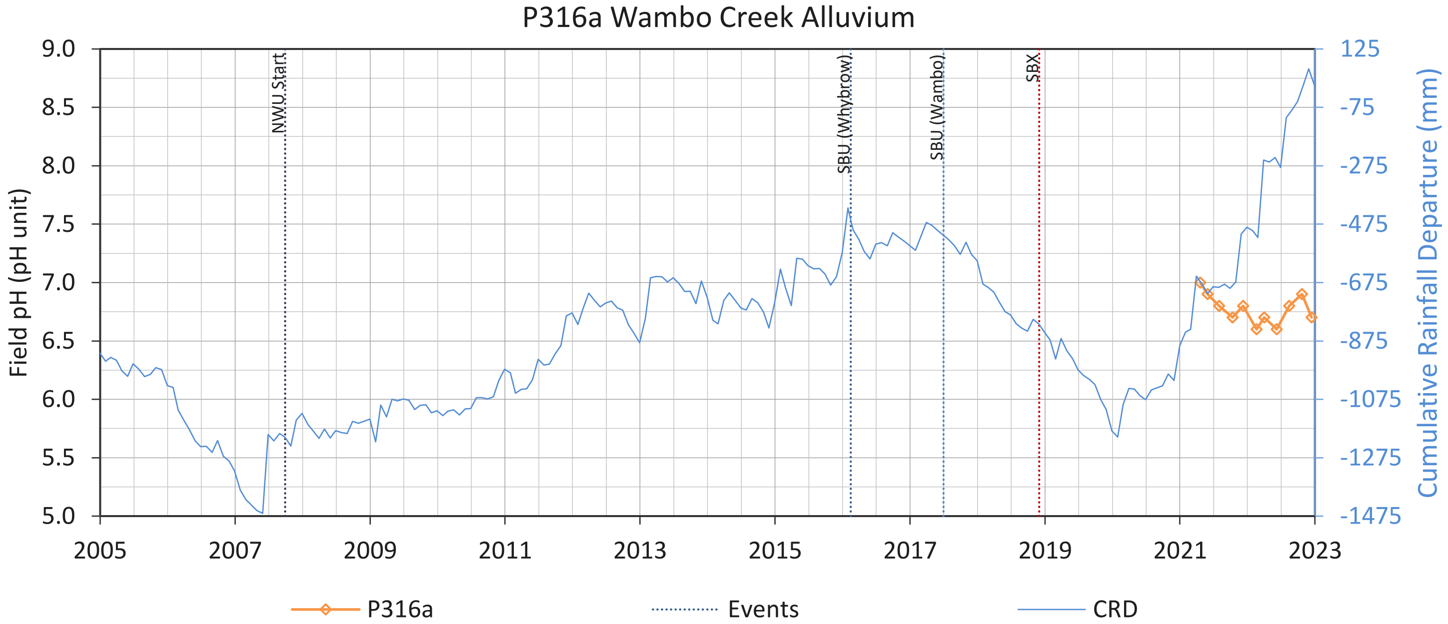

P200
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P200
Events
CRD

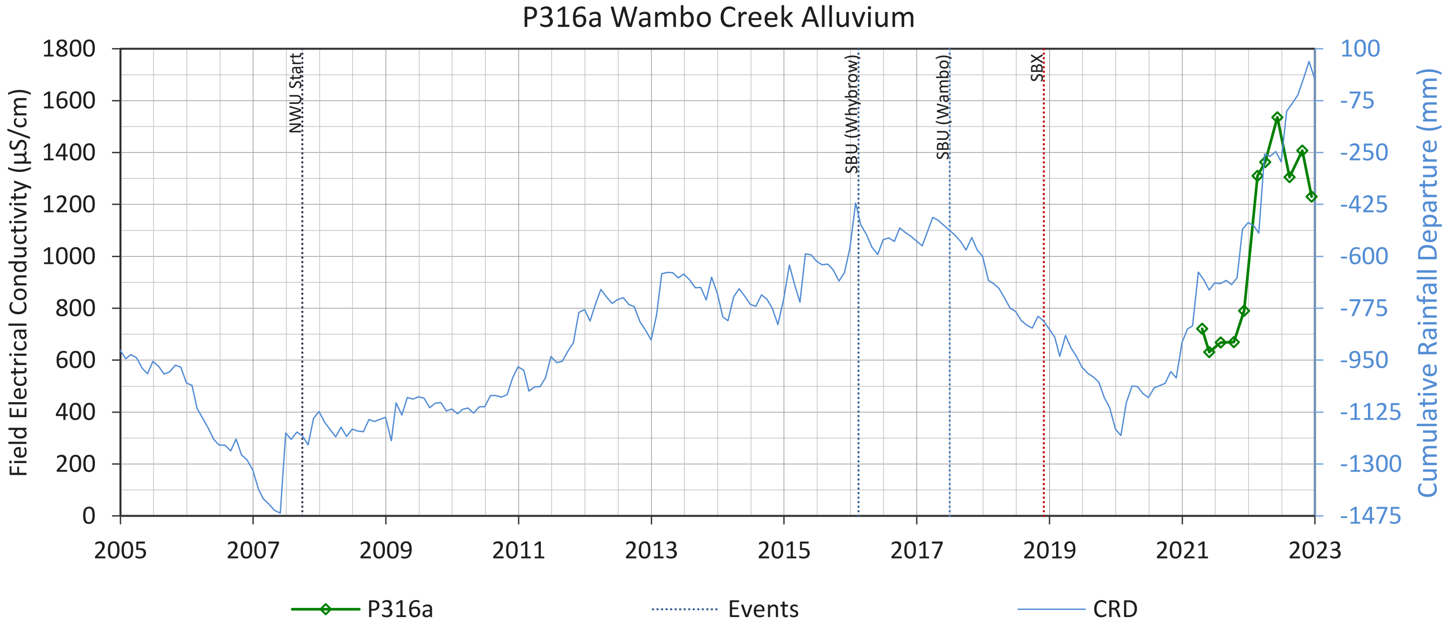

P207
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P207
Events
CRD

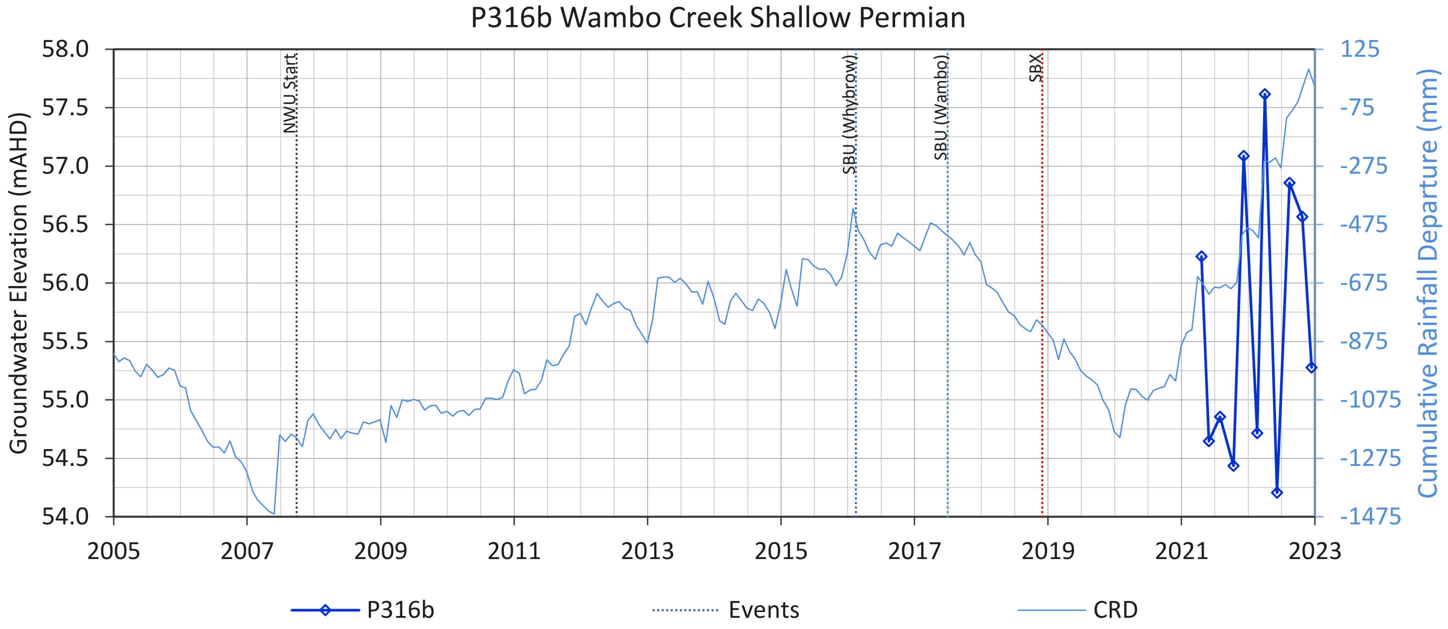

P207
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P207
Events
