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WATER MANAGEMENT PLAN - TAHMOOR SOUTH DOMAIN - LONGWALLS SOUTH 1A - SOUTH 7A

Tahmoor Coal Pty Ltd



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1 Introduction

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing underground coal mine located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW). Tahmoor Mine surface facilities are situated between the towns of Tahmoor and Bargo within the Wollondilly Local Government Area (LGA). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

The location of Tahmoor Mine in the regional context is shown in **Figure 1**.

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) for expansion of underground longwall mining to the south of historical workings (referred to as the Tahmoor South Domain). The Project comprises the extraction of up to 4 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal, with a total of up to around 35 Mt of ROM coal proposed to be extracted over a 10-year period. Modification 3 to SSD 8445 (MOD 3), approved in May 2025, enables mining of an additional longwall panel, Longwall South 7A, to the south of the previously approved Tahmoor South Domain A series longwalls.

Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Thirteen longwalls are proposed in this domain which are divided into a series of seven northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 7A (LW S1A-S7A), are the focus of the current Extraction Plan.

The location of LW S1A-S7A and associated Study Area are illustrated in **Figure 2**.

1.2 Purpose

This Water Management Plan has been prepared to support the Extraction Plan for the secondary extraction of coal from LW S1A-S7A.

The purpose of this Water Management Plan is to provide a framework for Tahmoor Coal personnel to ensure that compliance is achieved with relevant internal and external regulatory requirements related to surface water and groundwater monitoring and management within the Extraction Plan Study Area. The plan ensures that impacts on the environment and community are, given that secondary extraction is to proceed, minimised and managed within a structured framework.

This Water Management Plan complies with Development Consent (SDD 8445) (the Consent) Condition C8.

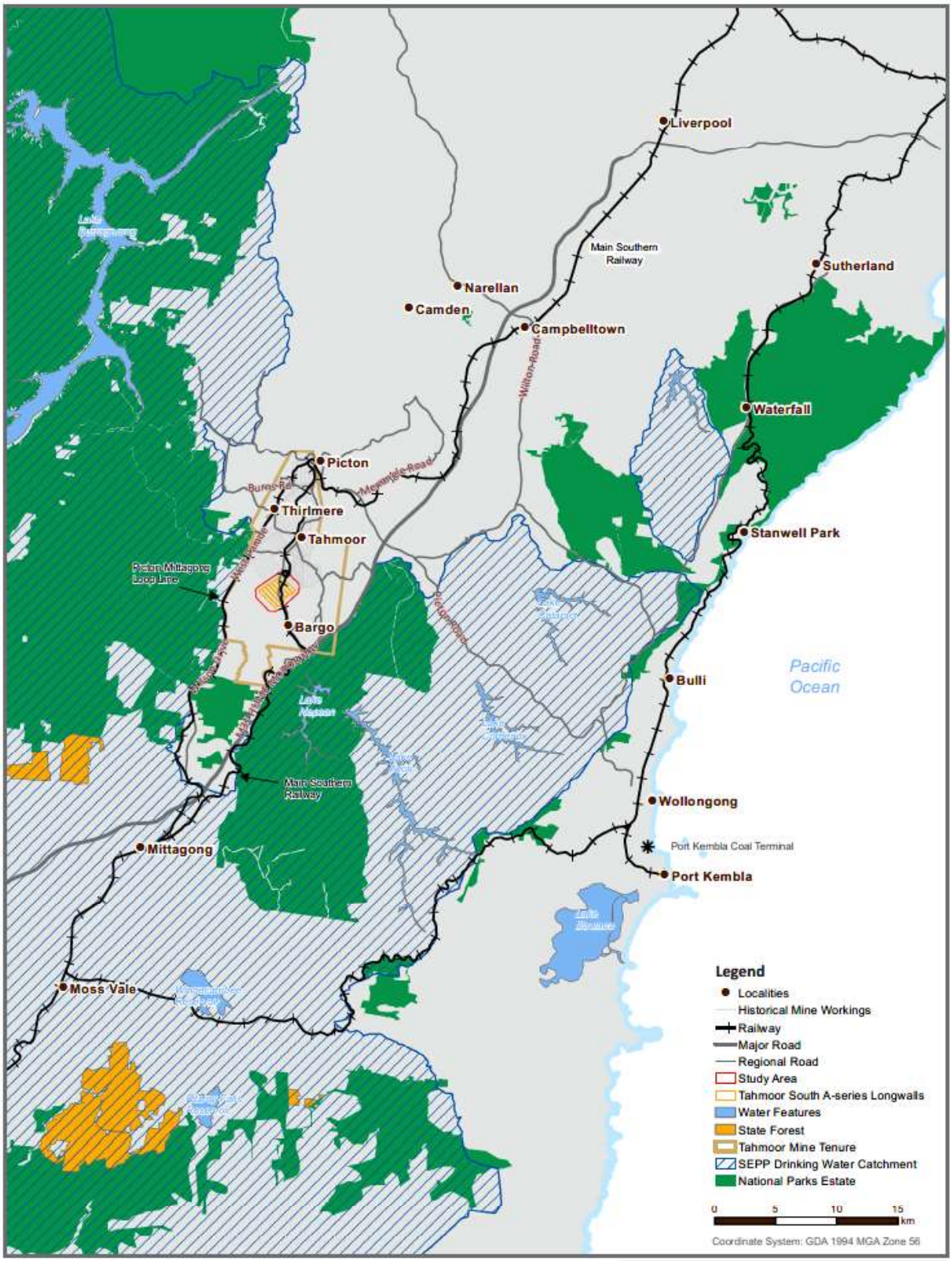

Figure 1 Regional Context

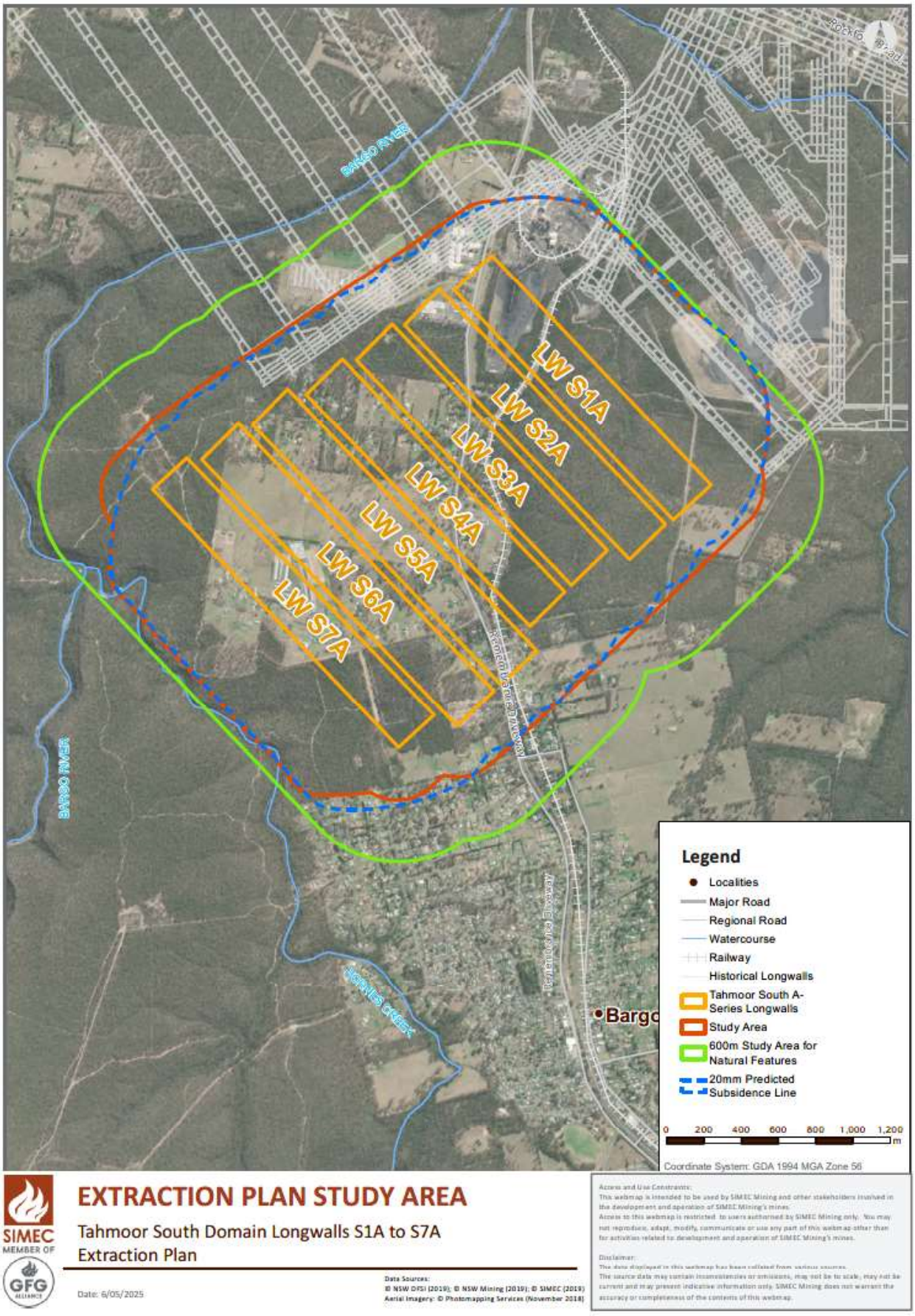

Figure 2 Water Management Plan Study Area

1.3 Scope

The Study Area applicable to this management plan consists of a combination of the predicted 20 millimetre (mm) total subsidence contour and the 35 degree angle of draw as shown in **Figure 2** (labelled Study Area).

Relevant environmental features within a 600 metre (m) buffer from extraction that could be susceptible to far-field or valley related movements have also been included for consideration.

1.4 Preparation of this Management Plan

This Water Management Plan has been prepared by ATC Williams on behalf of Tahmoor Coal.

Camilla West (ATC Williams – Senior Associate Scientist (BSc (Hons), PhD) has been endorsed by the Department of Planning, Industry and Environment (DPIE, later the Department of Planning and Environment (DPE), now the Department of Planning, Housing and Industry (DPHI)) as a suitability qualified water scientist to prepare this management plan.

1.5 Plan and Structure

This Water Management Plan:

- Addresses specific requirements set by Development Consent SSD 8445, EIS Commitments, Leases, Licences, and regulatory requirements (refer to **Section 2**);
- Addresses comments received during stakeholder consultation (refer to **Section 2.5**);
- Provides an overview of surface water and groundwater resources associated with the Study Area (refer to **Section 3**);
- Provides a summary of the environmental performance of the Tahmoor South Project to date with respect to surface water and groundwater resources relevant to the Study Area (refer **Section 4**);
- Provides details on the predicted subsidence impacts and environmental consequences to surface water and groundwater resources from the extraction of LW S1A-S7A (refer to **Section 5**);
- Outlines the monitoring program for potential subsidence-related impacts to surface water and groundwater resources (refer to **Section 6**);
- Outlines the management strategies for potential subsidence-related impacts to surface water and groundwater resources (refer to **Section 7**);
- Outlines the strategies for implementation, reporting, and review of this document (refer to **Section 8**);
- Provides document information (refer to **Section 8**); and
- Provides Trigger Action Response Plans (TARPs) to be implemented to manage and protect surface water and groundwater resources within the Study Area (refer to **Appendix A**).

This Water Management Plan has been prepared with inputs from the following reports:

- Tahmoor South Project Environmental Impact Statement (EIS) and associated appendices;
- Tahmoor South Project Second Amendment Report and associated appendices;
- Tahmoor South Project Longwall S7A Modification Report (SSD 8445 Mod 3) and associated appendices;
- Groundwater Impact Assessment (SLR, 2024) (**Appendix D** of this Water Management Plan);
- LW S1A-S7A Biodiversity Management Plan; and
- LW S1A-S6A Subsidence Predictions and Impact Assessments Report (MSEC, 2022) (Appendix A of the Extraction Plan Main Document) and Modification 3 – Longwall South 7A Subsidence Predictions and Impact Assessment Report (MSEC, 2024) (Appendix B of the Extraction Plan Main

Document).

2 Regulatory Requirements

2.1 Introduction

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database. The following sections summarise key legislation, approval conditions and guidelines relevant to this Water Management Plan.

2.2 Project Approval

2.2.1 Development Consent Conditions

LW S1A-S7A will be extracted in the Tahmoor South Domain under Development Consent SSD 8445, as discussed further in Section 3.2.1 of the Extraction Plan Main Document. SSD 8445 provides the conditional planning approval framework for mining activities in the Tahmoor South Domain to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this management plan from SSD 8445 are detailed in **Table 1**.

SSD 8445 has been modified on three occasions as follows:

- Modification 1 - Extension of time to commission the Tahmoor Coal Water Treatment Plant, approved on 19 July 2022;
- Modification 2 - Underground brine disposal and transfer of mine water, approved on 13 June 2023; and
- Modification 3 – Addition of longwall panel LW S7A to the existing approved mine plan, approved on 26 May 2025.

Approval (EPBC 2017/8084) was also granted in 2021 by the then Department of Agriculture, Water and the Environment (DAWE) (now Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW)) for the Tahmoor South Project under sections 130(1) and 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

It is noted that LW S3A was shortened by 104 m, as approved by DPHI on 27 March 2024. LW S4A has been shortened by 104 m as approved by DPHI on 11 November 2024. Modifications to this longwall are addressed in a separate document, with further discussion omitted from this document. Changes to the monitoring program, as presented in this document, have not resulted from the longwalls shortening.

Table 1 Key Conditions from SSD 8445 regarding Surface Water and Groundwater Resources

<table>
<tr><th>Condition Reference</th><th>Condition Requirement</th><th>Where Addressed</th></tr>
<tr><td colspan="3">Compensatory Water Supply</td></tr>
<tr><td>B25</td><td>Prior to the commencement of second workings under this consent, the Applicant must complete a bore census for all licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 metres as a result of the development.</td><td>Section 5.3.2.2 and Appendix D</td></tr>
<tr><td>B26</td><td>The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with the NSW Natural Resources Access Regulator (NRAR) and NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) - Water, and to the satisfaction of the Planning Secretary.</td><td>Section 7.2.1.3</td></tr>
<tr><td>B27</td><td>The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply should be provided (at least on an interim basis) as soon as practicable after the loss is identified, unless otherwise agreed with the landowner. The burden of proof that any loss of water supply is not due to mining impacts rests with the Applicant.</td><td>Section 7.2.1.3</td></tr>
<tr><td colspan="3">SUBSIDENCE
Performance Measures – Natural and Heritage Features etc.</td></tr>
<tr><td>C1</td><td>The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 7.</td><td>Section 6, Section 7, Appendix A</td></tr>
<tr><td>Excerpt from Table 7</td><td>Table 7: Subsidence impact performance measures - natural and heritage features etc
<table>
<tr><th>Feature</th><th>Performance Measures</th></tr>
<tr><td colspan="2">Water Resources</td></tr>
<tr><td>All watercourses within the Subsidence Area</td><td>No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS</td></tr>
<tr><td>Other watercourses</td><td>Negligible environmental consequences including beyond those predicted in the EIS, including:
- negligible diversion of flows or changes in the natural drainage behaviour of pools;
- negligible decline in baseline channel stability;
- negligible gas releases and iron staining; and
- negligible increase in water turbidity</td></tr>
<tr><td>GDEs including Thirlmere Lakes</td><td>Negligible impacts including:
- negligible change in groundwater levels; and
- negligible change in groundwater quality.</td></tr>
</table>
Notes for Table 7 (C1):
Notes:
• These performance measures apply to all mining taking place after the date of this consent.
• The Applicant is required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent (see condition CB).</td><td>Section 6, Section 7, Appendix A</td></tr>
</table>

Condition Reference	Condition Requirement	Where Addressed
C2	Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Planning Secretary will be the final arbiter.	**Section 6**
Extraction Plan		
C8	The Applicant must prepare an Extraction Plan for all second workings on the site of the development to the satisfaction of the Planning Secretary. Each Extraction Plan must:	Noted. This management plan is part of the LW S1A-S7A Extraction Plan Application.
C8(e)	Provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent.	**Section 5**
C8(f)	Describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 7 and Table 8, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition B56;	**Section 6.1, Section 6.2, Section 7**
C8(g)(iii)	Include a Water Management Plan which has been prepared in consultation with NSW DCCEEW - Water and Conservation Programs, Heritage and Regulation Group (CPHR) and is consistent with the Water Management Plan required under condition B34, which provides for the management of potential impacts and environmental consequences of the proposed underground workings on watercourses and aquifers, including:	This management plan.
	• detailed baseline data on: - surface water flows, quality and geomorphic conditions of watercourses and/or water bodies that could be affected by subsidence; and - groundwater levels, yield and quality in the region, including for privately-owned licensed bores;	**Section 3**
	• detailed surface and groundwater impact assessment criteria, including specific trigger levels for: - investigating any potentially adverse impacts on water resources or water quality; - active remediation of geomorphic and erosional impacts (including supporting justification for the selected triggers); and - providing compensatory water supply to affected water users under condition B26 of this Schedule;	**Section 3.3.2.3, Section 6.1, Section 7, Appendix A**
	• a surface water monitoring program to monitor and report on: - stream flows and quality; - stream and riparian vegetation; - channel and bank stability; and - the effectiveness of remediation measures in controlling geomorphic and erosional impacts;	**Section 6.2**

Condition Reference	Condition Requirement	Where Addressed
C8(g)(iii)	• a groundwater monitoring program to monitor and report on: - groundwater inflows to the underground mining operations; - the height of groundwater depressurisation; - height of fracturing above indicative longwall panels following mining; - background changes in groundwater yield/quality against mine-induced changes, in particular, on privately-owned groundwater bores in the vicinity of the site; - permeability, hydraulic gradient, flow direction and connectivity of the deep and shallow groundwater aquifers; and - impacts of the development on GDEs (including Thirlmere Lakes);	**Section 6.2, Section 6.5**
	• a description of any adaptive management practices implemented to guide future mining activities in the event of greater than predicted impacts on aquatic habitat;	**Section 7.5**
	• a program to validate the surface water and groundwater models for the development and compare monitoring results with modelled predictions; and	**Section 7.2, Section 7.3, Appendix A**
	• a plan to respond to any exceedances of the surface water and groundwater assessment criteria, including a Watercourse Corrective Action Management Plan as detailed in Condition C12.	**Section 7.2, Appendix A**
C8(g)(viii)	Trigger Action Response Plans addressing all features in Table 7 and Table 8, which contain:	**Section 7.3, Appendix A**
	• appropriate triggers to warn of increased risk of exceedance of any performance measure;	
	• specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measures in Table 7 and/or Table 8, or where any such exceedance appears likely; and	**Section 7.5**
C8(g)(ix)	Contingency Plan that expressly provides for:	**Section 7.4, Appendix A**
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 7 and/or Table 8, or where any such exceedance appears likely;	**Section 7.5**
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures;	**Section 7.2, Section 7.5**
C8(i)	Include a program to collect sufficient baseline data for future Extraction Plans.	**Section 6.6**

Condition Reference	Condition Requirement	Where Addressed
Adaptive Management		
E4	The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to offset or other provisions as specified in this consent and/or penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity: • take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; • consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; • within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures or other course of action; and • implement reasonable remediation measures as directed by the Planning Secretary.	**Section 7.5**

In addition, this management plan includes relevant information from the Tahmoor South Site Water Management Plan, prepared in accordance with Condition B38, to ensure compliance with this document.

2.2.2 Management Plan Requirements

Condition E5 of the Consent outlines the general requirements for all management plans. **Table 2** lists the requirements under this condition and where these requirements have been addressed.

Table 2 Management Plan Requirements

Condition Reference	Condition Requirement	Where Addressed
E5	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	Noted.
(a)	a summary of relevant background or baseline data;	**Section 3**
(b)	details of:	NA
(b)(i)	• the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Sections 2.1, 2.2 and 2.3**
(b)(ii)	• any relevant limits or performance measures and criteria; and	**Section 3.3.2.3, Section 6.1, Appendix A**
(b)(iii)	• 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;	**Section 3.3.2.3, Section 6.1, Section 7.3, Appendix A**
(c)	any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 2**
(d)	a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 7**

Condition Reference	Condition Requirement	Where Addressed
(e)	a program to monitor and report on the:	NA
(e)(i)	• impacts and environmental performance of the development; and	**Section 5**
(e)(ii)	• effectiveness of the management measures set out pursuant to condition E5(d);	**Section 7.2**
(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 6.4, Appendix A**
(g)	a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 6.4, Section 6.5**
(h)	a protocol for managing and reporting any:	NA
(h)(i)	• incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	**Section 7**
(h)(ii)	• complaint; or	**Section 7**
(h)(iii)	• failure to comply with other statutory requirements;	**Section 7**
(i)	public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	**Section 7**
(j)	a protocol for periodic review of the plan.	**Section 7**

2.2.3 EIS Commitments

Condition A2(g) of the Consent states that the development may only be carried out generally in accordance with the EIS. The relevant EIS documents include:

- Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019;
- Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020;
- Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020; and
- Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

The EIS commitments relevant to this management plan are outlined in **Table 3**. These EIS commitments do not include commitments that are covered by the SSD 8445 Conditions of Consent.

Table 3 Relevant EIS Commitments

EIS Reference	Commitment	Where Addressed
GE-1	**Geomorphology** Potential impact: Impacts to geomorphological features in the Project Area from mining-induced subsidence Management and mitigation measures: • Pre, during and post-mining photographic surveys and visual inspections of geomorphological features for each longwall. Results would be documented in the Extraction Plan and Annual Review. • Annual catchment survey at 10 headwater photographic sampling locations to monitor mining-induced subsidence impacts of the Project over time. • A geomorphology survey (baseline and post mining) of waterways overlying each longwall to complement monitoring of subsidence at each longwall. • Installation of subsidence monitoring points before mining of secondary workings for all longwalls. The adaptive management plan for the Project would include re-evaluation of the monitoring techniques for subsidence and biodiversity after mining of each longwall. This would then inform monitoring for subsequent longwall panels. • Monitoring of knickpoint formation during mining of each longwall, and implementation of appropriate controls to prevent knickpoint formation. • Reporting of monitoring results within the Annual Review.	**Section 6, Section 8, Appendix A** of this document and Appendix A of the Extraction Plan Main Document
SW-1	**Surface water** Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Monitoring would be undertaken before mining commences to assess the baseline conditions above each longwall, and would include: • Geomorphological conditions • Water quality • Stream flow Monitoring sites will include: • Ongoing streamflow monitoring at existing monitoring sites. • An additional stream flow gauging station would be installed at Teatree Hollow, downstream of the edge of the longwall and upstream of Licensed Discharge Point (LDP) 1. • Additional water level monitoring to establish baseline water level data to enable the assessment of potential impacts to pool water levels. • Streamflow gauging activities would be continued. Enhanced low flow control weirs would be established at the existing gauging station at Dogtrap Creek downstream and the proposed new gauging station at Teatree Hollow to support the generation of reliable continuous flow data (including reliable low flow data) at the stations. Routine water level and water quality monitoring at the stations would also be continued. Monitoring results would be reported in the Annual Review.	**Section 6, Section 8, Appendix A**

EIS Reference	Commitment	Where Addressed
SW-2	**Surface water** Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Monitoring of waterways within 200 m of active longwall mining, including monthly photographic recording and monthly water quality sampling upstream and downstream of potentially affected areas. Results would be analysed in relation to action response triggers, as detailed in the surface water management plan. Monitoring to be reported in the Annual Review and six-monthly subsidence impact reports.	**Section 6, Section 8, Appendix A**
SW-5	**Surface water** Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Update the monitoring and management plans and the groundwater/surface water model in relation to impacts to the Thirlmere Lakes as findings from the OEH research project become available to guide ongoing management of impacts.	**Section 6, Appendix A, Appendix D**
SW-7	**Surface water** Potential impact: Surface water entitlement Management and mitigation measures: Obtain the necessary authorised entitlement to account for the maximum take of water from both surface water and groundwater sources in accordance with the Aquifer Interference Policy.	**Section 3.5.1, Section 5.5**
PAR #6	**Surface water** • Prior to the commencement of longwall mining, an adaptive monitoring and TARP would be developed. The following surface water elements would be incorporated into the plan: - TARPs for water quality exceedances which incorporate both baseline and control monitoring data. - TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis. - TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites.	**Section 6, Section 7.3, Appendix A**
PAR #9	**Surface water** Monitoring of streamflow, pool water levels and water quality would continue for two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation.	**Section 6**

EIS Reference	Commitment	Where Addressed
GW-3	**Groundwater** Potential impact: Impacts to groundwater as a result of mining induced subsidence Management and mitigation measures: Update and maintain regional groundwater monitoring network, with monitoring results reported annually within the Annual Review. This would include replacement of failed bores around Tahmoor North and Tahmoor South, as well as establishing new bores. Monitoring of groundwater levels would include: • A condition assessment of bores and monitoring equipment (VMPs) of new bores around Tahmoor South, with a specific update of the GWMP. • Geophysical logging of boreholes that allow changes in groundwater storage and fracture apertures to be quantified and depth of rock deformation to be identified (i.e. observations of non-deformed ground which could be at least 10- 30 m below surface). • Re-install at least one bore in the footprint of a Tahmoor North longwall (e.g. at TNC029) to monitor post-mining groundwater level and groundwater quality. • Monitoring in longwall centre-lines of pre- and post-mining conditions Tahmoor South. This would be undertaken for the longwall (101A), and then every two or three after that. Packer testing would also be undertaken, followed by installing VMPs at four elevations in the Hawkesbury Sandstone and then two in the Bulgo Sandstone to assist in defining a profile of fracturing and depressurisation above longwalls. Results from monitoring would be compared to those from groundwater monitoring of reference sites including upstream and outside the predicted subsidence impact zone where relevant	**Section 6, Appendix D**
GW-5	**Groundwater** Potential impact: Impacts to groundwater as a result of mining induced subsidence Management and mitigation measures: Revision of the groundwater model to: • Take further advantage of unstructured mesh capabilities; • Incorporate conceptual developments from the OEH Thirlmere Lakes Research Program (once complete); and • Incorporate the results of mine inflow monitoring; Incorporate monitoring data from groundwater bores in the Western Domain of Tahmoor North.	**Appendix D**

2.2.4 EPBC Act Approval Conditions

Conditions relevant to this management plan from the approval (EPBC 2017/8084) granted by the DAWE (now Commonwealth DCCEEW) for the Project are outlined in **Table 4**.

Table 4 EPBC Act Approval Conditions

Condition	Condition Requirement	Where Addressed

3	For the protection of water resources, the approval holder must comply with State development consent conditions A7, B23, B24, B30, B31, B32, B33, B34, B35, B36, C1, C2, C8, C9 and C10	Relevant conditions applicable to this Extraction Plan are discussed in **Section 2.1.1** and the Extraction Plan Main Document. Condition A7 of SSD 8445 is not considered relevant to this Extraction Plan. Conditions B30, B31, B32, B33, B34, B35 and B36 of SSD 8445 are covered by the generic Water Management Plan for the Tahmoor South Domain, which has been approved by DPE (now DPHI). Conditions B23 and B24 of SSD 8445 will be reported on in the Annual Review.
4	The approval holder must ensure there is no adverse effect on the function of a water resource as a result of the action.	**Section 5**

2.2.5 Extraction Plan Guideline

This management plan has been updated in accordance with the NSW Department of Planning and Environment (DPE) *Extraction Plans Guideline* (DPE, 2022), as detailed in **Table 5**.

Table 5 Extraction Plan Guideline Requirements for Key Sub-Plans

Extraction Plan Guideline Content Requirements for Key Sub-Plans	Where Addressed
A short overview of relevant landscape features, heritage sites, environmental values, built features or other values to be managed under the sub-plan.	**Section 3**
Setting out the consent's performance measures directly relevant to the features or values to be managed under the sub-plan.	**Section 2.1.1, Section 5.1**
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements.	**Section 2, Section 5.1, Section 6**
Setting out performance indicators to ensure compliance with the performance measures and statutory requirements.	**Section 5.1, Appendix A**
A description of the relevant features or values to be managed under the sub-plan and their significance.	**Section 3**
A description of all currently predicted subsidence impacts and environmental consequences relevant to the features and values to be managed under the sub-plan.	**Section 4**
A description of all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the mining company's commitments.	**Section 6, Section 7, Appendix A**
A description of the baseline monitoring network and baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites that may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites).	**Section 3**
A description of the proposed environmental monitoring of subsidence impacts and environmental consequences.	**Section 6**
A description of proposed monitoring of remediation measures.	**Section 6, Section 7.2, Appendix A**
A description of adaptive management.	**Section 7.5**
Listing responsibilities for implementation of the plan.	**Section 8**
An attached Trigger, Action, Response Plan	**Appendix A**

2.3 Relevant Legislation and Policies

The relevant legislation and policies pertaining to the protection and management of surface water and groundwater resources in New South Wales are detailed in the subsections below.

2.3.1 Protection of the Environment Operations Act 1997

The *Protection of the Environmental Operations Act 1997* and the *Protection of the Environment Operations (General) Regulation 2009* set out the general obligations for environmental protection in NSW. The Tahmoor Mine operates in accordance with Environment Protection Licence (EPL) 1389.

2.3.2 Water Management Act 2000

The objects of the *Water Management Act 2000* are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) develops, assesses and recommends changes to water sharing/water resources plans and water management rules for regional water in NSW in accordance with the *Water Management Act 2000*. A primary objective of NSW DCCEEW is the sustainable management and use of water resources, balancing environmental, social and economic considerations. Water Sharing Plans (WSPs) have been developed for much of the

State and these establish rules for sharing and trading water between the environment, town water supplies, basic landholder rights and commercial uses. The NSW Department of Natural Resources Access Regulator (NRAR) is an independent regulatory body and is responsible for compliance with and enforcement of the regulatory framework.

2.3.2.1 Water Sharing Plans

The Study Area is regulated by the *Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources 2023*. The main Water Source relevant to the Study Area, as defined in the *Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources 2023*, is the Maldon Weir Water Source.

Water used in existing and on-going mining and coal processing operations at Tahmoor Coal will continue to be sourced from the underground operations (groundwater ingress and recycling of supply for mining operations) and from water captured within the existing pit top water management system – principally at the coal handling and processing plant and rejects emplacement area, which are partially located within the Study Area. Some water is also supplied under agreement with Sydney Water.

The Study Area is also located within the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2023*. The *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2023* is used to manage the average long-term annual volume of water extracted from relevant groundwater sources.

The Groundwater Source and associated Management Zone relevant to the Study Area is the Sydney Basin Nepean Groundwater Source and the Nepean Management Zone 2, respectively.

The Sydney Basin Nepean Groundwater Source has an annualised limit on entitlement (LTAAEL) of 64,785 megalitres (ML), while the current entitlement is 31,446.4 ML (based on the WaterNSW Water Register[1] 2025-2026 water year).

2.3.2.2 NSW Aquifer Interference Policy

The Project will include the dewatering of the geological strata proposed to be mined. In accordance with the *NSW Aquifer Interference Policy* (AIP), such activity is classified as an 'Aquifer Interference'. In order to meet the requirements of the 'minimal impact considerations' of the AIP, a groundwater assessment is required to be conducted.

The AIP was developed to provide a framework to guide the assessment of impacts that may result following the 'take' of water from an aquifer. It outlines the requirements for obtaining licences for approved aquifer interference activities, as well as considerations for the assessment of impacts.

The AIP specifies 'minimal harm considerations' for highly and less productive aquifers, while also defining thresholds for water table and groundwater pressure drawdown, and changes in groundwater and surface water quality. There are specific minimal impact considerations for:

- "Highly productive" groundwater;
- "Less productive" groundwater;
- "Water supply" works;
- "High Priority" Groundwater Dependent Ecosystems (GDEs); and
- "High Priority" Culturally significant sites.

The AIP categorises groundwater source productivity (highly productive or less productive) based on characteristics of salinity and aquifer yield. The Project proposes to mine the Bulli Coal Seam which is located at depth beneath the 'Highly Productive' Hawkesbury Sandstone aquifer (refer **Appendix D**).

[1] https://waterregister.waternsw.com.au/water-register-frame; accessed July 2025.

2.4 Other Leases and Licences

All development consents, leases, licences, and other relevant approvals are stored in the Cority Compliance Management database, which is administered by both site and Liberty GFG Corporate. A summary of the relevant mining leases is provided in **Table 6**. A summary of other approvals and licences is provided in **Table 7**.

Table 6 Mining Leases

Lease	Title	Granted	Expires
CCL 716	Original Tahmoor Leases	15/06/1990 (Instrument of Renewal 16/8/2023)	13/03/2042
CCL 747	Bargo Mining Lease	23/05/1990 (Instrument of Renewal 21/11/2005)	06/11/2025 (renewal determination issued 16 May 2025 and effective 7 November 2025)
ML 1308	Small Western Lease to west of CCL 716	2/03/1993 (Instrument of Renewal 24/6/2014)	2/03/2035
ML 1376	Tahmoor North Lease	28/08/1995 (Instrument of Renewal 28/3/2023)	28/08/2043
ML 1539	Tahmoor North Extensions Lease	16/06/2003	16/06/2035
ML 1642	Pit-top and REA surface Mining Lease	27/08/2010 (Instrument of Renewal 17/10/2022)	27/08/2031

Table 7 Environmental Approvals and Licences

Lease	Title	Granted
Environmental Protection Licence 1389	01/05/1994, latest variation 28/06/2024	No Expiry
WAL36442	06/12/2013	No Expiry
WAL25777	27/10/2014	No Expiry
WAL43656	01/8/2022	No Expiry
SWC871469 (Leased)	11/07/2025	01/07/2026
SWC868868 (Leased)	01/07/2024	30/06/2025*
WAL45204	07/08/2024	No Expiry
WAL43631	08/03/2021	No Expiry
WAL43655	09/03/2021	No Expiry
WAL43657	09/03/2021	No Expiry
WAL43659	09/03/2021	No Expiry
XSTR200005 Dangerous Goods Licence	02/02/2017	02/02/2027
5061521 Radiation Management Licence	29/10/2025	29/10/2026

*Lease in process of renewal for FY2026

2.5 Stakeholder Consultation

The following stakeholders were consulted during the preparation of this management plan:

- DPE Environment, Energy and Science Group (EES) (now part of NSW DCCEEW);
- DPE Water (now part of NSW DCCEEW);
- WaterNSW;
- Crown Lands (now part of NSW DPHI); and
- Wollondilly Shire Council.

The feedback provided by stakeholders is summarised within **Table 8** below. This consultation table does not include consultation completed during the Extraction Plan review stage post submission to DPE (now DPHI).

A summary of all consultation undertaken for the Extraction Plan is provided in **Section 2.1.2** of the Extraction Plan Main Document, and a copy of the incoming correspondence is also provided in **Appendix C** of the Extraction Plan Main Document.

Table 8 Consultation to Date

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation	Where Addressed
EES	3 February 2022	Consideration is to be given to subsidence impacts to Hornes Creek and the re-opening of fractures in the Bargo River associated with historical mining. This will require an appropriate water monitoring program and a clear commitment to undertake necessary remediation actions should impacts occur.	**Section 6** and **Appendix A**
		An update is to be provided on the progress of the remediation of Myrtle and Redbank Creek	**Appendix F**
DPE Water	19 January 2022	A record of pre- and post- subsidence state of key rock bars and pools should be maintained for review of impact predictions reporting.	**Section 5** and **Appendix A**
WaterNSW	10 January 2022	The Extraction Plan is to confirm that the potential impacts to the Sydney Drinking Water Catchment and Special Areas are as per that detailed in the EIS.	**Section 5**
		Monitoring and management measures relevant to the Sydney Drinking Water Catchment and Special Areas are to be detailed.	**Section 5** Impacts to the Sydney Drinking Water Catchment and Special Areas are not predicted to occur.
		The Extraction Plan is to consider WaterNSW Mining Principles and Water Monitoring Guidelines for Underground Mining Activities.	**Section 5**
Crown Lands	2 February 2022	Mitigation of impacts on the Bargo River and other watercourses, as a consequence of the longwall extraction works, will need to be addressed in the plan.	**Appendix A**

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation	Where Addressed
Wollondilly Shire Council	14 February 2022	An assessment of impacts to surface and groundwaters be consistent with all current scientific research that includes the Characterisation and Modelling of Geological Fault Zones Guideline publication	**Section 4** and **Appendix D**
		A detailed geological model that identifies the likely interaction of subsidence induced fractures with the modelled groundwater environment as part of complying with the above IESC publication.	**Appendix E**
		An assessment of potential impacts of mining activities to the operation of private bores and mitigation measures to address any identified potential adverse implications.	**Section 5.3.2.2, Section 5, Section 7.2.1.3, Appendix A** and **Appendix D**
		Trigger Response Action Plans and related monitoring programs that are developed as part of the Extraction Plan and Water Plan are to be scientifically based, supported by commensurate data. They are requested in this regard to include appropriate ecological focussed indicators to monitor any impacts to the ecological health of waterways at a suitable timeframe that would restrict the need for Creek Management Action Plans.	**Appendix A**

3 Existing Environment

3.1 Surface Water Resources

Tahmoor Mine is located within the Bargo River catchment. From its headwaters near the townships of Hill Top and Yerrinbool, the Bargo River flows in a generally north-easterly direction through incised valleys and gorges to its confluence with the Nepean River (refer **Figure 3**). The headwaters of the Bargo River rise approximately 18 km to the south of the Tahmoor Mine. The confluence of the Bargo River and the Nepean River is located approximately 9 km downstream of the Tahmoor Mine. Flow in the Bargo River upstream of the Tahmoor Mine are unregulated.

The headwaters of the Nepean River rise in the coastal ranges to the south of Tahmoor Mine. Streamflow in the Nepean River near Tahmoor is highly regulated by the Upper Nepean Water Supply Scheme, operated by WaterNSW, which incorporates four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers. Releases from the Cordeaux, Avon and Nepean Dams are made to enable withdrawal for water supply purposes from the Pheasants Nest Weir located further downstream on the Nepean River. The Nepean Dam is situated some 18 km upstream of the Bargo River confluence, while the Pheasants Nest Weir is located approximately 7 km upstream of the confluence. The Nepean River, downstream of Pheasants Nest Weir and adjacent to and downstream of the Study Area, is not part of the Sydney Drinking Water Catchment or the Special Areas[2]. The Study Area is also located outside of the Sydney Drinking Water Catchment and the Special Areas. Cow Creek is the closest watercourse to LW S1A-S7A that is located in the Sydney Drinking Water Catchment – located approximately 4.7 km south-east of the Study Area boundary (refer **Figure 3**).

The Nepean River flows into the Warragamba River near Wallacia at which point it is referred to as the Hawkesbury-Nepean River. The Hawkesbury-Nepean catchment is one of the largest coastal catchments in NSW with an area of some 21,400 square kilometres (km^2) from its mouth in Broken Bay on the northern side of the Sydney Metropolitan area.

The Study Area is located predominantly within the Teatree Hollow catchment which is a sub-catchment of the Bargo River. Small portions of the Study Area are also located within the Hornes Creek and Bargo River catchments (refer **Figure 3**). The Dogtrap Creek catchment, which overlies the approved B series longwalls, is located to the east of the Study Area and just within the 600 m Study Area for natural features. The lower reaches of Teatree Hollow, Dogtrap Creek and the Bargo River have, to varying degrees, experienced subsidence-related effects due to historical mining operations at the Tahmoor Mine.

3.1.1 Bargo River

The Bargo River catchment area is approximately 130 km^2 at its confluence with the Nepean River. The river consists of a sequence of pools, glides and rockbars across sandstone bedrock, with occasional boulder fields and cobblestone riffles. The Bargo River flows into the Nepean River approximately 9 km downstream of the Teatree Hollow confluence. The lower 4 km of the river pass through the Bargo River Gorge, which is characterized by steep rock faces up to 110 m high.

The river flows in a generally north-easterly direction through incised valleys and gorges to its confluence with the Nepean River. The reach of the Bargo River adjacent to the Tahmoor Mine downstream of the Picton Weir was affected by historical mining-induced subsidence. However, mining related effects to streamflow in the Bargo River are considered negligible with flow in the Bargo River adjacent to the Tahmoor Mine near perennial.

[2] The Special Areas comprise undisturbed areas around WaterNSW Drinking Water storages and infrastructure. Public access and activities are restricted to protect water quality in these areas.

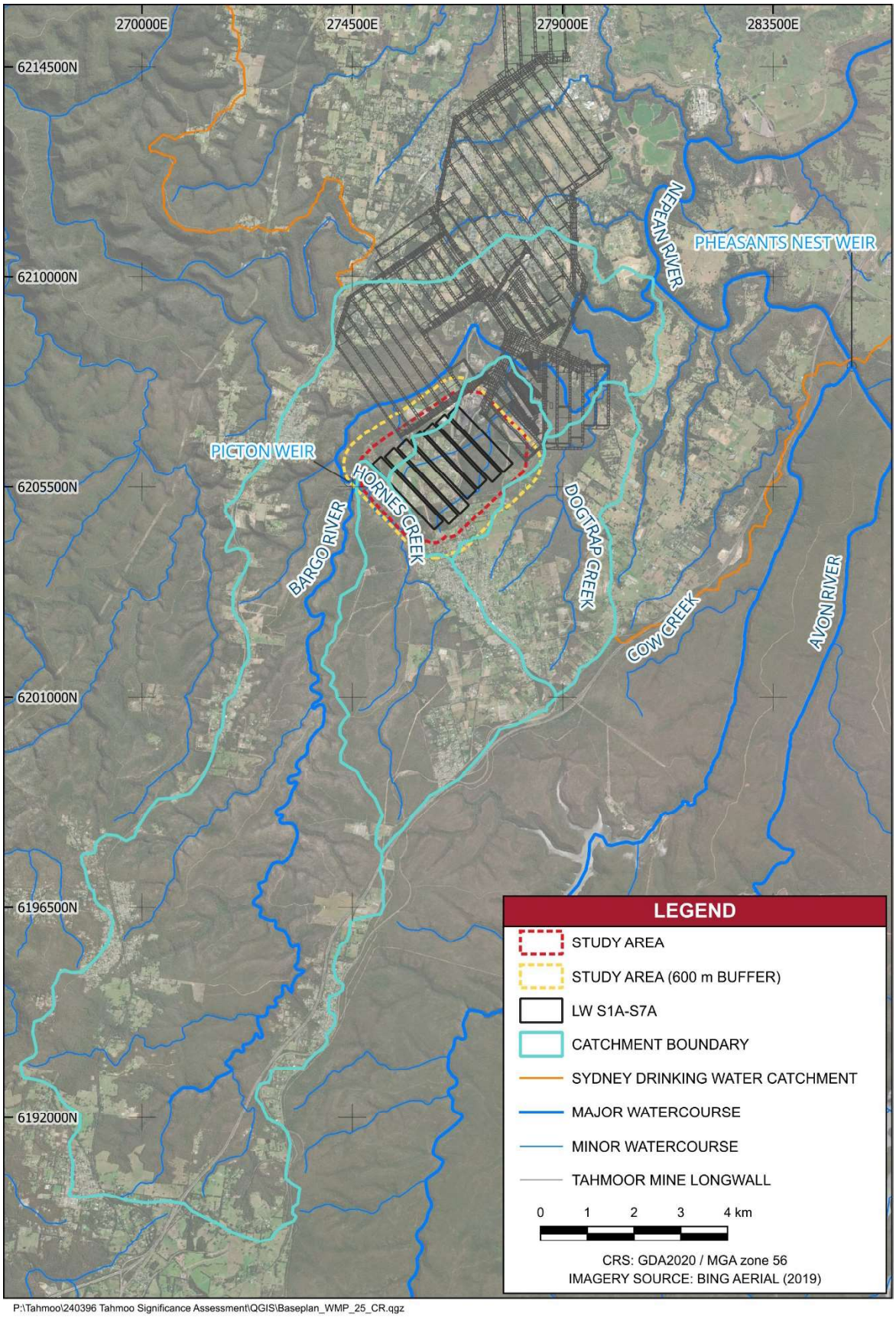

Figure 3 Study Area Surface Water Resources

The headwaters of a second order tributary of the Bargo River overlie the western edge of the approved LW S5A to LW S6A (refer **Figure 4**). Rock slabs and bedrock outcrop were mapped in the mid to lower reach of the tributary and a total of 6 pools were identified with the dominant pool control comprising boulders (Gippel, 2013). Predominantly hard (likely to be fixed) knickpoints[3] of varying dimensions were observed in the Bargo River tributary (Gippel, 2013). The baseline geomorphology surveys conducted in 2013 and 2023 identified that the Bargo River tributary was generally in good geomorphic condition (i.e. essentially natural with intact form and process). Sites where the redirection of surface flow to the subsurface was observed, presumed to be associated with historical mining-induced bed fracturing, were classified as having moderate geomorphic condition (Gippel, 2013).

3.1.2 Teatree Hollow

Teatree Hollow traverses the Tahmoor Mine area, with the confluence of Teatree Hollow and the Bargo River located approximately 600 metres (m) downstream of the Tahmoor Mine Pit Top. The mid to upper reaches of Teatree Hollow overlie LW S1A-S7A. The headwaters of Teatree Hollow rise in the northern part of the Bargo Township with the main watercourse flowing generally north-northeast to the Bargo River. Downstream of the Bargo Township, Teatree Hollow predominantly traverses bushland to the confluence with the Bargo River.

Teatree Hollow is a third order stream from the eastern edge of LW S1A to the confluence with the Bargo River and has a total catchment area of approximately 8 km^2. A third order tributary joins with Teatree Hollow at the eastern edge of LW S1A (refer **Figure 4**). This tributary overlies LW S1A-S6A and is a lower order stream (first to second order) upstream of LW S2A.

Teatree Hollow tributary and the headwaters of Teatree Hollow traverse the Australian Wildlife Sanctuary (refer **Figure 4**). The Australian Wildlife Sanctuary (the Sanctuary), formerly the Wirrimbirra Sanctuary, is a State heritage listed flora and fauna sanctuary, native plant nursery and education centre. The Sanctuary overlies LW S1A-S4A. Five pools were mapped within the Sanctuary boundary, two of which are of notable size – pool TT2 and pool TT3. Pool TT3 and pool TT11 are referred to as the Ockenden Pool by the Sanctuary and pool TT2 is referred to as the Big Pool.

The baseline geomorphology survey (Gippel, 2013) identified that the upper to mid reach of Teatree Hollow and the mid to lower reach of Teatree Hollow Tributary were predominantly in good geomorphic condition while the mid to lower reach of Teatree Hollow and the upper reach of Teatree Hollow Tributary were predominantly in moderate geomorphic condition. The sites of moderate geomorphic condition related to minor culvert or track crossings, low riparian vegetation cover or discharge from LDP1 (Gippel, 2013). The upper reaches of Teatree Hollow and Teatree Hollow Tributary were characterised by a low relief landscape, with a dominant bed material of mud (cohesive clay/silt/sand) and notable grass coverage (Gippel, 2013). Teatree Hollow and Teatree Hollow tributary are ill-defined in the upper reaches, with surface water travelling predominantly as overland flow or in shallow, eroded gullies. In the mid to lower reaches, the landscape was characterised as high relief with dominant bed material of mud, sand, boulders and/or exposed bedrock and little low flow channel grass coverage. The main channels of Teatree Hollow and Teatree Hollow tributary become progressively more defined with distance downstream.

[3] A knickpoint is a part of a watercourse where there is a steep fall in channel bed elevation and, as such, may be susceptible to erosion and channel instability.

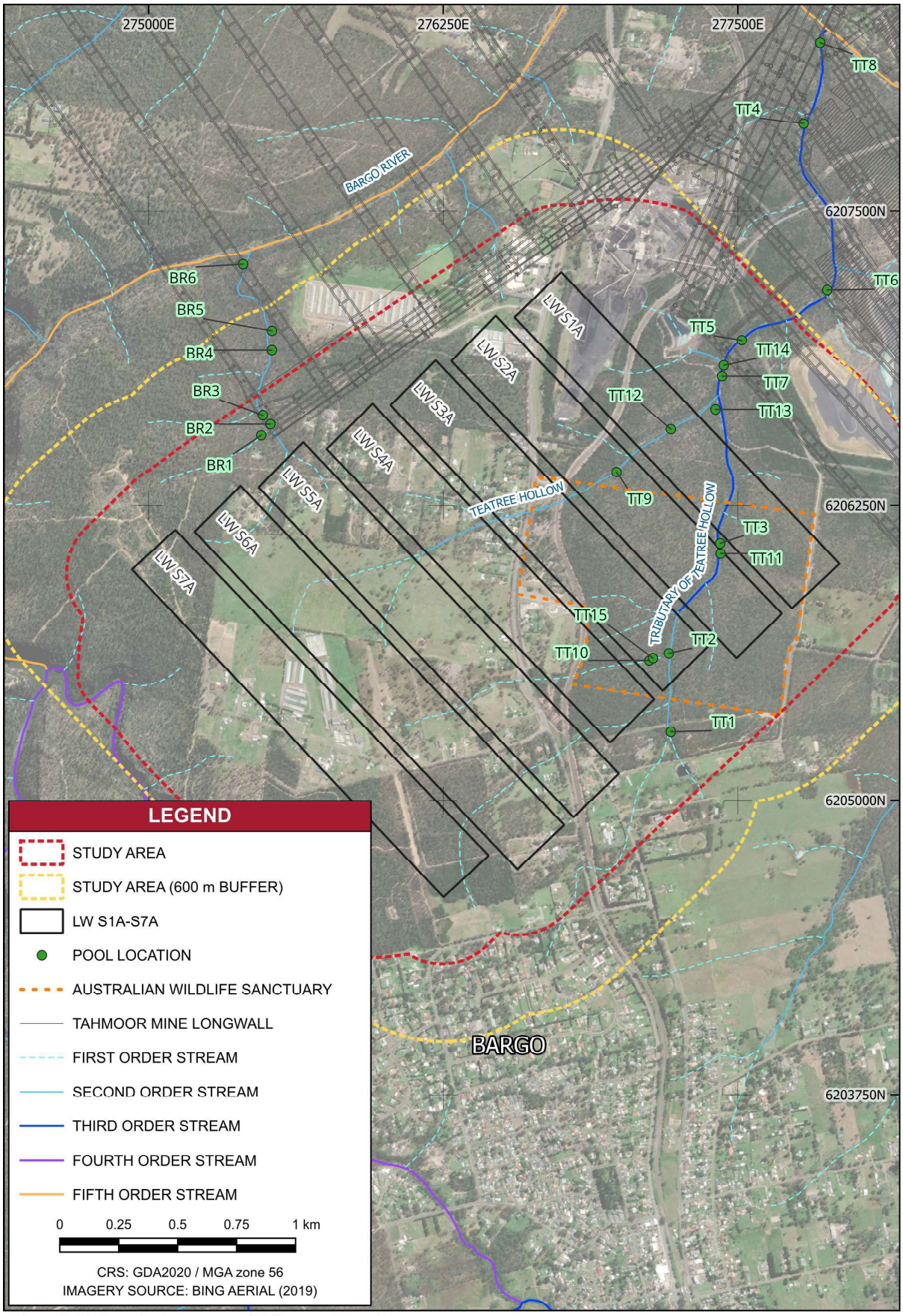

Figure 4 Teatree Hollow and Bargo River Tributary Stream Order and Pools

Exposed bedrock comprising rock slabs, rock bars and bedrock outcrop, were mapped in the upper reaches of Teatree Hollow Tributary and in the mid to lower reaches of Teatree Hollow. A total of 15 pools were mapped in Teatree Hollow and Teatree Hollow Tributary with the dominant pool control comprising rockbars, boulders and cohesive clay/silt/sand (Gippel, 2013). Of the 15 pools, 7 pools directly overlie LW S1A-S3A (refer **Figure 4**).

Ferruginous seeps and suspended colloids were observed at locations in Teatree Hollow and Teatree Hollow tributary during the baseline surveys conducted in 2022, prior to the commencement of mining of LW S1A (Brienen Environment & Safety, 2022a; b). In addition, gas bubbling was observed in shallow ponded water at channel morphology site CM6 during the baseline surveys (refer **Figure 24** for location) (Brienen Environment & Safety, 2022c).

Hard (likely to be fixed) and soft (likely to be mobile) knickpoints of varying dimensions were mapped in Teatree Hollow and Teatree Hollow Tributary (Gippel, 2013). Soft knickpoints, with the potential to impact channel stability, were identified in the mid to lower reaches of Teatree Hollow and the upper to mid reach of Teatree Hollow Tributary. Two notable soft knickpoints were identified in Teatree Hollow, one located just downstream of pool TT13 and one located just downstream of pool TT5. The deeply incised section downstream of pool TT5 extended for 130 m and comprised a bed sand deposit which was identified as rare for the area surveyed (Gippel, 2013).

In accordance with EPL 1389, Tahmoor Coal is licensed to discharge to Teatree Hollow from two licenced discharge points (LDP) and three licenced overflow points (LOPs). The locations of LDP1, LDP16 and the LOPs are shown in **Figure 6**.

3.1.3 Dogtrap Creek

Dogtrap Creek has a total catchment area of approximately 13.6 km^2 to its confluence with the Bargo River. A very small portion of the catchment area lies within the Study Area (600 m Buffer) (refer **Figure 3**). Dogtrap Creek is a third order stream from approved LW S4B to the confluence with the Bargo River.

3.1.4 Hornes Creek

Hornes Creek catchment is located to the south-southwest of LW S1A-S7A. The catchment area of Hornes Creek is approximately 19.3 km^2 which comprises predominantly bushland, rural-residential area and residential area associated with the Bargo township. Hornes Creek is a fourth order stream adjacent to the Study Area and at its confluence with the Bargo River (refer **Figure 5**).

The Picton Weir is located just downstream of the confluence of Hornes Creek and the Bargo River. Stored water in the Picton Weir is understood to extend to pool HC16 in Hornes Creek (refer **Figure 5**). The Picton Weir was constructed in the late 19th century to supply the township of Bargo. Currently, the weir is heavily silted and no longer used for town water supply.

Hornes Creek is located in a confined valley with the bed material predominantly comprised of exposed bedrock. The baseline geomorphology survey (Gippel, 2013; 2023) identified that Hornes Creek was generally in good geomorphic condition. A total of 12 pools were mapped in Hornes Creek adjacent to the Study Area boundary, with a further five pools mapped upstream. The pool hydraulic controls were found to comprise boulders or bedrock outcrop (refer **Figure 5** for pool locations). Significant bedrock features comprised rock slabs and rockbars.

