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MEMBER OF



GROUNDWATER MANAGEMENT PLAN

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. Underground workings extend north under the town of Tahmoor and Picton with two ventilation shafts being located on the outskirts of town. 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.

Tahmoor Mine surface facilities are situated in between the townships of Tahmoor and Bargo, and adjacent to Remembrance Drive on land owned by Tahmoor Coal with mining conducted under both crown and freehold property (see Figure 1). Surface facilities at Tahmoor Mine include administration buildings and offices, a materials store, diesel tanks, electrical workshop, mechanical workshop, bathhouse, water storage tanks, ventilation fan, CHPP, storage areas, run of mine (RoM) stockpile and product stockpiles. A third party owned power station is also located on-site and utilises methane from the mines' gas drainage system to produce electricity.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to gain approval for the Tahmoor South Coal Project (the Project), which involves use of the existing surface infrastructure and the expansion of underground longwall mining to the south of the existing workings (referred to as the Tahmoor South Domain). Tahmoor Coal subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020). In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) for the extraction of up to 4 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

Modification 1 to SSD 8445 (MOD 1), approved in July 2022, sought to extend the commissioning date of the Water Treatment Plant. Modification 2 to SSD 8445 (MOD 2), approved in June 2023, proposed the underground storage of brine in the historical Tahmoor North Western Domain mining area and the temporary storage of excess mine water in the historical Tahmoor North mining area.

1.2 Purpose

The purpose of this Groundwater 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 groundwater management at Tahmoor Coal. The plan ensures that impacts on the community are minimised and managed within a structured framework.

This plan is to ensure compliance with Development Consent (SDD 8445) (the Consent) **Condition B34, Schedule 2**.

1.3 Scope

This Groundwater Management Plan includes management measures and monitoring requirements relating to:

- a) **Planning;**
- b) **Stakeholder Consultation;**
- c) **Environmental Management and Monitoring;**
- d) **Implementation and Reporting;**
- e) **Review and Improvement;**
- f) **Document Information; and**
- g) **Change Information.**

The Groundwater Management Plan applies to all activities associated with Tahmoor Coal and forms part of the Environmental Management System (EMS).

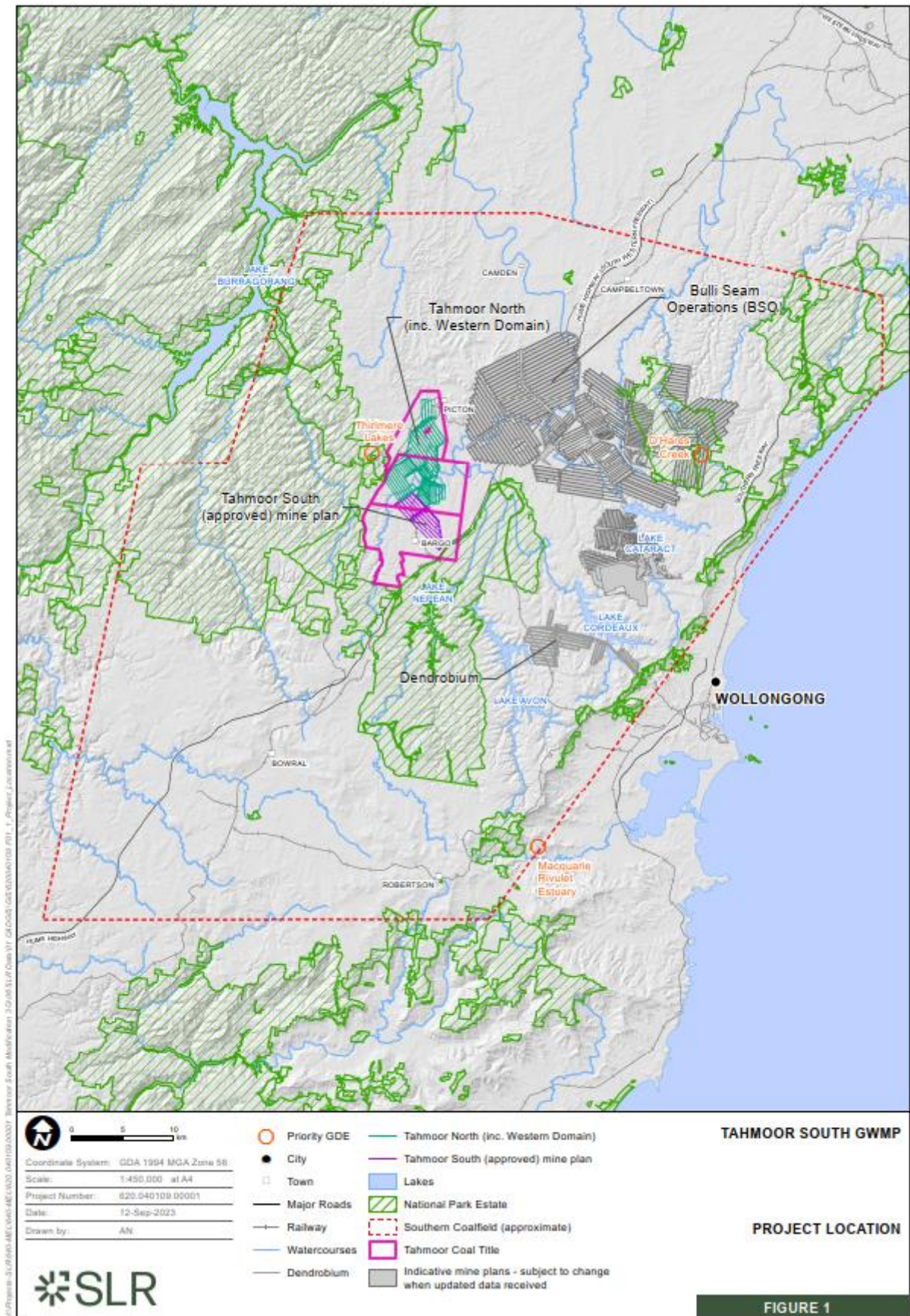


Figure 1 Tahmoor Coal Site Location

2 Planning

2.1 Statutory Requirements and Legislation

2.1.1 Relevant Legislation and Policy

2.1.1.1 Water Management Act 2000

The *Water Management Act 2000* is the regulatory framework for the management and control of water use within NSW. In conjunction with the *Water Act 1912*, it governs the licensing of water to users. In addition, the *Water Management Act 2000* allows for the development and implementation of Water Sharing Plans (WSPs). WSPs regulate the trade and sharing of surface and groundwaters between competing needs and users throughout NSW.

2.1.1.1.1 RELEVANT WATER SHARING PLANS AND GROUNDWATER MANAGEMENT AREAS

Tahmoor Mine currently extracts groundwater that drains into underground mine workings and pumps this water to the surface via three dewatering lines before treating the water and discharging it off site.

Tahmoor Mine falls within the 'Greater Metropolitan Region Groundwater Sources' WSP (NOW, 2011b), which commenced in 2011. **Figure 2** indicates the extent of this WSP, along with the various groundwater sources in this region that are regulated by the WSP. A WSP is used to manage the average long-term annual volume of water extracted from a given groundwater source. The relevant Groundwater Source for the Tahmoor Mine is:

- Sydney Basin Nepean Sandstone.

Other relevant Groundwater Sources include:

- Sydney Basin – Central, located 10 km to the east and north-east.
- Sydney Basin – South, located 15-20 km east and south-east; and
- Goulburn GMA - located over 25 km to the west and south.

The Sydney Basin – Nepean Sandstone Groundwater Source is further subdivided into Management Zones (MZ), as shown using hatching on **Figure 2**. The Tahmoor South domain (CCL 747) is located within the **Nepean Management Zone 2**, while Zone 1 covers the southern 'third' of the Groundwater Source as well as a smaller area to the west of Camden – these are both at least 10 km from the Tahmoor South Domain.

The Nepean Sandstone Groundwater Source has an annual limit on entitlement (LTAAEL) of 99,568 ML (NOW, 2011a), while current entitlement is 31,346 ML (based on the WaterNSW Water Register 2020-2021 water year).

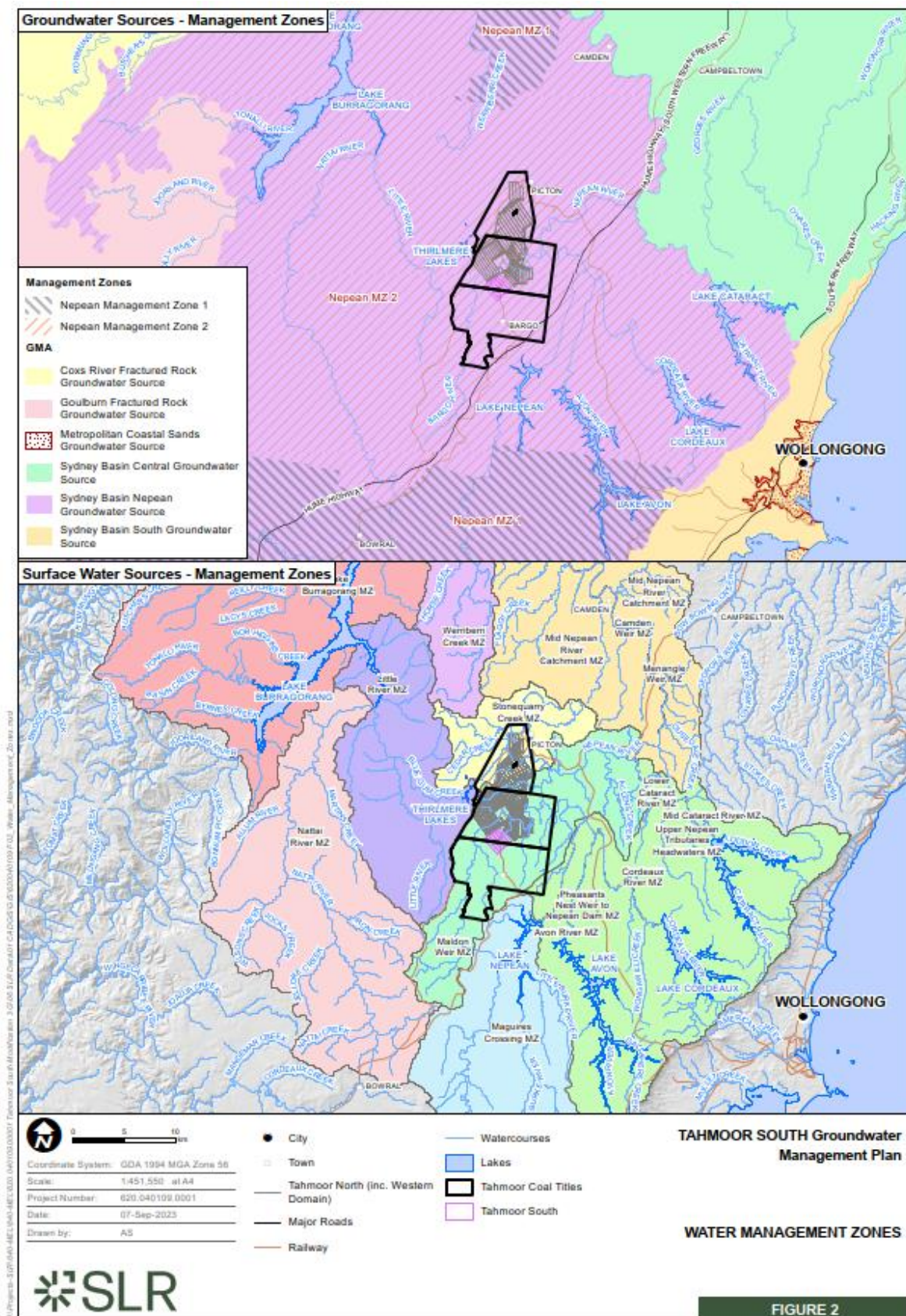


Figure 2 Relevant WSPs and Groundwater Management Areas

2.1.1.2 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (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 (NSW Government, 2012).

Underground mining generally requires the dewatering of the geological strata. In accordance with the 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 conducted.

The AIP requires an estimation of "all quantities of water that are likely to be taken from any water source during and following cessation of the activity and all predicted impacts associated with that activity". Water take and impact estimation is to be based on a "complex modelling platform" for any mining activity not subject to the Gateway process, where the model makes use of the "available baseline data that has been collected at an appropriate frequency and scale and over a sufficient period of time to incorporate typical temporal variations".

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 separate 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. Tahmoor Mine is located within the 'Highly Productive' Hawkesbury Sandstone aquifer. The Hawkesbury Sandstone aquifer is the most utilised aquifer in this region. Water sourced from the underlying Narrabeen Group and Permian Coal Measures comprises the remaining portion of water sourced around Tahmoor Mine (HydroSimulations, 2018).

It should be noted that the categorisation of groundwater source productivity does not make any vertical distinction of aquifer productivity. This is relevant as the higher yielding Hawkesbury Sandstone aquifer overlies the lower-yielding Narrabeen Group/Permian Coal Measures groundwater systems which are at greater depths.

2.1.2 Development Consent Conditions

The requirement for this groundwater management plan is established by Condition B34 (v) under Schedule 1 of the Consent. **Table 1** outlines the requirements under this condition and identifies where these requirements have been addressed.

Table 1 Development Consent Conditions

Condition Reference	Condition	Where Addressed
B34	Prior to the commencement of construction activities, the Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must: Groundwater Management Plan that includes: • detailed baseline data regarding groundwater levels, yield and quality for privately-owned groundwater bores (as required under condition B25(a)) and the condition of GDEs (including Thirlmere Lakes) potentially impacted by the development; • a program to periodically review and update data regarding groundwater levels, yield and quality at privately-owned groundwater bores in the vicinity of the development, including any bores potentially impacted by cumulative groundwater drawdown; • a detailed description of the groundwater management system, including commitments to: ○ install an additional monitoring bore in the footprint of Tahmoor North to monitor post-mining groundwater level and quality; ○ install additional monitoring bores (minimum of four) at or near the Thirlmere Lakes; ○ install bores above the initial longwalls to define profile fracturing and depressurisation in the Hawkesbury Sandstone and Bulgo Sandstone; ○ monitor shallow groundwater within the Hawkesbury Sandstone; ○ monitor volumetric take (mine inflow), including inflows to the underground mine; and ○ regularly review the monitoring program to ensure robust and reliable monitoring is undertaken, including reviewing the performance of vibrating wire piezometers; • groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts (or trends) associated with the development, on: ○ regional and local aquifers (alluvial and hard rock); and ○ groundwater supply for other users such as licensed privately-owned groundwater bores; • uncertainty analysis of the potential impacts of mining the proposed longwalls on the water levels in Thirlmere Lakes, based upon results from the current Thirlmere Lakes Research Program and other ongoing monitoring and investigations; • a program to monitor and evaluate:	Section 4.1 Section 4.3.2 Section 4.3 and Appendix B Section 4.3.3 Section 4.3.5 Section 4.4.1, Appendix G Section 4.2 and Appendix E, Appendix G

	○ compliance with the relevant performance measures listed in Table 4 (of the commitments) and the performance criteria of this plan; ○ water loss/seepage from water storages into the groundwater system; ○ groundwater inflows, outflows and storage volumes, to inform the Site Water Balance; ○ impacts on water supply for other water users; ○ impacts on GDEs (including Thirlmere Lakes); ○ the hydrogeological setting of any nearby alluvial aquifers and the likelihood of any indirect impacts from the development; and ○ the effectiveness of the groundwater management system; • reporting procedures for the results of the monitoring program, including notifying other water users, the NSW Office of Environment and Heritage and Thirlmere Lakes Research Program of any elevated results; • a trigger action response plan to respond to any exceedances of the relevant performance measures and groundwater performance criteria, and repair, mitigate and/or offset any adverse groundwater impacts of the development, including impacts on Thirlmere Lakes; • a Groundwater Modelling Plan that: ○ provides details for the future groundwater model re-build and recalibration which must be completed within 2 years of the commencement of development under this consent; ○ is independently third-party reviewed; ○ provides for the incorporation of the outcomes of the findings of the Thirlmere Lakes Research Program and other relevant research on the Thirlmere Lakes; ○ considers field data and the outcomes of subsidence monitoring; ○ provides for periodic validation and where necessary recalibration, of the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and • a plan to respond to any exceedances of the performance measures in Table 4.	Section 4.4.1 Section 4.1.9 and Appendix D Appendix B and Appendix G Section 4.2 Section 4.4.1 and Section 4.4.2 Section 4.4.1 and Appendix G Section 4.2, Appendix E and Appendix F Section 4.4.1 and Appendix D
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2.1.3 Management Plan Requirements

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

Table 2 Management Plan Requirements

Condition Reference	Condition	Where Addressed
E5	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	NA
(a)	a summary of relevant background or baseline data;	Section 4.1
(b)	details of:	NA
(b) (i)	the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 2.1
(b) (ii)	any relevant limits or performance measures and criteria; and	Section 4.4
(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 4.4
(c)	any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Section 2.1.2
(d)	a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Section 4.2
(e)	a program to monitor and report on the:	NA
(e) (i)	impacts and environmental performance of the development; and	Section 4.3
(e) (ii)	effectiveness of the management measures set out pursuant to condition E5(d);	Section 4.2.1
(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 4.4
(g)	a program to investigate and implement ways to improve the environmental performance of the development over time;	Sections 4.5 and 6
(h)	a protocol for managing and reporting any:	NA
(h) (i)	incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Sections 5.3, 5.4 and 5.5
(h) (ii)	complaint; or	Section 5.6
(h) (iii)	failure to comply with other statutory requirements;	Covered collectively within Sections 5.3, 5.4 and 5.5
(i)	public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 7.1
(j)	a protocol for periodic review of the plan.	Section 6

2.2 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.

