INDEPENDENT ADVISORY PANEL FOR UNDERGROUND MINING

ADVICE RE:

TAHMOOR SOUTH

LONGWALLS S1A – S6A

EXTRACTION PLAN

August 2022

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EXECUTIVE SUMMARY

Tahmoor South is a new underground mining area of the Tahmoor Coal Mine, located south of the Bargo River, between the townships of Tahmoor and Bargo, approximately 75 kilometres (km) south-west of Sydney in the Southern Coalfield of NSW. Extraction of coal at Tahmoor South was approved by the NSW Independent Planning Commission in April 2021, under State Significant Development Consent SSD 8445.

Tahmoor Coal Pty Ltd (the Applicant) owns and operates Tahmoor South and has previously extracted coal at the Tahmoor Coal Mine, under several different development consents via bord and pillar and longwall mining methods. The Applicant has submitted an Extraction Plan (EP) for Longwalls South 1A to South 6A (LW S1A-S6A).

Extraction of the proposed longwalls will be the first secondary extraction to take place under this Consent.

On 27 June 2022, the NSW Department of Planning and Environment (DPE) requested the Independent Advisory Panel for Underground Mining (the Panel) to provide advice in relation to the EP.

Specifically, DEP requested advice on the four TARPs included in the Extraction Plan and whether they are "fit for purpose" and whether they:

- *reflects the subsidence impact performance measures included in the consent;*
- *supports measurement of compliance with the performance measures;*
- *have triggers (and associated performance indicators) which adequately inform the mine's overall performance with respect to subsidence impact and environmental consequences;*
- *is (or will be at the time of extraction) based on sufficient baseline data;*
- *where subject to external variables that are not yet finalised (eg site specific guideline values (SSGVs) for stream water quality), that the process of establishing these variables is sufficiently transparent and certain and enables regulatory review and approval;*
- *is internally consistent and comprehensive (eg for stream water quality, a single exceedance of an SSGV appears to be not covered by either the Level 1 or Level 2 triggers);*
- *is framed such that each trigger, action and response is subject to a single straight forward meaning which is easily understood; and*
- *would benefit from any other comments or advice from the Panel.*

The Panel reviewed a range of documents in preparing its advice, met on multiple occasions via videoconference and requested supplementary information from the Applicant. The Panel also undertook a site inspection of Tahmoor South and relevant surrounding significant features.

The Panel's findings include a number of recommendations relating to the Extraction Plan's subsidence, groundwater and surface water assessments. Key recommendations include:

- Additional continuous surface subsidence monitoring sites be installed, between the edge of LWS6A and the Picton Weir to the west, and above the previous mined panels to the north-west of the mining area, approaching and across Bargo River.

- Subsidence impact mitigation measures be considered and developed for the rock shelter above the boundary between LWS1A and LWS2A in order to minimise the risk of adverse impacts to this rock shelter. This should be done in conjunction with an assessment of the relative merits, value and mining impact susceptibility of all of the 19 rock shelters across the Tahmoor South Domain, in order to prioritise which 18 of these 19 (as a minimum) need to be protected.

- Revisions to be made to the groundwater monitoring network to focus on localised groundwater level and water quality impacts more closely, and to ensure that sufficient baseline data is available against which meaningful triggers, actions and responses are framed.

- The Panel is of the opinion that there are a number of deficiencies throughout the revised set of TARPs provided on 25 July 2022, forming Appendix B of the Extraction Plan. There is a clear need for greater clarity, more definition with respect to monitoring and other actions, and more precise and responsive Action/Response plans.

  Some introductory comments relevant to all TARPs is contained in Section 5.0 of this report. The full details of the identified TARP deficiencies and any specific TARP recommendations are contained within Section 5 of this report. A summary of the priority TARP review comments is contained in Section 6 of this report.

1.0 SCOPE OF WORK

Tahmoor South is a new underground mining area of the Tahmoor Coal Mine, located south of the Bargo River, between the townships of Tahmoor and Bargo, approximately 75 kilometres (km) south-west of Sydney in the Southern Coalfield of NSW.

Extraction of LWs S1A to S6A was approved by the NSW Independent Planning Commission in April 2021, under State Significant Development Consent SSD 8445. Extraction of the proposed longwalls will be the first secondary extraction to take place under this Consent.

Condition C8 of the Development Consent requires the preparation of an Extraction Plan prior to the commencement of second workings. The Extraction Plan must demonstrate that mining operations do not cause exceedance of performance measures identified in Conditions C1 and C5 of Part C of the Consent.

On 27 June 2022, NSW Department of Planning and Environment (DPE) requested the Independent Advisory Panel for Underground Mining (the Panel) to provide advice in relation to the Extraction Plan for Longwall South 1A to South 6A.

Specifically, the DPE requested advice on the four TARPs included in the Extraction Plan and whether they are "fit for purpose" and whether they:

- *reflects the subsidence impact performance measures included in the consent;*
- *supports measurement of compliance with the performance measures;*
- *have triggers (and associated performance indicators) which adequately inform the mine's overall performance with respect to subsidence impact and environmental consequences;*
- *is (or will be at the time of extraction) based on sufficient baseline data;*
- *where subject to external variables that are not yet finalised (eg site specific guideline values (SSGVs) for stream water quality), that the process of establishing these variables is sufficiently transparent and certain and enables regulatory review and approval;*
- *is internally consistent and comprehensive (eg for stream water quality, a single exceedance of an SSGV appears to be not covered by either the Level 1 or Level 2 triggers);*
- *is framed such that each trigger, action and response is subject to a single straight forward meaning which is easily understood; and*
- *would benefit from any other comments or advice from the Panel.*

The Chair of the Panel (Em. Professor Jim Galvin) nominated the following members of the Panel to prepare the advice:

- Em. Professor Bruce Hebblewhite – Panel Convenor – Subsidence and mining
- Professor Neil McIntyre – Surface water
- John Ross – Groundwater
- Dr Lucy Reading – Groundwater and surface water

2.0 METHOD OF OPERATION

The Panel convened by videoconference throughout the preparation of its advice and was administratively supported by Secretariat staff provided by the DPE's Major Projects and Resource Assessment Teams. The Panel also undertook a site inspection on 19 July 2022. A wide range of documents were reviewed by the Panel in preparing this review.

The principal documents are summarised in Table 1.

Table 1: Key documents reviewed by the Panel

Document Reference	Document Name
Extraction Plan	Extraction Plan – Tahmoor South Longwalls South 1A to 6A, dated May 2022, including the following addendums/volumes: • Extraction Plan: Main Document • Water Management Plan • Water Management Plan – Appendix E – Groundwater Technical Report • Land Management Plan • Biodiversity Management Plan • Heritage Management Plan • Built Features Management Plan • Public Safety Management Plan • Plan 1 – Approved Plan • Plan 2 – Surface Features • Plan 3 – Seam Geology • Plan 5 – Land Ownership • Plan 6 – Geological Sections • Plan 7 – Subsidence Monitoring Program • Plan 8 – Aerial Photo
The Applicant's Revised TARPs	Response to further information regarding TARPS - dated 25 July 2022 - Revised Appendix B – Master Trigger Action Response Plan – V1 and V2
The Applicant's Response to an Additional Information Request	Response to Further Information following IAPUM Meeting –including: • Land Management Plan – Geotechnical Assessment - Dated May 2022 • Water Management Plan – Baseline Private Bore Assessment Report – dated April 2022 • Letter dated 28 July 2022 providing additional information on monitoring bores, data loggers, 'make good' strategy and cliff details
Agency Advice	• DPE Water • Crown Lands • Resource Regulator • DPI Agriculture • Heritage NSW • Mining, Exploration and Geoscience

2.1. SITE VISIT, SUBSEQUENT INFORMATION AND MEETINGS

Site Visit

On 19 July 2022, the Panel undertook a site inspection. The inspection involved a briefing at Tahmoor Coal Mine by the Applicant, followed by an inspection of key surface features including local streams, pools and an aboriginal cultural heritage site. During the site visit, the Panel also visited Redbank Creek and Myrtle Creek to inspect previous creek remediation, associated with the subsidence impacts from the northern longwalls.

The Panel was accompanied by the Applicant and its relevant consultants and the DPE's Secretariat for the Panel.

Subsequent Information

The Panel sourced additional reports from the Applicant, as outlined in Table 1.

Meetings

The Panel convened several times over the course of preparing its advice. Table 2 summarises the schedule of meetings held in chronological order.

Table 2: Schedule of meetings held

Meeting Date	Meeting Information
8 July 2022	Panel Meeting – Initial Briefing by DPE
19 July 2022	Site Inspection – Visit to Tahmoor Coal Mine and Surface sites
27 July 2022	Revised TARPs Discussion
3 August 2022	Report Review Discussion

3.0 PRIMARY FOCUS OF THIS ADVICE

As has been indicated in section 1 of this Panel report, the scope provided by DPE to the IAPUM Panel was to primarily focus on the management plan initiatives proposed by the Applicant, in the form of Trigger Action Response Plans (TARPs) documented in Appendix B of the Extraction Plan. Following the submission of the Extraction Plan to DPE, some feedback was provided to the Applicant from the Department. During the site visit by members of the Panel, further discussion took place at the mine on the TARPs. As a result of these various communications, the Applicant agreed to submit a revised set of TARPs to replace the previous Appendix B Master Plan. These revised TARPs were submitted and provided to the Panel on 25 July 2022. It is this revised set that has been considered by the Panel in this review report.

TARPs are a common tool used by industry within the framework of risk management for a project such as this one. The intention of TARPs is to provide a clear and concise means of managing the risks posed by identified hazards and prevent, wherever possible, the escalation of the risks to unacceptable levels.

The Panel's review of the TARPs proposed by the Applicant has considered the clarity, appropriateness, adequacy and expected effectiveness of the TARPs to manage the various risks, consistent with the performance measures that have been defined in the Development Consent for the project (SSD8445). This consideration of effectiveness includes the assessment of any appropriate and proactive management initiatives included to ensure that the risk levels do not exceed those defined by the project Development Consent.

Section 5 of this report addresses the Panel's review of the TARPs in the context described above. It is important to state that it is not the role of the Panel to provide a prescriptive or detailed review of the actual TARP wording. The Panel's comments should be considered in the context of guidelines for achieving the most appropriate TARPs, as management tools, taking into account the parameters listed above – *clarity, appropriateness, adequacy and effectiveness,* or in the words of the DPE scoping instruction, *"fit for purpose"*.