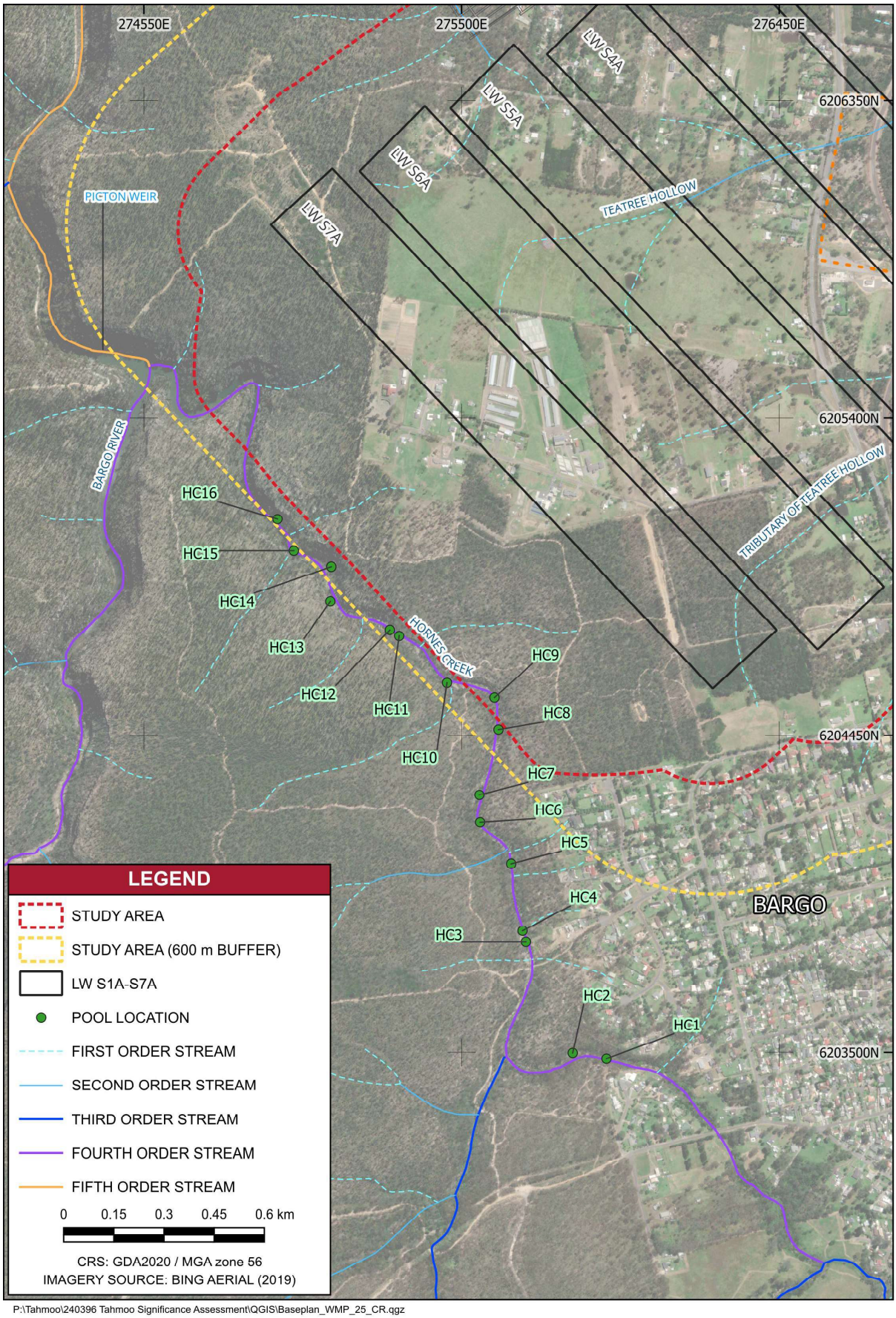

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Figure 5 Hornes Creek Stream Order and Pools

3.2 Surface Water Monitoring Program

The locations of existing surface water monitoring sites are shown in **Figure 6**. **Table 9** lists the monitoring sites relevant to the Study Area and the period of monitoring data record for each site.

The monitoring site nomenclature is associated with the watercourse and pool number (i.e. TT12 is pool 12 on Teatree Hollow) and the type of monitoring to be implemented: water quality (Q), automated (continuous) and manual water level monitoring (La), monthly manual water level measurements only (Lm), rating relationship derived streamflow (R) and streamflow gauging station (F).

A streamflow rating relationship (R) has been derived for specific sites on the Bargo River, Dogtrap Creek, Teatree Hollow and Hornes Creek. A streamflow rating is a relationship specific to each site which enables flow rate to be derived from recorded water level at that particular site location. An extended period of time is generally required following station establishment to develop a rating relationship. For specific sites, the ratings were extended to high flows by theoretical means using surveyed stream cross-sections.

A streamflow gauging station has been constructed on Teatree Hollow (TT-F1) and Dogtrap Creek (DT-F1). To enable accurate and continuous low flow monitoring, the TT-F1 gauging station is comprised of a concrete and steel v-notch weir and the Dog Trap Creek weir is comprised of a sharp-crested reinforced concrete weir and an aluminium flume.

Monitoring sites DT3-QLa and DT4-QLa on Dogtrap Creek are utilised as reference sites, with monitoring data recorded at these sites reviewed against monitoring data recorded at potential impact sites (refer **Appendix A**). Monitoring at other sites in the Dogtrap Creek catchment is undertaken to inform the Extraction Plan for LW S1B-S6B and, as such, monitoring records are not presented in this Water Management Plan unless relevant.

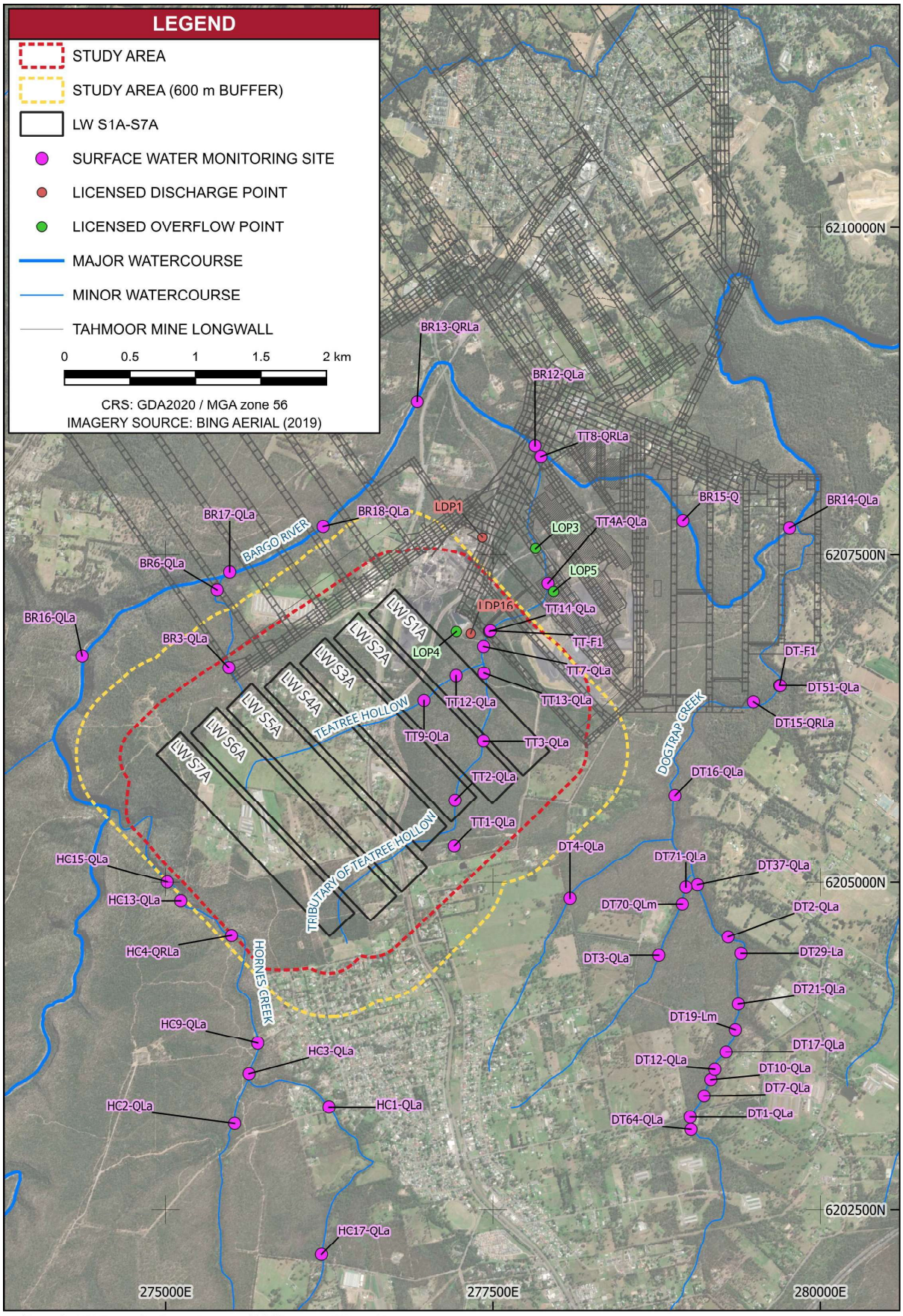

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Figure 6 Surface Water Monitoring Sites

Table 9 Study Area Monitoring Sites - Period of Record

Site Name	Monitoring Type	Period of Record
Bargo River Catchment		
BR3-QLa	Water level and water quality	Oct 2022 – current (La) Sep 2022 – current (Q)
BR6-QLa	Water level and water quality	Dec 2022 – current (La) Sep 2022 – current (Q)
BR12-QLa	Water level and water quality	Jan 2019 – current (Q & La)
BR13-QRLa	Water level, streamflow and water quality	Apr 2012 – Jun 2015 (Q) Feb 2019 – current (Q) Mar 2013 – current (La & R)
BR14-QLa	Water level and water quality	Apr 2012 – Jun 2015 (Q) Feb 2019 – current (Q) Mar 2013 – current (La)
BR15-Q	Water quality	Sep 2022 – current (Q)
BR16-QLa	Water level and water quality	Oct 2022 – current (La) Sep 2022 – current (Q)
BR17-QLa	Water level and water quality	Oct 2022 – current (La) Sep 2022 – current (Q)
BR18-QLa	Water level and water quality	Oct 2022 – current (La) Sep 2022 – current (Q)
Teatree Hollow Catchment		
TT-F1	Streamflow gauging station	Mar 2021 – Aug 2022 (derived baseline flow data) Sep 2022 – current (F)
TT1-QLa	Water level and water quality	Aug 2019 – current (Q) Feb 2020 – current (La)
TT2-QLa	Water level and water quality	Aug 2019 - Mar 2020 (Q) Jan 2020 - Mar 2020 (La) July 2022 - current (Q & La)
TT3-QLa	Water level and water quality	Aug 2019 - Mar 2020 (Q) Feb 2020 - Mar 2020 (La) July 2022 - current (Q & La)
TT4A-QLa	Water level and water quality	May 2020 – current (Q & La)
TT7-QLa	Water level and water quality	Mar 2019 – current (Q) Jan 2020 – current (La)
TT8-QRLa	Water level, streamflow and water quality	Sep 2012 – Jun 2015 (Q) Apr 2019 – current (Q) Mar 2013 – current (La & R)
TT9-QLa	Water level and water quality	July 2022 - current (Q & La)
TT12-QLa	Water level and water quality	Sep 2021 – current (Q & La)
TT13-QLa	Water level and water quality	Oct 2021 – current (Q & La)
TT14-QLa	Water level and water quality	Sep 2021 – current (Q & La)
Hornes Creek Catchment		
HC1-QLa	Water level and water quality	Sep 2019 – current (Q & La)

Site Name	Monitoring Type	Period of Record
Hornes Creek Catchment		
HC9-QLa	Water level and water quality	May 2012 – Jun 2015 (Q) Oct 2020 – current (Q) Mar 2013 – Nov 2015 (La) Feb 2019 – current (La)
HC4-QRLa	Water level, streamflow and water quality	Sep 2019 – current (Q, La & R)
HC17-QLa	Water level and water quality	Mar 2019 – current (Q & La)
HC2-QLa	Water level and water quality	Mar 2020 – current (Q & La)
HC3-QLa	Water level and water quality	Sep 2019 – current (Q & La)
HC15-QLa	Water level and water quality	Jan 2024 – current (Q & La)
Dogtrap Creek Catchment		
DT3-QLa	Water level and water quality	Sep 2019 – current (Q & La)
DT4-QLa	Water level and water quality	Sep 2019 – current (Q & La)

3.3 Baseline Monitoring Records

3.3.1 Water Level and Streamflow

Appendix B presents plots of water level records for the monitoring sites listed in **Table 9**. For comparative purposes, rainfall data from SILO Point Data[4] for a point in close proximity to the watercourses is also presented on the plots.

Field records of the presence of pooled and flowing water at relevant monitoring sites in Teatree Hollow, Hornes Creek, the Bargo River and Dogtrap Creek are collected during the monthly monitoring campaigns at each monitoring site. Due to data gaps[5] in the water level records for some sites, the field records have been used to calculate the frequency of days in which water was present at each monitoring site at the time of sampling.

Table 10 presents a summary of the field records for sites monitored from August 2019. The summary is presented for the following periods:

- Teatree Hollow sites - August 2019 to October 2022: baseline period prior to the commencement of mining of LWS1A (October 2022).
- Bargo River, Hornes Creek and Dogtrap Creek sites - August 2019 to December 2024: full period of record from August 2019 as mining related effects to Bargo River, Hornes Creek and Dogtrap Creek have not occurred.

[4] The SILO Point Data is a system which provides synthetic daily climate data sets for a specified point by interpolation between surrounding point records held by the Bureau of Meteorology – refer https://www.longpaddock.qld.gov.au/silo/point-data/.
[5] Data gaps occur due to site access restrictions, decommissioning of monitoring sites, sensor errors and dry periods.

Table 10 Frequency of Samples with Water Present

Site	Number of Sampling Days	Frequency of Sampling Days Pool was Dry	Frequency of Sampling Days with Pooled Water	Frequency of Sampling Days with Flowing Water
Bargo River Catchment				
BR12-QLa	62	0%	2%	98%
BR13-QRLa	59	0%	100%	100%
BR14-QLa	65	0%	100%	100%
Teatree Hollow Catchment				
TT1-QLa	31	13%	3%	84%
TT7-QLa	32	19%	0%	81%
TT4/TT4A-QLa*	30	87%	3%	10%
Hornes Creek Catchment				
HC1 -QLa**	52	4%	4%	92%
HC9-QLa	65	2%	5%	94%
HC4-QRLa	53	0%	8%	92%
HC17-QLa	65	5%	2%	94%
HC2-QLa	65	8%	2%	91%
HC3-QLa	65	0%	6%	94%
Dogtrap Creek Catchment				
DT3	46	11%	13%	76%
DT4	42	31%	5%	64%

* Monitoring site TT4-QLa was moved immediately downstream in May 2020 and renamed TT4a-QLa.
** Monitoring site HC1-QLa water level sensor was relocated in January 2023 to approximately 20 m upstream of the original location.

The data presented in **Table 10** indicates that the monitoring sites on the Bargo River contained water at the time of each sampling event between August 2019 to December 2024. BR13-QRLa and BR14-QLa were flowing on all sampling occasions while BR12-QLa was flowing on 98% of sampling occasions. Based on the continuous water level records presented in **Appendix B**, in late 2019 and early 2020 during a drought period, connective streamflow in the Bargo River at monitoring sites BR13-QRLa and BR14-QLa ceased.

The presence of water at the monitoring sites in Teatree Hollow catchment varied from upstream to downstream with TT1-QLa (upstream Teatree Hollow tributary) recorded as dry on 13% of sampling occasions and TT4/TT4A-R (downstream Teatree Hollow) recorded as dry on 87% of sampling occasions. As discharge from LDP1 reports to TT8-QRLa, the pool was recorded as holding water for the duration of monitoring (refer Chart C4, **Appendix B**).

The data presented in **Table 10** indicates that flowing water was recorded on at least 91% of sampling occasions at all monitoring sites on Hornes Creek. The number of sampling occasions in which the pools were recorded as dry declined from upstream to downstream with HC17-QLa (upstream) recorded as dry on 5% of sampling occasions and HC4-QRLa (downstream) holding water on all sampling occasions. Monitoring site HC2-QLa on Hornes Creek tributary was flowing on 91% of sampling occasions and dry on 8% of sampling occasions.

Table 11 presents summary statistics of streamflow recorded at select streamflow monitoring sites listed in **Table 9**. With the exception of TT-F1, the summary statistics have been derived for the full period of record at each site. The streamflow records for TT-F1 are presented for the baseline monitoring period to the commencement of mining of LW S1A in October 2022.

It should be noted that high flow rates have been theoretically derived and may not be accurate. With the exception of TT-F1 and DT-F1, low flow rates are considered estimates due to the nature of the streamflow control (natural control) and the associated challenges in monitoring low flows at a natural control.

Table 11 Streamflow Summary Statistics

Statistic	Streamflow Rate (ML/d)			
	BR13-QRLa	TT-F1	DT-F1	HC4-QRLa
Min	0.14	0	0	0
Median	3.8	0	0	7
Mean	25	11	2	22
Max	8,513	854	193	481

3.3.2 Surface Water Quality

3.3.2.1 Default Guideline Values

For comparative purposes and to provide an indication of baseline water quality conditions within and adjacent to the Study Area, water quality data for the period of record has been compared to the ANZECC (2000) and ANZG (2018) default guideline values for the protection of aquatic ecosystems and recreational use in accordance with the perceived principal beneficial uses of the surface water resources in the area. The default guideline values are summarised in **Table 12**.

Table 12 Surface Water Default Guideline Values

Parameter	ANZECC (2000) & ANZG (2018) Default Guideline Values		
	Aquatic Ecosystems (95%ile level of species protection) †	Upland Rivers (NSW) ‡	Recreational Use‡
pH (pH units)	-	6–5 - 8	6–5 - 8.5
EC (µS/cm) and TDS (mg/L)	-	EC 350	TDS 1,000
Total Alkalinity as $CaCO_3$ (mg/L)	-	-	500
Chloride (mg/L)	-	-	400
Sulphate (mg/L)	-	-	400
Sodium (mg/L)	-	-	300
Aluminium (mg/L) pH > 6.5	0.055	-	-
Arsenic (mg/L) (As III)	0.024	-	-
Barium (mg/L)	-	-	1
Cadmium (mg/L)	0.0002	-	-
Copper (mg/L)	0.0014	-	1
Iron (mg/L)	-	-	0.3
Lead (mg/L)	0.0034	-	0.05
Manganese (mg/L)	1.9		0.1
Nickel (mg/L)	0.011	-	-
Selenium (mg/L)	0.011	-	0.01
Zinc (mg/L)	0.008	-	5
NOx (mg/L)	-	0.015	-
Total Phosphorous (mg/L)	-	0.02	-
Total Nitrogen (mg/L)	-	0.25	-

Note: EC = Electrical Conductivity; TDS = Total Dissolved Solids; - no relevant trigger value; † ANZG (2018); ‡ ANZECC (2000).

Water quality summary tables are presented in **Appendix C** for each monitoring site. Where default guideline values for aquatic ecosystems and/or upland rivers were available, the monitoring results were compared with these default guideline values and the percentage of exceedances reported. Where a default guideline value was available for recreational use only, the monitoring results were compared with the recreational use default guideline value and the percentage of exceedances reported. Where laboratory results have been recorded at below the limit of detection the result has been analysed assuming the concentration was equal to the limit of detection.

3.3.2.2 Baseline Water Quality Results

Bargo River

The field and laboratory pH records for monitoring sites on the Bargo River indicate slightly acidic to alkaline conditions, with some exceedances of the ANZECC (2000) default guideline value for pH recorded at all monitoring sites. The field EC records indicate that EC values have ranged between 64 µS/cm and 406 µS/cm at BR13-QRLa and between 99 µS/cm and 337 µS/cm at BR12-QLa. At BR14-QLa, field EC values have ranged between 158 µS/cm and 2,070 µS/cm due to the influence of higher EC water discharged at LDP1 prior to commissioning of an upgraded water treatment plant (WTP).

Exceedances of the default guideline values for aluminium, iron and zinc (dissolved and total) have been recorded historically at the monitoring sites on the Bargo River, including at BR13-QRLa which is located upstream of the confluence with Teatree Hollow and therefore upstream of releases from LDP1. This indicates that concentrations of aluminium, iron and zinc are naturally elevated in the Bargo River. Exceedances of the ANZG (2018) default guideline value for copper were recorded at all monitoring sites. Additionally, exceedances of the ANZECC (2000) default guideline values for total nitrogen and total phosphorus have been recorded historically at all monitoring sites.

Exceedances of the ANZG (2018) default guideline value for arsenic, barium and nickel have been recorded historically at BR14-QLa due to the influence of higher concentrations of these constituents discharged at LDP1. In accordance with EPL 1389, Tahmoor Coal have commissioned an upgraded WTP to reduce the concentration of constituents released to LDP1.

Teatree Hollow

The field and laboratory pH records for monitoring sites on Teatree Hollow and Teatree Hollow tributary indicate slightly acidic to alkaline conditions, with some exceedances of the ANZECC (2000) default guideline value range for pH recorded at all monitoring sites. Field and laboratory pH records for monitoring site TT8-QRLa consistently exceed the ANZECC (2000) default guideline value range due to the influence of higher pH water discharged at LDP1 in accordance with EPL 1389.

The field EC records for monitoring sites on Teatree Hollow and Teatree Hollow tributary, upstream of mining influences, indicate that maximum EC values have ranged from 218 µS/cm recorded at TT13-QLa to 663 µS/cm recorded at TT1-QLa. Within the area of potential mining influences, the field EC records indicated that maximum EC values have ranged from 384 µS/cm recorded at TT14-QLa to 2,490 µS/cm recorded at TT8-QRLa. It should be noted that TT8-QRLa on Teatree Hollow is influenced by higher EC water discharged at LDP1.

Exceedances of the default guideline values for aluminium, copper, iron and zinc (dissolved and total) have been recorded historically at TT1-QLa, TT2-QLa, TT7-QLa, TT12-QLa and TT13-QLa, located upstream of existing mining influences, indicating that these constituents are naturally elevated in the Teatree Hollow catchment. Additionally, exceedances of the ANZECC (2000) default guideline values for total nitrogen and total phosphorus have been recorded historically at all monitoring sites.

Exceedances of the ANZG (2018) default guideline value for arsenic, barium, cadmium and nickel have been recorded historically at TT8-QRLa due to the influence of higher concentrations of these constituents discharged at LDP1. The ANZG (2018) default guideline value for total lead was exceeded in one sample recorded at TT4A-QLa and 24% of samples recorded at TT8-QRLa, although the dissolved lead concentrations recorded at these sites did not exceed the ANZG (2018) default guideline value.

Hornes Creek

The field and laboratory pH records for monitoring sites on Hornes Creek indicate slightly acidic to alkaline conditions, with some exceedances of the ANZECC (2000) default guideline value range for pH recorded at all monitoring sites. The field EC records for monitoring sites on Hornes Creek indicate that maximum EC values have ranged from 289 µS/cm recorded at HC13-QLa to 694 µS/cm at HC9-QLa. Exceedances of the default guideline values for aluminium and iron (dissolved and total) have been recorded at all monitoring

sites. Exceedances of the default guideline values for copper (dissolved and total) have been recorded at all monitoring sites, excluding sites HC13 and HC15 (dissolved copper). Exceedances of the default guideline values for zinc (dissolved and total) have been recorded at all monitoring sites, excluding site HC13. Exceedances of the ANZG (2018) default guideline value for dissolved manganese were recorded at HC4-QRLa (2% of samples) and HC9-QLa (5% of samples). Exceedances of the ANZG (2018) default guideline value for dissolved nickel were also recorded at HC9-QLa (10% of samples). Additionally, exceedances of the ANZECC (2000) default guideline values for total nitrogen and total phosphorus have been recorded at all monitoring sites.

The ANZG (2018) default guideline value for total lead was exceeded in one sample recorded at HC4-QRLa and two samples recorded at HC9-QLa, although the dissolved lead concentrations recorded at these sites did not exceed the ANZG (2018) default guideline value.

3.3.2.3 Site Specific Guideline Values

In order to reflect local conditions, ANZG (2018) recommend that site specific guideline values (SSGVs) are derived for physical and chemical constituents monitored in surface water systems. ANZG (2018) recommend that the 80th percentile value of water quality monitoring data recorded over a period of 2 years should be adopted as the SSGV. The 20th percentile value of pH monitored over a period of 2 years is recommended to be adopted for the lower pH SSGV.

As constituent values may at times naturally exceed the 80th percentile value of the baseline water quality data, an exceedance of an SSGV is not considered as immediate evidence of an impact, rather an indication of potential changes in water quality characteristics which may result in impacts to aquatic ecosystems at monitored surface water sites.

As stated in **Section 3.3.2**, some constituents recorded at monitoring sites in the Bargo River, Teatree Hollow and Hornes Creek are naturally elevated above the default guideline values. As such, SSGVs have been derived for naturally elevated constituents where sufficient monitoring data is available. Where the baseline constituent values do not exceed the default guideline values, the default guideline values are proposed to be adopted in the assessment of a trigger exceedance (detailed in **Appendix A**). The SSGVs are only proposed for those constituents which are naturally elevated or which have the potential to be influenced by mining of LW S1A-S7A. The water quality monitoring data for all constituents would continue to be recorded and reviewed throughout the duration of the Project to identify any additional constituents which may need to be assessed against the surface water quality TARP (refer **Appendix A**).

The SSGVs for Teatree Hollow sites, with the exception of TT1-QLa which has not been affected by mining to date, have been derived from baseline data up to commencement of mining of LW S1A. The SSGVs for monitoring sites located upstream or outside of the influence of Tahmoor South mining activities have been revised to reflect additional / contemporary baseline monitoring data.

Due to the influence of discharge from Tahmoor Mine, which is undertaken in accordance with EPL 1389, SSGVs have only been proposed for monitoring sites which are located upstream of LDPs.

Table 13 presents the SSGVs for relevant surface water monitoring sites. The values that were derived from baseline monitoring data are shown in bold. Where laboratory results have been recorded at below the limit of detection the result has been analysed assuming the concentration was equal to the limit of detection.

In accordance with the surface water quality TARP presented in **Appendix A**, the SSGVs would be compared against monitored data in order to identify exceedances of the trigger levels and initiate further action.

Table 13 Site Specific Guideline Values

Parameter	BR3-QLa	BR6-QLa	BR12-QLa	BR13-QRLa	BR16-QLa	BR17-QLa	BR18-QLa	HC9-QLa	HC4-QRLa	HC3-QLa
No. of Values[(1)]	19	22	24	24	24	24	24	24	24	24
pH (pH units)	**5.8** – 8	**5.3** - 8	6.5 - 8	6.5 - 8	6.5 - 8	6.5 - 8	**6.3 - 8**	**6 - 8**	6.5 - 8	6.5 - 8
EC (µS/cm)	350	350	350	350	350	350	350	**352**	350	350
Dissolved Aluminium (mg/L) pH > 6.5	**0.1**	**0.09**	**0.06**	**0.06**	0.055	0.055	**0.07**	**0.14**	**0.15**	**0.11**
Dissolved Copper (mg/L)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Dissolved Iron (mg/L)	0.3	0.3	**0.62**	**0.67**	**0.69**	**0.69**	**0.91**	**2.1**	**0.57**	**0.45**
Dissolved Manganese (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)	0.008	**0.03**	0.008	0.008	0.008	0.008	0.008	**0.01**	0.008	0.008

Parameter	TT1-QLa	TT2-QLa	TT7-QLa	TT12-QLa	TT13-QLa	TT14-QLa	DT3-QLa	DT4-QLa
No. of Values[(1)]	56	12	35	13	13	13	49	44
pH (pH units)	6.5 – 8	**6 – 8**	6.5 – 8	6.5 – 8	6.5 – 8	6.5 – 8	6.5 - 8	6.5 - 8
EC (µS/cm)	**512**	350	**359**	350	350	350	350	350
Dissolved Aluminium (mg/L) pH > 6.5	**0.1**	**0.17**	**0.06**	**0.1**	0.092	**0.11**	**0.08**	**0.2**
Dissolved Copper (mg/L)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Dissolved Iron (mg/L)	**0.76**	**0.55**	**0.81**	**0.64**	**0.47**	**0.57**	**0.48**	**0.60**
Dissolved Manganese (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)	**0.03**	**0.02**	**0.03**	0.008	0.008	0.008	0.008	0.008

Note: The values that were derived from baseline monitoring data are shown in bold. [1] Minimum number of values used in SSGV derivation – for some constituents, a greater number of values were used.

3.3.3 Baseline Aquatic Habitat and Stream Health

Four seasons of aquatic ecology monitoring were undertaken between 2012 and 2013 on the Bargo River, Hornes Creek and Teatree Hollow. Additional baseline aquatic ecology monitoring campaigns were undertaken between 2019 and 2022, prior to the commencement of mining of LW S1A. Details of the baseline monitoring is presented in the Biodiversity Management Plan and summarised as follows.

Monitoring undertaken during periods of below average rainfall identified that low streamflow rates placed natural stresses on the aquatic environment and the availability and quality of aquatic habitat. Regeneration was observed at sites that had been impacted by bushfires in late 2019. Overall, aquatic habitat quality was considered good at all sites with the exception of two sites in the Bargo River, located upstream of the confluence with Teatree Hollow, which were considered to be highly disturbed.

Stream health assessments, using the Australian River Assessment System (AUSRIVAS) methods, identified that Teatree Hollow had impaired stream health conditions when compared to reference site and control site data. The results indicated that Teatree Hollow was subject to environmental stress likely due to a combination of natural and anthropogenic factors including agriculture and road crossings. Niche (2021) note that this has likely been exacerbated by bushfire impacts and changes in climatic conditions varying between extended periods of below average rainfall and notable high rainfall events.

The majority of sites monitored in Teatree Hollow, Hornes Creek and the Bargo River scored in Band B and Band C indicating significantly to severely impaired stream health. One site in the Bargo River scored in Band A on one occasion (indicating similar conditions to the reference sites) while one site in Teatree Hollow scored in Band D on one occasion (indicating extremely impaired stream health).

Macroinvertebrate assemblage results indicated large variability across the sites, with less dispersion observed at sites monitored in the Bargo River and Hornes Creek. A total of nine fish species were detected during the surveys with the most commonly encountered species being the Yabby (*Cherax destructor*), Common Freshwater Shrimp, (*Paratya australiensis*), Eastern Gambusia (*Gambusia holbrooki*) and Australian Smelt (*Retropinna semoni*). No threatened fish species were recorded during the surveys and are considered unlikely to be present in the Study Area. The Sydney Hawk Dragonfly (*Austrocordulia leonardi)*, listed as endangered, was not identified during the targeted surveys and the species is considered unlikely to be present in the Study Area.

3.4 Tahmoor Coal Water Access Licences

Tahmoor Coal holds a Water Access Licence (WAL) for the Sydney Basin Nepean Groundwater Source, in accordance with the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2023*. Additionally, Tahmoor Coal holds WALs for the Stonequarry Creek Water Source and Maldon Weir Water Source, in accordance with the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources* 2023. The WALs currently held by Tahmoor Coal are detailed in **Table 14**.

Table 14 Tahmoor Coal Water Access Licences

WAL	Water Sharing Plan	Water Source	Management Zone	Entitlement	Category
36442	Greater Metropolitan Region Groundwater Sources WSP 2023	Sydney Basin Nepean Groundwater Source	Nepean Management Zone 2	1,642 units	Aquifer
SWC868868 (Leased)	Greater Metropolitan Region Groundwater Sources WSP 2023	Sydney Basin Nepean Groundwater Source	Nepean Management Zone 2	1000 ML	Aquifer
25777	Greater Metropolitan Region Unregulated River Water Sources WSP 2023	Maldon Weir		5 ML	Unregulated river
SWC871469 (Leased)		Maldon Weir		11 ML	
43656		Maldon Weir		25 ML	
45204		Stonequarry Creek Water Source		25 ML	
43631		Little River Water Source		0 ML	
43655		Maguires Crossing Water Source		0 ML	
43657		Upper Nepean Rivers	Pheasants Nest to Nepean Dam	0 ML	
43659		Upper Nepean Rivers	Pheasants Nest to Nepean Dam	0 ML	

Note: WSP = Water Sharing Plan.

3.5 Other Water Users

3.5.1 Water Access Licences

As of June 2021, there were 21 WALs allocated for the Maldon Weir Water Source, excluding WALs held by Tahmoor Coal, with a corresponding total share component of 662.5 ML for the period July 2025 to June 2026 (inclusive)[6]. One WAL was associated with a property located adjacent to the Bargo River downstream of the Study Area (refer **Figure 7** for locations). The remainder of WALs within the Maldon Weir Water Source were located outside of the potential zone of influence associated with mining of LW S1A-S7A.

3.5.2 Farm Dams

A total of 45 farm dams have been identified within the Study Area, the locations of which are shown in **Figure 8**. The farm dams have been identified as typically shallow (less than three metres deep), of earthen construction and established by localised cut and fill operations within natural watercourses (MSEC, 2022 and MSEC, 2024). Monitoring of farm dams, TARPs and proposed management measures are detailed in the Land Management Plan.

[6] https://waterregister.waternsw.com.au - accessed July 2025.

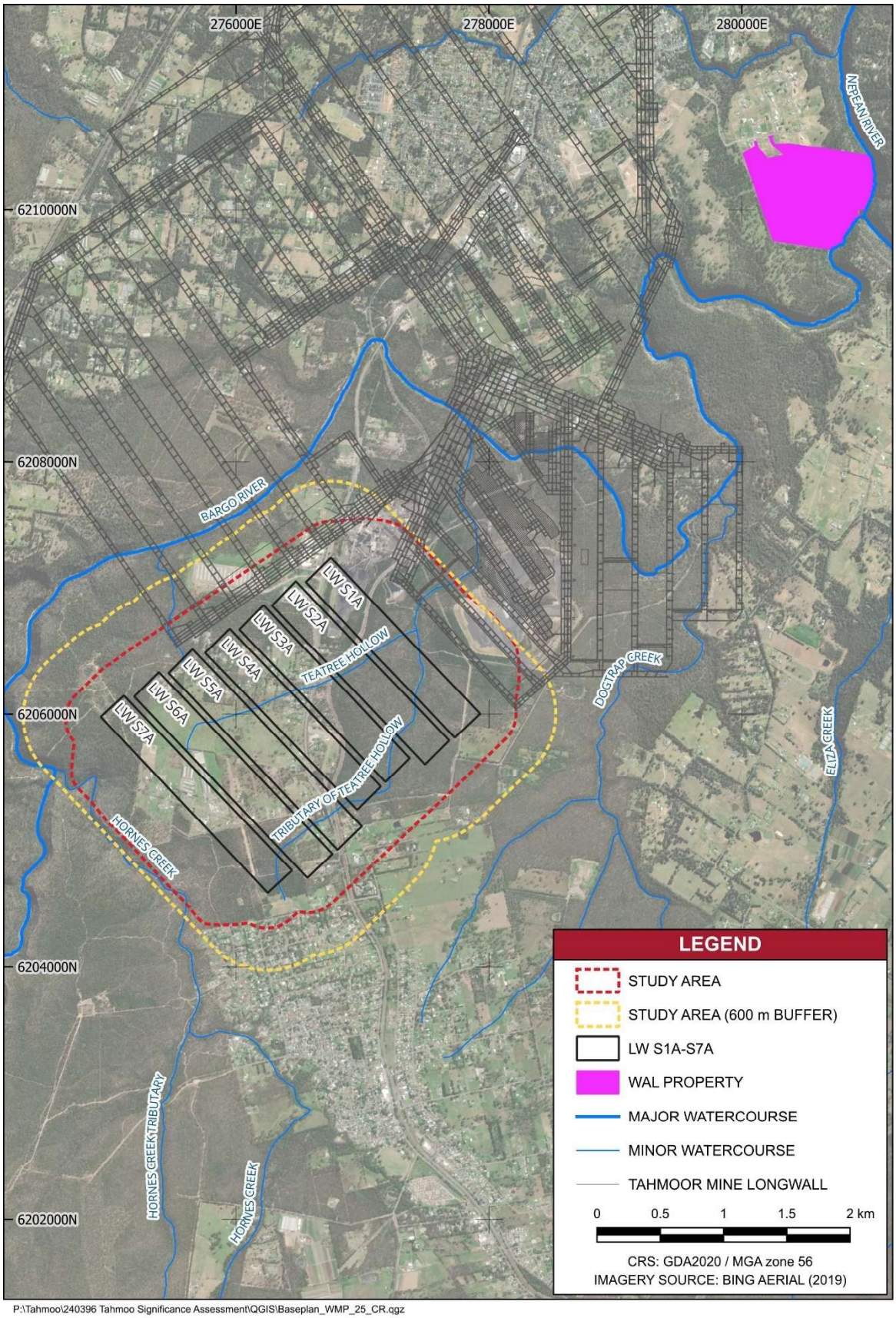


Figure 7 Study Area WAL Properties

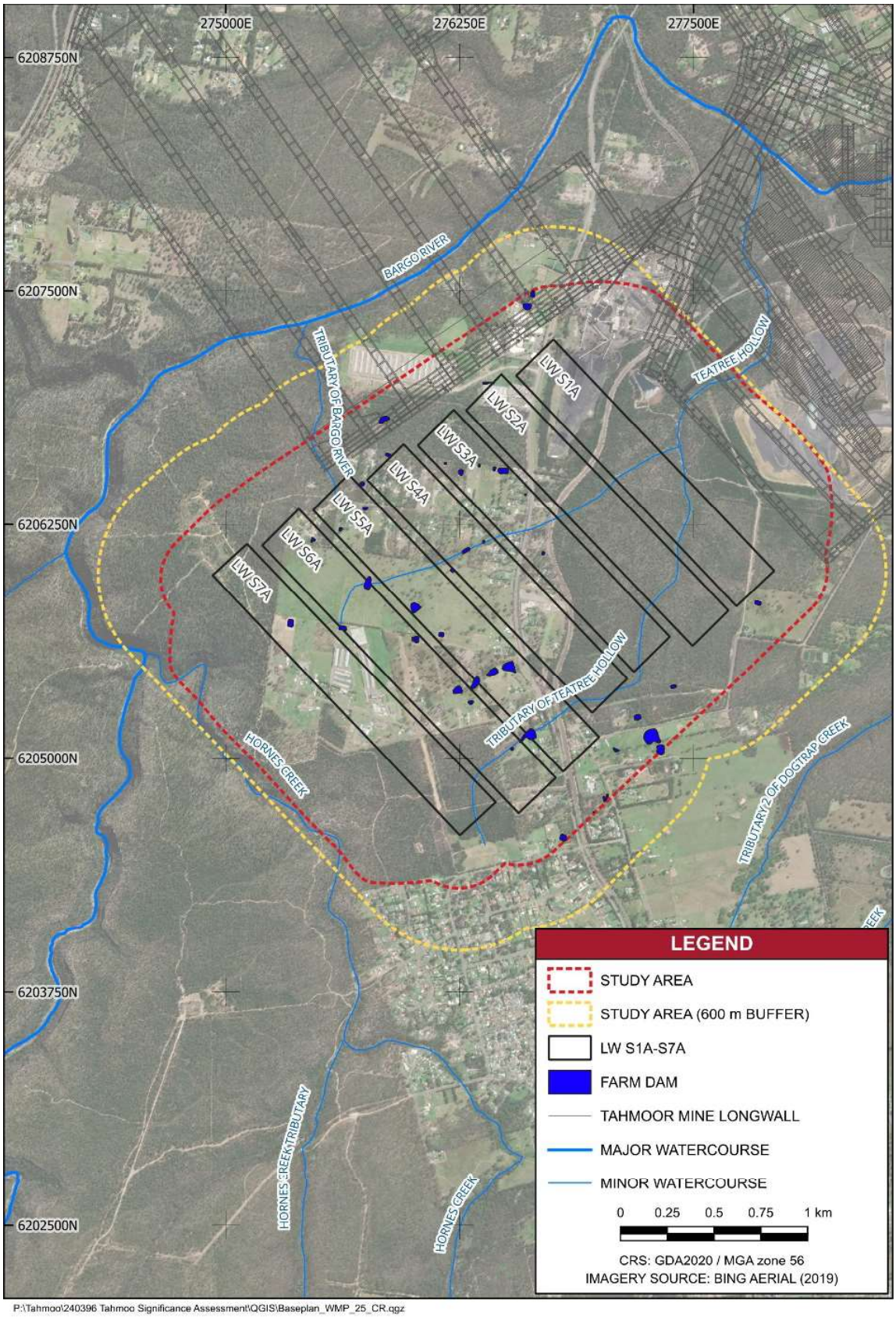


Figure 8 Study Area Farm Dams

3.6 Groundwater Resources

The groundwater resources within and adjacent to the Study Area are detailed in the Groundwater Impact Assessment (**Appendix D**) and summarised as follows.

3.6.1 Hydrogeological Units

The major hydrostratigraphic units that characterise the area around Tahmoor Mine are the Sydney Basin Triassic and Permian rock units, with the Hawkesbury Sandstone being the primary aquifer. These aquifers fall within the Sydney Basin Nepean Groundwater Source and have been classified as being 'Highly Productive' by the NSW Government based on considerations of bore yield and groundwater quality. The Bulgo Sandstone and Illawarra Coal Measures of the Triassic Narrabeen Group supply additional water to this system; however, contributions are substantially lower (SLR, 2024).

SLR (2024) note that limited surficial alluvium has been mapped in the Study Area. The shales of the Triassic Wianamatta Group are more extensive, predominantly to the north of the Tahmoor Mine, however have limited potential as a highly productive aquifer and are limited in the vicinity of LW S1A-S7A.

The key hydrogeological units relevant to the Study Area are summarised below (SLR, 2024):

- Alluvium – the Thirlmere Lakes alluvium comprising an upper peat sequence that grades into a distinct oxidised silty clay that underlies the entirety of the lakes. The oxidised silty clay layer acts as a local aquitard. The Thirlmere Lakes alluvium is mapped as being approximately 300 m west of the Tahmoor Mine and approximately 3,500 m west of LW S1A-S7A.
- Wianamatta Group – composed of the Liverpool Subgroup which includes the Bringelly Shale Formation, Minchinbury Sandstone and Ashfield Shale Formations. This formation is present as hill cappings overlying the Hawkesbury Sandstone formation, particularly in the northern region of the Tahmoor Coal leases. The formation predominantly comprises shales with low permeability and poor water quality.
- Hawkesbury Sandstone – a porous rock aquifer of moderate resource potential, with higher resource potential in areas where secondary porosity has developed, such as the Nepean Fault zone. SLR (2024) reaffirmed this conceptualisation and noted that while the unit is generally homogenous at the regional scale, localised variation in fracture density and structure influences flow behaviour in proximity to features such as the Nepean Fault Zone. Over the Tahmoor Mine area, groundwater in this aquifer generally flows in an east to north-easterly direction. The water table is approximately 20 m below the ground surface in proximity to surface drainage lines, and 40-50 m below the ground surface in areas not associated with surface drainage lines. This formation is dominant across the Tahmoor Mine and beneath the alluvium and Wianamatta Group formation, except in eroded areas along valleys in the western region where the Narrabeen Group formation has been exposed.
- Narrabeen Group – composed of interbedded sandstone, claystone and siltstone with low permeability and low resource potential. This formation is present across the Tahmoor Mine site underlying the Hawkesbury Sandstone formation.
- Illawarra Coal Measures – composed of interbedded sandstones, shale, mudstones and coal seams including the Bulli Coal seam (2-4 m thick), the Eckersley Formation (8-38 m thick) which includes the Balgownie Seam, Loddon Sandstone and Lawrence Sandstone, the Wongawilli Seam (8-10 m thick) and the Kembla Sandstone. The poor water quality results in low resource potential. This formation is present across the Tahmoor Mine site underlying the Narrabeen Group formation.

3.6.2 Historic Groundwater Inflow

Since 2009, groundwater inflow to the Tahmoor Mine (Tahmoor North and Western Domain) has ranged from an estimated 2 ML/d to 6 ML/d. Calculated total groundwater inflow volumes to the Tahmoor Mine workings for water years 2019 to 2024 are presented in **Table 15**. The groundwater inflow to the Tahmoor Mine workings was calculated as described in SLR (2023)[7]. **Figure 9** presents the calculated total groundwater inflow volumes for water years 2016 to 2024 in comparison to the WAL36442 entitlement currently held by Tahmoor Coal for access to the Sydney Basin Nepean Groundwater Source.

Table 15 Calculated Groundwater Inflow to the Tahmoor Mine Workings

Water Year*	Average Daily Inflow (ML/day)	Total Inflow (ML)
2018 – 2019	3.4	1,225
2019 – 2020	3.3	1,207
2020 – 2021	4.5	1,641
2021 – 2022	4.3	1,577
2022 - 2023	2.9	1,068
2023 - 2024	3.6	1,310

* 1 July to 30 June.

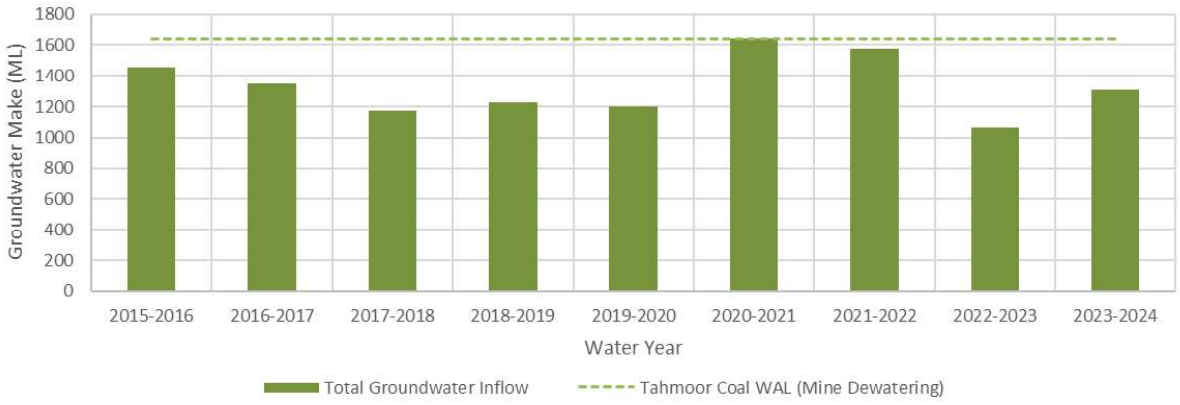


Figure 9 Calculated Groundwater Inflow to the Tahmoor Mine Workings

As stated in **Section 3.4**, WAL36442 provides Tahmoor Coal with 1,642 units of entitlement to the Sydney Basin Nepean Groundwater Source, in accordance with the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2023*. Based on the calculated groundwater inflow volumes to the Tahmoor Mine workings for each water year from 2016, as presented in **Figure 9**, the 1,642 units of entitlement held by Tahmoor Coal have not been exceeded to date.

3.6.3 Baseline Groundwater Levels

Groundwater level monitoring data for the Tahmoor South reference sites, as detailed in the Groundwater Monitoring Plan (SLR, 2024), are presented and discussed in the sections which follow. Sites TBC009, TBC018, TBC019B, TBC020, TBC024, TBC026, TBC027, TBC032, TBC034 and TBC038 are equipped with Vibrating Wire Piezometers (VWPs) with monitoring commencing between 2012 and 2013. Data loggers have also been installed in P51a, P51b, P52a, REA4, P53a, P53b, P53c, P55a, P55b and P55c. The depths of each VWP sensor and monitored strata are presented in **Appendix D** (SLR, 2024).

[7] Groundwater inflow to the Tahmoor Mine workings is calculated as the residual of water supplied to the underground workings (monitored flows), water re-circulated underground and water pumped from the underground workings to the surface (monitored flows).

3.6.3.1 Site TBC027

TBC027 is located 2,700 m south-west of approved LWS6B and 500 m west of Hornes Creek. Groundwater level records are available for this site from April 2013 and have been recorded at various depths in the HBSS, BGSS, BUCO, WWCO, BHCS and the WBCS (refer **Figure 10**). The baseline monitoring data indicates that groundwater levels have generally increased by 1-2 m during periods of above average rainfall. Above average rainfall in early 2020 resulted in an increase in water levels of approximately 4-6 m.

A pressure differential of approximately 6-7 m has been recorded in the upper (HBSS-95m) and lower (HBSS-132 m and HBSS-169m) Hawkesbury Sandstone units, with an evident downward vertical gradient. Groundwater levels in the upper Bulgo Sandstone unit (BGSS-198 m) appear less responsive to rainfall recharge with generally stable groundwater levels recorded since the commencement of monitoring. This suggests limited aquifer connectivity between the Hawkesbury Sandstone unit and the Bulgo Sandstone unit.

Groundwater depressurisation, likely due to regional mining (i.e. Tahmoor North), was recorded from mid-2016 to early 2020, with groundwater levels decreasing by approximately 10-12 m in the lower Bulgo Sandstone and coal seams. From early 2020, groundwater levels stabilised with minor observed recovery.



Figure 10 TBC027 Groundwater Level Monitoring

3.6.3.2 Site TBC034

TBC034 is located 2,500 m southwest of LWS6B and 1,500 m west of the Bargo River. Groundwater level records are available for this site from April 2013 and have been recorded at various depths in the HBSS, BGSS, BUCO, WWCO, BHCS and the WBCS (refer **Figure 11**). Groundwater levels recorded in all units were generally stable with only minor changes in groundwater level recorded in response to changes in climatic conditions.

An evident downward vertical gradient was recorded in the HBSS layers. Some degree of aquifer connectivity was recorded between the upper and mid BGSS (BGSS-196m to BGSS-294.3m) and the lower HBSS (HBSS-161m).

A pressure differential of 40-45 m between the lower (BGSS-343.5m) and upper (BGSS-196m) BGSS units was recorded indicating a strong downward vertical gradient in this unit. SLR (2021) note that this is likely reflective of the Western Domain fault.

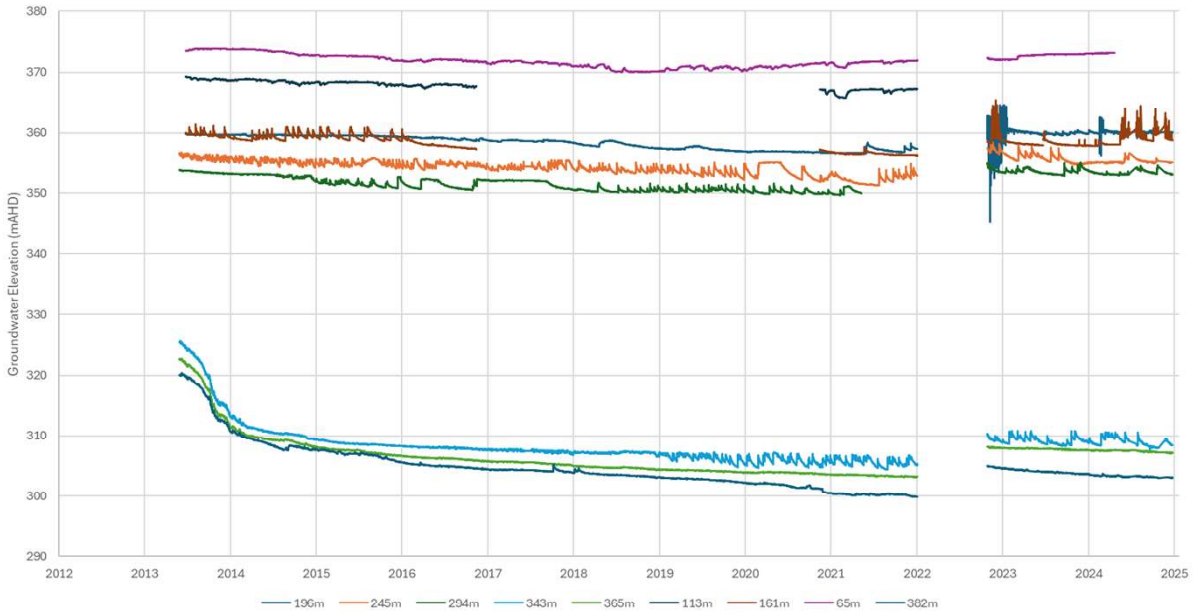


Figure 11 TBC034 Groundwater Level Monitoring Data

3.6.4 Baseline Groundwater Quality

Groundwater quality across the Study Area has been characterised through sampling of purpose-installed open standpipes and selected private landholder bores. Parameters analysed include electrical conductivity (EC), pH, major ions, nutrients, and metals. Data collected between 2022 and 2023 are summarised in the SLR (2024) Groundwater Impact Assessment (**Appendix D**) and form the basis for baseline characterisation. Open standpipes installed in May 2022 at key monitoring locations were sampled to assess groundwater quality in the Hawkesbury Sandstone and Narrabeen Group. Values of EC at these bores ranged from approximately 160 to 1,800 µS/cm, with a median of 1,500 µS/cm. The pH values ranged from 4.7 to 6.6. These records are presented in **Table 16**. Groundwater within the Hawkesbury Sandstone is generally of low to moderate salinity and slightly acidic, but typically suitable for stock and domestic use.

Groundwater quality data for deeper units are limited. Publicly available regional data indicate Total Dissolved Solids (TDS) concentrations between 3,200 and 27,500 mg/L, consistent with poor quality groundwater and limited beneficial use.

Water quality data obtained from selected private landholder bores located within and around the Study Area indicate EC values ranged from 165 to 3,378 µS/cm, with a median of 810 µS/cm. The pH values were generally acidic to neutral.

Table 16 Tahmoor South Groundwater Monitoring Bore – Salinity and pH Summary (June 2023)

Bore ID	EC (µS/cm)	pH
P51A	162.9	5.18
P51B	1,378	10.66
P52	1,257	5.88
P53A	1,018	6.36
P53B	988	7.47
P53C	1,144	6.66
P54A	N/A (dry)	N/A (dry)
P54B	N/A (dry)	N/A (dry)
P55A	1,772	5.57
P55B	1,402	5.68
P55C	1,273	6.16
P56A	953	5.41
P56B	1,135	11.46
P56C	929	8.15
REA4	282	6.88
GW104659	573.2	5.79
GW109257	793	4.21
GW112473	551.7	4.36
GW105395	3,582	5.84
GW104323	1,279	4.01
GW104008	1,584	5.88

Notes: mbgl = metres below groundwater level; EC = electrical conductivity.
Source: SLR (2024).

Review of the local and regional data indicates that:

- Groundwater in the alluvium and Wianamatta Group is of mixed quality. Evaporative concentration of salts may occur in alluvial aquifers, particularly in clay-rich zones. The marine origin and low permeability of the Wianamatta Shales typically results in elevated salinity.
- There are limited groundwater quality data available for the Narrabeen Group and no direct sampling results for the Illawarra Coal Measures within the Study Area. Regional data indicate that the Illawarra Coal Measures host brackish to saline water. Older units such as the Shoalhaven Group exhibit a range of salinities from fresh to saline.
- The Hawkesbury Sandstone is the primary aquifer utilised in the area. While groundwater salinity is variable, it is generally suitable for stock and domestic use and most irrigation.

3.6.5 Groundwater Flow, Recharge and Discharge

The interpreted water table elevation in shallow groundwater aquifers within and adjacent to the Study Area is presented in **Figure 12.** Groundwater generally flows in a south-west to north-east direction, consistent with regional topography and interpreted potentiometric surfaces (SLR, 2024).

Groundwater levels tend to be shallower in proximity to surface drainage lines, with depths generally ranging between 20 and 40 m below ground surface. In areas not associated with surface drainage, water levels are typically 40 to 50 m below ground surface (SLR, 2024). Water table gradients broadly follow surface topography across the Study Area, consistent with regional potentiometric surfaces interpreted

from monitoring data (SLR, 2024). While localised recharge from surface water may occur where creeks intersect shallow water tables, these interactions are spatially limited and depend on local hydraulic gradients and lithological conditions.