EIS commitments relevant to this management plan are outlined in **Table 3**.

Table 3 EIS Commitments

EIS Reference	Commitment	Where Addressed
HR-9	Potential impact: Variation in salinity or contaminants of concern in the REA runoff Management and mitigation: Conduct surface water and groundwater monitoring during active placement of coal handling and preparation plant rejects.	Section 4.3.1.1, Appendix B and Appendix D
GW-6	Groundwater The mitigation measures outlined in Section 11.3.5 and Appendix I of the EIS prepared for the Project remain applicable to the Amended Project. Although, the revised Groundwater Assessment provides further detail regarding monitoring of groundwater during operation of the project, such that monitoring would include: - A condition assessment of bores and monitoring equipment (VMPs) of new bores around Tahmoor South, with a specific update of the GWMP; - Re-install at least one bore in the footprint of a Tahmoor North longwall (eg at TNC029) to monitor post-mining groundwater level and groundwater quality; and - Monitoring in longwall centre-lines of pre- and post-mining conditions Tahmoor South. This would be undertaken for the longwall (LW101A), 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.	4.1.5.1, Appendix B 4.3.1, Appendix B 4.3.1, Appendix B
PAR	Groundwater In addition to these measures, since exhibition of the EIS, Tahmoor Coal has installed a number of piezometers in and around Longwalls 31-32 and the Western Domain longwalls (in Tahmoor North) at the northern edge of the mine. These have already, and will in future, provide useful information for conceptualisation and model calibration/verification.	4.3.1, Appendix B, Appendix E and Appendix F

2.3 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 4**. A summary of other approvals and licences is provided in **Table 5**.

Table 4 Mining Lease

Lease	Title	Granted	Expires
CCL 716	Original Tahmoor Leases	15/06/1990	13/03/2042
CCL 747	Bargo Mining Lease	23/05/1990	06/11/2025
ML 1376	Tahmoor North Lease	28/08/1995	28/08/2043
ML 1308	Small Western lease to west of CCL716	02/03/1993	02/03/2035
ML1642	Pit-top and REA surface Mining Lease	27/08/2010	27/08/2031
ML 1539	Tahmoor North Extensions Lease	16/06/2003	16/06/2024

Table 5 Approvals/Licences

Approval Title / Description	Date Granted	Expiry Date
Environmental Protection Licence 1389	01/05/2012	No Expiry
WAL36442	6/12/2013	No Expiry
WAL25777	27/10/2014	No Expiry
WAL 43572	07/05/2021	No Expiry
WAL43656	01/08/2022	No Expiry
SWC839757	10/07/2023	No Expiry

3 Stakeholder Consultation

3.1 Internal Stakeholder Communication

Internal stakeholders include employees, contractors and visitors of Tahmoor Coal. *TAH-HSEC-00119- Communication and Engagement Procedure* has been developed to include the following:

- a) Methods of communication between internal stakeholders;
- b) Types of information that is communicated between internal stakeholders;
- c) Responsibilities for communication of information to internal stakeholders; and
- d) Review of communication methods, including the consideration of feedback to / from internal stakeholders.

3.2 External Stakeholder Communication

External stakeholders include neighbours and the local / regional community, local council, state and federal government agencies and regulators, and press / media. Any external communications relating to groundwater will be conducted in accordance with Tahmoor Coal's standard communications procedures. External stakeholders are identified within the following documents:

- *TAH-HSEC-00031- Community Development Plan; and*
- *TAH-HSEC-00039 – Stakeholder Engagement Plan.*

External stakeholder communication is undertaken in accordance with:

- *TAH-HSEC-00039– Stakeholder Engagement Plan; and*
- *TAH-HSEC-00119- Communication and Engagement Procedure.*

These documents include information on the following topics:

- a) Methods of communication to external stakeholders.
- b) Types of information that is communicated between external stakeholders.
- c) Responsibilities for communication of information to external stakeholders.
- d) Review of communication methods, including the consideration of feedback to / from external stakeholders.

A key objective of *TAH-HSEC-00119 - Communication and Engagement Procedure* is to maintain positive relationships established with the local community and other external stakeholders.

3.3 Consultation to Date

A draft version of this management plan was distributed to the following stakeholders for review and feedback:

- a) Natural Resource Access Regulator (NRAR)**
- b) Department of Planning, Infrastructure and Environment (DPIE) Water**
- c) EPA**

The feedback provided by stakeholders is summarised within **Table 6** below.

Table 6 Consultation to Date

Consulted Parties	Consultation Conducted	Outcomes of Consultation
EPA	Draft plan provided for comment on 16/11/2021. Feedback on draft plan received on 29/11/2021.	Comments reviewed and addressed in Appendix E.
DPIE Water	Draft plan provided for comment on 16/11/2021. No comments on the plan have been received as of 25/03/2022. Feedback provided by DPIE Water via email on 03/04/2022 stated that DPIE Water would prefer to review the plan once it is in final draft form, with all required elements and supporting work and documents (including modelling) complete and available.	No comments required to be addressed.
NRAR	Draft plan provided for comment on 16/11/2021. No feedback received as of 25/03/2022.	No comments required to be addressed.

4 Environmental Management and Monitoring

4.1 Baseline Data

4.1.1 Geology

The geology around Tahmoor Mine comprises interbedded sandstones, siltstones, shales of the Triassic Wianamatta Group, Hawkesbury Sandstone and Narrabeen Group, and the interbedded sandstones, siltstones, and coal seams of the Permian Illawarra Coal Measures, and the Shoalhaven Group. Sill and dyke intrusions have been identified from surface mapping and drilling records.

4.1.2 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 *Nepean Sandstone 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 of the Narrabeen Group and the underlying Illawarra Coal Measures supply additional water to this system; however, contributions are substantially lower.

The extent of surficial units around Tahmoor Mine are presented in **Figure 3**. Generally, there is limited extent of alluvium in this region. Surficial exposure is dominated by the Hawkesbury Sandstone, with some capping via overlying Wianamatta Formation. The major units are described in the following sub-sections.

Alluvium

The alluvium is composed of two main units – the Thirlmere Lakes alluvium and the Quaternary to modern alluvium (**Figure 3**):

- The Thirlmere Lakes alluvium is Cretaceous in age and are positioned within a thin valley that forms the upper reaches of Blue Gum Creek to the west of Tahmoor Mine. It has been described as 'laterised alluvium' (Moffit, 1999) and is characterised by clayey sands and sandy clays with maximum thicknesses of 40 m to 60 m.
- The modern to Quaternary aged alluvium typically exists within watercourses in the northern regions of the mine lease. The main body of alluvium is located near the Western Domain i.e. along Stonequarry Creek downstream (east) of the Western Domain, extending downgradient to Picton.

Groundwater conditions are likely to be unconfined. Recharge to the alluvium is expected to be predominantly from rainfall, rainfall runoff and peak streamflow events (SLR, 2021).

There is no mapped alluvium adjacent to or above the Tahmoor South mine footprint.

Wianamatta Formation

Shale formations that have been largely eroded and are present as hill cappings overlying the Hawkesbury Sandstone. The shales have poor permeability and water quality, however, can lead to the development of springs in areas in contact with the Hawkesbury Sandstone (HydroSimulations, 2018).

Hawkesbury Sandstone

This unit forms a porous rock aquifer of moderate resource potential, tending to higher resource potential in areas where secondary porosity (jointing and fracturing) is more developed, such as in structural zones like the Lapstone Monocline/Nepean Fault zones (HS/SLR, 2020).

In the area of Tahmoor Mine, groundwater in this aquifer generally flows in a south to north-easterly direction, although there is evidence of a weak groundwater divide roughly in line with the western edge of the mine lease. This runs from around Mittagong in the south, through the Thirlmere Lakes area and to the north-west of Tahmoor North. From this divide groundwater flows either to the east and north-east, generally towards the Nepean River, or to the west draining to the Blue Gum Creek/Little River/Nattai River catchment (HS/SLR, 2020).

Hawkesbury Sandstone exhibits a range of salinities (fresh to saline) with a median value of approximately 500 mg/L (GeoTerra, 2013). Publicly available data from AGL's Camden Gas Project indicated an average total dissolved solid (TDS) of about 380 mg/L for Hawkesbury Sandstone groundwater (Parsons Brinckerhoff, 2013). These values are supported by the data collected in the previous bore census for the Western Domain (GeoTerra, 2019), where three of the four samples of groundwater electrical conductivity (EC, which is a measure of salinity) were <1,700 $\mu\text{S}/\text{cm}$ (approx. 1,000 mg/L).

Following the significant rainfall events in Feb-March 2021, there was a gradual decline in water quality (fresher groundwater) within the Hawkesbury Sandstone across the Western Domain with EC ranging from 255 $\mu\text{S}/\text{cm}$ to 70 $\mu\text{S}/\text{cm}$ (SLR, 2021). Some significant freshening in groundwater (from 1500 $\mu\text{S}/\text{cm}$ to approximately 100 $\mu\text{S}/\text{cm}$) occurred locally around the Western Domain due to rainfall recharge. The private bores show a stable salinity in 2021 with a slight freshening at GW105228 from 1270 $\mu\text{S}/\text{cm}$ in late October 2020 to 1000 $\mu\text{S}/\text{cm}$ in July 2021. The latest records in EC at other private bores are within baseline levels (SLR, 2021).

Illawarra Coal Measures

The Illawarra Coal Measures includes the Bulli Coal and Wongawilli Coal seams, which are the major economic coal seams in the Southern Coalfield (HS/SLR, 2020). Tahmoor Mine, including the Tahmoor South workings, targets the Bulli Coal seam. The Bulli Coal seam is typically 375 – 410 metres deep at Tahmoor South.

Groundwater levels in the Illawarra Coal Measures follows a regional south-to-north gradient. However, as this aquifer is targeted for coal extraction at Tahmoor and several other nearby coal mines this gradient is reversed in some areas indicating flow towards the relevant mine workings.

The radius of influence around the mine workings, in the Bulli seam, appears to be around 600-1,000 m. SCT (2013) also analysed groundwater pressures and observed pressure reduction at 700-1,200 m from the nearest longwall.

This aquifer is not targeted for use as the water quality is poor (HS/SLR, 2020). The Illawarra Coal Measures have an average TDS of 11,000 mg/L and a range 3,200-27,500 mg/L was reported for groundwater from the Illawarra Coal Measures.

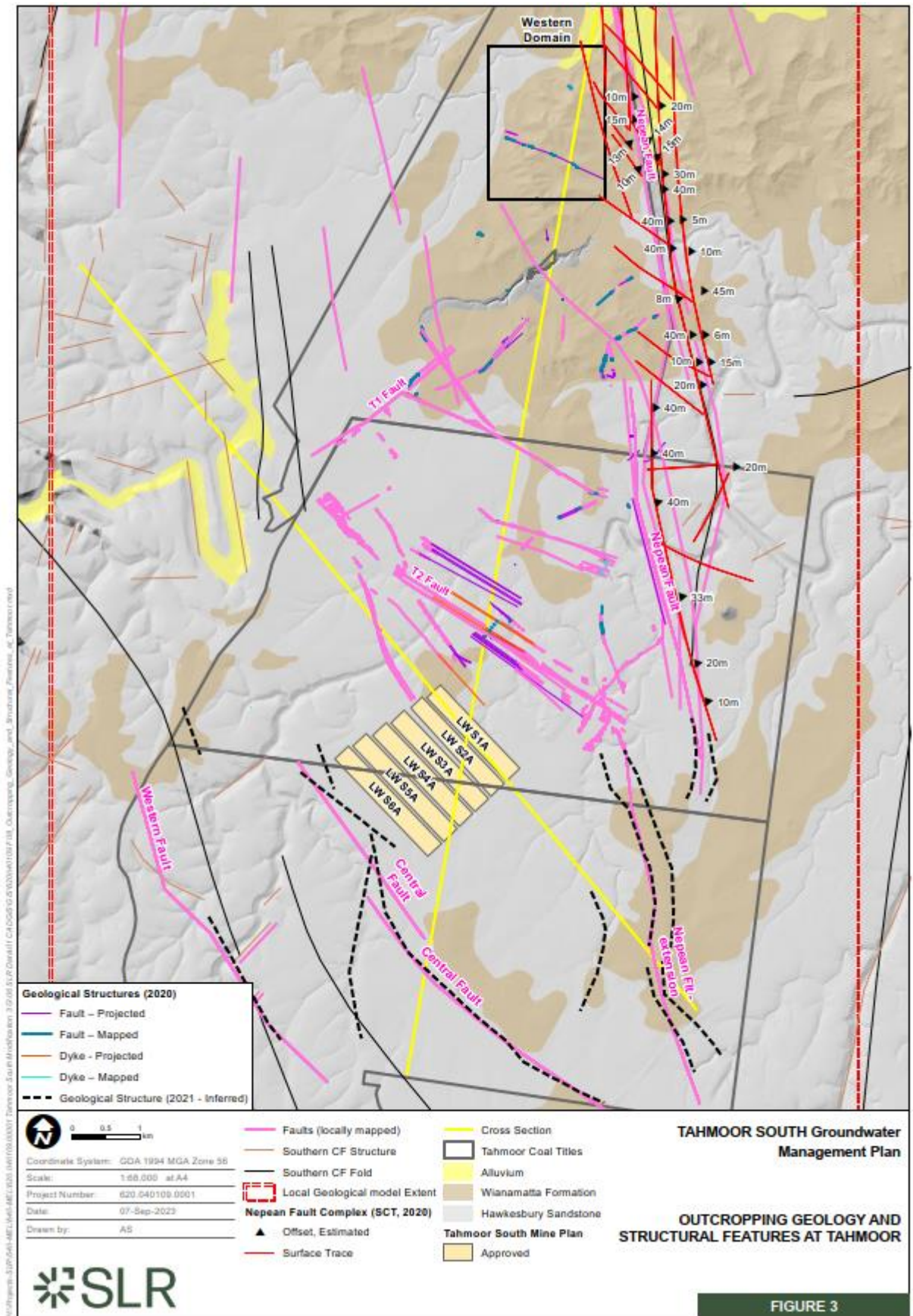


Figure 3 Surficial Geological Outcrop and major faults

4.1.3 Geological Structure

There are a number of geological structures mapped in the vicinity of Tahmoor Mine. The main ones are described as follows and shown on **Figure 3**. It is expected that as development occurs in the Tahmoor South area, additional structures will be identified and characterised.

4.1.3.1 Nepean Fault

The largest of these geological structures are the Nepean Fault (trending north-south) and several NW-SE trending features (faults and monoclines) near parts of the existing Tahmoor Mine and east of the Project. The Nepean Fault is known to have different properties to the host geological units. It could be either a hydraulic barrier or a conductive fault, as it is observed that there are large hydraulic gradients across the fault. Tahmoor Coal has observed water inflows to the mine to be higher than typical at a point where the mine workings intersected the fault zone, which indicates that the Nepean Fault is generally more permeable than the surrounding geology.

Further discussion of increased inflows during the intersection of Longwall 16 is presented in **Section 4.1.3.4**

4.1.3.2 T1 and T2 Faults

The 'T1' and 'T2' faults which are present at the western edge of the previously extracted Tahmoor longwalls between the mine and the Thirlmere Lakes. These faults lie essentially to the north of (and are not intersected by) the proposed Tahmoor South longwalls.

4.1.3.3 Other Structures

Other features of note are:

- the Camden Syncline, which plunges from south to north, and is located about 3.3 km east of the eastern-most Tahmoor South longwall panels, and more or less coincident with the Nepean River at this point;
- Bargo Fault, heading more or less west, which diverges from the Nepean Fault and crosses the mined area of Tahmoor North;
- the Central and Western Faults, which trend NW-SE, just outside the proposed southern limit of the Tahmoor South longwalls. The alignment of the Central Fault is essentially congruent with the course of Hornes Creek, suggesting that the creek might exist at this location due to the influence of this structural feature;
- Victoria Park Fault, lying near to the west of the Tahmoor North longwalls 26-31, and distant from Tahmoor South;
- There are other smaller faults mapped within the extent of the historical Tahmoor workings.

4.1.3.4 Water make associated with structures

As noted above, the Nepean Fault zone has been associated with greater water makes (inflow) than is typical. The intersection of other faults, such as the Bargo Fault and Victoria Park Faults, by mining has not produced notable additional water inflows. Investigative drilling into fault zones has also proved difficult. For this reason, it is believed that most of the faults in the area act as barriers to flow, possibly because of the presence of fines or mineralisation within the fault zone.

4.1.4 Historic Groundwater Inflow

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.