As a precursor to the TARP review, the Panel also wishes to provide some additional review commentary on the overall Extraction Plan, including such factors as proposed monitoring programs, prediction techniques and so on. This commentary is provided in section 4 of the Panel Report, as it may have impact on the subsequent TARP review.

It is important to recognise that the advice provided by the Panel is specific to the current proposed Extraction Plan for the northern block of longwall panels, LWS1A to LWS6A. It is understood that a further block of longwall panels is proposed to be extracted within the same Tahmoor South Domain, further to the south. Whilst this advice may make reference to important collection of baseline data for subsequent consideration and management of possible future extraction plans for the area of the mining lease to the south of these current longwall panels, the current Panel advice should not be interpreted as offering any opinion or recommendation with respect to any proposed extraction beyond LWS6A in the current Extraction Plan.

4.0 SUBSIDENCE ASSESSMENT

4.1. SUBSIDENCE PREDICTION AND MANAGEMENT

The Extraction Plan and supporting documentation provided makes predictions of subsidence effects and impacts on the surface as a result of the mining of longwall panels S1A to S6A in the Tahmoor South Domain. The Panel notes the methodology used for such prediction by the Applicant's consultants, MSEC, and accepts that the prediction methodology, and hence the initial results are acceptable. However, it is noted by the Panel that, as a normal part of responsible due diligence, the predictions should be reviewed on a panel-by-panel basis, and recalibrated as required, as subsidence monitoring data is collected and analysed.

It is noted that the proposed mining panels have panel widths of 285m and a maximum mining height of 2.2m. The minimum depth of cover is in the range of 365m to 380m over the six panels.

The surface topography above the proposed mining area is gently sloping terrain with a mix of residential development, light industry, agriculture and natural bushland. There are several creeks and watercourses that feed into the adjacent Bargo River, the primary watercourse being Teatree Hollow. The surface above the mining area is also crossed by a major road (Remembrance Drive) and the Main Southern Railway. The impact of the proposed mining extraction and resultant surface subsidence effects on all of these surface features – both natural and built features – has been assessed as part of the MSEC subsidence study.

Previous mining has occurred at Tahmoor with panels located to the north-west, north and north-east. This previous mining has assisted in providing good confidence levels in the subsidence prediction methods used for Tahmoor South based on the extensive previous monitoring experience.

During the site inspection by members of the Panel on 19 July 2022, the relevant sections of Teatree Hollow were inspected, as were some previous remediation sites on Myrtle Creek and Redbank Creek. These remediation sites involved installation of grout curtains across the creeks at various rock bars and some additional grouting within the floor of selected rock pools. The Panel members noted the reported and apparent visual success of these remediation measures, to date, in restoring creek flow and pool water levels. It is understood that similar remediation measures will be applied in Teatree Hollow as and when required.

4.1.1. Recommendations

A comprehensive subsidence monitoring program is proposed over the proposed Tahmoor South mining area, and adjacent locations of particular interest. The Panel believes the proposed monitoring regime is sufficiently extensive and appropriate and the technology to be used for monitoring meets the highest industry standards. However, there are two additional locations where the Panel recommends some additional monitoring be installed, beyond the boundary of the designated mining area. These are:

1. Between the edge of LWS6A and the Picton Weir to the west.
2. Above the previous mined panels to the north-west of the mining area, approaching and across Bargo River.

In both of these cases, it is considered worthwhile to establish a monitoring regime using equipment such as 3D, 24/7 GNSS monitoring stations, to detect the approaching onset of any significant far-field movements in these locations, prior to any impacts being experienced at either Picton Weir or the Bargo River. The results from these additional sites should act as triggers for possible further actions. In the case of the Bargo River location, the monitoring would also provide valuable assessment of the unlikely, but possible re-activation of subsidence associated with the previous underground mining goaf areas as a result of mining in the South Domain.

The results from both of these additional sites should be incorporated into the overall subsidence monitoring program and related management plans and TARPs.

4.2. POTENTIAL IMPACTS ON HERITAGE SITES

The most significant indigenous heritage site above the first six longwall panels is a rock shelter adjacent to a tributary of Teatree Hollow, as shown in Figure 1.

Figure 1. Aboriginal rock shelter in vicinity of Teatree Hollow

The location of this heritage site relative to the proposed mine plan is shown in Figure 2. The site location is marked on the boundary between LWS1A and S2A, marked as site 52-2-4471.

It is understood that this rock shelter is one of 19 across the entire Tahmoor South Domain but is the only one above the “A” group of longwalls, LWS1A to S6A. Under the terms of the Development Consent, mining should not impact more than 10% of the total number of rock shelters across the whole Tahmoor South Domain, i.e. less than 2 shelters in total are permitted to suffer mining-induced impacts (such as cracking, rock falls, toppling etc) across the entire Tahmoor South Domain.

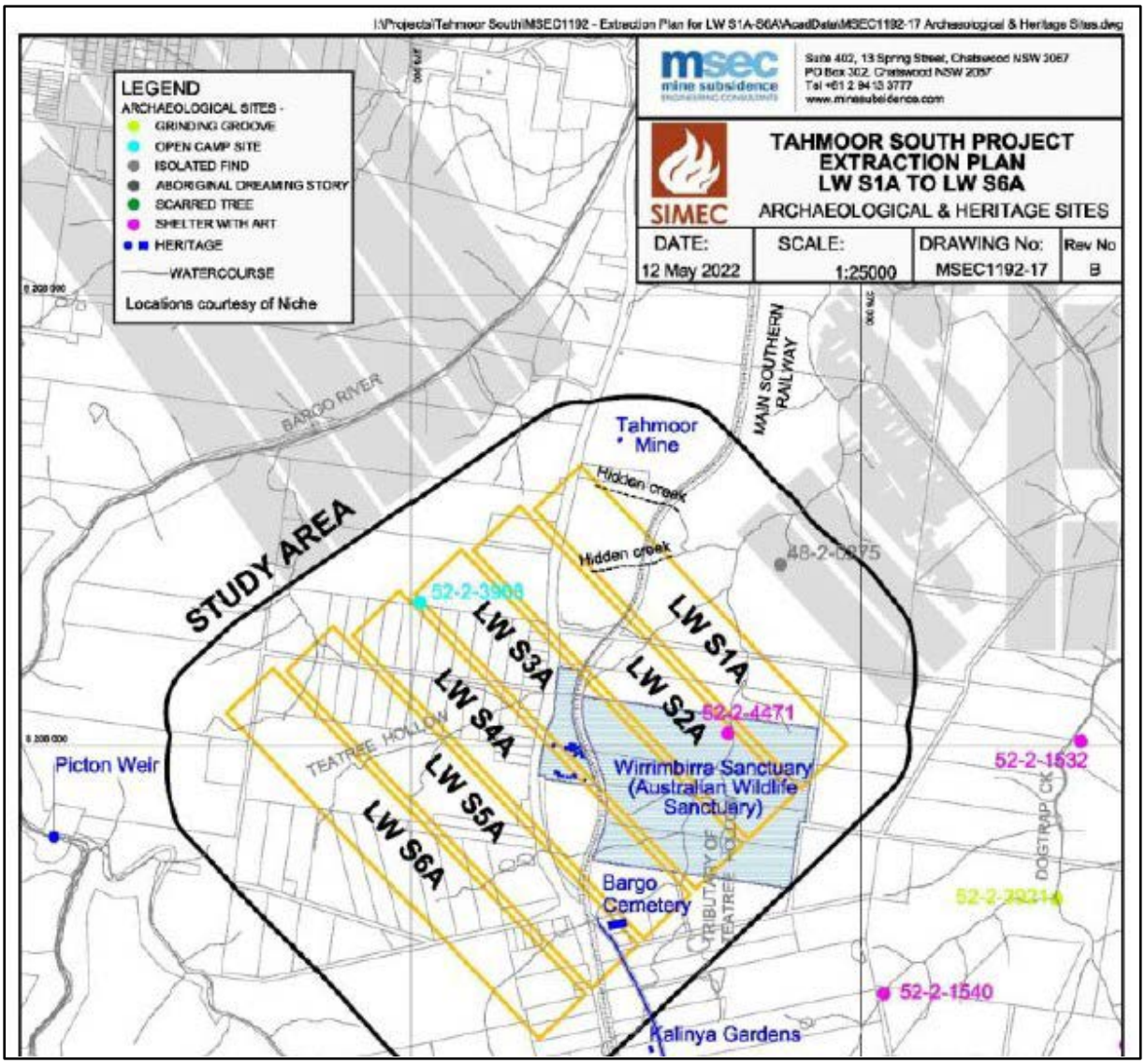

Figure 2. Mine plan showing heritage sites *(source: Tahmoor presentation on 19.07.22)*

Given the location of this shelter above the panel edge of LWS2A, it will clearly be subject to subsidence effects including vertical subsidence, tilt and tensile strain – all of which have the potential to induce adverse impacts such as those noted above. Such impacts would then result in potential damage and/or loss of the rock shelter. Under the Development Consent conditions, this would then account for the 10% limit of impact to the total of 19 rock shelters, meaning that no further rock shelter impact would be permitted across the subsequent longwall B panels further to the south. The nature, quality and locations of the other 18 rock shelters is not known by the Panel.

Given this situation, whilst it would be technically permitted under the Development Consent to allow adverse impacts to occur at this first site, it is the Panel's view that it may be prudent to consider implementing some mitigation measures prior to the approach of both LWS1A and S2A, to minimise the likelihood of serious impacts occurring. This should be done in conjunction with an assessment of the relative merits, value and mining impact susceptibility of all of the 19 rock shelters, in order to prioritise which 18 of these 19 (as a minimum) need to be protected.

4.2.1. Recommendations

It is recommended that subsidence impact mitigation measures be considered, and a mitigation plan developed for implementation in conjunction with the rock shelter above the boundary between LWS1A and LWS2A in order to minimise the risk of adverse impacts to this rock shelter.

The above recommended mitigation plan should be developed in conjunction with and informed by a broader assessment of the relative merits and value of all of the 19 rock shelters, in order to prioritise which 18 of these 19 (as a minimum) need to be protected.