The Bargo River is interpreted to exhibit both gaining and losing behaviour depending on local topographic and hydraulic conditions. Similarly, Dogtrap Creek may alternate between gaining and losing conditions. These interactions are primarily controlled by stream incision depth, connectivity with the shallow aquifer, and temporal variations in recharge. A tributary of Teatree Hollow located above LW S2A is a lower order stream that is not connected to the groundwater table, with groundwater levels significantly deeper than the streambed, suggesting limited potential for sustained baseflow (SLR, 2024).

In the Hawkesbury Sandstone, groundwater is inferred to flow eastward across LW S1A-S7A area, and from the south-west to north-east across the LW S1B-S6B area. In the lower Bulgo Sandstone and Bulli Seam, regional groundwater flow is similarly inferred to trend north-east, based on interpreted heads (SLR, 2024).

3.6.6 Groundwater Use

3.6.6.1 Groundwater Dependent Ecosystems

Thirlmere Lakes are the closest 'High Priority' groundwater dependent ecosystem to the Tahmoor Mine, being 650-700 m from historical Tahmoor longwalls at their closest points, but at least 3,500 m from LW S1A-S7A (refer **Figure 13**). The Thirlmere Lakes are of high conservation importance, gazetted as the Thirlmere Lakes National Park in 1972 and providing habitat for dependent aquatic species (Schädler & Kingsford, 2016). The nearest Tahmoor Mine longwall panels to the Thirlmere Lakes were mined between 1996 and 2002. Further information pertaining to the Thirlmere Lakes is provided in **Section 3.7.**

3.6.6.2 Springs

Relevant literature indicates that the Hawkesbury Sandstone may contain springs that have developed in saturated and perched aquifers of the formation (HydroSimulations, 2018). However, no significant springs or soaks have been mapped or located in the vicinity of the Project. Field investigations carried out by Brienen Environment & Safety (2022d) supported this finding. This was further confirmed by site inspections undertaken in January 2024 by Niche Environment and Heritage, who found no evidence of springs (SLR, 2024).

3.6.6.3 Anthropogenic Use

As stated in the EIS Groundwater Assessment (HydroSimulations, 2020), there are 982 registered bores and an associated 791 WALs within the immediate vicinity of the Study Area. The Hawkesbury Sandstone, surficial alluvium and basalt aquifers were the predominant target aquifers (89% of the total) with approximately 10% targeting the Bulgo Sandstone.

A total of 52 registered bores which had the potential to incur a Project related groundwater drawdown of greater than 2 metres, as identified in the EIS, were incorporated into the Private Bore Baseline Survey in 2022 as per the requirements of the Aquifer Interference Policy. During the survey process an additional six bores were incorporated into the survey at the request of individual landholders. The "heritage well", previously identified in the *Statement of Heritage Impact (SoHI)* for the Wirrimbirra Sanctuary (EMM, 2020) was also incorporated. Subsequently, a total of 59 private bores were proposed to be assessed, however, only 40 of these bores were inspected due to access restrictions. The baseline survey commenced on 15 January 2022 and was concluded by 15 March 2022. SLR (2024) predicted that a total of 13 registered private bores were likely to experience greater than 2 metres of drawdown as a result of extraction from LW S7A, while 27 private bores were predicted to experience greater than 2 metres of cumulative drawdown.

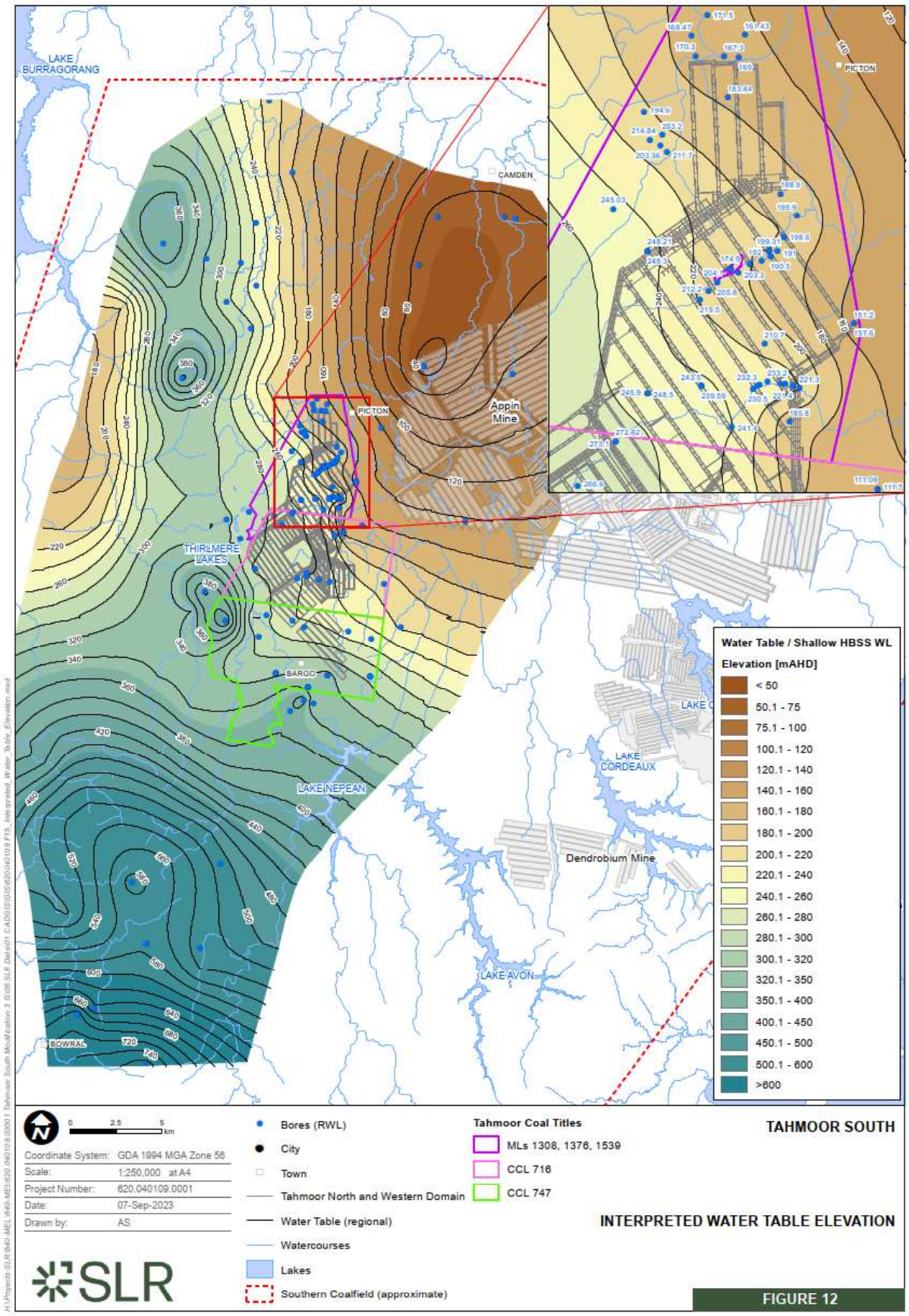


Figure 12 Interpreted Water Table Elevation (Shallow Hawkesbury Sandstone)

3.7 Thirlmere Lakes

The Thirlmere Lakes are situated in the upper reaches of Blue Gum Creek, which ultimately flows to Lake Burragorang (Warragamba Dam) – the main water supply storage of Sydney. The Thirlmere Lakes are a series of five interconnected Lakes (in order from most upstream to downstream): Gandangarra, Werri Berri, Couridjah, Baraba and Nerrigorang (refer **Figure 13**).

The water level of the Thirlmere Lakes has fluctuated over time, however, a notable decline in water level between 2017 and 2019 has initiated further research on the hydrological and hydrogeological characteristics of the lakes.

The Thirlmere Lakes Research Program identified that the lakes are a climate-sensitive wetland, with their water balance primarily driven by rainfall and evaporation (DPE, 2022). Input to the Thirlmere Lakes is primarily rainfall-runoff from small localised catchments, although the lakes can also receive water via infiltration[8] and interflow[9] processes from the surrounding catchment. Outflow from the lakes predominantly comprises evapotranspiration and streamflow, with a small component of outflow comprising groundwater discharge (DPE, 2022).

The water balance assessment identified that the primary influence on water level variation over the period of study (January 2014 to September 2020) was climatic, with the water balance accounting for approximately 83-98% of lake level variation during this period (DPE, 2022).

The geological investigations identified that there was no direct geological link between the Thirlmere Lakes and the Tahmoor Mine and there was no chemical or isotopic evidence of a correlation between groundwater in the mine and surface water in the lakes. DPE (2022) note that a lack of chemical or isotopic signature does not preclude the possibility of indirectly diminished groundwater discharge and/or runoff into to the lakes as a result of mining or other anthropogenic influences. However, the field and modelling results suggest that the recent water level declines are primarily associated with climate variability versus longwall mining.

[8] The process by which water on the ground surface enters the soil (DPE, 2022).

[9] The lateral movement of water in the unsaturated zone that returns to the surface prior to discharging to the groundwater system (DPE, 2022).

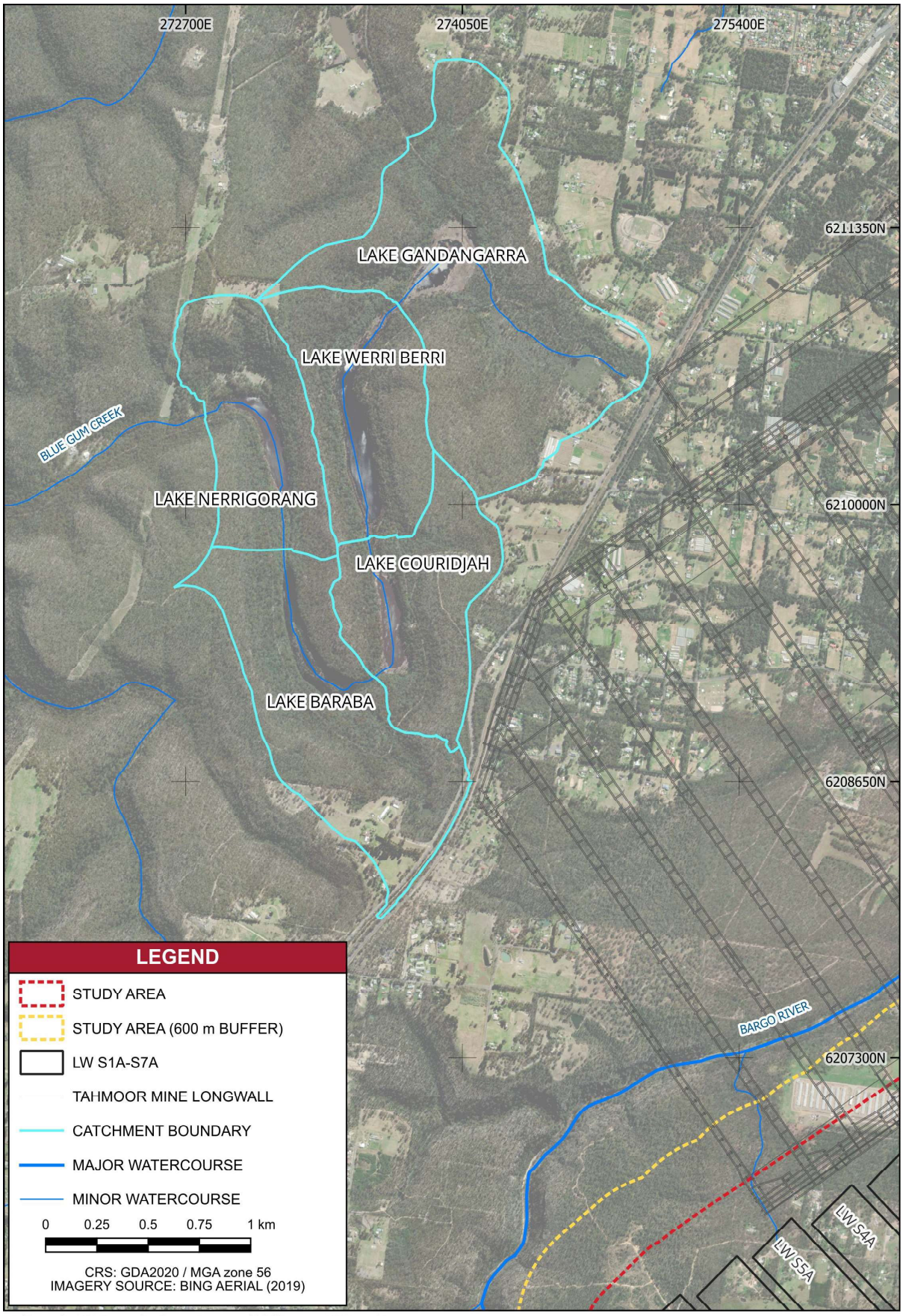


Figure 13 Thirlmere Lakes

4 Review of Environmental Performance

4.1 Surface Water

The following sections summarise the effects to surface water features within and adjacent to the Study Area associated with mining of LW S1A-S3A.

Hornes Creek, the Bargo River and the Bargo River tributary are currently located outside of the potential influence of mining of LW S1A-S3A. To date, impacts to these watercourses have not occurred as a result of mining of LW S1A-S3A.

4.1.1 Effects to Physical Features

Table 17 summarises the impacts to physical features that have been visually observed at pools on Teatree Hollow and Teatree Hollow tributary following commencement of mining of LW S1A-S3A.

Table 17 Summary of Physical Effects to Pools

Pool	Summary of Visual Inspection Records
TT2	Mining related fractures observed directly upstream of pool TT2 from July 2023.
TT3	Visually observed anomalous change in water level and overland connected flow from July 2024.
TT7	Iron staining in excess of baseline conditions observed from March 2023 to March 2024.
TT9	Four fractures were observed in November 2024, approximately 140 m upstream of pool TT9.
TT10	A fracture upstream of pool TT10 was observed in October 2024.
TT11	Mining-related fractures observed upstream of pool TT11 from February 2023.
	Minor gas bubbling observed.
TT12	Mining-related fractures observed upstream, downstream and in the centre of pool TT12 from March 2023.
TT13	Fractures visually observed in the centre of pool TT13 from July 2023.
TT15	A fracture was identified downstream of the pool in October 2024.

4.1.2 Water Level Effects

Mining induced-surface fracturing has resulted in atypical declines in water level[10] recorded at pools TT2, TT3, TT7, TT9, TT12 and TT13 and visually observed at pools TT10, TT11 and TT15 (refer **Appendix B**).

A change in water level behaviour has also been recorded at pool TT7, located downstream of LW S1A. The change in water level behaviour is considered partly related to backwater effects associated with the TT-F1 gauging station weir and partly to the re-emergence of diverted surface flow from upstream fracturing. Diverted surface flow has been visually observed as re-emerging near the confluence of Teatree Hollow and Teatree Hollow tributary, immediately upstream of pool TT7.

Table 18 lists the monitoring sites (pools) and period in which a Level 3 trigger in relation to water level has occurred.

[10] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

Table 18 Level 3 Trigger Period - Water Level

Monitoring Site	Pool	Level 3 Trigger Period
TT2-QLa	TT2	13 August to 28 November 2023 30 August to 29 November; 9 to 31 December 2024
TT3-QLa	TT3	7 March to 28 November 2023 26 February to 4 April; 14 July to 29 November 2024
TT7-QLa	TT7	10 November to 28 November 2023 30 October to 29 November 2024
TT12-QLa	TT12	7 March to 28 November 2023 1 March to 4 April; 18 August to 29 November 2024
TT13-QLa	TT13	21 March to 30 April 2023; 14 May to 28 November 2023 30 July to 30 November; 13 to 31 December 2024

4.1.3 Water Quality Effects

Table 19 lists the monitoring sites (pools) and period in which a water quality trigger has occurred.

Table 19 Trigger Levels - Water Quality

Monitoring Site	Pool	Trigger Level	Constituent	Trigger Period
TT7-QLa	TT7	Level 3	Electrical conductivity	March to August 2023
TT3-QLa	TT3	Level 1	Dissolved nickel	June to August 2023
TT7-QLa	TT7	Level 2	Dissolved iron	April to August 2023
TT12-QLa	TT12	Level 2	Dissolved zinc	April to August 2023
TT2-QLa	TT2	Level 1	Dissolved aluminium	September to November 2023
TT13-QLa	TT13	Level 1	Dissolved zinc	August 2024

As stated in **Section 4.1.2**, diverted surface flow has been visually observed as re-emerging near the confluence of Teatree Hollow and Teatree Hollow tributary, immediately upstream of pool TT7.

The interaction of the diverted surface flow with the subsurface geology, in combination with below average rainfall conditions, is considered to have resulted in periodic exceedances of water quality triggers at pool TT7. From March to August 2023, a Level 3 trigger was recorded in relation to electrical conductivity values recorded at pool TT7. It is noted that the trigger exceedances occurred during periods of below average rainfall when negligible surface flow was reporting to the downstream reach of Teatree Hollow. As such, the load of constituents passing downstream of pool TT7 was likely to have been low.

4.1.4 Summary

As detailed in the Tahmoor South Project EIS, the Tahmoor South Project Amendment Report (AECOM, 2020), the Second Project Amendment Report (EMM, 2020) and the Tahmoor South Project Longwall S7A Modification Report (EMM, 2024), where Teatree Hollow and Teatree Hollow tributary are directly mined beneath, subsidence effects were expected to be of sufficient magnitude to result in the buckling of underlying strata and associated surface fracturing at some locations. At these locations, it was considered likely that water would be diverted from the watercourse into the underlying dilated strata. The diverted flow would be conveyed via the dilated strata and remerge further downstream in the watercourse as surface flow. As such, although Teatree Hollow and Teatree Hollow tributary were likely to incur localised reductions in pool water level and streamflow associated with fracturing in the vicinity of LW S1-S7A, the net reduction in streamflow conveyed from the Teatree Hollow catchment to the Bargo River was expected to be small.

Isolated, episodic pulses in salinity and dissolved metals were expected to occur in Teatree Hollow and the Teatree Hollow tributary due to subsidence induced changes in surface water runoff, underflow and baseflow discharging to these watercourses.

Based on the impacts to surface water features as a result of mining of LW S1A-S3A summarised in the proceeding sections, the following is considered:

- No greater impact than that predicted in the EIS and associated Project Amendment reports has occurred to watercourses within the Subsidence Area.
- No impacts have occurred to other watercourses.
- No exceedance of the performance measures has occurred.
- No material environmental harm has occurred.

4.2 Groundwater

In accordance with SSD 8445, Tahmoor Coal is required to report the groundwater monitoring results annually within the Annual Review report. Monitoring was completed during the reporting period in accordance with the Groundwater Management Plan and this Water Management Plan. The network as described here was deemed suitable to capture potential impacts from the inclusion of LWS7A, via Modification 3, and monitoring and reporting will remain consistent with the existing approach.

Further, in accordance with Condition E5 (f) of SDD 8445, in the event that performance measures (in the form of pre-defined triggers) are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with the Trigger Action Response Plans (TARPs), and all such triggers, actions and responses will be reported in the Annual Review.

A review of the temporal groundwater and water quality trends was conducted as a component of the 2024 Annual Review. The water level records for groundwater monitoring bore P52 are shown in **Figure 14** in comparison to the TARP trigger levels and the cumulative rainfall departure (residual). Temporal plots for all trigger parameters and each monitoring bore and provided in the Annual Review reports.

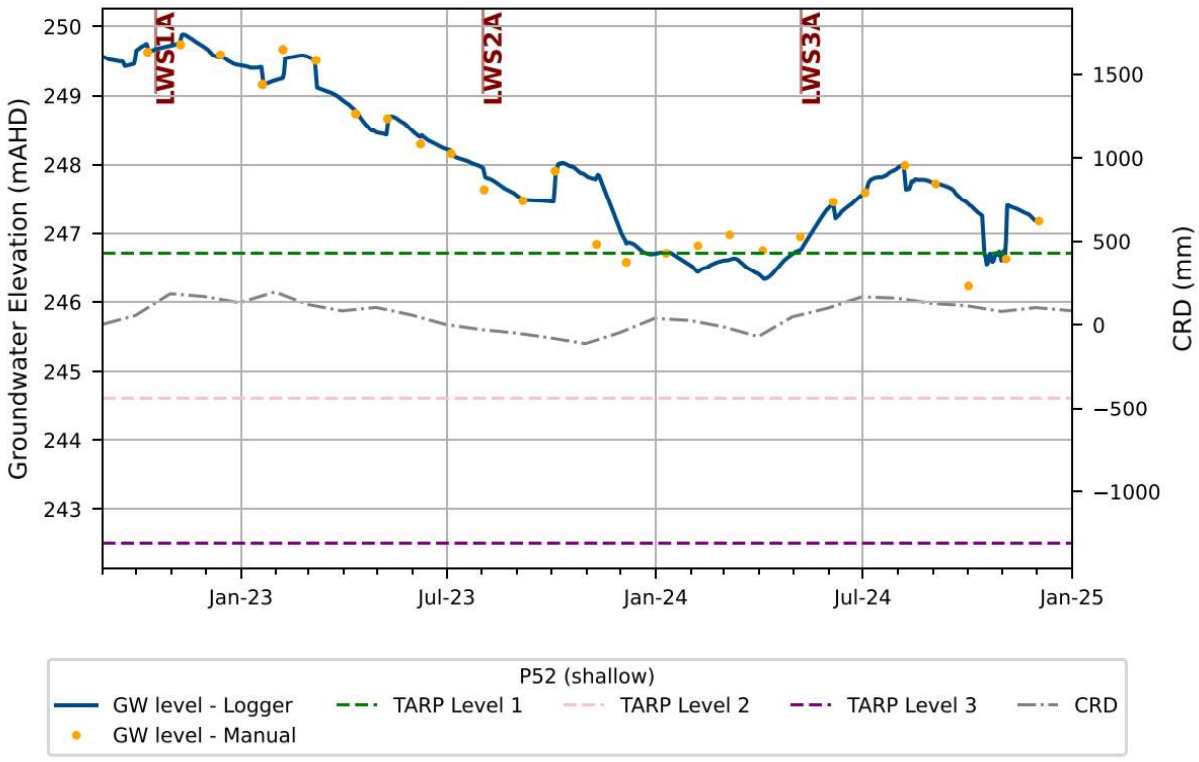


Figure 14 P52 TARP Assessment Hydrograph

Table 20 and **Table 21** present a summary of the active groundwater level and groundwater quality exceedances, respectively, as of 31 December 2024.

Table 20 Groundwater Level Exceedances

Monitoring Site	Constituent	Trigger Level	TARP
P51B	Groundwater level	Level 1	WMP8, WMP12
P53A	Groundwater level	Level 1	WMP8, WMP12
P53B	Groundwater level	Level 1	WMP8, WMP12
P53C	Groundwater level	Level 2	WMP8, WMP12
P55A	Groundwater level	Level 1	WMP8, WMP12
P55B	Groundwater level	Level 3	WMP8, WMP12
P55C	Groundwater level	Level 3	WMP8, WMP12
GW104659	Groundwater level	Level 1	WMP8
GW109257	Groundwater level	Level 1	WMP8
TBC032 (HBSS-95m)	Shallow VWP	Level 3	WMP9
TBC032 (HBSS-131m)	Shallow VWP	Level 3	WMP9
TBC032 (BHCS-181m)	Shallow VWP	Level 2	WMP9
TBC032 (BGSS-200m)	Shallow VWP	Level 1	WMP9

Table 21 Groundwater Quality Exceedances

Monitoring Site	Exceedance Parameter (Criteria 1 and 2 met)	Trigger Level
REA4	Ba	Level 2
P53C	Ba	Level 2
P53B	Ba	Level 2

5 Predicted Subsidence Impacts and Environmental Consequences

5.1 Subsidence Predictions

The maximum predicted values of total subsidence, upsidence and closure for relevant watercourses, after mining of LW S1A-S7A (MSEC, 2024), are presented in **Table 22**.

Table 22 Maximum Total Subsidence, Upsidence and Closure Predictions for Watercourses

Location	Maximum Predicted Subsidence (mm)	Maximum Predicted Upsidence (mm)	Maximum Predicted Closure (mm)
Bargo River	<20	30	20
Hornes Creek (downstream of pool HC16)	40	80	150
Hornes Creek (upstream of pool HC16)	25	45	70
Teatree Hollow	1,400	400	275
Teatree Hollow	1,350	450	375
Note: Downstream reaches of Teatree Hollow and Teatree Hollow tributary have been mined beneath (LWS1A to LWS3A). The maximum predicted parameters provided in this table include those resulting from the extraction of LWS1A to LWS3A.			

Source: MSEC (2024)

Watercourses which are located directly above LW S1-S7A may experience the full range of predicted subsidence movements detailed in MSEC (2024). The predicted upsidence and compressive strains due to valley closure are of sufficient magnitude to result in fracturing of bedrock in sections of Teatree Hollow and Teatree Hollow tributary which directly overlie the longwall panels (MSEC, 2024).

The minimum distance from the centreline of the Bargo River to LW S7A is 520 m. The maximum total upsidence and closure associated with mining of LW S7A are predicted to be low, 30 mm and 20 mm respectively. Impacts have previously been recorded due to direct undermining of the Bargo River, however, impacts have not occurred when secondary extraction has been undertaken more than 500 metres in plan distance from the Bargo River. Given the distance of the Bargo River from LW S7A and the low predictions of total upsidence and closure, it is considered very unlikely that surface fractures would develop in the Bargo River (MSEC, 2024).

The minimum distance from the centreline of Hornes Creek to LW S7A, downstream of pool HC16 (refer **Figure 5**), is 330 m. It is noted that this section of Hornes Creek is influenced by backwater effects from Picton Weir. The minimum distance from the centreline of Hornes Creek to LW S7A, upstream of pool HC16, is 360 m. As Hornes Creek is not proposed to be directly undermined, the risk of surface fracturing is considered to be low. In the unlikely event that fracturing occurs, the fractures are expected to be minor and isolated (MSEC, 2024).

Subsidence related impacts to Dogtrap Creek, located a minimum plan distance of 1,800 m from the LW S1-S7A, are not expected to occur.

5.2 Potential Impacts to Surface Water Resources

5.2.1 Water Quantity

Potential water quantity impacts associated with mining of LW S1-S7A, as addressed in the following sections, include:

- Reduction in baseflow rates and change in low flow regime;
- Change in pool water level and streamflow characteristics due to subsidence induced fracturing and tilt;
- Change in flood regime of watercourses and local tributary gullies;
- Change in overland flow behaviour; and
- Reduction in water supply to downstream surface water users.

5.2.1.1 Baseflow and Low Flow Regime

SLR (2024) describe baseflow reduction as '…a change in gradient between the aquifer and the watercourse, which may reduce the rate at which baseflow occurs or induce additional leakage via increased hydraulic gradients'.

The baseflow reduction associated with cumulative mining activities[11] was predicted using an updated numerical groundwater model, as described in **Appendix D**. The predicted baseflow reduction rates for watercourses within the vicinity of the Study Area, as detailed in SLR (2024) are listed in **Table 23**.

Table 23 Predicted Baseflow Reduction for Watercourses

Watercourse	Predicted Baseflow Reduction (ML/d)
Eliza Creek	0.015
Carters Creek	0.01
Dogtrap Creek	0.018
Teatree Hollow	0.02
Cow Creek	0.003
Stonequarry Creek	0.025
Bargo River	0.014
Bargo River	0.034
Bargo River	0.056
Hornes Creek	0.002
Nepean River	0.144
Matthews Creek	0.01
Cedar Creek	0.003
Redbank Creek	0.007
Avon River	0.02
Cordeaux River	0.05
Rumker Gully	<0.001
Myrtle Creek	0.02
Dry Creek	0.006

[11] Includes Tahmoor (LW S1A-S7A), Appin, Dendrobium, Metropolitan, Russell Vale and Cordeaux mines

Baseflow reduction associated with cumulative mining activities was predicted to be greatest in the sub-catchments of the Bargo River, Myrtle Creek, Nepean River, Dogtrap Creek and Teatree Hollow predicted SLR, 2024). In comparison to predictions presented in the EIS, the SLR (2024) groundwater model predicted less baseflow reduction in most of creeks and rivers.

Cumulative baseflow reduction was predicted to be negligible in Cow Creek which is located to the south-east of the Study Area and within the Sydney Drinking Water Catchment (refer **Figure 3**).

Baseflow reduction is expected to be most noticeable during periods of low flow which would normally be dominated by baseflow. The effect on low flows can be seen by comparing the flow duration curves generated for the pre-mining and post-mining scenarios.

Figure 15 and **Figure 16** show the effect of the predicted baseflow reduction rates on streamflow at monitoring site B13-QRLa on the Bargo River and monitoring site HC4-QRLa on Hornes Creek. As shown on **Figure 15** and **Figure 16**, the predicted reduction in baseflow contribution to Hornes Creek and the Bargo River is considered negligible and would likely be indiscernible from natural fluctuations in streamflow at these locations.

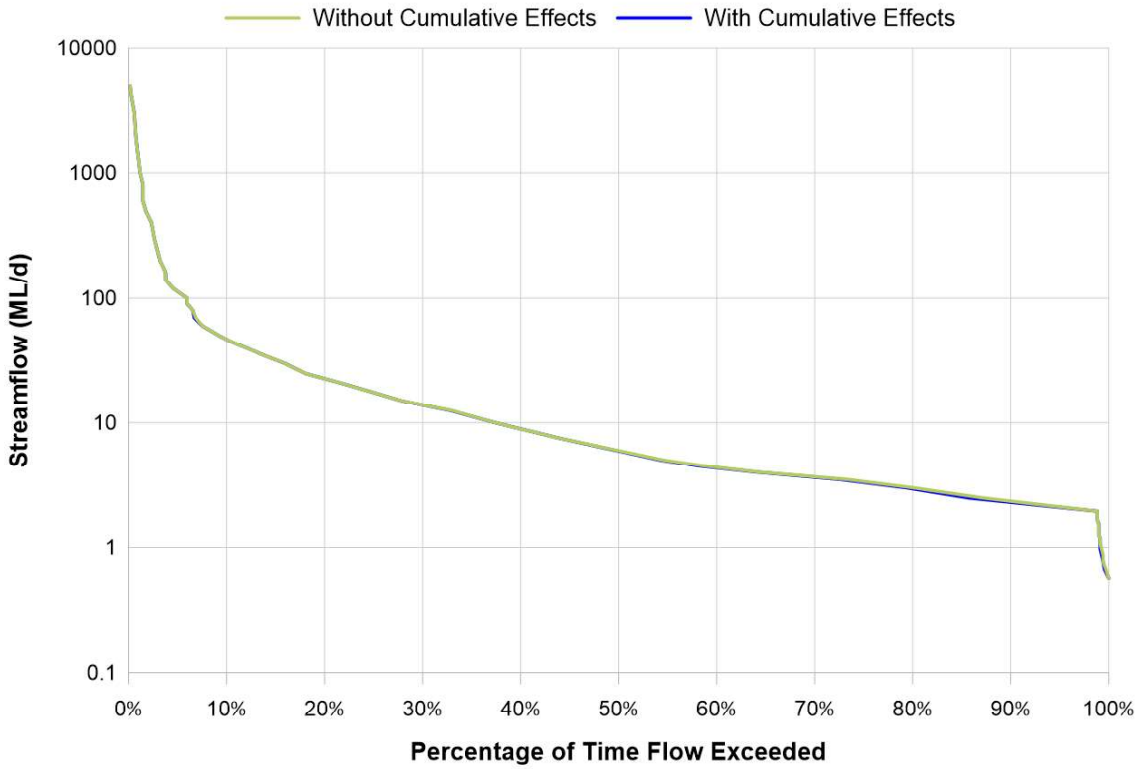


Figure 15 Flow Duration Curve – Bargo River (BR13-QRLa) Predicted Baseflow Reduction Effect

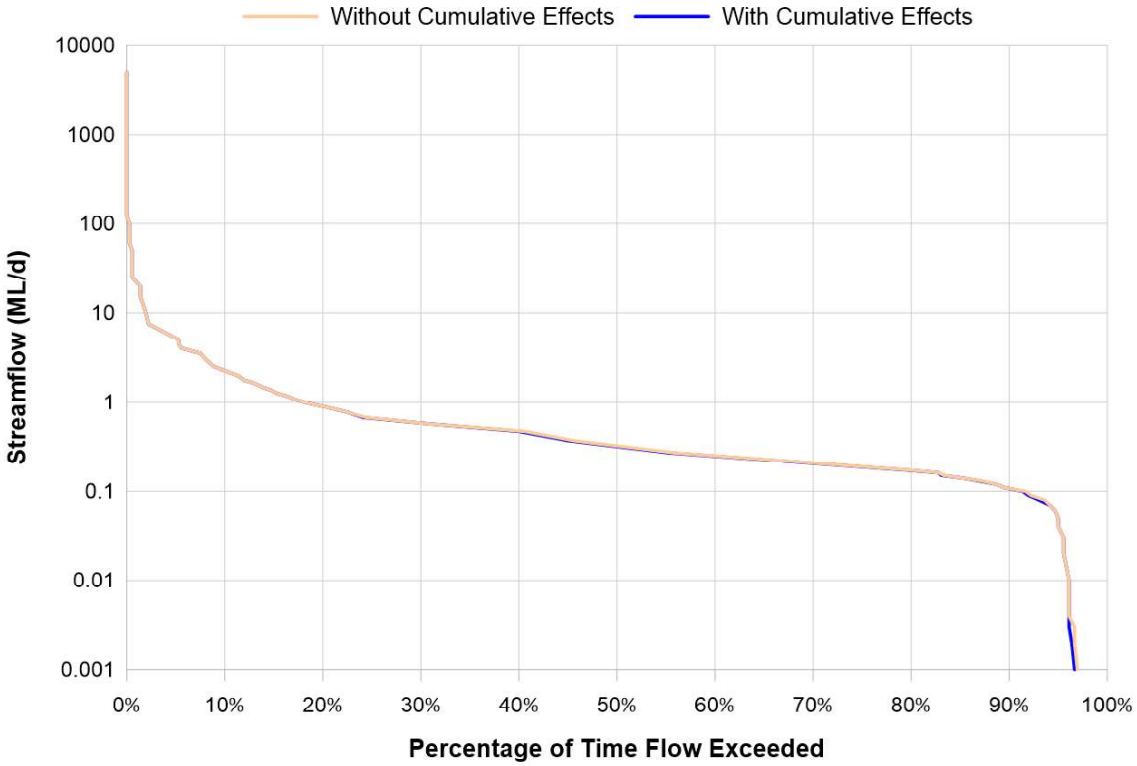


Figure 16 Flow Duration Curve – Hornes Creek (HC4-QRLa) Predicted Baseflow Reduction Effect

5.2.1.2 Pool Water Level and Streamflow

Where Teatree Hollow and Teatree Hollow tributary are directly mined beneath, upsidence and compressive strains due to valley closure are expected to be of sufficient magnitude to result in the buckling of underlying strata and associated surface fracturing at some locations. At these locations it is likely that water would be diverted from the watercourse into the underlying dilated strata. The diverted flow would be conveyed via the dilated strata and remerge further downstream in the watercourse as surface flow. As such, although Teatree Hollow and Teatree Hollow tributary are likely to incur localised reductions in pool water level and streamflow associated with fracturing in the vicinity of LW S1-S7A, the net reduction in streamflow conveyed from Teatree Hollow to the Bargo River is expected to be negligible.

This is consistent with that stated in the EIS and observed at historical Tahmoor Mine areas. Mining related impacts associated with Tahmoor North, including streambed and rockbar fracturing, occurred at a number of locations in Redbank Creek resulting in diversion of surface flow through the dilated strata and re-emergence of the flow further downstream in Redbank Creek. A study undertaken by Tammetta (2021), concluded that, although there was a statistically significant reduction in streamflow at sites in Redbank Creek which had been directly mined beneath, there was no evidence of a statistically significant reduction in streamflow at the downstream monitoring site in Redbank Creek beyond the extent of subsidence effects.

Surface water level and streamflow monitoring within and adjacent to the Study Area is conducted (refer **Section 6**) and TARPs have been developed to assess the need for a response which may include remediation (refer **Appendix A**).

5.2.1.3 Overland Flow and Flooding

The maximum predicted incremental tilt associated with mining of LW S7A is 8.9 mm/m and the maximum predicted total tilt after mining of LW S1A-S7A is 10 mm/m (MSEC, 2024). Based on the natural gradient of the surface overlying LW S7A and the predicted post-subsidence topography associated with mining of LW S1A-S7A, subsidence effects are estimated to result in a 0.3% increase in surface gradient overlying LW S7A. While minor changes to the natural drainage behaviour may occur in some locations, the predicted increase in gradient is considered negligible and unlikely to result in significant impacts to overland flow or channel morphology.

Negligible change in gradient is predicted to occur to the Bargo River tributary or in the catchment of Hornes Creek. Vertical subsidence and tilt associated with mining of LW S7A is predicted to affect a small portion only of the catchment of the Bargo River and Hornes Creek, with subsidence effects expected to be low (refer **Section 5.1**). As such, increases in the flood extent of the Bargo River and Hornes Creek are unlikely to occur as a result of mining of LW S7A.

A flood study was conducted to assess the potential cumulative effects of the longwall layout and associated subsidence predictions on flooding of land within and adjacent to LW S1A-S7A (Doug, 2024). Specifically, areas at risk of a potential increase in flood levels due to subsidence induced changes in surface topography have been identified.

Figure 17 and **Figure 18** depict the simulated maximum areas inundated during passage of the 1% annual exceedance probability (AEP) peak flow event in the southern (upstream) and northern (downstream) portion of the Teatree Hollow catchment respectively.

The hydraulic model results for the 1% AEP flood event indicate that overbank flooding is predicted to occur under existing conditions at:

- Areas upstream of the culverts beneath Remembrance Driveway and Caloola Road (location 1 shown in **Figure 17**);
- The corridor between Remembrance Driveway and the railway embankment to the east of Caloola Road (location 2 shown in **Figure 17**);
- A portion of the Main South Railway Line adjacent to Teatree Hollow (to the north of location 2 shown in **Figure 17**); and,
- To the west of Remembrance Driveway overlying LW S5A (location 3 shown in **Figure 17**).

Further downstream, inundation is limited to the main channel areas.

The hydraulic model predictions indicate that the effects of subsidence may result in a minor increase in areas subject to flood inundation on the western side of Remembrance Driveway in the vicinity of Caloola Road (location 1 shown in **Figure 17**), the western side of Remembrance Driveway in the vicinity of and Yarran Road (location 3 shown in **Figure 17**) and to the east of Caloola Road (location 2 shown in **Figure 17**). Based on the hydraulic model predictions for LW S1A-S7A, a maximum increase in the 1% AEP flood level of 0.49 m is predicted to occur at a property bounding Caloola Road and Remembrance Driveway.

It is noted that the predicted increase in flood extent is predominantly related to subsidence effects associated with mining of LW S1A-S6A. These findings are generally consistent with that presented in the EIS (HEC, 2020). As detailed in HEC (2020):

- The effects of subsidence were predicted to result in an increase in areas subject to flood inundation on the western side of Remembrance Driveway adjacent to Caloola Road during a 1% AEP event; and
- The largest increase in flood inundation was predicted to occur on the western side of Remembrance Driveway overlying LW S3A (referred to as LW 103A in HEC, 2020) - area upstream of the culverts beneath Remembrance Driveway and Caloola Road.

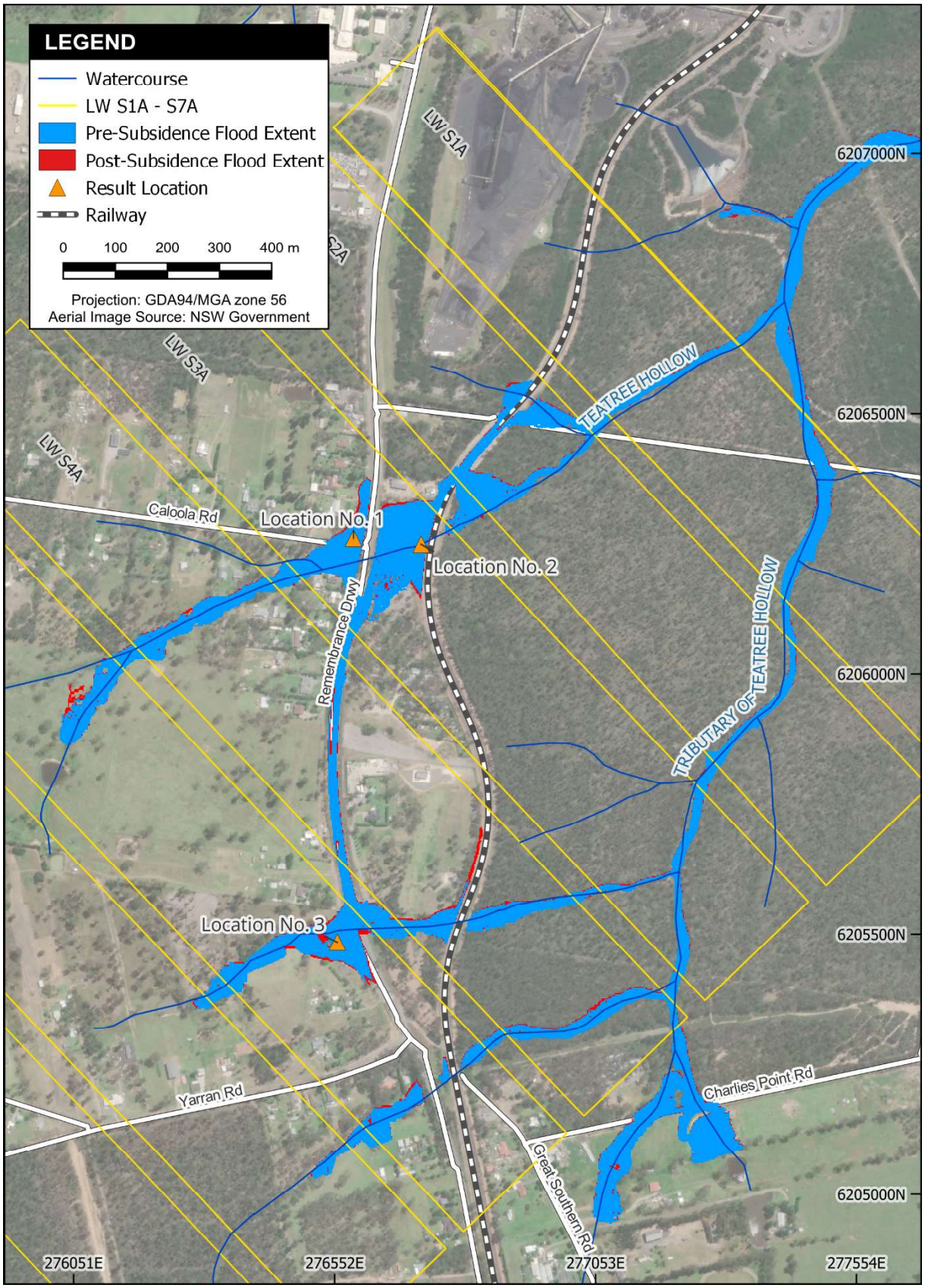


Figure 17 Extent of Predicted 1% AEP Flooding – Southern (upstream) Teatree Hollow catchment

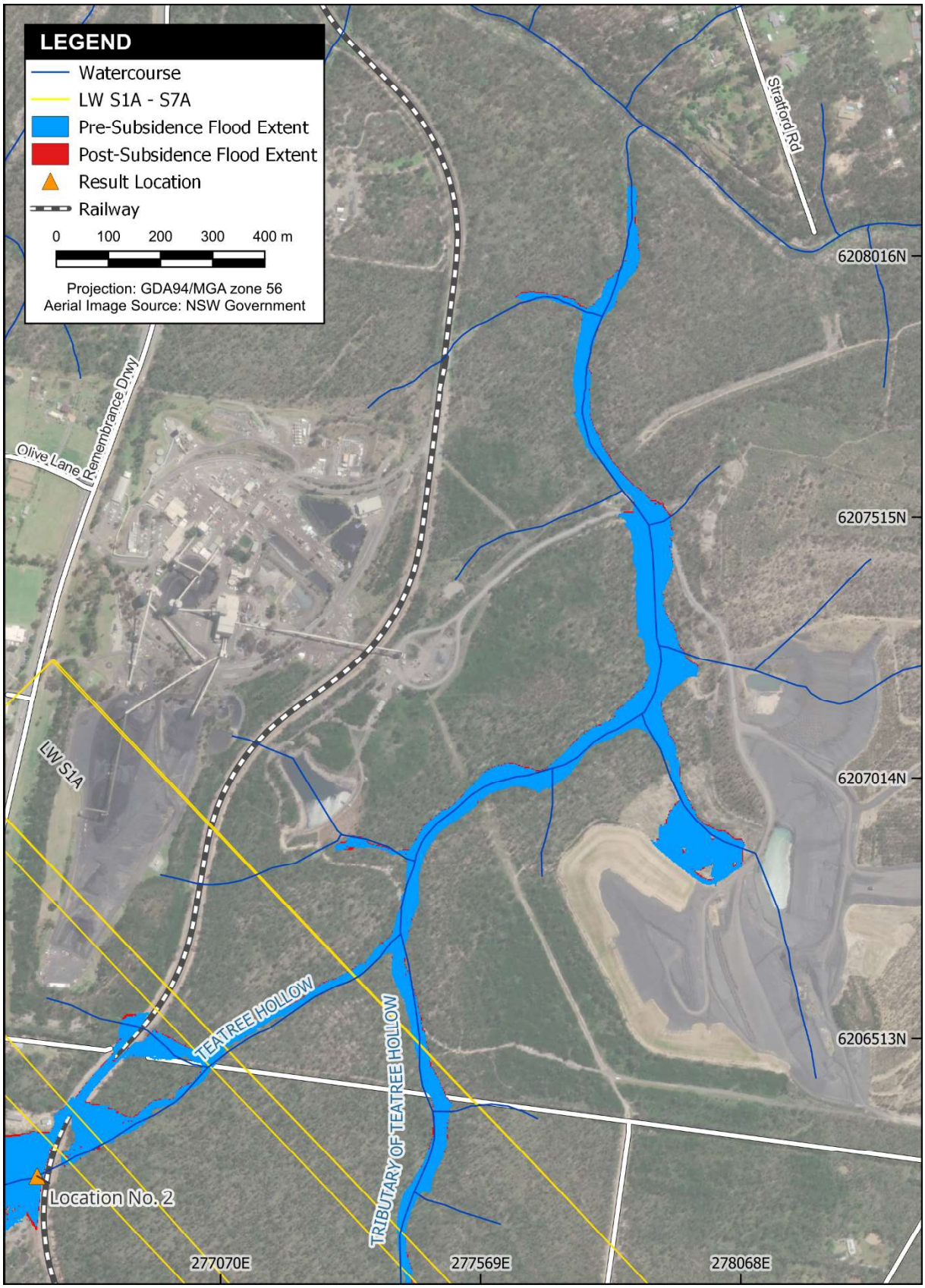


Figure 18 Extent of Predicted 1% AEP Flooding – Northern (downstream) Teatree Hollow catchment

5.2.2 Water Quality

5.2.2.1 Elevated Constituents

Flushing of freshly exposed fractures in sandstone bedrock has the potential to liberate contaminants resulting in localised and transient increases in water quality constituents. Additionally, significant reductions in pool water level and associated transformation processes occurring in stored sediments has the potential to result in intermittent changes in pool water quality characteristics. Subsidence induced fracturing may also increase the extent and prevalence of ferruginous deposition (iron staining).

As stated in **Section 4.1.3**, episodic elevated dissolved iron and electrical conductivity values have been recorded at monitoring site TT7-QLa (pool TT7) since the commencement of mining of LW S1A-S3A. It is considered that the episodic increases in specific constituents recorded at TT7-QLa were related to the re-emergence of upstream diverted surface flow in combination with below average rainfall conditions. Additionally, an increase in dissolved aluminium was recorded at monitoring site TT2-QLa during a period in which the pool water level was very low and visually observed as stagnant.

Ferruginous colloids in the water and precipitated on or staining the bed material of Teatree Hollow and Teatree Hollow tributary were observed prior to commencement of mining of LW S1A. An increase in iron staining has subsequently been observed upstream of pool TT7 following commencement of mining of LW S1A.

While it is anticipated that intermittent, episodic increases in specific constituents will continue to occur in Teatree Hollow and Teatree Hollow tributary during mining of LW S1A-S7A, it is not expected that mining of LW S7A would substantially increase this effect. As stated in **Section 3.1.2**, the reach of Teatree Hollow tributary overlying LW S7A is characterised by a low relief landscape, with a dominant bed material of mud (cohesive clay/silt/sand) and notable grass coverage. Additionally, pools have not been mapped in the reach of Teatree Hollow tributary overlying LW S7A. As such, it is considered that the potential for flushing of freshly exposed sandstone bedrock fractures and associated liberation of contaminants or increased iron staining is low in the upper reaches of Teatree Hollow tributary overlying LW S7A.

Water quality monitoring within and adjacent to the Study Area is proposed (refer **Section 6**) and TARPs have been developed to assess the need for a response which may include remediation (refer **Appendix A**).

5.2.2.2 Gas Emissions

Methane is naturally present in many natural shallow surface water and groundwater systems as a result of organic decomposition and redox-methanogenesis reactions (NSW Department of Planning, 2008). When sediments are disturbed by mining related subsidence effects, methane derived naturally may be released more rapidly in surface water systems (NSW Department of Planning, 2008). The generative fluxes and concentrations are generally low and inconsequential (NSW Department of Planning, 2008).

As stated in **Section 3.1.2**, gas emissions were observed in shallow ponded water at channel morphology site CM6 (refer **Figure 24** for location) during the baseline period prior to the commencement of mining of LW S1A. Evidence of vegetation dieback associated with gas emissions at monitoring site CM6 was not observed (Brienen Environment & Safety, 2022c). Gas emissions were also previously observed intermittently at a monitoring site in Matthews Creek during mining of LW W1-W2 in the Western Domain. Evidence of vegetation dieback due to observed gas emissions at this location was not observed (Niche, 2021).

As such, should mining of LW S7A result in gas emissions occurring in local watercourses, it is considered unlikely that impacts to vegetation would occur.

5.2.3 Erosion and Sedimentation

Slight increases in the gradients of Teatree Hollow and Teatree Hollow tributary may occur where the watercourses flow into the predicted subsidence trough near the longwall edges (MSEC, 2022). However, the predicted maximum increase in grade is 1% which is relatively small compared with the natural

watercourse gradients. As such, the potential for increased scouring and erosion is not expected to be substantial (MSEC, 2022).

Consistent with the EIS, localised areas of increased erosion may occur in watercourses where the streambed material is comprised predominantly of mud and/or sand or where soft knickpoints are present. Although the potential increase in erosion is expected to be negligible, knickpoints and watercourse stability will be monitored as summarised in **Section 6** and detailed in **Appendix B**.

5.2.4 Aquatic Biodiversity

Potential impacts to aquatic biodiversity associated with mining LW S1A-S7A are detailed in the Biodiversity Management Plan and summarised as follows.

In the event of fracturing, which is predicted to occur for the reaches of Teatree Hollow and Teatree Hollow tributary which directly overlie LW S1A-S7A, there is potential for a reduction in pool water level and associated reduction in available aquatic habitat and macroinvertebrate biomass. Additionally, a temporal reduction in fish passage may occur during periods of low flow. It is noted, however, that few fish species were observed during the aquatic ecology surveys and aquatic threatened species are considered unlikely to be present in the Study Area (refer **Section 3.3.3**).

For macroinvertebrates, while total biomass will likely be reduced, it is unlikely that a catchment scale change in overall assemblage and family richness will be measurable. The liberation of contaminants from subsidence induced fracturing in watercourses, with resulting localised and transient water quality impacts, has the potential to impact aquatic biota. This is particularly the case where increased iron precipitation occurs. Streams that are acidic and low in alkalinity are more likely to be impacted as these surface water systems have less buffering capacity against changes to pH. The surface water systems within the Study Area typically have low alkalinity and slightly acidic to near neutral pH conditions (refer **Section 3.3.2** and **Appendix C**). As such, changes to pH would have greater impact on these surface water systems and associated aquatic biota.

Where localised and transient pulses in metals are observed, the impacts to stream fauna are similarly expected to be localised, with fauna likely to recover from transient spikes in concentrations. Localised long-term changes to fauna may occur if metal concentrations are elevated for prolonged periods of time.

5.3 Potential Impacts to Groundwater Resources

The potential impacts to groundwater can be divided into two principal types:

- Impacts to groundwater level, i.e. drawdown and depressurisation, and associated changes in groundwater quantity due to groundwater discharge into the mine workings and changes to strata permeability and porosity; and
- Impacts to water quality characteristics due to enhanced aquifer connectivity/mixing.

Potential impacts have been assessed by SLR (2024) utilising an updated and comprehensive numerical groundwater model. Further information pertaining to recent model updates are provided in the Groundwater Impact Assessment (**Appendix D**).

5.3.1 Predicted Groundwater Inflow

Table 24 presents the predicted groundwater inflow to Tahmoor South for each water year to the end of the approved mine life (SLR, 2024).

Table 24 Predicted Groundwater Inflow

Water Year*	Predicted Groundwater Inflow - Tahmoor South	
	Average Rate (ML/d)	Annual Volume (ML)
2024-2025	0.47	170.3
2025-2026	0.30	108.3
2026-2027	0.35	128.0
2027-2028	0.15	55.1
2028-2029	0.14	49.3
2029-2030	0.18	65.9
2030-2031	0.22	79.6
2031-2032	0.24	88.5
2032-2033	0.25	92.4

* 1 July to 30 June.

Groundwater inflow to Tahmoor South was predicted to increase over the first half of the operational life of LW S1A-S7A, reaching a peak of approximately 789.3 ML (average of 2.16 ML/day) in water year 2024. Inflow rates are predicted to decline gradually from water year 2024 to 2032.

Groundwater inflow to Tahmoor South was predicted to reach a maximum peak of 0.47 ML/day at the beginning of 2024. Inflow rates are predicted to decrease gradually from 2025 until the cessation of mining for the A series, in Oct 2027, where inflows to Tahmoor South are predicted to reach an average rate of approximately 0.20 ML/day.

As stated in **Section 3.4**, WAL36442 provides Tahmoor Coal with 1,642 units of entitlement from the Sydney Basin Nepean Groundwater Source, in accordance with the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2023*. The predicted groundwater inflow, as presented in **Table 24** indicates that the 1,642 units of entitlement held by Tahmoor Coal is not expected to be exceeded over the duration of the approved mine life.

As historically required, groundwater 'take' associated with the Tahmoor Mine workings, i.e. the total groundwater inflow to the active and historical Tahmoor Mine workings that is subsequently transferred to the surface, has been predicted and is reported in **Table 24**.

In order to facilitate the understanding of ongoing water licence requirements, the predictive groundwater flow model was run for the EIS approved A Series and B Series extraction. The 'direct' take for all mining at Tahmoor South is provided in **Table 25.**

Table 25 Predicted Direct Take for all Tahmoor South Mining

Water Year *	A Series Direct Take (ML)	B Series Direct Take (ML)	LW S7A Direct Take (ML)	Net Tahmoor Direct Take (ML)
2024-2025	170	130	0	301
2025-2026	109	99	0	208
2026-2027	28	277	100	405
2027-2028	26	243	29	298
2028-2029	38	346	11	396
2029-2030	53	324	13	389
2030-2031	64	210	16	290
2031-2032	71	313	18	401
2032-2033	73	184	19	276

* 1 July to 30 June.