Operational water balance reviews will continue to be performed monthly collating groundwater extractions, as well as imported water to inform on-site water management. Such a system has been in operation at Tahmoor since 2009 (14 years) and will continue for the life of Tahmoor South. Advice from SIMEC is that it is not possible to separately meter the volumes that enter the mine workings in the 'Drift' and in the workings (at seam level). The volumetric flux monitoring will therefore provide data on the total groundwater inflow to all workings, where dewatering of Tahmoor North/Western Domain workings will cease soon after LW W4 is completed (in 2022). This will mean that inflow to Tahmoor South workings will be the primary component of groundwater inflow.

Since 2009, inflows to the Tahmoor Mine have been within the range of 2 Megalitres per day (ML/d) to 6 ML/d. **Figure 4** presents a history of the calculated inflows ('water make') at Tahmoor Mine between 2015 and 2021. The average inflow to the mine for current water year (July-2022 to May - 2023) is 2.9 ML/d. It was 4.4 ML/d for the previous water year (July 2021 to June 2022) and was 4.5 ML/d for the water year 2020-21 (SLR, 2021). It is noted, that pumping may cease for short periods (i.e. due to equipment failure and other reasons), the water balance may estimate zero inflow for short periods (i.e. an underestimate of true inflow). Conversely, if pumping is required to be increased to make up for earlier shortfalls in pumping, the water balance may estimate higher inflow for short periods (i.e. overestimate the true inflow). As a result, longer-term averages are more reliable than the short-term inflow estimates.

The period between mid-2020 shows an increase in inflows to greater than 5 ML/day at the end of July 2020 likely due to the extraction of LW W1. Inflows declined in late 2020, before rising in February 2021 (early in LW W2), with the peak at just over 6 ML/d in March and April 2021. Inflows to the Western Domain are not metered in isolation from other parts of Tahmoor North (they are metered along with all other pump-out) but are estimated to be greater than 2.5 ML/d at analysis between Feb – April 2021. Other than the minor fault observed in the southern 'half' of LW W1 and LW W2, no other obvious geological structures have been noted as intersecting current workings.

Inflows predicted by the rebuilt numerical groundwater model (SLR, 2022) for the Tahmoor South workings are shown on **Figure 5**.

Inflows to the underground operations are predicted to increase over the first half of the operational life of LW S1A-S6A, reaching a maximum peak of approximately 2.5 ML/day at the beginning of 2025. Inflow rates decline gradually from 2025 until the cessation of mining in 2026, where inflows to LW S1A-S6A reach a steady rate of approximately 0.12 ML/day. The average inflow rate over the total duration of mining at LW S1A-S6A is calculated at 0.8 ML/day.

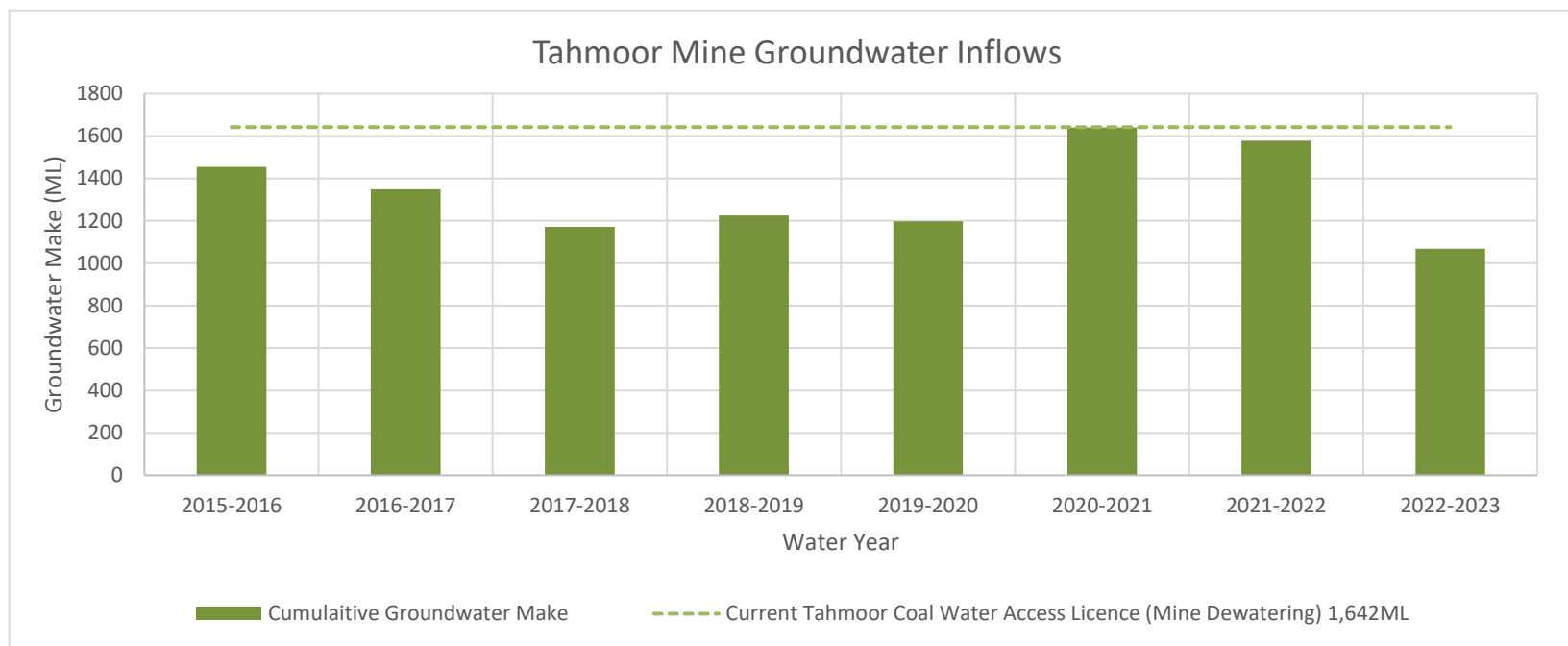


Figure 4 Historic Groundwater Inflow [Measured] for the period between 2015 – 2023

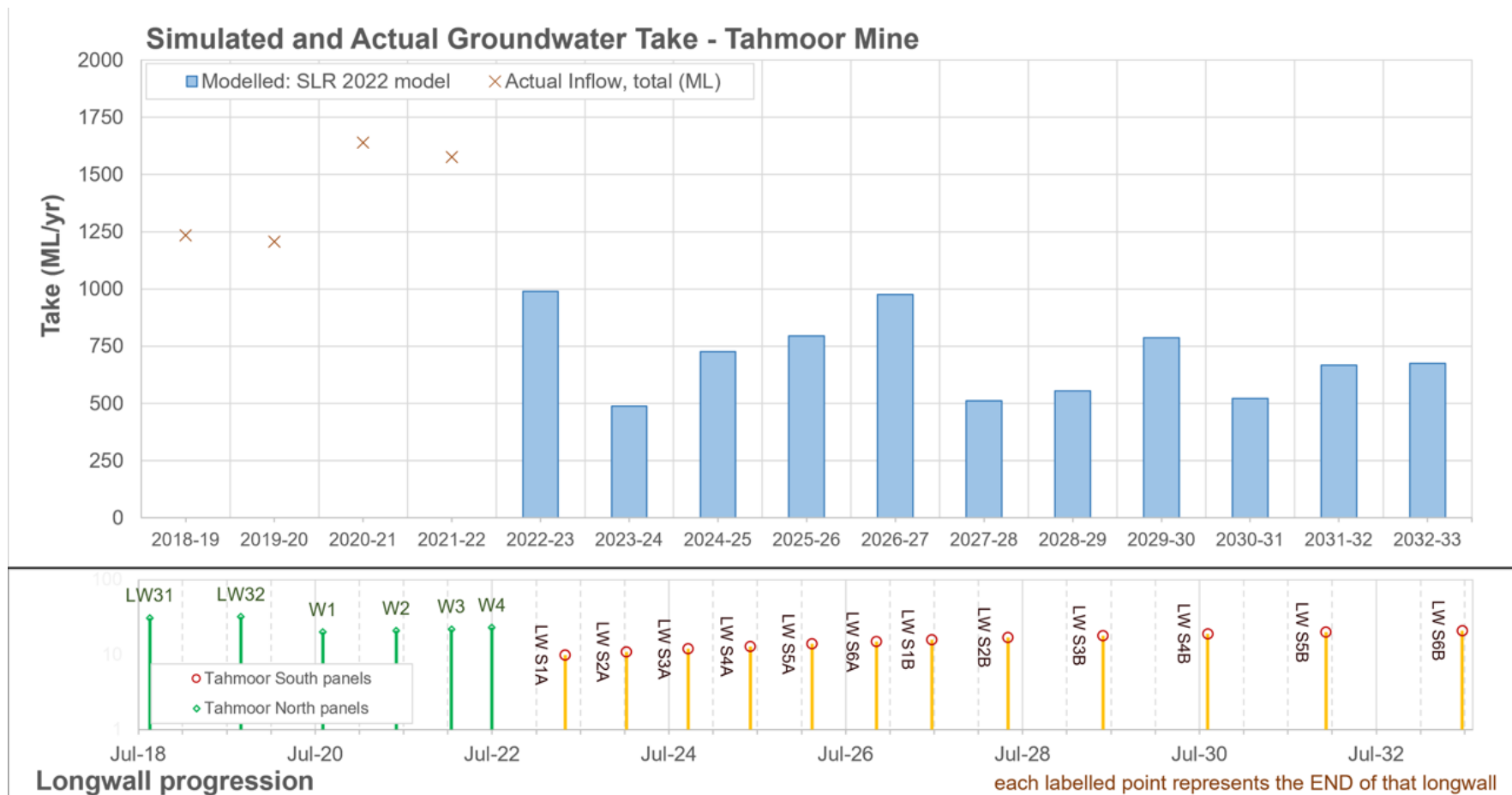


Figure 5 Simulated Groundwater Take

4.1.5 Groundwater Levels

4.1.5.1 Tahmoor South Monitoring Bores

Historically, thirteen bores exist that are equipped with Vibrating Wire Piezometers (VWPs) in the Tahmoor South monitoring network, and these are described in **Table 7** and shown on **Figure 6**. Works are underway to repair and re-instate sensors that are inactive. Telemetry has been installed providing continuous access to data.

In accordance with recommendations via approved Development Consent SSD 8445 MOD2 (determination date 13 June 2023), a selection of current monitoring points associated with the historical working, namely the Western Domain, will be incorporated into the Tahmoor South ongoing monitoring regime. The VWPs selected for ongoing monitoring include WD02, TNC036 and TNC040, included in Table 7.

Table 7 Summary of existing VWPs in Tahmoor South

Bore ID	Easting	Northing	Status	Targeted Aquifer*	Type	Sensor Depths (m bns)
TBC009	278511	6202058	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	30, 75, 140, 182, 192, 322, 343, 357, 381, 391, 397m
TBC018	279645	6204509	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	70 (inactive), 11, 164, 179, 198, 282, 366, 377, 404, 426, 432m
TBC020	280909	6204059	Inactive	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	70, 105, 141, 194, 211, 293, 375, 397, 401, 434, 439m
TBC024	274763	6204163	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	117, 139, 168, 185, 240, 295, 350, 371, 384, 391m
TBC026	281603	6207068	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, LRSS, WWCO	VWP	95, 135, 176, 191, 211, 278, 344, 409, 432, 440, 460m
TBC027	275708	6202210	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	95, 132, 169, 181, 198, 253, 306, 362, 384, 396, 400m
TBC032	277244	6204725	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	95, 131, 168, 181, 200, 237, 294, 371, 397, 437m
TBC034	272956	6205076	Existing	HBSS, BHCS, BGSS, WBCS, BUCO, WWCO	VWP	65 (inactive), 113 (inactive), 161(inactive), 176, 196, 245, 294, 343, 364, 382m
WD02	278245.5	6215178.3	Existing	HBSS, BACS, BGSS	VWP	130, 200, 240, 280, 305, 330, 355, 410m
TNC036	277268.6	6215382.0	Existing	HBSS, BGSS, BUCO	VWP	65, 97, 169, 214, 298, 412, 463m
TNC040	279003.6	6214520.9	Existing	WMFM, HBSS, BGSS, BUCO	VWP	27, 65, 131, 225, 252, 352, 452, 501m

* WNFm – Wianamatta Group, HBSS – Hawkesbury Sandstone, BHCS – Bald Hill Claystone, BGSS – Bulgo Sandstone, SPCS – Stanwell Park Claystone, SCSS – Scarborough Sandstone, WBCS – Wombarra Claystone, CCSS – Coal Cliff Sandstone, BUCO – Bulli Coal Seam, WWCO – Wongawilli Coal Seam

To compliment this VWP Network, an additional 14 open standpipes have been constructed for ongoing water level and quality monitoring. As per the additional VWPs incorporated from the historical workings monitoring network, P14 and P16 open standpipes have been included in the Tahmoor South monitoring network. The construction details and initial water levels are provided in **Table 8**.

Table 8 Summary of existing Open Standpipes in Tahmoor South

Bore ID	Easting	Northing	Target Aquifer	Depth (m)	Monitoring Regime
P50 a, b, c (Thirlmere1)	273900	6208500	HBSS	Approx. 20, 35, 65	monthly
P51a	275623.00	6206431.71	HBSS	19.96	15 minute intervals
P51b	275620.60	6206419.68	HBSS	35.38	15 minute intervals
P57 a, b (Hornes1)	275500	6204600	HBSS	Approx. 20, 35	monthly
P52a	277649.84	6206848.30	HBSS	41.17	15 minute intervals
P53 a	277649.91	6206496.48	HBSS	41	15 minute intervals
P53b	277658.61	6206492.50	HBSS	60.55	15 minute intervals
P53c	277665.80	6206489.23	HBSS	80.78	15 minute intervals
P54a	277809.68	6205951.98	HBSS	25	monthly
P54b	277806.92	6205944.68	HBSS	35.99	monthly
P55a	277297.77	6205283.12	HBSS	41.05	15 minute intervals
P55b	277303.32	6205270.96	HBSS	59.36	15 minute intervals
P55c	277296.45	6205262.51	HBSS	81.90	15 minute intervals
P56 a	276645.55	6206175.36	HBSS	20.9	15 minute intervals
P65b	276639.18	6206166.92	HBSS	45.56	15 minute intervals
P56c	276637.06	6206154.37	HBSS	80.4	15 minute intervals
P14A	278398.4	6216535.9	Alluvium/colluvium	6	15 minute intervals
P14B	278392.6	6216534.3	HBSS	16.6	15 minute intervals
P14C	278397.2	6216541.8	HBSS	31.6	15 minute intervals
P14D	278391.4	6216540.0	HBSS	61.6	15 minute intervals
P16A	277350.5	6215146.7	HBSS	27.5	15 minute intervals
P16B	277349.9	6215140.4	HBSS	45.5	15 minute intervals
P16C	277347.3	6215135.3	HBSS	75.5	15 minute intervals

In addition to the VVPs and new OSPs, there are three bores located on pit-top and seven bores located within the Reject Emplacement Area (REA), as described in **Table 9** shown on **Figure 8**. The REA and pit-top piezometers have data loggers installed recording water levels every 12 hours, with data downloaded on a quarterly basis. Water pressure in the VVPs (when operational) is recorded every 12 hours with data downloaded on a quarterly basis. Figures depicting hydrographs for these bores are provided in Appendix B of the Tahmoor South Groundwater Monitoring Plan (**Appendix B**).