4.3. POTENTIAL IMPACTS ON GROUNDWATER

Groundwater impact predictions arising from the extraction of Longwalls S1A to S6A are detailed in the groundwater technical report (SLR 2022a) that is Appendix E of the Water Management Plan (WMP) (Tahmoor Coal 2022b).

The potential groundwater impacts modelled and assessed in SLR 2022a are:

- Increased mine inflow (groundwater take)
- Loss of flow in permanent streams
- Water level drawdown and pressure reductions in all groundwater systems
- Greater than 2m of drawdown in private water supply bores

The SLR numerical model (described in SLR 2022a) has evolved across multiple mine sites and adequately represents all the groundwater systems present beneath the site and the wider area and is consistent with the latest conceptual model. It has been peer reviewed by Brian Barnett from Jacobs and his focus is on *"ensuring that the model is designed, constructed and used to obtain confident estimates of future impacts to environmental assets including existing groundwater users and potential diversion of groundwater from shallow aquifers that are accessed by other users including GDEs."*

The model predicts mine inflows of between 0.12 and 2.5 ML/day (with an average of 0.8 ML/day) during the operational life of Longwalls S1A to S6A. These inflows are relatively small and manageable.

Groundwater discharges from the Hawkesbury Sandstone groundwater system via springs and river/creek bed leakage provide baseflow to permanent (gaining) streams across the wider area. Modelling suggests that drawdown in this aquifer will have a negligible impact on the groundwater contribution to baseflows of local watercourses (collectively less than 0.02 ML/day). Changes to groundwater contributions to baseflow are unlikely to be measurable at any surface water monitoring sites. However, groundwater drawdown and the cracking of the Teatree Hollow and tributary creek beds may change creek conditions from gaining to losing and thereby reduce streamflow in the permanent stream/water hole sections of undermined reaches of the creek. This loss to shallow groundwater may re-emerge as groundwater baseflow further downstream. The volume of such losses and gains is unlikely to be measurable.

Predicted project related and cumulative drawdowns are described in SLR 2022a for the layered hydrogeological units from the water table in the Hawkesbury Sandstone to the

depressurised Bulli Coal Seam. Drawdowns in the Hawkesbury Sandstone aquifer are the most important impacts as this groundwater system provides baseflows to creeks and sustains supplies at private water supply bores. The Hawkesbury Sandstone groundwater system is a highly productive groundwater source as defined under the NSW Aquifer Interference Policy (AIP) (DPI Water 2012). Maximum drawdown in the Hawkesbury Sandstone aquifer is predicted to be less than 4m (both at the water table and at depth in the lower Hawkesbury Sandstone) with the predicted drawdown extending no more than 1km to the north-east of Longwall S1A or 1km south-west of Longwall S6A. The only high priority GDE is the (remote) Thirlmere Lakes located 3.5km to the north of the north-western extremities of these six longwalls. Groundwater level drawdowns in any groundwater system are not predicted to extend to Thirlmere Lakes.

Greater than 2m of drawdown is predicted at only two private water supply bores due to the extraction of Longwalls S1A to S6A, however the cumulative impact of all mining predicts there are 20 water bores with potential drawdown impacts greater than 2m. It is uncertain whether all registered water bores within 2km of Longwalls S1A to S6A have been considered, as a check of the WaterNSW groundwater database has identified several water bores not listed in the modelling study (Table 4.8 of SLR, 2022a). These are located just north of Bargo within 750m of Longwall S6A and are GW105883 and GW105847. Also, these and several other registered water bores were not identified or referenced in the Baseline Private Bore Assessment Report (SLR 2022b).

Potential water level impacts are important to monitor at the closest water bores (that is those within 1km of the proposed longwalls) to validate the model predictions. It is important that ‘make good’ arrangements are negotiated with private water bore users as soon as mining induced drawdowns in excess of 2m are identified (see Section 5.1.6).

4.3.1. Recommendations

The potential groundwater impacts of longwall extraction of coal from the Bulli Coal Seam within Longwalls S1A to S6A are relatively minor with the exception of creek bed cracking and potential loss of groundwater contributions to baseflow, and potential drawdown impacts (in excess of the AIP criteria of 2m) to private water bores overlying or located within 1km of the proposed longwalls.

Several registered water bores within 1km of the proposed longwalls have not been identified as still existing (GW105883, GW105847). If possible, these bores should be field checked to determine whether they still exist. If no field verification is possible, then it should be assumed that these bores exist and are operational. Maximum drawdowns should be predicted for each of these sites.

4.4. POTENTIAL IMPACTS ON SURFACE WATER

Surface impact predictions arising from the extraction of Longwalls S1A to S6A are detailed in Section 4 of the WMP (Tahmoor Coal 2022b), with references to the Environmental Impact Statement (Tahmoor Coal 2018) for the originally proposed mine plan. The potential impacts modelled and assessed in Tahmoor Coal (2022b) are:

- Physical impacts to watercourses including fracturing and changes in gradient

- Loss of baseflow and changes to low flow regime
- Subsidence-related impact to pool water levels, overland flow and flooding
- Changes to water quality and gas emissions
- Erosion and sedimentation
- Physical impacts to integrity of farm dams
- Impacts to Thirlmere Lakes due to groundwater drawdown

The assessment of surface water impacts relies partly on the subsidence predictions including strain, tilt and valley closure. This assessment concludes that watercourses directly above LW S1-S6A (Teatree Hollow, the Tributary of Teatree Hollow, the Tributary of Bargo River and small un-named tributary creeks) may experience the full range of predicted subsidence movements. Conclusions include *"although Teatree Hollow and Teatree Hollow tributary are likely to incur localised reductions in pool water level and streamflow associated with fracturing in the vicinity of LW S1-S6A, the net reduction in streamflow conveyed from Teatree Hollow to the Bargo River is expected to be negligible"*.

The potential need for remediation to restore pool water levels within the subsidence area is recognised and part of the TARP process (see below). Similarly, the potential for episodic and localised increases in water quality parameters is recognised, with the potential need for remediation. Impacts on ponding and flood inundation are predicted to be negligible. The relatively low levels of subsidence affecting farm dams is noted in the WMP, and potential impacts, actions and responses are allowed for in the TARPs. Impacts to Thirlmere Lakes due to groundwater drawdown are assessed using the groundwater model and predicted drawdowns did not extend to the Thirlmere Lakes. Impacts to water courses outside the subsidence area are predicted to be negligible. The possibility of re-activation of historical fracturing at Bargo River has been raised during consultation, which is proposed to be managed by monitoring and TARPs (also see previous recommendations on increased subsidence monitoring between the subsidence area and Bargo River).

The Panel has not identified any omissions or flaws in the surface water impacts assessment (while noting the preceding relevant comments on the subsidence assessment and groundwater modelling). The Panel has not considered potential impacts due to interception and discharges of water from the coal handling and processing plant and rejects emplacement area and other surface operations.

4.4.1. Recommendations

All recommendations on surface water are contained in Sections 5.1.1 to 5.1.5 in discussion of the specific surface water TARPs.

5.0 REVIEW OF MANAGEMENT PLAN TARPS

It has already been noted in the introductory scope for this report (section 1) and the summary focus discussion in section 3, that the priority task of the Panel in conducting this review was to focus on the *"fit for purpose"* content and structure of the revised set of TARPs provided by the Applicant on 25.07.2022 as an updated version of Appendix B to the Extraction Plan.

TARPs are a common tool used by industry within the framework of risk management for a project such as this one. The intention of TARPs is to provide a clear and concise means of managing the risks posed by identified hazards and prevent, wherever possible, the escalation of the risks to unacceptable levels.

It is not the role of the Panel to provide a prescriptive or detailed review of the actual TARP wording. The Panel's comments should be considered in the context of guidelines for achieving the most appropriate TARPs, as management tools, taking into account the parameters listed previously – *clarity, appropriateness, adequacy and effectiveness*, or in the words of the DPE scoping instruction, *"fit for purpose"*.

Prior to addressing each set of individual TARPs, some general comments are worth noting. These comments are applicable to most if not all of the TARPs. They are as follows:

- Reference to the relevant Performance Measures contained within the Development Consent is valuable, and should be as clear and meaningful as possible, with no ambiguity of intent or application.
- Similarly, where Performance Indicators have been pre-defined or are proposed, the basis of these should be clear and unequivocal, with specific reference to whatever monitoring regimes already exist or are proposed.
- All TARPs should use precise and definitive "action" verbs under the Action section, for example, the use of the verb "consider", which is widely used in the current Tahmoor TARPs, is not appropriate, in the opinion of the Panel. Consideration should be taking place at all times across all aspects of the management plan. So rather than *"consider increasing the frequency of monitoring"*, for example, the TARP should directly state *"increase the frequency of monitoring to …"*, albeit still being able to qualify or limit the circumstances under which such an increase would take place.
- The Actions and Response Plans in a TARP should be designed, wherever possible, to prevent or limit the chance of the risk event escalating to a higher level. In this regard, such actions and responses need to contain as many pro-active and concrete management initiatives as possible, rather than purely containing passive *"after the event"* responses or simply reporting of non-compliance. It is recognised that this may not always be possible but should be a priority wherever it can be achieved.

It is noted from the Tahmoor presentation made during the Panel's site visit that there are a number of both Property Management Plans and Infrastructure Management Plans specific to different sites and locations across the mining area. This includes significant infrastructure such as the Main Southern Railway. It is understood that not all of these Plans have been completed as yet, but will be in place, prior to any potential mining impacts occurring in the relevant vicinities. These management plans have or will contain further risk management approaches and potentially further TARPs. However, they have not been reviewed as part of the Panel's

current scope of work. Nevertheless, they are important and must be completed in a timely manner and integrated into the overall TARP Management Plan.

The Tahmoor Master TARP Plan, as presented in Appendix B of the Extraction Plan, contains TARPs grouped under four major headings or categories. These are:

- Water Management Plan
- Land Management Plan
- Biodiversity Management Plan
- Heritage Management Plan

Each of these Plans and the TARPs contained within them are now discussed individually below.