For groundwater licencing, the 'direct' and 'indirect' take is predicted via groundwater modelling. The 'direct' take is the water intercepted during active mining and typically brought to the surface. The 'indirect' take can be described as the groundwater flux into the historical voids (i.e. post-mining during recovery, as water levels re-equilibrate there will be a volume of flux into the void space). This groundwater is not removed from the aquifer.

As stated above, Tahmoor Coal currently holds sufficient WAL entitlements to account for the groundwater inflow volumes predicted to be transferred from the Tahmoor Mine workings (A Series and B Series) to the surface over the duration of the approved mine life.

The predicted 'indirect' or 'passive' water flux into historical voids is provided in **Table 26**. The maximum flux within the aquifer is expected in 2033-34 at 2,859 ML/year. Tahmoor Coal is seeking to obtain additional WAL entitlement to account for the passive or indirect take representing groundwater stored in the void space of the historical mine workings post-recovery and not removed from the aquifer.

Table 26 Predicted Indirect Water Flux to Historical Voids

Water Year *	Average Daily Passive Take (ML/d)	Cumulative Passive Take (ML)
2024-2025	6.2	2250.5
2025-2026	5.8	2110.5
2026-2027	5.3	1917.3
2027-2028	4.9	1788.8
2028-2029	4.3	1571.4
2029-2030	4.1	1502.1
2030-2031	4.0	1452.5
2031-2032	3.3	1213.4
2032-2033	5.4	1970.5
2033-2034	7.8	2858.5
2034-2035	6.5	2356.8
2035-2036	5.2	1882.2
2036-2037	4.4	1607.8
2037-2038	4.0	1470.5
2038-2039	3.7	1348.9
2039-2040	3.4	1248.5
2040-2041	3.4	1228.9

Water Year *	Average Daily Passive Take (ML/d)	Cumulative Passive Take (ML)
2041-2042	2.7	1003.7
2042-2043	0.8	291.9
2043-2044	0.1	49.9
2044-2045	0.1	44.4
2045-2046	0.1	42.3
2046-2047	0.1	39.5
2047-2048	0.1	37.0
2048-2049	0.1	32.4
2049-2050	0.1	28.7
2050-2051	0.1	25.5
2051-2052	0.1	29.2
2052-2053	0.1	23.8
2053-2054	0.1	25.4
2054-2055	0.1	22.2
2055-2056	0.1	19.2
2056-2057	0.04	16.4
2057-2058	0.04	15.8
2058-2059	0.04	14.7
2059-2060	0.04	12.3
2060-2061	0.03	11.5
2061-2062	0.03	11.8
2062-2063	0.03	11.5
2063-2064	0.03	11.8
2064-2065	0.03	11.4
2065-2066	0.03	11.3
2066-2067	0.03	10.5
2067-2068	<0.01	<10

5.3.2 Groundwater Levels

5.3.2.1 Predicted Drawdown

The predicted maximum drawdown associated with mining of LW S1A-S7A (cumulative drawdown incl. Appin, Dendrobium, Metropolitan, Russell Vale and Cordeaux mines) are presented in **Figure 19** to **Figure 21**. **Figure 19** shows the predicted maximum water table drawdown associated with mining at Tahmoor South (LW S1A-S7A) and surrounding mines. The water table (shallow groundwater aquifers) has been featured as this reflects the highest level of connectivity with environmental (surface) features (refer **Appendix D**). The results presented in **Figure 19** indicate that the maximum predicted water table drawdown is generally between 20 to 50 m within the Study Area, with the predicted drawdown extending approximately 5 to 6 km to the north and northeast, and approximately 2 to 3 km southwest towards Lake Nepean.

Figure 20 presents the predicted maximum drawdown in the lower Hawkesbury Sandstone which is the predominant source of local groundwater extraction. **Figure 20** shows that the maximum drawdown extends radially from the Study Area. The 1 m drawdown contour extends 3 to 4 km to the south towards Lake Nepean, and 5 to 6 km to the north and northeast.

Figure 21 shows that the maximum predicted depressurisation (1 metre contour) extends approximately

2 km to the south and 2 km to the east of from LW S1A-S7A. The cone of depression is predicted to be steepest around the extracted longwalls.

The extent of the maximum drawdown predicted by the updated numerical groundwater modelling is less than that presented in the EIS. The difference in drawdown extent is due to the updated model structure, the use of depth dependence functions and pilot points in the updated model.

The predicted cumulative mining effects are detailed in **Appendix D**.

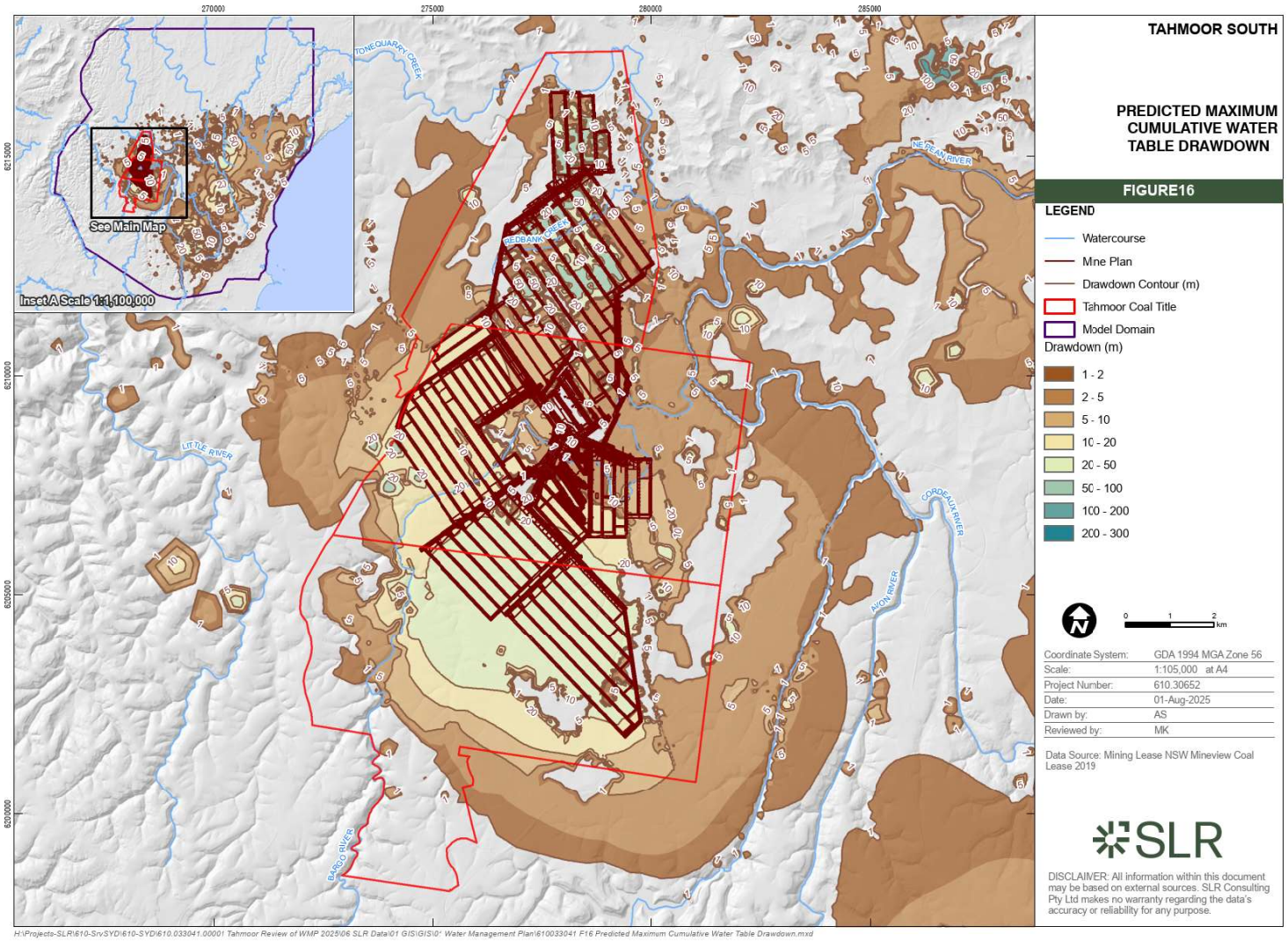


Figure 19 Predicted Maximum Cumulative Water Table (Shallow Hawkesbury Sandstone) Drawdown

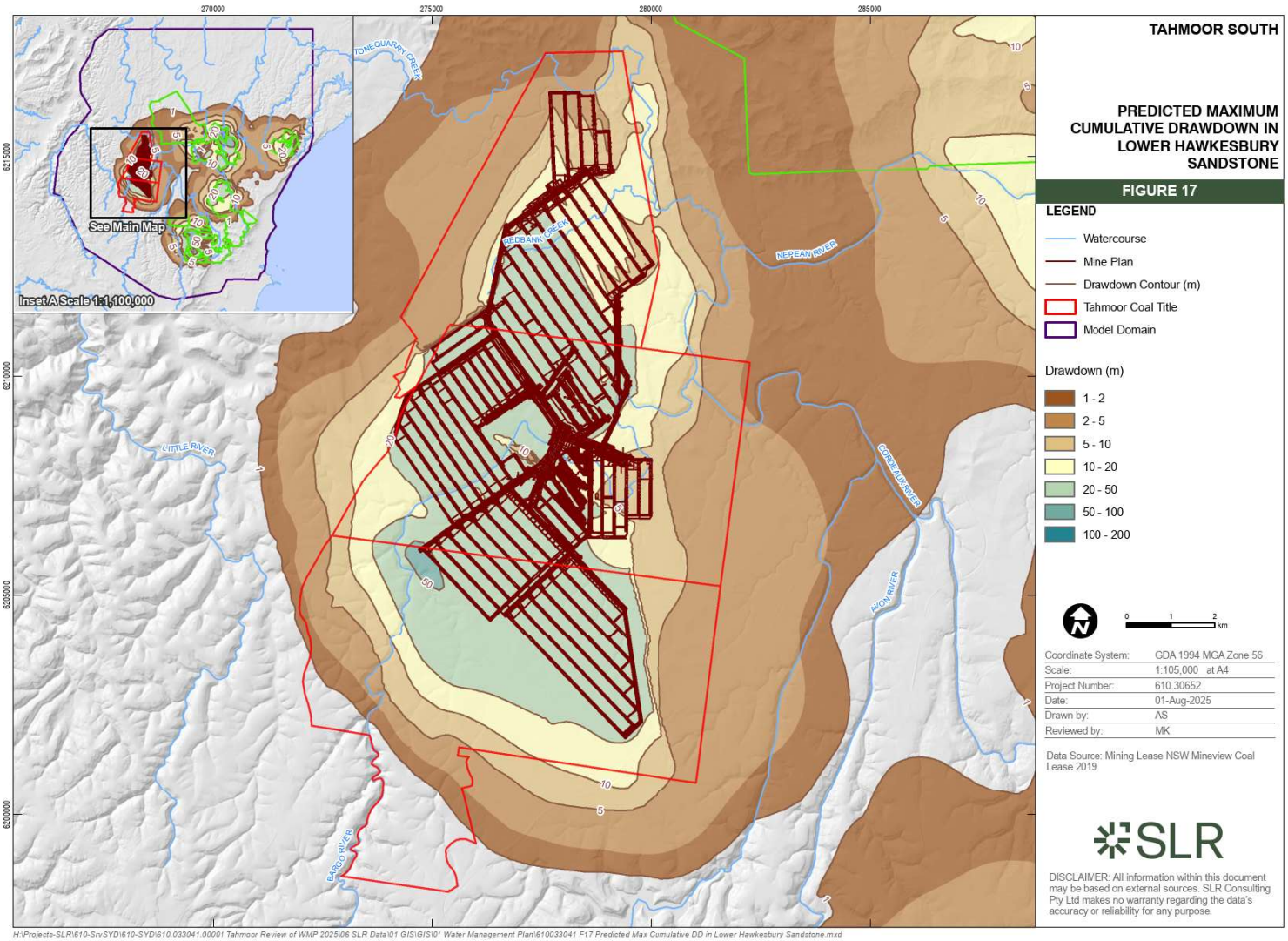


Figure 20 Predicted Maximum Cumulative Drawdown in the Lower Hawkesbury Sandstone

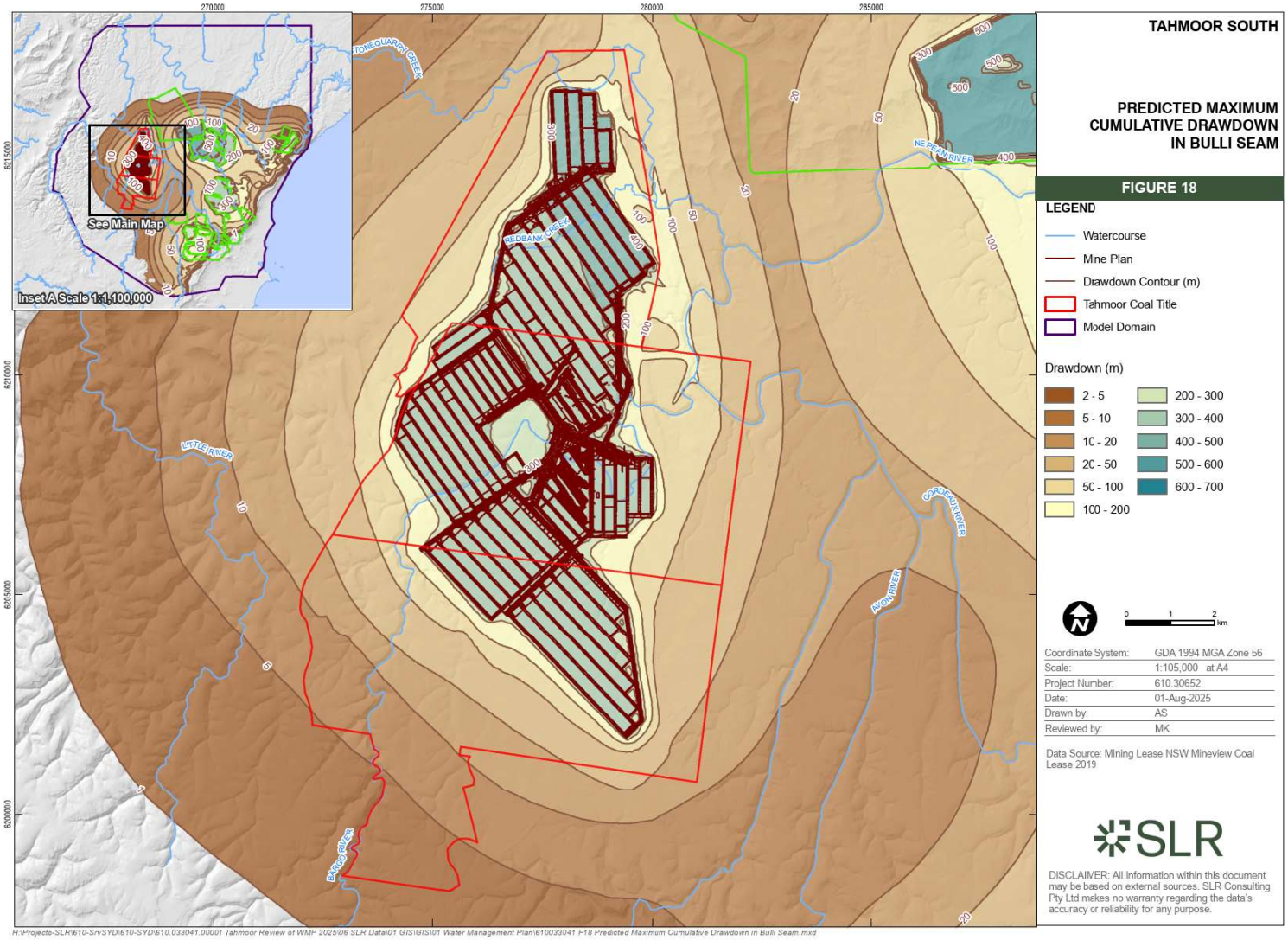


Figure 21 Predicted Maximum Cumulative Drawdown in Bulli Seams

5.3.2.2 Groundwater Levels – Private Bores

A total of 27 private bores predicted to experience a maximum drawdown exceeding 2 m over the life of the LW S1A–S7A sequence. These predictions are based on the adopted 2 m drawdown criterion consistent with the NSW Aquifer Interference Policy (AIP) for assessing potential bore impact (SLR, 2024).

Ongoing monitoring of five private groundwater bores has been negotiated, as summarised in **Section 6** and detailed in **Appendix D**, and a TARP would be implemented, as detailed in **Appendix A**. Where a reduction in groundwater yield or groundwater quality occurs at private groundwater bores and investigation outcomes indicate a mining related effect, mitigation measures would be implemented as described in **Section 7.2.1.3.**

5.4 Potential Impacts to Thirlmere Lakes

The numerical groundwater model (SLR, 2024) predicted minimal cumulative impacts to the Thirlmere Lakes. Predicted change in leakage ranged between negligible at Baraba Lake to the largest loss of leakage predicted for Lake Werri Berri at 0.07 ML/day. This predicted minimal impact is consistent with findings from the NSW Government Thirlmere Lakes Research Program (TLRP) that found that the historical mining at Tahmoor North had likely only a negligible to very minor effect on the lake water balance, and consistent with the conclusions of the Tahmoor South EIS. A TARP has also been developed for Thirlmere Lakes to monitor for early warning signs of potential impacts and to initiate appropriate actions and responses.

5.5 Potential Impact to Water Supply and Other Water Users

As stated in **Section 3.4**, Tahmoor Coal hold a total 41 ML entitlement for water access from the Maldon Weir Water Source, in accordance with the *Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources 2023*. As such, Tahmoor Coal hold sufficient WALs to account for the predicted annual baseflow reduction in the Bargo River of associated with mining of LW S1A-S7A (refer **Section 5.2.1.1**.

While streamflow reduction may increase as mining of Tahmoor South progresses, it is expected that majority of streamflow diverted via the subsurface fracture network would re-emerge upstream of pool TT7. It is also considered that mining of LW S7A is unlikely to result in impacts to Teatree Hollow streamflow downstream of pool TT7 in excess of that expected to occur as a result of mining of LW S1A-S6A.

Tahmoor Coal would continue to assess streamflow reduction monitored at TT-F1 in Teatree Hollow on a quarterly basis. Where the streamflow reduction assessment indicated that there was potential for the WAL volume held by Tahmoor Coal to be exceeded in the future, Tahmoor Coal would seek to acquire additional WAL volume from the water market.

6 Subsidence Monitoring Program

6.1 Performance Measures and Indicators

Performance measures for surface water and groundwater resources are provided in **Table 7** of Condition C1 of SSD 8445 and summarised in **Table 27**. The Biodiversity Management Plan and associated TARPs address potential impacts and proposed triggers, actions and responses in relation to aquatic and riparian ecosystems.

Table 27 Subsidence Performance Measures and Performance Indicators for Surface Water and Groundwater Resources

Feature	Subsidence Performance Measures	Subsidence Performance Indicators
All watercourses within the Subsidence Area	No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.	Exceedance of the impact assessment criteria, as defined in the relevant Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure. This performance measure and performance indicator have been incorporated into TARP WMP1, WMP3 and WMP5.
Other watercourses	Negligible environmental consequences including beyond those predicted in the EIS, including: • Negligible diversion of flows or changes in the natural drainage behaviour of pools; • Negligible decline in baseline channel stability; • Negligible gas releases and iron staining; and • Negligible increase in water turbidity.	The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water level decline and/or water quality changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River. Performance indicators in relation to channel stability are not proposed as soft knickpoints have not been mapped in Hornes Creek or the Bargo River. This performance measure and performance indicator have been incorporated into TARP WMP2, WMP4 and WMP6.
GDEs including Thirlmere Lakes	Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality.	The performance measure will be considered to be exceeded if a Level 3 TARP is triggered and the investigation outcomes indicate a mining related impact based on monitoring data for the Thirlmere Lakes. This performance measure and performance indicator have been incorporated into TARP WMP13 (groundwater bores monitoring for Thirlmere Lakes).

For the purpose of this management plan, 'negligible' is defined as being 'so small and insignificant as to

not be worth considering'. A negligible impact is viewed with regards to a long term context, causing little or no impact. If a short term impact causes a greater than negligible impact, the impact can still be considered negligible if the impacts are of a limited duration and are considered negligible when considered over the long term.

As detailed in **Section 5** and consistent with that presented in the EIS, where Teatree Hollow and Teatree Hollow tributary are directly mined beneath, surface fracturing and diversion of flow to the underlying dilated strata is predicted to occur. As such, TARPs have been designed to enable identification of potential impacts and to initiate appropriate actions and responses. Where mining related impacts occur to watercourses, remediation works are proposed to be implemented as documented in the TARPs. Where required, the remediation works would be guided by a Watercourse Corrective Management Action Plan (WCAMP) which would include performance indicators relating to the effectiveness of the proposed remediation works. Further discussion on remediation actions is provided in Section **5.2.1.2**.

Based on the predicted subsidence impacts (MSEC, 2022 and MSEC, 2024), it is considered that the performance measures for surface water and groundwater resources within the Study Area will be achieved during and after mining of LW S1A-S7A.

Regarding the performance measure for 'all watercourses within the Subsidence Area', the EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures.

6.2 Surface Water and Groundwater Monitoring Program

A subsidence monitoring program for surface water and groundwater resources has been implemented to monitor the impacts and consequences of subsidence effects during the extraction of LW S1A-S7A. The aim of the monitoring program is to identify where there is a risk of impact to surface water and groundwater resources as a result of extraction activities. The monitoring program provides for the opportunity to record the condition of each monitoring site during the following three phases:

- Prior to mining – baseline survey of the condition of the site before the commencement of mining;
- During mining – monitoring of the condition of the site during active subsidence to establish whether there has been any change to the site or if changes have occurred from the effects of subsidence; and
- Post mining – monitoring of the condition of the site after mining to identify whether there has been any change to the site in the period since mining, and to assess if the ground surface conditions have stabilised.

The monitoring program was designed with consideration to the predicted subsidence associated with LW S1A-LW S7A and the potential effects of predicted subsidence, upsidence, closure and tilt on surface water and groundwater resources. Where feasible the locations of monitoring sites have been aligned for monitoring of ground movements, surface water and groundwater.

The TARP triggers have been designed to enable identification of potential impacts based on the before and after monitoring at reference and performance measure sites. If an impact is identified to have occurred or is likely to occur, the relevant TARP (refer to **Appendix A**) would then be referred to for the identification of appropriate mitigation strategies.

Access for features associated with the TARPs have been established with long-term Land Access Agreements covering a large proportion of Teatree Hollow, Teatree Hollow tributary, the Bargo River, the

Bargo River tributary and Hornes Creek. Extensive consultation has occurred to reach agreement with as many landowners as possible associated with these watercourses. Tahmoor Coal will continue to consult with the community regarding Land Access Agreements.

6.2.1 Quality Assurance / Quality Control

A Before-After-Control-Impact (BACI) framework has been implemented, where feasible, for surface water and groundwater monitoring and has been incorporated in the design of the TARP triggers. The monitoring program aims to develop a baseline (before) dataset for a range of surface water and groundwater features and to assess operational and post-mining (after) impacts through the monitoring of reference (control) and performance measure (impact) sites.

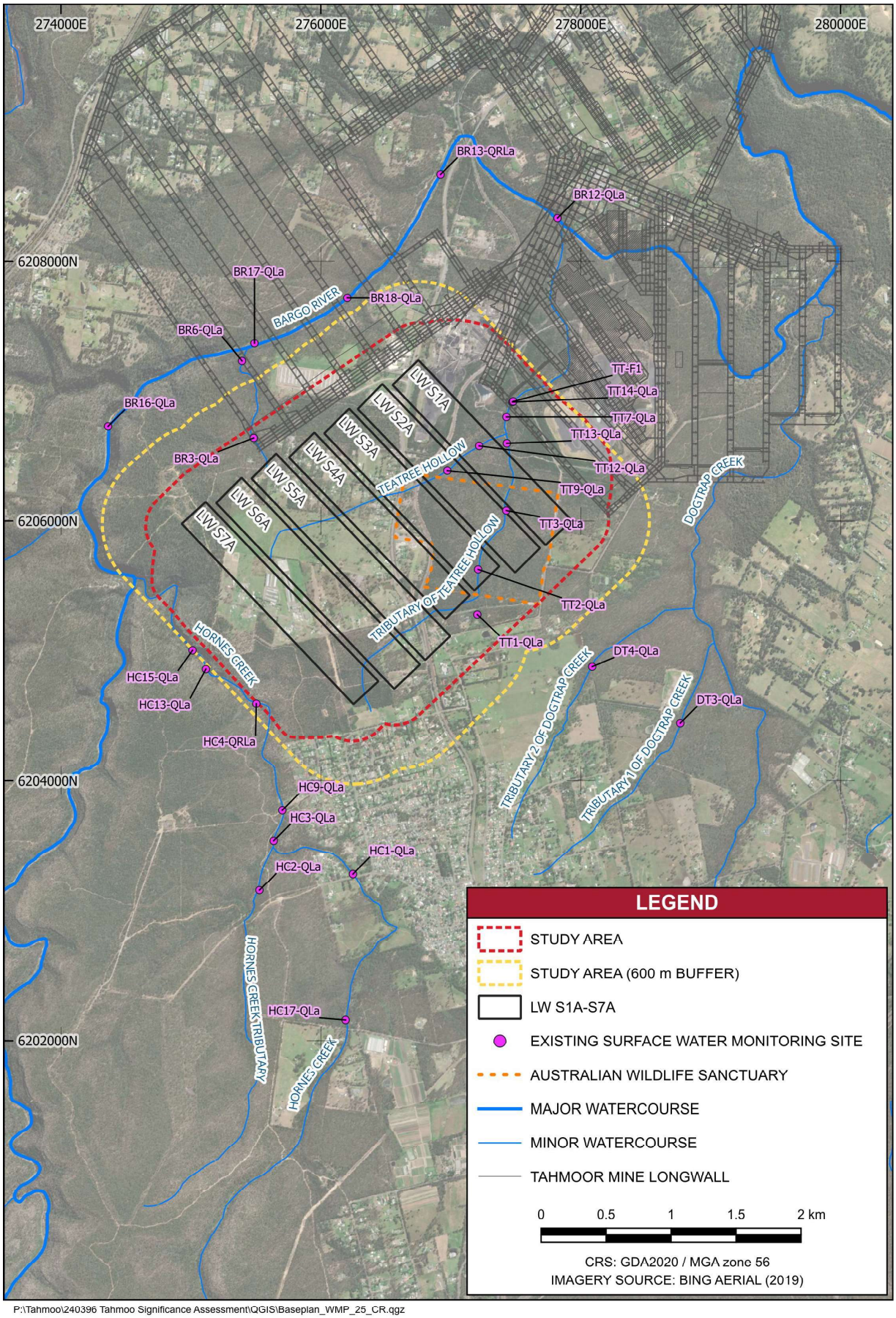
Quality assurance and quality control (QA/QC) for water quality monitoring is and would continue to be undertaken in accordance with the *Australian and New Zealand Guidelines for Fresh & Marine Water Quality* (ANZG, 2018). The sample collection is and would continue to be undertaken by an experienced field technician. The sample analysis undertaken by a National Association of Testing Authorities (NATA) accredited laboratory and the data analysis undertaken by a specialist consultant. Where a data record is identified as potentially erroneous by the specialist consultant, the value is and would be queried with and reviewed by the field technician. The same process is and would be undertaken for pool water level records, with the records also verified through comparison of the manual field measurements and automatic water level logger records.

6.2.2 Monitoring Site Locations and Monitoring Program Summary

The locations of surface water monitoring sites are shown on **Figure 22** to **Figure 24**. **Figure 25** shows the locations of surface water monitoring sites in relation to subsidence monitoring sites and maximum subsidence prediction contours. Subsidence monitoring includes Global Navigation Satellite System (GNSS) units, pegs and survey marks.

The locations of groundwater monitoring sites are shown on **Figure 26** and **Figure 27**. **Figure 28** shows the maximum predicted groundwater level drawdown in relation to subsidence monitoring sites.

A summary of the monitoring program is provided in **Table 28**.



P:\Tahmoo\240396 Tahmoo Significance Assessment\QGIS\Baseplan_WMP_25_CR.qgz

Figure 22 Surface Water Monitoring Sites Specific to LWS1A-S7A

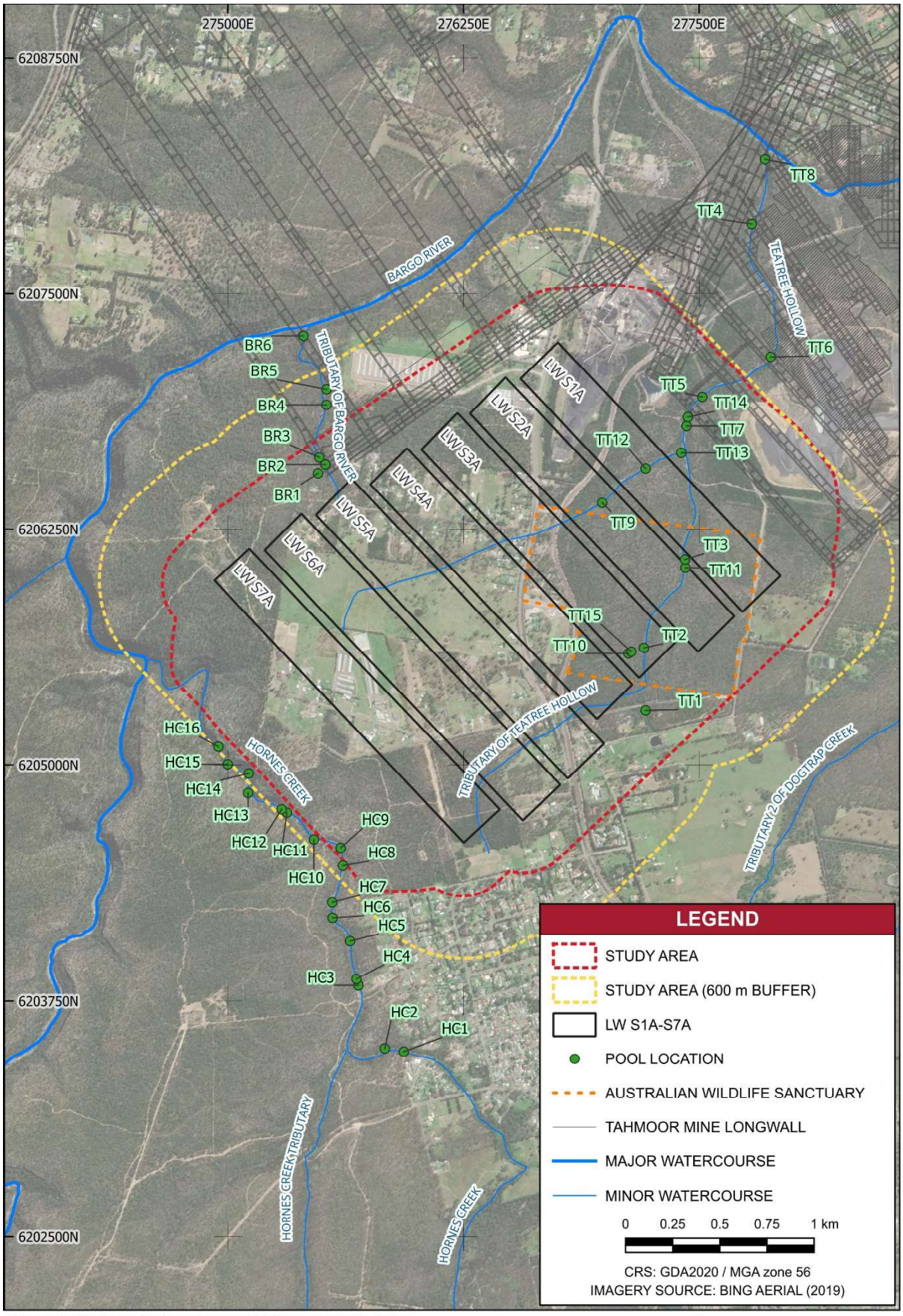


Figure 23 Pool Visual Inspection Sites

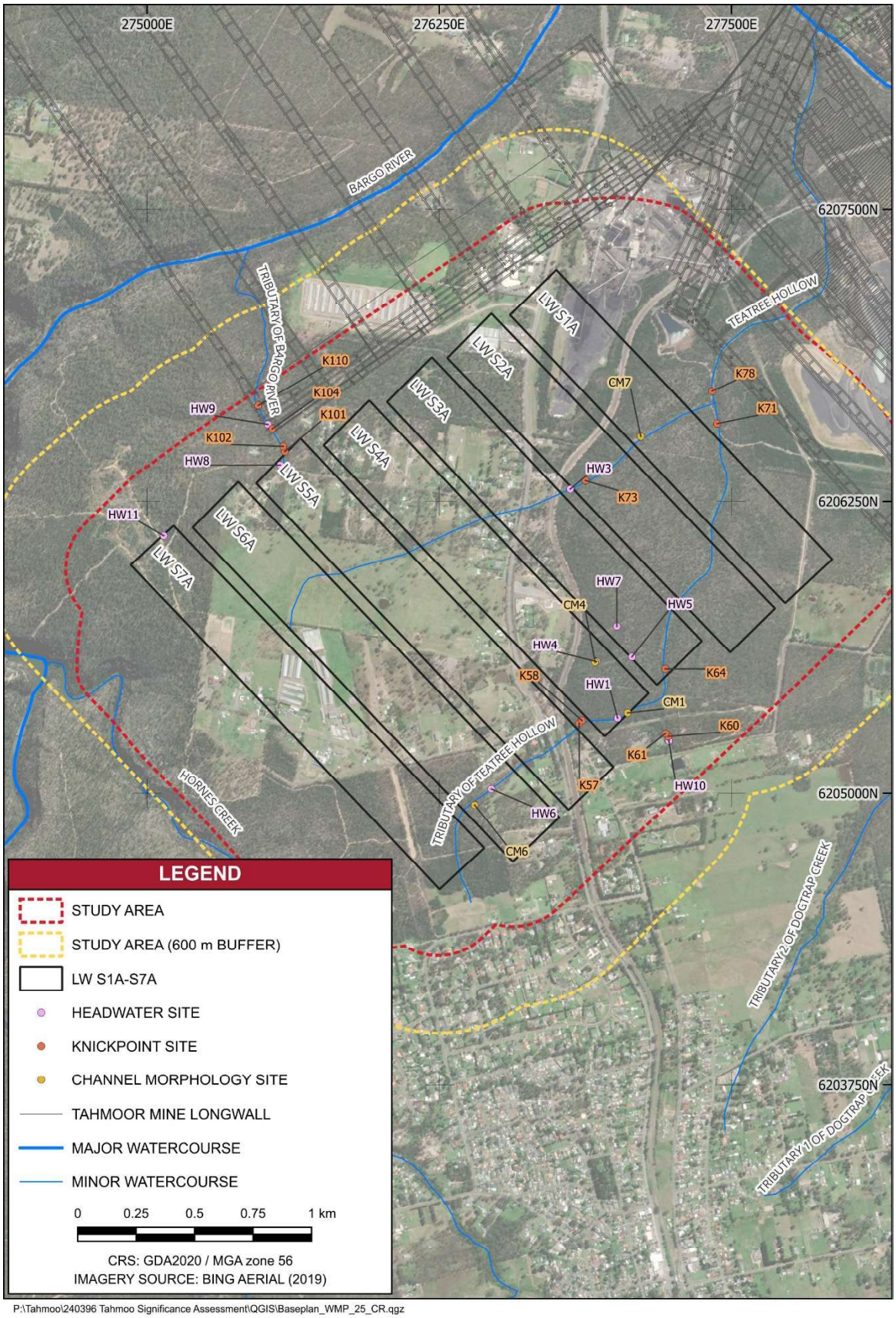


Figure 24 Morphology and Channel Stability Monitoring Sites

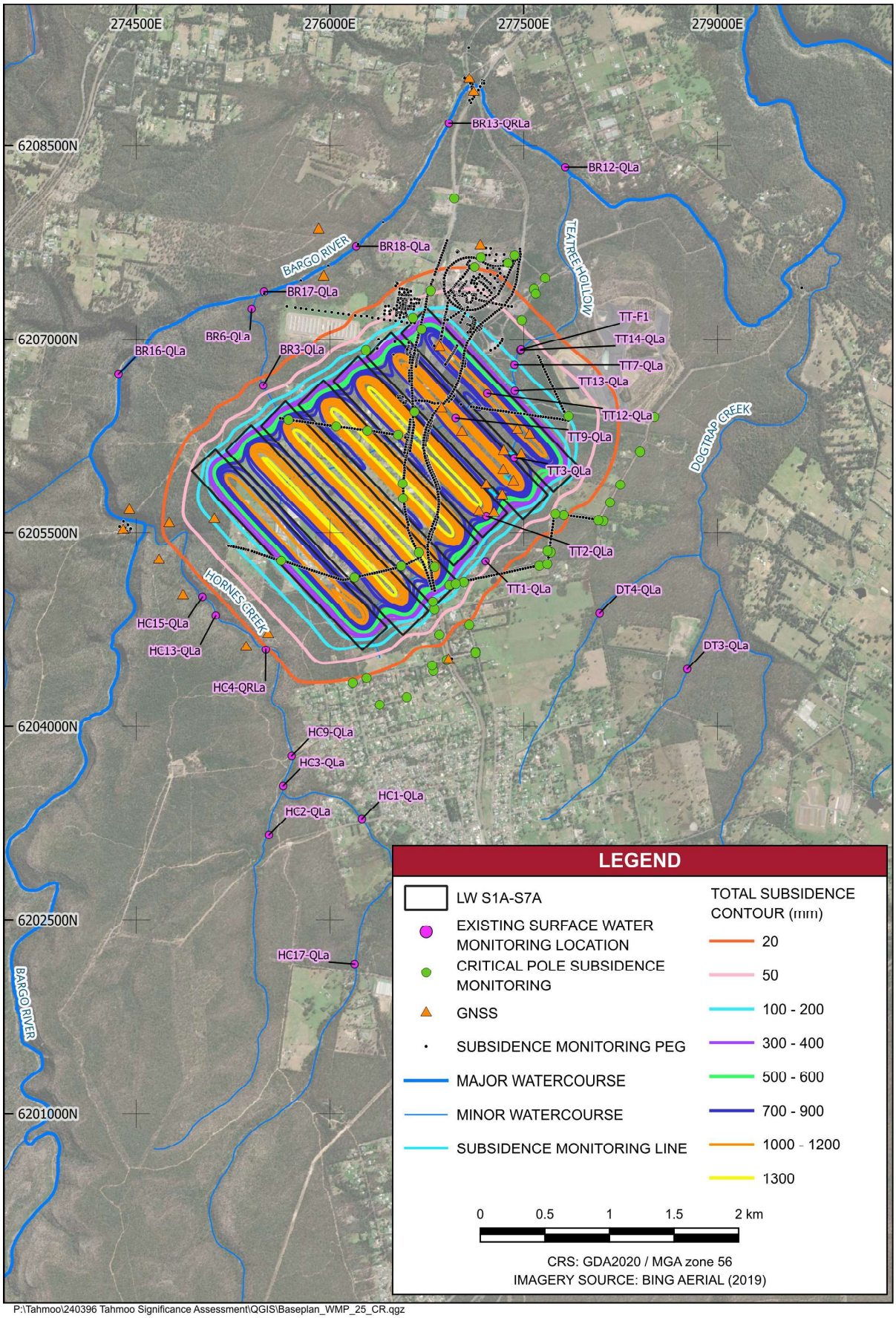


Figure 25 Surface Water Monitoring Sites, Subsidence Monitoring Sites and Maximum Subsidence Prediction Contours

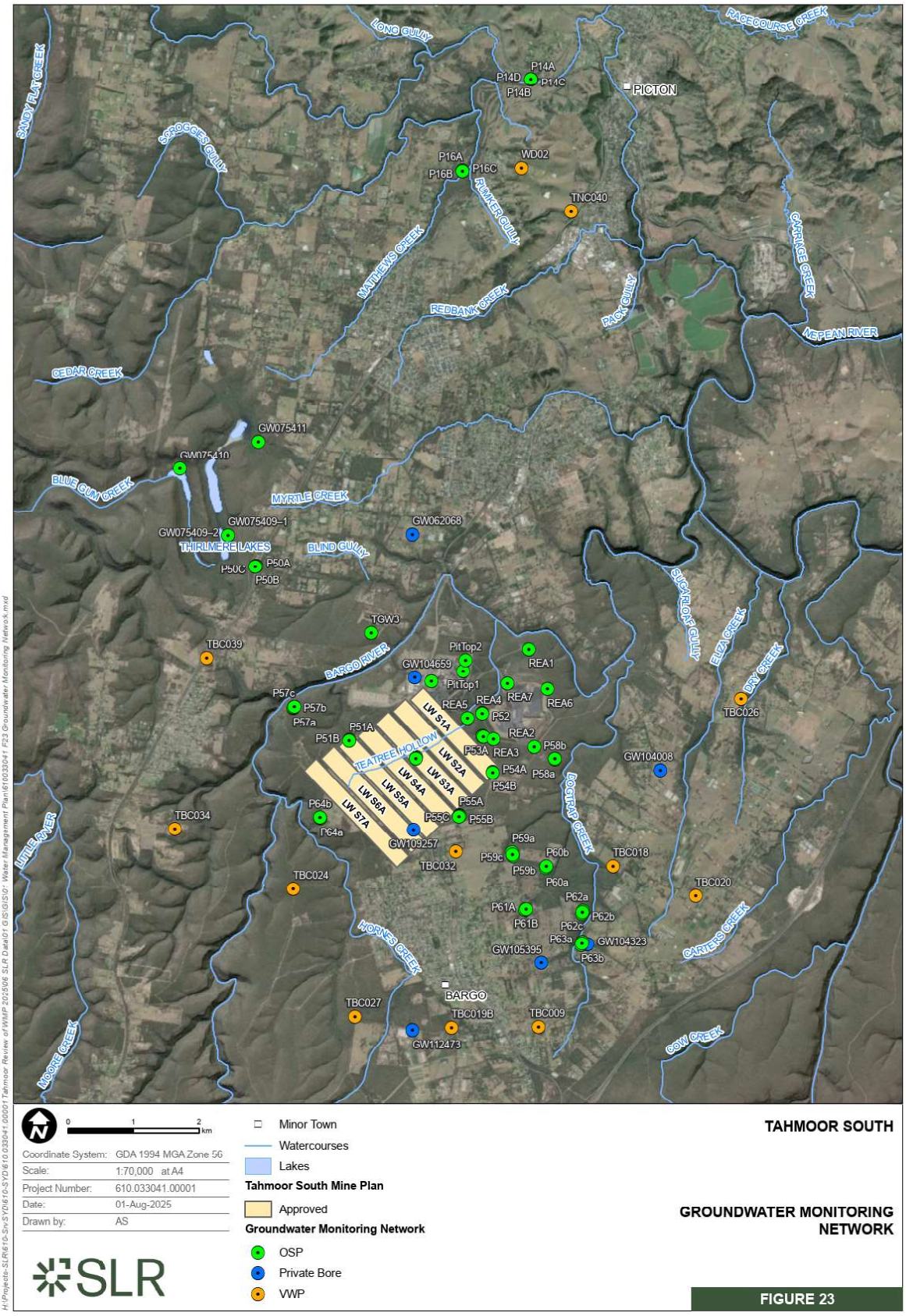


Figure 26 Existing and Proposed Groundwater Monitoring Sites

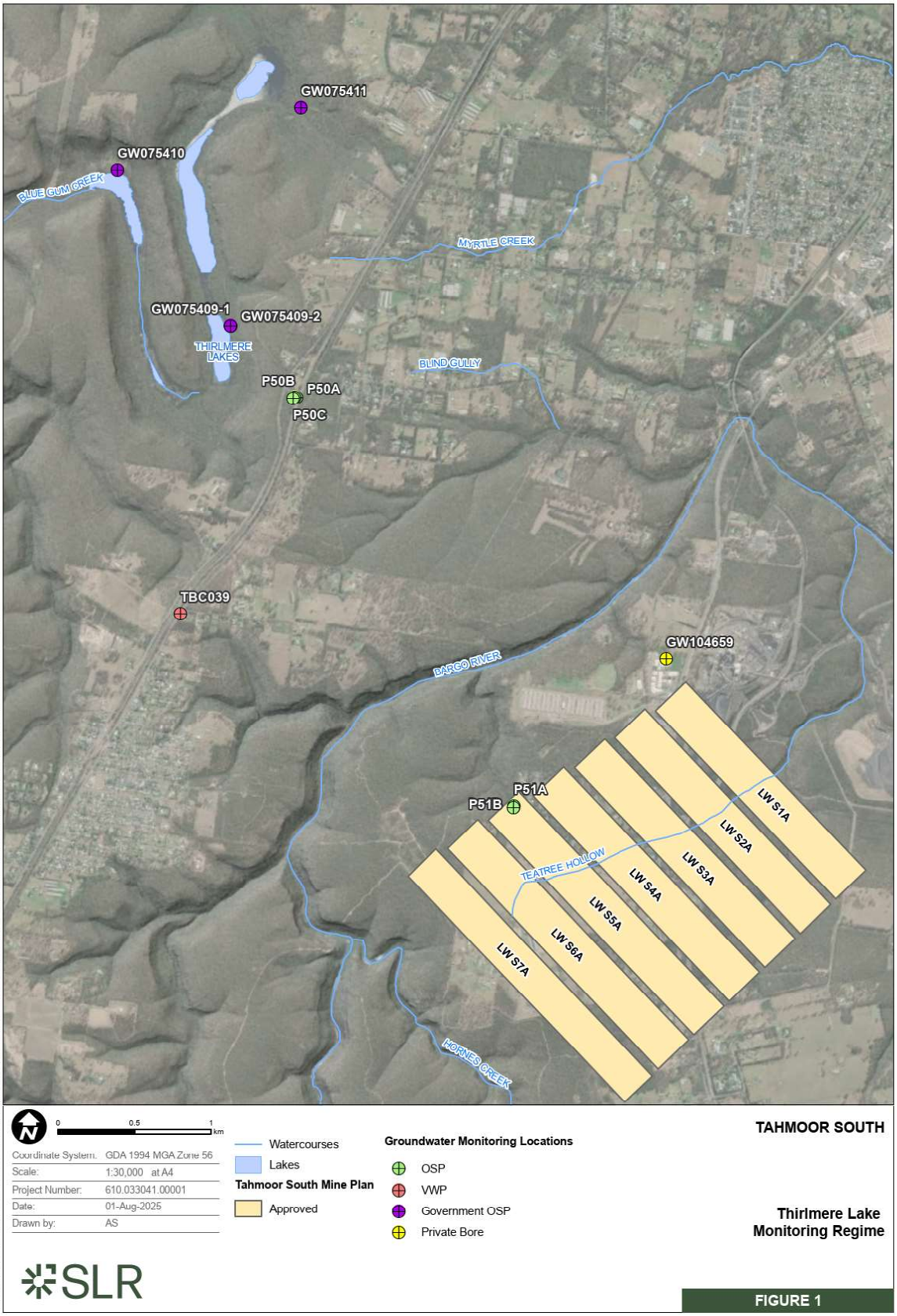


Figure 27 Thirlmere Lakes Monitoring Sites

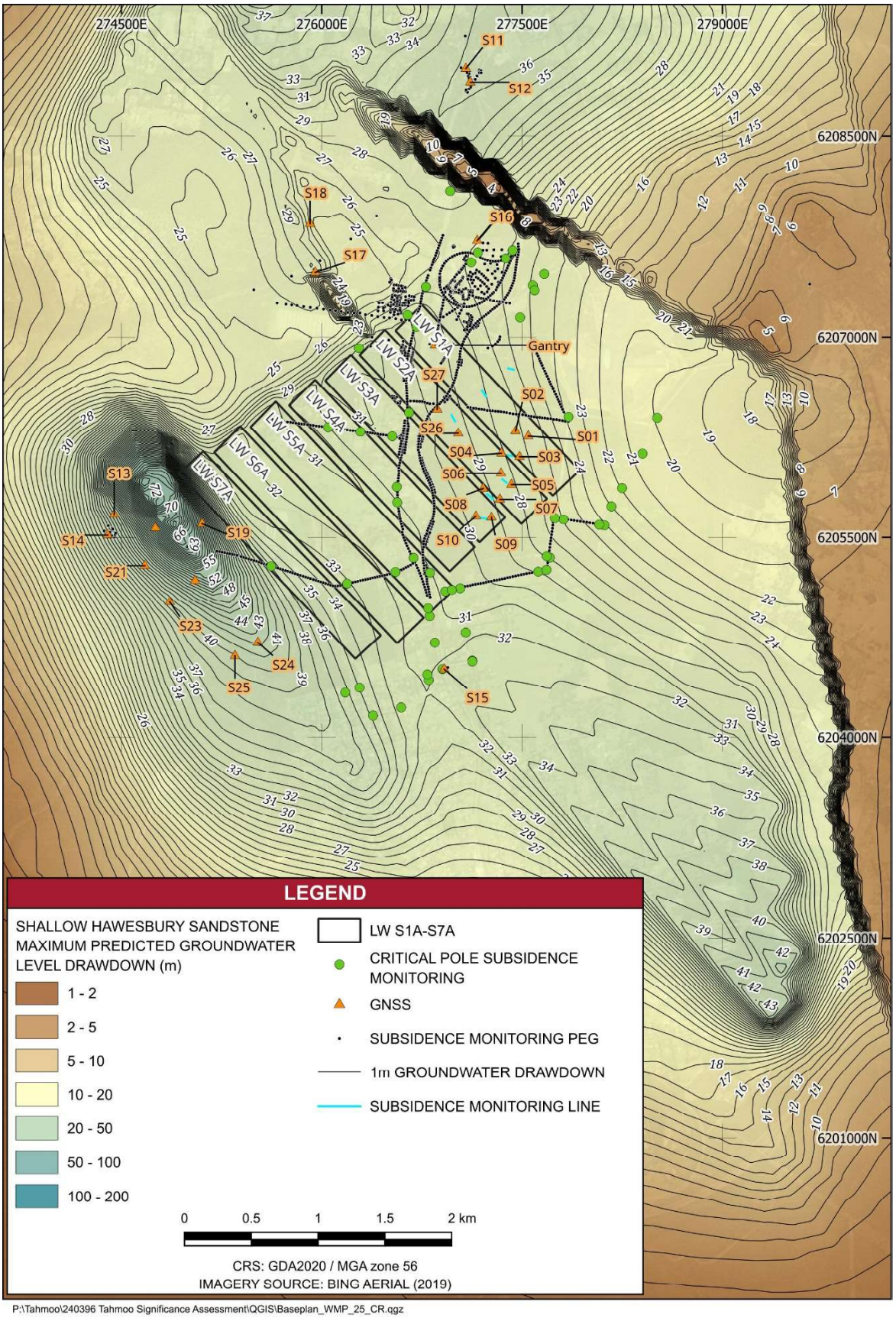


Figure 28 Maximum Predicted Cumulative Groundwater Level Drawdown and Subsidence Monitoring Sites

Table 28 Monitoring Program for Surface Water Resources Relevant to LW S1A–S7A

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Streamflow	TT-F1	Continuous record. Data downloaded prior to the commencement of secondary extraction in relevant catchment.	Continuous record. Data downloaded and reviewed monthly.	Continuous record, data downloaded and reviewed quarterly for 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.
Surface water quality	TT1-QLa, TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa, HC1-QLa, HC9-QLa, HC4-QRLa, HC2-QLa, HC3-QLa, HC13-QLa, HC15-QLa, HC17-QLa, BR3-QLa, BR6-QLa, BR13-QRLa, BR12-QLa, BR16-QLa, BR17-QLa, BR18-QLa, DT3-QLa, DT4-QLa	Monthly sampling prior to secondary extraction of the relevant longwall.	Monthly sampling and analysis or as required by a specified action relevant to a trigger level.	Monthly sampling and analysis for a minimum of 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.
		Parameters: Field analysis: pH, electrical conductivity (EC) and dissolved oxygen (DO), temperature and oxygen reduction potential (ORP). Laboratory analysis for: pH, EC, total dissolved solids, total suspended solids, turbidity, major cations[†], sulphate, alkalinity, chloride, dissolved and total metals[‡], total kjeldahl nitrogen, total nitrogen, total phosphorus, total cations and total anions.		
Pool water level	TT1-QLa, TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa, HC1-QLa, HC9-QLa, HC4-QRLa, HC2-QLa, HC3-QLa, HC13-QLa, HC15-QLa, HC17-QLa, BR3-QLa, BR6-QLa, BR12-QLa, BR13-QRLa, BR16-QLa, BR17-QLa, BR18-QLa, DT3-QLa, DT4-QLa	Continuous record and monthly manual measurements. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.		

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Physical features and natural behaviour of pools and reaches	Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary pools and reaches	One observation prior to mining using fixed location photo points.	Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone^ using fixed location photo points.	Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.
Morphology and channel stability	Headwater and knickpoint sites in Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary	One observation prior to mining using fixed location photo points. One catchment survey of 10 headwater sites.	Observations of knickpoint formation every month during the active subsidence period for sites within the active subsidence zone using fixed location photo points. Annual catchment survey of 10 headwater sites.	One observation of knickpoint formation at sites that are no longer within the active subsidence zone using fixed location photo points. One catchment survey of 10 headwater sites. Post-mining geomorphology survey following completion of mining LW S7A.

^ Survey area to include upstream, downstream and adjacent pools (to the extent of the potential impact) where a trigger exceedance has occurred at a potential impact site(s) in accordance with the TARPs

† Calcium, magnesium, sodium and potassium.

‡ Aluminium, arsenic, barium, copper, iron, lead, lithium, manganese, nickel, selenium, strontium and zinc.

Table 29 Monitoring Program for Groundwater Resources Relevant to LW S1A–S7A

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Groundwater level at all monitoring bores	Existing sites (VWPs): TBC009, TBC018, TBC019B, TBC020, TBC024, TBC026, TBC027, TBC032, TBC033, TBC034, TBC038, TBC039	VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time.	VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time.	Continuous record of water level/pressure for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.
	Existing sites (OSP): REA4, P51a, P51b, P52a, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c, P57a, P57b, P57c, P50a, P50b, P50c Private Bores (OSP): GW109257, GW104008, GW112473, GW104659, GW104323	Continuous record and monthly manual measurements of water level. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.	Continuous record and monthly manual measurements of water level. Data downloaded and reviewed monthly.	Continuous record (where loggers installed) and quarterly manual measurements of water level for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.
Groundwater level at Thirlmere Lakes	Existing VWP: TBC039 Existing OSP: GW104659, P50a, P50b, P50c NSW Government monitoring bores: GW075409–1, GW075409–2, GW075410, GW075411	Continuous record and monthly manual measurements of water level and water quality. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.	Continuous record and monthly manual measurements of water level and water quality. Data downloaded and reviewed monthly.	Continuous record (where loggers installed) and quarterly manual measurements of water level for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Groundwater quality at monitoring bores within and adjacent to the Study Area	Existing sites (OSP): REA4, P50a, P50b, P50c, P51a, P51b, P52, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c, P57a, P57b, P57c Private Bores (OSP): GW109257, GW104008, GW112473, GW104659, GW104323	Monthly sampling.	Monthly sampling and analysis.	Quarterly sampling and analysis for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.
Groundwater quality at Thirlmere Lake monitoring bores	Existing OSPs: GW104659, P50a, P50b, P50c NSW Government monitoring bores: GW075409–1, GW075409–2, GW075410, GW075411	Monthly sampling. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.	Monthly sampling and analysis. Downloaded and reviewed monthly.	Quarterly sampling and analysis for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.