Table 9 Reject Emplacement Area (REA) Piezometers

Bore ID	Easting	Northing	Status	Targeted Aquifer	Type	Depth (metres)
REA1	278362.3	6207826.8	Active	REA	OSP	54.8
REA2	278441.2	6206332.2	Active	REA	OSP	58
REA3	277820.7	6206453.4	Active	REA	OSP	41
REA4	277650.8	6206835.2	Active	REA	OSP	57.5
REA5	277424.2	6206769.0	Active	REA	OSP	7.2
REA6	278643.3	6207214.8	Active	REA	OSP	46.3

Bore ID	Easting	Northing	Status	Targeted Aquifer	Type	Depth (metres)
REA7	278035.1	6207307.3	Active	REA	OSP	43
PitTop1	277357.6	6207494.9	Active	pit-top	OSP	55.04
PitTop2	277396.0	6207663.2	Active	pit-top	OSP	6.85
PitTop4	276872.2	6207331.6	Active	pit-top	OSP	33.7

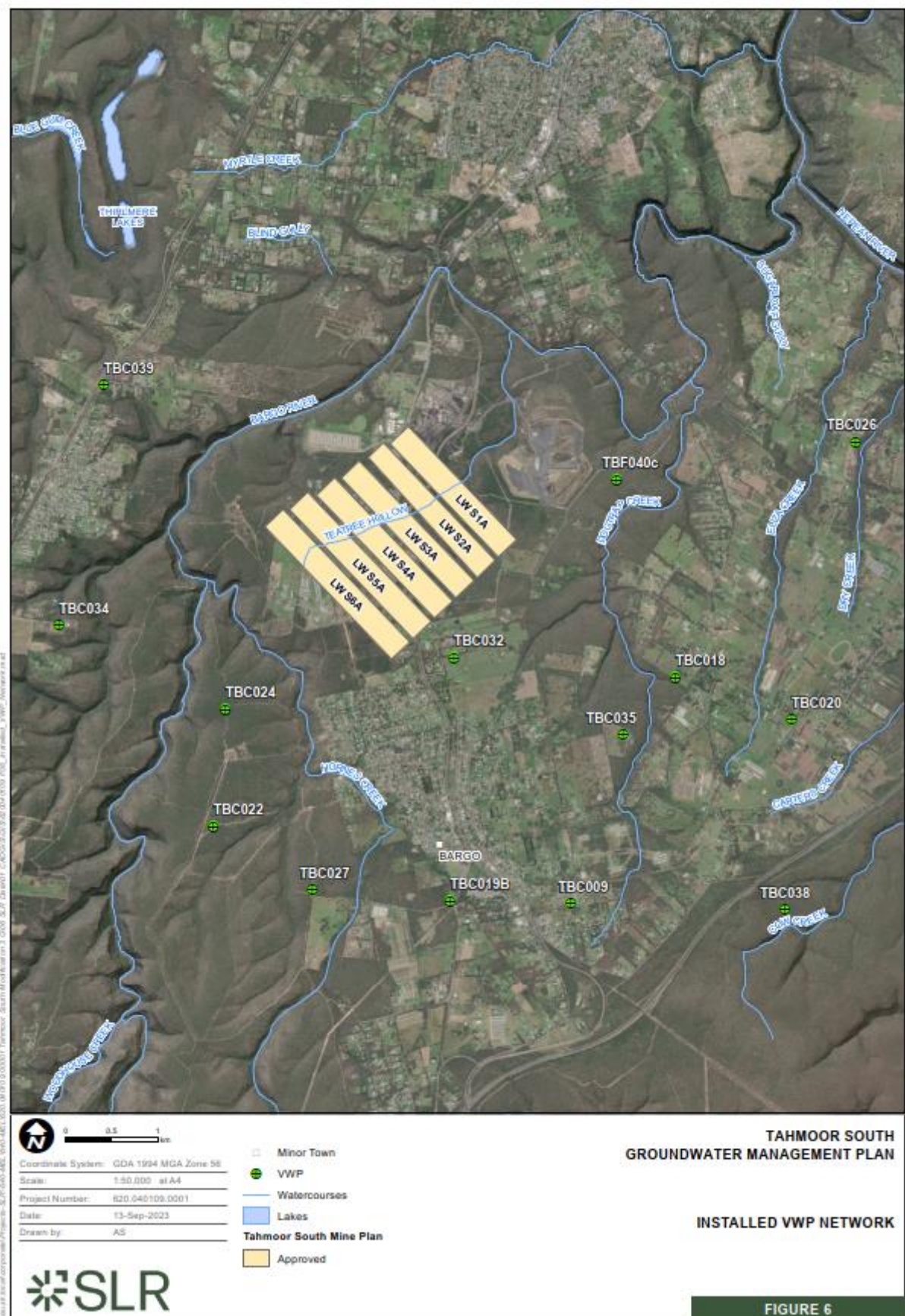


Figure 6 Vibrating Wire Piezometers

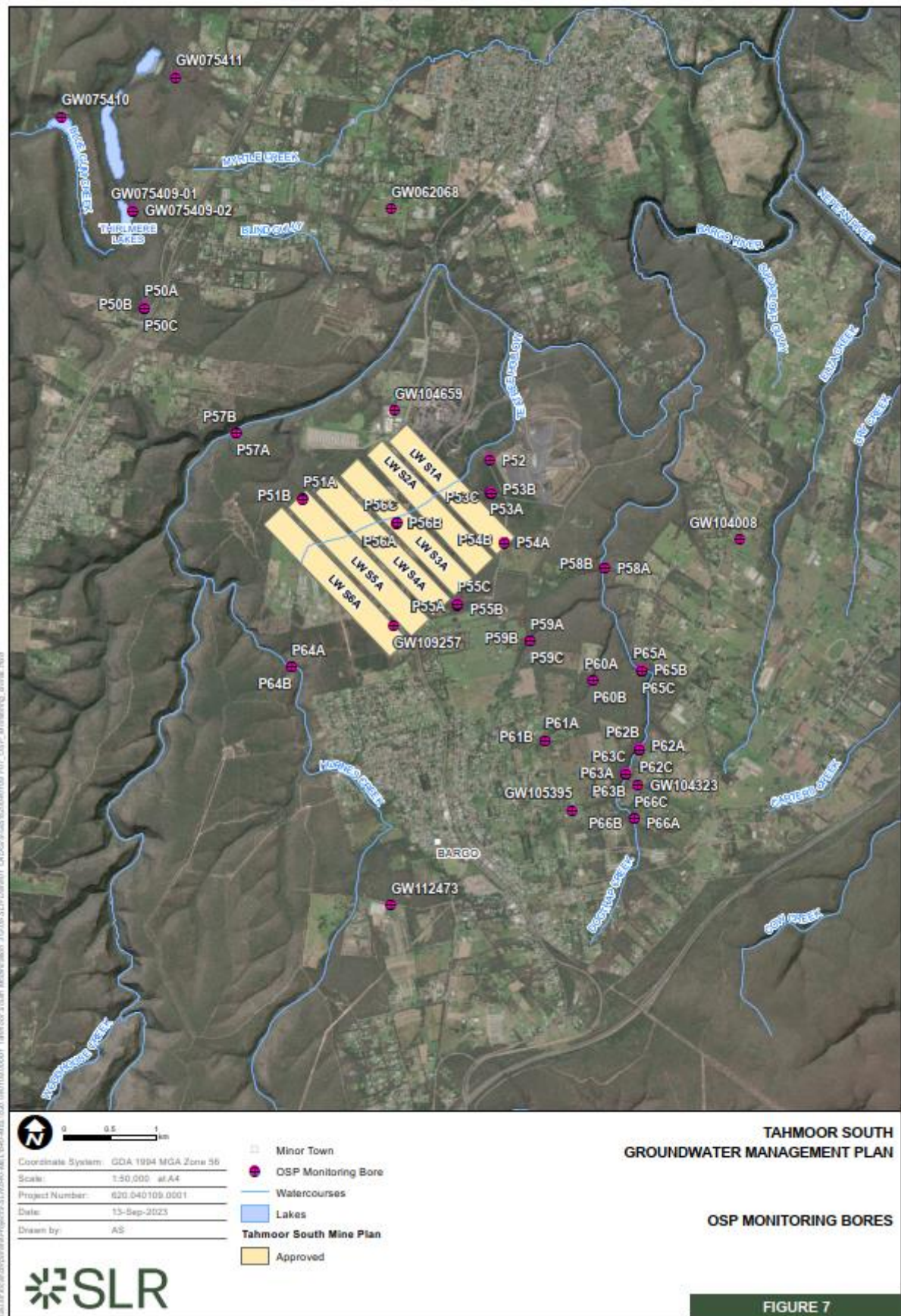


Figure 7 OSP Monitoring Bores

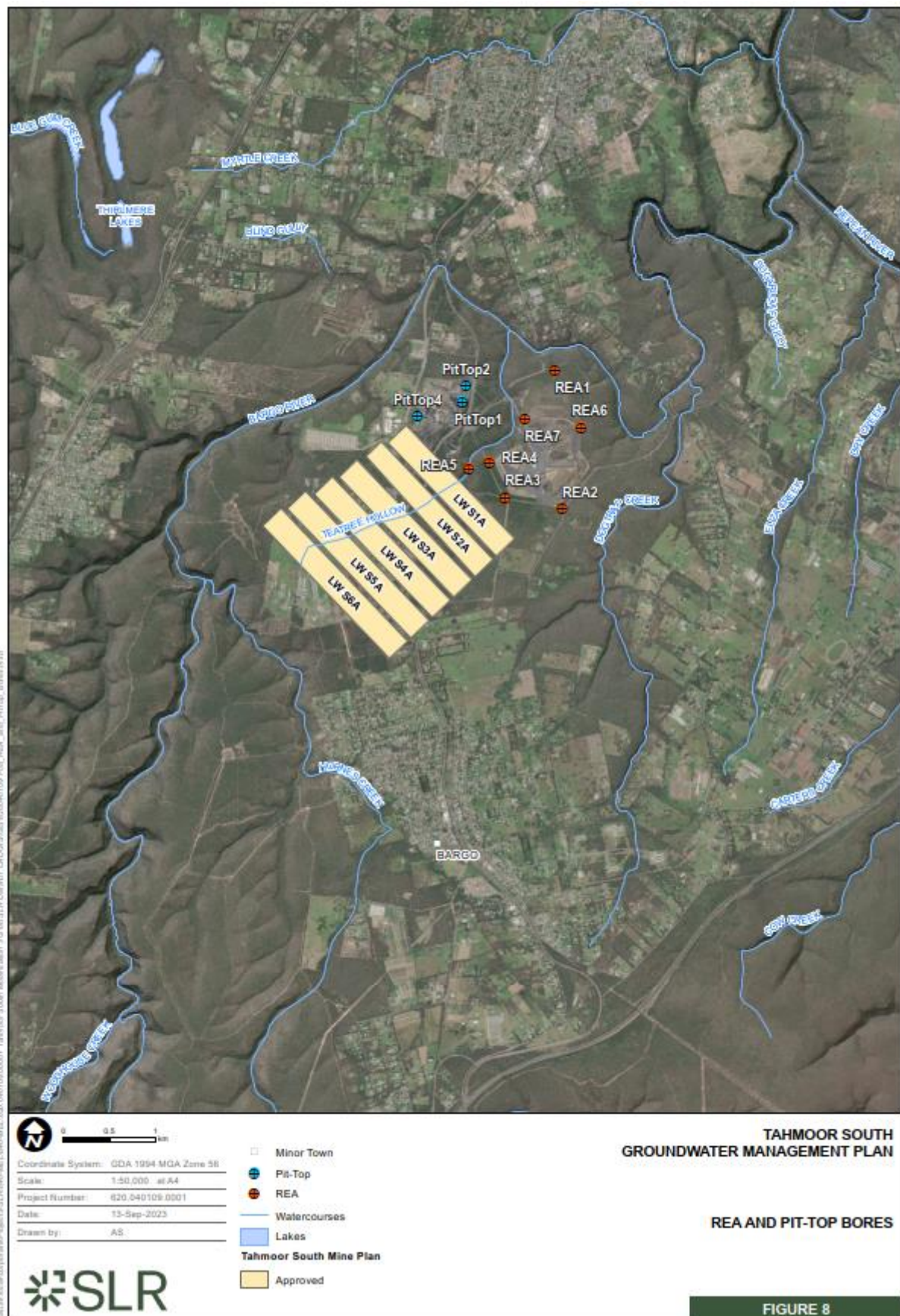


Figure 8 REA and Pit-top Piezometers

4.1.5.2 Private Bores

The pre-mining private landholder bore survey commenced in January 2022 and was concluded by 15th March 2022, surveying a total of 40 bores. Water level data was captured for all bores where possible and summarised in **Table 10**. Six bores have been incorporated into the routine monitoring regime, with water levels manually recorded monthly.

Table 10 Groundwater Levels in Private Bores

Bore	Ongoing Monitoring	Current Use and Frequency	Aquifer	Bore Depth (m)	Groundwater Depth (metres below ground)
10CA119328	no	Irrigation, daily (when onsite dam is low)	HBSS	NR	54.4
115NTG	no	Not currently used, pump to be installed next month	HBSS	~160 - 170 m	41.67
GW032443	no	Not currently used	HBSS	10.71 (measured, likely blocked)	0.71
GW059618	no	No one onsite for comment, likely not in use as no infrastructure connected	HBSS	122.71	19.96
GW062068	yes	Not used due to "part cave-in" 11 years ago	HBSS	>100	21.93
GW102452	no	Formerly used for aquaculture (~50,000L/day)	HBSS	71.41	36.41
GW103023	no	No current use. Formerly used for water extraction to supply aquaculture enterprise	HBSS	51.43	17.68
GW103036	no	Daily, irrigation	HBSS	127.42	68.49
GW103615	no	Not currently used	HBSS	73.1	65.36
GW104008	yes	When required to fill the dam and irrigate lawns	HBSS	>100	46.84
GW104323	yes	Daily use (on timer) for crop irrigation	HBSS	79.8	68.6
GW104659	yes	To replenish adjacent dam, regulated by timer	HBSS	50.08	43.8
GW105395	yes	Not currently used	HBSS	53.1	0.5
GW105803	no	Not currently used	HBSS	80 (anecdotal, not measured)	17.05
GW106546	no	Once per week for stock watering	HBSS	63.63 (likely blockage as installed to 116 metres)	41.67
GW109257	yes	Not used for two years, previously used to fill site dam	HBSS	NR	37.06
GW111518	no	Frequent use when required, for crop irrigation	HBSS	28.3 (owner described depth of 28.3 so potential obstruction)	19.24
GW111828	no	Not currently used, previously used intermittently when water not available from GW115773 as irrigation back-up	HBSS	60.7 (likely blocked as install depth recorded as 205 m)	Dry or blocked

GW111842	no	Not currently used	HBSS	69.4 (likely blocked as install depth recorded as 240 m)	Dry or blocked
GW112415	no	Daily use to fill dam and irrigate lawn	HBSS	96.96	42.86
GW112473	yes	Daily use to fill dam	HBSS	NR	32.95
GW115773	no	Daily use for irrigation	HBSS	81.87	75.85
GW116897	no	Not currently used, waiting for pump install for future crop use	HBSS	51.2 (potential blockage as install recorded to 160m)	19.9
GW45404	no	Not used in years	HBSS	72.73 (could be blocked)	Dry
Heritage Well	no	Unused	HBSS	3.12	1.15

4.1.6 Hydraulic Conductivity

For the purpose of describing or quantifying how water flows through a porous or fractured medium, the term 'permeability' is used interchangeably with 'hydraulic conductivity' in this document. Data has been sourced from packer testing with some available from core testing, conducted at Tahmoor, Appin and Dendrobium Mines. Packer testing primarily tests horizontal hydraulic conductivity (Kh), but can also be useful in characterising the likely vertical hydraulic conductivity (Kv) in sedimentary units. Data indicated that there is large range of values among formations, however it should be noted that there is limited core testing data (Kv), particularly outside of the Hawkesbury Sandstone (HBSS).

Data suggests a decreasing permeability with depth of the rock mass as a whole; however, that trend is mainly evident for the non-coal units while the coal seams are key exceptions to this general trend:

- Decreasing from the Hawkesbury Sandstone down to the Wombarra Claystone, then a step up at the Bulli Coal seam due to the higher permeability of the coal material; and
- A further decreasing trend in the sandstone and siltstone units below the Bulli Coal Seam.
- Like the Bulli Coal, the Wongawilli Coal seam is more permeable than the surrounding sandstone and siltstone units.
- There is a weak trend of decreasing matrix permeability with depth observed in the core data (SLR, 2021).

The installation of three further Height-of-Fracturing (HoF) holes are proposed for investigating fracturing conditions, as per the Groundwater Monitoring Plan (SLR, 2021b), one more in the A-block, and two in the B-block. This follows the ongoing investigation in the Western Domain at bores WD01-WD02.

4.1.7 Groundwater Quality

Monitoring Bores

Water quality samplings is currently conducted at monitoring bores located across the Tahmoor South domain, inclusive of the Pit-top area (Pit Top 1, 2, 4) and the Reject Emplacement Area (REA1-7), dedicated nested open standpipes and seven private bores. The bores included in the ongoing monitoring regime are presented in **Table 11**. This includes the 7 open standpipes incorporated from the historical working areas to meet the requirements of the Mod 3 approval. Tahmoor Coal conducts full laboratory water quality analysis at these bores, inclusive of the following parameters:

- Electrical conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO);
- Nutrients (Total N, Total P);
- Major Ions (Ca, Cl, K, Na, SO₄, HCO₃, F);

- Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity; and
- Total (Fe, Mn) and dissolved metals (Fe, Mn, Cu, Pb, Zn, Ni, Al, As, Se, Li, Sr, Co).
- EC is recorded at NSW government monitoring bores at Thirlmere Lakes since 2012.

Table 11 Groundwater Quality Monitoring Network

Bore	Easting	Northing	Bore Depth (m)	Monitoring Regime
REA1	278362.3	6207826.8	54.8	quarterly
REA2	278441.2	6206332.2	58	quarterly
REA3	277820.7	6206453.4	41	quarterly
REA4	277650.8	6206835.2	57.5	monthly
REA5	277424.2	6206769	7.2	quarterly
REA6	278643.3	6207214.8	46.3	quarterly
REA7	278035.1	6207307.3	43	quarterly
PitTop1	277357.6	6207494.9	55.04	quarterly
PitTop2	277396	6207663.2	6.85	quarterly
PitTop4	276872.2	6207331.6	33.7	quarterly
P51a	275623.00	6206431.71	19.96	monthly
P51b	275620.60	6206419.68	35.38	monthly
P52a	277649.84	6206848.30	41.17	monthly
P53 a	277649.91	6206496.48	41	monthly
P53b	277658.61	6206492.50	60.55	monthly
P53c	277665.80	6206489.23	80.78	monthly
P54a	277809.68	6205951.98	25	monthly
P54b	277806.92	6205944.68	35.99	monthly
P55a	277297.77	6205283.12	41.05	monthly
P55b	277303.32	6205270.96	59.36	monthly
P55c	277296.45	6205262.51	81.90	monthly
P56 a	276645.55	6206175.36	20.9	monthly
P65b	276639.18	6206166.92	45.56	monthly
GW109257	276603.8	6205057	120	monthly
GW104008	280359	6205978	140	monthly
GW112473	276586	6202000	138	monthly
GW104659	276616	6207392	132	monthly
GW105395	278546.8	6203033	90	monthly
GW104323	276242	6206412	79.8	monthly
P14A	278398.4	6216535.9	6	monthly (then quarterly)
P14B	278392.6	6216534.3	16.6	monthly (then quarterly)
P14C	278397.2	6216541.8	31.6	monthly (then quarterly)
P14D	278391.4	6216540.0	61.6	monthly (then quarterly)
P16A	277350.5	6215146.7	27.5	monthly (then quarterly)

P16B	277349.9	6215140.4	45.5	monthly (then quarterly)
P16C	277347.3	6215135.3	75.5	monthly (then quarterly)

Field water quality has been undertaken for EC and pH on a monthly basis since August 2019. **Appendix C** presents the baseline data (EC and pH) for the Pit Top and REA bores, with the rainfall residual mass included for comparison to climatic trends.