5.1. WATER MANAGEMENT PLAN

Surface Water

The eight surface water TARPS provided by the Applicant on 25.07.2022 are:

- Stream water quality for all watercourses within the subsidence area
- Stream water quality for other watercourses outside of subsidence area
- Pool water level for all watercourses within the subsidence area
- Pool water level for other watercourses (outside of subsidence area)
- Physical features and natural behaviour of pools for all watercourses within the subsidence area
- Physical features and natural behaviour of pools for other watercourses (outside the subsidence area
- Channel stability, sedimentation and erosion for all watercourses within the subsidence area
- Farm dams

Prior to reviewing these TARPs in sections 5.1.1 to 5.1.5 below, the omission of a flow loss TARP is discussed here. The performance measures (PMs) include requirements related to flow losses both for areas inside and outside the subsidence area. The proposed performance indicators (PIs) and TARPs do not explicitly address these requirements. A flow gauge (TT-F1) has recently been constructed downstream of LW S1 so that "*The streamflow monitoring data will enable estimation of the annual streamflow volume reduction in Teatree Hollow*" (WMP, Tahmoor Coal 2022b, Section 5.3); however, the Panel understands that due to weather-related delays the weir has not been surveyed and no baseline flow data are yet available. There is a plan to reconstruct baseline flows by correlating with baseline pool water levels measured at a pool further upstream on Teatree Hollow. The accuracy of the reconstructed flow data will depend on the strength and stability of the correlation, which are uncertain. This, combined the general difficult of separating mining effects from background variability in flows, means that assessment of flow loss for Teatree Hollow may have significant accuracy limitations.

Regarding the value of developing a PI and/or TARP for flow loss at Teatree Hollow, the Panel notes the following: 1) the Teatree Hollow catchment especially downstream of the subsidence area is hydrologically disturbed including the presence of discharges from the mine operations. Hence, in principle at least, understanding flow loss is not as important as in more pristine environments or controlled water supply catchments; 2) even if the reconstruction of baseline flows is reasonably successful (indeed, even if the weir had been constructed soon enough to capture 2 years of baseline flow), separating mining-induced baseflow losses from natural variability is likely to be challenging unless losses are substantial (perhaps > 0.5ML/day depending on various factors, compared to the predicted baseflow loss at Teatree Hollow of 0.001 ML/day); 3) pool water levels if they are measured accurately and continuously (as proposed), supplemented by monitoring of connected shallow groundwater (see Panel recommendations on surface water-groundwater interactions), is a more rigorous way to detect non-negligible baseflow loss, albeit with no quantification of loss volumes; 4) the principal potential value of a flow gauge in this situation is to quantify significant flow volume losses for the purpose of assessing water access license requirements.

The Panel recommends that flow loss PIs should be proposed (one each for areas within and outside the subsidence areas) and reviewed prior to approval of the Extraction Plan for the purpose of assessing performance against the PM related to flow loss. For within the subsidence area (Teatree Hollow flow gauge) the proposal should be reviewed alongside reconstructed baseline data. For the reasons discussed above, i.e. progressive flow loss will be more effectively picked up by other TARPs, the Panel does not consider it necessary to have flow loss TARPs.

Regarding other omissions from the WMP, the Panel notes that Development Consent SSD 8445 stipulates that the WMP must include an Erosion and Sediment Control Plan. Such a plan is not explicit and is implicit in a minimalist way (Section 6.2.2.1 and the TARP tables appear to be the only parts addressing erosion control). Consent SSD 8445 also requires the WMP to include a Long-Term Water Management Strategy that includes provision for long-term monitoring. This plan is also not explicit. The Panel recommends that an Erosion and Sediment Control Plan and a Long-Term Water Management Strategy that meet the list of requirements in the Consent are included in or referred to by the WMP.

Groundwater

In the Development Consent for the Tahmoor South Coal Project (SSD 8445) dated 23 April 2021 and in Part B (Specific Environmental Conditions) and Part C (Specific Environmental Conditions – Underground Mining) there are no specific performance measures relating to the protection of groundwater resources (that is, measures to protect groundwater level and groundwater quality attributes). However, in Table 4 of Condition B33 it does state the Applicant must *"minimise risks to the receiving environment and downstream water users"* which can be argued to include minimising risks to consumptive groundwater users and groundwater dependent ecosystems (GDEs).

Compensatory water supply requirements are detailed in Conditions B25 to B29.

Condition B34 (v) details the specific requirements of Groundwater Management Plans (GMP) that are to be included in the WMP. A GMP for these six longwalls is included in the WMP (Tahmoor Coal 2022b).

In Table 7 of Condition C1 there is one performance measure relating to GDEs including Thirlmere Lakes that states:

- Negligible impacts including:
    - Negligible change in groundwater levels, and
    - Negligible change in groundwater quality

There are more detailed groundwater requirements listed in the Extraction Plan consent conditions particularly Condition C8 (g) (iii) Water Management Plan which requires:

- Detailed baseline data
- Detailed surface and groundwater impact assessment criteria, including specific trigger levels
- A groundwater monitoring program to monitor and report on various attributes

Condition C8 (g) (viii) outlines the requirements for TARPs. In the WMP (Tahmoor Coal 2022b), groundwater TARPS are provided in Appendix A and these are repeated in Appendix B of the Extraction Plan (Tahmoor Coal 2022a). These TARPS were superseded by the revised TARPs provided to the Panel on 25 July 2022. The six groundwater TARPS are:

- Shallow Groundwater Level (Open Standpipes and Private Bores)
- Shallow Groundwater Pressure (VWP Sensors <200m Depth)
- Groundwater Level/Pressure Deep VWPs (>200m Depth excluding monitoring the Bulli Seam)
- Groundwater Quality (Open Standpipes and Private Bores)
- Groundwater-Surface Water Interaction (for Groundwater Bores not associated with Thirlmere Lakes)
- Groundwater-Surface Water Interaction (for Groundwater Bores associated with Thirlmere Lakes)

Details provided in each of these TARPs and whether they are "fit for purpose" are described in Sections 5.1.6 to 5.1.11 below. Comments on the adequacy of the proposed monitoring program are also included for each of the TARPs.

5.1.1. Stream Water Quality TARPs

Two sets of stream water quality TARPs are proposed: one for watercourses within the subsidence area; and one for those outside. Except where noted, the comments below refer to both sets of water quality TARPs.

The general challenge of the water quality TARPs (and other surface water TARPs) is that subsidence impacts are largely random in location and degree, and hence the subsidence effects on water flows and quality are unpredictable (in degree, location and duration) except in general qualitative terms. Hence, the EIS predicts "*where the longwalls mine directly beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur*." The

challenge of the TARPs is to set a clear PI that represents exceedance of this PM, and a series of clear and practical performance thresholds that define the trigger levels. In this case, considering the PM definition, this means defining triggers that encompass; 1) the presence of an impact on water quality; 2) the duration of the impact; 3) the extent of the impact along the watercourse. (1) is approached by the definition of SSGVs and exceedance of these being a potential trigger. Use of SSGVs in this way is recognised good practice. The degree of the increase is NOT represented in the proposed TARPs, which is arguably a limitation; however representing the degree of increase would involve the identification of increasingly extreme percentiles of water quality beyond the SSGV, which would be increasingly arbitrary due to statistical uncertainty. The Panel does not recommend complicating the TARPs in this manner. (2) is approached by limiting the trigger level to the number of consecutive months. The Panel supports this approach, with reservations noted below. (3) is not represented in the proposed trigger levels. This is a significant limitation, as it could allow exceedance of the SSGV over the entire length of watercourses covered by this TARP for up to three months with no trigger. The Panel therefore recommends that the water quality trigger levels, rather than only being related to consecutive months above the SSGV, are additionally related to the proportion or number of pools affected within the relevant watercourse length (e.g. 1 month exceedance over >50% of the monitored pools in the subsidence area might be an additional trigger for level 1).

The stream water quality TARPs allow periods of months with SSGV exceedances to pass without triggers. For example, the TARP implies that exceedances may occur for 3 consecutive months before being reported to stakeholders and 4 consecutive months before increased frequency of monitoring is considered. Generally, the Panel agrees that multi-month scales are appropriate, so that over-frequent responses and actions are not taken due to episodic water quality responses (unless they are observed at multiple non-reference sites, as covered in previous comment). In the particular case of the level 2 trigger, waiting until after 4 months of exceedances at any site (without corresponding exceedances at reference sites) before increasing monitoring frequency is not considered suitable. The increased monitoring frequency may be important, especially at level 3, in the investigations and in determining whether a corrective action is warranted. The Panel recommends that an increased frequency is implemented at a lower trigger level than currently proposed.

A related limitation of the proposed TARP for watercourses within the subsidence area is that a Performance Indicator (PI) has not been proposed, with the explanatory comment "*Rehabilitation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators*." The Panel understands from the WMP (section 6.2.1.3) that the suitable PI will be derived in collaboration with relevant government agencies. While this is understandable, the Panel considers that a PI is required in this TARP as a proposal of how performance will be assessed in relation to the PM (i.e. what combination of water quality measurements would constitute greater than "*localised and transient increases in water quality constituents*"). If there is uncertainty about the appropriate PI an initial PI could be proposed with recognition that it may be updated based on improving knowledge of SSGVs and/or outcomes of collaboration with government agencies. In contrast, the proposed TARP for watercourses outside the subsidence area defines a PI. The Panel recommends that a PI is proposed.

For the proposed TARP for watercourses within the subsidence area, it may be logical for the current "Exceeding performance measure" level to become a level 4, then the "Exceeds performance measure" relates to the water quality after CMAs are applied (or after CMAs are

concluded to be inapplicable). If the remediation is a response to failing a PM then the existing format is logical, but if remediation is a valid part of adaptive management to achieve PMs then the current use of "Exceeds performance measure" is not logical. The Panel recommends that the Department consider which should apply and that the format of this TARP (and others with the same issue) be amended if necessary. The water quality TARPs (and other surface water TARPs) often refer to *"Implement CMAs, subject to land access"*. The WMP (in particular Appendix F) gives examples of creek CMA projects undertaken for nearby impact creeks, and most of these projects have been rated by the Applicant mine as moderately or highly effective. However, the access constraints to Teatree Hollow and Teatree Hollow Tributary appear to be different to the examples in Appendix F. Based on current information the Panel is not confident that land access to the full length of Teatree Hollow and Teatree Hollow Tributary without undue disturbance will be practical. Related to that issue, CMAs are currently proposed to be considered at trigger levels 1 and 2 without reference to a WCAMP, and then at the highest trigger level a WCAMP is proposed to be developed. It would be preferable for all potential CMAs to be integrated into the WCAMP. The Panel recommends that a WCAMP for the subsidence area, including review of all potential CMAs and their applicability, is proposed as part of the Extraction Plan.