CRD

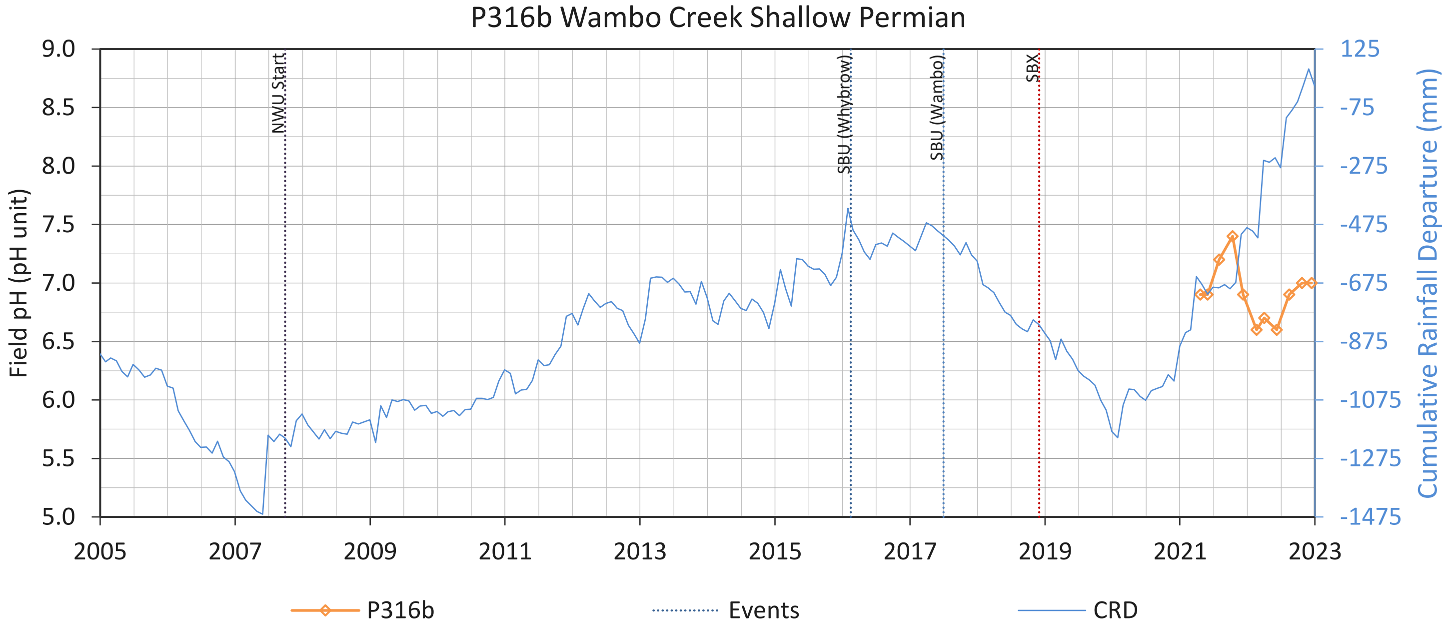

P207
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P207
Events
CRD

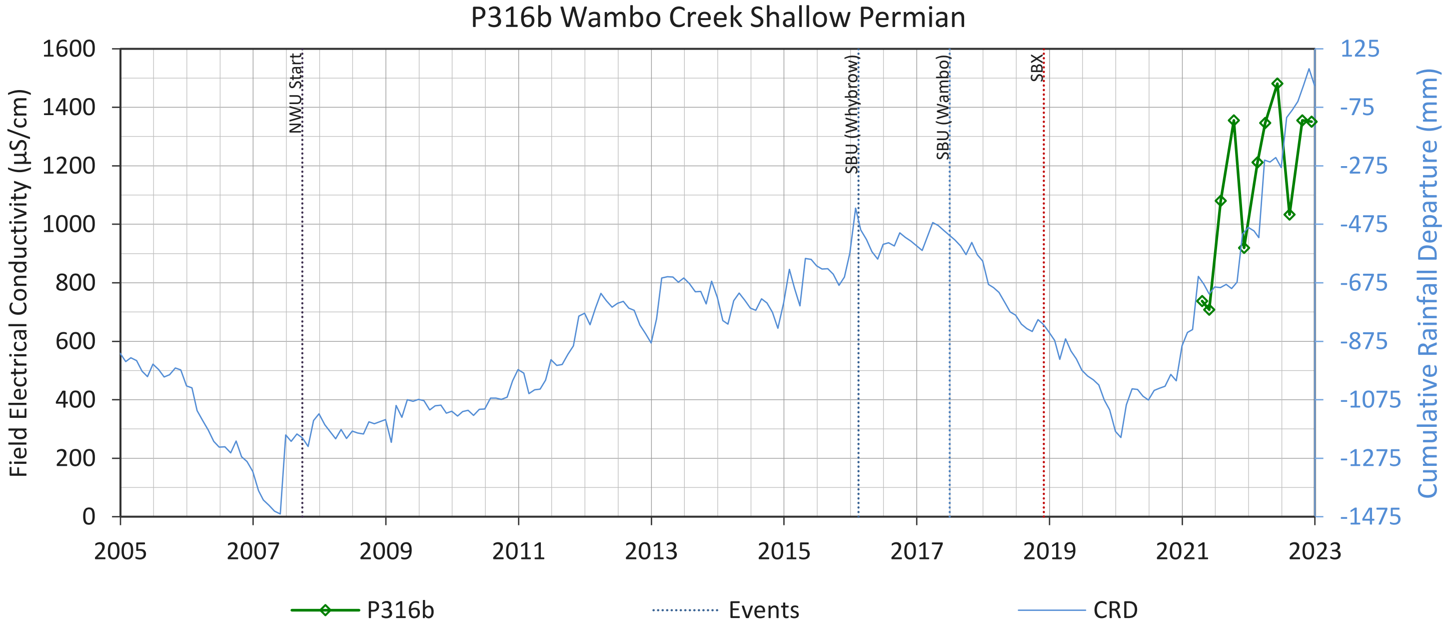

P316a Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
57.5
57.0
56.5
56.0
55.5
55.0
150
-175
-500
-825
-1150
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P316a
Events
CRD