OSP = open standpipe, VWP = vibrating wire piezometer

6.3 Streamflow Gauging Stations

A streamflow gauging station is located on Teatree Hollow (TT-F1 in **Figure 22**) with baseline streamflow data available from January 2020 to October 2022. The streamflow monitoring data recorded at this site from commencement of mining LW S1A is assessed in comparison to the baseline streamflow dataset to quantify the reduction in Teatree Hollow streamflow due to mining effects.

6.4 Groundwater Extraction Monitoring

Groundwater pumped from all sumps in the mine workings is currently, and will continue to be, monitored by means of flow meters fitted to pipelines recording pumping times and rates. This water reporting to the underground workings and sumps may include groundwater seepage inflows, supply inflows (potable supply and for operations) and some re-circulation.

6.5 Longwall Fracturing Investigations

TSC-1 is a fully cored borehole, with a full suite of geological, geotechnical and hydrogeological testing conducted through the sequence (refer **Figure 26** for location). The borehole was cored from surface to seam, with the Bulli Seam depth of 404.00 m. The location of this borehole (off the southern end of LW S1A) makes it suitable as a pre-mining Height of Fracturing (HoF) investigation borehole. A post-mining HoF borehole would be installed following completion of mining.

A second pre-mining HoF borehole (LWS4A_HOF01), refer **Figure 23** for location, has been drilled above LW S4A prior to the influence of mining (completion of LWS4A_HOF01 in the early stages of extraction of LW S2A). The borehole was PCD drilled from surface to a total depth of 303m. Characterisation of borehole LWS4A_HOF01 has been conducted using a full suite of geophysics, acoustic and optical scanner, borehole camera, lugeon style packer testing and the installation of vibrating wire piezometers (VWPs) A post-mining HoF borehole would be installed following completion of the relevant longwall.

6.6 Baseline Monitoring to Support Future Extraction Plans

Monitoring data collected and analysed during the mining of LW S1A-S7A would be used to inform future Extraction Plans for the Project. The monitoring program for future Extraction Plans would build on the baseline monitoring undertaken to date, with additional monitoring sites implemented as required. The monitoring program would be adapted to changing priorities, mine design and/or include improvements to the overall design of the monitoring program.

The surface water monitoring to be implemented for the B Series Extraction Plan is shown in **Figure 6** and includes monitoring of pool water level, water quality and streamflow in Dogtrap Creek in addition to monitoring of pool physical features and geomorphology.

As indicated in **Table 28**, a period of post-mining monitoring is proposed for all groundwater monitoring bores of interest. These bores of interest would be established 12 months prior to completion of extraction of LW S7A and would be dependent on a review of historical data, bore suitability (i.e., bore condition, access agreements, etc.) and suitability for purpose.

The intention of the post-mining monitoring is to allow ongoing review of potential impacts (i.e. depressurisation lags) and degree of recovery whilst also providing continued baseline data to support future Extraction Plans, both in terms of conceptual understanding of the effects of longwall mining and for improving confidence in the ability to simulate these in numerical models.

7 Subsidence Management Strategies

7.1 Mine Design Considerations

The Tahmoor South Domain mine plan has undergone a series of amendments since the issue of the first EIS for the Project in 2014. These mine plan revisions are summarised below:

- EIS Submission (2014): Original EIS submission, which was placed on hold and subsequently withdrawn in late 2015;
- EIS Submission (January 2019): Updated EIS submission based on revised Secretary's Environmental Assessment Requirements (SEARs) issued in June 2018;
- Project Amendment Report (February 2020): The mine design was modified to reduce potential environmental impacts of the Project through the reduction in the extent of longwall mining. This was achieved by the following modifications:
    i. Removal of LW 109, which was located directly beneath Dogtrap Creek. This would result in elimination of direct impacts to Aboriginal heritage items;
    ii. Configuration of the longwall layout to comprise two series of shorter longwall panels;
    iii. Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; and
    iv. Reduction in the height of extraction within the longwall panels from up to 2.85 m to up to 2.6 m.
- Second Amendment Report (August 2020): The mine design was again modified to further reduce potential environmental impacts. This included the removal of two longwalls in the southern part of the mine near the township of Bargo (LW 107B and LW108B), which would result in a reduction in magnitude of subsidence impacts.
- Subsequent to SSD 8445 approval, LW S3A was shortened by 104 m, as approved by DPHI on 27 March 2024. LW S4A has been shortened by 104 m as approved by DPHI on 11 November 2024.

The numerous modifications of the Tahmoor South Domain mine plan have resulted in a reduction of the magnitude and extent of subsidence impacts, as well as avoidance of significant impact to sensitive surface features of the environment, including Aboriginal heritage items.

The current mine plan provides access to the Tahmoor South Domain from the existing pit top facilities. This mine design minimises surface impacts from mining through the avoidance of establishing new surface facilities.

7.2 Management, Remediation and Verification Measures

7.2.1 Mitigation Measures and Corrective Management Actions

For watercourses which are affected by mining-induced subsidence effects but the effects do not extend as far as surface fracturing or flow diversion, corrective management actions (CMAs) would be implemented as described in the TARPs (refer **Appendix A**). The CMAs would be proposed and implemented based on the nature of non-fracture effects. The monitoring of and success of the CMAs would be reported in the Annual Review.

In accordance with Consent Condition C12 and as described in the TARPs (refer **Appendix A**), a Watercourse Corrective Action Management Plan (WCAMP) will be prepared for watercourses damaged by subsidence impacts. 'Damage' of a watercourse is considered to relate to mining-induced fracturing of a watercourse and redirection of streamflow and/or localised and transient increases in water quality

constituents.

7.2.1.1 Soft Knickpoints and Headwater Streams

If notable development of soft knickpoints and/or notable erosion and sedimentation of headwater streams was observed, the knickpoints and headwater streams would be professionally assessed in order to identify appropriate corrective management actions. The most reliable approach to erosion control comprises rock grade structures, however, the exact nature of the management measure would be assessed based on the nature of the erosion and sedimentation and site access restrictions.

7.2.1.2 Pool and Watercourses

As noted in **Section 5**, there is potential that, where directly undermined, Teatree Hollow and the Teatree Hollow tributary may experience the full range of subsidence related effects and, as such, a reduction in pool water holding capacity and connective streamflow may occur. Accordingly, surface water level and streamflow monitoring within and adjacent to the Study Area is proposed (refer **Section 6**) and TARPs have been developed to assess the need for a response which may include remediation (**Appendix A**).

Stream remediation measures, comprising grout curtains and grout pattern injection, have been successfully implemented in Redbank Creek and Myrtle Creek to remediate subsidence impacts associated with mining in Tahmoor North.

Appendix E presents a detailed assessment of the effectiveness of remediation works conducted to date in Redbank Creek and Myrtle Creek. The effectiveness of remediation works was assessed with respect to the improvement in pool water holding capacity, pool water level recession and aquatic habitat and stream health. The assessment outcomes identified that the effectiveness of the remediation works has been predominantly high at sites in Myrtle Creek and predominantly medium to high at sites in Redbank Creek.

A WCAMP would be developed where subsidence results in fracturing of the stream bed or controlling rockbars of watercourses. The WCAMP would be developed consistent with that developed and implemented for Myrtle Creek and Redbank Creek, incorporating learnings from these remediation works. It is envisaged that a staged approach to the remediation works would be adopted, with outcomes from each stage used to guide the approach adopted for the next stage.

The WCMAP would be developed in collaboration with relevant government agencies and would incorporate performance measures and indicators for assessing the effectiveness of the remediation works implemented. The performance measures and indicators would relate to the effectiveness of the remediation works for improving pool water holding capacity, pool water level recession and aquatic habitat and stream health.

7.2.1.3 Private Groundwater Bores

As detailed in **Appendix A** and **Appendix D**, where a mining related activity results in detrimental impact to private groundwater bores, Tahmoor Coal would implement make good provisions in consultation with the affected landholder and where applicable, Subsidence Advisory NSW. Tahmoor Coal commits to facilitation of "make good" provisions beyond the period of maximum drawdown and post-mining.

Tahmoor Coal has been implementing this process during the life of Tahmoor/Tahmoor North. The process allows for bore owners to apply to Tahmoor Coal if they believe the level or quality of a bore has declined triggering an assessment into the potential cause (i.e. mining related). If it is identified from an independent investigation that the mine is responsible, then remedial action would be implemented.

The make good process would be staged by Tahmoor Coal in accordance with the proposed mining schedule and the results of predictive groundwater modelling. Contact has been made with landholders whose registered bores are predicted to experience a drawdown of greater than 2 m, as per the NSW Aquifer Interference Policy (AIP) criterion, or whose bores are at risk of subsidence related impacts. Following this initial contact with landholders and where access was granted, a baseline field survey has been completed to verify bore details – location, depth, condition of bore and pump, standing water

levels, groundwater quality and usage (where possible). Survey findings have been provided to the landholder so that they have the same baseline information as Tahmoor Coal. This information has provided both parties with a thorough understanding of the current bore condition and a reference point for comparison with subsequent bore assessments as mining progresses. The verified bore data has also been included in the recent update of the groundwater model.

In the event that a mining-related impact to a private bore has been confirmed and any further potential impacts are understood (based on groundwater modelling), the landholder and Tahmoor Coal would develop a make good agreement. This agreement would include specific make good mitigation measures and would outline a potential timeframe for undertaking these measures in consultation with the landholder. The make good agreement would include and consider the conditions of any development consents, the provisions of the AIP and the NSW Coal Mine Subsidence Compensation Act 2017.

There are a number of make good options that may be adopted, based on the details and characteristics of an individual bore and the extent of mining-induced impacts. These mitigation measure options include:

- Bore maintenance where physical adjustments and regular maintenance of the bore(s) are required to return them to pre-mining conditions. This could include extending the depth of the bore(s), or lowering of the pump(s) to return yield to pre-mining conditions;
- Replacement of bore(s) to provide a yield at least equivalent to the yield of the affected bore prior to mining. This may be required where deepening of an existing bore is not possible (e.g. the bore has partially collapsed or the bore hole has sheared);
- Provision of access to an alternative source of water or compensatory water supply. This option may be offered while other measures are being undertaken and could include connection to the town water supply or the provision of on-site storage (e.g. dam or water tanks); and
- Compensation to reflect increased water extraction costs (e.g. due to lowering pumps or installation of additional or alternative pumping equipment).

The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply should be provided (at least on an interim basis) as soon as practicable after the loss is identified, unless otherwise agreed with the landowner. The burden of proof that any loss of water supply is not due to mining impacts rests with Tahmoor Coal, in accordance with Condition B27 of SSD 8445.

If there is a dispute as to whether the loss of water is to be attributed to the development or the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution, in accordance with Condition B28 of SSD 8445. If Tahmoor Coal is unable to provide an alternative long-term supply of water, compensation will be provided to the affected landowner, to the satisfaction of the Planning Secretary.

7.2.2 Verification Methods

The groundwater model would be validated periodically via comparison of monitoring results with modelled predictions. Re-calibration would occur as necessary, and an independent review of the model would be undertaken every three years. Following each round of model re-calibration, trigger levels would be reviewed against the model predictions and revised as necessary. The revised trigger levels would be documented in an updated version of this Water Management Plan.

Operational water balance reviews would continue to be undertaken monthly collating groundwater extraction rates and on-site water supply and usage.

Where pool remediation works are required, monitoring of pool water level would continue for the duration of remediation works and for two years post-remediation in order to provide a suitable timeframe for assessment of the effectiveness of remediation works. Additionally, aquatic ecology surveys would continue for two years post-remediation.

7.3 Trigger Action Response Plan

A series of TARPs have been developed to address various components of surface water and groundwater resources relating to the performance indicators to be adopted during LW S1A-S7A mining, in accordance with Condition C8(g)(viii) of the Consent (refer to **Appendix A**).

The primary aims of the TARP are to:

- Define appropriate trigger levels for surface water and groundwater resources;
- Develop specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded; and
- Present a plan in the event that a performance measure is exceeded or is likely to be exceeded and describe the management / corrective actions to be implemented (i.e. notifications to relevant agencies, groundwater reviews, revision in any WCMAP).

The 'Normal Condition' section of each TARP indicates that the environment is performing within normal levels or natural variability. Deviation from baseline or expected condition triggers an increased level of risk to the environment (Level 1 or higher based on escalating corresponding risk).

7.3.1 Implementation of Monitoring Program and TARP Requirements

Tahmoor Coal's standard approach for all monitoring, reporting, investigation and remediation is to commence all tasks as soon as practicable. The following sections provide more information on this standard approach to be adopted during the LW S1A-S7A pre-mining, mining and post-mining phases:

- All monitoring commitments will be tracked on a weekly basis so that tasks are completed as required, taking into consideration land access and environmental factors. Post-mining monitoring will typically be completed within one month of the completion of the relevant longwall and prior to the influence from the active subsidence zone on the feature from the next longwall;
- Following the receipt of monitoring data and laboratory results, specialist consultants will review the data against the relevant TARPs as soon as practicable. If any TARP trigger has occurred, specialist consultants will notify Tahmoor Coal as soon as practicable. Monitoring results and TARP triggers will also be discussed during the monthly Environmental Response Group meetings, and any relevant information from other disciplines will be shared within the group. It is noted that discussions amongst specialists from different disciplines will not be restricted to ERG meetings, and relevant specialists will be included at any time to discuss results and assist with the completion of required actions and responses, as required;
- In the event of a TARP trigger occurrence, Tahmoor Coal will initiate all requirements (actions and responses) in accordance with the relevant TARP (i.e. investigation, report, negotiation, CMA determination, or similar) as soon as practicable and endeavour to commence actions and responses within one month of the exceedance being recorded. This timeframe is noted to be subject to issues outside of Tahmoor Coal's control such as land access constraints, inclement weather, extended timeframes where further monitoring is required, and inability to communicate with a third party / landholder;
- Tahmoor Coal will complete the required actions and responses relating to the TARP trigger as soon as practicable and will endeavour to finalise these requirements, subject to issues outside of Tahmoor Coal's control, as follows:

- Level 1 and Level 2 TARP trigger actions and responses within three months of the exceedance being recorded;
- Level 3 and Level 4 TARP trigger actions and responses within six months of the exceedance being recorded; and
- Exceeds Performance Measures actions and responses in accordance with the timeframes provided in the relevant TARPs.

The TARPs define levels of variation in environmental conditions following commencement of mining, as compared to normal (baseline) conditions, and the actions required to be implemented in response to each level of variation. The assessment and investigation action and responses have been designed accordingly:

- A Level 1 or Level 2 trigger would initiate an initial assessment,
- A Level 3 trigger would initiate a detailed investigation, incorporating findings from the initial assessment. A Level 3 trigger may also initiate development of a WCAMP (detailed further in **Section 6.3.3**).

7.3.2 Establishment of Trigger Levels

7.3.2.1 Water Quality (SSGVs)

The surface water quality SSGVs are listed in **Table 13** and **Appendix A**.

Based on a detailed analysis of the baseline water quality records for Teatree Hollow, Hornes Creek and the Bargo River, the SSGV (80th or 20th percentile baseline value) is regularly exceeded for two consecutive months under normal (non-mining) conditions. As such, it is considered that three consecutive months of SSGV exceedances would indicate a deviation from normal conditions and this forms the basis of the water quality TARP Level 1 trigger (refer WMP1 and WMP2).

The proposed trigger criteria in relation to groundwater resources are detailed in **Appendix D**.

7.3.2.2 Water Level

The water level TARPs (WMP3 and WMP4) define levels of variation in pool water level from normal conditions and the actions required to be implemented in response to each level of variation. Level 1 provides an early warning indication that there has been a change in water level characteristics at a given monitoring site. Level 2 provides an indication that this change is atypical with consideration to baseline conditions.

The ‘greater than 10 cm decline’ which forms a component of the Level 1 trigger definition indicates a deviation in excess of level sensor accuracy (i.e. greater than 10 mm) however is less than the deviation in water level under ‘normal’ climatic conditions. The Level 2 trigger definition refers to ‘atypical’ characteristics which is a deviation in water level in excess of natural variability.

The proposed trigger criteria in relation to groundwater resources are detailed in **Appendix D**.

7.3.2.3 Streamflow Reduction

An Australian Water Balance Model (AWBM) has been developed and calibrated to the baseline streamflow records for TT-F1 (Teatree Hollow). In accordance with the TARPs (WMP3 and WMP4) a streamflow reduction assessment is conducted if a Level 1 trigger or above occurs in relation to pool water level decline. The streamflow reduction assessment comprises comparison of simulated streamflow ('no mining scenario') with streamflow data recorded at TT-F1. Where there is a deviance in the modelled and recorded streamflow, the volumetric variance is calculated and compared to the WAL volume held by Tahmoor Coal. The volumetric variance in streamflow is reported as surface water take on an annual basis.

7.4 Contingency Plan

In accordance with Conditions C8(g)(ix) and E5(f) of the Consent, in the event that performance measures (in the form of pre-defined triggers) are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with these TARPs (refer to **Appendix A**). This response is a contingency plan that describes the management / corrective management actions which would be implemented where required to remedy the exceedance.

If a WCMAP is required in accordance with the TARP, this plan will be prepared in accordance with Section 3.6.3 of the Extraction Plan Main Document.

The success of remediation measures that have been implemented for any TARP exceedance would be reviewed as part of any WCMAP and the Annual Review.

7.4.1 Watercourse Corrective Action Management Plan

A WCAMP will be prepared for watercourses damaged by subsidence impacts. Further to this, the development of WCAMP is triggered in the following TARPs:

- Stream water quality for all watercourses within subsidence area;
- Stream water quality for other watercourses (Bargo River and Hornes Creek);
- Pool water level for all watercourses within subsidence area;
- Pool water level for other watercourses (Bargo River and Hornes Creek);
- Physical features and natural behaviour of watercourses within the subsidence area; and,
- Physical features and natural behaviour of pools for other watercourses (Bargo River and Hornes Creek).

In the event that a WCAMP is required, it may be appropriate to implement the WCAMP at a later date, e.g., at the conclusion of subsidence. The timeframe for implementation of remediation works would be detailed in the WCAMP.

7.5 Adaptive Management Strategies

7.5.1 Adaptive Management for Surface Water and Groundwater

There are no specific adaptive management strategies currently proposed for the management of surface water and groundwater resources in the Study Area. However, potential contingency measures in the event of unforeseen impacts or impacts in excess of those predicted could include:

- Providing a suitable offset(s) to compensate for the reduction in the quantity of water resources/flow, as stated in **Section 6.2.1**; and/or
- Make good provisions, to be negotiated with an affected landholder, in the event that water supply from a surface water system (as designated by a Water Supply Works and Water Use Approval) is impacted, as stated in **Section 6.2.1**.

7.5.2 Continuous Improvement

Tahmoor Coal have adopted the "Plan-Do-Check-Act" model as shown in **Figure 29**. This model will be applied to all aspects of Tahmoor Coal's environmental management and is utilised to embed the continuous improvement process in all system documents.

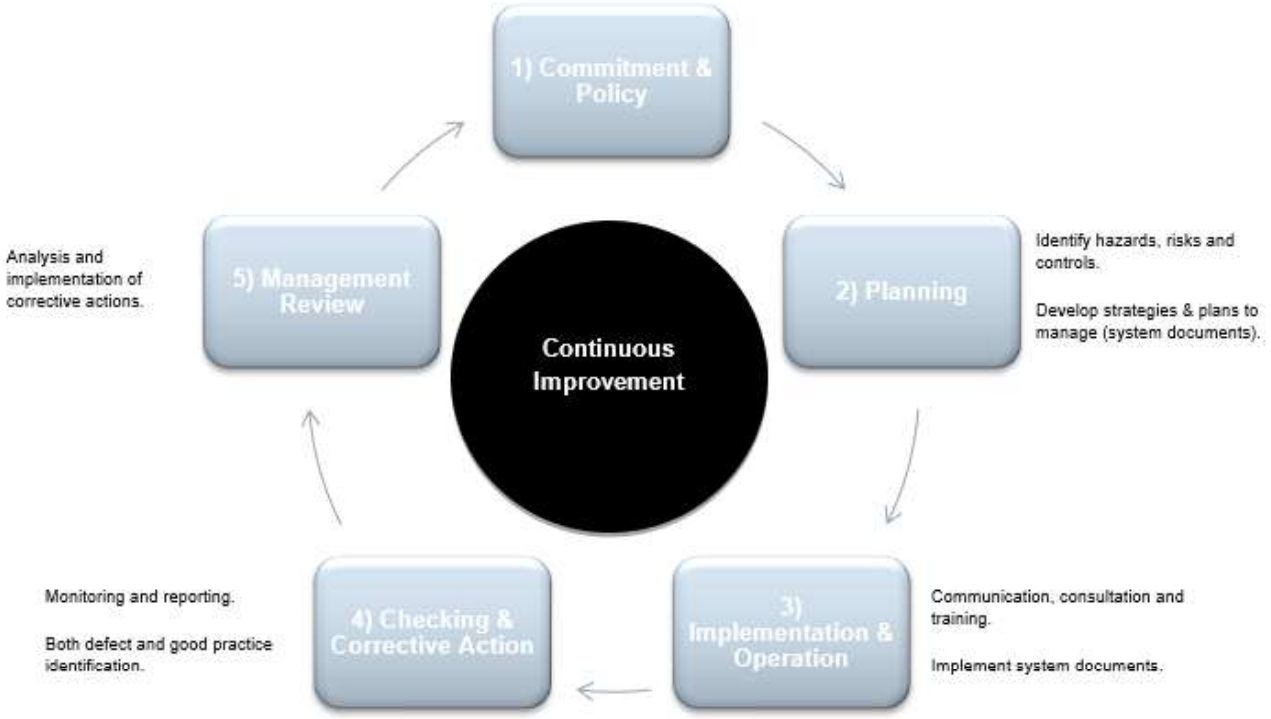


Figure 29 Continuous Improvement Model

8 Implementation and Reporting

8.1 General Requirements

This section of the management plan describes the key elements of implementation and reporting specific to the management of surface water and groundwater resources.

A description of requirements and procedures that are applicable to the extraction of LW S1A-S7A in general are provided in the Extraction Plan Main Document. This detail includes:

- Environmental Management System Framework;
- General reporting requirements, including details regarding the Annual Review, and Annual Return;
- Incident management and reporting requirements;
- Non-compliance management and reporting requirements;
- Exceedances management and reporting requirements;
- Compliant and dispute management protocol;
- Audit and review requirements for general environmental performance, including internal audits and reviews, and independent environmental audits;
- General roles and responsibilities;
- Employee and contractor training requirements;
- Response groups to facilitate the review of monitoring data;
- Internal and External Stakeholder Communication Procedures;
- Access to information requirements, including Tahmoor Coal website and the Tahmoor Colliery Community Consultative Committee;
- Document control protocol; and
- Risk assessment for built and natural features and corresponding outcomes.

8.2 Reporting Requirements

8.2.1 Performance Measure Exceedance

In accordance with Condition E4 of the Consent, where any exceedance of the criteria or performance measures outlined within this document has occurred, Tahmoor Coal will:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the relevant government agency describing those options and any preferred remediation measures / corrective management actions or other course of action;
- Within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures / corrective management actions or other course of action; and
- Implement reasonable remediation measures / corrective management actions as directed by the Planning Secretary.

8.2.2 Specific Reporting for Surface Water and Groundwater

Monitoring and management of surface water and groundwater resources relevant to extraction of LW S1A-S7A will be reported in the Annual Review reports. The Annual Review will also include review and reporting of the suitability of monitoring sites (including reference sites).

8.3 Review and Auditing

8.3.1 Plan Audit

Audits of the Water Management Plan are to be conducted in consultation with the Plan owner and nominated individuals and shall focus on the content and implementation.

Audits on the content shall consist of a determination of understanding of the Water Management Plan by the individual's allocated responsibility under this plan.

Audits on the implementation shall consist of reviews of the safe working procedures and risk assessments developed to ensure safe operation of this Water Management Plan, they may also involve discussions with personnel involved in the management plan to determine understanding and compliance.

Should an audit of this Water Management Plan determine that a deficiency is evident in the content or implementation, a corrective action must be developed and implemented. Actions will be assigned to a nominated individual and tracked in the Cority Compliance Management database.

Tahmoor Coal is responsible for verifying that the nominated corrective action has been implemented by way of a follow up audit.

Any changes to the Water Management Plan are to be managed and communicated to all personnel in line with the Change Management Process.

8.3.2 Plan Review

This Water Management Plan will be reviewed as follows:

Event based: in accordance with Condition E7 (a) of the Consent, a review will be required within 3 months of any incident, event or finding that identifies an inadequacy in the Water Management Plan risk assessment or associated documents to continue to effectively manage the identified hazard; a change to the workplace itself or any aspect of the work environment, a change to a system of work, a process or a procedure; or

Time based: in the absence of regular event-based reviews and in accordance with Condition E7 (b-e) of the Consent, this plan will be reviewed within three months of:

- the submission of an Annual Review under Condition E13;
- the submission of an Independent Environmental Audit under Condition E15;
- the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or
- notification of a change in development phase under Condition A19.

If deemed appropriate, relevant stakeholders may be included in the review process. All reviews are to be documented. The process for review of this document will be in according to Tahmoor Coal's *Document and Record Control* (TAH-HSEC-00124).

Following changes (or as otherwise required above), a copy of the amended management plan will be forwarded to the Secretary of the DPHI for approval.

8.4 Roles and Responsibilities

The implementation of surface water and groundwater monitoring and associated TARPs required in relation to mining of LW S1A-S7A is the responsibility of the Tahmoor Coal Environment and Community Group, particularly the Approvals Specialist.

9 Document Information

9.1 Referenced Documents

Reference information, listed in **Table 30** below, is information that is directly related to the development of this document or referenced from within this document.

Table 30 Reference Information

Title
Department of Planning and Environment (DPE) (2022), Extraction Plan Guideline.
ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
ANZG (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
Brienen Environment & Safety (2022a). Teatree Hollow Pool Baseline Survey (August 2022). Prepared by for SIMEC Mining, August.
Brienen Environment & Safety (2022b). Headwaters Baseline Survey (September 2022). Prepared for SIMEC Mining, September.
Brienen Environment & Safety (2022b). Teatree Hollow Channel Morphology Baseline Survey (August 2022). Prepared for SIMEC Mining, August, September.
Brienen Environmental & Safety (2022d). *Tahmoor South Springs Assessment.* Prepared for Tahmoor Coal Pty Ltd, August.
DPE (2022). *Thirlmere Lakes – A Synthesis of Current Research*. Department of Planning and Environment – Environment, Energy and Science, March.
NSW Department of Planning (2008). *Impacts of underground coal mining on natural features in the Southern Coalfield: Strategic Review*. State of New South Wales through the NSW Department of Planning (DoP).
EMM (2020). *Tahmoor South Project: Wirrimbirra Sanctuary – Statement of Heritage Impact*. Prepared for Tahmoor Coal Pty Ltd.
EMM (2024). Tahmoor South Project Longwall S7A Modification Report (SSD 8445 Mod 3). Prepared for Tahmoor Coal Pty Ltd, May.
Gippel (2013). *Tahmoor South Project Environmental Impact Statement Technical Specialists Report – Geomorphology*. Prepared for Tahmoor Coal, December.
Gippel (2023). Tahmoor Mod 3 – LW S7A, Technical Specialist Report, Geomorphology. Prepared for Tahmoor Coal Pty Ltd, December.
HEC (2020). *Tahmoor South Amended Project Surface Water Impact Assessment*. Prepared for Tahmoor Coal Pty Ltd, February.
HydroSimulations (2018). *Tahmoor South Project EIS: Groundwater Assessment*. Report HS2018/52, December.
HydroSimulations (2020). *Tahmoor South – Amended Project Report: Groundwater Assessment*. Report HS2019/42 (v4), August.
MSEC (2022). *Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A: Subsidence ground movement predictions and subsidence impact assessments for natural features and surface infrastructure*. Prepared for SIMEC Mining, May.
MSEC (2024). Tahmoor Coal – Modification 3 – Longwall S7A. Prepared for SIMEC Mining, March.
Niche (2021). Aquatic Biodiversity Technical Report Tahmoor North – Western Domain Longwalls West 1 and West 2. Prepared for Tahmoor Coal, February.

Title
Schädler, S. and Kingsford, R.T. (2016). *Long-term changes to water levels in Thirlmere Lakes – drivers and consequences*. Centre for Ecosystem Science, UNSW, Australia.
Simec: • SIMEC (2019) Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019. • SIMEC (2020a) Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020. • SIMEC (2020b) Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020. • SIMEC (2020c) Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.
SLR (2023). Tahmoor South Six-Monthly Compliance Report. Prepared for Tahmoor Coal, September.
SLR (2024). Tahmoor South Mod 3 – LW S7A Groundwater Impact Assessment. Prepared for Tahmoor Coal, May 2024.
Tahmoor Coal (2022). *Tahmoor South Site Surface Water Management Plan*.
Tammetta (2021). *Assessment of Surface Water Losses Redbank and Myrtle Creeks Tahmoor Coal Mine*. Prepared for the Natural Resources Access Regulator, July.

9.2 Related Documents

Related documents, listed in **Table 31** below, are internal documents directly related to or referenced from this document.

Table 31 Related Documents

Number	Title
TAH-HSEC-00124	Document and Record Control
TAH-HSEC-00365	LW S1A-S7A Extraction Plan Main Document
TAH-HSEC-00361	LW S1A-S7A Water Management Plan
TAH-HSEC-00362	LW S1A-S7A Land Management Plan
TAH-HSEC-00363	LW S1A-S7A Biodiversity Management Plan
TAH-HSEC-00364	LW S1A-S7A Heritage Management Plan
TAH-HSEC-00366	LW S1A-S7A Built Features Management Plan
TAH-HSEC-00365	LW S1A-S7A Public Safety Management Plan
TAH-HSEC-00367	LW S1A-S7A Subsidence Monitoring Plan

9.3 Glossary of Terms

Section 8.3 of the Extraction Plan Main Document provides a compiles Glossary of Terms.

9.4 Abbreviations

Abbreviations used in this document are provided below in **Table 32**.

Table 32 Abbreviations

Abbreviation	Definition
AIP	Aquifer Interference Policy
AWBM	Australian Water Balance Model
BACI	Before-After-Control-Impact
BGSS	Bulgo Sandstone
BHCS	Bald Hill Claystone
BUCO	Bulli Coal Seam
CCL	Consolidated Coal Lease
CMAP	Corrective Management Action Plan
CPHR	Conservation Programs, Heritage and Regulation Group
CTF	Cease to Flow
Crown Lands	NSW Department of Planning and Environment – Crown Lands
Commonwealth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water Formerly known as Commonwealth Department of Agriculture, Water and the Environment (DAWE)
DAWE	Commonwealth Department of Agriculture, Water and the Environment Now known as Commonwealth Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW)
DPE	Department of Environment and Planning Formerly known as NSW Department of Planning, Industry and Environment (DPIE) Now known as NSW Department of Planning, Housing and Infrastructure (DPHI)
DPE – Water	NSW Department of Planning and Environment – Water Now part of NSW Department of Climate Change, Energy, the Environment and Water
DPHI	NSW Department of Planning, Housing and Infrastructure Formerly known as NSW Department of Planning and Environment (DPE)
DPIE	Department of Planning, Industry and Environment (former) Now known as NSW Department of Planning, Housing and Infrastructure (DPHI)
EIS	Environmental Impact Statement
EES	Environment, Energy and Science Group
LDP	Licensed Discharge Point
LGA	Local Government Area
LOP	Licensed Overflow Point
LW	Longwall
MZ	Management Zone
NATA	National Association of Testing Authorities
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water Formerly part of NSW Department of Planning and Environment
OSP	Open Standpipe
ROM	Run-of-mine

Abbreviation	Definition
SSGV	Site Specific Guideline Value
TARP	Trigger Action Response Plan
VWP	Vibrating Wire Piezometer
WAL	Water Access Licence
WBCS	Wombarra Claystone
WWCO	Wongawilli Coal Seam

9.5 Change Information

Full details of the document history are recorded below in **Table 33**.

Table 33 Document History

Version	Date Reviewed	Review Type (Major/Minor)	Reviewed By	Change Summary
1.0	May 2022	Major	April Hudson, Charlie Wheatley, Zina Ainsworth, Malcolm Waterfall, Peter Vale	New Document.
2.0	September 2022	Major	April Hudson, Charlie Wheatley, Zina Ainsworth	Updated document following consultation with DPE (now DPHI), government agencies and the Independent Advisory Panel for Underground Mining.
3.0	January 2023	Major	April Hudson, Zina Ainsworth	Updated to reflect implemented monitoring program. Review in accordance with Condition E7(e) following the commencement of first and second workings (18 October 2022) of the Consent SSD 8445.
4.0	June 2023	Major	April Hudson, Zina Ainsworth	Reviewed in accordance with Condition E7(b) and (c) following the submission of an Annual Review (31st March 2023) and following the submission of an Independent Environmental Audit of the Consent SSD 8445.
4.1	October 2023	Minor	April Hudson, Zina Ainsworth	Updated in accordance with request for information received from DPE (now DPHI) following submission of version 4.0.
5.0	June 2024	Major	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(b) following the submission of an Annual Review (28 March 2024).
6.0	February 2025	Major	Nick Le Baut, Zina Ainsworth	Review following the approval of Amendment 2 (shortening of LWS4A) to the Tahmoor South LWS1A-S6A Extraction plan (11 November 2024).
7.0	October 2025	Major	Camilla West, Nick Le Baut, Zina Ainsworth	Review in accordance with Condition E7(d) following the approval of Modification 3 on 26 May 2025 and Condition E7(b) following the submission of an annual review 30 September 2025).

APPENDIX A – Trigger Action Response Plans

WATER MANAGEMENT PLAN TARP – WMP1 STREAM WATER QUALITY FOR ALL WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
All watercourses within the Subsidence Area[1].

Performance Measure
No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.

The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures.

Performance Indicator
Exceedance of the site specific guideline values (SSGVs), as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.

TARP Objective
This TARP defines levels of variation in surface water quality from normal conditions[3] and the actions required to be implemented in response to each level of variation.

Assessment Criteria
SSGV as listed in table below.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	TT7-QLa TT12-QLa TT13-QLa TT14-QLa	TT1-QLa
LW S2A	TT9-QLa TT3-QLa[4] All sites above	
LW S3A	TT2-QLa All sites above	
LW S4A	BR3-QLa	DT4-QLa DT3-QLa
LW S5A	TT1-QLa	
LW S6A	All sites above	
LW S7A		

All monitoring locations are shown in Figure 19 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Monthly sampling prior to secondary extraction of relevant longwall.

During Mining
Monthly sampling and analysis or as required by a specified action relevant to a trigger level.

Post-mining
Monthly sampling and analysis for a minimum of 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• Exceedance of an SSGV does not occur or occurs for less than three consecutive months.	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• Exceedance of an SSGV occurs at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Assess if the trigger was exceeded during the baseline period prior to commencement of mining activities. • Review water quality trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Discuss findings with and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater quality monitoring results) necessary to inform assessment. • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. limestone cobbles for increasing pH level).	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review. • Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. limestone cobbles for increasing pH level). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Review.
Level 2		

• Exceedance of an SSGV occurs at a given potential impact site in four or five consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.*
	• Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water quality change).
	• If increased monitoring is adopted, undertake further analysis of water quality trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
	• Review CMAs in light of findings from further investigations and consider additional remediation options.
	• Review Water Management Plan and modify if necessary.
		• *Responses as stated in Level 1.*
		• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		• Provide findings of CMA review to DPHI and key stakeholders for consultation.
		• Implement additional CMAs, subject to land access.

Level 3		

• Exceedance of an SSGV occurs at a given potential impact site in six consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.*
	• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 3 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effects unrelated to mining or the prevailing climate.
		• *Responses as stated in Level 2.*
		If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts:
		• Offer site visit with DPHI and other key stakeholders.
		• Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection.
		• Implement approved WCAMP, subject to land access.

Site Specific Guideline Value (SSGV)

Parameter	TT1-QLa	TT2-QLa	TT7-QLa	TT12-QLa	TT13-QLa	TT14-QLa	DT3	DT4

No. of Values[5]	56	12	35	13	13	13	49	44
pH (pH units)	6.5 – 8	6 – 8	6.5 – 8	6.5 – 8	6.5 – 8	6.5 – 8	6.5 - 8	6.5 - 8
EC (µS/cm)	512	350	359	350	350	350	350	350
Dissolved Aluminium (mg/L) pH > 6.5	0.1	0.17	0.06	0.1	0.092	0.11	0.08	0.2
Dissolved Copper (mg/L)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Dissolved Iron (mg/L)	0.76	0.55	0.81	0.64	0.47	0.57	0.48	0.60
Dissolved Manganese (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)	0.03	0.02	0.03	0.008	0.008	0.008	0.008	0.008

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] As defined by the site specific guideline value (SSGV).
[4] SSGVs have not been derived for TT3-QLa as the pool was dry on five of eight sampling occasions.
[5] Minimum number of values used in SSGV derivation – for some constituents, a greater number of values were adopted.

WATER MANAGEMENT PLAN TARP – WMP2 STREAM WATER QUALITY FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
Other watercourses.

Performance Measure
Negligible environmental consequences including beyond those predicted in the EIS.

Performance Indicator
The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water quality changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River.

TARP Objective
This TARP defines levels of variation in surface water quality from normal conditions[1], indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of variation or exceedance of the performance measure.

Assessment Criteria
SSGV as listed in table below.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	BR12-QLa BR13-QRLa	BR16-QLa
LW S2A	BR18-QLa All sites above	
LW S3A	BR17-QLa All sites above	
LW S4A LW S5A	BR6-QLa All sites above	DT4-QLa DT3-QLa All sites above
LW S6A LW S7A	HC13-QLa HC15-QLa HC4-QRLa HC9-QLa HC3-QLa All sites above	HC2-QLa HC17-QLa HC1-QLa All sites above

All monitoring locations are shown in Figure 19 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Monthly sampling prior to secondary extraction or other relevant mining activity.

During Mining
Monthly sampling and analysis or as required by a specified action relevant to a trigger level.

Post-mining
Monthly sampling and analysis for a minimum of 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• Exceedance of an SSGV does not occur or occurs for less than three consecutive months.	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• Exceedance of an SSGV occurs at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Assess if the trigger was exceeded during the baseline period prior to commencement of mining activities. • Review water quality trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater quality monitoring results) necessary to inform assessment. • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. limestone cobbles for increasing pH level).	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review. • Provide DPHI and key stakeholders with proposed CMAs for consultation (e.g. limestone cobbles for increasing pH level). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Review.
Level 2		

• Exceedance of an SSGV occurs at a given potential impact sites in four or five consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.*
	• Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water quality change).
	• If increased monitoring is adopted, undertake further analysis of water quality trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
	• Review CMAs in light of findings from further investigations and consider additional remediation options.
	• Review Water Management Plan and modify if necessary.
		• *Responses as stated in Level 1.*
		• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		• Provide findings of CMA review to DPHI and key stakeholders for consultation.
		• Implement additional CMAs, subject to land access.

Level 3		

• Exceedance of an SSGV occurs at a given potential impact site in six consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.*
	• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 3 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.
	• Undertake an investigation to determine if an exceedance of the performance measure is likely.
		• *Responses as stated in Level 2.*
		• If relevant, notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure within two business days.

Exceeds Performance Measure		
• It is concluded from the Level 3 investigation that mining results in exceedance of an SSGV at a given potential impact site for six or more consecutive months.	• Investigate reasons for the performance measure exceedance. • Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with future longwall extraction.	• Submit a report to DPHI (in accordance with E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPHI). • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project). • Offer site visit with DPHI and other key stakeholders.

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
				• Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Site Specific Guideline Value (SSGV)

Parameter	BR3-QLa	BR6-QLa	BR12-QLa	BR13-QRLa	BR16-QLa	BR17-QLa	BR18-QLa	HC9-QLa	HC4-QRLa	HC3-QLa
No. of Values[2]	19	22	24	24	24	24	24	24	24	24
pH (pH units)	5.8 – 8	5.3 - 8	6.5 - 8	6.5 - 8	6.5 - 8	6.5 - 8	6.3 - 8	6 - 8	6.5 - 8	6.5 - 8
EC (µS/cm)	350	350	350	350	350	350	350	352	350	350
Dissolved Aluminium (mg/L) pH > 6.5	0.1	0.09	0.06	0.06	0.055	0.055	0.07	0.14	0.15	0.11
Dissolved Copper (mg/L)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Dissolved Iron (mg/L)	0.3	0.3	0.62	0.67	0.69	0.69	0.91	2.1	0.57	0.45
Dissolved Manganese (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)	0.008	0.03	0.008	0.008	0.008	0.008	0.008	0.01	0.008	0.008

Notes:
[1] As defined by the SSGV.
[2] Minimum number of values used in SSGV derivation - for some constituents, a greater number of values were adopted.

WATER MANAGEMENT PLAN TARP – WMP3 POOL WATER LEVEL FOR ALL WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
All watercourses within the Subsidence Area[1].

Performance Measure
No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.

The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures.

Performance Indicator
Water level decline as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.

TARP Objective
This TARP defines levels of variation in pool water level from normal conditions[3] and the actions required to be implemented in response to each level of variation.

Assessment Criteria
- Comparison of baseline and operational recorded water level data (all levels).
- Water level recession analysis for Level 2 and above.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	TT7-QLa TT12-QLa TT13-QLa TT14-QLa	TT1-QLa
LW S2A	TT9-QLa TT3-QLa All sites above	
LW S3A	TT2-QLa All sites above	
LW S4A	BR3-QLa TT1-QLa All sites above	DT4-QLa DT3-QLa
LW S5A		
LW S6A		
LW S7A		

All monitoring locations are shown in Figure 19 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Continuous record and monthly manual measurements. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements. Data downloaded and reviewed monthly.

Post-mining
Continuous record and monthly manual measurements for a minimum of 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• The recorded water level has not declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• The recorded water level has declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Review water level trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Review streamflow data recorded at TT-F1 and conduct streamflow reduction assessment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater level monitoring results) necessary to inform assessment.	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review.
Level 2		

• The recorded water level has declined atypically[4] below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.*
	• Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water level change).
	• If increased monitoring is undertaken, conduct further analysis of water level trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
	• Review Water Management Plan and modify if necessary.
		• *Responses as stated in Level 1.*
		• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.

Level 3		

• The recorded water level has declined atypically[4] below the recorded baseline minimum level for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.*
	• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 3 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.
		• *Responses as stated in Level 2.*
		If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts:
		• Offer site visit with DPHI and other key stakeholders.
		• Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection.
		• Implement approved WCAMP, subject to land access.

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] As indicated by the baseline water level and recession rate.
[4] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions

WATER MANAGEMENT PLAN TARP – WMP4 POOL WATER LEVEL FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
Other watercourses.

Performance Measure
Negligible environmental consequences including beyond those predicted in the EIS, including:
- Negligible diversion of flows or changes in the natural drainage behaviour of pools.

Performance Indicator
The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water level changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River.

TARP Objective
This TARP defines levels of variation in pool water level from normal conditions[1] and the actions required to be implemented in response to each level of variation.

Assessment Criteria
- Comparison of baseline and operational recorded water level data (all levels).
- Water level recession analysis for Level 2 and above.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	BR12-QLa BR13-QRLa	BR16-QLa[2]
LW S2A	BR18-QLa All sites above	
LW S3A	BR17-QLa All sites above	
LW S4A LW S5A	BR6-QLa All sites above	DT4-QLa DT3-QLa All sites above
LW S6A LW S7A	HC13-QLa HC15-QLa HC4-QRLa HC9-QLa HC3-QLa All sites above	HC2-QLa HC17-QLa HC1-QLa All sites above

All monitoring locations are shown in Figure 19 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Continuous record and monthly manual measurements. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements. Data downloaded and reviewed monthly.

Post-mining
Continuous record and monthly manual measurements for a minimum of 12 months following the completion of LW S7A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• The recorded water level has not declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• The recorded water level has declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Review water level trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater level monitoring results) necessary to inform assessment.	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review.
Level 2		

• The recorded water level has declined atypically[3] below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.*
	• Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water level change).
	• If increased monitoring is adopted, undertake further analysis of water level trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
	• Complete water level recession analysis for sites where Level 2 has been reached.
	• Review Water Management Plan and modify if necessary.
		• *Responses as stated in Level 1.*
		• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.

Level 3		

• The recorded water level has declined atypically[3] below the recorded baseline minimum level for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.*
	• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 3 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.
	• Undertake an investigation to determine if an exceedance of the performance measure is likely.
		• *Responses as stated in Level 2.*
		• If relevant, notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure within two business days.

Exceeds Performance Measure		
• It is concluded from the detailed investigation that mining has resulted in an atypical[2] decline in water level for greater than one month (as a consecutive period).	• Investigate reasons for the performance measure exceedance. • Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with further longwall extraction.	• Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPHI). • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project). • Offer site visit with DPHI and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
				remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Notes:
[1] As indicated by the baseline water level and recession rate.
[2] Data collected from BR11-QLa (water quality data collected between 2012-2021 and water level data collected between 2013-2021) will be used in combination with data from BR16-QLa to provide a long-term baseline dataset for the Bargo River upstream of mining activities.
[3] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

WATER MANAGEMENT PLAN TARP – WMP5 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature All watercourses within the Subsidence Area[1]. **Performance Measure** No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS. The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures. **Performance Indicator** Variation in pool physical features and natural behaviour, as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure. **TARP Objective** This TARP defines levels of variation in pool physical features and natural behaviour and the actions required to be implemented in response to each level of variation. **Assessment Criteria** Comparison of baseline and operational pool physical features and natural behaviour.	**Locations** Accessible pools and reaches in Teatree Hollow, Teatree Hollow Tributary and Bargo River Tributary (subject to land access). All monitoring locations are shown in Figure 20 of the Water Management Plan. Channel morphology site CM7, refer Figure 21. **Monitoring Frequency** **Pre-mining** One observation prior to mining using fixed location photo points. **During Mining** Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone[3] using fixed location photo points. **Post-mining** Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.	**Normal Condition**		
		• No observed impact to pool water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s)[3]. AND/OR • Visual observation of fracturing.	• *Actions as required for Normal Condition.* • Assess visual change along watercourse (upstream to downstream) to observe any spatial changes with consideration to climatic conditions. • Discuss findings with and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results) necessary to inform assessment. • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached or at other relevant sites, subject to land access, as follows: ○ Fortnightly, for sites within the active subsidence zone. ○ Monthly, outside of the active subsidence period. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g., surface fracturing of weathered bedrock that does not affect water holding capacity of rockbar control or pool base or confirmed as a mining-related impact).	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review.
		Level 2		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing other catchment changes, effect unrelated to mining or the prevailing climate). • Review Water Management Plan and modify if necessary. • If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows: ○ Fortnightly, for sites within the active subsidence zone. ○ Monthly, outside of the active subsidence period.	• *Responses as stated in Level 1.* • Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s). AND • The change in behaviour has been investigated and confirmed to be related to mining effects.	• *Actions as stated in Level 2.*	• *Responses as stated in Level 2.* • Offer site visit with DPHI and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] Survey area to include upstream, downstream and adjacent pools (to the extent of the potential impact) where a trigger exceedance has occurred at a potential impact site(s) in accordance with the TARPs.

WATER MANAGEMENT PLAN TARP – WMP6 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
Other watercourses.

Performance Measure
Negligible environmental consequences including beyond those predicted in the EIS, including:
- Negligible diversion of flows or changes in the natural drainage behaviour of pools;
- Negligible gas releases and iron staining; and
- Negligible increase in water turbidity.

Performance Indicator
The performance measure will be considered to be exceeded if changes in physical features and natural behaviour of pools occur for three consecutive months and the investigation outcomes indicate a mining related impact based on visual observation records for sites in Hornes Creek and the Bargo River.

TARP Objective
This TARP defines levels of variation in pool physical features and natural behaviour and the actions required to be implemented in response to each level of variation.

Assessment Criteria
Comparison of baseline and operational pool physical features and natural behaviour.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	BR12-QLa BR13-QRLa	BR16-QLa
LW S2A	BR18-QLa All sites above	
LW S3A	BR17-QLa All sites above	
LW S4A LW S5A	BR6-QLa All sites above	DT4-QLa DT3-QLa All sites above
LW S6A LW S7A	HC13-QLa HC15-QLa HC4-QRLa HC9-QLa HC3-QLa All sites above	HC2-QLa HC17-QLa HC1-QLa All sites above

All monitoring locations are shown in Figure 20 of the Water Management Plan.

Pre-mining
One observation prior to mining using fixed location photo points.

During Mining
Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone using fixed location photo points.

Post-mining
Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• No observed impact to pool water level, overland connected flow, iron staining, gas release, turbidity or channel stability - as compared with baseline conditions.	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		

• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s).
AND/OR
• Visual observation of fracturing.
	• *Actions as required for Normal Condition.*
	• Assess visual change along watercourse (upstream to downstream) to observe any spatial changes with consideration to climatic conditions.
	• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results) necessary to inform assessment.
	• Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. surface fracturing of weathered bedrock that does not affect water holding capacity of rockbar control or pool base or confirmed as a mining-related impact).
		• Report trigger exceedance to DPHI and key stakeholders.
		• Report trigger exceedance and investigation outcomes in Annual Review.

Level 2		

• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.*
	• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing other catchment changes, effect unrelated to mining or the prevailing climate).
	• Review Water Management Plan and modify if necessary.
	• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
	  ○ Fortnightly, for sites within the active subsidence zone.
	  ○ Monthly, outside of the active subsidence period.
	• Undertake an investigation to determine if an exceedance of the performance measure is likely.
		• *Responses as stated in Level 1.*
		• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		• If relevant, notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure within two business days.

Exceeds Performance Measure		
• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s). AND • The change in behaviour has been investigated and confirmed to be related to mining effects.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with further longwall extraction.	• *Responses as stated in Level 2.* • Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPHI). • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project). • Offer site visit with DPHI and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPHI and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

WATER MANAGEMENT PLAN TARP – WMP7 CHANNEL STABILITY, SEDIMENTATION AND EROSION

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant[1,2,3]. **TARP Objective** This TARP defines levels of variation in channel stability, erosion and sedimentation and the actions required to be implemented in response to each level of variation. **Assessment Criteria** Comparison of baseline and operational condition of headwater streams and soft knickpoints.	**Locations** As shown in Figure 21 of the Water Management Plan: • 10 headwater sites • Channel morphology sites CM1, CM4 and CM6 • Soft knickpoints **Monitoring Frequency** **Pre-mining** • One observation prior to mining using fixed location photo points. • One inspection of 10 headwater sites. **During Mining** • Observations of knickpoint formation every month during the active subsidence period for sites within the active subsidence zone using fixed location photo points. • Annual inspection of 10 headwater sites. **Post-mining** • One observation of knickpoint formation at sites that are no longer within the active subsidence zone using fixed location photo points. • One inspection of 10 headwater sites. • Post-mining geomorphology survey following completion of mining.	**Normal Condition**		
		• No further development of soft knickpoints or increased erosion of headwater streams.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		

		• Visually observed minor increase in knickpoint development and/or minor erosion and sedimentation of headwater streams.	• *Actions as required for Normal Condition.*
			• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, biodiversity monitoring results) necessary to inform assessment.
			• Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached or at other relevant sites, subject to land access, as follows:
			  ○ Fortnightly, for sites within the active subsidence zone.
			  ○ Monthly, outside of the active subsidence period.
			Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in increased erosion).
			• Consider and decide on reasonable and feasible options for remediation as relevant (e.g. enhanced vegetation establishment, rock armouring).
				• Report trigger exceedance to DPHI and key stakeholders.
				• Report trigger exceedance and investigation outcomes in Annual Review.
				• Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for approval (e.g. enhanced vegetation establishment, rock armouring).
				• Implement CMAs, subject to land access.
				• Monitor and report on success of CMAs in Review.

		Level 2		

		• Visually observed moderate increase in knickpoint development and/or moderate or greater increase in erosion and sedimentation of headwater streams.	• *Actions as stated in Level 1.*
			• If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows:
			  ○ Fortnightly, for sites within the active subsidence zone.
			  ○ Monthly, outside of the active subsidence period.
			• Undertake an investigation to assess if the change in behaviour is related to mining effects (e.g. subsidence induced, other catchment changes, effect unrelated to mining or the prevailing climate).
			• Obtain specialist advice on further CMAs.
			• Review CMAs in light of findings from further investigations and consider additional remediation options.
			• Review Water Management Plan and modify if necessary.
				• *Responses as stated in Level 1.*
				• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
				If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts:
				• Offer site visit with DPHI and other key stakeholders.
				• Provide findings of CMA review to DPHI and key stakeholders for consultation.
				• Implement additional CMAs, subject to land access.

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] It is noted that SSD 8445 does not specify a performance measure in relation to channel stability, sedimentation and erosion for all watercourses within the Subsidence Area[1].
[3] It is noted that no soft knickpoints have been mapped in Hornes Creek or Bargo River. Therefore, assessment of 'decline in baseline channel stability' for these watercourses is not applicable.

WATER MANAGEMENT PLAN TARP – WMP8 SHALLOW GROUNDWATER LEVELS (OPEN STANDPIPES AND PRIVATE BORES)

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="6"><u>Performance Measure Feature</u>
No performance measure relevant.

<u>TARP Objective</u>
This TARP defines levels of deviation in groundwater level from ‘normal’ or baseline conditions and the actions to be implemented in response to each level deviation.
This TARP supports TARP WMP13, where groundwater levels as they pertain to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) are covered.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level.</td><td rowspan="6"><u>Locations</u>
Open standpipes
Existing sites:
P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P54c, P55a, P55b, P55c, P56a, P56b, P56c
P50a, P50b, P50c, P57a, P57b, P57c[3]

Private bores
GW109257, GW104008, GW112473, GW104659, GW104323

All monitoring locations are shown in Figure 324 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Continuous logger (hourly intervals) and monthly manual measurements of water level.

During Mining
Continuous logger (hourly intervals) and monthly manual measurements of water level.

Post-mining
Continuous record (where loggers installed) and quarterly manual measurements of water level for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• Groundwater level remains consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two meters.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Greater than 2 m water level reduction[1] for a period of greater than 6 months following the commencement of extraction.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and determine if mining related.
• Undertake investigation to demonstrate if the decline will impact the long-term viability of the affected water supply works.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).
The investigation will be commenced/completed as efficiently as practicable. If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Where impact is deemed attributable to mining, initiate negotiations with impacts landowners as soon as practicable. Consider all reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores, etc - as per Section 6.2.1.4 of the Water Management Plan).
For Open Standpipe Monitoring Bores
• For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Report trigger exceedance to DPHI and key stakeholders.
• Report trigger exceedance and investigation outcomes in Annual Review.