It could be understood from the proposed highest water quality trigger that on the basis of 6 months of monitoring a decision may be taken to undertake remediation. Due to the potential cost and intrusiveness of remediation, and the potential requirement for a year or more of data to determine whether mining impacts persist (due to natural variability of water quality, the potential for ongoing subsidence impacts and the potential for natural recovery), a substantially longer period between the first SSGV exceedance and determining the applicability of remediation would be appropriate. The Panel recommends that a longer period between the first trigger level and potentially implementing remediation should be allowed for in the TARPs.

There are various places where precision in language may be improved, for example "*Exceedance of an SSGV occurs for less than three consecutive months*" could be more precisely written "*No exceedances of an SSGV, or exceedances occur for less than three consecutive months*". As another example, the level 3 TARP includes *"Undertake a detailed investigation to assess if the change in behavior is related to mining effects …"*. It is unclear in what respect this differs from the reviews/investigations that are proposed at levels 1 and 2. *"Review Water Management Plan"* could be more precisely written as "*Review Water Management Plan in consultation with relevant agencies and stakeholders*"; while *"Advise DPE and key stakeholders of any required amendments to Water Management Plan and modify if necessary"* could be clarified by editing it to read "*Publish amendments to Water Management Plan following approval from DPE*". The Panel recommends that the precision, clarity and consistency of all surface water TARPs are improved.

The Panel also recommends that Column 2 of the water quality TARP tables should refer to a list of water quality parameters.

The number and location of sites, parameters monitored, and frequency is appropriate (noting the recommendation about increasing frequency at a lower trigger level). The three newer sites on Teatree Hollow have only been in place since September-October 2021 and therefore are not expected to provide the target minimum of 2 years of baseline water quality data. The Panel recommends that the frequency of baseline monitoring should be increased at these three sites to achieve a minimum of 24 baseline samples.

Applying water quality TARPs and PIs is challenging especially in intermittently flowing pools due to high natural variability of water quality. The suitability of the proposed sites should be reviewed as part of six-monthly reporting.

5.1.2. Pool Water Level TARPs

Two sets of pool water level TARPs are provided: one for watercourses within the subsidence area; and one for those outside. Except where noted, the comments below refer to both sets of pool water level TARPs.

As was the case for the corresponding water quality TARP, the pool water level TARP for watercourses within the subsidence area does not propose a PI because "*Rehabilitation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan. These plans will contain relevant performance indicators*". In contrast, the corresponding TARP for watercourses outside the subsidence area does use a PI. The relevant PM is "*No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS*". The EIS for pools within the subsidence area, based on valley closure predictions, states "*two of the approximately 14 mapped pools in Tea Tree Hollow were identified to be at moderate risk*". Therefore, there are predictions in the EIS that are a relevant basis for a pool water level PI for pools within the subsidence area. The Panel recommends that a PI is proposed.

The minimum pool water level recorded in the baseline period is used as a threshold for determining triggers at all trigger levels. Some pools have recent baseline periods that are relatively wet periods, whereby minima may be higher than normal, while at other sites the baselines encompass drought conditions so the minima will be exceptionally low or zero. For any pools that dried up sufficiently for water levels to be recorded as zero during the baseline period, the lower level triggers are redundant. The pool water level recession rates are also encompassed in the level 2 and 3 triggers but only if the water level has fallen below the baseline minimum. Addressing this limitation, the TARP on Physical Features and Natural Behaviour of Pools is complementary, since any visually observed abnormal response of pool level (as well as other criteria) at any of the monitoring sites should lead to a trigger and further investigation at trigger level 1. 6-monthly reporting of pool level data (as part of subsidence impact reports) will allow objective assessment of whether the combination of the two TARPs is effectively leading to triggers on a monthly basis; if not then a more robust pool water level TARP may be needed. In conclusion, setting trigger levels for intermittent or ephemeral watercourses is fundamentally challenging and, while the proposed methods have limitations, the Panel considers that the approach is appropriate balance of practicality and rigour, subject to ongoing review.

For watercourses within the subsidence area, trigger level 1 seems to be redundant, since level 2 would identify any important decline in pool water levels that level 1 would identify. Level 1 could be removed or "*by greater than 10 centimetres (cm)*" could be deleted. The Panel recommends that consideration is given to this.

The Panel has not reviewed in detail the appropriateness of each proposed reference site (as listed in Appendix B in the WMP), with respect to whether the pool water level regimes are reasonably comparable between the impacted and reference site. As with the success of the

pool water level TARP, it is recommended this is reviewed in detail as part of reviewing six monthly subsidence impact reports.

5.1.3. Physical Features and Natural Behaviour of Pools TARP

As a matter of precision, in the TARPs for watercourses within the subsidence area and for those outside, the Level 1 trigger could be better written, for example as "*Visually observed ~~change~~ anomaly in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions – occurs in one month and ~~the same~~ a similar anomaly has not occurred at the reference site(s)*" The first of these edits is suggested because the water level will usually change relative to baseline, rather it is anomalous levels that should be noted; the second because the same change would not be expected at two sites. This comment also applies to other trigger levels.

As a matter of consistency, in the TARP for watercourses outside the subsidence area, the definition of the PI and of the ultimate trigger level is inconsistent with the corresponding pool level and water quality TARPs, in terms of the relation between the PI and the upper two triggers. It would be preferable to improve consistency here, for example by introducing to the Physical Features TARP a level 3 trigger and moving the text of the first bullet point in the current highest-level trigger to this new level 3.

Other comments already made that apply to these TARPs are: ambiguity around difference between the detailed investigation and the earlier investigations; the time period of impacts allowed prior to WCAMP implementation; and the absence of a PI for watercourses within the subsidence area.

5.1.4. Channel Stability, Sedimentation and Erosion TARP

A PM is *"Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS"*. The channel is part of the aquatic and riparian ecosystem and therefore this PM is relevant. The Panel recommends that a PI is proposed.

In the level 1 trigger, "*10% increase in length*…" is potentially ambiguous, since erosion may be signified by a knickpoint moving upstream rather than its length increasing. This comment also applies to level 2. The Panel recommends that this example is removed.

5.1.5. Farm Dams TARP

The relevant PM is under Built Features, Section C5 of the Development Consent, which includes "*Damage must be full repairable and must be fully investigated and repaired*…" The Panel recommends that a corresponding PI is proposed. The trigger levels are defined by specific cracking and leakage features that (in principle anyway) exclude the need for actions and responses following significant damage or suspected damage that does not conform to these specifics. For example, for the level 1 trigger (or a new, lower level trigger), the addition of a less specific degree of visible damage should be considered. This may include a report (from either a routine inspection or from the landowner or other member of the public) of any new cracks or leakage from the dam. As another example, the proposed level 3 trigger is defined by a specific type of cracking in the dam wall, whereas it is possible that significant physical damage and leakage that would require a dam replacement or alternative water supply

will not involve such a specific type of cracking. The Panel recommends that consideration be given to whether additional, less specific trigger level criteria are required.

5.1.6. Shallow Groundwater Level (Open Standpipes and Private Bores) TARP

This TARP relates to monitoring and management of the shallow water levels within the upper Hawkesbury Sandstone groundwater system and private water supply bores of any depth. Dedicated site monitoring bores are completed as nested sites with depths ranging from 20 metres (m) to 85m (Table 5-3 SLR 2022a and SIMEC 2022). Water bore depths mostly range between 50m and 120m with the deepest water bore reported to be 150m deep (SLR 2022b).

The performance indicator is monthly (manual) monitoring of water levels at a selection of site monitoring bores and private bores where access has been negotiated.

(i) Monitoring network and frequency

- Tahmoor Coal's monitoring bore network (open standpipes) provides good spatial and depth coverage across the Longwall S1A to S6A area. No additional sites are required.
- Of the seven private water bores proposed for monitoring, five are located more than 2km from any of the longwalls and are unlikely to be impacted by water level drawdown associated with the extraction of longwalls S1A to S6A. It would be beneficial if negotiated access could be obtained for at least one additional private bore within 1km of the proposed longwalls.
- The proposed monitoring frequency of monthly manual measurements pre-mining and during mining is insufficient to differentiate natural (or pumping) events from mining induced drawdown. It is recommended that dataloggers (collecting data at a 6-hourly frequency) be installed at a minimum two nested monitoring bore sites.

(ii) Trigger levels

- The criteria for the three trigger levels are appropriate, although for the "Normal Condition" it would be useful to
    - identify in the WMP the baseline period (for each/all sites) that will be used as the pre-mining data set against which changes will be assessed
- A reference table that describes the TARP Level 1, 2 and 3 groundwater level trigger elevations is required for each of Tahmoor Coal's nominated monitoring shallow open standpipes:
    - Currently Table 6-1 in Appendix E of the WMP (SLR 2022a) is incomplete. The referenced Table 6-3, which is required for the TARP described below in 5.1.7, lists only shallow VWPs

(iii) Actions and responses

- (all Levels) Slightly different actions and responses should be proposed for dedicated monitoring bores versus private water bores. For instance:
    - "Make good" negotiations need only be commenced/finalised with owners of impacted private bores (Level 1)

- The full range of "make good" options should be listed in the Level 1 actions to provide transparency as to the available options
- Actions (if any) should be defined separately for monitoring bore sites where greater than 2m drawdown is observed

- (Level 1 Action) The TARP should indicate the timeframe to commence and complete investigations. Commencement within 1 month and completion within 2 months would be appropriate
- (Level 1 Action) Rather than *"Consider all reasonable and feasible options for remediation ……"*, a more concrete action is required such as *"Initiate negotiations with impacted landowners within 2 months of a Level 1 trigger regarding remediation/make good options ...."*
- (Level 1 Response) re the above dot point, the required response would be to finalise negotiations and to implement the agreed "make good" arrangements (or corrective management actions)
- (Level 3 Action) The water level data should be used to update the numerical model and rerun the predictive scenarios to determine the likely extent and depth of drawdown, and to determine whether additional private water bores are likely to be impacted

(iv) TARP Recommendations from the Panel:

- Update the open standpipe and monitoring bore network list in the TARP once all sites are completed/become operational and negotiated access for private water bores is confirmed
- Install dataloggers at a minimum two nested monitoring bore sites (that is, all open standpipes at each of the two sites)
- Revise actions and responses to clearly different actions/responses for dedicated monitoring bores versus private water bores, and ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations and third-party negotiations
- Update the Groundwater Modelling Plan to recalibrate the model and run new predictive scenarios for Level 3 water level exceedances
- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP), and the required reference table (from Appendix E of SLR 2022a) that identifies the groundwater elevations for Level 1, 2 and 3 triggers

5.1.7. Shallow Groundwater Pressure (VWP sensors <200m depth) TARP

This TARP mostly relates to monitoring and management of the aquifers within the lower Hawkesbury Sandstone groundwater system and upper Narrabeen Group groundwater system above the Bald Hill Claystone. Multiple Vibrating Wire Piezometers (VWPs) have been constructed across the broader region to monitor above and below the Bald Hill Claystone (Table 5-3 SLR 2022a).