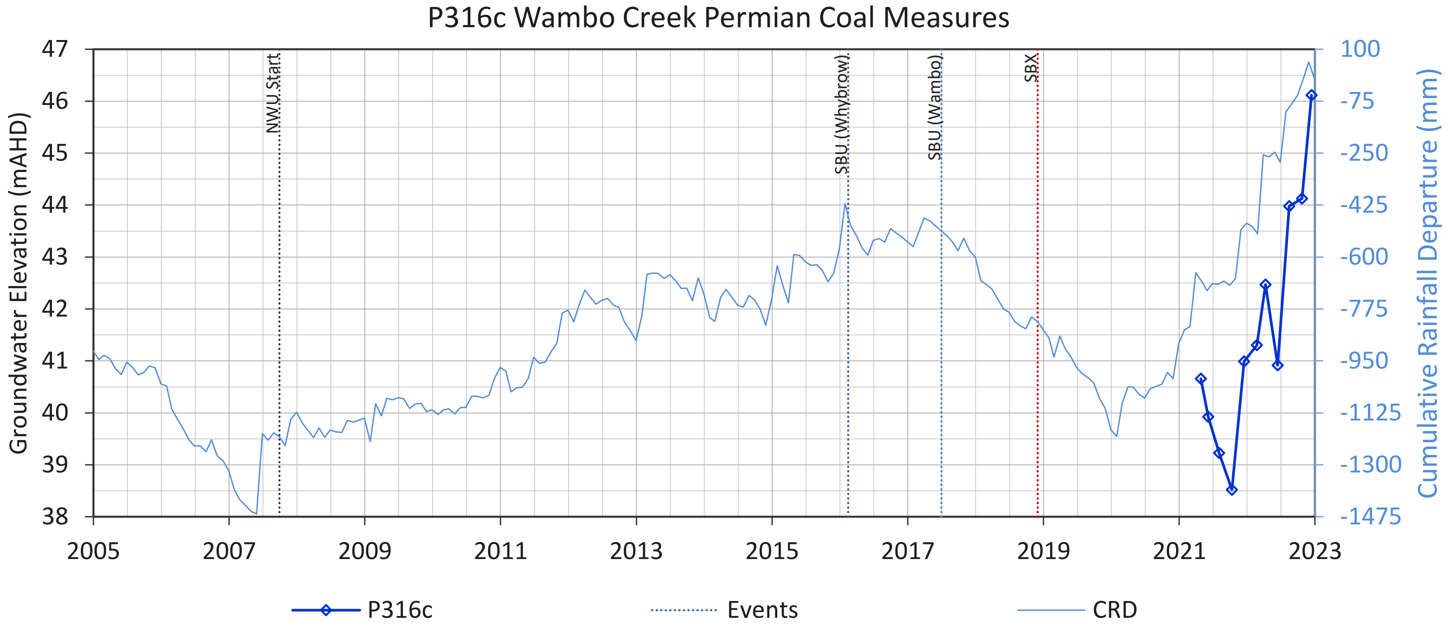

P316a Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P316a
Events
CRD

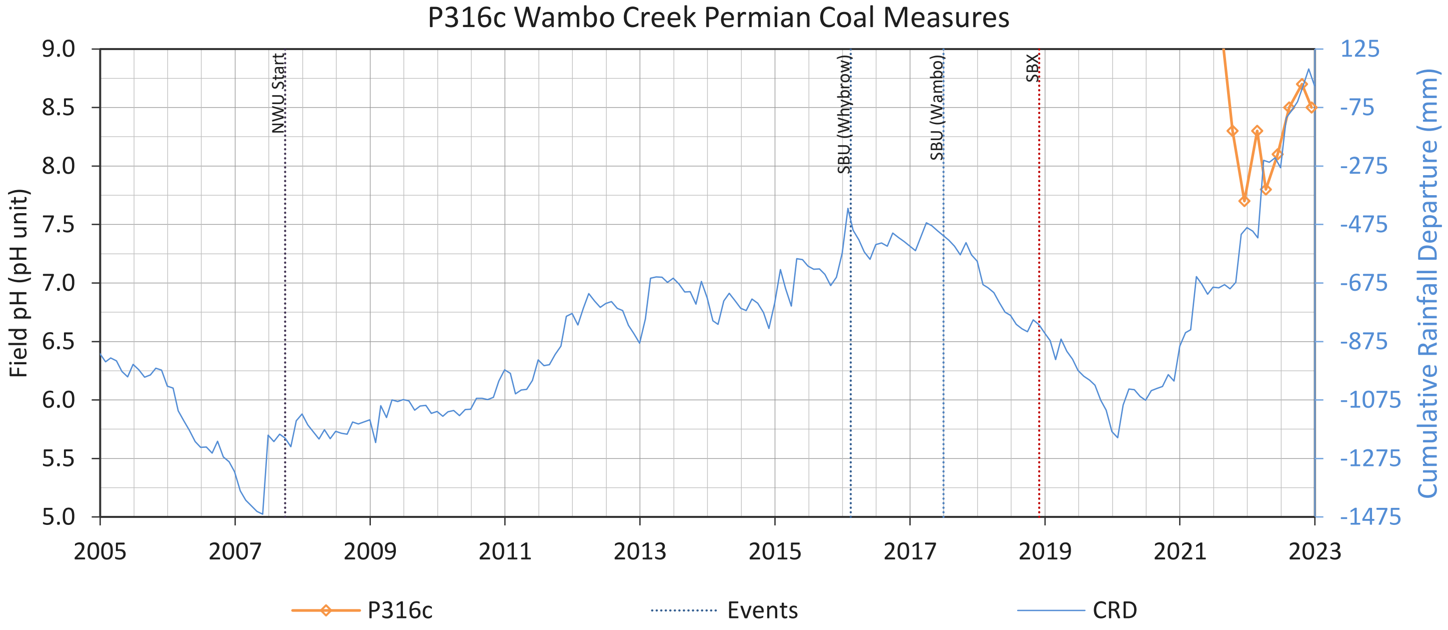

P316a Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
1800
1600
1400
1200
1000
800
600
400
200
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
P316a
Events
CRD