If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access (finalise negotiations and implement the agreed “make-good” arrangements)
• Monitor and report on success of CMAs in Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Water level declines below the average between the ‘maximum modelled drawdown’ (Level 3 trigger) and the ‘2 m drawdown’ (Level 1 trigger)[1] for a period of greater than 6 months following the commencement of extraction.
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Actions as stated in Level 1.
• Consider increasing frequency of monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access., as follows:
○ Fortnightly, for sites within the active subsidence zone.
• Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact). Increased monitoring could be beneficial where commensurate responses in paired surface water monitoring locations have been observed.
• Compare against base case and deterministic model scenarios[2].
• Review Water Management Plan and modify if necessary.
For Private Bores:
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Responses as stated in Level 1.
• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
For Private Bores:
• Provide findings of CMA review to DPHI and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td>Level 3</td><td></td><td></td></tr>
</table>

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
		• Water level reduction greater than the maximum modelled drawdown[1] for a period of greater than 6 months following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	For Private Bores and Open Standpipe Monitoring Bores: • *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached, and cause is unknown, Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).	For Private Bores and Open Standpipe Monitoring Bores: • *Responses as stated in Level 2.* For Private Bores: • Develop a Rehabilitation Management Plan in consultation with DPHI and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-3 in Appendix E of the Water Management Plan.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.
[3] Trigger levels to be defined for P50 and P57 bores when suitable baseline data available

WATER MANAGEMENT PLAN TARP – WMP9 SHALLOW GROUNDWATER PRESSURE (VWP SENSORS < 200 m DEPTH)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level.	**Locations** TBC032, TBC033, TBC009, TBC018, TBC0039 Monitoring of all VWP < 200 m depth intakes. Reference Sites: TBC027, TBC034, TBC038 All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **During Mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **Post-mining** Continuous record of water level/pressure for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.	**Normal Condition**		
		• No observable mining induced change at VWP intakes. • Up to 5 m water level reduction in VWP intakes[1] following the commencement of extraction for a period of less than six months.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Greater than 5 m water level reduction in VWP intakes[1] following the commencement of extraction for a period of greater than six months.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related, commence/complete as soon as practicable. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review.
		Level 2		
		• Water level declines below the calculated Level 2 trigger – being the average of Level 1 (the '5 m drawdown'[1]) and Level 3 (the 'maximum modelled drawdown') – following the commencement of extraction for a period of greater than six months. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 1.* • Review deeper VWP data at monitored sites. Determine whether additional review of data is required. Determine if review of additional existing VWP sites is required. • Consider increasing frequency of data review at sites where Level 2 has been reached or at other relevant sites. Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact). Increased monitoring could be beneficial where commensurate responses in paired surface water monitoring locations have been observed. • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Water level reduction greater than the maximum modelled drawdown[1] following the commencement of extraction for a period of greater than six months. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached and the cause is unknown. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). Commence/complete as soon as practicable • Undertake investigative to review model results in conjunction with field data.	• *Responses as stated in Level 2.*

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-4 in Appendix E of the Water Management Plan).
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP10 GROUNDWATER LEVEL / PRESSURE DEEP VWPS (> 200 m DEPTH EXCLUDING MONITORING THE BULLI COAL SEAM)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on modelled data for each reporting level. Model layers utilised to define predicted drawdown for each VWP logger provided in Table below.	**Locations** TBC009, TBC0018, TBC020, TBC026, TBC032, TBC033, TBC039 Reference sites: TBC027, TBC034, TBC038 Monitoring of all VWP > 200 m depth intakes excluding those monitoring the Bulli Coal Seam. All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **During Mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **Post-mining** Continuous record of water level/pressure for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.	**Normal Condition**		
		• Observed data does not exceed modelled impacts predicted drawdown by greater than 30 metres[1]. • Observed drawdown exceeds the modelled predicted drawdown[1], by greater than 30 metres for less than three consecutive months	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Observed drawdown exceeds the modelled predicted drawdown[1], by greater than 30 metres for greater than three consecutive months.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related to be commenced/completed as soon as practicable. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results).	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Review.
		Level 2		
		• Observed drawdown exceeds modelled predicted drawdown[1] by more than 30 metres greater than 6 consecutive months.	• *Actions as stated in Level 1.* • Consider increasing frequency of data review at sites where Level 2 has been reached or at other relevant sites. Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact). Increased monitoring could be beneficial where commensurate responses in paired surface water monitoring locations have been observed. Consider review data in conjunction with VWP data from additional existing VWP sites. • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Inclusion of more regional VWPs into data review to determine likely extent and depth of depressurisation. • Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Observed drawdown exceeds modelled predicted drawdown[1] by 30 metres, for 12 consecutive months or more.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached if the cause is unknown • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). To be commenced/completed as soon as practicable. • Review base case and deterministic model scenarios[2] in conjunction with water pressure data and report findings.	• *Responses as stated in Level 2.*

Notes:
[1] Predicted drawdown refers to the drawdown as generated by the groundwater model and varies over time as extraction progresses. Observed drawdown will be plotted on a monthly basis against the predicted drawdown to determine if a trigger has occurred. Therefore, as the predicted drawdown will be constantly changing according to extraction progression, it is not possible to set a specific trigger limit.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to assess the trigger level.

Sensor	Model Layer	Model Geology		Sensor	Model Layer	Model Geology
TBC09_322	8	BUSS Mid		TBC26_344	8	BUSS Mid
TBC09_343	8	BUSS Mid		TBC26_409	13	WBCS
TBC09_357	12	SBSS Lower		TBC26_432	15	Bulli Seam
TBC09_381	10	SPCS		TBC26_440	16	Eckersley
TBC09_391	15	Bulli Seam		TBC26_460	16	Eckersley
TBC09_397	17	Wongawilli		TBC32_200	8	BUSS Mid
TBC18_282	8	BUSS Mid		TBC32_237	8	BUSS Mid
TBC18_366	80..0	BUSS Mid		TBC32_257	8	BUSS Mid
TBC18_377	13	WBCS		TBC32_294	8	BUSS Mid
TBC18_404	15	Bulli Seam		TBC32_314	8	BUSS Mid

Performance Measure and Indicator, TARP Objective and Assessment Criteria			Monitoring Program			Management		
						Trigger	Action	Response
TBC18_426	17	Wongawilli		TBC33_247	8	BUSS Mid		
TBC18_432	17	Wongawilli		TBC33_306	8	BUSS Mid		
TBC20_211	8	BUSS Mid		TBC33_363	11	SBSS Upper		
TBC20_293	8	BUSS Mid		TBC33_384	16	Eckersley		
TBC20_375	8	BUSS Mid		TBC33_408	16	Eckersley		
TBC20_397	13	WBCS		TBC39_243	8	BUSS Mid		
TBC20_411	7	BUSS Upper		TBC39_299	8	BUSS Mid		
TBC20_434	17	Wongawilli		TBC39_354	11	SBSS Upper		
TBC20_439	4	HBSS Mid		TBC39_375	16	Eckersley		
TBC26_211	8	BUSS Mid		TBC39_402	16	Eckersley		
TBC26_278	8	BUSS Mid						

WATER MANAGEMENT PLAN TARP – WMP11 GROUNDWATER QUALITY (OPEN STANDPIPES AND PRIVATE BORES)

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant.

<u>TARP Objective</u>
This TARP defines levels of deviation in groundwater level from ‘normal’ or baseline conditions and the actions to be implemented in response to each level deviation.
This TARP supports TARP WMP13, where groundwater quality as it pertains to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) is covered.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level.</td><td rowspan="8"><u>Locations</u>
Open standpipes
Existing sites:
P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c, P50a, P50b, P50c, P57a, P57b, P57c[2]

Private bores
GW109257, GW104008, GW112473, GW104659, GW104323

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly water quality sampling.

During Mining
Monthly water quality sampling

Post-mining
Quarterly sampling and analysis for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.

Water Quality sample parameters:
Field Parameters
PH
EC
TDS
DO
Laboratory Analysis
Total alkalinity as CaCO3, HCO3, CO3, DOC
Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4)
Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Nitrogen
Total Phosphorus
Ionic Balance (Total Anions and Total Cations)</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• No observable changes in salinity, pH or metals outside of the baseline variability.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1] for 3 consecutive months or more. The effect does not persist after a significant rainfall recharge event.
AND
• A similar trend or response is noted at other monitored bores or private groundwater bores.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and determine if mining related.
• Undertake investigation to demonstrate if the change in quality will impact the long-term viability of the affected water supply works.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).
If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Initiate negotiations with impacted landholders as soon as practicable. Consider all reasonable and feasible options for remediation as relevant. This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners (e.g. provision of access to an alternative source of water).
For Open Standpipe Monitoring Bores
• For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Report trigger exceedance to DPHI and key stakeholders.
• Report trigger exceedance and investigation outcomes in Annual Review.
If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1], for 3 consecutive months or more. The effect persists after a significant rainfall recharge event.
AND
• The change in water quality is determined not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as stated in Level 1.
• Consider increasing frequency of monitoring and review of data at sites where Level 2 has been reached or at other relevant sites, subject to land access and feasibility.
Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact). Increased monitoring could be beneficial where commensurate responses in paired surface water monitoring locations have been observed
• Review Water Management Plan and modify if necessary.
For Private Bores:
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Responses as stated in Level 1.
• Advise DPHI and key stakeholders of any required amendments to Water Management Plan.
For Private Bores:
• Provide findings of CMA review to DPHI and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td>Level 3</td><td></td><td></td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1], for greater than 6 consecutive months.
AND
• The change in water quality is determined not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as stated in Level 2.
• Increase monitoring and review of data frequency for sites where Level 3 has been reached, and cause is unknown, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).
• Undertake investigative report to demonstrate if the water quality change will impact the long-term viability of any affected water supply works.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Responses as stated in Level 2.
For Private Bores:
If ascertained impact is due to mining activities and has potential to impact long-term viability of supply for private groundwater bores:
• Develop a Rehabilitation Management Plan in consultation with DPHI and landowner.
• Implement Rehabilitation Management Plan, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
1 Defined trigger levels for groundwater quality are listed in Table 6-5 of Appendix E of the Water Management Plan.</td></tr>
</table>

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
2 Trigger levels to be defined for P50 and P57 bores when suitable baseline data available				

WATER MANAGEMENT PLAN TARP – WMP12 GROUNDWATER - SURFACE WATER INTERACTION

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant.

<u>TARP Objective</u>
This TARP defines levels of deviation in surface water - groundwater interactions from 'normal' conditions and the actions to be implemented in response to each level deviation.
The instigation of this TARP will be dictated by triggers exceedances in pertinent groundwater or surface water sites requiring further investigation of groundwater – surface water interactions.

Where groundwater – surface water connectivity indicates in a gaining stream, there is potential for groundwater supporting riparian vegetation. Consequently, Riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE), and the pertinent Performance Measure applicable:
Negligible impacts including:
• Negligible change in groundwater levels; and
• Negligible change in groundwater quality.

Riparian GDEs are addressed through the Riparian Vegetation TARP (BMP3). Consultation through the ERG will link this TARP (WMP12) to BMP3 via actions in BMP3 to consider groundwater – surface water relationships when pertinent.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level. For this TARP, the aligned groundwater and surface water sites would be considered collectively to interpret potential changes/impacts to groundwater – surface water interaction.</td><td rowspan="8"><u>Locations</u>
Open standpipes
P51a, P51b, P52, REA4, P53a, P53b, P53c
P54a, P54b, P54c, P55a, P55b, P55c

The aligned surface water and groundwater sites are as follows:
• P51a, P51b with surface water site BR2-Qla
• P52, REA4 with surface water site-TT14-QLa
• P53a, P53b, P53c with surface water site-TT14-Qla
• P54a, P54b, P54c with surface water site TT3-QLa
• P55a, P55b, P55c with surface water site TT1-QLa

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly manual measurements of water level and water quality.

During Mining
Monthly manual measurements of water level and water quality.

Post-mining
Continuous record (where loggers installed) and quarterly manual measurements of water level for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities.</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• Observed (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent with baseline variability and/pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Observed (or inferred where not immediately neighbouring a surface water site) groundwater levels at surface water monitoring site decline below Level 1 (in TARP WMP8) following the commencement of extraction.</td><td>• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and determine if mining related.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).</td><td>• Report trigger exceedance to DPHI and key stakeholders.
• Report trigger exceedance and investigation outcomes in Annual Review.
If the changes have been confirmed to be related to mining effects:
• Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Observed (or inferred where not immediately neighbouring a surface water site) groundwater levels at aligned surface water monitoring site decline below Level 2 (in TARP WMP8) following the commencement of extraction.
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factor.</td><td>• Actions as stated in Level 1.
• Consider increasing frequency of monitoring and review of data at sites where Level 2 has been reached or at other relevant sites, subject to land access and feasibility.
Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact).
• Compare against base case and deterministic model scenarios[1].
• Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline.
• Review surface water data to assess for surface water level decline at relevant site.
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.
• Review Water Management Plan and modify if necessary.</td><td>• Responses as stated in Level 1.
• Provide findings of CMA review to DPHI and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.
• Advise DPHI and key stakeholders of any required amendments to Water Management Plan, including reporting on relationship of observations to baseline and deterministic model scenarios, as necessary.</td></tr>
<tr><td>Level 3</td><td></td><td></td></tr>
<tr><td>• Inferred groundwater levels at surface water monitoring site decline below Level 3 (in TARP WMP8) following the commencement of extraction.
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factor.</td><td>• Actions as stated in Level 2.
• Increase frequency of data review for sites where Level 3 has been reached and cause is unknown, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). Report to be commenced and completed as soon as practicable.</td><td>• Responses as stated in Level 2.
• Develop a Rehabilitation Management Plan in consultation with DPHI and key stakeholders.
• Implement Rehabilitation Management Plan, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
1 [1]"Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.</td></tr>
</table>

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature GDEs including Thirlmere Lakes[1]. **Performance Measure** Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality. **Performance Indicator** The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for the Thirlmere Lakes. **TARP Objective** This TARP defines levels of deviation at Thirlmere Lakes from 'normal' conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level.	**Locations** **"Early warning" bores** Existing sites: GW104659, TBC039 (sensor at 65 metres in Hawkesbury Sandstone (HBSS)), P50a, P50b, P50c[2] **Thirlmere Lakes bores (not trigger bores)** Existing sites: GW075409–1, GW075409–2, GW075410, GW075411 (paired with gauging station 212066) All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency (for "early warning" bores)** **Pre-mining** Monthly manual measurements of water level and water quality. **During Mining** Monthly manual measurements of water level and water quality. **Post-mining** Continuous record (where loggers installed) and quarterly manual measurements of water level for a minimum of 12 months following the completion of active dewatering or as deemed necessary in consideration to the status of aquifer recovery or as required for future extraction activities. Water Quality sample parameters: **Field Parameters** PH EC TDS DO **Laboratory Analysis** Total alkalinity as CaCO3, HCO3, CO3, DOC Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4) Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe) Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe) Total Nitrogen Total Phosphorus Ionic Balance (Total Anions and Total Cations)			
		Normal Condition		
		• Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge events.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Level 1 trigger of TARP WMP8 for a minimum of two "early warning" bores. OR • Level 1 trigger of TARP WMP11 for a minimum of two "early warning" bores.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results). If the changes have been confirmed to be related to mining effects: • Consider all reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores). This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners. • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes Annual Review. If the changes have been confirmed to be related to mining effects: • Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Review.
		Level 2		
		• Level 2 trigger of TARP WMP8 for a minimum of three bores "early warning" bores OR • Level 2 trigger of TARP WMP11 for a minimum of three bores ("early warning" bores and Thirlmere Lakes bores).	• *Actions as stated in Level 1.* • Consider increasing frequency of monitoring and review of data at sites where Level 2 has been reached or at other relevant sites, subject to land access and feasibility. Reasons for not increasing monitoring frequency could include confident identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change, or confirmed as a mining-related impact). Increased monitoring could be beneficial where commensurate responses in paired surface water monitoring locations have been observed Review Thirlmere Lakes monitoring bore data • Compare against base case and deterministic model scenarios[2]. • Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline. • Review surface water data to assess for surface water level decline at relevant site. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Water Management Plan and modify if necessary. • Undertake an investigation to determine if an exceedance of the performance measure is likely. To be commenced/completed as soon as practicable.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPHI and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPHI and key stakeholders of any required amendments to Water Management Plan. • If relevant, notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure within two business days.
		Exceeds Performance Measure		
		• Level 3 trigger of TARPs WMP8 for a minimum of four bores "early warning" bores) OR • Level 3 trigger of TARPs WMP11 for a minimum of four bores ("early warning" bores and Thirlmere Lakes bores). AND • Review of Thirlmere Lakes bores indicated potential impacts resulting from extraction	• *Actions as stated in Level 2.* If the changes have been confirmed to be related to mining effects: • Investigate reasons for the performance measure exceedance. To be commenced/completed as soon as practicable. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 2.* • Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPHI) describing remediation options and any preferred remediation measures or other course of action. • Implement any reasonable remediation measures as directed by DPHI, subject to land access. • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project). • Update numerical groundwater model and re-run predictive scenarios to determine the likely extent and depth of depressurisation in the vicinity of Thirlmere Lakes, and to determine whether any additional management actions are required such as modifying the mine plan

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Notes: [1] It is noted that the only Groundwater Dependent Ecosystem (GDE) pertinent to the Tahmoor South Project is that of Thirlmere Lakes[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level. [2] Trigger levels for P50 bores to be developed when suitable baseline data available.				