The performance indicator is water pressure readings at four sites (TBC024, TBC027, TBC034 and TBC038) where VWPs have been established and there are a number of sensors shallower than 200m depth. Data is collected hourly and telemetry allows the data to be viewed continuously.

(i) Monitoring network and frequency

- Tahmoor Coal's VWP network provides reasonable spatial and depth coverage across the broader region, however there is only one nominated site (TBC024) within 2km of the proposed longwall panels. The inclusion of TBC032 (<500m from S4A and S5A) and TBC033 (< 600m from S6A) would provide more useful (local) water pressure data than the remote TBC038 site located ~5km to the south-east of longwalls S5A/S6A.
- If some remote VWP sites are monitored as control sites and are likely to be unaffected by mining these longwalls this should be stated in the TARP.

(ii) Trigger levels

- The basis of the 5m water level reduction in the Level 1 trigger is not stated (note that this is much more than the (modelled) predicted maximum drawdown in the Lower Hawkesbury Sandstone). A more appropriate trigger may be a water level drawdown that is 2m lower than the lowest historical (natural) water level. Tahmoor Coal should:
    - identify in the WMP the baseline period (for each/all sites) that will be used as the pre-mining data set against which changes will be assessed
- The criteria for the three trigger levels are reasonable (except Level 1) but should be more focused on localised mine-induced depressurisation of the lower Hawkesbury Sandstone groundwater system and upper Narrabeen Group groundwater system above the Bald Hill Claystone:
    - The Normal Condition should reflect the (natural) low groundwater levels observed during the recent severe drought from 2018 to early 2020
    - Based on the predictive modelling results (Figure 4.49 of Appendix E of the WMP (SLR 2022a)) a maximum drawdown of 5m will not occur above the longwall panels let alone at greater distances at the nominated VWP monitoring sites
    - Tahmoor Coal should include trigger levels for TBC032 and TBC033, and consider deleting TBC034 and TBC038 from this TARP
- The reference table that describes the TARP Level 1, 2 and 3 groundwater level trigger elevations should be revised for each of the nominated VWPs as the natural low water levels observed between 2018 and 2020 have not been factored into the determining appropriate baseline/reference levels. The Panel recommends:
    - The reference and TARP levels for the lower Hawkesbury Sandstone groundwater system sensors and upper Narrabeen Group groundwater system sensors shown in Figures 6.1 to 6.14 in Appendix E of the Water Management Plan (SLR 2022a) be reviewed
    - Currently the table reference is to Table 6-4 when it should be Table 6-3. This table in Appendix E of the WMP (SLR 2022a) is incomplete and requires updating after the baseline/reference levels are revised

(iii) Actions and responses

- (Level 1 Action) The TARP should indicate the timeframe to commence and complete investigations. Commencement within 1 month and completion within 2 months would be appropriate
- (Level 2 Action) Rather than *"Consider increasing review of data at sites ……."*, more concrete actions are required such as *"Review deeper VWP data at monitored sites and at additional existing VWP sites"* and/or *"Determine whether additional WMP sites are required"*
- (Level 2 Response) re the above dot point, a potential response would be to construct additional VWPs to evaluate the extent of aquifer depressurisation
- (Level 3 Action) The water level data should be used to update the numerical model and rerun the predictive scenarios to determine the likely extent and depth of drawdown, and to determine whether shallower aquifers and private water bores are likely to be impacted

(iv) TARP Recommendations from the Panel:

- Revise the proposed VWP network by including and referencing sites that are located closer to Longwalls S1A to S6A
- Groundwater elevation triggers should be revised to account for the (natural) low water levels observed during the recent severe drought
- Review current actions and responses and correct errors in language (including the statement that the Level 2 trigger occurs for *"water level declines <u>below</u> the average of the 'maximum modelled drawdown'…"* and the statement about increasing "monitoring frequency" as a Level 2 action when the frequency is already stated as hourly.)
- Revise actions and responses to ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations
- Update the Groundwater Modelling Plan to recalibrate the model and run new predictive scenarios for Level 3 water level exceedances
- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP), and the required reference table (from Appendix E of SLR 2022a) that identifies the groundwater elevations for Level 1, 2 and 3 triggers.

5.1.8. Groundwater Level/Pressure Deep VWPs (>200m depth excluding monitoring the Bulli Seam) TARP

This TARP mostly relates to monitoring and management of the strata and minor aquifers within the lower Narrabeen Group groundwater system and Illawarra Coal Measures above the Bulli Coal Seam. Multiple Vibrating Wire Piezometers (VWPs) have been constructed across the broader region to monitor below the Bald Hill Claystone (Table 5-3 SLR 2022a).

The performance indicator is water pressure readings at 13 sites (TBC001, TBC009, TBC0018, TBC020, TBC019B, TBC024, TBC026, TBC027, TBC032, TBC033, TBC034, TBC038 and TBC039) where VWPs have been established and there are a number of sensors deeper than

200m depth. The key sites overlying or within 2km of the proposed longwalls are TBC001, TBC024, TBC032, and TBC033. Data is collected hourly and telemetry allows the data to be viewed continuously.

(i) Monitoring network and frequency

- Tahmoor Coal's deep VWP network provides good spatial and depth coverage across the broader region. There is also reasonable coverage within 2 km of the proposed longwalls.
- It may not be necessary to include the more remote VWPs in this TARP as the predicted maximum drawdown for all cumulative impacts is not expected to extend to the most remote VWPs.
- A key sites network (rather than all VWP sites) may be more appropriate for this TARP
- If some remote VWP sites are monitored as control sites and are likely to be unaffected by mining this should be stated in the TARP.

(ii) Trigger levels

- The criteria for each of the three trigger levels is 'predicted drawdown' which is undefined but assumed to be the predicted maximum drawdown in one of the seven model layers (model layers 7 to 14) covering these strata at each of the nominated VWP sites. The model layer to be referenced for the trigger should be explicitly stated.
- For the trigger level wording:
    - The Normal Condition should be more clearly stated as *"Observed levels are within (some measurable value – 10m?) of predicted impacts"*
    - For each of Levels 1, 2, and 3 start with the words *"Observed drawdown exceeds …."*
- A reference table that describes the TARP Level 1, 2 and 3 groundwater level trigger elevations should be included in the revised WMP (even though the escalation from Levels 1 to 2 to 3 is time-dependent). Currently the table reference is Table 6-4 in Appendix E of the WMP (SLR 2022a).

(iii) Actions and responses

- (Level 1 Action) The TARP should indicate the timeframe to commence and complete investigations. Commencement within 1 month and completion within 2 months would be appropriate
- (Level 2 Action) Rather than *"Consider increasing review of data at sites ……"*, more concrete actions are required such as *"Review VWP data at additional existing VWP sites"* and/or *"Determine whether additional WMP sites are required"*
- (Level 2 Response) re the above dot point, a potential response would be to construct additional VWPs to evaluate the extent of aquifer depressurisation, rather than increasing the monitoring frequency
- (Level 3 Action) The water level data should be used to update the numerical model and rerun the predictive scenarios to determine the likely extent and depth of

depressurisation, and to determine whether any additional management actions are required

(iv) TARP Recommendations from the Panel:

- Re-evaluate whether the drawdown criteria should just apply to key VWP sites located closer to the proposed longwalls rather than all nominated sites
- Revise actions and responses to ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations
- Update the Groundwater Modelling Plan to recalibrate the model and run new predictive scenarios for Level 3 water level exceedances
- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP), and the required reference table (currently Table 6-4 in Appendix E of SLR 2022a) that identifies the groundwater elevations for Level 1, 2 and 3 triggers

5.1.9. Groundwater Quality (Open Standpipes and Private Bores) TARP

This TARP relates to monitoring and management of the water quality within the upper Hawkesbury Sandstone groundwater system and private water supply bores of any depth. The nominated monitoring network is the same as shallow groundwater levels for open standpipes and water bores. The comments on the monitoring network stated in Section 5.1.6 are also relevant here.

Appendix E of the WMP (SRK 2022a) states that the setting of groundwater quality triggers is not feasible at this time due to the lack of data because (i) the installation of all dedicated monitoring bores is incomplete, and (ii) the monitoring of private bores has not commenced presumably because access agreements have not yet been finalised. Baseline water quality data should be a priority and collected as soon as practicable.

(i) Monitoring network and frequency

- The proposed monitoring frequency relates to water levels and not water quality. The water sampling frequency needs to be stated in the revised TARP

(ii) Trigger levels

- For the Normal Condition trigger, a minimum four quarterly water samples would be required to establish an initial water quality baseline
- The dissolved metal analytes that are to be included in the baseline should be stated in either the revised TARP or revised WMP
- (all Levels) The methodology that is to be used to define ‘increase’ in salinity, pH and nominated dissolved metals should be stated. A quantifiable metric is required

(iii) Actions and responses

- (all Levels) Different actions and responses should be proposed for dedicated monitoring bores versus private water bores. For instance:
    - ”Make good” negotiations need only be commenced/finalised with owners of impacted private bores (Level 1)

- The full range of "make good" options should be listed in the Level 1 actions to provide transparency as to the available options
- What actions (if any) are required if there are water quality exceedances at monitoring bore sites?