Private Bores

Historical groundwater quality data for the Study Area, in the form of EC, are summarised in **Figure 9**. These data were sourced from publicly available data from the NSW government Groundwater Works/Pinneena database, and from the bore census conducted by Geoterra (2013a). The information in the Groundwater Works database is a mix of qualitative (e.g. 'fresh', 'brackish') and quantitative (e.g. '500 ppm'). In order to convert or standardise these qualitative entries to an approximate quantitative measure some assumptions have been made. The resultant quantitative salinities were classified as shown on **Figure 9**, as well as assigning the various bores to layers using the geological model built for this study.

The data indicate that:

- Groundwater in the Alluvium and Wianamatta Formation are of mixed quality. It is likely that evaporative concentration of salts could occur in alluvial aquifers, especially in clayey facies. The marine origin and low permeability of the Wianamatta Shales tends to lead to higher salinities in this unit.
- There is little data for the Narrabeen Group or Illawarra Coal Measures. Older units such as the Shoalhaven Group exhibit a range of salinities from fresh to saline.

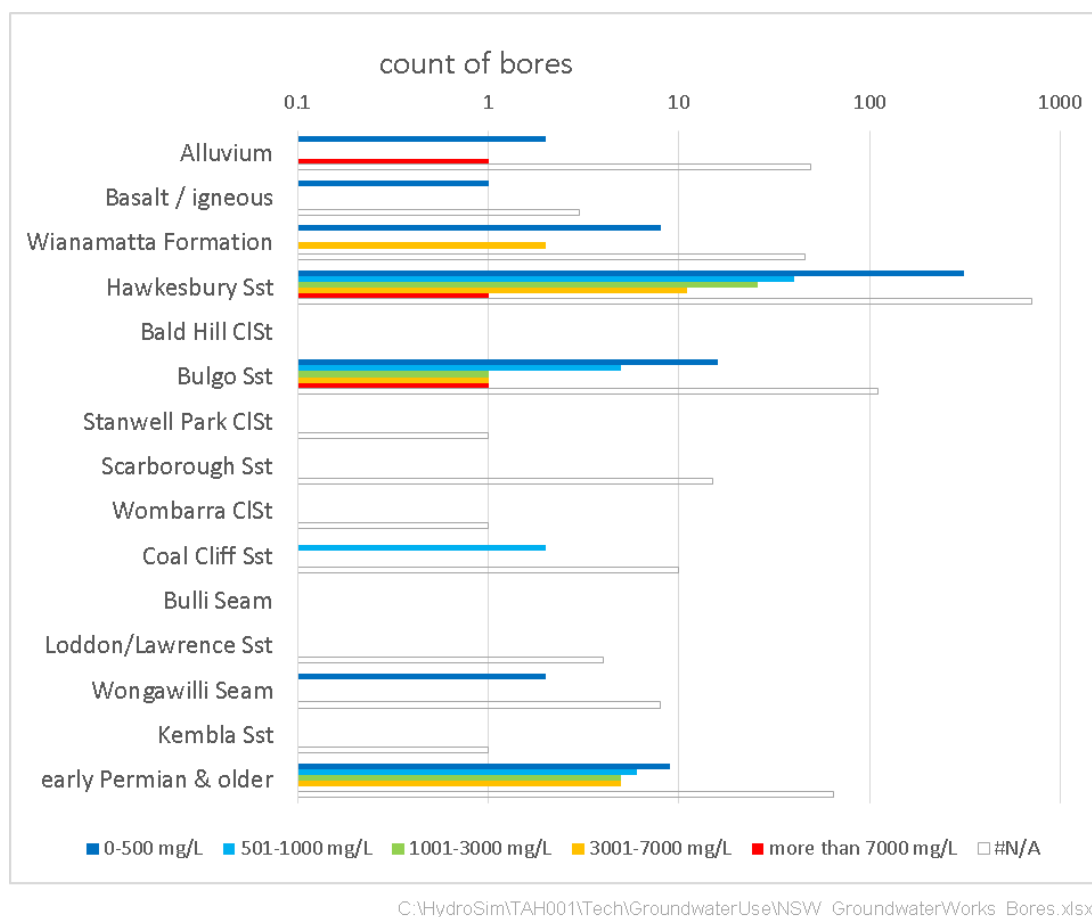


Figure 9 Summary of groundwater salinity data

In addition, Table 12 presents the salinity (as EC) recorded during the 2022 Private Bore Survey (SLR, 2022c). The median groundwater salinity is 810 $\mu\text{S}/\text{cm}$, with a minimum of 165 $\mu\text{S}/\text{cm}$ and a maximum of 3,378 $\mu\text{S}/\text{cm}$. There are no apparent trends with groundwater salinity and bore depth or location.

Table 12 Private Bore Survey Salinity Data

Bore	Ongoing Monitoring	Aquifer	Bore Depth (m)	Groundwater Salinity EC ($\mu\text{S}/\text{cm}$)
10CA119328	No	HBSS	NR	1472
115NTG	No	HBSS	~160 - 170 m	689
GW032443	No	HBSS	10.71 (measured, likely blocked)	226
GW059618	No	HBSS	122.71	2396
GW062068	Yes	HBSS	>100	165
GW070245	No	HBSS	NR	949
GW102179	No	HBSS	NR	1849
GW102344	No	HBSS	NR	801
GW102452	No	HBSS	71.41	371
GW103023	No	HBSS	51.43	3378
GW103036	No	HBSS	127.42	371
GW103559	No	HBSS	NR	487

GW104008	Yes	HBSS	>100	1323
GW104323	yes	HBSS	79.8	1025
GW104659	Yes	HBSS	50.08	539
GW105262	No	HBSS	NR	1828
GW105395	No	HBSS	53.1	3341
GW105803	No	HBSS	80 (anecdotal, not measured)	1108
GW105883	No	HBSS	NR	1686
GW110669	No	HBSS	NR, 111 metres install depth noted on bore	677
GW111518	No	HBSS	28.3	277
GW111669	No	HBSS	NR	481
GW111810	No	HBSS	NR	2058
GW112415	No	HBSS	96.96	1059
GW112473	Yes	HBSS	NR	515
GW115773	No	HBSS	81.87	820
GW116897	No	HBSS	51.2 (potential blockage as install recorded to 160m)	776
Heritage Well	No	HBSS	3.12	684
GW106590	No	HBSS	150 (Installed depth)	842

4.1.8 Groundwater Use

4.1.8.1 Groundwater Dependent Ecosystems

The Thirlmere Lakes are the closest 'High Priority' Groundwater Dependent Ecosystem to Tahmoor Mine, being 650-700 m from historical Tahmoor longwalls at their closest points, but at least 3,500 m from Tahmoor South longwalls.

Thirlmere Lakes are of high conservation importance, gazetted as a National Park in 1972, and providing habitat for dependent aquatic species (Schädler & Kingsford, 2016). The Lakes are a group of waterbodies in the Greater Blue Mountains World Heritage Area that includes Lake Gandangarra, Lake Werri Berri, Lake Couridjah, Lake Baraba and Lake Nerrigorang.

The water in Thirlmere Lakes is predominantly derived via rainfall. The Thirlmere Lakes Inquiry concluded that the Lakes appear to act as naturally losing system under both dry and wet conditions (Heritage Computing, 2012b; Schädler & Kingsford, 2016).

Preliminary findings by the NSW government Thirlmere Lakes Research Program (TLRP) indicate that historical effects of Tahmoor Mine on Thirlmere Lakes hydrology have likely been very small compared to climatic effects. The TLRP released the major findings report from the study, '*Thirlmere Lakes – A Synthesis of Current Research*', on the 24th March 2022 (DPE, 2022). The field and modelling results suggest that the recent water level declines are primarily associated with climate variability versus the nearby longwall mining. However, this conclusion does not preclude the influence of the ongoing longwall mining and bore extraction in the future, and ongoing monitoring was recommended. The findings of this report are aligned with existing conceptualisation of the Lakes and are supported by the proposed monitoring program and groundwater modelling.

Regional mapping of groundwater dependence of terrestrial ecology is shown on **Figure 10** (DPIE, 2018). Key areas as identified via this mapping include the Thirlmere Lakes and reaches of Dog Trap Creek and Teatree Hollow. This indicates a high probability of interaction of groundwater and surface water at these locations, in the form of riparian vegetation.

4.1.8.2 Springs

Literature indicates that it is likely that the Hawkesbury Sandstone may contain springs that have developed in saturated and perched aquifers within the unit (HydroSimulations, 2018). However, no significant springs or soaks have been mapped or located in the vicinity of the Project. Field investigations carried out by Brien Environment & Safety (2022) supported this finding. A further hydrogeological desktop study reviewing recent water levels, topography and state GDE mapping supported the conclusion that the presence of springs is unlikely (SLR, 2023).

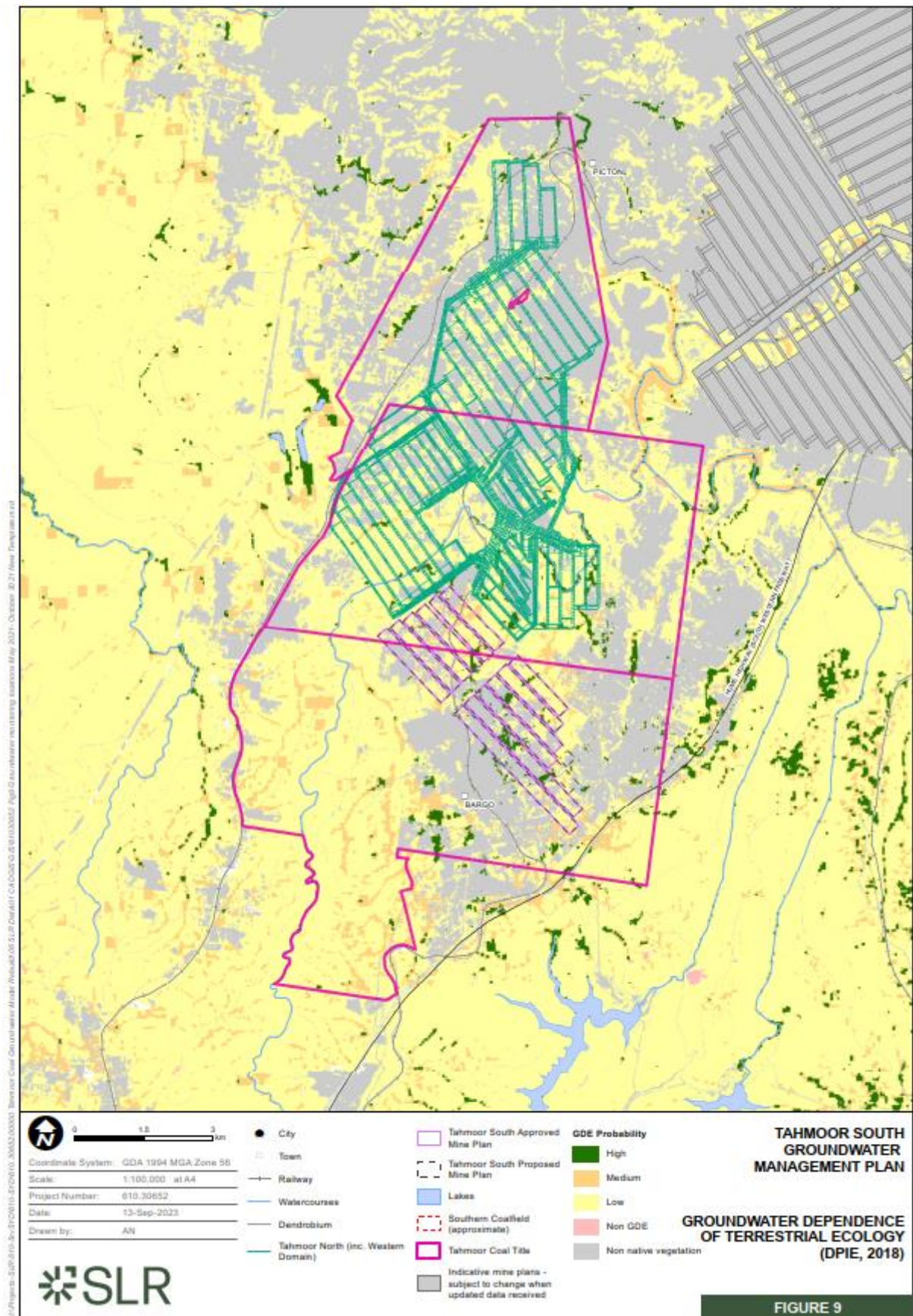


Figure 10 Groundwater Dependence of Terrestrial Ecology (DPIE, 2018)

4.1.8.3 Anthropogenic Use

The Hawkesbury Sandstone is a productive aquifer (**Section 4.1.2**) utilised by landholders for subsidiary water supply. Modelling for the Tahmoor South EIS indicated approximately 52 bores owned and operated by private landholders may be impacted (drawdown exceeding 2 metres, as per the AIP) as a result of the Tahmoor South extraction. Utilising the rebuilt Numerical Groundwater Model, completed for the LW S1A – LWS6A Extraction Plan, a summary of predicted drawdown resulting from this extraction is provided in **Table 13**.

The field survey was conducted to establish baseline conditions of as many bores as possible, with seven selected for ongoing monitoring.

Table 13 Private Groundwater Users potentially impacted by Tahmoor South operations

Work Number	Easting	Northing	Bore Depth (m)	LW S1A-S6A Potential Impact (m)	Cumulative Mining Impact (m)
GW104659	276617	6207391	132	1	14.4
GW105847	277020	6204404	NA	1.1	3.9
GW111810	277034	6204407	142	1.1	3.9
GW105883	277040	6204629	NA	1.4	4.5
GW014262	276764	6204587	48.8	1.6	4.6
GW111669	276232	6206450	120	2.2	10.8
GW109257	276603	6205052	120	2.2	6
GW032443	276415	6206336	130.1	2.4	10.2
GW102452	277234	6200992	120.5	<1	<1
GW103023	277261	6200993	165	<1	<1
GW103036	276840	6200964	132.5	<1	<1
GW103559	276504	6201854	190	<1	<1
GW105262	278609	6200731	104	<1	<1
GW111357	277051	6200982	144	<1	<1
GW111518	276882	6200987	150	<1	<1
GW112415	277479	6200865	139	<1	<1
GW112473	276577	6202010	138	<1	<1
GW116897	281442	6203190	160	<1	<1
GW108538	281155	6205941	66	<1	12.5
GW110669	274565	6207896	132	<1	12.1
GW062068	276581	6209579	150	<1	8.9
GW106590	280442	6206344	150	<1	4.7
GW111047	280015	6206037	120	<1	4.6
GW031294	279732	6205706	90.2	<1	4.2
GW007445	277454	6204323	134.1	<1	3.6
GW104008	280368	6205982	140	<1	3.5
GW105577	280728	6207041	162	<1	3.5
GW070245	280090	6205714	97.5	<1	3.3
GW053449	280369	6205813	105	<1	3.1

GW057969	281350	6206116	108	<1	2.5
GW100455	281877	6207020	96	<1	2.5
GW103615	279720	6204034	103	<1	2.5
GW054146	279886	6204676	104	<1	2.4
GW045404	282217	6206689	53.3	<1	2.2
GW051877	281673	6205875	92	<1	2.2
GW058634	279479	6203419	122	<1	2.2
GW104090	278208	6215913	150.5	<1	2.1
GW104323	279259	6203318	109	<1	2.1
GW105395	278543	6203037	90	<1	2
GW053450	282303	6205837	120	<1	1.8
GW107470	282069	6208057	132	<1	1.7
GW115773	282232	6205725	81.87	<1	1.7
GW062661	282609	6207469	126.5	<1	1.6
GW104860	282745	6206178	204.3	<1	1.6
GW106546	282785	6206765	116	<1	1.6
GW111828	282391	6205638	205	<1	1.6
GW100433	278540	6202588	126	<1	1.5
GW104454	281410	6204568	66	<1	1.5
GW052016	280259	6203604	110	<1	1.4
GW111842	282654	6205664	240	<1	1.4
GW102179	280953	6203826	153	<1	1.3
GW059618	281587	6204277	117	<1	1.2
GW102045	281266	6203733	120	<1	1.1
GW105803	282278	6204644	140	<1	1.1
GW101936	280604	6202851	126	<1	1
GW108842	282500	6204716	174	<1	1

4.1.9 On-site Water Storage

There are 20 earthen water storages and two water storage tanks across the Tahmoor Coal surficial workings area. Two investigations into the potential for seepage from these storages to groundwater have been completed including:

- Tahmoor South Surface Water Investigation, SLR 2022, which included a visual inspection and assessment, and
- Preliminary Surface Water and Groundwater Quality Investigation, SLR, 2022.