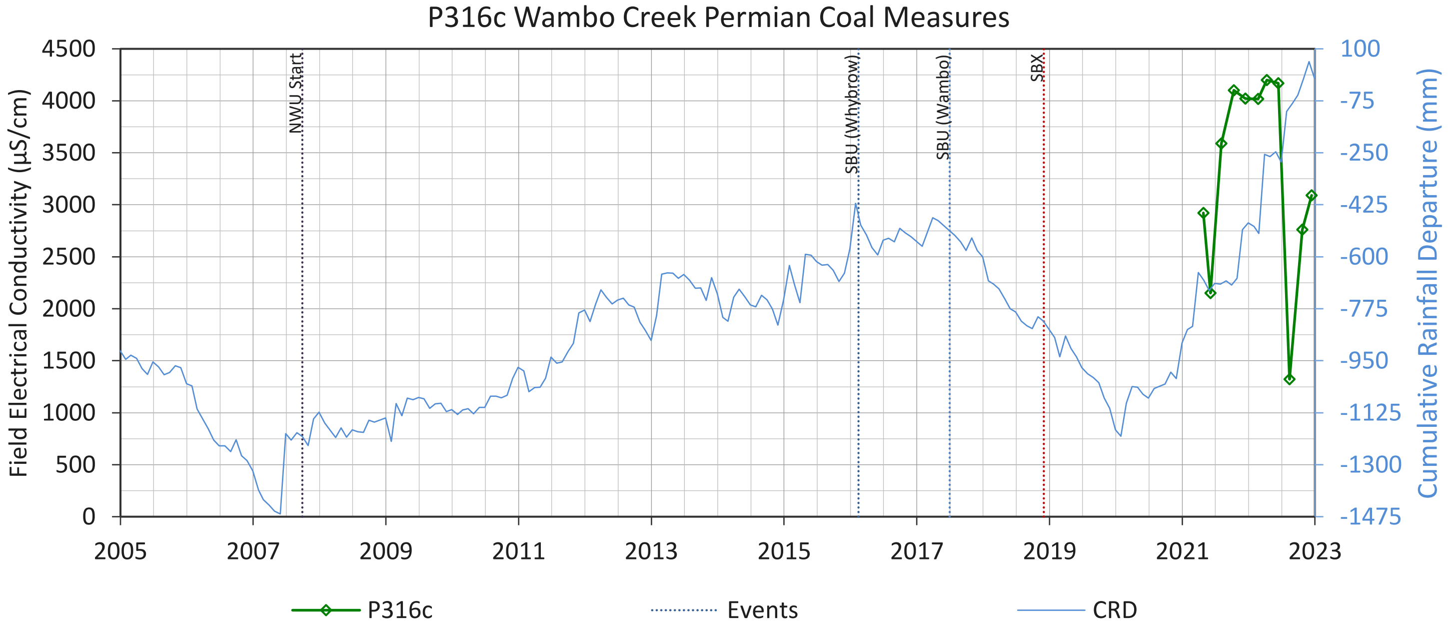

P316b Wambo Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316b
Events
CRD

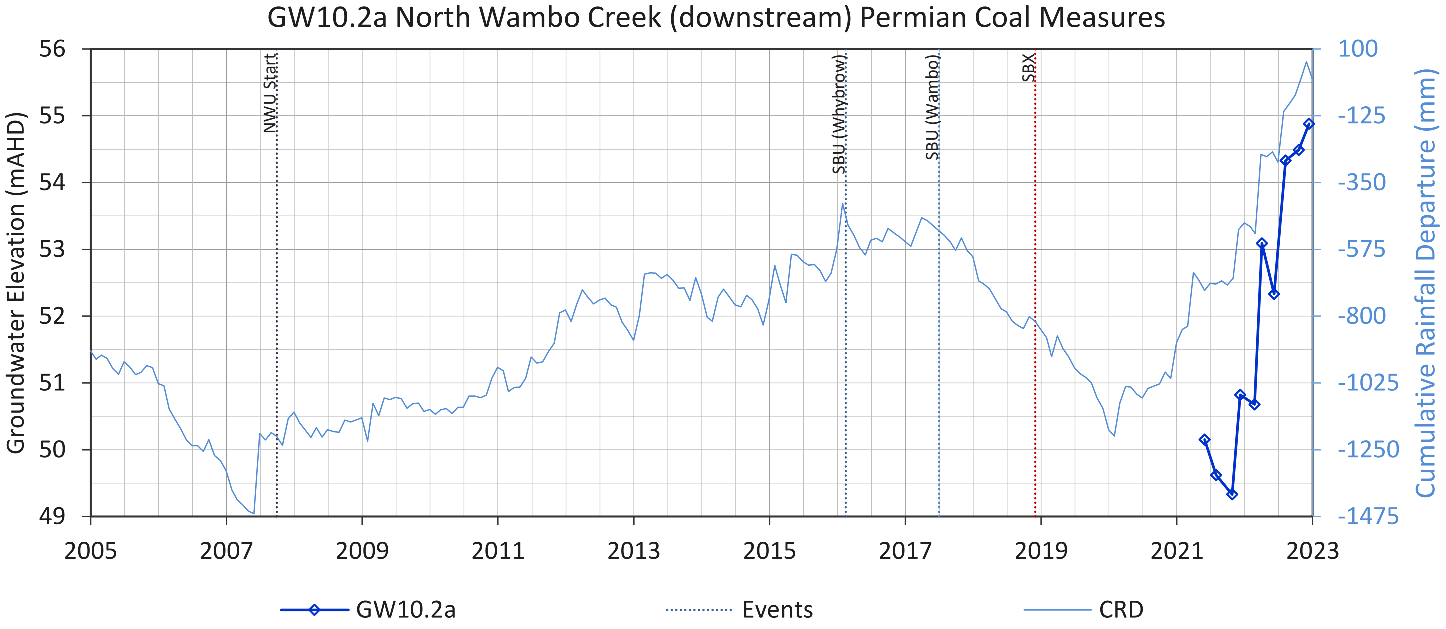

P316b Wambo Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316b
Events
CRD

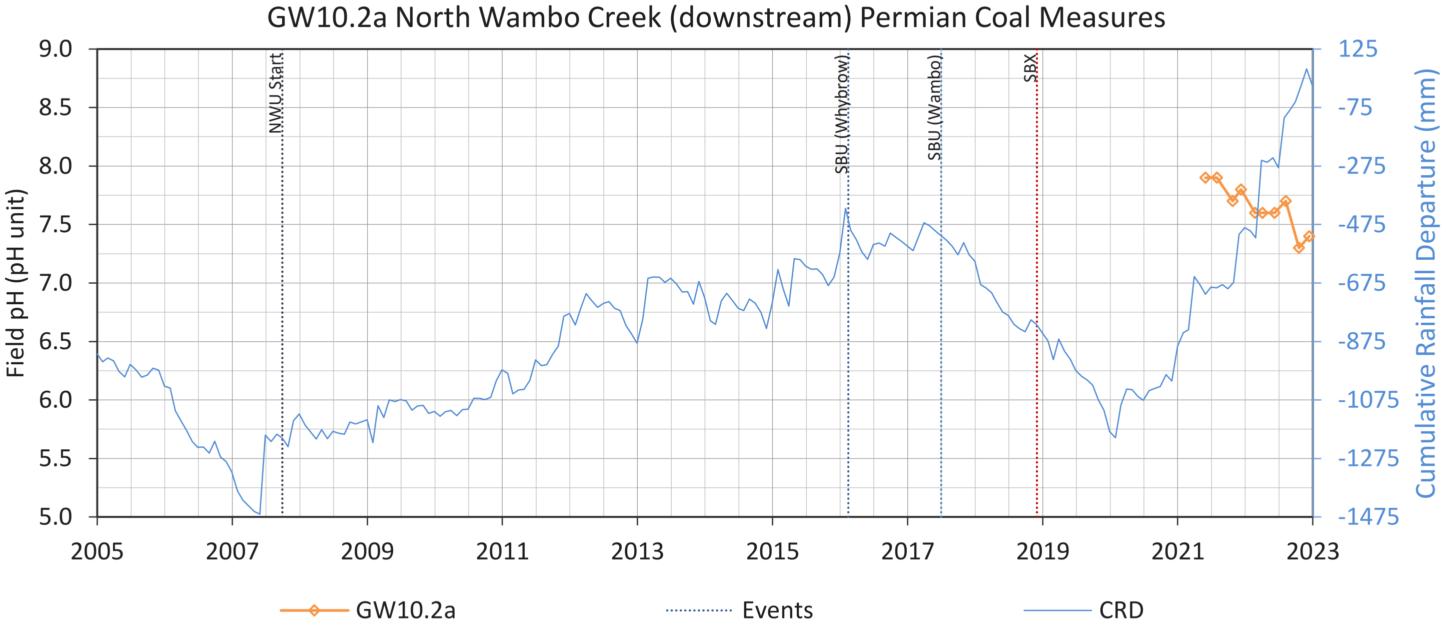

P316b Wambo Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316b
Events
CRD

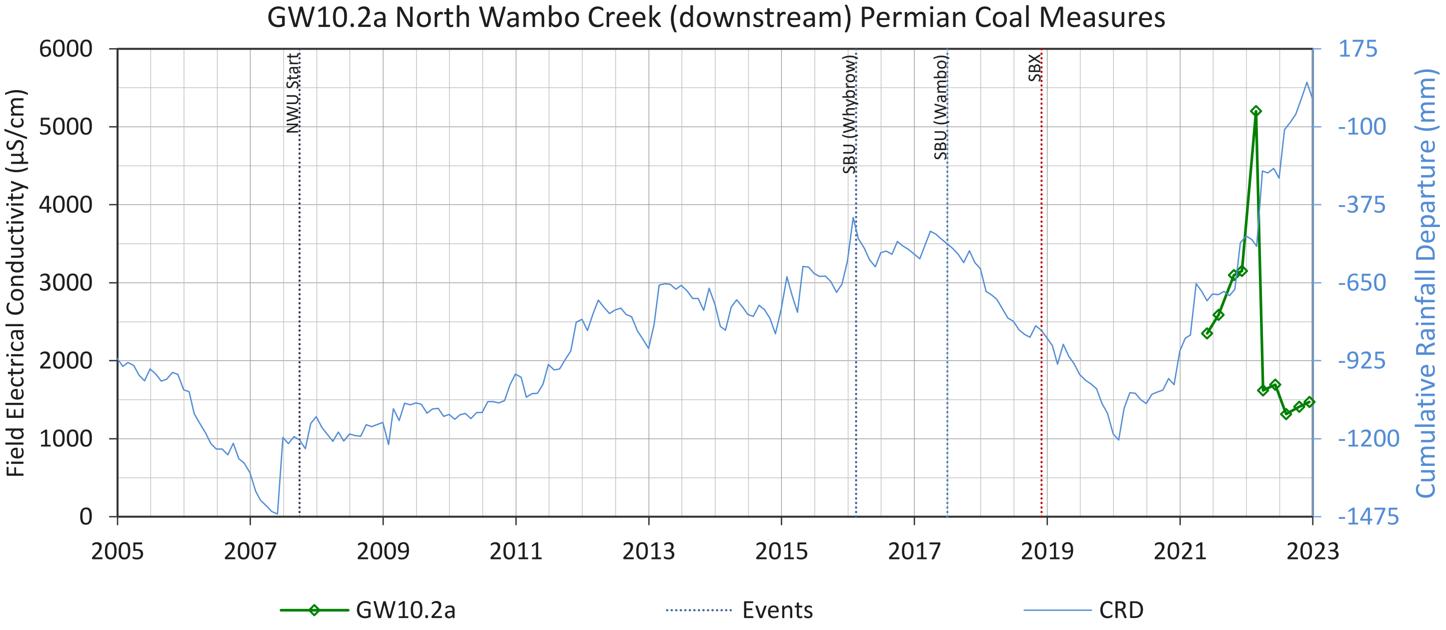

P316c Wambo Creek Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
47
46
45
44
43
42
41
40
39
38
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD


P316c Wambo Creek Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD


P316c Wambo Creek Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
100
-75
-250
-425
-600
-775
-950
-1125
-1300
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD


GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
56
55
54
53
52
51
50
49
100
-125
-350
-575
-800
-1025
-1250
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2a
Events
CRD


GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
125
-75
-275
-475
-675
-875
-1075
-1275
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2a
Events
CRD


GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
6000
5000
4000
3000
2000
1000
0
175
-100
-375
-650
-925
-1200
-1475
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
GW10.2a
Events
CRD

APPENDIX C

Vibrating Wire Piezometers – Data Quality Assessment

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mBGL)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
EX06	P321	307999	6399498	110.39	31.8	78.6	Arrowfield Seam	No data since 2019
					72.1	38.3	Warkworth Seam	ok
					161.2	-50.8	Vaux Seam	ok
					187.8	-77.4	Bayswater Seam	ok
SW64	P319	311121	6391412	64.4	11.0	53.4	Regolith	Sensor dry - all obs
					74.9	-10.5	Whybrow Seam	Sensor dry - all obs
					161.3	-96.9	Wambo Seam	ok
					265.3	-200.9	Interburden Sandstone	ok
SW30	P325	312068	6390138	65.2	10.5	54.7	Regolith	ok
					32.5	32.7	Permian Overburden	No data since 21/7/2019
					82.0	-16.8	Whybrow Seam	No data since 27/7/2018
					159.5	-94.3	Wambo Seam	No data since 27/7/2018
					203.0	-137.8	Whynot Seam	ok
					251.5	-186.3	Woodlands Hill Seam	ok
					336.5	-271.3	Arrowfield Seam	ok
P408	P408	307000	6399500	74.62	138.8	-64.1	Vaux Seam	No data after 8/6/2019
					187.0	-112.4	Bayswater Seam	ok
					223.8	-149.1	Pikes Gully Seam	ok

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mBGL)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
WJ175	P320	307573	6398890	85.86	344.0	-258.1	Middle Barret Seam	No data after 7/5/2022
					305.0	-219.1	Lower Arties Seam	No data after 17/4/2022