- (Level 1 Action) The TARP should indicate the timeframe to commence and complete investigations. Commencement within 1 month and completion within 2 months would be appropriate
- (Level 1 Action) Rather than *"Consider all reasonable and reasonable options for remediation ……"*, a more concrete action is required such as *"Initiate negotiations with impacted landowners within 2 months of a Level 1 trigger regarding remediation/make good options …."*
- (Level 1 Response) re the above dot point, the required response would be to finalise negotiations and to implement the agreed "make good" arrangements (or corrective management actions)

(iv) TARP Recommendations from the Panel:

- Update the open standpipe and monitoring bore network list once all sites are completed/become operational and negotiated access for private water bores is confirmed
- Revise actions and responses to clearly differentiate actions/responses for dedicated monitoring bores versus private water bores, and ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations and third-party negotiations
- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP), and the required reference table (currently Table 6-5 in Appendix E of SLR 2022a) that identifies the groundwater quality parameters for Level 1, 2 and 3 triggers

5.1.10. Groundwater-Surface Water Interaction (for Groundwater Bores not associated with Thirlmere Lakes) TARP

This TARP should reference the performance measure stated in Table 7 of Condition C1 of the Development Consent as baseflows to permanent streams are considered a GDE. The measure states there should be (i) a negligible change in groundwater levels, and (ii) a negligible change in groundwater quality impacting GDEs.

Changes to groundwater contributions to baseflow are unlikely to be measurable at any surface water monitoring sites, using the proposed monitoring methods. However, groundwater drawdown and the cracking of the Teatree Hollow and tributary creek beds may change creek conditions from gaining to losing and thereby reduce streamflow in the permanent stream/water hole sections of undermined reaches of the creek. This loss to shallow groundwater may re-emerge as groundwater baseflow further downstream with elevated dissolved iron concentrations. This has the potential to exceed the performance measure related to baseflow.

The TARP should focus on monitoring the surface water and groundwater levels which are measurable rather than trying to quantify baseflow contributions or losses; most importantly

when a perennial stream might change from gaining to losing. Trying to monitor flow volumes especially low volume baseflows is considered problematic.

Water quality triggers are not included in this groundwater-surface water TARP as they are already covered in relevant surface water TARPs.

(i) Monitoring network and frequency

- Five paired sites (that is nested monitoring bores with a nearby surface water monitoring site) are proposed in this TARP. Only those locations that are sited along perennial creek/waterhole sections are worthwhile.
- The proposed monitoring frequency of monthly manual measurements pre-mining and during mining is inadequate to monitor surface water-groundwater interaction. It is recommended that dataloggers (collecting data at an hourly frequency) be installed at pool water level gauges and within each of the monitoring bores to establish a height relationship and to confirm whether and when gaining or losing conditions prevail.

(ii) Trigger levels

- For the Normal Condition trigger, a pre-mining baseline relationship that defines whether a particular stream location is gaining or losing is required. The data and relationship should be measurable not inferred.
- The Level 1, 2, and 3 triggers again should be measurable and focus on gaining streams:
    - Level 1 shouldn't align with the shallow groundwater level TARP of a 2m decline (Section 5.1.6) but rather be defined as the level when the water table declines to the equivalent surface water level
    - Level 2 should be defined as when the water table declines below the surface water level but there is still visible flow or water in pools
    - Level 3 should be defined as when the water table declines below the surface water level and there is cracking and no longer visible flow or water in pools

(iii) Actions and responses

- (all Levels) Individual responses and actions are required for water levels
- (Level 2 Action) "*increase monitoring and review of data frequency*" if hourly monitoring is adopted, the increase in monitoring frequency will no longer be necessary. Specify the new data review frequency for this level 2 action.
- (Level 2 Action) "*compare against base case and deterministic model scenarios*" – this task should be clearly linked to a related response
- (Level 3 Action) the "*detailed investigation to assess whether the change in behaviour is due to mining events*" should be initiated in response to new recommended Level 2 trigger (above) because Level 1 and Level 2 will now provide early warning that mining impacts on surface water levels may be occurring
- (Level 3 Action) "*increase monitoring and review of data frequency*" this action should be replaced with an action that represents a direct response to the observed declines in water tables.

- (Level 3 Action) *"undertake a detailed investigation to assess if the change in behaviour is related to mining effects"*: indicate the timeframe to commence and complete investigations.

(iv) TARP Recommendations from the Panel:

- Revise triggers to remove inferred groundwater levels and focus on measurable triggers.
- Revise actions and responses to ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations and for development and implementation of rehabilitation plans
- Clearly separate out triggers, actions and responses for water levels
- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP).

5.1.11. Groundwater-Surface Water Interaction (for Groundwater Bores associated with Thirlmere Lakes)

Thirlmere Lakes is a series of five lakes and a "high priority" GDE that is located between 3.5 and 4.5 km from the north-western extremities of Longwalls S1A to S6A. It has been the subject of significant hydrological research in recent years. Evidence suggests that the periodic filling and drying of the lakes is a natural occurrence, and there is no evidence of direct hydrological links between surface water and the groundwater in the Permian coal seams. However shallow groundwater in the alluvial sediments and potentially the shallow sandstone aquifers is hydraulically connected to surface water lake levels. During wet periods, groundwater levels at some sites are higher than lake levels and groundwater provides a contribution to these lakes. During dry periods, groundwater levels are typically lower that lake levels and some lake leakage is likely to be occurring to shallow groundwater. The degree of connectivity between surface water in each of the lakes and shallow/deep groundwater is complex and further research is required (DPE 2022).

This TARP should reference the performance measure stated in Table 7 of Condition C1 of the development consent as the lakes are a GDE and groundwater contributions are important. The performance measure in the Development Consent states there should be (i) a negligible change in groundwater levels, and (ii) a negligible change in groundwater quality impacting GDEs.

Even though the numerical model drawdown contours do not extend to Thirlmere Lakes, and no lake losses are predicted, it is important that monitoring of groundwater levels and water quality between the proposed longwalls and the lakes is addressed in a separate TARP.

(i) Monitoring network and frequency

- Three WaterNSW monitoring bores, three Tahmoor Coal groundwater monitoring sites (being two nested standpipe locations and one VWP location), and two private bores are proposed for this TARP. The nominated sites are satisfactory (Figure 23 should be updated to show all bores).
- For the WaterNSW monitoring bores located closest to Lake Couridjah (GW075409/1 and GW075409/2) it would be useful to pair these sites with gauging station 212066

- The proposed monitoring frequency of monthly water level and water quality measurements pre-mining and during mining is adequate for Tahmoor Coal monitoring bores and the private bores. It is understood that the WaterNSW monitoring bores collect water level data at a greater frequency
- The proposed water quality network and field/analytical suite for water quality parameters is not stated.

(ii) Trigger levels

- For the Normal Condition trigger, the surface water and groundwater monitoring sites closest to Thirlmere Lakes are the key sites that should be nominated as the baseline sites. All other sites are 'early warning' sites. The data and relationship should be measurable not inferred.
- The Level 1 and 2 triggers should relate to 'early warning sites' and nominate metrics for both water levels and water quality that are clear and measurable.
- The "*Exceed Performance Measure*" trigger must relate to more than a negligible impact in water levels and/or water quality at Thirlmere Lakes

(iii) Actions and responses

- (all Levels) Individual responses and actions are required for water levels and water quality
- (Level 1 Action) The TARP should indicate the timeframe to commence and complete investigations. Commencement within 1 month and completion within 2 months would be appropriate
- (Level 2 Action) Rather than "*Consider all reasonable and feasible options for remediation ……*", this isn't appropriate for this TARP and more concrete actions are required that focus on the actions arising at 'early warning sites'
- (Exceed Performance Measure Action) Increased frequency of monitoring and potentially additional monitoring bores/VWPs are appropriate
- (Exceed Performance Measure Response) In parallel; with the Impact Response Plan, the water level data should be used to update the numerical model and rerun the predictive scenarios to determine the likely extent and depth of depressurisation in the vicinity of Thirlmere Lakes, and to determine whether any additional management actions are required such as modifying the mine plan

(iv) TARP Recommendations from the Panel:

- Clearly separate out triggers, actions and responses for water levels and water quality
- Nominate the key site/sites for the water level and water quality performance indicators to ensure there is a negligible change in groundwater levels and groundwater quality
- Revise actions and responses to ensure all are firm commitments
- For actions and responses provide appropriate timeframes for investigations
- Update the Groundwater Modelling Plan to recalibrate the model and run new predictive scenarios for the Exceeds Performance Measure response

- Update the Groundwater Management Plan in the WMP (Tahmoor Coal 2022b) including the monitoring network plan (Figure 23 of the WMP).

5.2. LAND MANAGEMENT PLAN

5.2.1. Steep Slope TARP

- The Performance Measure for this TARP refers to no greater impact or consequence than that predicted in the EIS. The TARP should include a specific statement (at least in summary form) of the EIS prediction.
- Level 1 Action should specify an increased monitoring frequency rate, to say fortnightly during mining, for example.
- Level 2 Action refers to *"consider actions to avoid or reduce the likelihood and/or consequence of slope instability and implement if feasible and effective"*. This action should be more definitive than just consider. It is not clear as to what type of actions might be addressed by this action – please identify some potential and practical/feasible strategies here.