Both reports are included in Appendix D. Findings of both reports concluded minimal likelihood of any connectivity between surface water storages and groundwater systems. The need for ongoing monitoring specific to leakage is considered unnecessary based on these findings.

4.2 Management Measures

Ongoing management measures include development and implementation of the Groundwater Modelling Plan (SLR, 2021). The Modelling Plan is provided in **Appendix E**. Please note that is Modelling Plan is currently referencing historic longwall names, as this was completed prior to finalising the nomenclature. According to the Consent Conditions, the plan should;

- provide details for the future groundwater model re-build and recalibration which must be completed within 2 years of the commencement of development under this consent;
- include planning for an independent third-party review;
- provide for the incorporation of the outcomes of the findings of the Thirlmere Lakes Research Program and other relevant research on the Thirlmere Lakes;
- consider field data and the outcomes of subsidence monitoring; and
- provide for periodic validation and where necessary recalibration, of the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions.

The Groundwater Modelling Plan (SLR, 2021f) has undergone independent third-party review, endorsed by the independent reviewer on the 23rd December 2021 (**Appendix F**). The Groundwater Modelling Plan follows the modelling process presented in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012) and addresses the modelling objectives, conceptualisation, model design, calibration approach and set up, the predictive modelling approach, the sensitivity and uncertainty analysis, and the outputs and reporting.

The Groundwater Model has undergone complete rebuild, with the modelling report appended to the Groundwater Technical Report supporting the LW S1A-S6A Extraction Plan.

4.2.1 Management Measure Effectiveness

The groundwater model will be validated periodically via comparison of monitoring results with modelled predictions. Re-calibration will occur as necessary, and an independent review of the model will occur every three years. Groundwater monitoring results will be compared to groundwater model predictions on an annual basis to assess actual versus predicted groundwater levels and/or drawdown (i.e. height of depressurisation), and groundwater inflows to the mine. This analysis will be incorporated in regular groundwater compliance reporting, such as the Annual Review and/or Six-monthly Review

Aligned with completion of model re-calibration the trigger levels dependent on modelling outputs will be reviewed and updated as necessary.

4.3 Monitoring

Groundwater monitoring will be undertaken in accordance with the relevant Australian Standards legislation and EPA approved methods for sampling, including (but not limited to):

- NSW DECC (2004) Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales.
- AS/NZS 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques, and the Preservation and Handling of Samples.
- AS/NZS 5667.11:1998 Water Quality - Sampling - Guidance on Sampling of Groundwaters.

Groundwater monitoring has commenced across all Tahmoor South monitoring sites for both groundwater levels and groundwater quality.

4.3.1 Tahmoor South Monitoring Network

The Tahmoor South Monitoring Network currently consists of a series of multi-level Vibrating Wire Piezometers (VWPs), Open standpipes (OSPs) and private bores.

The standpipe piezometers can be used for monitoring water levels manually or with an automated datalogger (installed in 10 sites to date), as well as for collection of water samples for groundwater quality monitoring purposes. The VWPs are grouted and therefore can only be used for monitoring groundwater pressures, but do allow for multiple instruments to be installed at different depths within a single borehole.

The network answers to the requirement of the Consent Conditions and EIS Commitments in addition to the key receptors identified, as detailed in the Groundwater Monitoring Plan provided in **Appendix B** (SLR, 2021h). The Groundwater Monitoring Plan is an active document, updated as implementation occurs.

In addition to the proposed 'Tahmoor South' network, monitoring results associated with Tahmoor North and the Western Domain have been incorporated into the numerical groundwater modelling, and where purposeful, into the Tahmoor South network (i.e. in the footprint of a Tahmoor North longwall). Additionally, monitoring in longwall centrelines of pre- and post-mining conditions at Tahmoor South will be undertaken for the longwall (LW101A), 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.

Please note, the Monitoring Plan currently references historic longwall names, which will be updated in subsequent versions.

4.3.1.1 Groundwater Monitoring Regime

Pre-extraction monitoring regimes for both groundwater level and quality are described below. The frequency of monitoring and the parameters to be monitored may be varied in consultation with regulators, during extraction as per adaptive management strategies. It is proposed that quarterly sampling may be suitable post-establishment of baseline conditions (24 months or more, at most sites, but 12 months of sampling at some sites near to LW 101A), with adjustments in frequency made as extraction progresses and based on proximity to the position of the active longwall.

4.3.1.1.1 GROUNDWATER LEVEL MONITORING

Prior to commencement of extraction groundwater level data have been collected on a monthly basis, or where loggers are installed, downloaded monthly. This is suitable to determine baseline aquifer conditions.

This monthly monitoring regime is continuing throughout extraction. However, during extraction in previous mining areas, Tahmoor Coal has demonstrated responsiveness to variability in groundwater levels that may be resultant of mining, via adaptive management practices. Consequently, the frequency of monitoring may be varied in consultation with DPE or advisory panels (or similar) as required.

Post-mining monitoring will continue with continuous recording for loggers and quarterly manual measurements of water level for 12 months following completion of the longwalls or as required in accordance with the Rehabilitation Plan.

4.3.1.1.2 GROUNDWATER QUALITY MONITORING

Monthly sampling was undertaken prior to longwall extraction occurring near to the monitoring points,. Ongoing monthly quality monitoring is currently underway. Frequency of monitoring may be reduced at some sites post collection of 24 baseline data points, dependent on intent and location (i.e. those more pertinent to the B-block, and not intended to be mined before 2024 may only require quarterly sampling).

Collection of field parameters will occur monthly, inclusive of:

- pH;
- Electrical Conductivity – EC ($\mu\text{S}/\text{cm}$);
- Total Dissolved Solids – TDS (mg/L).

A full suite of groundwater chemistry will be sampled monthly, inclusive of:

- Major ions: Ca, K, Na, Mg, F, Cl, SO_4 ;
- Total phosphorus and total nitrogen;
- Total alkalinity as CaCO_3 , HCO_3 , CO_3 , DOC; and
- Total and dissolved metals: (Fe, Mn, Cu, Pb, Zn, Ni, Al, As, Se, Li, Sr, Co, Ba).

4.3.2 Private Bore Monitoring

The private landholder bores census was concluded in March 2022. The Tahmoor Coal Community Liaison Specialist attempted to contact all pertinent landholders, with a total of forty bores surveyed. Where possible, the following information was collected;

- Current bore status (operational, destroyed, etc);
- Bore location and top of casing (surveyed);
- Bore equipment;
- Current use regime;
- Groundwater level;
- Groundwater quality (as per the regime described above);
- Land access agreements and suitability for routine monitoring.

The OSP monitoring network was developed to capture suitable spatial representation of the Hawkesbury Sandstone to capture potential impact to private bores. Additionally, six bores have been selected for inclusion into the ongoing monitoring regime. This selection was made on the suitability of the bores, land access agreements and spatial distribution.

4.3.3 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.

Operational water balance reviews will continue to be performed monthly collating groundwater extractions, as well as imported water to inform on-site water management. The 'groundwater inflow' calculated from the water balance is a licensable 'groundwater take' as per the AIP and *Water Management Act 2000*.

4.3.4 Post-mining groundwater Levels and Quality

The Tahmoor Commitments request to "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". It is recommended that monitoring of WD02 for post-mining water levels and P14P116 for water quality are a suitable to meet the post-mining monitoring requirements. **Figure 11** shows the location of these bores, with their proximity to the proposed site (previously TNC029). Re-instating this specific bore is not seen to add value to the network beyond the existing bores that can provide the required post-mining information.

4.3.5 Monitoring Equipment Effectiveness

Annual reviews of the monitoring network will be undertaken to assess the condition of the monitoring bores and associated equipment. Monitoring will be undertaken as per the standards described above, with equipment maintained to meet these standard requirements.

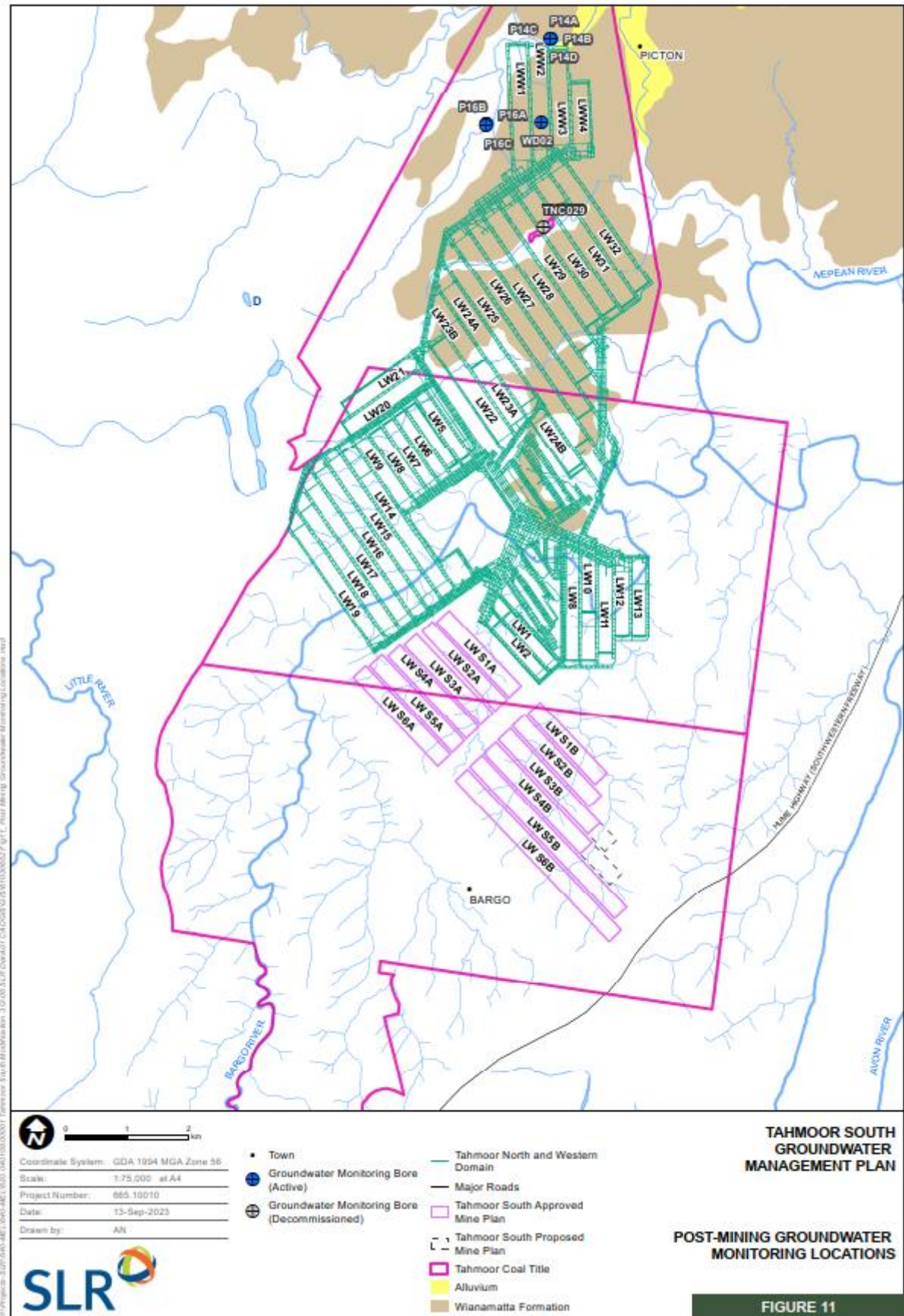


Figure 11: Post-mining groundwater monitoring locations

4.4 Contingency Plan

4.4.1 Trigger Action Response Plans

In accordance with Condition 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 the Trigger Action Response Plans (TARP) provided in **Appendix G**.

The primary actions of the TARP are to:

- Define appropriate trigger levels for ‘shallow’ and ‘deep’ groundwater levels, groundwater quality (pH, EC and metals) at monitoring bores and private bores;
- 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 a performance measures are exceeded or are likely to be exceeded and describe the management / corrective actions to be implemented (i.e. notifications to relevant agencies, groundwater monthly/quarterly reviews, revision in any Corrective Action Management Plan and/or Annual Reviews).

It is important to note that the Conditions refer to compliance with the “relevant performance measures listed in Table 4 (of the commitments)”, however Table 4 is only pertinent to Surface Water and not groundwater. The only exclusion to this is the Performance Measure referring to Groundwater Dependent Ecosystems (GDEs) including Thirlmere Lakes, for which the performance measure states;

- Negligible impacts including;
 - Negligible change in groundwater levels; and
 - Negligible change in groundwater quality.

This performance measure applies to the TARP titled “WMP13 - Groundwater Bores Monitoring for Thirlmere Lakes.

Each TARP has four levels of triggers – “Normal Conditions” - being where the environment is behaving or performing within normal or expected levels, through to Level 3 (L3) each with escalating risk to the environment via deviation from baseline or expected conditions.

The success of remediation measures that have been implemented for any TARP exceedance would be reviewed as part of any Corrective Action Management Plan and Six-monthly reporting, the latter which would provide an opportunity to review and update existing triggers if deemed necessary.

A total of six TARPS (TARP WMP8 to WMP13) are required to address various components of the groundwater system, including:

- WMP8 – Shallow Groundwater Levels (Open standpipes and private bores);
- WMP9 – Shallow Groundwater Pressures (VWP Sensors < 200 m depth);
- WMP10 – Groundwater Level / Pressure Deep VWPs (> 200 m depth excluding monitoring the Bulli Coal Seam);
- WMP11 – Groundwater Quality (Open standpipes and private bores);
- WMP12 – Groundwater – Surface-water interaction; and
- WMP13 – Groundwater Bores Monitoring for Thirlmere Lakes.

The TARPS are provided to work in conjunction with not only each other, but also other TARPS within the overarching Water Management Plan to provide a holistic approach to the overall management of the water system.

4.4.1.1 Methodology for Derivation of Triggers

Trigger levels have been developed utilising baseline data in conjunction with modelled drawdown predictions and climate data.

Historical data indicates that significant mining-related drawdown or depressurisation (tens to hundreds of metres) is typical in strata deeper than 200 metres below ground (mBG), and drawdown or depressurisation is less severe and less persistent in strata shallower than 200 mBG. Consequently, trigger levels have been set independently for these depth profiles.

4.4.1.1.1 GROUNDWATER LEVELS

Shallow monitoring (<200 metres)

In the Western Domain, climatic variations have not caused reductions in groundwater levels at shallow open-standpipe bores in excess of 2 m (SLR,2021). Differences at VWP's observed due to climatic variation, however, were observed to cause reductions in water levels of up to 5 m. Therefore, a water level reduction of greater than 2 m for shallow standpipe bores and 5 m for shallow VWP loggers for a period beyond 6 months was considered to be a possible indicator of greater than predicted impacts to groundwater (even if greater drawdown was predicted, the concept is to use this magnitude of drawdown as an early warning).

Shallow OSPs

The TARP Significance Levels (1, 2 and 3) will be assigned a trigger corresponding to a calculated groundwater elevation for each groundwater monitoring bores. For monitoring sites with short baseline periods (<6 months), the maximum groundwater level observed during pre-mining has been used as reference levels in the TARP level calculations. For bores with a longer baseline, the reference level has been defined following a review of the baseline data. **Table 14.**

Table 14 Shallow Monitoring Bore Trigger Levels

Bore ID	Groundwater Levels (mAHD)		
	TARP Level 2	TARP Level 3	TARP Level 4
Shallow OSP			
P51A	296.3	292.4	288.5
P51B	297.5	293.6	289.7
P52	246.7	244.6	242.5
P53A	255.8	253.7	251.6
P53B	255.8	253.7	251.6
P53C	253.6	251.4	249.1
P54A	260.7	259	257.4
P54B	259.9	258.2	256.6
P55A	271.1	269.7	268.2
P55B	266	264.4	262.9
P55C	259.7	258.2	256.6
P56A	288.2	284.8	281.4
P56B	278.9	275.5	272.1
P56C	257.4	254.1	250.7
REA4	248.3	246.2	244.1
Private Bores			

GW104008	234.7	234	233.2
GW104323	256.9	256.8	256.8
GW104659	249.8	243.6	237.4
GW105395	322.1	modelled DDN is equal to 2m	modelled DDN is equal to 2m
GW109257	280.9	278.9	276.9
GW112473	317.1	modelled DDN less than 1m	modelled DDN less than 1m

Shallow VPS

Regionally, climatic variations have been observed to cause reductions in water levels of up to 5 m in shallow (< 200 m depth) VWP. Therefore, a water level reduction of greater 5 m for shallow VWP loggers for a period beyond 6 months is considered to be a possible indicator of greater than predicted impacts to groundwater (even if greater drawdown was predicted, the concept is to use this magnitude of drawdown as an early warning).

A reference level has been generated for each VWP sensor, based on the average groundwater level observed prior to commencement of extraction.