					263.0	-177.1	Pikes Gully Seam	No data after 16/4/2022
					217.5	-131.6	Bayswater Seam	No data after 16/7/2022
					191.0	-105.1	Vaux Seam	No data after 19/5/2022
					92.0	-6.1	Warkworth Seam	No data after 26/5/2022
SW65	P324	310471	6391983	74.44	11.5	62.9	Regolith	sensor dry – all obs
					95.8	-21.3	Whybrow Seam	sensor dry – all obs
					157.0	-82.6	Wambo Seam	sensor near-dry
					269.8	-195.3	Woodlands Hill Seam	ok
					304.5	-230.1	Interburden	ok
SW62	P326	310087	6392874	75.48	43.0	32.5	Overburden	Ok
					113.5	-38.0	Wambo Seam	ok
					234.0	-158.5	Woodlands Hill Seam	ok
					294.5	-219.0	Arrowfield Seam	ok
SW28	P318	312599	6388922	71.05	11.0	60.1	Regolith	Sensor dry
					150.8	-79.7	Whybrow Seam	ok
					205.3	-134.2	Wambo Seam	ok
					314.3	-243.2	Woodlands Hill Seam	ok
					357.0	-286.0	Arrowfield Seam	ok
SW12	P323	309798	6393429	76.64	23.0	53.6	Overburden siltstone	sensor near-dry
					33.0	43.6	Whybrow Seam	sensor near-dry
					85.5	-8.9	Wambo Seam	ok
					224.5	-147.9	Woodlands Hill Seam	ok
					273.5	-196.9	Arrowfield Seam	ok
ELA3	P307	302941	6399995	141.25	65.3	76.0	Overburden sandstone	ok
					228.3	-87.0	Whybrow Seam	ok

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mBGL)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
					301.1	-159.8	Wambo Seam	ok
					332.5	-191.2	Whynot Seam	ok
P114_116	P316	311252	6391128	60.39	10.0	50.5	Alluvium	WL below sensor - all obs
					25.0	35.5	Regolith	Ok – all sensors missing 25/1/22-29/11/22
					50.6	9.8	Regolith-overburden	WL below sensor - all obs
					71.0	-10.6	Whybrow Seam	WL below sensor - all obs
Hunter 1	P329	307454	6400351	72.42	67.6	4.8	Vaux Seam	Ok: missing data (21/10/22-28/11/22)
					87.4	-15.0	Vaux Seam	Ok: missing data (21/10/22-28/11/22)
					117.5	-45.1	Bayswater Seam	Ok: missing data (11/9/22-28/11/22)
					150.5	-78.1	Pikes Gully Seam	Ok: missing data (11/9/22-28/11/22)
Hunter 2	P330	306533	6400050	73.62	67.0	6.6	Vaux Seam	Ok: no data 2022, back online in 2023
					137.3	-63.6	Vaux Seam	ok
					201.5	-127.9	Pikes Gully Seam	ok
P317	P317	307115	6394439	155.41	248.5	-93.1	Wambo Seam	No data since 2019
					213.0	-57.6	Wambo Rider Seam	No data since 2019
					174.0	-18.6	Whybrow Seam	No data since 2019
					100.0	55.4	Overburden	No data for short period in 2020, data ok otherwise
					35.0	120.4	Regolith	ok – near dry
ELA5	P328	303160	6398870	131.89	43.0	88.9	Overburden	ok
					275.0	-143.1	Whybrow Seam	Poor quality data from sensors - all obs
					350.0	-218.1	Wambo Seam	ok
					388.0	-256.1	Whynot Seam	Variable data in 2022
SW06	P322	312572	6395026	110.13	56.0	54.1	Regolith	No 2022 data
					65.0	45.1	Whynot Seam	
					128.0	-17.9	Whynot – Woodlands Hill Interburden	