5.2.2. Cliffs TARP

- The Performance Measure refers to negligible environmental consequences over more than 0.5% of the total face area of cliffs within the Subsidence Area. This measure needs to quantify what 0.5% represents – both in terms of face area, and also approximate cliff length for an average cliff height. Subsequent advice from the Applicant (letter of 28 July 2022) indicates that the total cliff face area across the A section of the Tahmoor South Domain is approximately 1,690 m^2 at an average height of just below 12m. 0.5% of this area therefore equates to no more than 8.5m^2. For an average cliff height of close to 12m, this represents less than 1m of cliff length, which means effectively a performance measure of negligible impact at all, rather than specifying the 0.5% level. The TARP should make this much clearer, and the actions and responses may need to be tightened further, accordingly.
- The monitoring program notes that the identified cliffs are near the finish lines of each longwall, so no requirement for monitoring during each panel mining. However, the post-mining monitoring should make clear that monitoring inspections will take place on completion of each longwall panel and should specify a time period within which such inspections will take place, e.g., within one month of each panel completion.
- Both Level 1 and Level 2 Actions refer to increasing frequency of monitoring, but there is no definition of what increased frequency level would be adopted – this should be specified.
- The Level 1 Response includes the provision of a proposed CMA to DPE and key stakeholders. There should be a nominated time period within which this must be carried out, after Level 1 is triggered.
- Level 2 Actions include *"undertake an investigation to determine if an exceedance of the performance measure is likely"*. It is not clear how such an investigation would be carried out, or on what basis such a determination would be made. In following up on this action, the response plan refers to various notifications and implementation of additional CMAs,

but it is not clear what the nature of such responses would include, in order to prevent an exceedance occurring. Some further practical examples (beyond those listed against Level 1) as a more concrete basis for the CMA would be useful. It is considered unlikely that repairing of cracks and installation of support would be sufficient, unless on a very large scale.

- At either the Level 2 stage, or if an exceedance actually occurs (? Level 3), is there any consideration of changes to the mining layout in response?

5.2.3. Agricultural Land TARP

No specific comments on this TARP other than the generic issues of more concrete actions, beyond simply "consider", and where possible, more specific recommendations on increased frequencies of monitoring.

5.3. BIODIVERSITY MANAGEMENT PLAN

The Panel membership does not have specialist expertise in the area of biodiversity. As previously advised to DPE, we will therefore not be providing any detailed commentary on the individual TARPs within this Management Plan. However, the broader, generic points made in the introduction to Section 5 of this report would be applicable to the various Biodiversity TARPs.

5.4. HERITAGE MANAGEMENT PLAN

5.4.1. Aboriginal Heritage Items TARP

- The Performance Measure for this TARP refers to no greater impact or loss of heritage value than that predicted in the EIS. The TARP should include a specific statement (at least in summary form) of the EIS prediction.
- The Performance Measure then refers specifically to aboriginal rock shelters, stating that the performance measure will be triggered *"if more than 10% of rock shelters in the Tahmoor South Domain are impacted"*. This figure of 10% should be quantified to an absolute number. As discussed in section 4.2, the Panel has been advised that there are 19 such rock shelters across the A and B sections of the Tahmoor South Domain. The 10% trigger therefore represents anything more than one single rock shelter incurring adverse impacts due to mining.
- The monitoring plan refers to monthly inspections of the single shelter above the A section of longwall panels, during mining of panels S1A to S4A. This shelter is located close to the chain pillar between LWS1A and LWS2A. It is recommended that visual inspection frequency should be increased at this location as each of these first two longwall panels approaches and then passes the site (within a face proximity zone of say at least 400m).
- Under the Level 1 Action plan, there is reference to consideration of reasonable and feasible options for remediation. This includes consideration of specialist advice on management of rock falls or toppling of the shelter. As discussed in section 4.2, it is strongly recommended that this section of the TARP contains a more pro-active component of potential mitigation

measures, prior to adverse impacts occurring, rather than simply focusing on remediation after the impacts have occurred.

- The Level 2 Action plan includes a statement of "*review mine design/predictions against mine criteria*". This statement needs to be far more specific and clearer on the intention and the available options. Exactly what mine design options or changes are available, and when could they be implemented? Would these changes be intended as pre-impact mitigation measures for this rock shelter, or would they be to inform future mining in the vicinity of rock shelters in the B section of the South Domain?

5.4.2. Historical Heritage Items TARP

- The Performance Measure for this TARP refers to no greater impact or loss of heritage value than that predicted in the EIS. The TARP should include a specific statement (at least in summary form) of the EIS prediction.
- The Level 2 Action plan includes a statement of "*review mine design/predictions against mine criteria*". This statement needs to be far more specific and clearer on the intention and the available options. Subsequent advice provided by the Applicant (letter of 28 July 2022) has indicated that on this point, with respect to Picton Weir:

  "*If extraction of LW S5A indicates that an environmental consequence has occurred at the Picton Weir (and a Level 2 of the relevant TARP had been triggered), Tahmoor Coal would be required to review the mine design and consider whether to amend the mine plan to minimize impacts to the weir from future longwalls. This could include shortening LW S6A to ensure that the weir is not impacted to the extent that it cannot be repaired in a manner that restores its heritage value*".

  This is considered to be an appropriate and important response which should be reflected in the TARP either directly, or by cross-referencing, and should also be linked into specific monitoring result triggers, including the recommended additional far-field movement monitoring.

6.0 SUMMARY RECOMMENDATIONS

The Panel has reviewed the Extraction Plan submitted by the Applicant, Tahmoor Coal, including the updated Appendix B to that Plan, provided to the Panel on 25 July 2022. As a result of this review the Panel offers the following recommendations:

1. Subsidence monitoring

   Additional continuous surface subsidence monitoring sites be installed, between the edge of LWS6A and the Picton Weir to the west, and above the previous mined panels to the north-west of the mining area, approaching and across Bargo River.

2. Aboriginal rock shelters

   Subsidence impact mitigation measures be considered and developed for the rock shelter above the boundary between LWS1A and LWS2A in order to minimise the risk of adverse impacts to this rock shelter. This should be done in conjunction with an assessment of the relative merits, value and mining impact susceptibility of all of the 19 rock shelters in the Tahmoor South Domain, in order to prioritise which 18 of these 19 (as a minimum) need to be protected.

3. Groundwater monitoring

   Revisions to the groundwater monitoring network to focus on localised groundwater level and water quality impacts more closely, and to ensure that sufficient baseline data is available against which meaningful triggers, actions and responses are framed.

4. TARPs

   The Panel is of the opinion that there are a number of deficiencies throughout the revised set of TARPs provided on 25 July 2022, forming Appendix B of the Extraction Plan. There is a clear need for greater clarity, more definition with respect to monitoring and other actions, and more precise and responsive Action/Response plans.

   Some introductory comments relevant to all TARPs is contained in Section 5.0 of this report. The full details of the identified TARP deficiencies and any specific TARP recommendations are contained within Section 5 of this report. A brief summary of the priority issues follows:

   Water Management Plan - Surface Water

   Revisions are required to each of the surface water TARPs to better reflect the management actions and responses required to minimise impacts. The Panel's detailed recommendations regarding the surface water TARPs and Performance Indicators are provided in the Section 5.1 introduction and Sections 5.1.1 to 5.1.5. The priority actions are to develop suitable Performance Indicators where these are omitted, include more robust triggers for surface water quality and farm dams, development of an integrated preliminary Watercourse Corrective Action Management Plan for the subsidence area, and addressing various issues of consistency, clarity and precision.

   Water Management Plan - Groundwater

   The primary risks to groundwater and associated dependent ecosystems are:

- Creek bed cracking and potential loss of groundwater contributions to baseflow, and
- Excessive drawdowns and loss of supplies in the Hawkesbury Sandstone groundwater system and upper Narrabeen Group groundwater system above the Bald Hill Claystone.

Revisions are required to each of the six groundwater TARPs to better reflect the management actions and responses required to minimise impacts to all underlying groundwater systems (and any associated GDEs), particularly the highly productive aquifers in the shallow sandstone groundwater systems.

The Panel's detailed recommendations regarding the six groundwater TARPs are provided in Sections 5.1.6 to 5.1.11 inclusive. The priority actions are to formalise the proposed monitoring networks for each of the TARPs and to ensure that the metrics for each of the proposed trigger levels are focused on ensuring there are manageable impacts to shallow groundwater resources, the groundwater supplies to impacted private water bore users are maintained, and that there are negligible impacts to GDEs.

Land Management Plan

Revisions are required to both the Cliffs and Steep Slopes TARPs in relation to greater clarity on performance measures, frequency of monitoring during mining and suggested content of any CMAs.

The Panel's detailed recommendations regarding these two TARPs are contained in Sections 5.2.1 and 5.2.2.

Biodiversity Management Plan

The Panel has not provided any detailed comment on these TARPs as the Panel membership does not have specialist expertise in these areas. However, the general comments contained in Section 5.0 of the report are applicable to the Biodiversity TARPs.

Heritage Management Plan

A number of specific issues of improvement in clarity and definition are addressed in both the Aboriginal Cultural Heritage Site TARP and the Historical Heritage Items TARP.

Two priority action items recommended have already been listed under recommendations 1 and 2 above, being the installation of additional "early warning" subsidence monitoring, including a location between the mining area and Picton Weir; and the review of aboriginal rock shelters and the development of a potential mitigation plan for the rock shelter between LWS1A and S2A.

The Panel's detailed recommendations regarding these two TARPs are contained in Sections 5.4.1 and 5.4.2.

REFERENCES

DPE 2022, *Thirlmere Lakes – A Synthesis of Current Research* EES Report 2022/0164 dated March 2022

DPI Water 2012, *NSW Aquifer Interference Policy* dated September 2012

SIMEC 2022, *Request for Further Information following IAPUM Meeting Letter* dated 28 July 2022

SLR 2022a, *LW S1A-S6A Extraction Plan Groundwater Technical Report*. SLR Ref: 610.30637.00000-R01 Version 3.0 dated May 2022

SLR 2022b, *Tahmoor South Baseline Private Bore Assessment Report*. SLR Ref: 610.30637.00000-R01 Version 3.0 dated April 2022

Tahmoor Coal 2022a, *Extraction Plan – Main Document – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022b, *Water Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022c, *Heritage Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022d, *Land Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022e, *Biodiversity Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022f, *Built Features Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022g, *Public Safety Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A.* Version 1 dated May 18, 2022

Tahmoor Coal 2022h, Plan 1 - Approved Plan, dated 5 May 2022

Tahmoor Coal 2022i, Plan 2 –Surface Features, dated 5 May 2022

Tahmoor Coal 2022j, Plan 3 - Seam Geology, dated 5 May 2022

Tahmoor Coal 2022k, Plan 5 – Land Ownership, dated 5 May 2022

Tahmoor Coal 2022l, Plan 6 – Geological Sections, dated 5 May 2022

Tahmoor Coal 2022m, *Plan 7 – Subsidence Monitoring Program* - dated May 18, 2022

Tahmoor Coal 2022n, Plan 8 – Aerial Photo, , dated 5 May 2022