At most sites the average groundwater levels sits at levels observed prior to the 2017-2019 NSW drought and in some cases to levels observed during the wetter conditions in 2021. This makes the groundwater level average a conservative reference level.

TARP Level 1 (L1) was then calculated as Reference level (mAHD) minus 5 m which is consistent with approaches adopted elsewhere at Tahmoor Mine (i.e. for the Western Domain).

Elsewhere at Tahmoor Mine, TARP Level 3 (L3) has been based on the maximum modelled drawdown and calculated as Reference Level minus maximum modelled drawdown. The maximum modelled drawdown at the reference sites ranges from 0 m to 3.3 m which is smaller than the adopted 5 m natural fluctuations to derive TARP L1. This results in some cases in the TARP L3 being higher than TARP L1.

Therefore, instead of calculating TARP L3 as “Reference Level minus maximum modelled drawdown”, TARP L3 is calculated as “TARP L1 minus the maximum modelled drawdown”. TARP L3 now lies below TARP L1.

TARP Level 2 (L2) is calculated as the average of L1 and L3.

Some VWP sensor are assigned model Layer 1 (i.e. TBC024 HBSS-117m; TBC027-HBSS-95m, TBC034-HBSS-65m). No drawdown is simulated in Layer 1 at those sites hence no TARP Level 2 and 3 can be derived here.

Trigger levels for the shallow VWP sensors are provided in **Table 15**

Table 15 Shallow VWP Trigger Levels

Bore	Groundwater Trigger Level (mAHD)			Model Layer
	TARP Level 1	TARP Level 2	TARP Level 3	
TBC024 - HBSS 117m	282.6	-	-	1
TBC024 - HBSS 139m	282.0	281.5	281.0	5
TBC024 - BHCSS 168m	284.5	283.6	282.8	6
TBC024 - BGSS 185m	284.3	282.3	280.3	8
TBC027 - HBSS-95m	315.1	-	-	1

TBC027 - HBSS-132m	307.8	307.6	307.3	5
TBC027 - HBSS-169m	307.2	307.0	306.8	5
TBC027 - BHCS-181m	305.7	305.5	305.3	16
TBC027 - BGSS-198m	305.3	305.1	304.9	8
TBC034 - HBSS-65m	366.8	-	-	1
TBC034 - HBSS-113m	363.0	362.7	362.3	4
TBC034 - HBSS-161m	353.4	353.1	352.8	4
TBC034 - BHCS-176m	349.9	349.4	348.9	16
TBC034 - BGSS-196m	353.3	352.1	350.9	8
TBC038 – XXX*	tbc	tbc	tbc	
TBC09-HBSS-30m	tbc	tbc	tbc	1
TBC09-HBSS-75m	304.4	304.2	304.1	2
TBC09-BHCS-182m	288.0	287.4	286.8	15
TBC09-BGSS-192m	285.4	285.2	285.0	8
TBC018 - WWFM/HBSS-70m	tbc	tbc	tbc	1
TBC018 - WWFM/HBSS-117m	246.9	246.6	246.2	1
TBC018 - HBSS (lower)-164m	245.7	245.4	245.1	5
TBC018 - BHCS-179m	243.5	243.1	242.8	3
TBC018 - BGSS-198m	239.7	237.8	236.0	8
TBC032 - HBSS-95m	257.3	256.7	256.2	4
TBC032 - HBSS-131m	250.0	249.3	248.6	5
TBC032 - HBSS-168m^	261.9	261.1	260.4	5
TBC032 - BHCS-181m	237.8	228.7	219.5	6
TBC032 - BGSS-200m	238.8	208.7	178.7	8
TBC033 - HBSS-65m	279.9	279.2	278.6	3
TBC033 - WWFM/HBSS-113m	273.3	272.7	272.0	1
TBC033 - HBSS (lower)-161m	263.6	262.9	262.2	5
TBC033 - BHCS-173m^	235.4	213.8	192.3	16
TBC033 - BGSS-190m	230.2	217.7	205.2	8

* Data unavailable (tbc) = to be confirmed, ^potential issues with VWP stability but trigger levels still reported

Deep monitoring (> 200 metres)

For bores that monitor depths greater than 200 m groundwater level monitoring results will be compared to groundwater model predictions on an annual basis comparing actual groundwater levels with predictions. In the event that monitoring data suggests divergence from the predicted trends (i.e. from numerical groundwater modelling predictions), the TARP would be enacted.

Each trigger level is associated with level of deviation from modelled predicted drawdown and period of time for which this deviation is experienced:

- Normal Conditions – Observed drawdown does not exceed modelled impacts predicted drawdown by greater than 30 metres. Observed drawdown exceeds the modelled predicted drawdown by greater than 30 metres for less than three consecutive months;

- Level 1 (L1) – Observed drawdown exceeds the modelled predicted drawdown, by greater than 30 metres for greater than three consecutive months;
- Level 2 (L2) – Observed drawdown exceeds modelled predicted drawdown by more than 30 metres for a greater than 6 consecutive months; and
- Level 3 (L3) – Observed drawdown exceeds modelled predicted drawdown for 12 consecutive months or more.

Bores encompassed within this TARP, including the associated model layer, are provided in **Table 16**, with associated predicted drawdown hydrographs provided in the LW S1A – S6A Extraction Plan, Groundwater Technical Report.

Table 16 Deep VWP Sensors and associated model layers

Bore	Model Layer	Model Geology
TBC09_322	8	BUSS Mid
TBC09_343	8	BUSS Mid
TBC09_357	12	SBSS Lower
TBC09_381	10	SPCS
TBC09_391	15	Bulli Seam
TBC09_397	17	Wongawilli
TBC18_282	8	BUSS Mid
TBC18_366	8	BUSS Mid
TBC18_377	13	WBCS
TBC18_404	15	Bulli Seam
TBC18_426	17	Wongawilli
TBC18_432	17	Wongawilli
TBC20_211	8	BUSS Mid
TBC20_293	8	BUSS Mid
TBC20_375	8	BUSS Mid
TBC20_397	13	WBCS
TBC20_411	7	BUSS Upper
TBC20_434	17	Wongawilli
TBC20_439	4	HBSS Mid
TBC26_211	8	BUSS Mid
TBC26_278	8	BUSS Mid
TBC26_344	8	BUSS Mid
TBC26_409	13	WBCS
TBC26_432	15	Bulli Seam
TBC26_440	16	Eckersley
TBC26_460	16	Eckersley
TBC32_200	8	BUSS Mid
TBC32_237	8	BUSS Mid
TBC32_257	8	BUSS Mid

TBC32_294	8	BUSS Mid
TBC32_314	8	BUSS Mid
TBC33_247	8	BUSS Mid
TBC33_306	8	BUSS Mid
TBC33_363	11	SBSS Upper
TBC33_384	16	Eckersley
TBC33_408	16	Eckersley
TBC39_243	8	BUSS Mid
TBC39_299	8	BUSS Mid
TBC39_354	11	SBSS Upper
TBC39_375	16	Eckersley
TBC39_402	16	Eckersley

Bulli Coal Seam

It is expected that the TARP will exclude loggers located in the Bulli Coal Seam on the basis that as this is the target coal seam, significant depressurisation effects are expected due to dewatering of mine workings. Additionally, there are no other groundwater users of this aquifer (environmental or anthropogenic), other than mines, that warrant the need to investigate head changes in this unit. However, monitoring will be undertaken and undergo review alongside the loggers included in the TARP.

4.4.1.1.2 GROUNDWATER QUALITY

The proposed methodology for calculating trigger values for EC, pH and metals at Tahmoor South monitoring bores and private bores is presented here. The proposed TARP is provided in **Appendix G**.

EC

Electrical conductivity (EC) is a measure of salinity and is used for monitoring of changes to groundwater salinity. Baseline data has undergone review and data cleansing prior to derivation of triggers. A single trigger level will be established for each bore, as the maximum observed EC in the pre-mining/early mining record plus ten per cent of that value.

pH

Each bore has been assigned a lower and upper trigger level, to represent the natural fluctuations in pH and enable capture of groundwater changes to more basic or acidic conditions. Baseline data (pre-mining and early-mining) has undergone review and data cleansing. Triggers are based on the minimum and maximum pH values recorded in the available dataset minus/plus 1 pH unit if the max/min pH are within four pH units (otherwise, just max/min are utilised). Again, regional data will be taken into consideration.

Dissolved Metals

A single trigger level concentration for metals has been assigned to the Tahmoor South monitoring bores and the private bores. Triggers have been derived for dissolved metals and total iron (Fe).

The trigger has been set at the 95th percentile value of all available baseline data to date.

4.4.1.2 Adaptive Management via TARPs

Adaptive Management is the implementation of management strategies as required dependent on ongoing outcomes and impacts of mining. For example, if surface water losses are identified, additional

management will be implemented to review this from a groundwater perspective (i.e. groundwater–surface water interaction study). Hence, adaptive management is responding to changing requirements for management based on ongoing review of data. Consequently, the two TARPs presented here have strong links to other primary TARPs and utilise the same network.

Groundwater – Surface Water Interaction

The Tahmoor South monitoring network has been developed to provide pertinent information on baseflow relationships with nested surface water and groundwater monitoring sites. Groundwater data would be reviewed alongside complementary monitoring.

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.

This TARP references Biodiversity Management Plan TARP – Riparian Vegetation (BMP3), which specifically defines levels of deviation in riparian vegetation condition from normal conditions and the actions required to be implemented in response to each level of deviation. The riparian vegetation can be considered a GDE with relevant Performance Measure, managed under the Riparian Vegetation TARP, supported by this TARP. TARP BMP3 will be enacted via this TARP as well as via its own specific criteria, to support investigations providing a holistic review of groundwater and surface water in relation to GDEs.

Groundwater Bores Monitoring for Thirlmere Lakes

The Thirlmere Lakes have a specific series of bores aimed at monitoring potential impacts on the Lakes resulting from longwall extraction. The network is designed to provide an early warning system of changes in groundwater conditions that may indicate a potential impact to Thirlmere Lakes, via a cross section of data between mine operations and the Lake, including the following sites:

- “Early warning” bores: GW062068, GW104659, TBC039 (sensor at 65 metres in Hawkesbury Sandstone (HBSS))
- “Thirlmere Lakes” bores: GW075409–1, GW075409–2, GW075410, GW075411 (paired with gauging station 212066) and proposed sites: P50a, P50b, P50c

Trigger levels are linked to the shallow water level and water quality triggers defined in their specific TARPs. Given the Thirlmere Lakes are considered GDEs, the relevant Performance Measure is incorporated, being;

- GDE Performance Measure: Negligible impacts including:
- Negligible changes in groundwater levels; and
- Negligible changes in groundwater quality.

4.4.2 Potential Ameliorative Actions – Private Bores

The monitoring network described above, provides water level and quality data at an adequate spatial and temporal scale to undertake investigations into potential impacts to existing groundwater users.

In accordance with Condition B26 – B29 of the Tahmoor South Domain Consent (SSD 8445), where a mining related impact has occurred at a private bore, Tahmoor Coal will implement a make good process.

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 their bore’s level or water quality has declined triggering an assessment into the potential cause (i.e. mining related). If it is deemed that the mine is responsible, then remedial action would be implemented, potentially deepening and/or replacing bores and wells, and/or providing an alternative water source to affected users.

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 incur 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, 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 negotiate a make good agreement. This agreement would include specific make good mitigation measures and outline a potential timeframe for undertaking these measures, if required. 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 re-establishment of saturated thickness in the affected bore(s) through extending the depth of the pump, or deepening of the bore(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 is not straight or vertical);
- 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); or
- Compensation to reflect increased water extraction costs (e.g. due to lowering pumps or installation of additional or alternative pumping equipment).

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.

4.5 Adaptive Management/Continuous Improvement

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

- a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;

- b) 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;
- c) 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
- d) implement reasonable remediation measures as directed by the Planning Secretary

Tahmoor Coal have adopted the “Plan-Do-Check-Act” model as shown in **Figure 12**. 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.

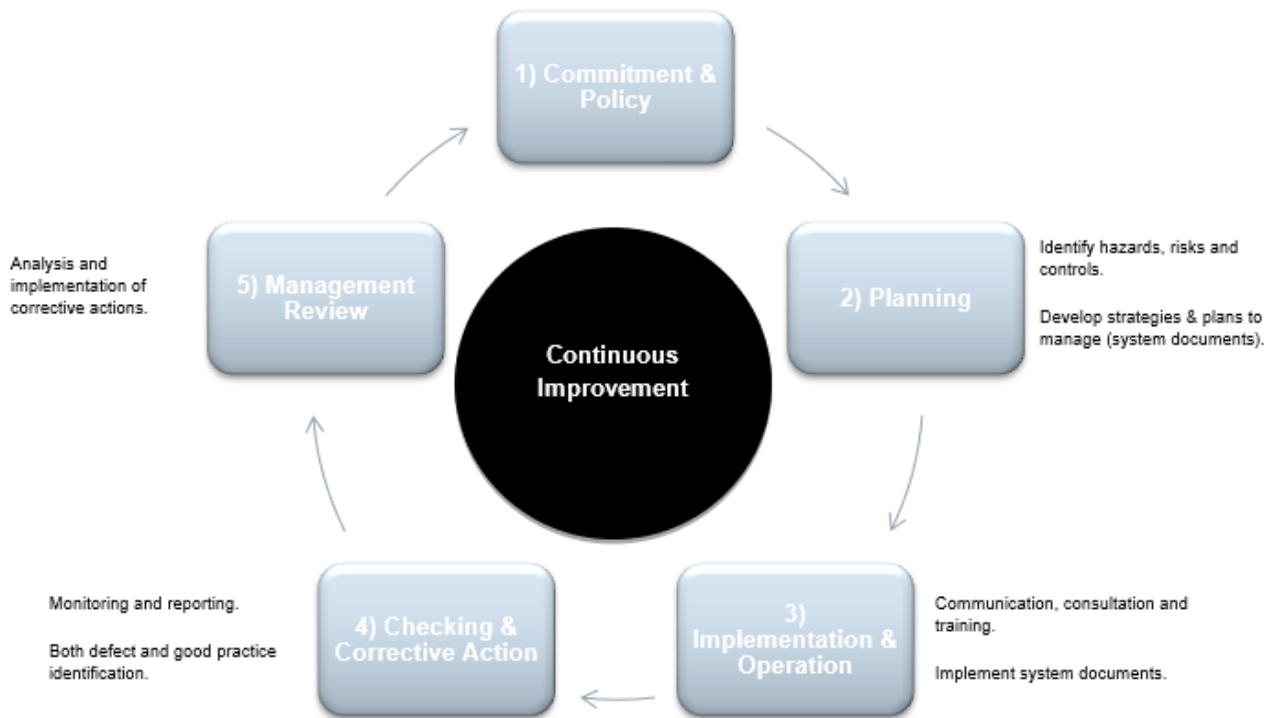


Figure 12: Continuous Improvement Model

5 Implementation and Reporting

5.1 Tahmoor Environmental Management System (EMS) Framework

The Tahmoor Environmental Management System (EMS) Framework provides the strategic context for the environmental management of Tahmoor Coal and forms part of the broader Health, Safety, Environment and Community (HSEC) management systems at Tahmoor Coal. The EMS outlines how Tahmoor Coal manages environment and community (E&C) aspects, impacts and performance. It provides a framework for the standards, plans and procedures implemented to ensure operations are managed in accordance with the ISO:14001 principles.

The objectives of the EMS are:

- a) To provide an overall framework for environmental management at Tahmoor utilising the principles of ISO:14001;
- b) To ensure compliance with all development consent, licences and approvals at Tahmoor Coal;
- c) To detail the relationship and interactions between various operational and environmental components at Tahmoor Coal;
- d) To provide effective mechanisms for external communications, maintaining a relationship with the local community; and
- e) To assist Tahmoor Coal employees and contractors in administering their responsibilities regarding environmental management.

This plan will be implemented in conjunction with the EMS framework.

5.2 General Reporting

General reporting requirements in accordance with Consent Condition E13 and E14, including submitting an Annual Review by the end of March each year (or other timeframe agreed by the Planning Secretary). The Annual Review will:

- a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;
- b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, including a comparison of these results against the:
 - i. relevant statutory requirements, limits or performance measures/criteria;
 - ii. requirements of any plan or program required under this consent;
 - iii. monitoring results of previous years; and
 - iv. relevant predictions in the EIS (or updated and contemporary modelling, as required by agencies).
- c) identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence;
- d) evaluate and report on:
 - i. the effectiveness of the noise and air quality management systems; and
 - ii. compliance with the performance measures, criteria and operating conditions of this consent;
- e) identify any trends in the monitoring data over the life of the development and provide any raw monitoring data as requested by the Planning Secretary;
- f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
- g) describe what measures will be implemented over the next calendar year to improve the environmental performance of the development.

Copies of the Annual Review must be submitted to Council and relevant agencies and made available to the CCC and any interested person upon request.

5.3 Incidents

The Consent defines an incident as *‘an occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance’*.

Material Harm is defined within the Consent as “harm to the environment that:

- involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or results in actual or potential loss or property damage of an amount, or
- amounts in aggregate, exceeding \$10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)”.

This definition excludes “harm” that is authorised under either this consent or any other statutory approval.’