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mBGL)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
N5	N5	306753	6395960	110.78	133.0	-22.2	Permian Overburden	ok
					89.5	21.3	Whybrow Seam	ok
					73.0	37.8	Interburden	ok
					30.0	80.8	Wambo Seam	ok
N3	N3	308313	6394574	104.968	190.0	-85.0	Permian Overburden	Sensor dry
					142.0	-37.0	Permian Overburden	Unreliable data since 2018
					108.5	-3.5	Permian Overburden	Unreliable data since 2016
					75.0	30.0	Whybrow Seam	Unreliable data since 2016
					55.0	50.0	Interburden	Unreliable data since 2016
N2	N2	308633	6393372	122.52	204.0	-81.5	Permian Overburden	WL below sensor from mid-2015
					172.5	-50.0	Permian Overburden	WL below sensor from Sept 2016
					140.0	-17.5	Permian Overburden	WL below sensor from Apr 2017
					100.0	22.5	Whybrow Seam	Ok
					70.0	52.5	Interburden	Ok
					40.0	82.5	Wambo Seam	ok
SBX_20 GW01	SBX_GW01	307009	6395884	107.9	43	65.0		Data ok to late 2021 – missing 2022
SBX_20 GW01	SBX_GW02	306909	6395939	108.9	65.8	43.1		Data ok to late 2021 – missing 2022
					61.7	47.2		
					53.7	55.2		
MG08-01 (Unlabelled)	MG08-01	311054	6392670	65.35	9.0	56.4	Alluvium	
					37.0	28.4	Permian	
					46.0	19.4	Whybrow Seam	
					60.0	5.4	Interburden	
					77.3	-12.0	Redbank Seam	
					90.0	-24.7	Interburden	
					101.0	-35.7	Wambo Seam	

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mBGL)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
MG08-01 (Incorrect)	MG08-01	311618	6392876	66			4 sensors at site – installation data unavailable. Naming incorrect – not consistent with MG08 install report	
MG09-01	MG09-01	310539	6391186	69.75	9.0	60.8	Alluvium	pressure below sensor for all obs sensors failed Oct 2014
					30.0	39.8	Permian Upper	
					60.0	9.8	Permian Lower	
					103.0	-33.3	Whybrow Seam	
					130.0	-60.3	Interburden	
					153.0	-83.3	Redbank Seam	
					170.0	-100.3	Interburden	
					192.0	-122.3	Wambo Seam	
Unknown Fenwick	U/ Fenwick	310636	6390994	70				5 Sensors - no data
GW20	GW20	309075	6393949	91.31	9.3	82.0	Base of Colluvium/ Alluvium	data not collected, suggest check/ test download next time, installation report incomplete. original template sheet only has data to 2011
					61.5	29.8	Whybrow Seam	
					93.0	-1.7	Redbank Seam	
					129.5	-38.2	Wambo Seam	
"Unknown 1"	MG06-01	310862	6392901	71.62	67.5	4.1	Wambo Seam	Data to June 2011 - none collected since then.
					69.5	2.1	Wambo Seam	
					71.0	0.6	Wambo Seam	
					74.0	-2.4	Interburden	

APPENDIX D

Groundwater Monitoring

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
GW02	Well	EX	309109	6389680	82.5	11.2		Upper South Wambo Creek Alluvium
GW08.2	MB	EX	311869	6392326		3	2 – 3	North Wambo Creek Alluvium
GW09.2	MB	EX	311743	6392326		7.4	4.5 – 7.4	North Wambo Creek Alluvium
GW10.2	MB	EX	311872	6392264		3	2 – 3	
GW10.2a	MB	EX	311872	6392264		25	22 – 25	
GW11	Well	EX	309228	6389699	76.335	9.6		Upper South Wambo Creek Alluvium
GW13	MB	EX	313810	6388990	61.839	15	6 – 15	Regolith
GW15	MB	EX	313164	6392807	61.895	17.4	13.8 – 17.4	Wollombi Bk alluvium
GW16	MB	EX	306639	6396174	112.445	12.15	6.2 – 12.2	Alluvium, Regolith
GW17	MB	EX	306886	6396096	110.685	14	11 – 14	Regolith
GW21	MB	EX	308647	6393378	121.824	36	24 – 36	Whybrow Coal Interburden
GW22	MB	EX	311335	6389535	88.403	54	42 – 54	Whybrow Coal Interburden
GW24	MB	EX	305791	6395668	118.8	13.4	11.7 – 13.4	North Wambo Creek – Consolidated Bedrock
GW25	MB	EX	305299	6395288	129.6	5.6	2.6 – 5.6	North Wambo Creek – Alluvium
GW26	MB	EX	305299	6395668	129.4	13.2	11.7 – 13.2	North Wambo Creek – Consolidated Bedrock
P106 (repair/ replace)	MB	Blocked	311518	6391084	61.07	11	5 - 11	Alluvium
P109 (replacement)	MB	Proposed	311215	6390768	62.44			Alluvium

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
P109 (replacement)	MB	Proposed	311215	6390768	62.44			Permian
P316(a,b,c)	MB	EX	311255	6391096		7	4 – 7	Wambo Creek alluvium
	MB	EX	311252	6391090		13	10 – 13	Weathered Permian
	MB	EX	311249	6391083		26	23 – 26	Permian
P16	MB	EX	313480	6394655	57.48	11.5	5 – 10.5	West Wollombi Brook Colluvium
P20	MB	EX	313639	6394166	57.4	10.6	6 – 9.2	West Wollombi Brook Colluvium
P28	MB	EX	311396	6392632	63.1	-	-	Whybrow Coal Overburden
P29	MB	EX	311820	6392560	60.8	-	-	Whybrow Coal Overburden
P202	MB	EX	311854	6391262	60.265	20	14 – 20	Overburden Whybrow
P301	MB	EX	309360	6391466	88.18	20.4	??? - 20.4	Alluvium, shallow overburden
P315	MB	EX	309084	6391856	94.74	9.5	??? – 9.5	Stoney Creek Alluvium/Regolith
P317	VWP	Unknown	307115	6394439	155.41	248.5	35	Regolith
							100	Overburden
							174	Whybrow Seam
							213	Wambo Rider Seam
							248.5	Wambo Seam
P318	VWP	Unknown	312599	6388922	71.05	357	11	Regolith
							150.79	Whybrow Seam
							205.25	Wambo Seam
							314.25	Woodlands Hill
							357	Arrowfield Seam
P319	VWP	Unknown	311125	6391412	64.4	265.3	11	Regolith
							74.9	Whybrow Seam
							161.3	Wambo Seam
							265.3	Interburden Sandstone

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
P320	VWP	Unknown	307573	6398890	85.86	344	92	Warkworth
							191	Vaux
							217.5	Baywater
							263	Pike Gully
							305	Lower Arties
							344	Middle Barrett
P321	VWP	Unknown	307573	6398890	110.39	187.8	31.8	Arrowfield
							72.1	Warkworth
							161.15	Vaux
							187.82	Bayswater
UG139	VWP	EX	306665.45	6395172.7	128.9	402.0	263.0	Unnamed D
							281.0	Unnamed E
							319.0	Interburden Glen Munro - Unnamed E
							329.0	Glen Munro
							375.0	Interburden Arrowfield - Glen Munro
							382.0	Arrowfield
							402.0	Interburden Warkworth - Bowfield
UG166A	VWP	EX	306488.43	6398076	141.5	260.0	130.0	Unnamed D
							153.0	Unnamed E
							183.0	Blakefield
							200.0	Glen Munro
							238.0	Arrowfield
							254.0	Bowfield
							260.0	Bowfield
BH1	MB	EX	313265	6394804	59.09	9.3	2.1 – 8.1	Tertiary Alluvium
BH1G	Dewatering	EX	310104	6391551		-		Whybrow Seam