APPENDIX B – Surface Water Level Monitoring Data Plots

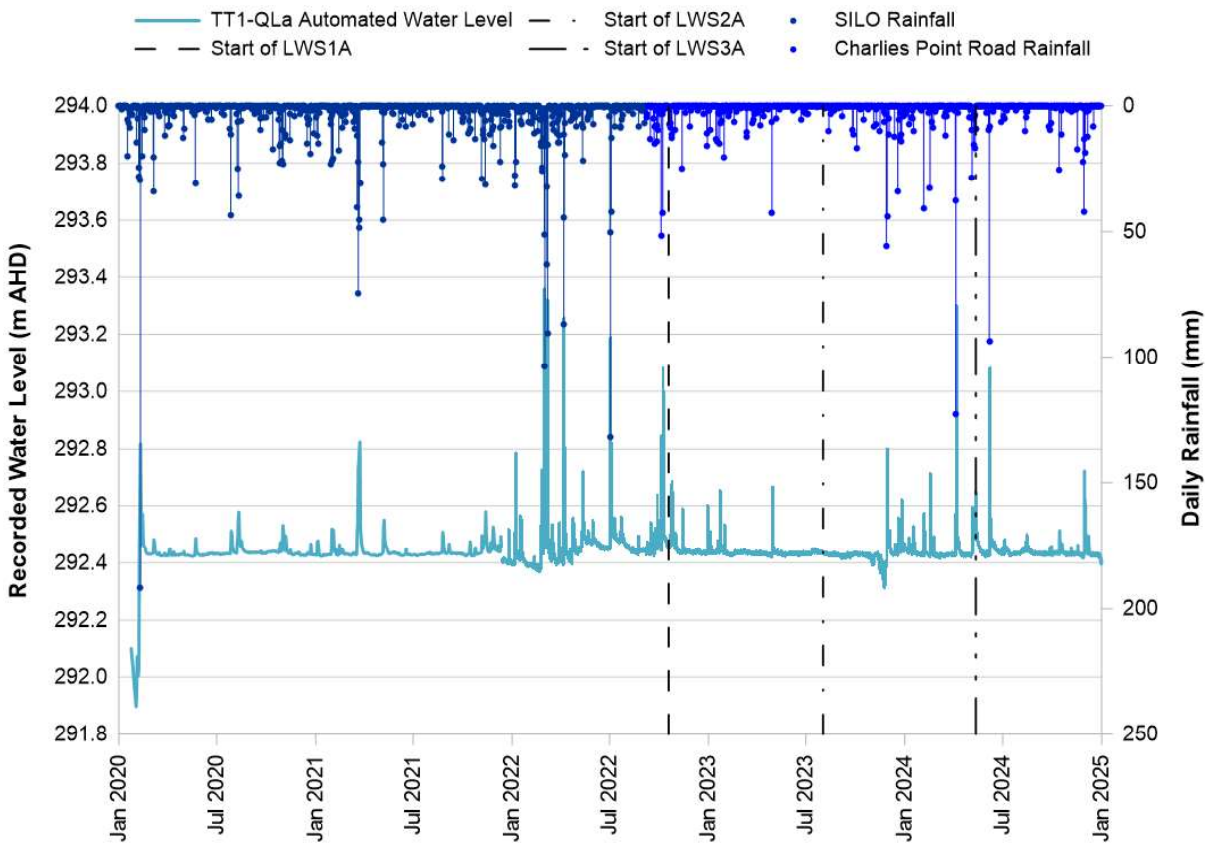


Chart C1: TT1-QLa Water Level Monitoring Data

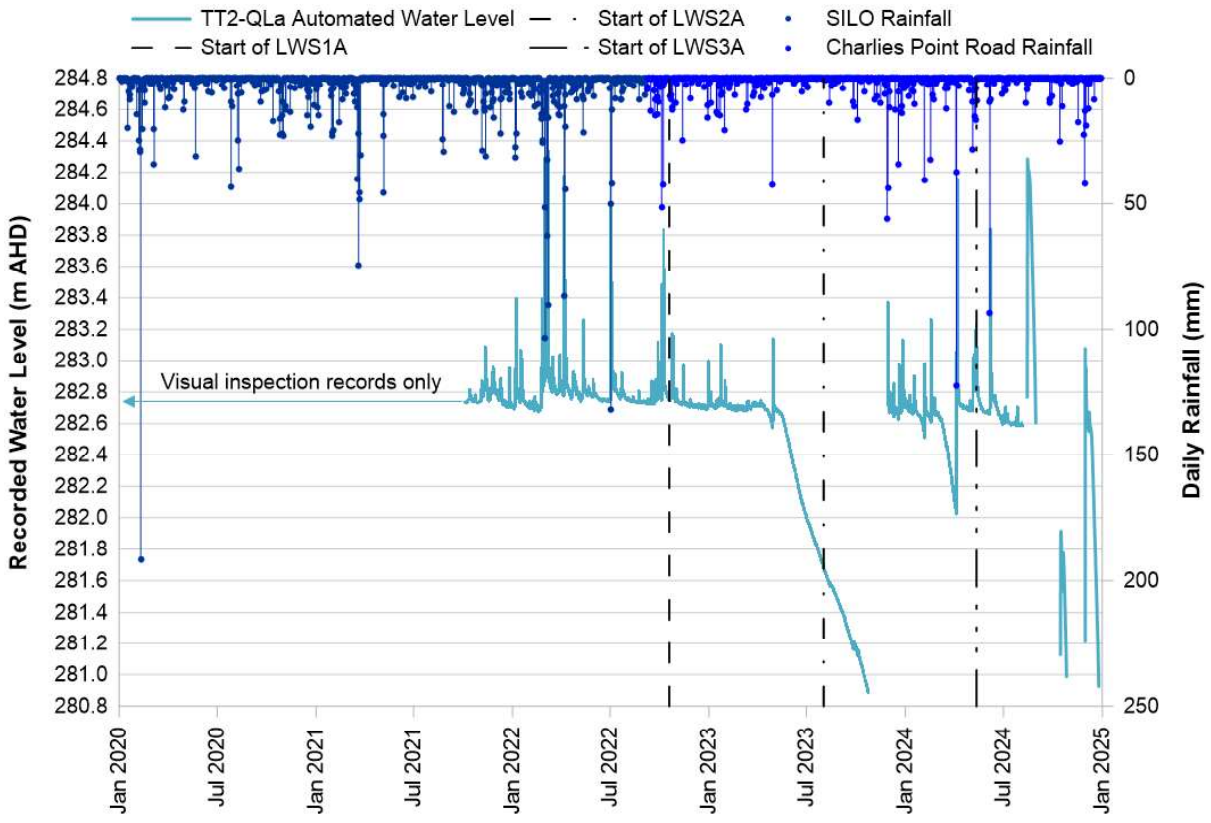


Chart C2: TT2-QLa Water Level Monitoring Data

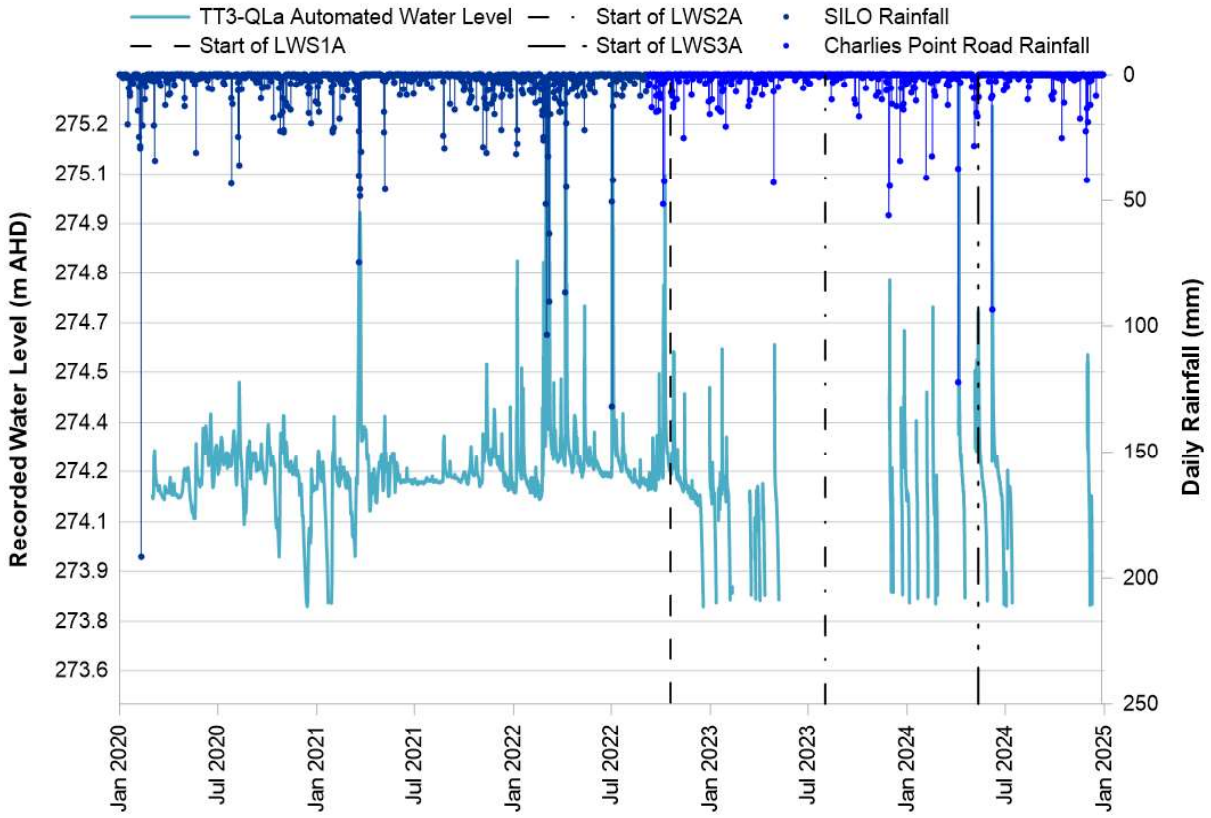


Chart C3: TT3-QLa Water Level Monitoring Data

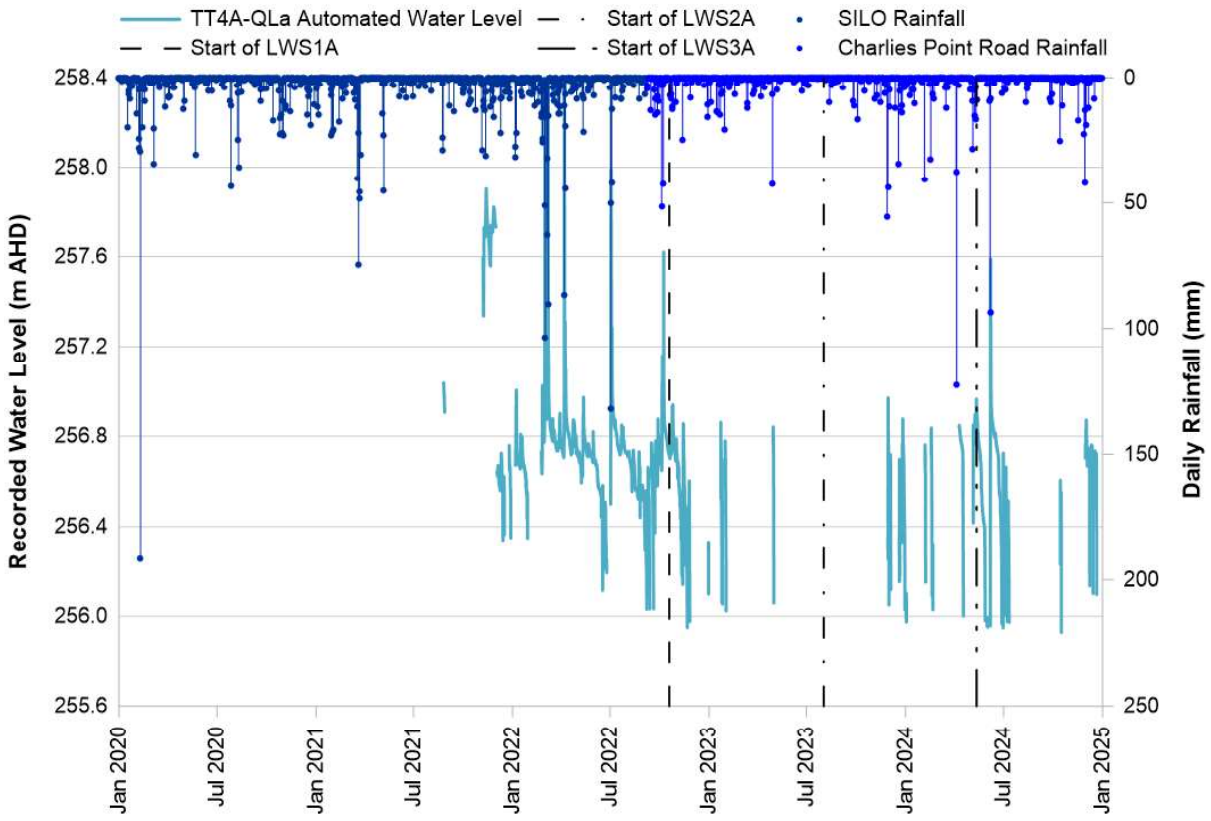


Chart C4: TT4A-QLa Water Level Monitoring Data

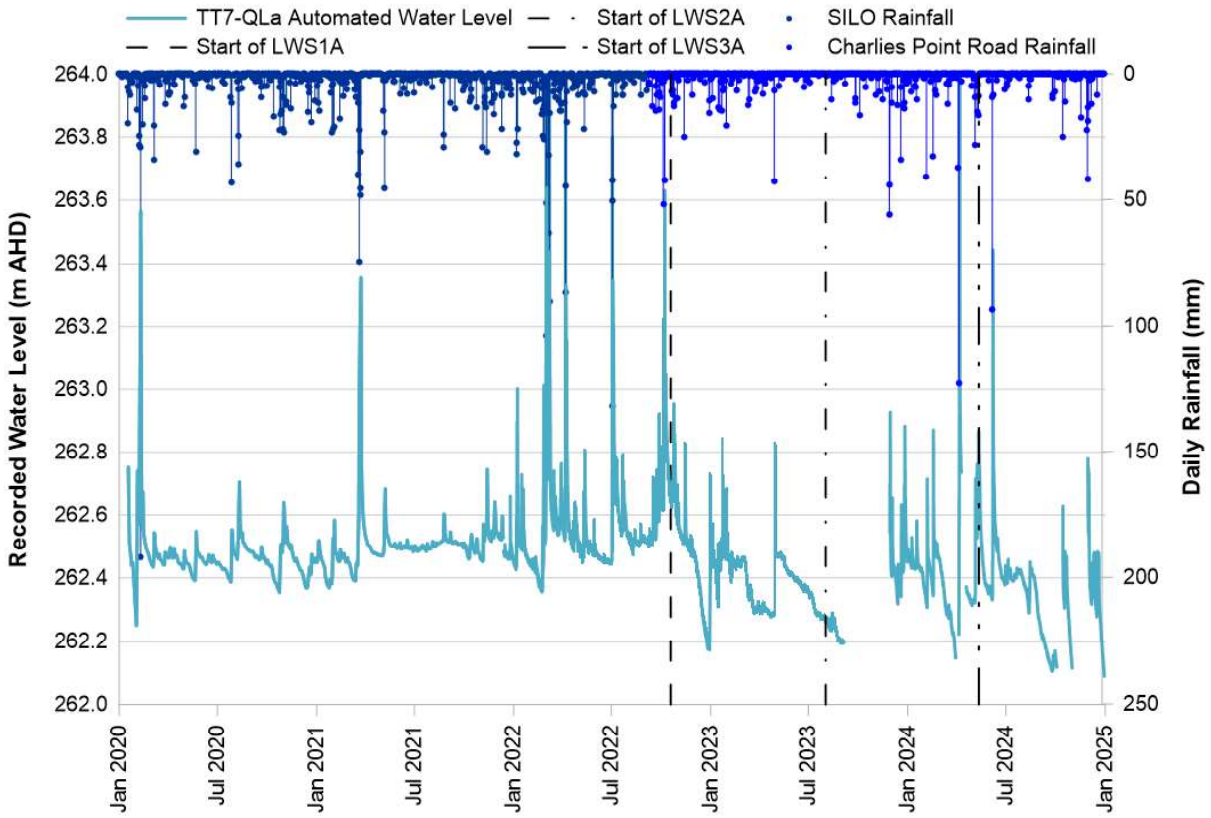


Chart C5: TT7-QLa Water Level Monitoring Data

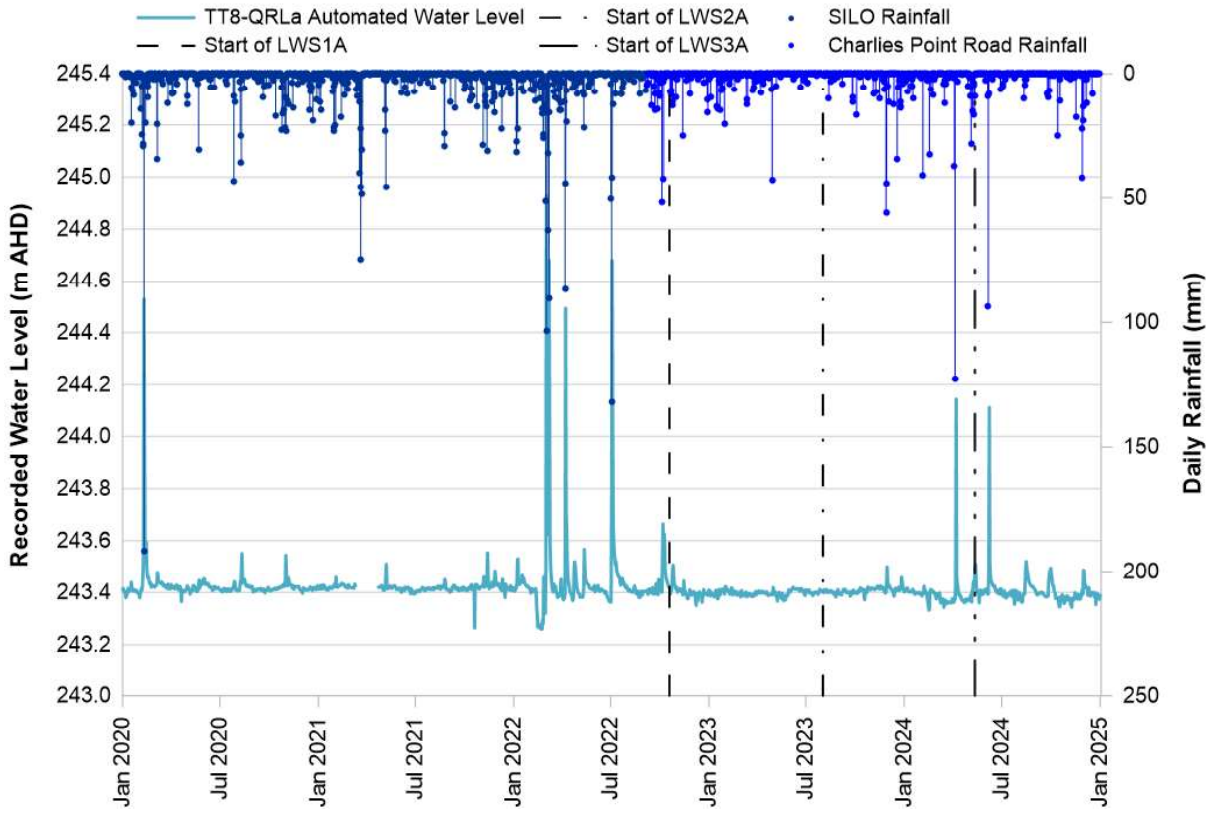


Chart C6: TT8-QRLa Water Level Monitoring Data

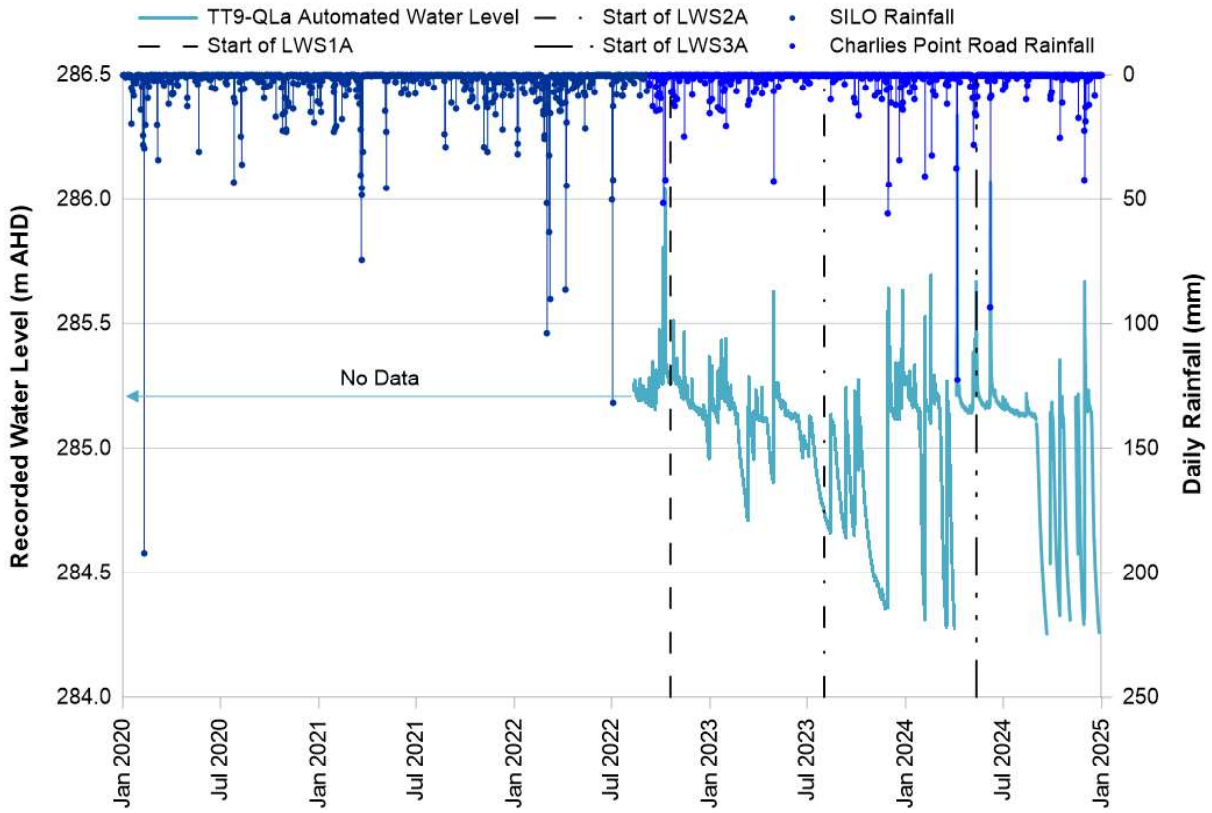


Chart C7: TT9-QLa Water Level Monitoring Data

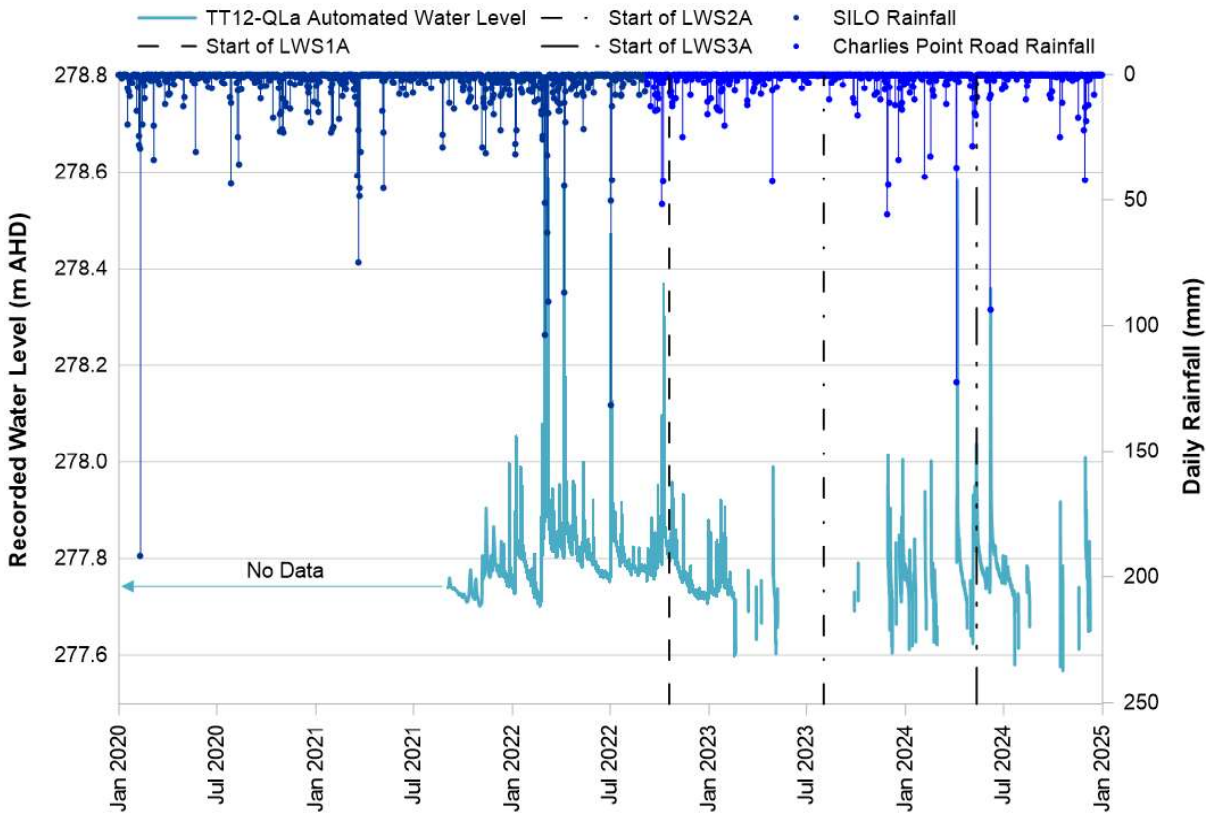


Chart C8: TT12-QLa Water Level Monitoring Data

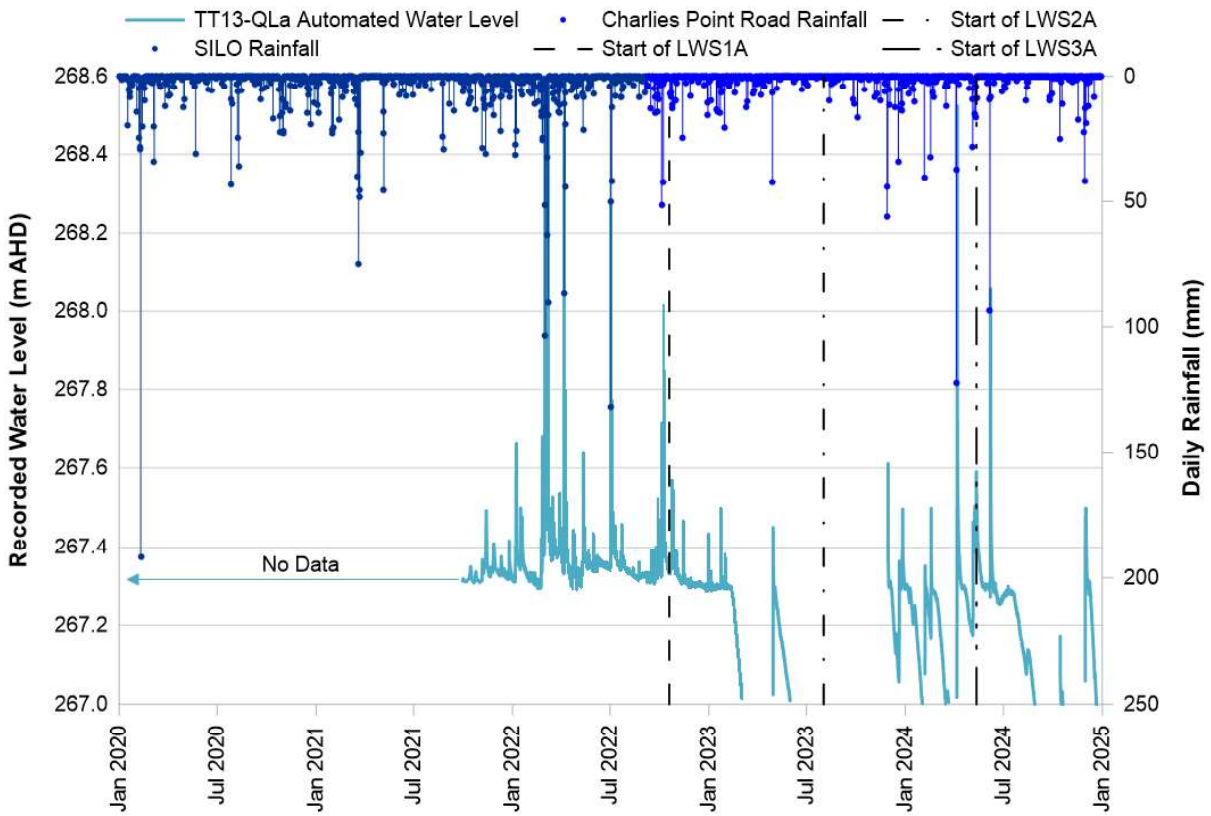


Chart C9: TT13-QLa Water Level Monitoring Data

Bargo River

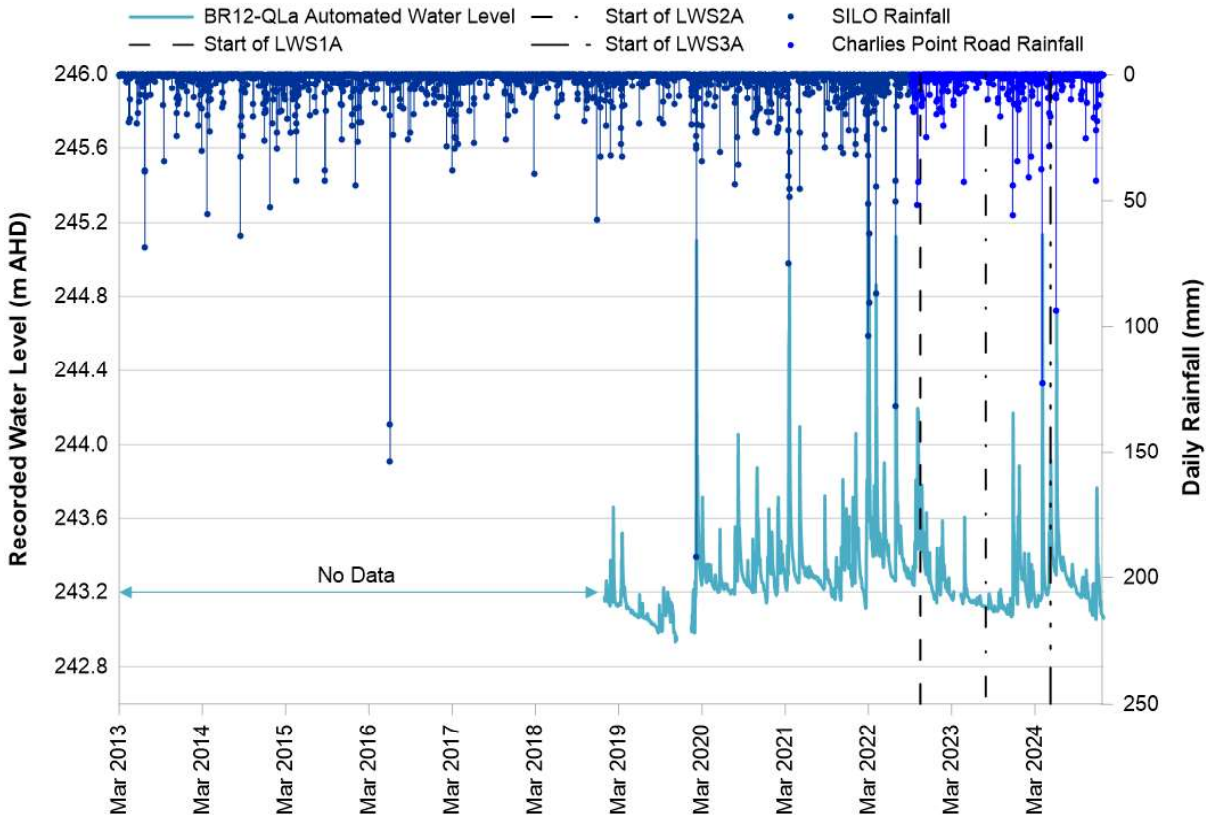


Chart C10: BR12-QLa Water Level Monitoring Data

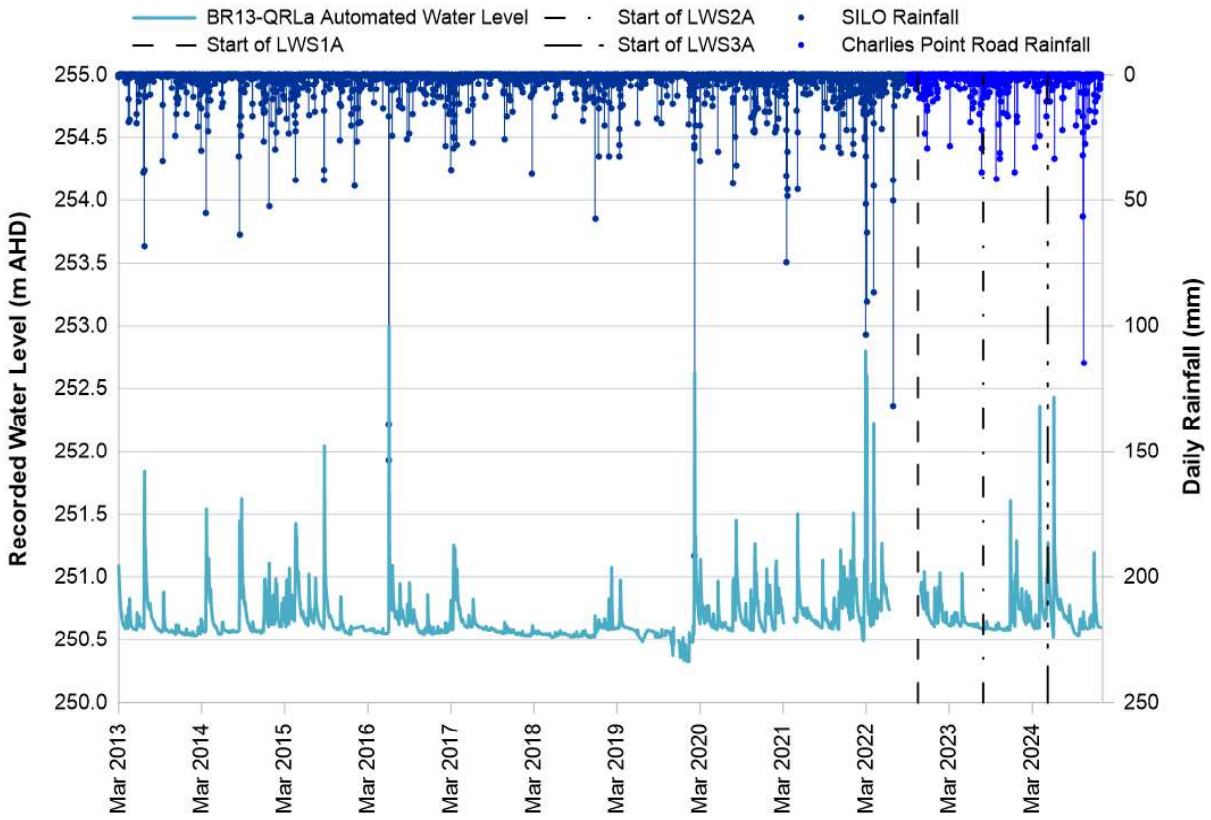


Chart C11: BR13-QRLa Water Level Monitoring Data

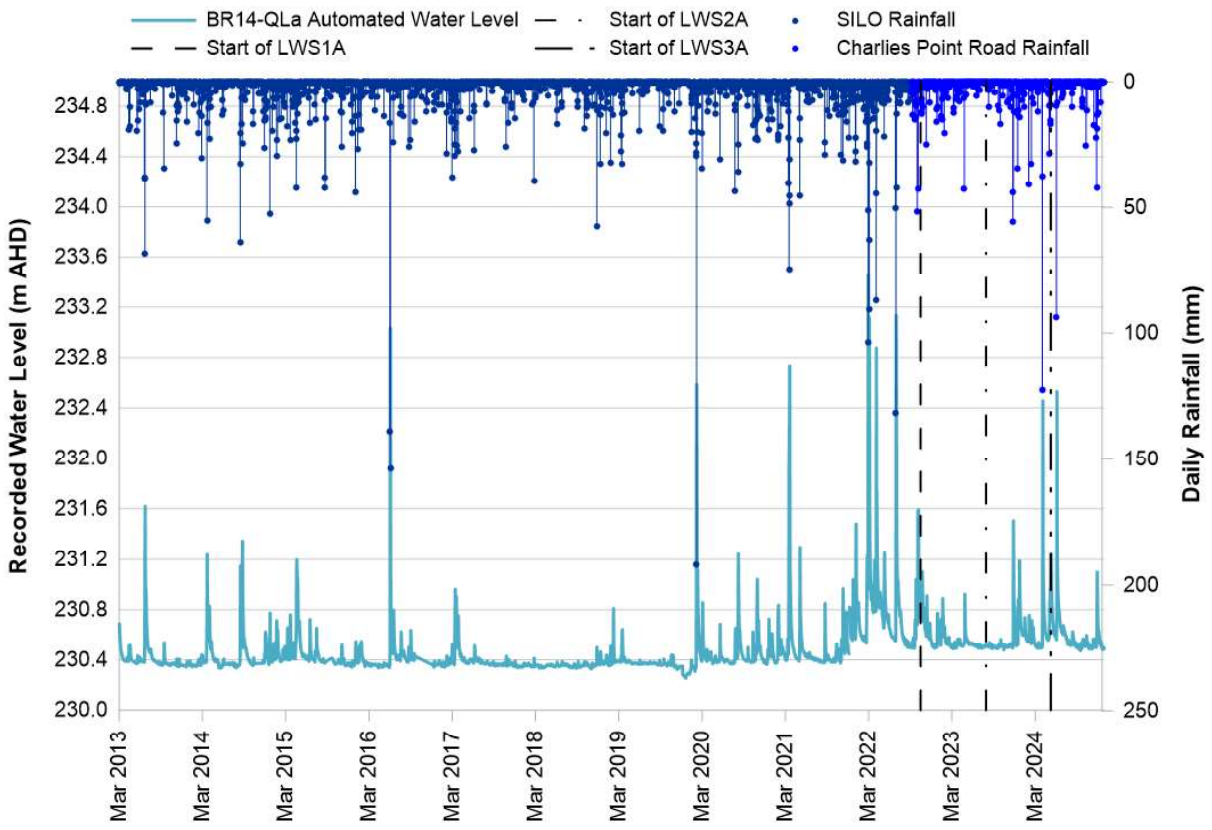


Chart C12: BR14-QLa Water Level Monitoring Data

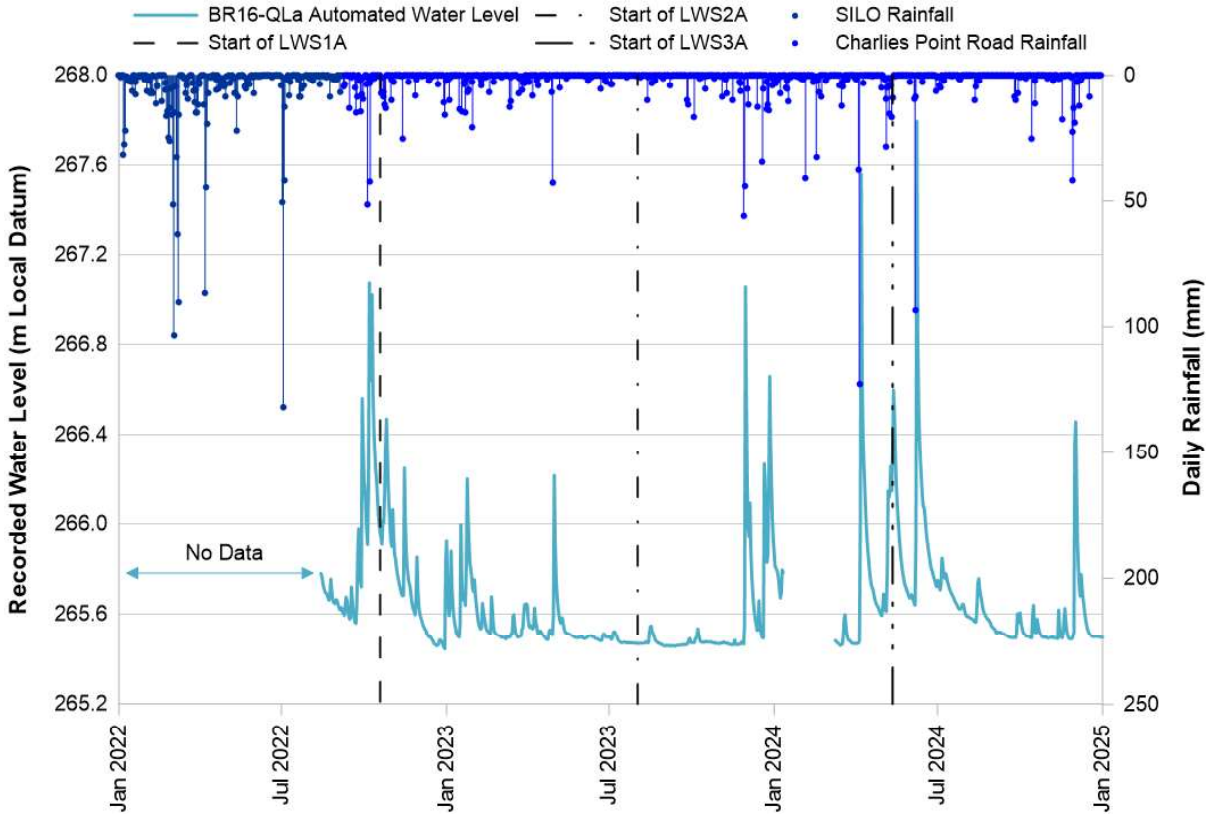


Chart C13: BR16-QLa Water Level Monitoring Data

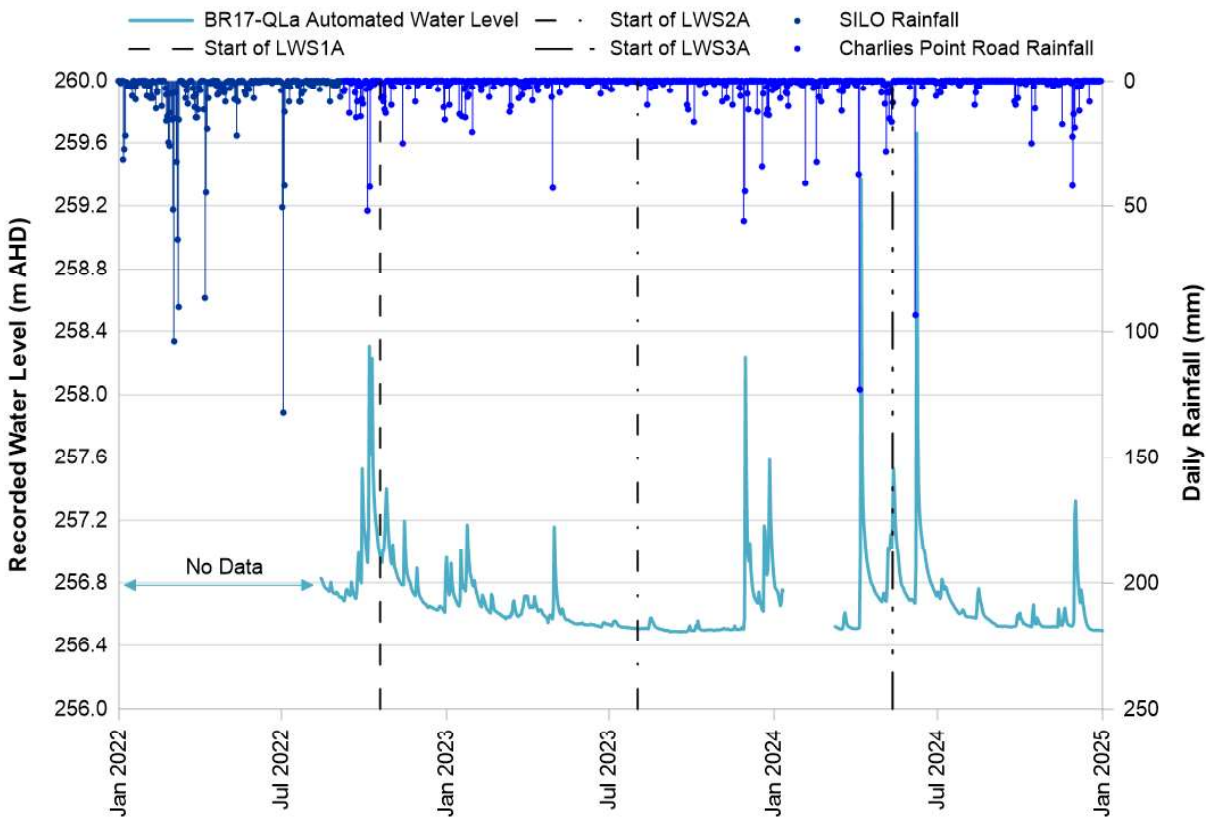


Chart C14: BR17-QLa Water Level Monitoring Data

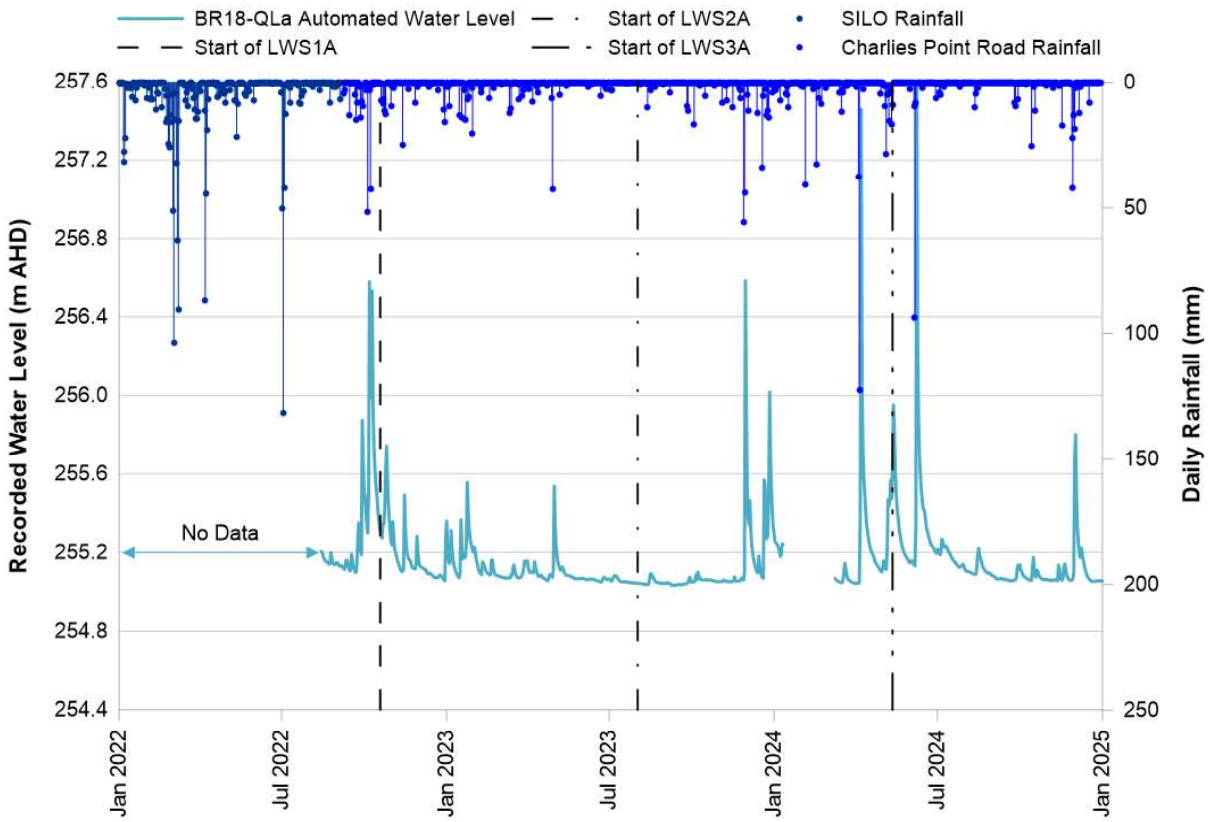


Chart C15: BR18-QLa Water Level Monitoring Data

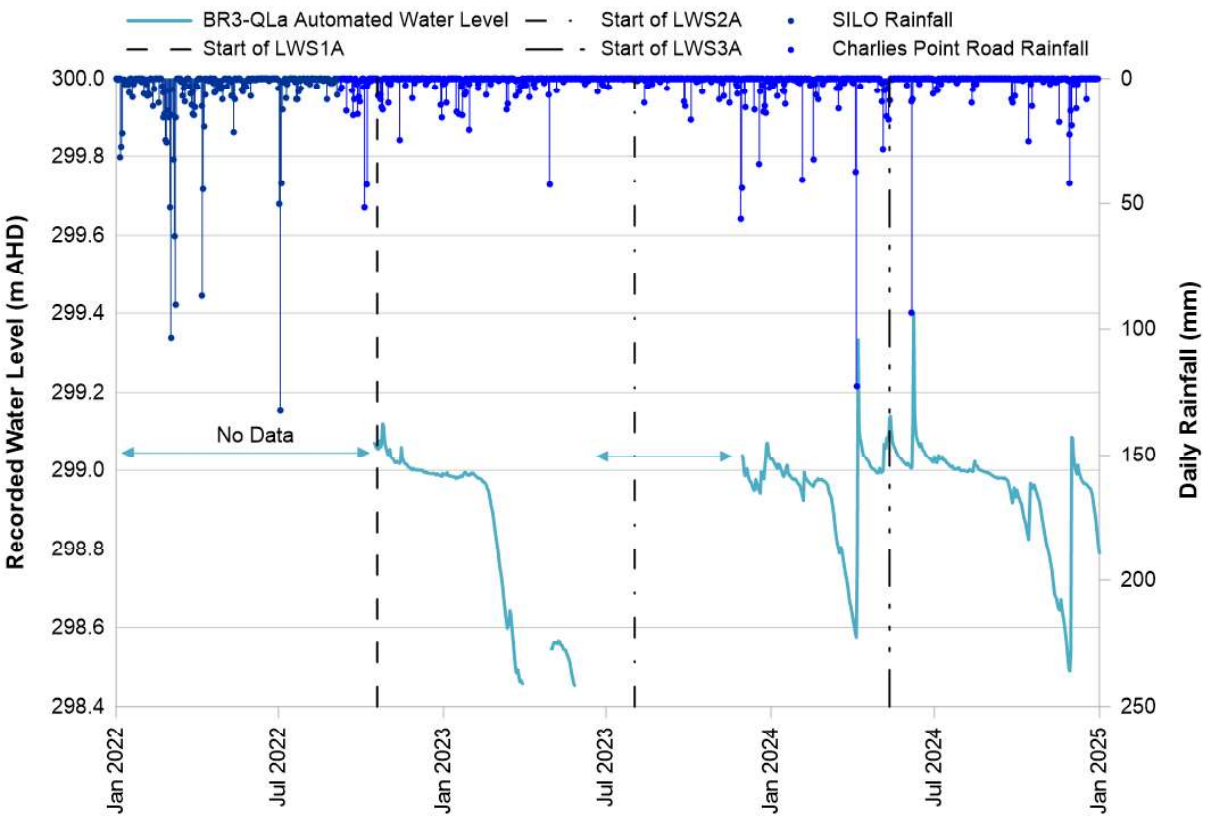


Chart C16: BR3-QLa Water Level Records

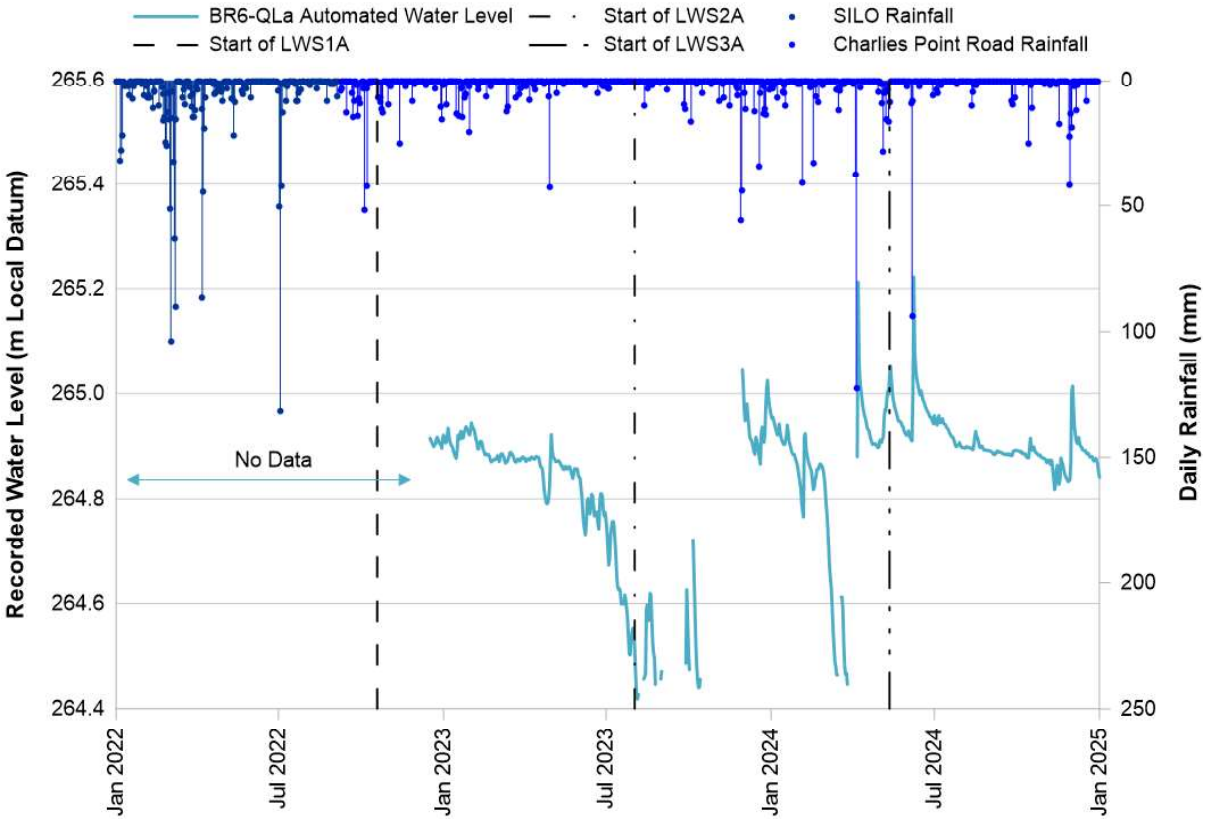


Chart C17: BR6-QLa Water Level Records

Hornes Creek

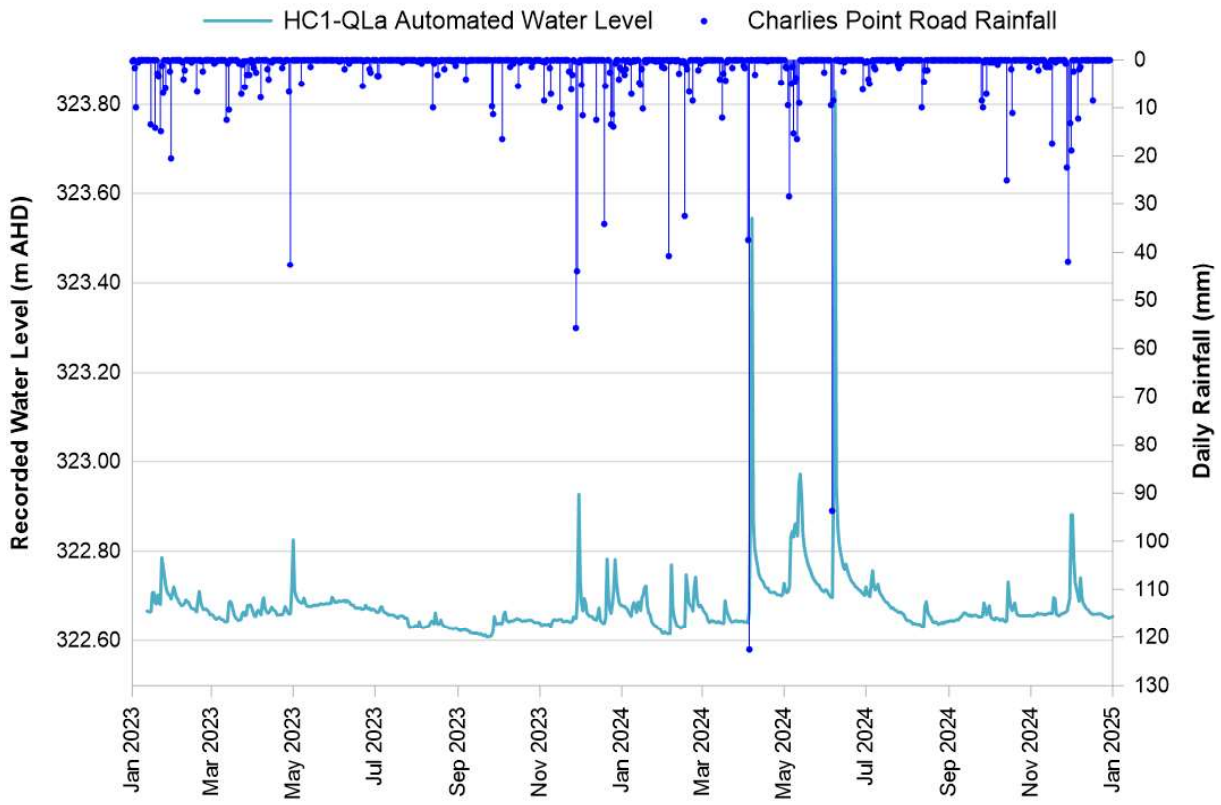


Chart C18: HC1-QLa Water Level Monitoring Data

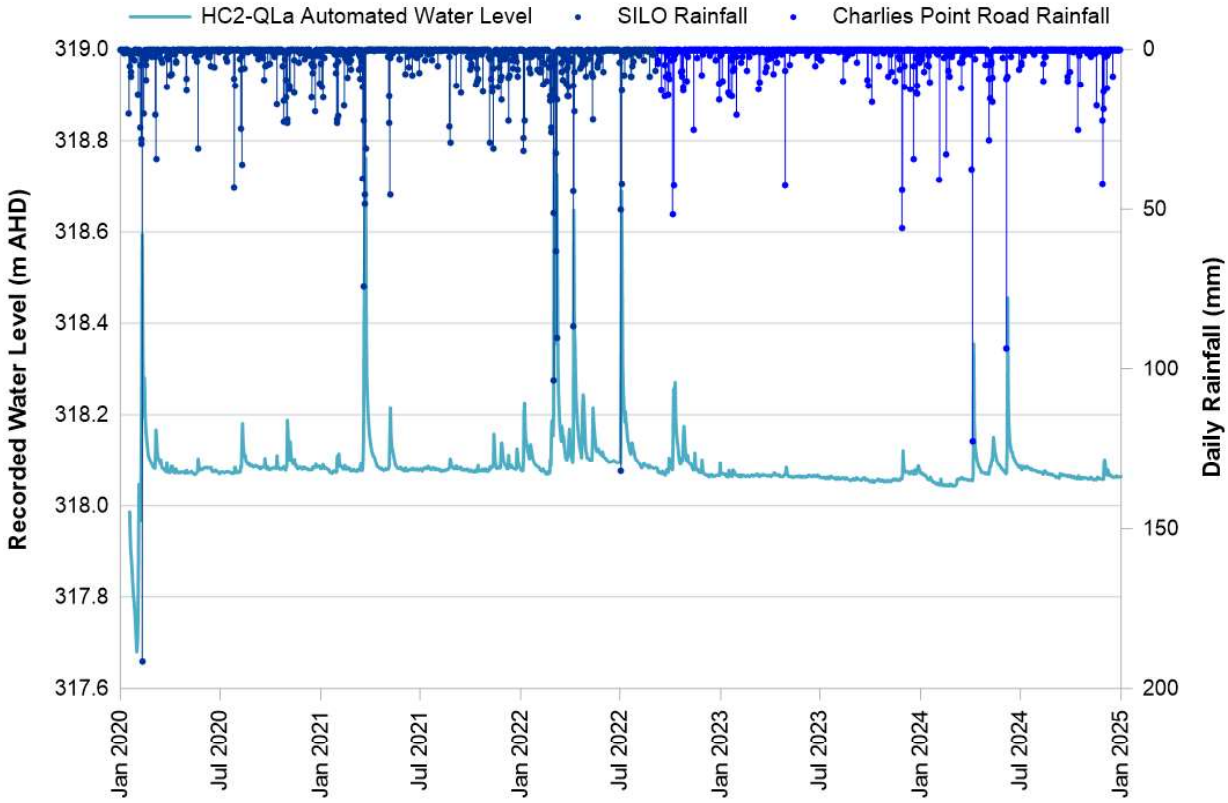


Chart C19: HC2-QLa Water Level Monitoring Data

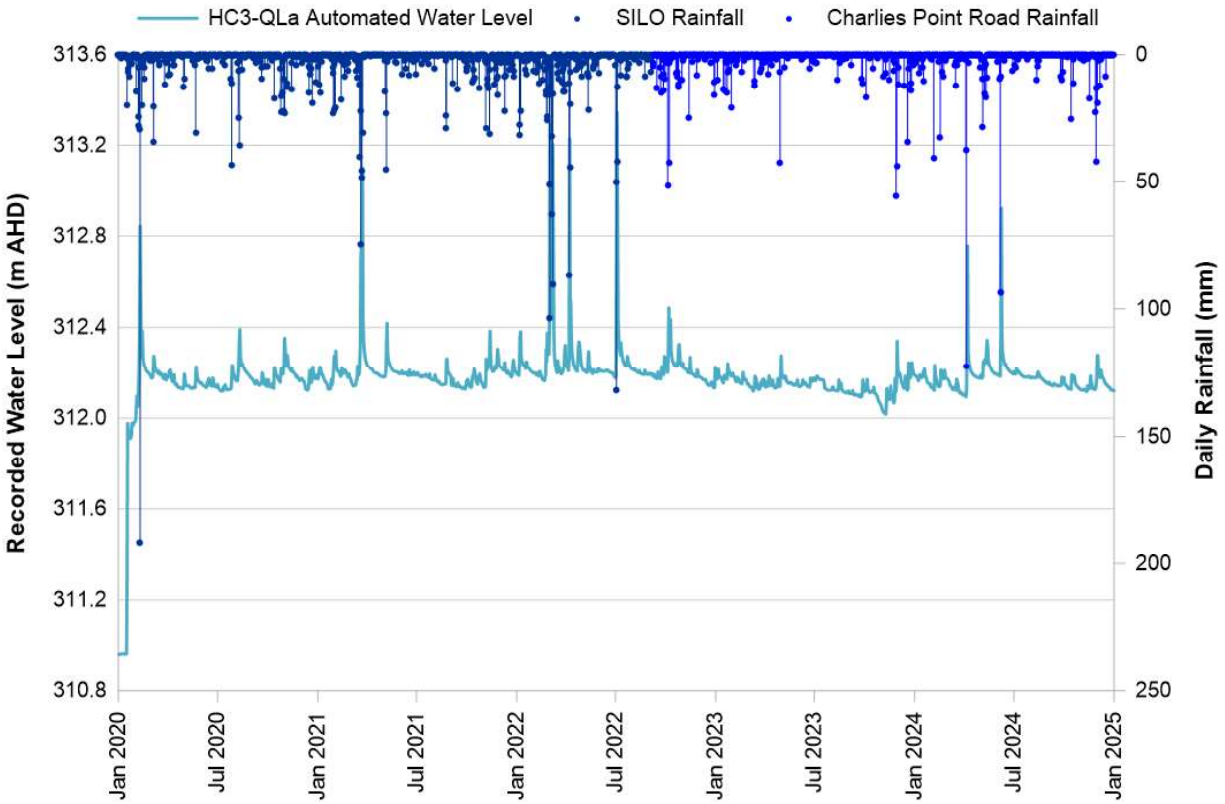


Chart C20: HC3-QLa Water Level Monitoring Data

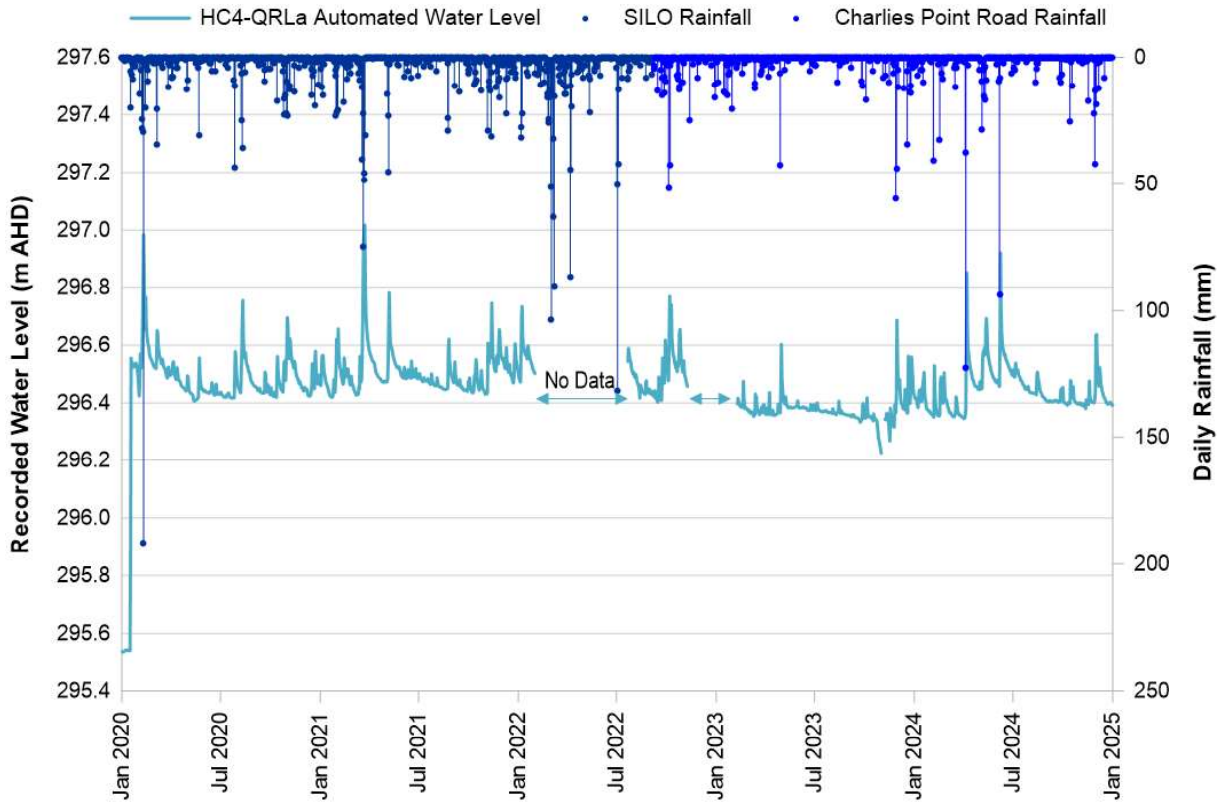


Chart C21: HC4-QRLa Water Level Monitoring Data

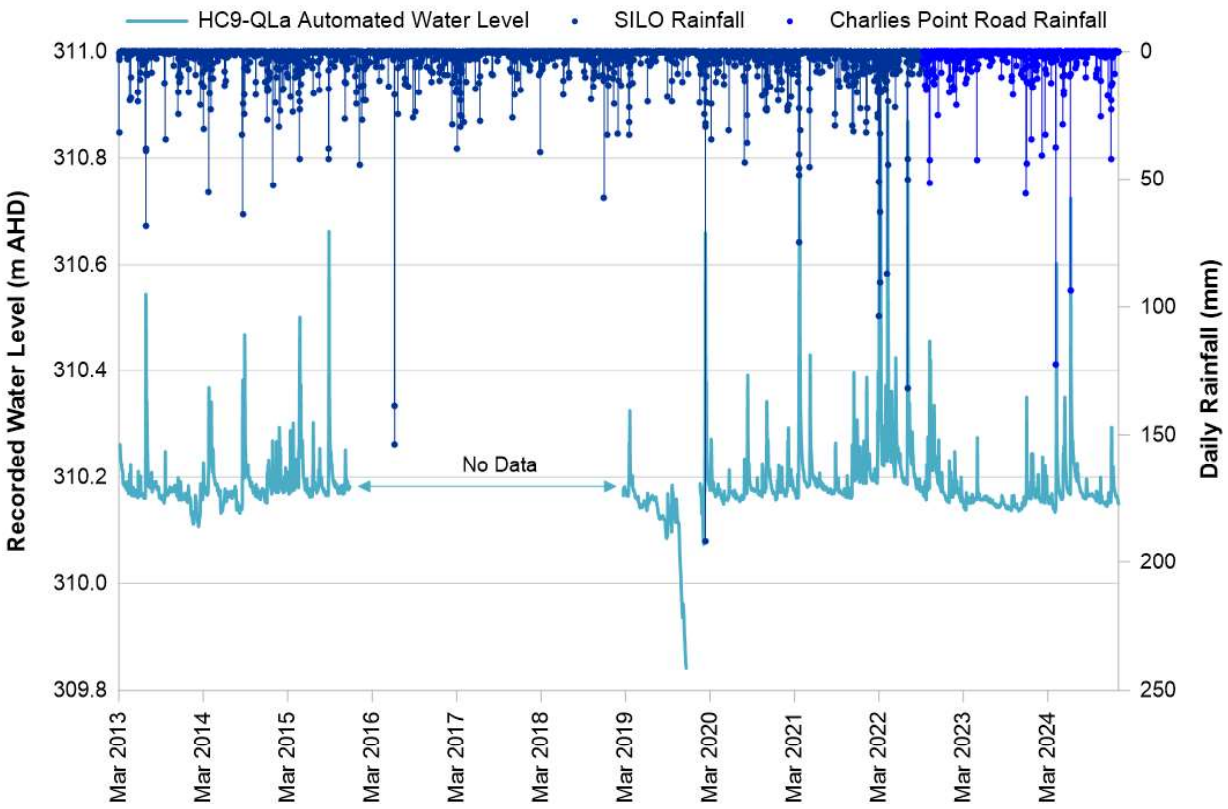


Chart C22: HC9-QLa Water Level Monitoring Data

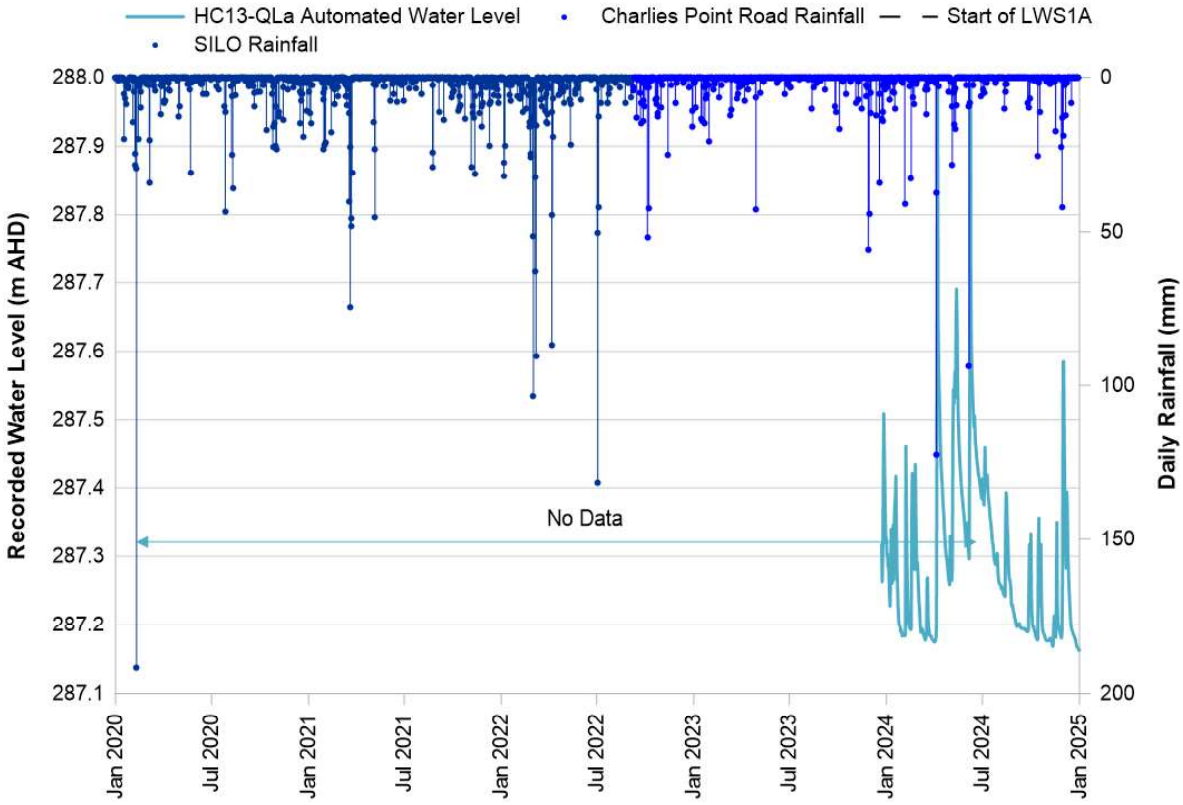


Chart C23: HC13-QLa Water Level Monitoring Data

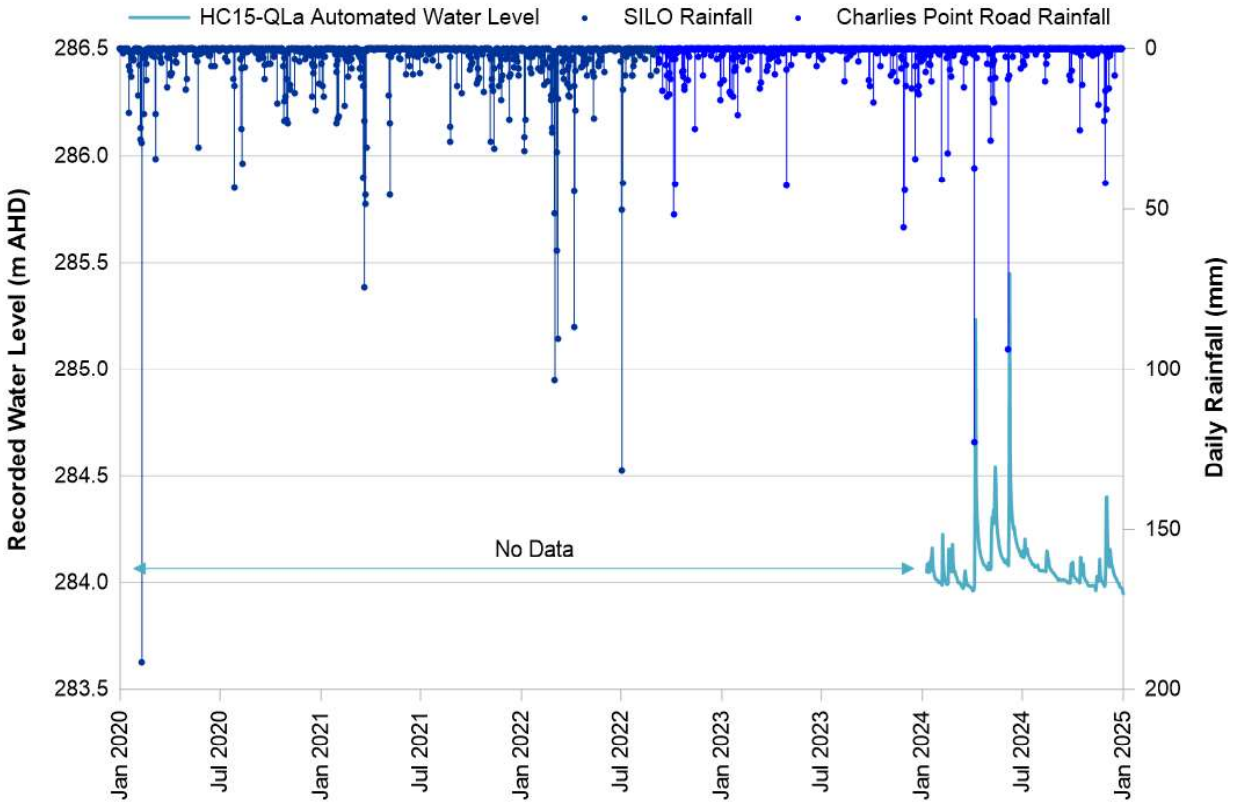


Chart C24: HC15-QLa Water Level Monitoring Data

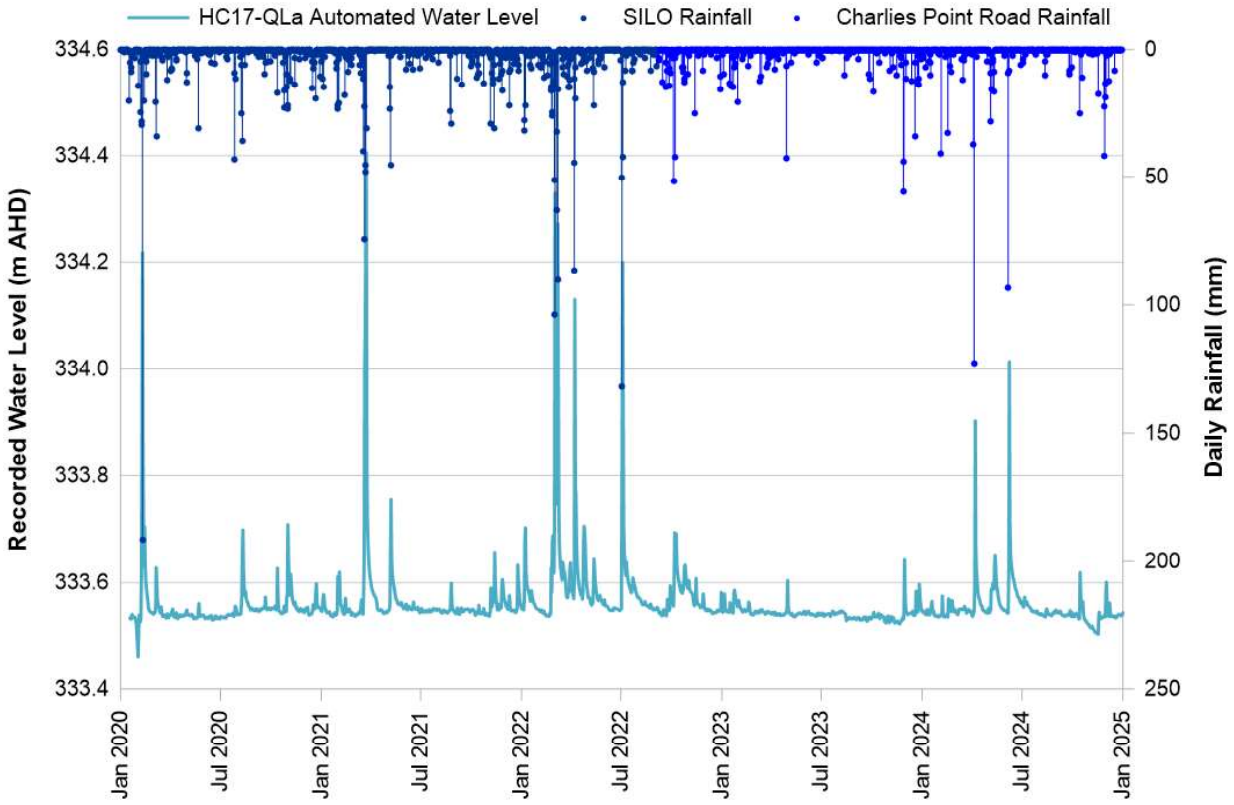


Chart C25: HC17-QLa Water Level Monitoring Data

Dogtrap Creek

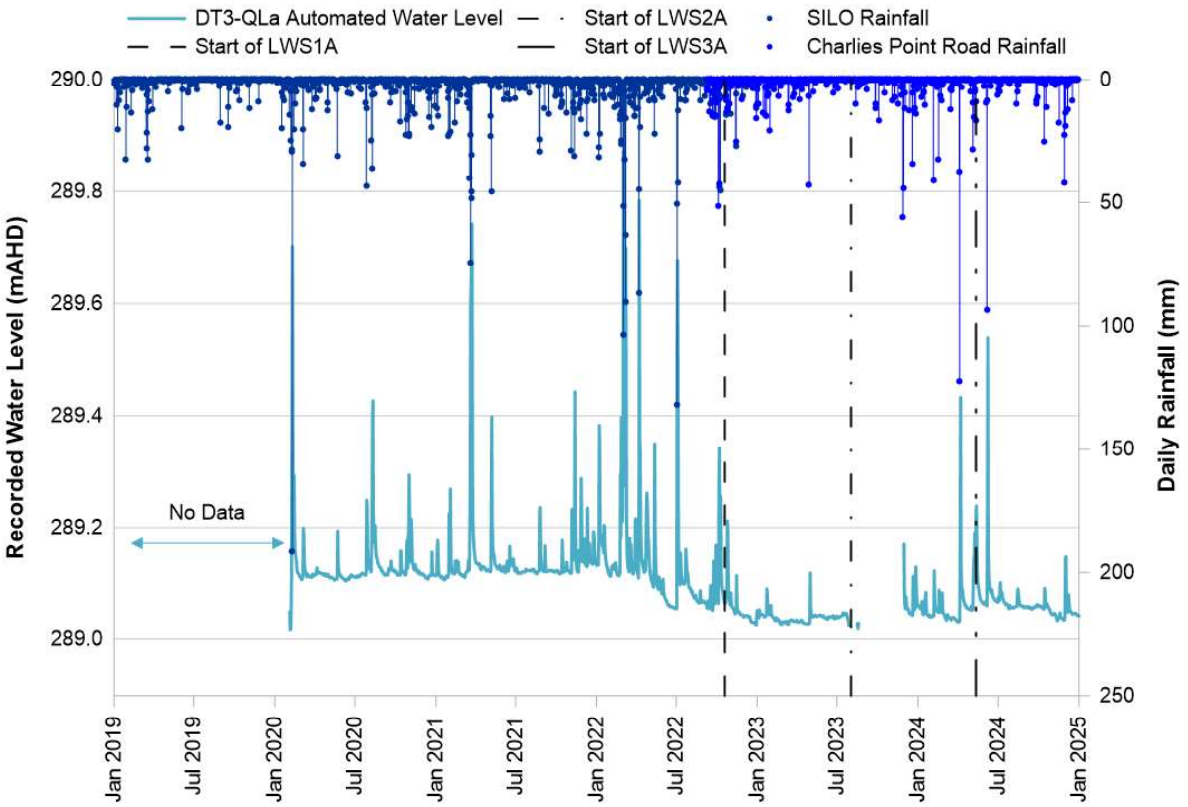


Chart C26: DT3-QLa Water Level Monitoring Data

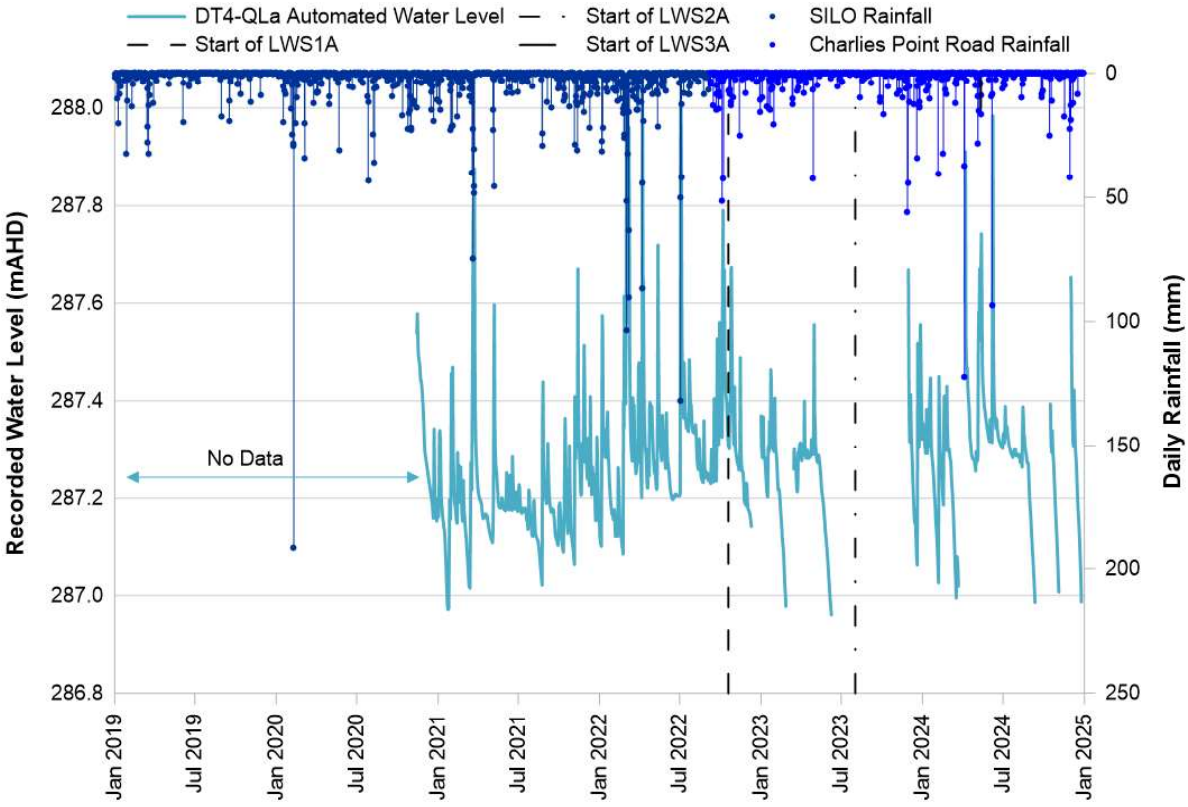


Chart C27: DT4-QLa Water Level Monitoring Data

APPENDIX C – Surface Water Quality Summary Tables

Bargo River (BR3-QLa and BR6-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR3-QLa					BR6-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	19	5.44	6.6	7.47	42%	22	5.1	5.72	6.62	95%
Lab pH	6.5 - 8‡	19	5.87	6.31	6.82	79%	22	5.67	6.07	6.49	100%
Field EC (µS/cm)	350‡	19	33.3	94.6	132.8	0%	22	98.2	211.4	348.6	0%
Lab EC (µS/cm)	350‡	19	77	88	103	0%	22	81	191	287	0%
Field DO	-	19	2.71	8.27	10.53	-	22	3.89	7	10.4	-
Sulphate as Turbidimetric SO_4	400*	19	3	5	6	0%	22	4	5	14	0%
Total Alkalinity as $CaCO_3$	500*	19	5	8	16	0%	22	2	7	11	0%
Chloride	400*	19	13	18	24	0%	22	16	47.5	81	0%
Dissolved Calcium	-	20	1	1	2	-	22	1	1	2	-
Dissolved Magnesium	-	20	1	2	2	-	22	2	5.5	9	-
Dissolved Potassium	-	20	1	2	2	-	22	1	1	2	-
Dissolved Sodium	300*	19	10	12	15	0%	22	11	24.5	35	0%
Dissolved Aluminium	0.055†	19	<0.01	0.03	0.32	32%	22	0.02	0.055	0.13	50%
Dissolved Arsenic	0.024†	20	<0.001	<0.001	<0.001	0%	21	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	20	0.001	0.002	0.004	0%	22	0.003	0.013	0.025	0%
Dissolved Copper	0.0014†	20	<0.001	<0.001	<0.001	0%	22	<0.001	<0.001	<0.001	0%
Dissolved Iron	0.3*	19	<0.05	0.14	0.35	11%	22	<0.05	<0.05	0.18	0%
Dissolved Lead	0.0034†	20	<0.001	<0.001	<0.001	0%	22	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	19	<0.001	<0.001	0.002	-	21	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	19	0.001	0.002	0.01	0%	22	0.006	0.06	0.212	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR3-QLa and BR6-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR3-QLa					BR6-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	20	<0.001	<0.001	<0.001	0%	22	<0.001	0.0035	0.009	0%
Dissolved Selenium	0.011†	20	<0.01	<0.01	<0.01	0%	22	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	20	0.001	0.004	0.008	-	22	0.005	0.0115	0.014	-
Dissolved Zinc	0.008†	20	<0.005	<0.005	<0.005	0%	22	<0.005	0.019	0.044	73%
Total Aluminium	0.055†	19	0.03	0.08	0.53	63%	22	0.04	0.085	0.65	73%
Total Arsenic	0.024†	20	<0.001	<0.001	<0.001	0%	21	<0.001	<0.001	<0.001	0%
Total Barium	1*	20	0.001	0.002	0.017	0%	22	0.004	0.014	0.026	0%
Total Cadmium	0.0002†	2	<0	-	<0	0%	5	<0	<0	<0	0%
Total Copper	0.0014†	20	<0.001	<0.001	<0.001	0%	22	<0.001	<0.001	0.012	18%
Total Iron	0.3*	19	<0.05	0.26	1.14	47%	22	<0.05	<0.05	0.46	5%
Total Lead	0.0034†	20	<0.001	<0.001	<0.001	0%	22	<0.001	<0.001	0.002	0%
Total Lithium	-	20	<0.001	<0.001	0.004	-	22	<0.001	<0.001	0.003	-
Total Manganese	1.9†	19	0.001	0.004	0.021	0%	22	0.007	0.071	0.219	0%
Total Nickel	0.011†	20	<0.001	<0.001	<0.001	0%	22	<0.001	0.004	0.009	0%
Total Selenium	0.011†	20	<0.01	<0.01	<0.01	0%	22	<0.01	<0.01	<0.01	0%
Total Strontium	-	20	0.001	0.004	0.016	-	22	0.005	0.0115	0.014	-
Total Zinc	0.008†	20	<0.005	<0.005	0.032	10%	22	<0.005	0.031	0.078	77%
Nitrogen Oxides	0.015‡	18	<0.01	<0.01	0.15	28%	22	<0.01	0.06	0.9	95%
Total Nitrogen	0.25‡	18	<0.1	0.4	0.6	61%	22	<0.1	0.25	1.8	50%
Total Phosphorus	0.02‡	18	<0.01	<0.01	0.04	11%	22	<0.01	0.015	0.03	18%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR12-QLa and BR13-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR12-QLa					BR13-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	67	6.1	7.3	9.1	9%	68	5.7	7.0	9.1	9%
Lab pH	6.5 - 8‡	62	5.6	6.6	8.4	48%	63	4.1	6.5	7.8	54%
Field EC (µS/cm)	350‡	67	99.2	196.3	337	0%	68	64.1	191	406	3%
Lab EC (µS/cm)	350‡	62	98	193	1230	3%	61	87	187	490	5%
Field DO	-	67	2.9	9.5	99.3	-	68	4.8	10.0	104.9	-
Sulphate as Turbidimetric SO_4	400*	62	<1	5	24	0%	88	2	5	18	0%
Total Alkalinity as $CaCO_3$	500*	62	4	11	573	2%	88	<1	8	57	0%
Chloride	400*	62	20	45	102	0%	88	16	45	119	0%
Dissolved Calcium	-	62	2	4	21	-	88	1	3	17	-
Dissolved Magnesium	-	62	2	5	16	-	88	1	5	14	-
Dissolved Potassium	-	62	1	2	22	-	88	1	2	13	-
Dissolved Sodium	300*	62	12	22	246	0%	88	10	23	50	0%
Dissolved Aluminium	0.055†	62	<0.01	0.02	0.13	24%	61	<0.01	0.02	0.16	23%
Dissolved Arsenic	0.024†	62	<0.001	<0.001	0.014	0%	61	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	62	0.01	0.01	2.08	2%	61	0.01	0.01	0.06	0%
Dissolved Copper	0.0014†	62	<0.001	<0.001	0.002	2%	61	<0.001	<0.001	0.004	2%
Dissolved Iron	0.3*	62	<0.05	0.31	1.56	50%	61	<0.05	0.36	1.52	54%
Dissolved Lead	0.0034†	62	<0.001	<0.001	<0.001	0%	61	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	33	<0.001	<0.001	0.544	-	32	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	62	0.01	0.07	1.10	0%	61	0.03	0.13	0.64	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR12-QLa and BR13-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR12-QLa					BR13-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	62	<0.001	<0.001	0.03	2%	61	<0.001	<0.001	0.006	0%
Dissolved Selenium	0.011†	62	<0.01	<0.01	<0.01	0%	61	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	62	0.01	0.03	0.51	-	61	0.01	0.02	0.13	-
Dissolved Zinc	0.008†	62	<0.005	<0.005	0.064	8%	61	<0.005	<0.005	0.111	16%
Total Aluminium	0.055†	62	<0.01	0.06	3.06	52%	88	<0.01	0.06	0.92	51%
Total Arsenic	0.024†	62	<0.001	<0.001	0.016	0%	88	<0.001	<0.001	0.006	0%
Total Barium	1*	62	0.01	0.02	2.62	2%	88	0.01	0.02	0.06	0%
Total Cadmium	0.0002†	5	<0	<0	<0	0%	34	<0	0.0001	0.0001	0%
Total Copper	0.0014†	62	<0.001	<0.001	0.003	21%	88	<0.001	<0.001	0.006	10%
Total Iron	0.3*	62	<0.05	0.78	3.62	84%	88	0.12	1.01	3.28	90%
Total Lead	0.0034†	62	<0.001	<0.001	0.003	0%	88	<0.001	<0.001	0.003	0%
Total Lithium	-	62	<0.001	<0.001	0.522	-	88	<0.001	<0.001	0.004	-
Total Manganese	1.9†	62	0.01	0.08	1.02	0%	88	0.03	0.14	0.65	0%
Total Nickel	0.011†	62	<0	<0.001	0.032	3%	88	<0.001	<0.001	0.007	0%
Total Selenium	0.011†	62	<0.01	<0.01	<0.01	0%	88	<0.01	<0.01	<0.01	0%
Total Strontium	-	62	0.01	0.03	0.57	-	88	0.01	0.03	0.14	-
Total Zinc	0.008†	62	<0.005	<0.005	0.07	23%	88	<0.005	0.006	0.11	28%
Nitrogen Oxides	0.015‡	62	<0.01	0.11	1.48	95%	88	<0.01	0.10	1.54	94%
Total Nitrogen	0.25‡	62	<0.1	0.40	2.4	74%	88	<0.10	0.35	1.9	77%
Total Phosphorus	0.02‡	62	<0.01	<0.01	0.2	19%	88	<0.01	<0.01	0.16	23%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR14-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR14-QLa					BR16-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	69	7.5	8.3	10.7	75%	28	6.41	6.73	7.91	14%
Lab pH	6.5 - 8‡	60	6.3	8.1	8.9	62%	27	5.98	6.46	6.75	59%
Field EC (µS/cm)	350‡	69	158.3	699	2070	72%	28	96.1	171.15	255.5	0%
Lab EC (µS/cm)	350‡	59	161	590	2260	69%	27	90	152	228	0%
Field DO	-	69	5.6	9.8	100.0	-	28	6.89	9.235	11.31	-
Sulphate as Turbidimetric SO_4	400*	79	4	10	33	0%	27	<1	4	8	0%
Total Alkalinity as $CaCO_3$	500*	79	20	313	1100	29%	27	5	11	27	0%
Chloride	400*	79	22	57	118	0%	27	18	36	74	0%
Dissolved Calcium	-	79	1	9	20	-	27	2	3	5	-
Dissolved Magnesium	-	79	1	8	15	-	27	2	4	6	-
Dissolved Potassium	-	79	2	10	27	-	27	1	2	3	-
Dissolved Sodium	300*	79	21	150	504	19%	27	11	18	27	0%
Dissolved Aluminium	0.055†	59	<0.01	0.04	0.2	42%	27	<0.01	0.02	0.13	19%
Dissolved Arsenic	0.024†	60	<0.001	0.0075	0.051	12%	26	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	59	0.08	0.56	2.39	31%	27	0.01	0.01	0.02	0%
Dissolved Copper	0.0014†	60	<0.001	<0.001	0.002	3%	27	<0.001	<0.001	0.002	4%
Dissolved Iron	0.3*	59	<0.05	0.19	0.58	29%	27	0.21	0.56	1.19	89%
Dissolved Lead	0.0034†	60	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	32	0.009	0.108	0.7	-	26	<0.001	<0.001	0.007	-
Dissolved Manganese	1.9†	59	0.00	0.02	0.10	0%	27	0.03	0.12	0.27	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR14-QLa and BR16) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR14-QLa					BR16-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	59	<0.001	0.011	0.064	49%	27	<0.001	<0.001	<0.001	0%
Dissolved Selenium	0.011†	60	<0.01	<0.01	<0.01	0%	27	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	59	0.03	0.17	0.52	-	27	0.009	0.02	0.04	-
Dissolved Zinc	0.008†	60	<0.005	0.0085	0.04	50%	27	<0.005	<0.005	<0.005	0%
Total Aluminium	0.055†	79	0.02	0.1	1.54	84%	27	<0.01	0.06	0.49	52%
Total Arsenic	0.024†	80	<0.001	0.0115	0.086	21%	26	<0.001	<0.001	<0.001	0%
Total Barium	1*	79	0.09	0.92	4.56	43%	27	0.01	0.01	0.02	0%
Total Cadmium	0.0002†	26	<0	0.0001	0.0001	0%	6	<0	<0	<0	0%
Total Copper	0.0014†	80	<0.001	<0.001	0.006	20%	27	<0.001	<0.001	0.002	4%
Total Iron	0.3*	79	<0.05	0.45	2.03	58%	27	0.49	1.01	2.03	96%
Total Lead	0.0034†	80	<0.001	<0.001	0.007	5%	27	<0.001	<0.001	<0.001	0%
Total Lithium	-	79	0.009	0.378	1.39	-	27	<0.001	<0.001	0.002	-
Total Manganese	1.9†	79	0.01	0.03	0.11	0%	27	0.04	0.13	0.29	0%
Total Nickel	0.011†	79	<0	0.018	0.097	62%	27	<0.001	<0.001	0.002	0%
Total Selenium	0.011†	80	<0.01	<0.01	<0.01	0%	27	<0.01	<0.01	<0.01	0%
Total Strontium	-	79	0.03	0.22	0.75	-	27	0.01	0.03	0.034	-
Total Zinc	0.008†	80	<0.005	0.0135	0.11	76%	27	<0.005	<0.005	0.04	4%
Nitrogen Oxides	0.015‡	79	0.03	0.74	2.92	100%	27	0.02	0.08	0.37	96%
Total Nitrogen	0.25‡	79	0.30	1.10	3.3	100%	27	<0.1	0.4	0.80	85%
Total Phosphorus	0.02‡	80	<0.01	0.02	0.15	28%	27	<0.01	0.02	0.09	41%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR17-QLa and BR18-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR17-QLa					BR18-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	27	6.42	6.88	7.67	4%	28	4.94	6.505	7.35	50%
Lab pH	6.5 - 8‡	27	5.93	6.41	6.75	67%	27	6	6.35	6.69	74%
Field EC (µS/cm)	350‡	27	96.1	174.5	249.4	0%	28	96.1	174.8	259.6	0%
Lab EC (µS/cm)	350‡	27	91	151	225	0%	27	94	157	230	0%
Field DO	-	27	6.91	9.34	11.39	-	28	6.82	9.02	96.9	-
Sulphate as Turbidimetric SO_4	400*	27	<1	4	8	0%	27	2	4	6	0%
Total Alkalinity as $CaCO_3$	500*	27	5	10	26	0%	27	5	10	18	0%
Chloride	400*	27	19	36	75	0%	27	19	37	78	0%
Dissolved Calcium	-	27	2	3	4	-	27	2	3	4	-
Dissolved Magnesium	-	27	2	4	6	-	27	2	4	6	-
Dissolved Potassium	-	27	1	2	3	-	27	1	2	3	-
Dissolved Sodium	300*	27	11	18	27	0%	27	12	18	28	0%
Dissolved Aluminium	0.055†	27	<0.01	0.02	0.11	22%	27	<0.01	0.03	0.43	26%
Dissolved Arsenic	0.024†	27	<0.001	<0.001	<0.001	0%	26	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	27	0.01	0.01	0.02	0%	27	0.006	0.012	0.033	0%
Dissolved Copper	0.0014†	27	<0.001	<0.001	0.002	4%	27	<0.001	<0.001	0.01	4%
Dissolved Iron	0.3*	27	0.12	0.42	1.02	74%	27	0.23	0.69	1.25	89%
Dissolved Lead	0.0034†	27	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	26	<0.001	<0.001	<0.001	-	26	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	27	0.03	0.07	0.23	0%	27	0.034	0.12	0.647	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR17-QLa and BR18-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR17-QLa					BR18-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	27	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	0.007	0%
Dissolved Selenium	0.011†	27	<0.01	<0.01	<0.01	0%	27	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	27	0.01	0.02	0.03	-	27	0.01	0.023	0.034	-
Dissolved Zinc	0.008†	27	<0.005	<0.005	<0.005	0%	27	<0.005	<0.005	0.03	4%
Total Aluminium	0.055†	27	<0.01	0.05	0.19	37%	27	<0.01	0.06	0.35	56%
Total Arsenic	0.024†	27	<0.001	<0.001	<0.001	0%	26	<0.001	<0.001	<0.001	0%
Total Barium	1*	27	0.01	0.01	0.02	0%	27	0.006	0.013	0.022	0%
Total Cadmium	0.0002†	6	<0	<0	<0	0%	6	<0	<0	<0	0%
Total Copper	0.0014†	27	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	0.002	7%
Total Iron	0.3*	27	0.47	0.87	1.39	96%	27	0.47	1.14	1.91	96%
Total Lead	0.0034†	27	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	<0.001	0%
Total Lithium	-	27	<0.001	<0.001	0.002	-	27	<0.001	<0.001	0.002	-
Total Manganese	1.9†	27	0.03	0.08	0.25	0%	27	0.037	0.122	0.3	0%
Total Nickel	0.011†	27	<0.001	<0.001	<0.001	0%	27	<0.001	<0.001	0.005	0%
Total Selenium	0.011†	27	<0.01	<0.01	<0.01	0%	26	<0.01	<0.01	<0.01	0%
Total Strontium	-	27	0.01	0.03	0.03	-	27	0.011	0.025	0.031	-
Total Zinc	0.008†	27	<0.005	<0.005	0.007	0%	27	<0.005	<0.005	0.031	15%
Nitrogen Oxides	0.015‡	27	0.03	0.09	0.38	96%	27	0.02	0.09	0.36	96%
Total Nitrogen	0.25‡	27	<0.1	0.4	0.70	70%	27	<0.1	0.3	1.1	63%
Total Phosphorus	0.02‡	27	<0.01	0.02	0.06	33%	27	<0.01	0.02	0.08	30%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR15-Q) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR15-Q				
		No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	29	7.33	8.18	8.61	66%
Lab pH	6.5 - 8‡	29	5.86	7.96	8.67	52%
Field EC (µS/cm)	350‡	29	151.3	387.8	1355	52%
Lab EC (µS/cm)	350‡	29	1	380	1230	52%
Field DO	-	29	6.01	9.67	10.86	-
Sulphate as Turbidimetric SO_4	400*	29	<1	7	15	0%
Total Alkalinity as $CaCO_3$	500*	29	<1	120	577	7%
Chloride	400*	29	1	41	90	0%
Dissolved Calcium	-	29	1	6	16	-
Dissolved Magnesium	-	29	1	6	13	-
Dissolved Potassium	-	29	1	5	15	-
Dissolved Sodium	300*	29	1	58	275	0%
Dissolved Aluminium	0.055†	29	<0.01	0.03	0.2	28%
Dissolved Arsenic	0.024†	30	<0.001	0.003	0.017	0%
Dissolved Barium	1*	29	0.001	0.365	1.64	24%
Dissolved Copper	0.0014†	30	<0.001	<0.001	0.002	3%
Dissolved Iron	0.3*	29	<0.05	0.22	0.61	31%
Dissolved Lead	0.0034†	30	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	28	<0.001	0.115	0.69	-
Dissolved Manganese	1.9†	29	0.001	0.027	0.049	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Bargo River (BR15-Q) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	BR15-Q				
		No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	30	<0.001	0.0055	0.034	27%
Dissolved Selenium	0.011†	30	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	29	0.001	0.099	0.354	-
Dissolved Zinc	0.008†	30	<0.005	0.006	0.023	30%
Total Aluminium	0.055†	29	<0.01	0.06	0.42	55%
Total Arsenic	0.024†	30	<0.001	0.0035	0.019	0%
Total Barium	1*	29	0.001	0.37	1.78	24%
Total Cadmium	0.0002†	6	<0	<0	<0	0%
Total Copper	0.0014†	30	<0.001	<0.001	0.002	17%
Total Iron	0.3*	29	<0.05	0.54	1.08	69%
Total Lead	0.0034†	30	<0.001	<0.001	<0.001	0%
Total Lithium	-	29	<0.001	0.147	0.87	-
Total Manganese	1.9†	29	0.001	0.036	0.065	0%
Total Nickel	0.011†	30	<0	0.0065	0.067	33%
Total Selenium	0.011†	30	<0.01	<0.01	<0.01	0%
Total Strontium	-	29	0.001	0.104	0.499	-
Total Zinc	0.008†	30	<0.005	0.0085	0.049	50%
Nitrogen Oxides	0.015‡	28	<0.01	0.35	1.14	93%
Total Nitrogen	0.25‡	28	<0.1	0.8	1.8	93%
Total Phosphorus	0.02‡	29	<0.01	0.02	0.05	28%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT1-QLa and TT4-QLa/TT4A-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT1-QLa					TT4-QLa/TT4A-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	59	6.2	6.8	8.3	31%	12	6.6	7.6	8.3	25%
Lab pH	6.5 - 8‡	56	6.1	7.0	7.7	7%	10	6.5	7.1	8.2	30%
Field EC (µS/cm)	350‡	59	273.3	447.6	663	88%	12	157	223.6	1250	33%
Lab EC (µS/cm)	350‡	56	158	416	780	80%	10	170	207.5	1250	30%
Field DO	-	59	0.2	7.4	81.3	-	10	0.2	10.1	99.7	-
Sulphate as Turbidimetric SO_4	400*	56	9	22.5	126	0%	10	6	9	26	0%
Total Alkalinity as $CaCO_3$	500*	56	23	61.5	187	0%	10	35	48	712	10%
Chloride	400*	56	25	75	149	0%	10	12	28.5	109	0%
Dissolved Calcium	-	56	5	10	55	-	10	5	7	34	-
Dissolved Magnesium	-	56	5	13	37	-	10	3	5.5	19	-
Dissolved Potassium	-	56	3	8	31	-	10	3	4.5	14	-
Dissolved Sodium	300*	56	22	47	72	0%	10	22	25.5	234	0%
Dissolved Aluminium	0.055†	56	<0.01	0.02	0.59	25%	10	0.02	0.075	0.66	70%
Dissolved Arsenic	0.024†	56	<0.001	<0.001	0.003	0%	10	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	56	0.01	0.04	0.15	0%	10	0.04	0.05	0.51	0%
Dissolved Copper	0.0014†	56	<0.001	<0.001	0.004	20%	10	<0.001	<0.001	0.004	20%
Dissolved Iron	0.3*	55	<0.05	0.39	1.14	60%	9	<0.05	0.24	0.4	33%
Dissolved Lead	0.0034†	56	<0.001	<0.001	<0.001	0%	10	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	35	<0.001	<0.001	0.005	-	10	<0.001	0.01	0.642	-
Dissolved Manganese	1.9†	56	0.01	0.09	3.00	2%	10	0.00	0.01	0.07	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT1-QLa and TT4-QLa/TT4A-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT1-QLa					TT4-QLa/TT4A-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	56	<0.001	<0.001	0.003	0%	10	<0.001	<0.001	0.007	0%
Dissolved Selenium	0.011†	56	<0.01	<0.01	<0.01	0%	10	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	56	0.03	0.09	0.70	-	10	0.04	0.06	0.52	-
Dissolved Zinc	0.008†	56	<0.005	0.013	0.215	63%	10	<0.005	<0.005	0.034	30%
Total Aluminium	0.055†	56	<0.01	0.2	2.03	96%	10	0.09	0.205	2.44	100%
Total Arsenic	0.024†	56	<0.001	<0.001	0.003	0%	10	<0.001	<0.001	0.002	0%
Total Barium	1*	56	0.01	0.05	0.16	0%	10	0.03	0.06	0.50	0%
Total Cadmium	0.0002†	7	<0	<0	<0	0%	0	-	-	-	-
Total Copper	0.0014†	55	<0.001	<0.001	0.010	25%	10	<0.001	<0.001	0.004	40%
Total Iron	0.3*	56	0.06	1.47	3.59	98%	10	0.16	0.61	1.3	90%
Total Lead	0.0034†	56	<0.001	<0.001	0.003	0%	10	<0.001	<0.001	0.006	10%
Total Lithium	-	56	<0.001	<0.001	0.004	-	10	<0.001	0.0095	0.71	-
Total Manganese	1.9†	56	0.01	0.11	2.97	2%	10	0.00	0.01	0.13	0%
Total Nickel	0.011†	56	<0.001	<0.001	0.01	0%	10	<0.001	0.0015	0.008	0%
Total Selenium	0.011†	56	<0.01	<0.01	<0.01	0%	10	<0.01	<0.01	<0.01	0%
Total Strontium	-	56	0.03	0.09	0.74	-	10	0.04	0.06	0.51	-
Total Zinc	0.008†	56	<0.005	0.0165	0.34	68%	10	<0.005	<0.005	0.04	40%
Nitrogen Oxides	0.015‡	55	<0.01	0.04	0.57	87%	10	0.05	0.09	3.25	100%
Total Nitrogen	0.25‡	55	0.20	0.70	7.3	96%	10	0.20	0.35	4.0	90%
Total Phosphorus	0.02‡	55	<0.01	0.04	2.58	69%	10	<0.01	0.02	0.44	20%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT2-QLa and TT3-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT2-QLa					TT3-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	12	5.8	7.1	8.2	42%	7	6.3	6.9	7.4	14%
Lab pH	6.5 - 8‡	12	6.4	7.0	8.3	17%	5	6.2	6.6	7.3	40%
Field EC (µS/cm)	350‡	12	157	212.5	542	8%	7	139	182.7	240	0%
Lab EC (µS/cm)	350‡	12	148	242	542	17%	5	131	159	240	0%
Field DO	-	10	0.2	6.2	11.3	-	6	4.7	9.8	11	-
Sulphate as Turbidimetric SO_4	400*	12	7	11.5	27	0%	5	8	10	11	0%
Total Alkalinity as $CaCO_3$	500*	12	14	29	107	0%	5	21	25	33	0%
Chloride	400*	12	21	40	121	0%	5	23	30	52	0%
Dissolved Calcium	-	12	4	5.5	31	-	5	4	4	5	-
Dissolved Magnesium	-	12	4	5	15	-	5	4	5	5	-
Dissolved Potassium	-	12	3	5.5	14	-	5	2	3	4	-
Dissolved Sodium	300*	12	10	25	66	0%	5	16	19	33	0%
Dissolved Aluminium	0.055†	12	0.02	0.07	0.47	58%	5	<0.01	0.03	0.18	40%
Dissolved Arsenic	0.024†	12	<0.001	<0.001	0.006	0%	5	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	12	0.01	0.01	0.07	0%	5	0.01	0.01	0.02	0%
Dissolved Copper	0.0014†	12	<0.001	<0.001	0.004	8%	5	<0.001	<0.001	<0.001	0%
Dissolved Iron	0.3*	11	<0.05	0.31	0.75	55%	4	0.18	-	0.51	50%
Dissolved Lead	0.0034†	12	<0.001	<0.001	0.002	0%	5	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	12	<0.001	<0.001	<0.001	-	5	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	12	0.01	0.02	0.65	0%	5	0.01	0.01	0.04	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT2-QLa and TT3-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT2-QLa					TT3-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	12	<0.001	<0.001	0.002	0%	5	<0.001	<0.001	<0.001	0%
Dissolved Selenium	0.011†	12	<0.01	<0.01	<0.01	0%	5	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	12	0.03	0.03	0.28	-	5	0.02	0.03	0.03	-
Dissolved Zinc	0.008†	12	<0.005	0.012	0.034	50%	5	<0.005	<0.005	0.006	0%
Total Aluminium	0.055†	12	0.07	0.175	3.39	100%	5	0.08	0.12	0.52	100%
Total Arsenic	0.024†	12	<0.001	<0.001	0.01	0%	5	<0.001	<0.001	<0.001	0%
Total Barium	1*	12	0.01	0.01	0.09	0%	5	0.01	0.01	0.02	0%
Total Cadmium	0.0002†	0	-	-	-	-	0	-	-	-	-
Total Copper	0.0014†	12	<0.001	<0.001	0.012	17%	5	<0.001	<0.001	<0.001	0%
Total Iron	0.3*	12	0.22	0.48	1.95	83%	5	0.43	0.52	0.92	100%
Total Lead	0.0034†	12	<0.001	<0.001	0.006	8%	5	<0.001	<0.001	<0.001	0%
Total Lithium	-	12	<0.001	<0.001	<0.001	-	5	<0.001	<0.001	<0.001	-
Total Manganese	1.9†	12	0.01	0.02	0.78	0%	5	0.01	0.01	0.04	0%
Total Nickel	0.011†	12	<0.001	<0.001	0.005	0%	5	<0.001	<0.001	0.002	0%
Total Selenium	0.011†	12	<0.01	<0.01	<0.01	0%	5	<0.01	<0.01	<0.01	0%
Total Strontium	-	12	0.02	0.03	0.30	-	5	0.02	0.03	0.03	-
Total Zinc	0.008†	12	<0.005	0.014	0.05	67%	5	<0.005	<0.005	0.01	20%
Nitrogen Oxides	0.015‡	12	<0.01	0.06	0.57	92%	5	<0.01	0.04	0.07	80%
Total Nitrogen	0.25‡	12	0.20	0.40	5.0	75%	5	0.20	0.20	0.4	40%
Total Phosphorus	0.02‡	12	<0.01	0.02	0.79	33%	5	<0.01	<0.01	0.03	20%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT7-QLa and TT8-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT7-QLa					TT8-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	34	6.4	7.0	8.0	15%	31	6.8	8.7	8.9	97%
Lab pH	6.5 - 8‡	35	5.8	6.6	7.4	29%	31	8.3	8.7	8.8	100%
Field EC (µS/cm)	350‡	34	147.9	252.1	687	29%	31	147	2060	2490	94%
Lab EC (µS/cm)	350‡	35	137	246	703	34%	30	768	2090	2490	100%
Field DO	-	34	0.7	9.6	98.2	-	9	9.3	10.9	102.8	-