Tahmoor Coal manages and responds to incidents in accordance with the following plans:

- a) Emergency and Incident Manual (TAH-HSEC-232).
- b) Pollution Incident Response Management Plan (TAH-HSEC-00155).
- c) Notification of Environmental Pollution Incidents (TAH-HSEC-00224).

These plans have been developed to manage preparation, incident response and reporting requirements under the Protection of the Environment Operations Act 1997 (NSW).

The management plans provide roles and responsibilities, management strategies, action and response plans and record management protocols for incidents and emergencies.

A Written Incident Notification will be submitted to the Planning Secretary via the Major Projects website within seven days after Tahmoor Coal becomes aware of an incident.

Written Incident Notifications will include:

- a) the development and application number;
- b) details of the incident (date, time, location, a brief description of what occurred and why it is classified as an incident);
- c) how the incident was detected;
- d) when Tahmoor Coal became aware of the incident;
- e) any actual or potential non-compliance with conditions of consent;
- f) describe what immediate steps were taken in relation to the incident;
- g) identify further action(s) that will be taken in relation to the incident; and
- h) identify a project contact for further communication regarding the incident.

Within 30 days of the date on which the incident occurred or as otherwise agreed to by the Planning Secretary, Tahmoor Coal will provide the Planning Secretary and any relevant public authorities (as determined by the Planning Secretary) with a Detailed Incident Report.

Detailed Incident Reports will include:

- a) a summary of the incident;
- b) outcomes of an incident investigation, including identification of the cause of the incident;
- c) details of the corrective and preventative actions that have been, or will be, implemented to address the incident and prevent recurrence; and
- d) details of any communication with other stakeholders regarding the incident.

5.4 Non-Compliances

The Consent defines a non-compliance as ‘an occurrence, set of circumstances or development that is in breach of the consent’.

Non-compliances or system defects detected during monitoring, inspections and audits will be managed in accordance with the Tahmoor Coal Environmental Management Framework Document (TAH-HSEC-00173), with corrective action plans developed and implemented to rectify any issues.

The Planning Secretary will be notified in writing via the Major Projects website within seven days after Tahmoor Colliery becomes aware of any non-compliance.

If a non-compliance is detected, the following steps will be followed:

- a) Identify and confirm the non-compliance (i.e. review against approval criteria or condition and confirm that a non-compliance has occurred);
- b) Complete internal environmental incident reporting documentation including an investigation to capture all relevant information;
- c) In accordance with the relevant approval, determine what action (i.e. external reporting) is required. Specifically, determine if immediate reporting is required and to which stakeholders, or ensure that the event is captured for future reporting;
- d) Following the incident investigation, develop a corrective action plan aimed at preventing future re-occurrence; and
- e) Complete all required reporting and consult with relevant agencies on the corrective action plan to be implemented.

A non-compliance notification will identify the following:

- a) the development and the application number,
- b) the condition of consent that the development is non-compliant with
- c) the way in which it does not comply and the reasons for the non-compliance (if known); and
- d) any actions which have been, or will be, undertaken to address the non-compliance.

A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

5.5 Exceedances

For the purposes of this plan, an exceedance is defined ‘any instance where monitoring results show an exceedance of criterion outlined within the Consent or other regulatory instrument’.

Exceedances will be managed by Tahmoor Coal through the Contingency Plan and TARP process as outlined in **Section 4.4** and **Appendix G**.

Exceedance reporting will occur as per the response in the Trigger Actions Response Plans, with reporting to DPIE (and other relevant agencies) within 7 days of investigation completion where a TARP Level 4 has occurred.

5.6 Complaints and Disputes

Community Complaints at Tahmoor Coal are managed in accordance with *TAH-HSEC-00119- Communication and Engagement* and *TAH-HSEC-00120- Community Complaints & Enquiry Procedure*. Tahmoor Coal operates a 24-hour complaints line (1800 154 415) for receiving community complaints and other stakeholder communications. The general process detailed in *TAH-HSEC-00120- Community Complaints & Enquiry Procedure* for responding to complaints is:

- a) Acknowledging all complaints and responding to the complainant within 24 hours where practicable;
- b) Registering all complaint details in Cority;

- c) Investigating complaints impartially considering the facts and the circumstances prevailing at the time;
- d) Implementing corrective actions if required; and
- e) Reporting to relevant stakeholders of investigation outcomes and corrective actions taken.

A record of all community complaints in relation to activities undertaken by the licensee must be kept in a legible form and be in accordance to Tahmoor Coal's Environmental Protection Licence (EPL) 1389.

The following information will also be kept in the event of a community complaint, as required by Section M4 in Tahmoor Coal's EPL 1389:

- a) The date and time of the complaint;
- b) The method by which the complaint was made;
- c) Any personal details of the complainant which were provided by the complainant or a note to that effect;
- d) The nature of the complaint;
- e) The action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
- f) If no action was taken by the licensee, the reasons why no action was taken.

These records must be kept for at least 4 years after the complaint was made and be able to be produced to any authorised officer who asks to see them.

In the event of a dispute or conflict between Tahmoor Coal personnel and a member of the community, the Tahmoor Coal E&C Manager will facilitate communication between both parties to reach a resolution, which may include a meeting with the complainant to discuss the issue.

Where relevant, negotiations will be initiated in accordance with any relevant Consent conditions. This general process is documented in *TAH-HSEC-00119- Communication and Engagement*. If a dispute cannot be resolved, the matter will be escalated to involve the site Operations Manager or General Manager as required and may involve consultation with the relevant government agency to assist in reaching a determination on the matter

5.7 Risk and Change Management

Aspects and impacts at Tahmoor Coal are considered for operational activities, legislative requirements and internal and external stakeholder views. Key environmental aspects and impacts are identified during the annual review of the Tahmoor Coal Environment and Community (E&C) Broad Brush Risk Assessment (BBRA) and the operational Life of Mine (LOM) Risk Assessment and Site Wide Broad-Brush Risk Assessment (Mine BBRA).

The purpose of the E&C BBRA is to identify significant E&C aspects and impacts across the site, the risk they pose and the controls necessary to effectively manage them. Management of potential impacts is prioritised according to the level of risk each aspect is assigned. Once all identified aspects, impacts, risks and management controls have been identified within the Annual E&C Risk Assessment, associated plans are updated accordingly.

The purpose of the Mine BBRA is to identify significant aspects and impacts of operations at a site level. Existing or proposed management controls are identified to reduce the risk of impacts on the E&C. The need for any new (or modifications to existing) approvals is also identified during this process.

The LOM Risk Assessment considers aspects and impacts of business activities at a strategic level. These risk assessments cover the life of mine risks associated with each operation. The outcomes of the LOM Risk Assessment are used in conjunction with the Tahmoor Coal E&C BBRA and Mine BBRA to develop the annual capital and operational budget and the associated work schedule.

In accordance with Tahmoor Coal's Health & Safety Management System, project and activity specific risk assessments are completed as required and include assessment of E&C risks.

5.8 Roles & Responsibilities

E&C management is regarded as part of the responsibilities of all employees and contractors at Tahmoor Coal. Specific information pertaining to the role, responsibility, authority and accountability of key personnel involved in environmental management at Tahmoor Coal is provided in **Table 17** below.

Table 17 Accountabilities

Role	Accountabilities for this document
Operations Manager	Provide adequate environmental personnel/resources for implementation of this plan and associated plans.
Environment & Community Manager	Facilitate a process of managing overall compliance with regulatory requirements and undertake external reporting for legislative non-compliances as required. Determine adequate resources and funds are available to ensure the effectiveness of this procedure; and certify compliance and adherence to this plan. Develop, implement and maintain this plan. Liaise with relevant government authorities in relation to regulatory conditions and compliance issue. Liaise with the community as required and as per the Stakeholder Engagement Strategy, including facilitation of Community Consultative Committee meetings.
All Managers	Activities under their control are to be undertaken in accordance with this plan and associated management plans and site procedures. Manage environmental controls within their jurisdiction are operated and maintained in a proper and efficient manner. Report all environmental incidents and complaints in a timely manner.

Role	Accountabilities for this document
Environmental Specialist	Responsible for coordinating environmental compliance on-site including timely completion of monitoring and reporting in accordance with internal and external requirements. Sign off on the accuracy of reports and the suitability of recommendations. Develop, implement, review and maintain this plan and system documents. Implement process for self-assessment audits. Assign persons responsible for completion of audit actions and set a due by date. Monitor that planned actions arising out of audits are implemented. Ensure all community complaints are addressed, investigated and appropriately managed as per site procedures, and reported internally as per internal requirements.
All Coordinators	Activities under their control are to be undertaken in accordance with this plan and associated management plans and site procedures. Manage environmental controls within their jurisdiction are operated and maintained in a proper and efficient manner. Report all environmental incidents and complaints in a timely manner.
All Persons	Activities under their control are to be undertaken in accordance with this plan and associated management plans and site procedures. Manage environmental controls within their jurisdiction are operated and maintained in a proper and efficient manner. Report all environmental incidents and complaints in a timely manner.

5.9 Internal Audits & Reviews

In accordance with internal company requirements, Tahmoor Coal has implemented a system for the monitoring and review of E&C performance at the site. Tahmoor Coal is to provide ongoing monitoring and regular management review of E&C performance to:

- Confirm the adequacy and effectiveness of management plans, procedures and standards;
- Address any identified weaknesses;
- Share good performance and lessons learnt with other sites; and
- Ensure ongoing compliance with all leases, licences and approvals.

Process or area specific internal audits are also conducted periodically, generally administered by the General Manager E&C, focussing on the following areas:

- Air quality;
- Water management;
- Erosion and sediment control; and
- Statutory approvals.

These audits may be conducted by consultants on behalf of Tahmoor Coal, by Liberty GFG employees or may be self-assessments conducted by Tahmoor Coal personnel. Audit results and corrective actions are recorded in Cority and assigned to responsible personnel for completion within appropriate timeframes.

5.10 Independent Environmental Audit

In accordance with Conditions E15 – E20 of the Consent, Tahmoor Coal will complete Independent Environmental Audits of the development at the frequencies determined within DPE's Independent Audit Post Approval Requirements (2020), and outlined below in **Table 18**.

Table 18 Independent Audit Frequencies

Phase	Initial Independent Audit	Ongoing Independent Audit Intervals
Construction	Within 12 weeks of the commencement of construction	At intervals, no greater than 26 weeks from the date of the initial Independent Audit or as otherwise agreed by the Secretary.
Operation	Within 26 weeks of the commencement of operation	At intervals, no greater than 3 years or as otherwise agreed by the Secretary.
Closure /Rehabilitation	Within 52 weeks from notifying of suspension/ceasing of operations	At intervals no greater than 1 year or as otherwise agreed by the Secretary.

The audits will assess:

- a) Environmental performance of the Mine;
- b) Compliance with the requirements of all relevant:
 - i. Development consents;
 - ii. Mining leases;
 - iii. Exploration Authorisations; and
 - iv. Site environmental protection licence

The audit will also assess:

- a) Environmental assessments; and
- b) Plans and programs required by above approvals.

The audit will review the adequacy of the following requirements under the abovementioned approvals:

- a) Strategies;
- b) Plans; and
- c) Programs

The audit will recommend appropriate measures and corrective actions to improve environmental performance at Tahmoor Coal. Audit results and corrective actions are recorded in Cority and assigned to responsible personnel for completion within appropriate timeframes.

5.11 Employee & Contractor Training

Environmental training for Tahmoor Coal employees and contractors is conducted in accordance with the Environment & Community Training Needs Analysis, which Tahmoor Coal manages through the Scenario Training Database. General environmental awareness training is provided to all employees and contractors annually through a generic visitor induction and the SafeCoal training session scheduled by the Tahmoor Coal Health, Safety & Training Department.

6 Review and Improvement

6.1 Plan Audit

Audits of the Groundwater 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 Groundwater 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 Groundwater Management Plan, they may also involve discussions with personnel involved in the management plan to determine understanding and compliance.

Should an audit of this Groundwater 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 Cority.

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

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

6.2 Plan Review

This **Groundwater Management Plan** will be reviewed:

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 Groundwater 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:

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

If deemed appropriate, external service providers may be included in the review process. All reviews are to be documented.

7 Document Information

Relevant legislation, standards and other reference information will be regularly reviewed and monitored for updates and will be included in the site management system. Related documents and reference information in this section provides the linkage and source to develop and maintain site compliance information.

7.1 Access to Information

Information pertaining to Tahmoor Coal's general environmental performance against internal targets and external approvals criteria is reported to the community via the mine website and Tahmoor Coal's Community Consultative Committee (TCCCC). Examples of reports to government agencies include:

- a) Environmental Protection Licence Annual Return (submitted to Environment Protection Authority);
- b) Annual Review (submitted to Department of Planning & Infrastructure, Council, TCCCC etc.); and
- c) Independent Environmental Audit (submitted to Department of Planning & Infrastructure).

These reports are prepared in accordance with relevant guidelines and *TAH-HSEC-00119- Communication and Engagement* and are published on Tahmoor Coal's website in accordance with *TAH-HSEC-00221- Website Management Procedure*.

7.2 Related Documents

Related documents, listed in the below table, are internal documents directly related to or referenced from this document.

Table 19 Related Documents

Number	Title
TAH-HSEC-00375	Tahmoor Coal Environmental Management Strategy
TAH-HSEC-00119	Communication and Engagement
TAH-HSEC-00120	Community Complaints & Enquiry Procedure
TAH-HSEC-00221	Website Management Procedure
TAH-HSEC-00031	Community Development Plan
TAH-HSEC-00381	Social Impact Management Plan
TAH-HSEC-00039	Stakeholder Engagement Plan
TAH-HSEC-00232	Emergency and Incident Manual

7.3 Reference Information

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

Table 20 Reference Information

Title
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SLR, 2022, Tahmoor South Private bore Survey, prepared for Tahmoor Coal, April 2022

SLR, 2022b, Groundwater Technical Report, LW S1A – S6A Extraction Plan, prepared for Tahmoor Coal, October 2022

8 Change Information

Table 21 Full details of the document history are recorded in the document control register, by version

Version	Date Reviewed	Review team (Consultation)	Change Summary
1.0	02/11/2021	Michelle Grierson, Natalie Brumby, Thomas O'Brien, April Hudson	New Document
2.0	17/06/2022	Natalie Brumby	Reviewed in accordance with Condition E7(b) of SSD 8445 following submission of the 2021 Annual Review to DPE. Reviewed in accordance with condition E7(e) of SSD 8445 following change in development phase under condition A9 (construction commencement on 16 th May 2022).
3.0	18/10/2022	Sharron Hulbert (SLR Consulting), Natalie Brumby	Reviewed in accordance with Condition E7(c), (d) and (e) following an Independent Environmental Audit (10 th August 2022), following the approval of any modification (Mod 1 approved 19 th July 2022) and following the commencement of first and second workings (18 th Oct 2022) of the Consent SSD 8445.
4.0	30/06/2023	Sharron Hulbert (SLR Consulting), Natalie Brumby	Reviewed in accordance with Condition E7(b) following the submission of an Annual Review (31 st March 2023) and Condition E7(c) following the submission of an Independent Environmental Audit (2 nd June 2023).
5.0	13/09/2023	Sharron Hulbert (SLR Consulting), Natalie Brumby	Reviewed in accordance with Condition E7(d) following the approval of any modification (MOD 2 - 13 th June 2023) of the Consent SSD 8445 and to incorporate recommendations from approved MOD 2 Development Consent. Section 4, Figures 6, 7 and 11, Tables 5, 7, 8, 11 and 14 updated.

APPENDIX A – Approval Letter (14/04/2022)



Planning,
Industry &
Environment

Zina Ainsworth
Environment & Community Manager
Tahmoor Coal Pty Ltd
2975 Remembrance Drive
Tahmoor, NSW, 2573

14/04/2022

Dear Ms. Ainsworth

**Tahmoor South Coal (SSD-8445)
Groundwater Management Plan**

I refer to the Groundwater Management Plan submitted in accordance with Condition B34(e)(v) of Schedule 2 of the Development Consent for Tahmoor South Coal (SSD-8445).

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions of consent.

Accordingly, the Secretary has approved the Groundwater Management Plan (Version 1, dated 2 November 2021). Please ensure that the approved plan is placed on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 3406.

Yours sincerely

A handwritten signature in black ink, appearing to read 'W Jones'.

Wayne Jones
Team Leader - Post Approval
Resource Assessments

As nominee of the Secretary

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APPENDIX B – Tahmoor South Groundwater Monitoring Plan

APPENDIX C – Baseline data for the REA and Pit-top Bores

APPENDIX D – On-site Storages – Groundwater Interaction Studies

APPENDIX E – Groundwater Modelling Plan

APPENDIX F – Groundwater Modelling Plan – Reviewer Endorsement

APPENDIX G –Trigger Action Response Plans (TARP)

APPENDIX H – Response from Agencies

Agency	Date Response Received	Comments	Response
EPA	29-11-2021	The EPA has reviewed the plan and notes that the groundwater monitoring sub-plan (Appendix C) has not been attached to the main document.	Appendix C appended
		The EPA recommends that a map showing the locations of the groundwater monitoring bores around the pit top and Reject emplacement Area be included in section 4.1.5.1.	Additional figure (Figure 8) included in Section 4.1.5.1, showing locations of REA and pit-top piezometers.