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
BH2	Dewatering	EX	308867	6390147		-		Whybrow Seam
BH2A	Dewatering	EX	308868	6390096		-		Whybrow Seam
BH3	MB	EX	313399	6394644	54.39	65.4 -	55.4 – 61.4	Woodlands Hill Seam
BH4C	Dewatering	EX	309323	6391080		-		Whybrow Seam
BH4D	Dewatering	EX	-	-		-		Whybrow Seam, Wambo Seam
GW30	MB	EX	306076	6395716	118.6	8.5	5.5 – 8.5	North Wambo Creek - Alluvium
GW31	MB	EX	305876.6	6395582	122.12	10.0	7 - 10	North Wambo Creek - Alluvium
GW32	MB	EX	306393.8	6395829	115.05	7.0	4 – 7	North Wambo Creek - Alluvium
GW33	MB	EX	306592.4	6395946				North Wambo Creek - Alluvium
GW34	MB	EX	307357	6395779	104.23	4.0	2.5 - 4	North Wambo Creek - Alluvium
GW35	MB	EX	306987.9	6396012	107.28	9	6 - 9	North Wambo Creek - Alluvium
GW36a	MB	EX	306248	6395901	113	7.9	4.9 – 7.9	North Wambo Creek - Alluvium
GW36b	MB	EX	306247	6395907	113	16.6	13.4 – 16.4	North Wambo Creek - Weathered Sandstone (In Channel)
SBX_20_GW02a	MB	EX	306905.3	6395946.4	108.92	20	17 – 20	
SW Dam 1A	MB	Proposed	310903	6391145		7-10 (approx.)		Alluvium/colluvium
SW Dam 1B	MB	Proposed				14 – 20 (approx.)		Base of weathered Permian
SW Dam 2A	MB	Proposed	311119	6391405		12 – 15 (approx.)		Base of weathered Permian
SW Dam 2B	MB	Proposed				22 – 25 (approx.)		Fresh Permian
N2	VWP	EX	308663	6393376	122.53	204	40	Permian Overburden
							70	Permian Overburden
							100	Permian Overburden
							140	Whybrow Seam
							172.5	Interburden

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
N2							204	Wambo Seam
N3	VWP	EX	308314	6394575	104.97	- 190	30	Permian Overburden
							55	Permian Overburden
							75	Permian Overburden
							108.5	Whybrow Seam
							142	Interburden
							190	Wambo Seam
N5	VWP	EX	306755	6395963	110.78	133	30	Permian Overburden
							73	Whybrow Seam
							89.5	Interburden
							133	Wambo Seam
P316	VWP	EX	311252	6391128	60.39	71	10	Alluvium
							25	Regolith
							50.63	Regolith Overburden
							71	Whybrow Seam
P323	VWP	EX	309797	6393428	76.65	85.5	23	Overburden siltstone
							224.5	Woodlands Hill Seam
							273.5	Arrowfield Seam
P323	VWP	EX	309799	6393431	76.64	273.5	95.75	Whybrow Seam
							157	Wambo Seam
P324	VWP	EX	310471	6391983	74.44	304.5	11.5	Regolith
							95.75	Whybrow Seam
							157	Wambo Seam
							269.75	Woodlands Hill Seam
							304.5	Interburden
P325	VWP	EX	311806	6390306	65.2	336.5	10.5	Regolith

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
P325							32.5	Permian Overburden
							82	Whybrow Seam
							159.5	Wambo Seam
							203	Whynot Seam
							251.5	Woodlands Hill Seam
							336.5	Arrowfield Seam
P325a	MB	EX	312062	6390137	65.2	8	5 - 8	Wambo Creek Alluvium
P326	VWP	EX	310087	6392874	75.48	332.5	43	Overburden
							113.5	Wambo Seam
							234	Woodlands Hill Seam
							294.5	Arrowfield Seam
P327	VWP	EX	302941	6399995	141.25	332.5	43	Overburden
							113.5	Wambo Seam
							234	Woodlands Hill Seam
							294.5	Arrowfield Seam
P328	VWP	EX	303160.33	6398869.64	131.89	338	43	Overburden
							275	Whybrow Seam
							350	Wambo Seam
							388	Whynot Seam
P329	VWP	EX	307454	6400351	72.42	150.5	67.6	Vaux Seam 1
							87.4	Vaux Seam 2/3
							117.5	Bayswater Seam
							150.5	Pikes Gully Seam
P329a	MB	EX	307456	6400352	72.42	16	10 - 16	Hunter River Alluvium
P330	VWP	EX	306533	6400050	73.62	201.5	201.5	Pike Gully Seam
P330a	MB	EX	306533	6400052	73.63	13	10 - 13	Hunter River Alluvium

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
SBX_GW01	VWP	EX	307009.9	6395886	107.95	51	61.7	Whybrow Overburden (Siltstone/Sandstone)
SBX_GW02	VWP	EX	306910.5	6395943	108.88	78.3	65.8	Whybrow Seam
							61.7	Whybrow Overburden (Siltstone/Sandstone)
							53.7	Whybrow Overburden (Siltstone/Sandstone)
P331	VWP	EX	305397	6396881	60.83	282.29	50	Narrabeen Group*
							118	Overburden 1*
							2185	Overburden 2*
							260.5	Whybrow seam*
P332	VWP	EX	305779	6397521	60.9	144.31	40	Sandstone
							80	Siltstone
							114	Coal (WWA)
P333	VWP	EX	306152	6397780	61.05	83.8	22	Weathered Sandstone
							39	Siltstone
							54	Siltstone
Wambo-03	Dewatering	EX	311699	6392752				Wambo Seam
Wambore South	Dewatering	EX	311812	6392555				Wambo Seam

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APPENDIX I
ANNUAL COMPLIANCE REPORT
(EPBC 2016/7636 AND EPBC 2016/7816)

WAMBO COAL PTY LTD
2022 ANNUAL COMPLIANCE REPORT

(EPBC 2016/7636 and EPBC 2016/7816)

1 January – 31 December 2022

Document Control

Title	Wambo Coal 2022 Annual Compliance Report (EPBC 2016/7636 and EPBC 2016/7816)
General Description	Review of compliance with the conditions of EPBC 2016/7636 and EPBC 2016/7816
Document Owner	Manager: Environment & Community

Revisions

Rev No	Date	Description	By	Checked	Signature
1	March 2023	Original	WCPL	ND	

This report addresses Condition 5 of the Wambo Coal Pty Limited (WCPL) Environment Protection and Biodiversity Conservation (EPBC) Approval 2016/7636 for the South Wambo Underground Mine, which states:

> *The person taking the action must publish a report on the website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.*

Table 1 provides a reconciliation of the conditions of EPBC 2016/7636 and their compliance status.

This report also addressed Condition 5 of the WCPL EPBC Approval 2016/7816 for the South Bates Extension Underground Mine, which states:

> *The person taking the action must publish a report on the website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.*

Table 2 provides a reconciliation of the conditions of EPBC 2016/7816 and their compliance status.