Sulphate as Turbidimetric SO_4	400*	35	6	9	36	0%	52	11	18.5	40	0%
Total Alkalinity as $CaCO_3$	500*	35	11	33	126	0%	52	339	981.5	1320	98%
Chloride	400*	35	24	50	195	0%	52	36	79.5	122	0%
Dissolved Calcium	-	35	3	5	42	-	52	5	18	27	-
Dissolved Magnesium	-	35	4	6	15	-	52	9	14	21	-
Dissolved Potassium	-	35	3	4	12	-	52	11	24	40	-
Dissolved Sodium	300*	35	17	34	81	0%	52	132	467.5	651	94%
Dissolved Aluminium	0.055†	35	<0.01	0.03	0.27	29%	30	<0.01	0.045	0.11	40%
Dissolved Arsenic	0.024†	35	<0.001	<0.001	0.002	0%	30	0.004	0.056	0.094	83%
Dissolved Barium	1*	35	0.01	0.02	0.15	0%	30	0.86	2.47	5.36	97%
Dissolved Copper	0.0014†	35	<0.001	<0.001	0.004	9%	30	<0.001	<0.001	0.007	43%
Dissolved Iron	0.3*	34	0.07	0.52	1.54	82%	30	<0.05	<0.05	0.48	3%
Dissolved Lead	0.0034†	35	<0.001	<0.001	<0.001	0%	30	<0.001	<0.001	0.003	0%
Dissolved Lithium	-	11	<0.001	<0.001	0.004	-	7	0.37	0.854	1.09	-
Dissolved Manganese	1.9†	35	0.01	0.06	0.59	0%	30	0.00	0.01	0.06	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT7-QLa and TT8-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT7-QLa					TT8-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	35	<0.001	0.002	0.011	0%	30	0.006	0.0525	0.081	97%
Dissolved Selenium	0.011†	35	<0.01	<0.01	<0.01	0%	30	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	35	0.02	0.03	0.18	-	30	0.32	0.53	0.90	-
Dissolved Zinc	0.008†	35	<0.005	0.011	0.091	60%	30	0.008	0.0435	0.111	97%
Total Aluminium	0.055†	35	0.06	0.16	0.75	100%	52	0.02	0.11	0.70	87%
Total Arsenic	0.024†	35	<0.001	<0.001	0.002	0%	52	0.004	0.069	0.162	90%
Total Barium	1*	35	0.01	0.03	0.13	0%	52	0.91	3.04	6.47	98%
Total Cadmium	0.0002†	0	-	-	-	-	22	0.0001	0.0001	0.0003	9%
Total Copper	0.0014†	35	<0.001	<0.001	0.004	11%	52	<0.001	0.002	0.006	73%
Total Iron	0.3*	35	0.39	0.90	3.04	100%	52	<0.05	0.11	0.77	6%
Total Lead	0.0034†	35	<0.001	<0.001	0.002	0%	52	<0.001	0.002	0.015	23%
Total Lithium	-	35	<0.001	<0.001	0.005	-	52	0.361	1.22	1.82	-
Total Manganese	1.9†	35	0.01	0.07	0.67	0%	52	0.01	0.02	0.10	0%
Total Nickel	0.011†	35	<0.001	0.002	0.01	0%	52	<0	0.059	0.111	96%
Total Selenium	0.011†	35	<0.01	<0.01	<0.01	0%	52	<0.01	<0.01	<0.01	0%
Total Strontium	-	35	0.02	0.03	0.18	-	51	0.33	0.66	1.12	-
Total Zinc	0.008†	35	<0.005	0.023	0.09	71%	52	0.011	0.0655	0.32	100%
Nitrogen Oxides	0.015‡	35	<0.01	0.05	2.47	80%	52	0.20	1.82	12.50	100%
Total Nitrogen	0.25‡	35	<0.1	0.30	4.5	57%	52	1.00	2.80	13.5	100%
Total Phosphorus	0.02‡	35	<0.01	<0.01	0.13	20%	52	<0.01	0.03	0.14	54%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT12-QLa and TT13-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT12-QLa					TT13-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	14	6.71	7.20	7.53	0%	13	6.41	6.82	7.19	15%
Lab pH	6.5 - 8‡	13	6.05	6.78	7.61	15%	13	5.71	6.45	7.37	62%
Field EC (µS/cm)	350‡	14	167.7	197.9	260	0%	13	130.8	163.9	218	0%
Lab EC (µS/cm)	350‡	13	165	187	250	0%	13	119	152	377	8%
Field DO	-	14	8.49	11.06	108.3	-	13	7.71	9.86	99.9	-
Sulphate as Turbidimetric SO_4	400*	13	<4	6	9	0%	13	7	9	15	0%
Total Alkalinity as $CaCO_3$	500*	13	34	43	54	0%	13	13	22	76	0%
Chloride	400*	13	24	32	44	0%	13	22	28	66	0%
Dissolved Calcium	-	13	4	5	6	-	13	2	3	15	-
Dissolved Magnesium	-	13	5	6	8	-	13	3	4	12	-
Dissolved Potassium	-	13	3	3	5	-	13	2	4	8	-
Dissolved Sodium	300*	13	20	24	36	0%	13	15	20	42	0%
Dissolved Aluminium	0.055†	13	<0.01	0.06	0.23	54%	13	<0.01	0.02	0.21	23%
Dissolved Arsenic	0.024†	13	<0.001	<0.001	<0.001	0%	13	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	13	0.01	0.01	0.02	0%	13	0.01	0.01	0.035	0%
Dissolved Copper	0.0014†	13	<0.001	<0.001	0.002	8%	13	<0.001	<0.001	0.003	8%
Dissolved Iron	0.3*	12	0.13	0.33	0.82	58%	12	0.07	0.23	0.79	33%
Dissolved Lead	0.0034†	13	<0.001	<0.001	<0.001	0%	13	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	13	<0.001	<0.001	0.005	-	13	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	13	0.01	0.02	0.02	0%	13	0.00	0.01	0.07	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT12-QLa and TT13-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT12-QLa					TT13-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	13	<0.001	<0.001	<0.001	0%	13	<0.001	<0.001	<0.001	0%
Dissolved Selenium	0.011†	13	<0.01	<0.01	<0.01	0%	13	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	13	0.03	0.03	0.05	-	13	0.02	0.02	0.09	-
Dissolved Zinc	0.008†	13	<0.005	<0.005	0.012	8%	13	<0.005	<0.005	0.007	0%
Total Aluminium	0.055†	13	0.08	0.14	0.39	100%	13	0.06	0.09	0.49	100%
Total Arsenic	0.024†	13	<0.001	<0.001	<0.001	0%	13	<0.001	<0.001	<0.001	0%
Total Barium	1*	13	0.01	0.01	0.02	0%	13	0.007	0.01	0.04	0%
Total Cadmium	0.0002†	3	<0	-	<0	0%	3	<0	-	<0	0%
Total Copper	0.0014†	13	<0.001	<0.001	0.049	15%	13	<0.001	<0.001	<0.001	0%
Total Iron	0.3*	13	0.27	0.79	1.24	85%	13	0.22	0.48	1.3	77%
Total Lead	0.0034†	13	<0.001	<0.001	0.003	0%	13	<0.001	<0.001	<0.001	0%
Total Lithium	-	13	<0.001	<0.001	0.004	-	13	<0.001	<0.001	<0.001	-
Total Manganese	1.9†	13	0.01	0.01	0.03	0%	13	0.00	0.01	0.072	0%
Total Nickel	0.011†	13	<0.001	<0.001	0.002	0%	13	<0.001	<0.001	<0.001	0%
Total Selenium	0.011†	13	<0.01	<0.01	<0.01	0%	13	<0.01	<0.01	<0.01	0%
Total Strontium	-	13	0.03	0.03	0.05	-	13	0.02	0.02	0.10	-
Total Zinc	0.008†	13	<0.005	<0.005	0.040	15%	13	<0.005	<0.005	0.01	8%
Nitrogen Oxides	0.015‡	13	<0.01	0.07	0.13	92%	13	<0.01	<0.01	0.06	38%
Total Nitrogen	0.25‡	13	<0.1	0.40	0.80	85%	13	<0.10	0.20	0.70	23%
Total Phosphorus	0.02‡	13	<0.01	0.02	0.05	15%	13	<0.01	<0.01	0.06	31%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT14-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT14-QLa				
		No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	14	6.59	7.25	7.62	0%
Lab pH	6.5 - 8‡	13	6.13	6.88	7.93	23%
Field EC (µS/cm)	350‡	14	167.2	196.8	384	7%
Lab EC (µS/cm)	350‡	13	155	195	383	8%
Field DO	-	14	9.07	10.26	109.3	-
Sulphate as Turbidimetric SO_4	400*	13	6	8	9	0%
Total Alkalinity as $CaCO_3$	500*	13	27	43	89	0%
Chloride	400*	13	24	34	61	0%
Dissolved Calcium	-	13	4	5	14	-
Dissolved Magnesium	-	13	5	5	9	-
Dissolved Potassium	-	13	3	4	6	-
Dissolved Sodium	300*	13	18	24	52	0%
Dissolved Aluminium	0.055†	13	<0.01	0.05	0.25	38%
Dissolved Arsenic	0.024†	13	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	13	0.01	0.02	0.07	0%
Dissolved Copper	0.0014†	13	<0.001	<0.001	<0.001	0%
Dissolved Iron	0.3*	12	0.10	0.39	0.61	75%
Dissolved Lead	0.0034†	13	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	13	<0.001	0.002	0.007	-
Dissolved Manganese	1.9†	13	0.008	0.022	0.063	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Teatree Hollow (TT14-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	TT14-QLa				
		No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	13	<0.001	<0.001	0.002	0%
Dissolved Selenium	0.011†	13	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	13	0.024	0.03	0.086	-
Dissolved Zinc	0.008†	13	<0.005	<0.005	0.006	0%
Total Aluminium	0.055†	13	0.04	0.18	0.49	92%
Total Arsenic	0.024†	13	<0.001	<0.001	<0.001	0%
Total Barium	1*	13	0.01	0.02	0.08	0%
Total Cadmium	0.0002†	3	<0	-	<0	0%
Total Copper	0.0014†	13	<0.001	<0.001	0.027	15%
Total Iron	0.3*	13	0.35	0.79	1.02	100%
Total Lead	0.0034†	13	<0.001	<0.001	<0.001	0%
Total Lithium	-	13	<0.001	<0.001	0.008	-
Total Manganese	1.9†	13	0.01	0.024	0.064	0%
Total Nickel	0.011†	13	<0.001	<0.001	0.004	0%
Total Selenium	0.011†	13	<0.01	<0.01	<0.01	0%
Total Strontium	-	13	0.02	0.04	0.09	-
Total Zinc	0.008†	13	<0.005	<0.005	0.022	23%
Nitrogen Oxides	0.015‡	13	<0.01	0.04	0.06	62%
Total Nitrogen	0.25‡	13	<0.1	0.20	0.60	46%
Total Phosphorus	0.02‡	13	<0.01	<0.01	0.04	15%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC1-QLa and HC2-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC1-QLa					HC2-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	63	6.27	6.83	8.14	14%	60	5.91	6.485	8.63	57%
Lab pH	6.5 - 8‡	54	5.72	6.79	7.22	24%	51	5.46	6.26	7.81	90%
Field EC (µS/cm)	350‡	63	137.9	239.3	350	0%	60	61.7	153.3	339	0%
Lab EC (µS/cm)	350‡	54	1	230	331	0%	51	62	154	449	2%
Field DO	-	63	1.34	7.69	97.2	-	60	0.17	9.38	99.8	-
Sulphate as Turbidimetric SO_4	400*	53	<1	11	35	0%	50	<2	<3	26	0%
Total Alkalinity as $CaCO_3$	500*	54	<1	29.5	56	0%	51	2	6	148	0%
Chloride	400*	53	1	43	78	0%	50	14	36	70	0%
Dissolved Calcium	-	54	1	7	18	-	51	1	1	37	-
Dissolved Magnesium	-	54	1	5	9	-	51	1	3	20	-
Dissolved Potassium	-	54	1	4	7	-	51	1	1	12	-
Dissolved Sodium	300*	54	1	24.5	36	0%	51	10	21	35	0%
Dissolved Aluminium	0.055†	54	<0.01	0.04	0.56	37%	51	<0.01	0.03	0.25	27%
Dissolved Arsenic	0.024†	55	<0.001	<0.001	0.002	0%	52	<0.001	<0.001	0.002	0%
Dissolved Barium	1*	53	0.00	0.02	0.07	0%	50	0.01	0.04	0.091	0%
Dissolved Copper	0.0014†	55	<0.001	<0.001	0.003	16%	52	<0.001	<0.001	0.003	4%
Dissolved Iron	0.3*	54	<0.05	0.42	2.22	70%	51	<0.05	0.14	0.5	14%
Dissolved Lead	0.0034†	55	<0.001	<0.001	<0.001	0%	52	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	32	<0.001	<0.001	0.002	-	32	<0.001	<0.001	0.002	-
Dissolved Manganese	1.9†	54	0.00	0.13	1.30	0%	51	0.02	0.07	1.07	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC1-QLa and HC2-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC1-QLa					HC2-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	55	<0.001	<0.001	0.007	0%	52	<0.001	<0.001	0.002	0%
Dissolved Selenium	0.011†	55	<0.01	<0.01	<0.01	0%	52	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	54	0.00	0.04	0.14	-	51	0.00	0.01	0.47	-
Dissolved Zinc	0.008†	55	<0.005	<0.005	0.023	16%	51	<0.005	0.007	0.02	45%
Total Aluminium	0.055†	54	<0.01	0.15	1.74	91%	51	<0.01	0.1	1.1	86%
Total Arsenic	0.024†	55	<0.001	<0.001	0.002	0%	52	<0.001	<0.001	0.002	0%
Total Barium	1*	53	0.00	0.03	0.06	0%	50	0.008	0.04	0.09	0%
Total Cadmium	0.0002†	8	<0	<0	<0	0%	7	<0	<0	<0	0%
Total Copper	0.0014†	55	<0.001	<0.001	0.009	24%	52	<0.001	<0.001	0.002	6%
Total Iron	0.3*	54	<0.05	1.45	5.64	96%	51	0.09	0.41	1.41	61%
Total Lead	0.0034†	55	<0.001	<0.001	0.002	0%	52	<0.001	<0.001	<0.001	0%
Total Lithium	-	55	<0.001	<0.001	0.004	-	52	<0.001	<0.001	<0.001	-
Total Manganese	1.9†	54	0.00	0.15	1.10	0%	51	0.02	0.07	1.25	0%
Total Nickel	0.011†	55	<0.001	<0.001	0.007	0%	52	<0.001	<0.001	0.007	0%
Total Selenium	0.011†	55	<0.01	<0.01	<0.01	0%	52	<0.01	<0.01	<0.01	0%
Total Strontium	-	54	0.00	0.04	0.14	-	51	0.00	0.01	0.48	-
Total Zinc	0.008†	55	<0.005	0.007	0.033	35%	51	<0.005	0.011	0.044	59%
Nitrogen Oxides	0.015‡	53	<0.01	0.10	1.98	75%	51	<0.01	0.03	0.45	63%
Total Nitrogen	0.25‡	54	<0.1	0.50	2.70	89%	51	<0.10	0.20	3.00	41%
Total Phosphorus	0.02‡	54	<0.01	0.03	0.34	63%	51	<0.01	<0.01	0.18	18%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC3-QLa and HC4-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC3-QRLa					HC4-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	65	6.27	7.06	8.22	6%	64	6.67	7.415	8.44	8%
Lab pH	6.5 - 8‡	56	5.73	6.74	7.39	32%	54	5.8	6.675	7.5	28%
Field EC (µS/cm)	350‡	65	89.6	209	306	0%	64	113.7	239.95	536	14%
Lab EC (µS/cm)	350‡	56	111	201	293	0%	54	109	239	436	9%
Field DO	-	65	0.69	9.47	102.7	-	64	1.25	10.065	102.1	-
Sulphate as Turbidimetric SO_4	400*	54	<3	8	25	0%	52	<1	9	31	0%
Total Alkalinity as $CaCO_3$	500*	55	8	23	57	0%	53	3	20	66	0%
Chloride	400*	54	16	36.5	65	0%	52	21	47.5	128	0%
Dissolved Calcium	-	55	2	5	14	-	53	2	6	16	-
Dissolved Magnesium	-	55	3	4	7	-	53	2	6	12	-
Dissolved Potassium	-	55	1	3	6	-	53	1	3	9	-
Dissolved Sodium	300*	55	12	22	33	0%	53	14	28	56	0%
Dissolved Aluminium	0.055†	55	<0.01	0.06	0.49	53%	53	<0.01	0.03	0.48	38%
Dissolved Arsenic	0.024†	56	<0.001	<0.001	<0.001	0%	54	<0.001	<0.001	0.002	0%
Dissolved Barium	1*	54	0.01	0.02	0.03	0%	52	0.008	0.022	0.074	0%
Dissolved Copper	0.0014†	56	<0.001	<0.001	0.002	14%	54	<0.001	<0.001	0.003	13%
Dissolved Iron	0.3*	55	0.06	0.32	1.36	53%	53	<0.05	0.33	2.78	53%
Dissolved Lead	0.0034†	56	<0.001	<0.001	<0.001	0%	54	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	32	<0.001	<0.001	<0.001	-	30	<0.001	<0.001	0.002	-
Dissolved Manganese	1.9†	55	0.01	0.05	0.34	0%	53	0.002	0.049	2.57	2%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC3-QLa and HC4-QRLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC3-QLa					HC4-QRLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	56	<0.001	<0.001	<0.001	0%	54	<0.001	<0.001	0.003	0%
Dissolved Selenium	0.011†	56	<0.01	<0.01	<0.01	0%	54	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	55	0.01	0.03	0.11	-	53	0.013	0.033	0.134	-
Dissolved Zinc	0.008†	56	<0.005	<0.005	0.017	7%	54	<0.005	<0.005	0.019	7%
Total Aluminium	0.055†	55	0.06	0.14	1.45	100%	53	<0.01	0.09	4.65	70%
Total Arsenic	0.024†	56	<0.001	<0.001	<0.001	0%	54	<0.001	<0.001	0.002	0%
Total Barium	1*	54	0.01	0.02	0.04	0%	52	0.01	0.0255	0.076	0%
Total Cadmium	0.0002†	7	<0	<0	<0	0%	8	<0	<0	<0	0%
Total Copper	0.0014†	56	<0.001	<0.001	0.004	16%	54	<0.001	<0.001	0.005	15%
Total Iron	0.3*	55	0.35	0.72	1.78	100%	53	0.14	0.86	5.01	91%
Total Lead	0.0034†	56	<0.001	<0.001	0.003	0%	54	<0.001	<0.001	0.005	2%
Total Lithium	-	56	<0.001	<0.001	<0.001	-	54	<0.001	<0.001	0.002	-
Total Manganese	1.9†	55	0.02	0.05	0.31	0%	53	0.009	0.061	2.31	2%
Total Nickel	0.011†	56	<0.001	<0.001	0.002	0%	54	<0.001	<0.001	0.004	0%
Total Selenium	0.011†	56	<0.01	<0.01	<0.01	0%	54	<0.01	<0.01	<0.01	0%
Total Strontium	-	55	0.02	0.03	0.11	-	53	0.017	0.035	0.142	-
Total Zinc	0.008†	56	<0.005	<0.005	0.05	18%	54	<0.005	<0.005	0.022	19%
Nitrogen Oxides	0.015‡	54	<0.01	0.08	1.13	83%	52	<0.01	0.06	1.57	77%
Total Nitrogen	0.25‡	55	<0.1	0.50	3.80	84%	53	<0.1	0.5	2.2	79%
Total Phosphorus	0.02‡	55	<0.01	0.02	0.11	40%	53	<0.01	0.02	0.19	40%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC9-QLa and HC13-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC9-QLa					HC13-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	68	3.14	6.83	8.37	37%	11	6.99	7.40	8.07	9%
Lab pH	6.5 - 8‡	60	4.02	6.54	7.35	43%	9	6.04	6.98	7.46	22%
Field EC (µS/cm)	350‡	68	113.4	240.6	694	22%	11	161.8	239.5	289.3	0%
Lab EC (µS/cm)	350‡	60	111	224	767	15%	9	166	237	268	0%
Field DO	-	68	1.61	9.405	102.6	-	11	7.2	9.43	11.4	-
Sulphate as Turbidimetric SO_4	400*	77	<2	8	26	0%	9	6	10	14	0%
Total Alkalinity as $CaCO_3$	500*	78	<1	20	65	0%	9	12	22	39	0%
Chloride	400*	77	16	49	250	0%	9	29	47	61	0%
Dissolved Calcium	-	78	2	5	17	-	9	4	7	10	-
Dissolved Magnesium	-	78	2	5	17	-	9	4	6	8	-
Dissolved Potassium	-	78	1	3	8	-	9	2	3	5	-
Dissolved Sodium	300*	78	13	29	96	0%	9	19	28	32	0%
Dissolved Aluminium	0.055†	59	<0.01	0.04	0.57	42%	9	<0.01	0.04	0.14	44%
Dissolved Arsenic	0.024†	60	<0.001	<0.001	<0.001	0%	9	<0.001	<0.001	<0.001	0%
Dissolved Barium	1*	58	0.01	0.03	0.23	0%	9	0.01	0.02	0.03	0%
Dissolved Copper	0.0014†	60	<0.001	<0.001	0.004	20%	9	<0.001	<0.001	<0.001	0%
Dissolved Iron	0.3*	60	0.23	0.66	13.4	90%	9	<0.05	0.42	2.71	56%
Dissolved Lead	0.0034†	60	<0.001	<0.001	<0.001	0%	9	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	32	<0.001	<0.001	0.004	-	9	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	60	0.01	0.09	2.28	5%	9	0.014	0.033	0.264	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC9-QLa and HC13-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC9-QLa					HC13-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	60	<0.001	<0.001	0.02	10%	9	<0.001	<0.001	<0.001	0%
Dissolved Selenium	0.011†	60	<0.01	<0.01	<0.01	0%	9	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	59	0.01	0.03	0.14	-	9	0.024	0.04	0.046	-
Dissolved Zinc	0.008†	60	<0.005	0.008	0.083	42%	9	<0.005	<0.005	0.012	11%
Total Aluminium	0.055†	78	<0.01	0.11	2.55	81%	9	0.03	0.19	0.62	78%
Total Arsenic	0.024†	79	<0.001	<0.001	0.01	0%	9	<0.001	<0.001	<0.001	0%
Total Barium	1*	77	0.01	0.03	0.25	0%	9	0.02	0.02	0.04	0%
Total Cadmium	0.0002†	26	<0	0.0001	0.0001	0%	0	-	-	-	-
Total Copper	0.0014†	79	<0.001	<0.001	0.017	32%	9	<0.001	<0.001	<0.001	0%
Total Iron	0.3*	78	0.4	1.54	25.80	100%	9	0.30	0.84	3.26	89%
Total Lead	0.0034†	79	<0.001	<0.001	0.004	3%	9	<0.001	<0.001	<0.001	0%
Total Lithium	-	79	<0.001	<0.001	0.009	-	9	<0.001	<0.001	<0.001	-
Total Manganese	1.9†	78	0.02	0.09	2.53	8%	9	0.024	0.036	0.314	0%
Total Nickel	0.011†	79	<0.001	<0.001	0.023	16%	9	<0.001	<0.001	0.002	0%
Total Selenium	0.011†	79	<0.01	<0.01	<0.01	0%	9	<0.01	<0.01	<0.01	0%
Total Strontium	-	78	0.02	0.03	0.13	-	9	0.03	0.04	0.05	-
Total Zinc	0.008†	79	<0.005	0.009	0.172	56%	9	<0.005	<0.005	0.007	0%
Nitrogen Oxides	0.015‡	77	<0.01	0.08	2.88	83%	9	<0.01	0.09	1.19	89%
Total Nitrogen	0.25‡	78	<0.1	0.40	3.60	76%	9	0.30	0.60	1.80	100%
Total Phosphorus	0.02‡	78	<0.01	0.02	0.16	38%	9	<0.01	0.02	0.07	44%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC15-QLa and HC17-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC15-QLa					HC17-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	11	6.85	7.16	7.56	0%	66	5.67	6.875	8.47	14%
Lab pH	6.5 - 8‡	9	6.06	6.91	7.43	22%	60	5.58	6.605	7.2	35%
Field EC (µS/cm)	350‡	11	159.6	238.5	295	0%	66	85.9	186.55	401	8%
Lab EC (µS/cm)	350‡	9	163	238	286	0%	60	1	187	478	7%
Field DO	-	11	6.26	9.57	100.28	-	66	0.27	9.655	103.5	-
Sulphate as Turbidimetric SO_4	400*	9	6	10	13	0%	59	<4	8	53	0%
Total Alkalinity as $CaCO_3$	500*	9	16	21	38	0%	60	5	13.5	82	0%
Chloride	400*	9	28	47	74	0%	59	15	40	109	0%
Dissolved Calcium	-	9	5	7	10	-	60	2	4	23	-
Dissolved Magnesium	-	9	4	6	9	-	60	2	4	16	-
Dissolved Potassium	-	9	2	3	5	-	60	1	3	15	-
Dissolved Sodium	300*	9	19	28	36	0%	60	11	22	43	0%
Dissolved Aluminium	0.055†	9	<0.01	0.02	0.12	44%	60	<0.01	0.06	0.88	55%
Dissolved Arsenic	0.024†	9	<0.001	<0.001	<0.001	0%	61	<0.001	<0.001	0.004	0%
Dissolved Barium	1*	9	0.012	0.019	0.037	0%	59	0.00	0.01	0.07	0%
Dissolved Copper	0.0014†	9	<0.001	<0.001	<0.001	0%	61	<0.001	<0.001	0.006	11%
Dissolved Iron	0.3*	9	0.07	0.38	2.42	78%	60	0.07	0.275	1.84	42%
Dissolved Lead	0.0034†	9	<0.001	<0.001	<0.001	0%	60	<0.001	<0.001	<0.001	0%
Dissolved Lithium	-	9	<0.001	<0.001	<0.001	-	32	<0.001	<0.001	0.003	-
Dissolved Manganese	1.9†	9	0.012	0.025	0.278	0%	60	0.02	0.06	1.61	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Hornes Creek (HC15-QLa and HC17-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	HC15-QLa					HC17-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	9	<0.001	<0.001	0.002	0%	61	<0.001	<0.001	0.005	0%
Dissolved Selenium	0.011†	9	<0.01	<0.01	<0.01	0%	61	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	9	0.023	0.037	0.047	-	60	0.01	0.02	0.21	-
Dissolved Zinc	0.008†	9	<0.005	<0.005	0.02	22%	60	<0.005	<0.005	0.253	35%
Total Aluminium	0.055†	9	0.04	0.09	0.67	78%	60	0.03	0.195	2.51	95%
Total Arsenic	0.024†	9	<0.001	<0.001	<0.001	0%	61	<0.001	<0.001	0.005	0%
Total Barium	1*	9	0.016	0.022	0.038	0%	59	0.01	0.01	0.07	0%
Total Cadmium	0.0002†	0	-	-	-	-	8	<0	<0	<0	0%
Total Copper	0.0014†	9	<0.001	<0.001	0.002	11%	61	<0.001	<0.001	0.014	23%
Total Iron	0.3*	9	0.36	0.98	2.91	100%	60	0.23	0.70	4.24	95%
Total Lead	0.0034†	9	<0.001	<0.001	<0.001	0%	61	<0.001	<0.001	0.003	0%
Total Lithium	-	9	<0.001	<0.001	<0.001	-	61	<0.001	<0.001	0.006	-
Total Manganese	1.9†	9	0.022	0.044	0.28	0%	60	0.02	0.07	1.53	0%
Total Nickel	0.011†	9	<0.001	<0.001	0.002	0%	61	<0.001	<0.001	0.006	0%
Total Selenium	0.011†	9	<0.01	<0.01	<0.01	0%	61	<0.01	<0.01	<0.01	0%
Total Strontium	-	9	0.024	0.04	0.054	-	60	0.01	0.03	0.22	-
Total Zinc	0.008†	9	<0.005	<0.005	0.032	33%	60	<0.005	0.008	0.263	42%
Nitrogen Oxides	0.015‡	9	0.03	0.1	0.46	100%	59	<0.01	0.1	5.26	86%
Total Nitrogen	0.25‡	9	0.4	0.6	1	100%	60	<0.1	0.40	6.60	73%
Total Phosphorus	0.02‡	9	<0.01	0.02	0.08	33%	60	<0.01	0.04	1.38	57%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Dogtrap Creek (DT3-QLa and DT4-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	DT3-QLa					DT4-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Field pH	6.5 - 8‡	56	6.3	6.9	8.2	0%	51	6.4	7.2	8.3	4%
Lab pH	6.5 - 8‡	49	5.8	6.8	7.5	16%	44	5.6	7.0	7.7	9%
Field EC (µS/cm)	350‡	56	76	178.5	283.5	0%	51	155	281.1	385.4	6%
Lab EC (µS/cm)	350‡	49	82	167	238	0%	44	154	266	373	7%
Field DO	-	56	2.6	8.4	94.0	-	51	2.7	8.7	94.6	-
Sulphate as Turbidimetric SO_4	400*	49	<1	<5	25	0%	44	<3	12	32	0%
Total Alkalinity as $CaCO_3$	500*	49	10	34	68	0%	44	24	50.5	92	0%
Chloride	400*	49	14	28	40	0%	44	22	41	80	0%
Dissolved Calcium	-	49	2	6	10	2%	44	6	12	18	2%
Dissolved Magnesium	-	49	2	4	8	-	44	4	6	10	-
Dissolved Potassium	-	49	2	5	8	-	44	3	5	7	-
Dissolved Sodium	300*	49	8	19	27	0%	44	17	28	43	0%
Dissolved Aluminium	0.055†	49	<0.01	0.03	0.7	31%	44	<0.01	0.09	1.57	57%
Dissolved Arsenic	0.024†	50	<0.001	<0.001	0.01	0%	45	<0.001	<0.001	0.002	0%
Dissolved Barium	1*	49	0.01	0.02	0.03	0%	44	0.01	0.03	0.04	0%
Dissolved Copper	0.0014†	50	<0.001	<0.001	0.003	4%	45	<0.001	<0.001	0.004	18%
Dissolved Iron	0.3*	49	<0.05	0.31	1.43	57%	44	0.06	0.35	2.12	61%
Dissolved Lead	0.0034†	50	<0.001	<0.001	<0.001	0%	45	<0.001	<0.001	0.002	0%
Dissolved Lithium	-	30	<0.001	<0.001	<0.001	-	24	<0.001	<0.001	<0.001	-
Dissolved Manganese	1.9†	49	0.00	0.02	0.36	0%	44	0.00	0.03	0.21	0%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

Dogtrap Creek (DT3-QLa and DT4-QLa) Water Quality Summary

Parameter (mg/L unless otherwise stated)	Guideline Value	DT3-QLa					DT4-QLa				
		No. Samples	Min	Median	Max	% Exceedance	No. Samples	Min	Median	Max	% Exceedance
Dissolved Nickel	0.011†	50	<0.001	<0.001	<0.001	0%	45	<0.001	<0.001	0.002	0%
Dissolved Selenium	0.011†	50	<0.01	<0.01	<0.01	0%	44	<0.01	<0.01	<0.01	0%
Dissolved Strontium	-	49	0.02	0.05	0.09	-	44	0.04	0.08	0.11	-
Dissolved Zinc	0.008†	50	<0.005	<0.005	0.061	16%	45	<0.005	<0.005	0.06	20%
Total Aluminium	0.055†	49	<0.01	0.12	0.79	90%	44	0.03	0.26	1.05	95%
Total Arsenic	0.024†	50	<0.001	<0.001	0.01	0%	45	<0.001	<0.001	<0.001	0%
Total Barium	1*	49	0.01	0.02	0.03	0%	44	0.02	0.03	0.04	0%
Total Cadmium	0.0002†	6	<0	<0	<0	0%	4	<0	-	<0	0%
Total Copper	0.0014†	50	<0.001	<0.001	0.004	22%	45	<0.001	<0.001	0.004	38%
Total Iron	0.3*	49	0.12	0.65	4.07	82%	44	0.2	0.87	4.15	93%
Total Lead	0.0034†	50	<0.001	<0.001	0.002	0%	45	<0.001	<0.001	0.002	0%
Total Lithium	-	50	<0.001	<0.001	<0.001	-	45	<0.001	<0.001	<0.001	-
Total Manganese	1.9†	49	0.00	0.02	0.39	0%	44	0.01	0.04	0.57	0%
Total Nickel	0.011†	50	<0.001	<0.001	0.004	0%	45	<0.001	<0.001	0.002	0%
Total Selenium	0.011†	50	<0.01	<0.01	<0.01	0%	44	<0.01	<0.01	<0.01	0%
Total Strontium	-	49	0.02	0.05	0.09	-	44	0.04	0.08	0.11	-
Total Zinc	0.008†	50	<0.005	<0.005	0.06	24%	45	<0.005	0.007	0.06	40%
Nitrogen Oxides	0.015‡	48	<0.01	0.02	0.56	54%	44	<0.01	0.06	2.98	82%
Total Nitrogen	0.25‡	48	<0.10	0.40	1.7	77%	44	<0.10	0.80	3.6	95%
Total Phosphorus	0.02‡	48	<0.01	0.02	0.09	29%	44	<0.01	0.04	0.18	66%

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) – the default guideline value relates to the total concentration of a constituent although should also be compared with the dissolved concentration which represents the bioavailable fraction; ‡ ANZECC (2000) default guideline value for Upland Rivers in NSW; * ANZECC (2000) water quality guideline value for recreational purposes.

APPENDIX D – Groundwater Impact Assessment

APPENDIX E – Remediation Progress Review Report