Table 1: EPBC Approval 2016/7636 Compliance Summary

Condition	Status	Comment
1. The person taking the action must: a. Not clear more than 0.9 ha of Central Hunter Valley Eucalypt Forest and 3.4 ha of foraging habitat for the Regent Honeyeater *(Anthochaera phrygia).*	Compliant	The action has not yet been commenced. WCPL has not cleared more than 0.9 hectares (ha) of Central Hunter Valley Eucalypt Forest or more than 3.4 ha of foraging habitat for the Regent Honeyeater (*Anthochaera Phrygia*) as part of the action.
b. Implement conditions A1 and A2 of Schedule 2 of the **state development consent** to minimise the impacts of the action on **protected matters**.	Compliant	WCPL implements Conditions A1 and A2, Schedule 2 of the Development Consent (DA 305-7-2003).
c. Implement environmental performance conditions B1-B11, B51-B55, B62-B73 and B75-B77 of Schedule 2 of the **state development consent**, where the conditions relate to avoiding, mitigating, managing, offsetting, monitoring or recording, or reporting on impacts to **protected matters**. In implementing these conditions, the approval holder must protect at least 18.3 ha of Central Hunter Valley Eucalypt Forest and at least 27.7 ha of foraging habitat for the Regent Honeyeater *(Anthochaera phrygia)* in perpetuity.	Compliant	WCPL implements Conditions B1-B11, B51-B55, B62-B73 and B75-B77 of Schedule 2 of the Development Consent (DA 305-7-2003). WCPL has amended an existing VCA under the NSW *National Parks and Wildlife Act 1974* to conserve Remnant Woodland Enhancement Program Area E in perpetuity, which includes 18.3 ha of Central Hunter Valley Eucalypt Forest and Woodland and 27.7 ha of foraging habitat for the Regent Honeyeater.
2. Within 30 days after the **commencement of the action**, the person taking the action must advise the **Department** in writing of the actual date of **commencement of the action**.	Not applicable	The action has not yet been commenced. Mining at the approved South Wambo Underground Mine is planned to commence after completion of mining at the South Bates Extension Underground Mine. WCPL will advise the Department in writing of the commencement of the action within 30 days of commencement.
3. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all management plans, programs, strategies and reviews required by condition 1. Each management plan, program, strategy and review must be published on the **website**, and notification must be provided to the **Department**, within 1 month of being approved by the Secretary of the NSW Department of Planning & Environment (or nominee of the Secretary).	Compliant	Copies of all management plans, programs, strategies and reviews required by condition 1 of EPBC 2016/7636 are available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports. Relevant management plans include the Site Water Management Plan and Biodiversity Management Plan. An Extraction Plan for areas related to the Action has not yet been prepared. Notification is provided to the Department within one month of the approval of any management plans, programs, strategies and reviews by the Secretary of the NSW Department of Planning & Environment (or nominee of the Secretary).

Condition	Status	Comment
4. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by condition 1, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of approval.	Compliant	WCPL maintains accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by condition 1. WCPL will make these records available upon request to the Department.
5. The person taking the action must publish a report on their **website** addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** (by email to EPBCmonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Compliant	The WCPL 2022 Annual Review (including this report) will be published on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.
6. Any potential or actual contravention of the conditions of this approval, including contravention of a commitment made in a management plan, program, strategy and review required by condition 1 must be reported to the **Department** within 7 days of the person taking the action becoming aware of the actual or potential contravention.	Not applicable	No events contravening (or potentially contravening) the conditions of this approval have occurred.
7. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor and audit criteria must be approved by the **Minister** prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the **Minister**.	Not applicable	Upon the direction of the Minister, WCPL will ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister.
8. If, at any time after 5 years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the **Minister**.	Not applicable	WCPL has not yet commenced the action. Mining at the approved South Wambo Underground Mine is planned to commence after completion of mining at the South Bates Extension Underground Mine. WCPL did not substantially commenced the South Wambo Underground Mine prior to 30 April 2022 (i.e. five years after the date EPBC 2016/7636 was granted), WCPL will seek the written agreement of the Minister prior to substantially commencing the action.

Table 2: EPBC Approval 2016/7816 Compliance Summary

Condition	Status	Comment
1. The person taking the action must: a. Implement administrative conditions A1 and A2 of Schedule 2 of the **state development consent** to minimise the impacts of the action on **protected matters**.	Compliant	WCPL implements Conditions A1 and A2, Schedule 2 of the Development Consent (DA 305-7-2003).
b. Implement environmental performance conditions B1-B3, B7-B10, B51-B55 and B62- B68 of Schedule 2 of the **state development consent**, where the conditions relate to avoiding, mitigating, managing, offsetting, monitoring or recording, or reporting on impacts to **protected matters**.	Compliant	WCPL implements Conditions B1-B3, B7-B10, B51-B55 and B62-B68, Schedule 2 of the Development Consent (DA 305-7-2003).
c. Notify the **Department** in writing of any proposed change to the **conditions** of the **state development consent**, referred to in conditions 1a and 1b, within 5 **business days** of formally proposing a change or becoming aware of any other proposed change.	Compliant	DA 305-7-2003 Modification 18 was lodged in November 2021, outside of the reporting period. DA 305-7-2003 Modification 19 was lodged on 1 August 2022. WCPL contacted the Department on 3 August 2022 to arrange a briefing on the Modification and EPBC approval strategy.
d. Notify the **Department** in writing of any change to conditions of the **state development consent**, referred to in conditions 1a to 1b, within 5 **business days** of a change to **conditions** being finalised.	Not compliant	DA 305-7-2003 Modifications 18 and 19 were approved on 25 January 2022 and 25 January 2023, respectively The Department was not notified in writing of changes to the conditions in Development Consent (DA 305-7-2003) (Modification 18) within the allocated time period following the conditions being finalised. On 27 January 2023, the Department was notified in writing to the approved changes to the Development Consent (DA 305-7-2003) (Modification 19).
2. Within 25 **business days** after the **commencement of the action**, the person taking the action must advise the **Department** in writing of the actual date of **commencement of the action**.	Compliant	WCPL provided a notification to the Department of the actual date of commencement of the action (3 December 2018), however this was not completed within 30 days of the commencement of the action.

Condition	Status	Comment
3. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all management plans and strategies required by conditions B1-B3, B7-B10, B51-B55 and B62-B68 of Schedule 2 of the **state development consent** on their website. Each management plan and strategy must be published on the **website** within 1 month of being approved by the **Secretary** and remain there for a period of no less than 5 years.	Compliant	Copies of all management plans, programs, strategies and reviews required by condition 1 of EPBC 2016/7636 are available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports. Relevant management plans include the Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24, Site Water Management Plan, Biodiversity Management Plan and Life of Mine Rejects Emplacement Strategy. Notification is provided to the Department within one month of the approval of any management plans, programs, strategies and reviews by the Secretary of the NSW Department of Planning & Environment (or nominee of the Secretary).
4. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to these conditions of **approval**, including measures taken to implement the management plans and strategies required by conditions B1-B3, B7-B10, B51-B55 and B62-B68 of Schedule 2 of the **state development consent**, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of this **approval**.	Compliant	WCPL maintains accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by Conditions B1-B3, B7-B10, B51-B55 and B62-B68, Schedule 2. WCPL will make these records available upon request to the Department.
5. The person taking the action must publish a report on their website addressing compliance with each of the **conditions** of this **approval**, including implementation of any management plans and strategies required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Compliant	The WCPL 2022 Annual Review (including this report) will be published on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

Condition	Status	Comment
6. Any potential or actual contravention of the conditions of this **approval**, including contravention of a commitment made in a management plan or strategy required by condition 1 must be reported to the **Department** no later than 7 **business days** of the person taking the action becoming aware of the actual or potential contravention, by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**.	Not applicable	No events contravening (or potentially contravening) the conditions of this approval have occurred.
7. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of **approval** is conducted and a report submitted to the **Minister**. The independent auditor and audit criteria must be approved by the **Minister** prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the **Minister**.	Not applicable	Upon the direction of the Minister, WCPL will ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister.
8. If, at any time after 5 years from the date of this **approval**, the person taking the action has not substantially **commenced the action**, then the person taking the action must not **commence the action** without the written agreement of the **Minister**.	Compliant	WCPL commenced the action within five years of the date of the approval of EPBC 2016/7816.